

# CONFERENCE PROCEEDINGS BOOK



## 8TH INTERNATIONAL CONFERENCE ON GLOBAL PRACTICE OF MULTIDISCIPLINARY SCIENTIFIC STUDIES

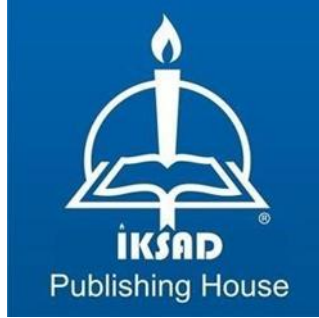
September 25-29, 2024 / DUBAI

### EDITORS

Prof. Dr. Mehmet Firat BARAN

Assoc. Prof. Dr. Seyithan SEYDOŐOĐLU

**INTERNATIONAL CONFERENCE ON GLOBAL PRACTICE OF  
MULTIDISCIPLINARY SCIENTIFIC STUDIES-VIII**



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OF MULTIDISCIPLINARY SCIENTIFIC STUDIES-VIII**

**September 25-29, 2024  
Dubai**

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**PROCEEDINGS BOOK  
(Abstracts & Full Texts)**

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**EDITORS**

**Prof. Dr. Mehmet Fırat BARAN  
Assoc. Prof. Dr. Seyithan SEYDOŐOĐLU**

**Cover Design: Arzu ALTUNTAŐ**

**ISSUED: October 21, 2024**

## INTERNATIONAL CONFERENCE ON GLOBAL PRACTICE OF MULTIDISCIPLINARY SCIENTIFIC STUDIES-VIII

### EVALUATION PROCESS and POLICIES

All applications have undergone double blind peer review process. In addition, each paper was accepted and the process of publishing in the book was carried out through editorial oversight. The published papers were presented and discussed at the meeting.

Full texts and abstracts published in accordance with the Symposium Policy have been prepared in accordance with ethical rules and APA standards. Authors of all papers are both ethically and legally responsible.

### PARTICIPANTS COUNTRIES

Türkiye, Albania, Algeria, Azerbaijan, Bangladesh, Bulgaria, Ethiopia, Georgia, India, Indonesia, Iran, Kazakhstan, Malaysia, Morocco, Nigeria, Pakistan, Philippines, Saudi Arabia, Slovenia, Sri Lanka, Uganda, Ukraine

### TOTAL ACCEPTED ARTICLES: 306

The Number of Accepted Papers from Türkiye: 134  
The Number of Accepted Full Papers from Other Countries: 159  
The Number of Total Papers: 293

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**September 25-29, 2024**

**Dubai**

**SYMPOSIUM SCHEDULE**



# 8<sup>th</sup> INTERNATIONAL CONFERENCE ON GLOBAL PRACTICE OF MULTIDISCIPLINARY SCIENTIFIC STUDIES

*September 25-29, 2024 / Dubai, UAE*

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## CONFERENCE PROGRAM

IN-PERSON PRESENTATIONS

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**Siirt** *Bilimin Işığında*  
**ÜNİVERSİTESİ**



# Face to Face / Swisotel Al Ghurair

27.09.2024

HALL-1 / SESSION-1



UAE LOCAL TIME: 08<sup>30</sup> : 10<sup>30</sup>

## HEAD OF SESSION: İlknur AYAN

Authors	Affiliation	Presentation title
Melekber Sülüoğlu Durul	<i>Kocaeli University</i>	Studies on Fall Olive ( <i>Elaeagnus umbellata</i> ) and Sapling Production Status
Melekber Sülüoğlu Durul Kerem Mertoğlu	<i>Kocaeli University</i>	Cutting Propagation Possibilities of Autumn Olive tree ( <i>Elaeagnus umbellata</i> Thunb.)
Hatice Bozoğlu Reyhan Aydın Zeynep Aybey	<i>Ondokuz Mayıs University</i>	Possibility of Use of Agrohomoopathy in Management of Bean Weevil ( <i>Acanthoscelides obtectus</i> Say)
Hatice Bozoğlu Reyhan Aydın Zeynep Aybey	<i>Ondokuz Mayıs University</i>	Bean Weevil ( <i>Acanthoscelides obtectus</i> Say) Damage in Beans Grown with Companion Planting
Ali Kaçar Selçuk Göçmez	<i>Aydın Adnan Menderes University</i>	The Effects of Using Olive Mill Wastewater Cake in Vermicompost Production on The Development of Earthworms ( <i>Eisenia fetida</i> )
Ali Ayhan Gülcan Kaymak Bayram Mehmet Can Elif Şahin Şeyma Pirçek	<i>Ondokuz Mayıs University</i>	Determination of the Effects of Humic Acid Application on Germination Parameters of Maize ( <i>Zea mays</i> L.)
Ali Ayhan İlknur Ayan Zeki Acar Fatih Alay	<i>Ondokuz Mayıs University</i>	Importance of Humic Acid in Agricultural Production, Its Effects on Yield and Quality of Forage Crops
Medine Çopur Doğrusöz Hatice Kanbur Çavuş	<i>Yozgat Bozok University</i>	The Potential of Magnetic Field Application on Forage Peato Enhance Germination and Seedling Parameter
Doruk Aydoğan Korkmaz Bellitürk	<i>Tekirdağ Namık Kemal University</i>	The Importance of Soil Analyses in Sustainable Agriculture
Emine Küçükler Selda Demir Erdal Ağlar	<i>Siirt University</i>	Periodicity and The Effects of Pruning on Periodicity in Pistachio
Alamettin Bayav Bektaş Kadakoğlu Ahmet Aslan	<i>Isparta University of Applied Sciences</i>	Academic Trends on Economic Analysis and Efficiency: A Bibliometric Study
Bektaş Kadakoğlu Bahri Karli Alamettin Bayav	<i>Isparta University of Applied Sciences</i>	Current Situation and Development of Poultry Farming in Türkiye
Selim Bacanak İlknur Ayan Fatih Kumbasar	<i>Ondokuz Mayıs University</i>	Problems and Solution Suggestions of Pastures in Amasya Province

(All speakers required to be connected to the session 10 min before the session starts)

Moderator is responsible for ensuring the smooth running of the presentation, managing the group discussion and dynamics.



# Face to Face / Swisotel Al Ghurair

27.09.2024

HALL-2 / SESSION-1



UAE LOCAL TIME: 08<sup>30</sup> : 10<sup>30</sup>

## HEAD OF SESSION: Gülen ÖZYAZICI

Authors	Affiliation	Presentation title
Muhammet Ali Gündeşli Remzi Uğur	<i>Gaziantep University</i>	Selection and Characteristics of Wild Olive Rootstocks Against Verticillium Wilt
Muhammet Ali Gündeşli Remzi Uğur	<i>Gaziantep University</i>	Importance and Role of Phenolic Compounds in Graft Incompatibility in Olive Trees
Erdal Öztünç Nurhan Keskin	<i>Van Yuzuncu Yil University</i>	Effects of Strigolactone and Mycorrhizal Treatments on Nitrogen, Chlorophyll, Flavanol and Anthocyanin Contents of Saplings in 110R/Narince Grafting Combination
Dicle Topluk Nurhan Keskin	<i>Van Yuzuncu Yil University</i>	A Preliminary Study on Determination of Natural Polyembryony Frequency of "Erciş" Grape Cultivar
Mehmet Arif Özyazici	<i>Siirt University</i>	<i>Plantago</i> sp.: A Comprehensive Review on Feed Value
Mehmet Arif Özyazici	<i>Siirt University</i>	Importance of Phosphorus Fertilization in Legume Forage Crops
Gülen Özyazici	<i>Siirt University</i>	Importance of Zinc Fertilization in Medicinal Plants
Gülen Özyazici	<i>Siirt University</i>	Evaluation of Priming Applications in Medicinal Plants
Hürmet Fulya Akiz	<i>Yozgat Bozok University</i>	Some Types of Continuity in Ideal Topological Spaces
Hürmet Fulya Akiz Medine Çopur Doğrusöz	<i>Yozgat Bozok University</i>	Water Efficiency in Field Crop Irrigation Through Topological Design
Fatma Gökmen Yılmaz Ayşegül Korkmaz	<i>Selçuk University</i>	The Relationship Between The Yield Of Sugar Beet Grown In Konya Region And Different Forms Of Nitrogen In The Soil
Emine Cihan	<i>Selçuk University</i>	Analysis of The Quality and Reliability of Youtube Videos on Cardiac Rehabilitation Exercises
Aslıhan Uzunhasanoğlu Ilknur Ayan Muhammet Şahin Gülcan Kaymak Bayram	<i>Ondokuz Mayıs University</i>	Determination of the Effect of Lamb Grazing on an Sown Pasture on Pasture Productivity and Botanical Composition

All speakers required to be connected to the session 10 min before the session starts)

Moderator is responsible for ensuring the smooth running of the presentation, managing the group discussion and dynamics.

# Face to Face / Swissotel Al Ghurair

27.09.2024

HALL-3 / SESSION-1



UAE LOCAL TIME: 08<sup>30</sup> : 10<sup>30</sup>

## HEAD OF SESSION: Sıddık KESKİN

Authors	Affiliation	Presentation title
Habibe Bay Özçalık Bihter Akin	<i>Selçuk University</i>	The Relationship Between Participation in Caregiving, Maternal Stress and Maternal Role Among Mothers Whose Babies Are Hospitalized in The Neonatal Intensive Care Unit
Yasemin Erkal Aksoy Sema Dereli Yilmaz Şerife Çelimli	<i>Selçuk University</i>	Effect of Using Birth Ball on Birth Satisfaction and Pain of Pregnant Women in The Labour Process: A Randomized Controlled Study
Süreyya Kiliç Sema Dereli Yilmaz	<i>Selçuk University</i>	Investigation of Women's Awareness and Attitudes Towards Urinary Incontinence
Mukadder Baylan Selen Filiz Aslan Burhan Aslan Gül Şahika Gökdemir	<i>Dicle University</i>	Effect of Empagliflozin Treatment on Physiological Parameters in Patients with Type 2 Diabetes Mellitus
Utkan Şahintürk Burcu Üstün Hamide Aydın Serkan Naci Koç Ümran Kurtan	<i>Istanbul University-Cerrahpaşa</i>	Exploring the Effect of Chemical Blowing Agents on Porous Carbon Nanofibers: A Structural And Electrochemical Investigation
Rüveyde Can Fatma Deniz Sayiner	<i>Selçuk University</i>	The Effect of Watching Videos with Virtual Reality Glasses During Episiotomy Repair on Pain, Anxiety and Satisfaction
Saliha Kurt Ilknur Karalezli	<i>Selçuk University</i>	Effect of Pendrend Syndrome on The Vestibular System
Hatice Bekci Tuğba Dedebaş Meryem Göksel Saraç	<i>Kayseri University</i>	Effects of Essential Oils on Cancer and Their Mechanisms of Action
Sıddık Keskin	<i>Van Yuzuncu Yıl University</i>	Instrumental Variables in Statistics with General Characteristics
Sıddık Keskin	<i>Van Yuzuncu Yıl University</i>	Moderator and Mediator Variables in Statistics
Hamide Aydın Parya Aghamohammadi Burcu Üstün Eda Akgül Osman Cem Altıncı Ümran Kurtan Serkan Naci Koç Muslum Demir	<i>Istanbul University-Cerrahpaşa</i>	Synthesis and Characterization of 2D Chromium Boride (CrB MBene) For Electrochemical Energy Storage
Hamide Aydın	<i>Istanbul University-Cerrahpaşa</i>	Molten Salt Synthesis, Structural and Electrochemical Characterizations of MnOx Nanorods
Özlem Erdem Sevinç Akkoyun Melek Altunkaya Emine Arslanlar Mustafa Onur Aladağ	<i>Selçuk University</i>	Determining of the Effect of Simulation Training on Self-Confidence and Satisfaction in Health Services Vocational School Students

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# Face to Face / Swissotel Al Ghurair

27.09.2024

HALL-1 / SESSION-2



UAE LOCAL TIME: 11<sup>00</sup> : 13<sup>00</sup>

## HEAD OF SESSION: Safiye SARI

Authors	Affiliation	Presentation title
Safiye Sari	<i>Ataturk University</i>	A General View of Traditional Erzurum Ehram Weaving in The Context of Art and Design
Alara Nur Keskin	<i>Ataturk University</i>	Archived Motif Features of Erzurum Ehram Weaving in Virtual Environment
Eyüp Salbur Hatice Harmankaya	<i>Selçuk University</i>	Creating Digital Pattern Designs Using Motifs in Ottoman Period Miniatures
Gamze Görgünay	<i>Ataturk University</i>	Animal Depictions in Ottoman Iznik Evangels
Funda Koçer	<i>Ataturk University</i>	XV. Century Baba Nakkaş Style's Present-Day Representative Tile Artist Mehmet Koçer
M. Berkay Kizilkan	<i>Siirt University</i>	Data-Based Decision Making Supported by Artificial Intelligence in Architectural Education
Nilgün Onursal	<i>Siirt University</i>	Kinetic Analysis of Nickel removal using Siirt/Pervari pomegranate waste peel
Şahin Ay	<i>Siirt University</i>	Public Finance in Turkey After the April 5 Decisions
Onur Karagül	<i>Kayseri University</i>	Student Experiences on Digital Teaching Materials Used in Common Compulsory Foreign Language (5i) Courses Delivered through Distance Education in Higher Education
Cavadzadə Gülşən	<i>Azərbaycan University</i>	“Kitabi-Dədə Qorqud” Dastanında Arxaikləşən Çoxmənalı Və Omonim Sözlər
Nizamettin Turan	<i>Siirt University</i>	The Importance of Stubble in Livestock, Harms of Burning Stubble and Solution Suggestions
Seyithan Seydoşoğlu Nizamettin Turan	<i>Siirt University</i>	A Forage Legume Tree Species: <i>Sesbania grandiflora</i>
Mehmet Fırat Baran	<i>Siirt University</i>	Determining the Energy Potential of Some Fruit Waste: A Case Study Of Edirne Province

(All speakers required to be connected to the session 10 min before the session starts)

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# Face to Face / Swissotel Al Ghurair

27.09.2024

HALL-2 / SESSION-2



UAE LOCAL TIME: 11<sup>00</sup> : 13<sup>00</sup>

## HEAD OF SESSION: Yusuf SERT

Authors	Affiliation	Presentation title
Salih Aybey	<i>Zonguldak Bülent Ecevit University</i>	Moral Education in Âşık Pasha's Garip-Nâme
Salih Aybey	<i>Zonguldak Bülent Ecevit University</i>	Educational Methods Used in Âşık Pasha's Work Named Garip-Nâme
Ayhan Dağdeviren	<i>Çankırı Karatekin University</i>	Dubai Tourism
Ayhan Dağdeviren	<i>Çankırı Karatekin University</i>	Bird Watching Tourism in Seyfe Lake
Hatice Yıldız	<i>Ankara Hacı Bayram Veli University</i>	Love Theme in Ihsan Raif Hanım's Poems
Yusuf Sert	<i>Yozgat Bozok University</i>	Mep and Frontier Orbital Analysis of 5-Hydroxythalidomide
Yusuf Sert	<i>Yozgat Bozok University</i>	In Silico Analysis of 5-Hydroxythalidomide Molecule
Canan Yılmaz Necla Ayaş	<i>Zonguldak Bülent Ecevit University</i>	Labor productivity and the share of foreign capital in the basic metal industry
Murat Çavuş Metin Akiz	<i>Yozgat Bozok University</i>	Mathematics and Physics in Early Republican Turkey: Prominent Scientists and Their Contributions
Metin Akiz Murat Çavuş	<i>Yozgat Bozok University</i>	Scientific Advances and Innovations in The Early Years of The Republic of Turkey
Emel Sünter	<i>Dokuz Eylül University</i>	The Healing Power of Asking Questions with Philosophical Healing
Hasan Yıkman Turan Ayanlar Işın İçöz Mehmet Yüksel Emre Safa Tengilimoğlu	<i>DHMI Aviation Academy</i>	The Recruitment of Qualified Personnel, Training Requirements and The Effects of Training on Personnel for the Safe Conduct of Airport Operations

(All speakers required to be connected to the session 10 min before the session starts)

Moderator is responsible for ensuring the smooth running of the presentation, managing the group discussion and dynamics.

# Face to Face / Swissotel Al Ghurair

27.09.2024

HALL-3 / SESSION-2



UAE LOCAL TIME: 11<sup>00</sup> : 13<sup>00</sup>

## HEAD OF SESSION: Manolya ACAR

Authors	Affiliation	Presentation title
Beray Gökteş Manolya Acar	<i>Baskent University</i>	The Relationship Between Postural Habits and Awareness Level and Musculoskeletal System Problems, Pain Severity, Fatigue and Quality of Life Level in Dentists
Hatice Kanbur Recep Şahingöz Cennet Yaman Elif Horan Atmaca	<i>Yozgat Bozok University</i>	Investigation of the Efficiency of Dye-Sensitized Solar Cells by Adding Different Coadsorbents to N719 Dye
Ayşegül Yılmaz	<i>Selçuk University</i>	Second Victim Case in Healthcare Workers
Ayşegül Yılmaz	<i>Selçuk University</i>	Nurses' Work Environments: Impact on Nurses, Patients and Health Care Institutions
Ayşe Uçar Selda Arslan	<i>Necmettin Erbakan University</i>	Hypertension Management and Nursing with Current Guidelines
Yeter Çilesiz Elif Kaygıner	<i>Sivas Bilim ve Teknoloji University</i>	Evaluation of Some Soybean Genotypes and Varieties Grown in Sivas Ecological Conditions in Terms of Antioxidant Capacity
Zehra Korkut	<i>Selçuk University</i>	Analysis of Physiotherapy and Rehabilitation Theses on Urinary Incontinence in Turkey
Ayşe Uçar Selda Arslan	<i>Necmettin Erbakan University</i>	Self-Management of Warfarin Use
Berna Yavuz Pehlivanlı Hatice Kanbur Çavuş Ali Pehlivanlı	<i>Yozgat Bozok University</i>	Comparison of Chemical and Physical Properties of Naturally Occurring Graphite in Kutahya Altıntaş-Oysu District and 99 % Purity Industrial Graphite
Berna Yavuz Pehlivanlı	<i>Yozgat Bozok University</i>	Organic Geochemical Characteristics of Bituminous Shales in the Hirka Formation
Ayşenur Çiydem Kamile Yasdımın Saffet Özgün	<i>KTO Karatay University</i>	Comparison of Urban Heat Island Formed in Konya Province and Its Effect on the Performance of Viper SD4 Training Aircraft

(All speakers required to be connected to the session 10 min before the session starts)

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# ONLINE SESSION / 25.09.2024

HALL-1 / SESSION-1

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 09:00 – 11:00



TÜRKİYE LOCAL TIME: 10:00 – 12:00

## HEAD OF SESSION: Dr. Ecem KARA

Authors	Affiliation	Presentation title
Ecem Kara Gökhan Baktemur	<i>Sivas Bilim ve Teknoloji University</i>	Determination of the Effects of Different Salt Concentrations On Lavender Growth Under In Vitro Conditions
Ecem Kara Gökhan Baktemur	<i>Sivas Bilim ve Teknoloji University</i>	Determination Of Tolerance Level Of Thyme Plant To Different Salinity Levels
Erhan Kahya Mehmet Fırat Baran Cihan Cinoğlu	<i>Tekirdağ Namık Kemal University</i>	Recognition Of Kiwifruit On Seedling For Precision Harvesting Systems With Yolov8 Deep Learning Model
Ismail Naneli	<i>Sakarya Uygulamalı Bilimler University</i>	Comparative Theoretical Analysis of Energy Potential Values of Wheat Straw Wastes: Afyon and Uşak Example
Ismail Naneli	<i>Sakarya Uygulamalı Bilimler University</i>	Comparative Theoretical Analysis of Energy Potential Values of Wheat Straw Wastes in Bilecik and Eskişehir Locations
Hacer Dolas	<i>Harran University</i>	Factors Affecting the Production and Use of Activated Carbon as an Adsorbent
Hacer Dolas	<i>Harran University</i>	Electrochemical Investigation of Polyaniline Electropolymerized on Different Surfaces
Aper Baydar Yeşim Bozkurt Çolak Mete Özfidaner	<i>Siirt University</i>	The Effect of Climate Change and Agricultural Drought on Water Resources
Ali Beyhan Ucak	<i>Siirt University</i>	Determination of Water Stress Tolerant Chickpea ( <i>Cicer arietinum</i> L.) Genotypes
Ruken Konuk Ali Beyhan Ucak Fırat Pala	<i>Siirt University</i>	Effect of Restricted Irrigation Applications on Water-Yield Relationships in Clearfield Sunflower Plant

(All speakers required to be connected to the session 10 min before the session starts)

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# ONLINE SESSION / 25.09.2024

HALL-2 / SESSION-1

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 09:00 – 11:00



TÜRKİYE LOCAL TIME: 10:00 – 12:00

## HEAD OF SESSION: Dr. Görkem ÖZTÜRK

Authors	Affiliation	Presentation title
Görkem Öztürk Mehmet Fırat Baran Belma Doğan Öz	<i>Siirt University</i>	Profitability Analysis Of Fruit Production: A Case Of Batman Province
Yasin Akansel Görkem Öztürk Belma Doğan Öz	<i>Siirt University</i>	Changes Brought By The Gap Project In The Socio-Economic Structure Of Farms In Şanlıurfa Province
Halit Deniz Şireli	<i>Dicle University</i>	Determination of the Effects of Heat Stress on Farm Animals
Halit Deniz Şireli	<i>Dicle University</i>	Communication Methods in Bees
Halit Deniz Şireli	<i>Dicle University</i>	Shortening of Lambing and Kidding Interval Used to Increase Lamb-Kid Productivity in Sheep and Goats
Murat Turan Irfan Inan Buse Karatekin	<i>Dicle University</i>	The Effects Of Lameness In Livestock Farming
Irem Toprakçı Yüksel Selin Şahin Sevgili	<i>Istanbul University- Cerrahpaşa</i>	Recovery Process Of The Phenolic-Rich Extract From Beetroot ( <i>Beta vulgaris</i> L.) Powder: An Optimization Study
Irem Toprakçı Yüksel Selin Şahin Sevgili	<i>Istanbul University- Cerrahpaşa</i>	Multi-Response Optimization Of Ultrasound-Assisted Extraction For The Bioactives In <i>Ocimum basilicum</i> L.
Aslı Görgülü Taki Karsli	<i>Eskisehir Osmangazi University</i>	Determination Of 90 Base Deletion Polymorphism In <i>Bmpr1b</i> Gene In Akkaraman And Anatolian Merino Sheep Breeds
Oğuzhan Özdemir	<i>Batman University</i>	Investigation of Biochemical Components of <i>Echinophora tenuifolia</i> Oil Using the GC-MS/Headspace Method

(All speakers required to be connected to the session 10 min before the session starts)

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# ONLINE SESSION / 25.09.2024

HALL-3 / SESSION-1

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 09:00 – 11:00



TÜRKİYE LOCAL TIME: 10:00 – 12:00

## HEAD OF SESSION: Dr. Mehdi Shalchi Tousi

Authors	Affiliation	Presentation title
Mehdi Shalchi Tousi	Beyte Internatinal University	Optimum Design of Reinforced Concrete Cantilever WOA Optimization Algorithm
Fowotade, Sulayman. A., Haruna D. Abubakar. Ahmad Fadhila. Hafsat Usman K	Hussaini Adamu Federal Polytechnic	Neem Bark Mediated - Biosynthesis and Characterisation of Silver Nanoparticles
Fatima Haroun	The Hashemite University	Using Photogrammetry for Digital Documentation of Heritage Sites and Objects in Jordan
Ukatu, V.E. Muhammad A.A.	Kebbi State University of Science and Technology	The Effect Of Management System On Some Haematological Parameters Of Layer Chicken At Labana Farm, Aliero, Kebbi State, Nigeria
Ukatu, V. E. Mada, N. S.	Kebbi State University of Science and Technology	Resistance Status of Anopheles gambiae (sensu lato) to Pyrethroid Insecticides in Argungu L. G. A., Kebbi State, Nigeria
Faruku Muhammad Aliero Zaharaddeen Adamu Khamisu Saratu Usman	Kebbi State University of Science and Technology	Development and Implementation of an Independent Inventory Management System: A Case Study of Dan Aggo Plaza
Manal Menchih Khalid Hilal Ahmed Kajouni	Sultan Moulay Slimane University	Chaotic Dynamics of Conformable Maturity-Structured Cell Population Models
Ismail Mehmeti Fisnik Bislimi Gazmend Deda Arben Tërstena Sokol Krasniqi	University of Applied Sciences in Ferizaj	Businesses as carriers of economic development and legal infrastructure - case study in Kosovo
Kajal Kharwar	University of Lucknow	Impact of Economic Growth and FDI on Income Inequality in India: A Study of the Widening Wealth Gap
Shaista Jamal Kidwai Nagendra Kumar Maurya	University of Lucknow	Assessing the Impact of Gender Inequality on Economic Development in India: A Study on the Economic Consequences of Gender Disparity

(All speakers required to be connected to the session 10 min before the session starts)

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# ONLINE SESSION / 25.09.2024

HALL-4 / SESSION-1

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 09:00 – 11:00



TÜRKİYE LOCAL TIME: 10:00 – 12:00

## HEAD OF SESSION: Dr. Monica Alina Toma

Authors	Affiliation	Presentation title
Zain Mushtaq	University of the Punjab	Impact Assessment Of Siderophore Producing Bacteria And L-Tryptophan On Nutritional Composition, Antioxidant Activity, And Volatile Compounds Of Potato
Muhammad Rizwan Tariq	University of the Punjab	Extension In Shelf Life Of Sugarcane Juice With The Implementation Of An Integrated Approach
Seema Sadiq Mohammad Zahid	Shibli National College	Covid-19 : Unprecedented Social Challenges Before Humanity In India
Zuma Ismayilova	The National Museum of History of Azerbaijan	Conclusions on the Formation of the Active Component of Ecological Culture through Museums
Driss Azdem Jamal Mabrouki Souad El Hajjaji	Mohammed V University in Rabat	Advances and Challenges in Water Desalination in Morocco: A Sustainable Solution for Water Scarcity
Ashrarul Hasib Riyadh Joynal Abedin	Jagannath University	Nanoparticle-Mediated Gene Silencing Strategies In Treatment Of Areca Nut Induced Oral Squamous Cell Carcinoma
Monica Alina Toma	The Bucharest University	The Woman As A Source Of Joy And Sadness In Nichita Stanescu's Poetry Volume, "A Vision Of Feelings" (1964)
Gheorghe Giurgiu Manole Cojocaru	Titu Maiorescu University	The Therapeutic Effects Of Deniplant Nutraceuticals On The Gut Microbiome In Patients With Psoriasis
Oluwakemi Racheal Oshinowo Moses Adeolu Agoi Benjamin Johnson Olasiju Olasunkanmi Julius Olatunde	Lagos State University of Education	The Importance And Implementation Of Human- Computer Interaction In Education: A Survey On Evolving Innovations In Classroom Management
Gheorghe Giurgiu Manole Cojocaru Dorina Burlacu Fermina Pérez Carmona	Titu Maiorescu University	Natural modulation of the intestinal microbiome in patients with celiac disease

(All speakers required to be connected to the session 10 min before the session starts)

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# ONLINE SESSION / 25.09.2024

HALL-5 / SESSION-1

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 09:00 – 11:00



TÜRKİYE LOCAL TIME: 10:00 – 12:00

## HEAD OF SESSION: Dr. Subhashish Dey

Authors	Affiliation	Presentation title
Zohaib Hassan Sain	Superior University	Leveraging Chatgpt For Efficient Evaluation And Feedback In The Educational Setting
Subhashish Dey	Seshadri Rao Gudlavalluru Engineering College	Four-Legged Uncontrolled Intersection Improvement In An Urban Area
Subhashish Dey	Seshadri Rao Gudlavalluru Engineering College	Experimental Investigations On Strength And Durability Properties Of Bamboo And Steel Fibre Reinforced Concrete
Deepak Bansal	Indian Institute of Finance	Design And Development Of Novel Approach For File Sharing For Security Using Blockchain Technology: Literature Review
R.Vidhyalakshmi K.Rajaganapathy	Bharath Institute Of Higher Education And Research	Unlocking the Secrets of Human Anatomy
Wajahat Ali Mohammad Nabeel Sheema Sadia	Aligarh Muslim University	A Comparative Study of Multi-Objective Solid Transportation Problem Solutions Under Uncertain Environments
Mark Anthony N. Polinar April Marie N. Mahipos Bertella G. Rabanes Imie Jasmin L. Flores	Mabolo National High School	Unheard Narratives of Public School Teachers' Coffee Consumption
Hebat-Allah S. Tohamy	National Research Centre	A Novel Approach to Chromium Pollution Control: Magnetite/Carbon Quantum Dots
Zineb Ait Fares Miloudi Hlaibi Noureddine Kamil Rachid Ouchn	Hassan II University of Casablanca	Polymeric membranes for desalination using membrane distillation: A review
Mohamed Ouabane Khadija Zaki Hanane Zaki Abdelkrim Guendouzi Abdelouahid Sbai Chakib Sekkate Tahar Lakhlifi Mohammed Bouachrine	My Ismail University	Inhibition of the Janus kinase protein (JAK1) by the A. Pyrethrum Root Extract for the treatment of Vitiligo pathology. Design, Molecular Docking, ADME-Tox, MD Simulation and in-silico investigation
Ananda Majumdar	University of Alberta	The Combination Of Flemish And Courtly Painting And The Five Senses Of Perception

(All speakers required to be connected to the session 10 min before the session starts)

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# ONLINE SESSION / 25.09.2024

HALL-1 / SESSION-2

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 11:30 – 13:30



TÜRKİYE LOCAL TIME: 12:30 – 14:30

## HEAD OF SESSION: Dr. Serap SARIBAŞ

Authors	Affiliation	Presentation title
Izem Dereli Hüseyin Bilal Macit	<i>Burdur Mehmet Akif Ersoy University</i>	A Brief Review Of Digital Gaming Habits And Addiction
Akbar Abbasi	<i>Girne University</i>	Integrating Artificial Intelligence into Emergency Medicine: A Comprehensive Overview
Aydın Selliog	<i>Mersin University</i>	Computer-Assisted Science Education For Students With Intellectual Disabilities: Sensory Organs
Belkıs Tekmen Yasemin Ermiş	<i>Başkent University</i>	A Research On Multicultural Studies In Early Childhood Education
Deniz Çınar	<i>Bağımsız araştırmacı</i>	The Impact Of Erp Systems On Inventory Management In Small And Medium-Sized Enterprises: Success Factors And Challenges
Yağmur Suzan Sönmez	<i>Girne American University</i>	The Place of the Theme of Life in the Renewed Secondary Education Biology Program
Ibrahim Çağrı Erkul	<i>Osmaniye Korkut Ata University</i>	The Uk Labour Party And The Palestinian Question: Comparing Jeremy Corbyn And Keir Starmer's Thoughts On An Endless Conflict
Serap Saribaş	<i>Karamanoğlu Mehmetbey University</i>	Autocracy In Opposition To Anarchy In A Comparative World Historyclass: Adaptation Of The Third Wave Experiment, The Wave
Serap Saribaş	<i>Karamanoğlu Mehmetbey University</i>	The Projection Of Reality In Fransico Goya's Print Paintings Goya's Ghosts
Gülay Ekici Ceyda Ceylan	<i>Gazi University</i>	Examination Of Educational Studies Written In The Field Of Digital Game Addiction

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# ONLINE SESSION / 25.09.2024

HALL-2 / SESSION-2

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 11:30 – 13:30



TÜRKİYE LOCAL TIME: 12:30 – 14:30

## HEAD OF SESSION: Dr. Selin ŞAHİN SEVGİLİ

Authors	Affiliation	Presentation title
Fırat Aşır İlhan Özdemir Şamil Öztürk	<i>Dicle University</i>	Quercetin Treatment As A Protective In Diabetic Rats
İlhan Özdemir Şamil Öztürk	<i>Dicle University</i>	Experimental Allergic Rhinitis Model
Ebru Bekmezci Halime Esra Meram	<i>Selcuk University</i>	The Effect Of Skin-To-Skin Contact On Breastfeeding And Nursing Approach
Ebru Bekmezci Halime Esra Meram	<i>Selcuk University</i>	Factors Affecting Mother-Baby Attachment And Nursing Care
Uğur Köktürk	<i>Zonguldak Bülent Ecevit University</i>	Comparison of the relationship between fragmented QRS and inflammatory markers in chronic coronary artery disease patients
Betül Uyar Mehmet Güneş	<i>Dicle University</i>	As An Acute Antisucidal Agent: Ketamine
Tugba Andac Guzel Esmâ Gamze Aksel	<i>Kayseri University</i>	A Comprehensive Analysis Of Veterinary Clinics With Respect To Furniture And Interior Design Characteristics
Bilge Açıan Hayriye Seza Altınışik Hanifa Abdal Medine Poyraz	<i>Istanbul 29 Mayıs University</i>	Evaluation Of The Reasons For School Dropout In Secondary Education And Offering Solutions In The Context Of School Social Work
Selin Şahin Sevgili	<i>Istanbul University-Cerrahpaşa</i>	Deep Eutectic Solvents: A Comprehensive Evaluation
Selin Şahin Sevgili	<i>Istanbul University-Cerrahpaşa</i>	The Concept Of Green Extraction For The Recovery Of Bioactives From Biomass
Hamide Arslan Tarus Duygu Dede Nurdan Demirci	<i>Marmara University</i>	Relationship Between Symptom Severity, Coping Strategies, And Quality Of Life In Women With Urinary Incontinence

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# ONLINE SESSION / 25.09.2024

HALL-3 / SESSION-2

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 11:<sup>30</sup> – 13:<sup>30</sup>



TÜRKİYE LOCAL TIME: 12:<sup>30</sup> – 14:<sup>30</sup>

## HEAD OF SESSION: Zohreh Asadi

Authors	Affiliation	Presentation title
Muthmainnatun Mufidah	UIN K.H. Abdurrahman Wahid Pekalongan	The role of the Indonesian Pawn Center (PGI) in improving the community's economy
Farhan Ahmad Kusumiyati Kusumiyati Mochamad Arief Soleh Muhammad Rabnawaz Khan Ristina Siti Sundari	Universitas Padjadjaran	Effects of Water Stress on Agronomic and Physiological Parameters in Chili Crops
Muhammad Mazhar Iqbal Malik Muhammad Akram Hafiz Qaiser Yasin Tehmena Rashid Zafar Munir	Agriculture Mechanization Research Institute	Setting Up Of Solar Tubewells In Waterlogged Areas Of District T.T. Singh, Punjab, Pakistan
Muhammad Mazhar Iqbal Malik Muhammad Akram Hafiz Qaiser Yasin Tehmena Rashid Zafar Munir	Agriculture Mechanization Research Institute	Promotion Of Gram Cultivation Through Smart Climate Agriculture Technologies In The Thal Area Of Punjab, Pakistan
Fatima Bouizzal Moulay Laarbi Ouahidi Youssef El Madhi Mohammed Dardour Abdellatif Harchrass	University Ibn Tofail	Assessing the Psychometric Properties of the Perceived Stress Scale for Teachers in Morocco
Ilhame Fitah Miloud Chakit Mohamed El Kadiri Sara Brikat Aboubaker El Hessni Abdelhalim Mesfioui	University Ibn Tofail	The evaluation of the social functioning of schizophrenia patients followed up in the health center My El Hassan of Kenitra, Morocco
Zohreh Asadi Davood Domairry Ganji Soroush Maddah Mohammad Jalili	<i>Babol Noshirvani University of Technology</i>	investigation of Savonius VAWTs with helix blades related to renewable wind energy based on analytical and numerical approaches
Ali Mirzagoli Elahe Neshat Payam Jalili Davood Domiri Ganji	Babol Noshirvani University of Technology	Chemical modeling of NOx reduction in a Cu-zeolite SCR catalyst
Zohreh Asadi Murtadha Ahmed Payam Jalili Davood Domiri Ganji	Babol Noshirvani University of Technology	Solving fractional differential equations with Semi-Analytical methods
Zohreh Asadi Ali Gholami M.Javidan Ali mirzagoli ganji Payam Jalili Davood Domiri Ganji	<i>Babol Noshirvani University of Technology</i>	Numerical simulation of the geometrical effects of the revolving spring turbulator on the improvement of heat transfer in tubular heat exchangers

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# ONLINE SESSION / 25.09.2024

HALL-4 / SESSION-2

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 11:<sup>30</sup> – 13:<sup>30</sup>



TÜRKİYE LOCAL TIME: 12:<sup>30</sup> – 14:<sup>30</sup>

## HEAD OF SESSION: Dr. Irina-Ana DROBOT

Authors	Affiliation	Presentation title
Michael O. Oni Basant K. Jha Taiwo, S. Yusuf Junaid M. Abba Baba I. Mundi Olaife H Adebayo Luqman A. Azeez	Ahmadu Bello University	Theoretical Analysis of mixed convective rarefied gas flow in a vertical microchannel with flow reversal and cubic density-temperature variation
Anouar Ben-Loghfyry Abderrahim Charkaoui Youness El Yazidi Anass Bouchriti	Hassan II University	A FOTV model based-bilevel approach for noise removal
Moses Adeolu Agoi Oluwakemi Racheal Oshinowo Benjamin Johnson Olasiju Solomon Abraham Ukpanah Oluwanifemi Opeyemi Agoi	Lagos State University of Education	Cutting-Edge Technology: An Appraisal Of The Efficacy Of Internet Services In Academia And Its Relevance In Educational Management
Irina-Ana Drobot	Technical University of Civil Engineering Bucharest	Japanese Ethics: A Key To Understanding An Asian Culture
Ishwar Mittal Aarti Rosy Dhall Mikul	Maharshi Dayanand University	The Influence of Service Quality on University Brand Equity: Insights from Students' Perceptions
Soufiane Elhadfi Jamal Chenouf Brahim Fakrach Hassane Chadli	Moulay Ismail University	Nano-Encapsulation: Probing Quaterthiophene with Infrared Spectroscopy in SWCNTs.
Said Babou Miloud Chakit Radia El Gui Leila Abouzzine Dine Aboubaker El Hessni Abdelhalem Mesfioui Youssef Sqalli-Houssaini	Ibn Tofail University	Acute and subacute toxicity of Ethanolic extract of Rosmarinus officinalis in female Wistar rats
Malika El Ouardi Miloud Chakit Ali Quyou Moulay Laarbi Ouahidi	Ibn Tofail University	Assessment of Family Supporting for Moroccan Primary School Students with Autism

(All speakers required to be connected to the session 10 min before the session starts)

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# ONLINE SESSION / 25.09.2024

HALL-5 / SESSION-2

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 11:<sup>30</sup> – 13:<sup>30</sup>



TÜRKİYE LOCAL TIME: 12:<sup>30</sup> – 14:<sup>30</sup>

## HEAD OF SESSION: Dr. Mohammed Saci Ferdia

Authors	Affiliation	Presentation title
Imoh Ime Ekanem Emem Okon Ikpe Kufre Richard Ekanem	Akwa Ibom State Polytechnic	A study on Adoption of Heat Exchangers as Industrial Hotspot in Equipment Cooling and Efficiency
Blessing Imoh Ime Ayodele Philip	Akwa Ibom State Polytechnic	Dynamics of Ineffective and Inefficient Management of Health Records: A Case Study of General Hospital Ituk Mbang, Uruan, Akwa Ibom State
Aniekan Essienubong Ikpe Imoh Ime Ekanem Emem Okon Ikpe	Akwa Ibom State Polytechnic	Fundamental Principles of Mechanical Ventilation Systems and their classifications in Conventional Engineering Practices
Mohammed Saci Ferdia	University of Sfax	The Effectiveness of Internal Auditing in Evaluating and Enhancing the Financial Performance of Economic Enterprises
Baiju Thomas	Ramakrishna Mission Vivekananda Educational and Research Institute	Fostering Storytelling Empowers Students with Learning Disability Improves Communication Skills in the Modern Era
Jakub Bałdyka Anna Kopiczko Patrycja Wiślak Jakub Adamczyk	Józef Piłsudski University of Physical Education in Warsaw	Determinants Of Bone Mineral Density In Female Elite Masters Athletes: A Cross-Sectional Study
Karuna Shanker Kanaujia	University of Lucknow	Challenges Hindering India's Progress toward a Five-Trillion-Dollar Economy
Osamah Ihsan Ali István Gábor Gyurika Taha Hussein Mohammed	University of Pannonia	A Comprehensive Analysis of Physical and Chemical Vapor Deposition Methods for Advanced Hard Coatings in Cutting Tools
Favour C. Uroko	University of Nigeria	Assessing care for the aged in contemporary Nigeria: Any help from Proverbs 14:30-31
Valbona Habili Sauku Ervin Ibrahim Silva Ibrahim	University of Tirana	Augmentative-Alternative Communication as a rehabilitative and educational approach to support communication and social interaction in autism spectrum disorder
Chems Eddine Boukhedimi	University of Tizi Ouzou	Does nationality impact on the consumption of organic foods?

(All speakers required to be connected to the session 10 min before the session starts)

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# ONLINE SESSION / 25.09.2024

HALL-1 / SESSION-3

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 14:00 – 16:00



TÜRKİYE LOCAL TIME: 15:00 – 17:00

## HEAD OF SESSION: Dr. Mehmet Hadi AYDIN

Authors	Affiliation	Presentation title
Seher Çağlar Mehmet Hadi Aydın	<i>Siirt University</i>	Determination of the Occurrence Rate and Prevalence of Cercospora Leaf Spot Disease ( <i>Cercospora beticola</i> Sacc.) in Sugar Beet Planting Areas in Yozgat Province
Seher Çağlar Mehmet Hadi Aydın	<i>Siirt University</i>	Determination of Producers' Approaches Against Cercospora Leaf Spot Disease ( <i>Cercospora beticola</i> Sacc.) Seen in Sugar Beet Planting Areas in Yozgat Province
Serife Gokcececek Yilmaz	<i>Nestle Purina Balikesir</i>	A Nutrition Solution Specially Formulated for Cats with Sensitive Skin and Coat Structure: Pro Plan Derma Care Cat
Ergül Demir Eray Selçuk	<i>Ankara University</i>	A Comparison Of Bayesian And Classical Maximum Likelihood Estimation Methods On Item Recovery In The 3pl Model
Ergül Demir	<i>Ankara University</i>	Using Chatgpt With Basic And Limited Information Of The Research To Find The Appropriate Statistical Technique
Ahmet Faruk Firat Ahmet Fezzioglu	<i>Festo San. ve Tic. A.Ş.</i>	Energy Efficiency and Contribution of Flowmeters in Compressed Air Systems
Selime Acar Mehmet Cengiz Karaismailoglu	<i>Bartın University</i>	Systematic Studies On Spartium junceum L. Species
Seval Eliş Ferhat Kizilgeci Mehmet Yıldırım	<i>Mardin Artuklu University</i>	Evaluation of Drought and Heat Stress-Tolerant Icarida Durum Wheat Lines Under Diyarbakir Conditions
Ferhat Kizilgeci Servet Özkan İntaş Seval Eliş	<i>Mardin Artuklu University</i>	Effect of Environmental Conditions on Grain Yield of Barley ( <i>Hordeum vulgare</i> L.) Genotypes
Berfin Aslı Gündem Arzu Altuntaş	<i>Siirt University</i>	Contribution Of Green Infrastructure To Disaster-Resilient Cities
Fatema Almerhej Arzu Altuntaş	<i>Siirt University</i>	Reuse Of Defaulted Industrial Areas
Müzeyyen Şengün Güleccen Kağan Kökten	<i>Sivas Provincial Directorate of Agriculture and Forestry</i>	Macro Elements and Energy Values of Herbage of Different Hungarian Vetch + Triticale Mixture Ratios

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# ONLINE SESSION / 25.09.2024

HALL-2 / SESSION-3

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 14:00 – 16:00



TÜRKİYE LOCAL TIME: 15:00 – 17:00

## HEAD OF SESSION: Dr. Yasemin MESDA

Authors	Affiliation	Presentation title
Hazal Boydak Demir Figen Balo	<i>Dicle University</i>	Energy Efficient Library Design with Green Building Studio Simulation
Hazal Boydak Demir Figen Balo	<i>Dicle University</i>	A Sample Study on the Effects of Aggregates Added to Construction Concrete on Energy Performance
Çağla Gül Şenkardeş Irem Dölen	<i>Bilgi University</i>	The Metaverse: Perceptions as a New Communication Medium
Ayşe Burcu Zülfikar	<i>Bursa Uludağ University</i>	The Role Of Technology In Panorama Museums: A Study On The Bursa 1326 Panorama Museum
Ahmet Aydın Ortaçay Özlem Sağıroğlu Demirci	<i>Gazi University</i>	Documentation and Determination of Problems of Ferit Bey Mansion Located on Plot 1, Island 134, Fevzi Çakmak District, Elazığ Province
Yasemin Mesda	<i>Cyprus International University</i>	Conservation And Restoration Proposals Of Salih Suphi Efendi Mansion: Lefke, Cyprus
Ali Endes	<i>Yozgat Bozok University</i>	Determination of Soil-Borne Fungal Disease Agents in Strawberry Production Areas of Yozgat Province
Genar Atıcı Hasan Ali Irik	<i>Erciyes University</i>	Determination of the Nitrogen and Phosphorus Removal Performance of Zeolite and Sawdust in Wastewater

(All speakers required to be connected to the session 10 min before the session starts)

Moderator is responsible for ensuring the smooth running of the presentation, managing the group discussion and dynamics.

# ONLINE SESSION / 25.09.2024

HALL-3 / SESSION-3

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 14:00 – 16:00



TÜRKİYE LOCAL TIME: 15:00 – 17:00

## HEAD OF SESSION: Ristina Siti Sundari

Authors	Affiliation	Presentation title
Saida Taoussi Ahmed Ouaha Imane Chaiboub Khalid Hoummada Abdelilah Lahmar Mohamed Naji Hssain Bih Bouchaib Manoun Jones Alami Abdeslam El Bouari Lahcen Bih	<i>Moulay Ismail University</i>	Enhanced Performance of All-Solid-State Lithium Batteries with Innovative Glass-Ceramic Electrolytes
Fateme Nadalinia Chari Davood Domiri Ganji Mehdi Mahboobtosi Payam Jalili Ali Mirzagoli Ganji Bahram Jalili	<i>Babol Noshirvani University of Technology</i>	Investigating MHD nanofluid flow under the influence of Joule heating and chemical reactions in parallel rotating disk
Khadija ZAKI Mohamed OUABANE Abdelkrim Guendouzi Mohammed Bouachrine Abdelouahid SBAI	<i>Moulay Ismail University</i>	Identification of activity-modulating fragments of thiazole derivatives as potential DHODH inhibitors using SMILES-based QSAR: In-Silico Study
Idowu Johnson Olusoji Oladunni Opeymi Adeniregun Kehinde Adesoji Bada Taiwo Funmilayo	<i>Obafemi Awolowo University Teaching Hospitals</i>	Level Of Awareness Of Public Health Implication Associated With Non-Vaccination Of Immunization Schedules Among Mothers With Children Under-Five In Ifelodun Local Government Area Of Osun State.
Felicia King-Agboto Clifford.O.Ugorji	<i>Imo State University</i>	The Impact Of Education Research On Promoting Sustainability And Inclusivity In Student Learning Environment
Amrouche Zoheir El Hadi Djamel Fauconnier Marie-Laure Laribi-Habchi Hassiba	<i>University of Khemis Miliana-Algeria</i>	Effect of catechins on the slimming activity of rabbits
Imene Boulhaia Nadji Moulai-Mostefa Abdelkader Hadjsadok Ali Aouabed	<i>University of Medea</i>	Elaboration And Characterization Of A Natural Composite Material Based On Colloidal Particles Of Microcrystalline Cellulose Coated With Modified Starch
Ristina Siti Sundari Reny Hidayati Budhi Wahyu Fitriadi Resti Yuninda Rikza fauzi Anwar Diva Aulia Salsabila	<i>University of Perjuangan Tasikmalaya</i>	Innovation of Cumin Leaves ( <i>Plectranthus amboinicus</i> SPRENG) and Garlic ( <i>Allium sativum</i> ) Enhancement to Agribusiness Variant of Odorless Salted Duck Eggs

(All speakers required to be connected to the session 10 min before the session starts)

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# ONLINE SESSION / 25.09.2024

HALL-4 / SESSION-3

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 14:00 – 16:00



TÜRKİYE LOCAL TIME: 15:00 – 17:00

## HEAD OF SESSION: Dr. Aliyu HASSAN

Authors	Affiliation	Presentation title
Valentina Marinescu Anda Anca Rodideal Ramona Marinache	University of Bucharest	Energy Crisis – Mass Media Coverage
Ramona Marinache Valentina Marinescu Anda Anca Rodideal	University of Bucharest	Society, Energy And Digital Transition
Aliyu Hassan	Air Force Institute of Technology	A Review Of Urban Floods And Uncontrolled Waste Disposal: Analysis Of Their Occurrence And Consequences
Retem Chahira Djouini Amina Bairi Abdel Madjid	Badji Mokhtar University	Assessment of post-stroke neurocognitive disorders in patients admitted to the specialized hospital establishment in Annaba-ALGERIA-
B Bhaskar Rao Chandrakant Naikodi Suresh L Sanjeevkumar Chetti	Davangere University	A Comprehensive Study of Suicidal Risk Identification from Social Networking Sites
Adama Sangare Lahsen Achkouch Ahmed Attou Ahmed Rachid Younesse El Cheikh Daouda Diakite	Hassan First University of Settat, Settat	Application of geometric average model for identifying high mineralization zones using gamma-ray spectrometry data in the boke bauxite district, republic of guinea
Kostyantyn Babov Vera Stepanova Mykolay Godziev Sergey Gushcha Alexander Plakida	Ukrainian Research Institute of Medical Rehabilitation and Resort Therapy of the Ministry of Health of Ukraine	Application Of Innovative Technologies In The System Of Habilitation Of Children With Psycholinguistic Delayed Development
Youssef Adnan Brahim El Ibrahim Nada Kheira Sebbar Hassan Ouachtak Abdelaziz Ait Addi	Ibn Zohr University	Synthesis Of A Novel Heterocyclic Compounds As Efficient Inhibitor For Carbon Steel Corrosion In Acidic Mediums: Surface Morphology And Electrochemical Studies
Aware Balasaheb Parasram Ashok Nivrutti Bhavale	Modern College of Arts	Counting of lattices having nullity up to two
Monika Lopuszanska-Dawid Miroslav Kopecky	Józef Piłsudski University of Physical Education in Warsaw	Determinants Of Health Behaviors Among Polish Residents: The Role Of Economic And Social Factors

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# ONLINE SESSION / 25.09.2024

HALL-5 / SESSION-3

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 14:00 – 16:00



TÜRKİYE LOCAL TIME: 15:00 – 17:00

## HEAD OF SESSION: Dr. Drita AVDYLI

Authors	Affiliation	Presentation title
Drita Avdyli	Mediterranean University of Albania	Economic Migration and Facing the Communist Government in the Diaspora (1961-1990)
Fatima Bouizzal Moulay Laarbi Ouahidi Youssef El Madhi Mohammed Dardour Abdellatif Harchrass	University Ibn Tofail	Statistical Insights into the Validity and Reliability of the Perceived Stress Scale for Moroccan Teachers
Brahmi Zahia Gherissi Djallel Eddine	University of Souk-Ahras	Influence Of Seasonal Feeding Practices On The Reproductive Cycles Of Female Camels
Abdessamad Ouasfi Khalid Rakib Abdellah Gantare	Hassan First University of Settat	Title: Professional risk mapping in the intensive care unit of Hassan II Hospital in Settat, Morocco.
Bate Garba Barde Ijanu Emmanuel Madu	Federal University Dutse	Identification And Application Of Drywood Termite ( <i>Cryptotermes cavifrons</i> Banks) Gut Microbiota For Plastics Biodegradation
Tasawar Iqbal Ali Ahmad	University of Agriculture	Anti-Inflammatory And Analgesic Properties Of Basil ( <i>Ocimum Basilicum</i> ) Oil In Rheumatoid Arthritis Treatment
Abdessamad El Hamaoui Miloud Chakit Hassan Saidi Abderazzak Khadmaoui	Ibn Tofail University	Psychological assessment of Social Support in Patients with Persistent Chronic Disease Followed up at Provincial Hospital of Kenitra, Morocco
Hassan Saidi Miloud Chakit Zakaria Abidli Abdessamad El Hamaoui Abderrazzak Khadmaou	Ibn Tofail University	Epidemiological Profile of Bacterial Meningitis in Children Under 12 Years of Age in the Kenitra Region, Morocco
Arij Bouzelmate Hassane Hjiat Inssaf Raiss	University of Abdelmalek Essaadi	Existence results for some degenerate nonlinear elliptic equations in weighted anisotropic Sobolev space
Ahmed Attahiru Yusuf Haruna	<i>Kebbi State University of Science and Technology</i>	A Review On Pharmacological Activities Of <i>Carica Papaya</i> Linn

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# ONLINE SESSION / 26.09.2024

HALL-1 / SESSION-1

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 09:00 – 11:00



TÜRKİYE LOCAL TIME: 10:00 – 12:00

## HEAD OF SESSION: Khadija Hassan Ali Al-Qusayr

Authors	Affiliation	Presentation title
Bouteldja Naima Mammeri Adel Attir Badreddine	University Pole	Continental Aquaculture in Algeria (Regions of El Oued): Socio-Economic and Environmental Impacts
Aisyah Nurul 'Aini Abdul Aziz	UIN K.H. Abdurrahman Wahid Pekalongan	Spiritual Message In The Song "Gala Bunga Matahari": Reflection Of Quranic Verses In Music
Abdessamad El Hamaoui Miloud Chakit Hassan Saidi Abderazzak Khadmaoui	Ibn Tofail University	Psychological assessment of Social Support in Patients with Persistent Chronic Disease Followed up at Provincial Hospital of Kenitra, Morocco
Hassan Saidi Miloud Chakit Zakaria Abidli Abdessamad El hamaoui Abderrazzak Khadmaou	Ibn Tofail University	Epidemiological Profile of Bacterial Meningitis in Children Under 12 Years of Age in the Kenitra Region, Morocco
Khadija Hassan Ali Al-Qusayr	University of Kufa	The Role of Oriental Studies in Analyzing the Prophet's Biography
Said Babou Miloud Chakit Radia El Gui Leila Abouzzine Dine Aboubaker El Hessni Abdelhalem Mesfioui Youssef Sqalli-Houssaini	Ibn Tofail University	Acute and subacute toxicity of Ethanolic extract of Rosmarinus officinalis in female Wistar rats
Malika El Ouardi Miloud Chakit Ali Quyou Youssef Aboussaleh	Ibn Tofail University	Assessment of Family Supporting for Moroccan Primary School Students with Autism
Sheeba Irafn	GIFT University Punjab	National response on the climate change threats: implications for sustainable economic growth in Pakistan
Amir Ali Shah Muhammad Mateen Afzal Awan Nouman Ashraf	University of Management and Technology Sialkot	Leveraging Ant Colony Optimization for Improved MPPT in Photovoltaic Systems Under Dynamic Conditions
Amir Ali Shah Muhammad Mateen Afzal Awan Nouman Ashraf	University of Management and Technology Sialkot	Adaptive Energy Harvesting Techniques for Solar Arrays in Variable Shading Environments

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# ONLINE SESSION / 26.09.2024

HALL-2 / SESSION-1

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 09:00 – 11:00



TÜRKİYE LOCAL TIME: 10:00 – 12:00

## HEAD OF SESSION: Misbah Liaqat

Authors	Affiliation	Presentation title
Junu Poudel Namita Nath Bhaben Tanti	Gauhati University	Evaluation of bamboo-derived microcrystalline cellulose as a binder and disintegrant in tablet preparation
Chizoma Catherine Okpara	Imo State University	Effect Of Digitalization On Advancing Psychology For Sustainable Development In Imo State University
Misbah Liaqat	Superior College Campus	Power Dynamics and Psychological Control in Harold Pinter's The Birthday Party: A Study Through French and Raven's Power Theory
Felicia King-Agboto Chizoma Catherine Okpara	Imo State University	Effect Of Different Teaching Method In Promoting Psychological Literacy Among Undergraduate Students
Clifford. O. Ugorji Felicia King-Agboto Nneka Chinyere Ezeugo Kalu Eke Osonwa	Nnamdi Azikiwe University	Effect Of Assessment Method On Academic Performance Of Students In Certification Program In Rivers State University
Divya O M Sagaya Aurelia P	CHRIST University	Machine Learning-Based Statistical Analysis of Pathological Voice Across Multiple Datasets with Comparative Evaluation Using Real-Time Data
Khadija Elkhalloufy	Sultan Moulay Slimane University	Analytical Solutions To $\Xi$ -Caputo Fractional Initial Value Problems Via Modified Laplace Transform
Alice Sisinno	Università degli Studi di Milano	Art Forgery and Legal Protections: Safeguarding Authenticity in the Art Market
Ali Farajzadeh Mahmood Ghobadi	Urmia University	Quasi-equilibrium Problems in Topological Spaces
Said Meftah Khadija Meftah Lehbib Bouyza	Hassan First University of Settat	Optimization of Conditions for Methyl Orange Dye Removal Using Activated Carbon from Cork Oak Fruit: Box-Behnken Response Surface Approach.

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# ONLINE SESSION / 26.09.2024

HALL-3 / SESSION-1

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 09:00 – 11:00



TÜRKİYE LOCAL TIME: 10:00 – 12:00

## HEAD OF SESSION: Andrey Popatanasov

Authors	Affiliation	Presentation title
Mohamed Bechir Ben Hamida	Imam Mohammad Ibn Saud Islamic University	Impact of Fluid-Structure Interaction on Heat Transfer in a Wavy L-Shaped Enclosure with a Moveable Baffle
Ukatu, V.E. Muhammad A.A.	Kebbi State University of Science and Technology	The Effect Of Management System On Some Haematological Parameters Of Layer Chicken At Labana Farm, Aliero, Kebbi State, Nigeria
S. M. Idris I.O. Obaroh D. D. Attah Sagir R I. Ibrahim A. Abubakar	Kebbi State University of Science and Technology Aliero	Effect Of Electromagnetic Radiation, Telecommunication Mast On Clariasgariepinus
Andrey Popatanasov Elitsa Petrova	Sofia University	Pakistani "flower bomb" – Pasoori as "weapon" for peace and unity. Sentiment and content analysis of the audience response towards it and the elicited artworks over the cyberspace
Melik Sami Khelil Sara Tallal Abdel Karim Bouzir	Mohamed Khider Biskra University	Urban Planning Challenges Arising from Spatio-Temporal Dynamics of Informal Housing
Melik Sami Khelil Sara Tallal Abdel Karim Bouzir	Mohamed Khider Biskra University	Vernacular Architecture: A Model for Low-Energy Solutions in Arid Climates
Sabrina Roguai Abdelkader Djelloul	Abbes Laghrour university khenchela	Copper oxide nanoparticle synthesis for photocatalytic efficiency
Neda Fatima Bushra Sumaiya	Integral University	Personalized Learning in Virtual Learning Environments: Enhancing Student Engagement through Technological Integration
Feruze Shakaj Valentina Sinaj	University of Tirana	An Econometric Analysis Of Factors Affecting The Demand For Higher Education In Albania.
Chizoma Catherine OKPARA	Imo State University	Relationship Between Stress And Teacher Job Satisfaction In Imo State Municipal

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# ONLINE SESSION / 26.09.2024

HALL-4 / SESSION-1

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 09:00 – 11:00



TÜRKİYE LOCAL TIME: 10:00 – 12:00

## HEAD OF SESSION: Daniyal Ahmed

Authors	Affiliation	Presentation title
Adelakun O. E Adegbite S. K.	University of Ibadan	Effects Of Flood On Rural Livelihood Activities Among Rural Households In Atiba Local Government Oyo State, Nigeria
Geoffrey Mitchell Anabela, P.Massano Joao Matias	Centre for Rapid and Sustainable Product Development	Digitalisation Of Polymers In Manufacturing And Design
Bolaji Comfort Adeniyi	Bamidele Olumilua University of Education	Customer Relationship Management Tools And Organizational Performance Of Commercial Banks In Southwest, Nigeria
Chokri Bayouhd Hedil Gaaya Afifa Majdoub Taoufik Bettaieb	Higher Agronomic Institute	Establishment Of An In Vitro Propagation Protocol Of Ucb-1 (Pistacia atlantica × P. integrima) Pistachio Rootstock
Mohd Kaif Qurratul Ain Ali Abdul Hannan	Muslim University	From Genocide to Exile: The Challenges Faced by Rohingya Refugees in Uttar Pradesh, India.
Iqra Parvez	Superior College campus for University Programs	Stem anatomical plasticity: a key feature in establishment of Erioscirpus comosus (Wall.) Palla. in diverse environmental conditions
Meriem Sandaoui Sanae El Ghachtouli Mohammed Azzi Zaina Zaroual	University Hassan II of Casablanca	A Comprehensive Overview of Ultrasound as a Sustainable Technology for Wastewater Treatment
Daniyal Ahmed	Lecturer University of Central Punjab	SheShield: Enhancing IoT for Women's Safety
Cláudia S.G.P. Pereira María Carpena Rodríguez João C.M. Barreira Miguel A. Prieto M. Beatriz P.P. Oliveira	University of Porto	Optimization of the operational conditions in the ultrasound-assisted extraction of $\beta$ -carotene from Himanthalia elongata
Ukatu, V. E. Mada, N. S.	Kebbi State University of Science and Technology	Resistance Status of Anopheles gambiae (sensu lato) to Pyrethroid Insecticides in Argungu L. G. A., Kebbi State, Nigeria

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# ONLINE SESSION / 26.09.2024

HALL-5 / SESSION-1

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 09:00 – 11:00



TÜRKİYE LOCAL TIME: 10:00 – 12:00

## HEAD OF SESSION: Sandra Trzcińska

Authors	Affiliation	Presentation title
Valiyeva Gulnara Jafar Aghayeva Asiya Haji Mashadiyeva-Bayramova Sabina Anvar Bayramov Adil Allahyar Mammadova Khayala Rajab	Azerbaijan Medical University	Pituitary Gland Regulation by the Hypothalamus
Mehriban Fərhad Qızı Rüstəmovə Nigar Vəli Qızı Məlikova Nərmin Vəli Qızı Bağirova Elşən Azər Oğlu Şadlinski Xanım Aydın Qızı Fatimə Dursun Qızı Abdulkərimova Vəli Yadulla Oğlu Əsmətov	Azərbaycan Tibb Universiteti	Klozapinin xroniki istifadəsinin zolaqlı cisimdə lipid peroksidi məhsullarının miqdarına təsirinin tədqiqi
Ulviyya Azizova Khayala Mammadova	Azerbaijan Medical University	The Role of Enzyme Allosteric Regulation in Metabolic Pathways
Akande, Sikirulai Abolaji Abdulrahim Al-Musbahu Musa, Ojeba Innocent Job, Samuel Olorunubi Udeme, Iniobong Nicholas Okuwobi Abdulmalik Olawale	Federal University of Technology	Mathematical Optimization Of Resource Allocation For Low-Resource Settings Management Of Diabetes: A Multi-Objective Approach
Jenifer Alat Stephen	Tashkent Medical Academy	Transforming Cancer Care: "The Integration Of Artificial Intelligence For Precision Oncology And Enhanced Clinical Decision-Making"
Nedeljko M. Milanović	University of Kragujevac	What Cooperation Advice Would Subject Teachers Give Today's Parents?
Marouane Saadia Rhihil Abdallah Benfakika Hind	Université Hassan II de Casablanca	1ère Edition de la conférence internationale sur : La réglementation et la gouvernance de l'action public face à la complexité sociale
Sandra Trzcińska	Wyższa Szkoła Rehabilitacji	The concept of KTS® (pol. Kompensacyjna Terapia Skolioz, ang. Compensatory Therapy of Scolioses - CTS) – scientific assumptions of the concept.
Usama Yaseen Muhammad Saad Zia Muhammad Usman Bilal Ahmad Zeeshan Ahmad	Padjadjaran University	Exploring Innovative Approaches for Carbon Sequestration: A Comprehensive Review of Current Strategies and Prospects
Luís Viegas Rui Cardoso Mohammadmahdi Alizadeh	University of Oporto	Inhabiting The Future: Architecting (In)The Body, (In)The Home, (In)The City, (In)The Cosmos

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# ONLINE SESSION / 26.09.2024

HALL-6 / SESSION-1

ZOOM ID: 897 0755 8402/ PASSCODE: 252627



UAE LOCAL TIME: 09:00 – 11:00



TÜRKİYE LOCAL TIME: 10:00 – 12:00

## HEAD OF SESSION: Peter Krajčovič

Authors	Affiliation	Presentation title
Peter Krajčovič	University of Ss Cyril and Methodius in Trnava	The Potential Of Digital Social Media Platforms As A Tool For Effective Promotion And Awareness Building Of Eco-Oriented Brands
Khadija Meftah Said Meftah Ihssane Hamzaoui Hajar Lamkhanter Omar Kharifi Jihane Fatihi Oussama Elelazzouni Salah Touil Aziza Abid	Sultan Moulay Slimane University	Storage post-harvest of opuntia ficus indica and its impact on the efficiency of bio-coagulants flocculants extracted
Felicia King-Agboto Clifford. O. Ugorji	Imo State University	Ownership Mentality And Students Academic Performance In Mathematics In Public Schools Inimo State
K. Thamizhmaran	Government College of Engineering	Multipath Routing Protocol Based on Cross-Layer Approach for MANET
Ume Salma Maryam Manzoor Tasawar Iqbal Muhammad Azam Kinza Laraib	University of Agriculture	Impact Of Traditional Herbal Medicine On Mental Health: A Digital Health Approach
Sándor Földvári	Debrecen University	The Origin Of Roses From The Islam In Hungary And Europe, Too: Rose Culture As Turkish Heritage In Hungary:
Mohamed Aatabe	Ibn Zohr University	Stochastic predictive control of off-grid photovoltaic systems under random load variations
Mouffouk Chaima Mouffouk Soumia Medghoul Hadjer Mehdaoui Meryem Haba Hamada	University of Batna 2 Mustapha Benboulaid	In Vitro Cytotoxic, Anti-Inflammatory, Antioxidant, And Hemolytic Effects of The Species Eryngium Triquetrum Val.
Lawyer Gianina Vera Porosnicu	<i>Kebbi State University of Science and Technology</i>	Victims of road accidents considering the case law of Romanian courts
Faruku Muhammad Aliero Zaharaddeen Adamu Khamisu Saratu Usman	<i>Kebbi State University of Science and Technology</i>	Development and Implementation of an Independent Inventory Management System: A Case Study of Dan Aggo Plaza

(All speakers required to be connected to the session 10 min before the session starts)

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# ABSTRACTS



# VERMİKOMPOST ÜRETİMİNDE ZEYTİNYAĞI ATIĞI KARASU KEKİ KULLANIMININ SOLUCAN (*Eisenia fetida*) GELİŞİMİ ÜZERİNE ETKİLERİ

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## Özet

Bu çalışmada, zeytinyağı üretimi aşamasında açığa çıkan, çevresel olarak önemli bir kirletici olan zeytin karasu kekinin farklı organik materyallerle karıştırılarak vermikompost işlemine tabi tutulması aşamasında kompost solucanlarında (*Eisenia fetida*) meydana gelen değişimler laboratuvar şartlarında incelenmiştir. Karasu keki, bazı organik atıklarla (pamuk çırçır atığı, cibre ve ahır gübresi) kuru ağırlık olarak %15, %30, %45, %60 oranlarında karıştırılarak 90 gün boyunca *Eisenia fetida* türü kompost solucanları ile vermikompostlama işlemine tabi tutulmuştur. Denemenin 90. gününde her uygulamada solucan ve kokon sayısı, solucan ağırlıkları belirlenmiştir. Deneme sonucundan %60 karasu keki ile oluşturulmuş karışımda solucanların aktifliğini koruduğu ve vermikompost işleminin gerçekleşebildiği belirlenmiştir. Bu sayede, ekonomik değeri olmayan ve özellikle zeytin üreticiliği yapılan bölgelerde çevre açısından su kaynaklarında önemli bir kirletici durumunda olan karasuyun yeniden tarımsal kullanıma kazandırılması hedeflenmiştir.

**Anahtar Kelimeler:** Vermikompost, *Eisenia fetida*, kompost solucanı, zeytin karasuyu keki, pamuk çırçır atığı, cibre

## THE EFFECTS OF USING OLIVE MILL WASTEWATER CAKE IN VERMICOMPOST PRODUCTION ON THE DEVELOPMENT OF EARTHWORMS (*Eisenia fetida*)

### **Abstract**

In this study, the changes observed in compost worms (*Eisenia fetida*) during the vermicomposting process of olive mill wastewater cake, which is an important environmental pollutant generated during olive oil production, mixed with different organic materials, were examined under laboratory conditions. The olive mill wastewater cake was mixed with different organic wastes (cotton gin waste, grape pomace, and barn yard manure) at ratios of 15%, 30%, 45%, and 60% by dry weight, and subjected to a 90-day vermicomposting process with *Eisenia fetida* compost worms. On the 90th day of the experiment, the number of worms and cocoons, as well as the weight of the worms, were determined for each treatment. The results indicated that in the mixture containing 60% olive mill wastewater cake, the worms remained active and the vermicomposting process was successful. This study aimed to reclaim the olive mill wastewater, which has no economic value and poses a significant environmental pollutant, especially in olive-producing regions, for agricultural use.

**Keywords:** Vermicompost, *Eisenia fetida*, compost worms, olive mill wastewater cake, cotton gin waste, grape pomace

# ANALYSIS OF THE QUALITY AND RELIABILITY OF YOUTUBE VIDEOS ON CARDIAC REHABILITATION EXERCISES

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## **Abstract**

**Objective:** The internet and online video repositories are increasingly utilized as a source of health education for patients about a variety of medical conditions. This study examine the content and evaluate the quality of cardiac rehabilitation exercise videos for chronic heart disease on the YouTube video sharing platform.

**Methods:** Videos were searched using the keywords “cardiac rehabilitation”, “exercises for cardiac patients”, “exercise for heart disease”, “cardiac physical therapy”. Total of 124 videos, of which 67 were included in the study and evaluated. The duration, time since upload, video power index, number of likes, number of dislikes, video source, number of comments, number of views, and view rate were recorded. The videos were also evaluated according to the journal of the American Medical Association (Jama), Global Quality Scale (Gqs), and Discern Scores.

**Results:** For the YouTube videos, the mean number of views was  $26,720.92 \pm 68,307.01$ , the mean comments was  $2.791 \pm 7.68$ , the mean number of likes was  $149.74 \pm 529.59$ , and the mean number of dislikes was 0. There was a statistically significant relationship between the total number of views and the mean discern ( $r = -0.279$ ;  $p = 0.022$ ) and gqs ( $r = -0.368$   $p = 0.002$ ) scores, while the number of likes, time since upload, video power index, and video duration were not statistically significantly correlated with the mean discern, gqs, or jama scores ( $p < 0.05$ ).

**Conclusion:** YouTube videos on cardiac rehabilitation exercises were found to be of high quality, but this does not mean they are beneficial for all patients. A physician or physiotherapist must be consulted before attempting the exercises demonstrated in the videos.

**Keywords:** YouTube, Cardiac Rehabilitation, Exercise, Content, Reliability

# KONYA YÖRESİNDE YETİŞTİRİLEN ŞEKER PANCARININ VERİMİ İLE TOPRAKTA BULANAN FARKLI FORMLARDAKİ AZOT ARASINDAKİ İLİŞKİLER

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## Özet

Bu çalışma, toprakta farklı azot formlarının şeker pancarı verimi üzerine etkilerini belirlemek amacıyla Konya Yöresinde 10 farklı yerde yürütülmüştür. Arazi denemelerinde hafif alkalın reaksiyonlu, kireçli ve düşük organik madde içeriğine sahip bir toprakta tesadüf blokları deneme desenine göre dört tekerrürlü olarak kurulmuştur. Denemelerde şeker pancarına 7 farklı azot dozu (kontrol, 4 kg da<sup>-1</sup>, 8 kg da<sup>-1</sup>, 12 kg da<sup>-1</sup>, 16 kg da<sup>-1</sup>, 20 kg da<sup>-1</sup>, 24 kg da<sup>-1</sup>) üre gübresi ile uygulanmıştır. Deneme alanlarından farklı derinliklerinden (0-20 cm, 20-40 cm, 40-60 cm, 60-80 cm, 80-100 cm, 100-120 cm) alınan toprak örneklerinin toplam N, mineralize olabilir organik N, KCl ile ekstrakte edilebilir NO<sub>3</sub>, NH<sub>4</sub> ve NO<sub>3</sub>+NH<sub>4</sub> (inorganik N), fenoldisülfonik asit ile berirlenen NO<sub>3</sub>-N içeriği ve denemeye uygulanan azot dozlarının şeker pancarının verim değerlerine belirlenmiş olup aralarındaki ilişkiler tespit edilmiştir. Çalışma sonucunda, toprakların 0-20 cm derinliğinden fenoldisülfonik asit ile NO<sub>3</sub>-N içeriği şeker pancarına uygulanan N0 (r=0.8592\*\*), N4 (r=0.8418\*\*), N20 (r=0.7357\*\*), N24 (r=0.7338\*\*), 20-40 cm derinliğinden fenoldisülfonik asit ile NO<sub>3</sub>-N içeriği şeker pancarına uygulanan N0 (r=0.9378\*\*), N4 (r=0.9168\*\*), N8 (r=0.8577\*\*), N12 (r=0.8144\*\*), N16 (r=0.7977\*\*), N20 (r=0.7812\*\*), N24 (r=0.7677\*\*), 40-60 cm derinliğinden fenoldisülfonik asit ile NO<sub>3</sub>-N içeriği şeker pancarına uygulanan N0 (r=0.8945\*\*), N4 (r=0.8842\*\*), N8 (r=0.8441\*\*), N12 (r=0.8003\*\*), N16 (r=0.7804\*\*), N20 (r=0.7653\*\*), N24 (r=0.7634\*\*), 60-80 cm derinliğinden fenoldisülfonik asit ile NO<sub>3</sub>-N içeriği şeker pancarına uygulanan N0 (r=0.7458\*\*), N4 (r=0.7654\*\*), N8 (r=0.8145\*\*), N12 (r=0.8018\*\*), N16 (r=0.7633\*\*), N20 (r=0.7204\*\*), N24 (r=0.7531\*\*), 80-100 cm derinliğinden fenoldisülfonik asit ile NO<sub>3</sub>-N içeriği şeker pancarına uygulanan N0 (r=0.8152\*\*), N4 (r=0.8035\*\*), N8 (r=0.7734\*\*), N12 (r=0.7545\*\*), N16 (r=0.7186\*\*), N20 (r=0.6883\*\*), N24 (r=0.7044\*\*), 100-120 cm derinliğinden fenoldisülfonik asit ile NO<sub>3</sub>-N içeriği şeker pancarına uygulanan N0 (r=0.6497\*\*) azot uygulamaları arasında ilişkiler belirlenmiştir. Sonuçta toprakta analiz metotlarından fenoldisülfonik asit metodu ile farklı dozlarda uygulanan azot miktarları arasında önemli ilişkiler olmasından dolayı gübreleme önerisinde bu analiz metodunun kullanılabileceği belirlenmiştir.

**Anahtar Kelimeler:** Azot formları, Amonyum, Fenoldisülfonik asit, KCl ile ekstrakte edilebilir, Nitrat, Şeker pancarı

## THE RELATIONSHIP BETWEEN THE YIELD OF SUGAR BEET GROWN IN KONYA REGION AND DIFFERENT FORMS OF NITROGEN IN THE SOIL

### Abstract

This study was carried out in 10 different locations in Konya region to determine the effects of different nitrogen forms in soil on sugar beet yield. In the field trials, it was established in a soil with a slightly alkaline reaction, calcareous and low organic matter content in four replicates according to the coincidence blocks experimental design. In the experiments, 7 different nitrogen doses (control, 4 kg da<sup>-1</sup>, 8 kg da<sup>-1</sup>, 12 kg da<sup>-1</sup>, 16 kg da<sup>-1</sup>, 20 kg da<sup>-1</sup>, 24 kg da<sup>-1</sup>) were applied to sugar beet with urea fertilizer. Total N, mineralizable organic N, KCl extractable NO<sub>3</sub>, NH<sub>4</sub> and NO<sub>3</sub>+NH<sub>4</sub> (inorganic N), NO<sub>3</sub>-N content determined by phenoldisulfonic acid, and nitrogen doses applied to the experiment were determined and their relationships were determined. As a result of the study, the content of phenoldisulfonic acid and NO<sub>3</sub>-N in 0-20 cm depth of the soils were N0 (r=0.8592\*\*), N4 (r=0.8418\*\*), N20 (r=0.7357\*\*), N24 (r=0.7338\*\*), phenoldisulfonic acid and NO<sub>3</sub>-N in 20-40 cm depth of the soils were N0 (r=0.9378\*\*), N4 (r=0.9168\*\*), N8 (r=0.8577\*\*), N12 (r=0.8144\*\*), N16 (r=0.7977\*\*), N20 (r=0.7977\*\*), 9168\*\*), N8 (r=0.8577\*\*), N12 (r=0.8144\*\*), N16 (r=0.7977\*\*), N20 (r=0.7812\*\*), N24 (r=0.7677\*\*), phenoldisulfonic acid from 40-60 cm depth and NO<sub>3</sub>-N content with sugar beet N0 (r=0.8945\*\*), N4 (r=0.8842\*\*), N8 (r=0.8441\*\*), N12 (r=0.8003\*\*), N16 (r=0.7804\*\*), N20 (r=0.7653\*\*), N24 (r=0.7634\*\*), NO<sub>3</sub>-N content with phenoldisulfonic acid from 60-80 cm depth applied to sugar beet N0 (r=0.7458\*\*), N4 (r=0.7654\*\*), N8 (r=0.8145\*\*), N12 (r=0.8018\*\*), N16 (r=0.7633\*\*), N20 (r=0.7204\*\*), N24 (r=0.7531\*\*), NO<sub>3</sub>-N content with phenoldisulfonic acid from 80-100 cm depth applied to sugar beet N0 (r=0.8152\*\*), N4 (r=0.8035\*\*), N8 (r=0.7734\*\*), N12 (r=0.7545\*\*), N16 (r=0.7186\*\*), N20 (r=0.6883\*\*), N24 (r=0.7044\*\*), phenoldisulfonic acid from 100-120 cm depth and NO<sub>3</sub>-N content of sugar beet N0 (r=0.6497\*\*) nitrogen applications. As a result, it was determined that phenoldisulfonic acid method, one of the soil analysis methods, can be used in fertilization recommendations since there is a significant relationship between the amount of nitrogen applied at different doses.

**Keywords:** Ammonium, Phenoldisulfonic acid, Can be extracted with KCl, Nitrate, Nitrogen forms, Sugar beet



## YENİDOĞAN YOĞUN BAKIM ÜNİTESİNDE BEBEKLERİ YATAN ANNELERİN BAKIMA KATILIMI, ANNE STRESİ VE ANNE ROLÜ ARASINDAKİ İLİŞKİ

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### Özet

Ebeveynliğe geçiş anne ve baba açısından zorlu bir öğrenme sürecidir. Bu süreç yenidoğan bebek herhangi bir nedenle yoğun bakıma yattığında özellikle anneler için daha stresli bir hal alabilmektedir. Bu çalışma yenidoğan yoğun bakım ünitesinde bebeği yatan annelerin bakıma katılma durumlarının maternal stres ve annelik rolü ile ilişkisini belirlemek amacıyla gerçekleştirilmiştir. Araştırmaya bebeği yenidoğan yoğun bakıma yatan toplam 193 kadın dâhil edilmiştir. Annelerin Bakıma Katılım Ölçeği puan ortalaması  $7.04 \pm 0.64$ , Anlamsal Farklılık Ölçeği puan ortalaması  $43.33 \pm 6.40$ , YYBÜ Anne Baba Stres Ölçek toplam puan ortalaması  $3.29 \pm 1.07$  bulunmuştur. Bakıma katılım ile Anne Baba Stres Ölçeği Görüntü Sesler, Bebekle ilişkili Annelik Rolü alt boyutu ile ölçek toplam puan arasında negatif yönde anlamlı bir ilişki olduğu belirlenmiştir. Hem ebeveynlerin ruh sağlığını korumak hem de uzun vadede sağlıklı bir ebeveyn-çocuk ilişkisini başlatmak için bu süreçte ebeveynler sağlık profesyonelleri tarafından desteklenmelidir. Yoğun bakım şartları da dikkate alınarak mümkün olduğunca bebeklerini görmelerine izin verilerek bakıma katılmaları konusunda desteklenmelidir.

**Anahtar Kelimeler:** yenidoğan, ebeveyn, anneler

**THE RELATIONSHIP BETWEEN PARTICIPATION IN  
CAREGIVING, MATERNAL STRESS AND MATERNAL ROLE AMONG  
MOTHERS WHOSE BABIES ARE HOSPITALIZED IN THE NEONATAL  
INTENSIVE CARE UNIT**

**Abstract**

The transition to parenthood is a challenging learning process for parents. The process can become more stressful, especially for mothers when the newborn baby is admitted to the intensive care unit for some reason. This study was conducted to determine the relationship between participation in caregiving and maternal stress and maternal role among mothers with babies in the neonatal intensive care unit in Turkey. A total of 193 women whose babies were hospitalized in the neonatal intensive care unit were included in the study. The mean scores of the participants were  $7.04 \pm 0.64$  on the Assessment of Mothers' Participation in Caregiving Scale,  $43.33 \pm 6.40$  on the Semantic Differential Scale, and  $3.29 \pm 1.07$  on the NICU Parental Stressor Scale. It was determined that there was a negative significant relationship between participation in caregiving and the mean scores on the total and sight and sounds and relationship with the infant and maternal role sub-dimensions of the Parental Stressor Scale. Considering the intensive care conditions, mothers should be allowed to see their babies as much as possible, and they should be supported to participate in the care.

**Keywords:** newborn, parents, mothers

**DOĞUM TOPU KULLANIMININ DOĞUM SÜRECİNDEKİ GEBE KADINLARIN  
DOĞUM MEMNUNİYETİ VE AĞRISI ÜZERİNE ETKİSİ: RASTGELE  
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**Özet**

**Amaç:** Bu çalışma doğum sürecinde doğum topu kullanımının gebelerin doğum tatmin ve ağrı düzeyleri üzerine etkisini değerlendirmek amacıyla yapılmıştır.

**Yöntem:** Çalışmanın türü randomize kontrollüdür. Çalışmanın verileri Mart 2020 ve Aralık 2021 tarihleri arasında Konya/Türkiye ilinde bulunan bir devlet hastanesinin doğum salonunda toplanmıştır. Çalışmanın örneklemini müdahale grubu için 57, kontrol grubu için 54 gebe oluşturmaktadır. Çalışmada veri toplama aracı olarak Tanıtıcı Bilgi Formu, Doğum Süreci Takip Formu, Görsel Ağrı Skalası ve Doğum Tatmin Ölçeği kullanılmıştır.

**Bulgular:** Müdahale grubundaki gebelerin kontrol grubuna göre birinci ve ikinci takip sırasında ağrı skorlarının daha düşük olduğu ve farkın istatistiksel olarak anlamlı olduğu belirlenmiştir. Müdahale grubundaki gebelerin doğumun aktif fazının süresi kontrol grubuna göre daha az olup aralarında istatistiksel olarak anlamlı fark tespit edilmiştir. Müdahale grubundaki gebelerin Doğum Tatmin Ölçek toplam puanının, bakım kalitesi, kadının kişisel özellikleri ve doğumda stres deneyimi alt boyutları puanının kontrol grubuna göre daha yüksek olduğu ve aralarındaki farkın anlamlı olduğu bulunmuştur.

**Sonuç:** Çalışmanın sonuçlarına göre gebelerin doğumun aktif fazında doğum topunun kullanılması gebelerin doğum sırasında ağrı düzeyini azaltmakta, doğum tatmin düzeyini arttırmaktadır.

**Anahtar Kelimeler:** Doğum topu, doğum tatmini, ağrı, sağlık profesyoneli bakımı

## **EFFECT OF USING BIRTH BALL ON BIRTH SATISFACTION AND PAIN OF PREGNANT WOMEN IN THE LABOUR PROCESS: A RANDOMIZED CONTROLLED STUDY**

### **Abstract**

**Objective:** This study was applied to evaluate the effect of birth ball use on birth satisfaction and pain levels of pregnant women during labor.

**Method:** The type of study is randomized controlled. The data of the study were collected in the delivery room of a state hospital in Konya/Turkey between March 2020 and December 2021. The sample of the study consisted of 57 pregnant women for the intervention group and 54 pregnant women for the control group. In the study, Descriptive Information Form, Birth Process Follow-up Form, Visual Analog Scale and Birth Satisfaction Scale-Revised were used as data collection tools.

**Results:** It was determined that the pain scores of the pregnant women in the intervention group were lower during the first and second follow-up than the control group, and the difference was statistically significant. The duration of the active phase of labor in the intervention group was shorter than in the control group, and a statistically significant difference was found between them. It was found that the Birth Satisfaction Scale-Revised total score, the sub-dimensions of quality of care, women's attributes and stress experienced during labor of the pregnant women in the intervention group were higher than the control group, and the difference between them was significant.

**Conclusion:** According to the results of the study, the use of a birth ball during the active phase of labor reduces the pain level during labor and increases the level of birth satisfaction of pregnant women.

**Keywords:** Birth ball, birth satisfaction, pain, health professional care

## KADINLARIN ÜRİNER İNKONTİNANSA İLİŞKİN FARKINDALIK VE TUTUMLARININ İNCELENMESİ

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### Özet

Bu çalışma, kadınların üriner inkontinansa ilişkin farkındalık ve tutumlarının incelemesi amacıyla planlanmıştır. Tanımlayıcı ve ilişki arayıcı türde planlanan çalışmanın örneklemini, Temmuz 2023-Mart 2024 tarihleri arasında İç Anadolu bölgesinde bulunan bir kamu hastanesine başvuran 199 üriner inkontinansı olan kadınlar oluşturmuştur. Veriler; Kişisel Bilgi Formu, Üriner İnkontinans Farkındalık ve Tutum Ölçeği ve Ürogenital Distres Envanteri kullanılarak toplanmıştır. Verilerin analizinde tanımlayıcı istatistikler, bağımsız gruplarda t testi, One-Way ANOVA testi ve Pearson korelasyon analizi kullanılmıştır. Çalışmanın tüm basamakları Helsinki Deklarasyonuna uygun olarak yürütülmüştür. Araştırmaya katılan kadınların yaş ortalaması  $44.31 \pm 7.83$  yıldır. Katılımcıların Üriner İnkontinans Farkındalık ve Tutum Ölçeği sağlık sorunu olarak kabulünü engelleyen faktörler alt boyut ortalama puanı  $22.22 \pm 6.69$ , sağlık motivasyonu alt boyut ortalama puanı  $10.73 \pm 3.96$ , üriner inkontinans ile başetme alt boyut ortalama puanı  $16.55 \pm 5.64$ , kısıtlanma alt boyut ortalama puanı  $9.99 \pm 3.50$  ve idrar kaçırma korkusu alt boyut ortalama puanı  $11.32 \pm 4.49$ 'dir. Ürogenital Distres Envanteri toplam ortalama puanı  $46.26 \pm 23.10$ 'dir. Sonuç olarak, araştırmaya katılan kadınların üriner inkontinansı sağlık sorunu olarak kabul etme düzeylerinin orta, üriner inkontinansa karşı sağlık motivasyonlarının yüksek, üriner inkontinans ile başetme yeteneklerinin orta düzeyde olduğu, üriner inkontinans nedeniyle hafif düzeyde kısıtlanma ve orta düzeyde idrar kaçırma korkusu yaşadıkları, üriner inkontinans semptom şiddetinin orta düzeyde olduğu belirlenmiştir. Kadınların üriner inkontinans konusunda farkındalıklarını artırmak ve bu konuda tutumlarında değişiklik yaratmak amacıyla müdahale çalışmaları yapılması önerilmektedir.

**Anahtar Kelimeler:** farkındalık; tutum; üriner inkontinans; ürogenital distres

## INVESTIGATION OF WOMEN'S AWARENESS AND ATTITUDES TOWARDS URINARY INCONTINENCE

### **Abstract**

The present study was planned to examine women's awareness and attitudes towards urinary incontinence. The sample of the descriptive and correlational study consisted of 199 women with urinary incontinence who applied to a public hospital in Central Anatolia between July 2023 and March 2024. Data were collected using Personal Information Form, Urinary Incontinence Awareness and Attitude Scale and Urogenital Distress Inventory. Descriptive statistics, independent samples t-test, One-Way ANOVA test and Pearson correlation analysis were used to analyze the data. All steps of the study were conducted in accordance with the Declaration of Helsinki. The mean age of the women participating in the study was  $44.31 \pm 7.83$  years. The mean scores of the factors that prevent acceptance as a health problem, health motivation, coping with urinary incontinence, restriction, and fear of urination sub-dimensions of the Urinary Incontinence Awareness and Attitude Scale were  $22.22 \pm 6.69$ ,  $10.73 \pm 3.96$ ,  $16.55 \pm 5.64$ ,  $9.99 \pm 3.50$ , and  $11.32 \pm 4.49$ , respectively. The total mean score of the Urogenital Distress Inventory was  $46.26 \pm 23.10$ . As a result, it was determined that the women who participated in the study had moderate levels of acceptance of urinary incontinence as a health problem, high levels of health motivation against urinary incontinence, moderate levels of ability to cope with urinary incontinence, mild level of restriction due to urinary incontinence and moderate level of fear of urinary incontinence, and moderate level of urinary incontinence symptom severity. Intervention studies are recommended to increase women's awareness about urinary incontinence and to change their attitudes about this issue.

**Keywords:** attitude; awareness; urinary incontinence; urogenital distress



# ELEKTROKİMYASAL ENERJİ DEPOLAMA İÇİN 2D KROM BORÜRÜN (CrB MBene) SENTEZİ VE KARAKTERİZASYONU

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## Özet

İki boyutlu (2D) malzemeler, nanometre ölçeğinde yüksek en boy oranlarına ve son derece ince kalınlığa sahip malzemelerdir. MBenes olarak bilinen geçiş metali borürleri, 2D ailesinin yeni ve keşfedilmemiş bir üyesidir. MBene üretimi hala büyük bir zorluktur ve bu nedenle, MBene'nin enerji depolama alanlarında uygulanmasına ilişkin çok fazla çalışma yoktur. Bu çalışmada, MAB fazı  $Cr_2AlB_2$ 'den 2D CrB MBene üretimi ve enerji depolama uygulamaları gerçekleştirilmiştir. 2D-CrB nano tabakaları, seyreltilmiş bir HCl çözeltisine daldırılarak  $Cr_2AlB_2$  tozlarından Al katmanlarının seçici olarak aşındırılmasıyla elde edildi. Hazırlanan 2D CrB nano tabakaları X-ışını kırınımı, taramalı elektron mikroskobu ve X-ışını fotoelektron spektroskopisi kullanılarak incelendi. 2D CrB MBene elektrotu, 0,1 A/g akım yoğunluğunda 92,3 F/g özgül kapasitans göstererek iyi elektrokimyasal performans gösterdi. Bu çalışma, MAB fazlarından birçok yeni 2D MBene malzemesinin sentezi ve çeşitli alanlardaki uygulamaları için umut verici bir strateji sunmaktadır.

**Anahtar Kelimeler:** MBene, Krom Borid nano tabakalar, Süperkapasitör

## SYNTHESIS AND CHARACTERIZATION OF 2D CHROMIUM BORIDE (CrB MBene) FOR ELECTROCHEMICAL ENERGY STORAGE

### Abstract

Two-dimensional (2D) materials are materials with high aspect ratios and extremely thin thickness at the nanometer scale. Transition metal borides, known as MBenes, are a novel and unexplored member of the 2D family. The fabrication of MBene is still a major challenge, and therefore, there are not many studies on the application of MBene in energy storage fields. In this study, 2D-CrB nanosheets were obtained by selectively etching Al layers from Cr<sub>2</sub>AlB<sub>2</sub> MAB phase by immersion in a dilute HCl solution and their electrochemical studies were carried out. The prepared 2D-CrB nanosheets were examined using X-ray diffraction, scanning electron microscopy, and X-ray photoelectron spectroscopy. The 2D CrB MBene electrode exhibited good electrochemical performance, showing a specific capacitance of 92.3 F/g at a current density of 0.1 A/g. This study presents a promising strategy for the synthesis of many new 2D MBene materials from MAB phases and their application in various fields.

**Keywords:** MBene, Chromium boride nanosheet, Supercapacitor

**Thanks:** The authors wish to thank the Scientific and Technological Research Council of Turkey TUBITAK (BIDEB 2247-D) under the project number 121C217.

# EXPLORING THE EFFECT OF CHEMICAL BLOWING AGENTS ON POROUS CARBON NANOFIBERS: A STRUCTURAL AND ELECTROCHEMICAL INVESTIGATION

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## Abstract

Chemical blowing agents (BA) are important additives that are generally activated by heat, pressure, or chemical reactions and can be able to evolve gas through thermal decomposition and generate pores [1,2]. They can be separated into organic and inorganic ones. Organic BAs generally have a lower decomposition temperature range than inorganic ones and typically produce more gas per unit weight. Among the chemical BAs, 4,4'-oxybis benzenesulfonylhydrazide (OBSH) and azodicarbonamides (ADC) are the most used crucial commercial organic BAs for various applications. Related to energy storage applications, particularly in supercapacitors, they have not been investigated. Supercapacitors are high-performance electrochemical devices that are alternatives to traditional cells and batteries for storing electrical energy [3]. Therefore, to contribute to the electrochemical performance by providing both heteroatom doping and porous structure enhancement to the carbon material, chemical foamings are significant [4]. Here, two kinds of chemical blowing agents (BAs), specifically, oxy-bis (benzene sulfonyl) hydrazide (OBSH), and azodicarbonamide (ADC) have been explored in the fabrication of carbon nanofibers for potential usage as the electrode materials in supercapacitors (SCs). The BAs are not only used as poring agents but also as heteroatom dopants. The type and the amount of BAs are significant to obtain a good porous carbon nanofiber structure and a low amount of usage provided a better nanostructure including a larger surface area (492.5 m<sup>2</sup>/g), a better total volume (0.216 cm<sup>3</sup>/g), higher level of structural disorder and defects (I<sub>D</sub>/I<sub>G</sub>, 1.02), and higher heteroatom content (5.26 at% N and 10.38 at% O) for C/OBSH-10 nanofiber. The symmetrical SC composed of C/OBSH-10 nanofiber electrode offers a specific energy of 6.2 Wh/kg at a specific power of 300 W/kg. Moreover, the cycling ability is superior (94.6%) after 10 000 charge-discharge test and this work can be a strategy to obtain other porous carbon-based materials for energy storage applications.

**Keywords:** Blowing agents (BAs), OBSH, ADC, carbon nanofiber, supercapacitor.

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## EPİZYOTOMİ ONARIMI SIRASINDA SANAL GERÇEKLIK GÖZLÜĞÜ İLE VIDEO İZLETİLMESİNİN AĞRI, ANKSİYETE VE MEMNUNİYETE ETKİSİ

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### Özet

Çalışma epizyotomi onarımı sırasında sanal gerçeklik gözlüğü ile video izletilmesinin ağrı, anksiyete ve memnuniyete etkisini belirlemek için amaçlandı. Randomize kontrollü deneysel olarak yürütülen çalışma, Haziran- Aralık 2022 tarihleri arasında Konya ilinde bulunan bir kamu hastanesinin doğumhanesinde yürütüldü. Araştırmanın evrenini hastaneye doğum yapmak için başvuran tüm primipar gebeler oluşturdu. Araştırma örneklemini belirtilen tarihler arasında çalışmaya katılmayı kabul eden 88 (44 müdahale, 44 kontrol) gebeden oluştu. Toplam 82 katılımcı ile çalışma sonlandırıldı. Araştırma verileri; araştırmacı tarafından hazırlanan bilgi formu, doğum eylemi izlem formu, durumluk anksiyete ölçeği, visual analog skala-ağrı, memnuniyet durumunu değerlendirme skalası ve formu ile toplandı. Araştırma bağımlı ve bağımsız gruplarda t testi, ki-kare, pearson korelasyon ve lojistik regresyon testleri kullanılarak analiz edildi. Kontrol ve müdahale grubundaki kadınların epizyotomi öncesi ve sonrası visual analog skala-ağrı ortalamalarında istatistiksel olarak anlamlı fark bulundu. Müdahale grubundaki kadınların durumluk anksiyete puan ortalaması sanal gerçeklik gözlüğü uygulaması sonrası azaldı. Müdahale grubundaki kadınların %92,7'si sanal gerçeklik gözlüğü'nün ağrısını azaltmada etkili olduğunu, kadınların tamamının daha sonraki doğumlarında sanal gerçeklik gözlüğü kullanılmak istediği ve başka gebelere tavsiye edeceği belirlendi. Epizyotomi onarımı sırasında sanal gerçeklik gözlüğü ile video izletilmesinin kadınların ağrı ve anksiyete düzeyini azaltmada etkili olduğu, sanal gerçeklik gözlüğü ile video izlemekten memnun oldukları belirlendi.

**Anahtar Kelimeler:** Sanal Gerçeklik, Ağrı, Anksiyete, Hasta Memnuniyeti

## **THE EFFECT OF WATCHING VIDEOS WITH VIRTUAL REALITY GLASSES DURING EPISIOTOMY REPAIR ON PAIN, ANXIETY AND SATISFACTION**

### **Abstract**

The study aimed to determine the effects of watching a video with virtual reality glasses during episiotomy repair on pain, anxiety and satisfaction. The randomized controlled experimental study was conducted in the delivery room of a public hospital in Konya province between June and December 2022. The universe of the study consisted of all primiparous pregnant women who applied to the hospital to give birth. The study sample consisted of 88 pregnant women (44 intervention, 44 control) who agreed to participate in the study between the specified dates. The study was concluded with a total of 82 participants. The research data were collected with the information form prepared by the researcher, labor follow-up form, state anxiety scale, visual analog scale-pain, satisfaction status evaluation scale and form. The study was analyzed using t-test, chi-square, Pearson correlation and logistic regression tests in dependent and independent groups. A statistically significant difference was found in the visual analog scale-pain means before and after episiotomy of women in the control and intervention groups. The mean state anxiety score of the women in the intervention group decreased after the application of the virtual reality glasses. It was determined that 92.7% of the women in the intervention group found the virtual reality glasses effective in reducing their pain, all of the women wanted to use the virtual reality glasses in their subsequent births and would recommend them to other pregnant women. It was determined that watching videos with the virtual reality glasses during the episiotomy repair was effective in reducing the pain and anxiety levels of the women, and they were pleased to watch the videos with the virtual reality glasses.

**Keywords:** Virtual Reality, Pain, Anxiety, Patient Satisfaction

## PENDRED SENDROMUNUN VE STİBÜLER SİSTEME ETKİSİ

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### Özet

Pendred sendromu, işitme kaybı ve guatr ile karakterize genetik bir hastalıktır. Bu sendromun neden olduğu vestibüler sistem yönelik etkiler, hastaların denge stabilitesini önemli ölçüde etkileyebilir. Pendred sendromu, otozomal resesif geçişli bir hastalıktır ve SLC26A4 (pendrin) genindeki mutasyonlar sonucu ortaya çıkar. Bu sendrom, erken yaşlarda başlayan işitme kaybı ve bazen denge problemleri ile kendini gösterir. Vestibüler sistem, üç boyutta hareketi algılamak ve dengeyi sağlamak için önemli bir rol oynar. Pendred sendromunda, bu sistemdeki anormallikler, iç kulaktaki yapısal bozukluklardan kaynaklanabilir. Özellikle endolenfatik kanal ve kesede genişleme (dilatasyon) sıkça gözlenir. Bu durum, denge duyusunda bozulmalara, dolayısıyla vertigoya (baş dönmesi) yol açabilir. Pendred sendromlu hastalarda vestibüler sistemle ilgili bulgular, denge kaybı, baş dönmesi ve koordinasyon problemleri şeklinde ortaya çıkabilir. Tanı genellikle işitme kaybı şikayeti ile başvuran hastalarda yapılan işitme testleri ve genetik analizler ile konur. Vestibüler fonksiyonlar, VEMP, videonistagmografi ve posturografi gibi yöntemler kullanılarak değerlendirilir. Pendred sendromlu hastalarda, işitme kaybı için işitme cihazları veya koklear implantlar kullanılabilir. Denge problemlerine yönelik ise fizyoterapi ve vestibüler rehabilitasyon programları, hastaların yaşam kalitesini artırmada etkili olabilir. Pendred sendromu, yalnızca işitme kaybı değil, aynı zamanda vestibüler sistem üzerinde de önemli etkilere sahip olan bir hastalıktır. Gelecekte yapılacak genetik ve klinik araştırmalar, bu sendromun vestibüler sisteme etkisinin daha iyi anlaşılmasına ve daha etkili tedavi ve rehabilitasyon yöntemlerinin geliştirilmesine katkıda bulunabilir.

**Anahtar Kelimeler:** Pendred sendromu, işitme kaybı, vertigo, vestibüler fonksiyon testleri



## EFFECT OF PENDREND SYNDROME ON THE VESTIBULAR SYSTEM

### **Abstract**

Pendred syndrome, with hearing loss and goitre characterised by a genetic disorder. The effects on the vestibular system caused by this syndrome can significantly affect the balance stability of patients. Pendred syndrome is an autosomal recessive disorder and is caused by mutations in the SLC26A4 (pendrin) gene. This syndrome is characterised by early onset of hearing loss and sometimes balance problems. The vestibular system plays an important role in perceiving movement in three dimensions and maintaining balance. In Pendred syndrome, abnormalities in this system may result from structural disorders in the inner ear. Especially dilatation of the endolymphatic duct and sac is frequently observed. This may lead to impairment in the sense of balance and thus vertigo (dizziness). In patients with Pendred syndrome, findings related to the vestibular system may manifest as loss of balance, dizziness and coordination problems. The diagnosis is usually made by hearing tests and genetic analyses performed in patients presenting with hearing loss. Vestibular functions are evaluated using methods such as VEMP, videonystagmography and posturography. Hearing aids or cochlear implants can be used for hearing loss in patients with Pendred syndrome. Physiotherapy and vestibular rehabilitation programmes for balance problems can be effective in improving the quality of life of patients. Pendred syndrome is a disease that has significant effects not only on hearing loss but also on the vestibular system. Future genetic and clinical research may contribute to a better understanding of the effects of this syndrome on the vestibular system and the development of more effective treatment and rehabilitation methods.

**Keywords:** Pendred syndrome, hearing loss, vertigo, vestibular function tests

## ERİTİLMİŞ TUZ SENTEZİ, MnO<sub>x</sub> NANOROTLARIN YAPISAL VE ELEKTROKİMYASAL KARAKTERİZASYONLARI

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### Özet

Eriyik tuz sentezi, reaksiyon kontrolü ve malzeme özellikleri açısından önemli avantajlar sunan, metal oksit nanomalzemelerin hazırlanması için çok yönlü ve etkili bir yöntem olarak ortaya çıkmıştır. Bu çalışmada, 400 °C'de MnO<sub>x</sub> nano çubukları sentezlemek için kolay bir erimiş tuz tekniği ve süperkapasitörler için elektrot malzemesi olarak potansiyel uygulaması çalışılmıştır. Farklı reaksiyon sürelerinde sentezlenen MnO<sub>x</sub> nano çubuk, X-ışını kırınımı, transmisyon elektron mikroskobu ve elektrokimyasal analiz yöntemleri ile karakterize edildi. MnO<sub>x</sub> elektrot malzemelerinin elektrokimyasal özellikleri, sentez süresinden önemli ölçüde etkilenmiştir. Elektrokimyasal ölçüm sonuçları, 2 saatte sentezlenen MnO<sub>x</sub> nano çubukların 1 A/g akım yoğunluğunda 62,5 F/g'lik özgül bir kapasitansa sahip olduğunu göstermektedir. Bu MnO<sub>x</sub> nano çubukların iyi elektrokimyasal performansı, süperkapasitörler için elektrot malzemesi olarak uygulama potansiyelinin olduğunu göstermektedir.

**Anahtar Kelimeler:** Metal oksit nanomalzemesi, Eriyik tuz yöntemi, Süperkapasitör elektrot malzemesi

## MOLTEN SALT SYNTHESIS, STRUCTURAL AND ELECTROCHEMICAL CHARACTERIZATIONS OF MnO<sub>x</sub> NANORODES

### **Abstract**

Molten salt synthesis has emerged as a versatile and efficient method for the preparation of metal oxide nanomaterials, offering significant advantages in terms of reaction control and material properties. In this study, we report a facile molten salt technique to synthesize MnO<sub>x</sub> nanorods at 400 °C, and its potential application as electrode materials for supercapacitors. The MnO<sub>x</sub> nanorods synthesized at different reaction times were characterized by X-ray diffraction, transmission electron microscopy, and electrochemical analysis methods. The electrochemical properties of the MnO<sub>x</sub> electrode materials were significantly affected by the synthesis time. Electrochemical measurement results show that MnO<sub>x</sub> nanorods synthesized in 2 h had a specific capacitance of 62.5 F/g at a current density of 1 A/g. The good electrochemical performance of these MnO<sub>x</sub> nanorods indicates that they have potential application as electrode material for supercapacitors.

**Keywords:** Metal oxide nanomaterials, Molten salt synthesis, Supercapacitor electrode materials

# SAĞLIK HİZMETLERİ MESLEK YÜKSEKOKULU ÖĞRENCİLERİNDE SİMÜLASYON EĞİTİMİNİN ÖZGÜVEN VE MEMNUNİYET ÜZERİNE ETKİSİNİN BELİRLENMESİ

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## Özet

Bu çalışma Sağlık Hizmetleri Meslek Yüksekokulu 1. sınıf Diyaliz ve Anestezi öğrencilerinde simülasyon kullanımının öğrencilerin özgüven ve memnuniyetlerine etkisini belirlemek amacıyla yapılmış, retrospektif ve tanımlayıcı nitelikte bir çalışmadır. Öğrencilere damaryolu açma ve kan alma uygulamaları teorik olarak anlatılarak simülasyon uygulaması yaptırılmıştır. Veri toplama aracı olarak Öğrenci Bilgi Formu, Öğrenmede Öğrenci Memnuniyeti ve Özgüven Ölçeği kullanıldı. Çalışmada  $p < 0,05$  düzeyindeki değerler istatistiksel olarak önemli kabul edilmiştir. Çalışmada öğrencilerin öğrenmede öğrenci memnuniyeti ve özgüven ölçeği şimdiki öğrenme ile ilgili memnuniyet alt boyutu puan ortalaması  $4,44 \pm 0,401$  ve öğrenmede öz güven alt boyutu puan ortalaması  $4,52 \pm 0,354$  olarak bulunmuştur. Öğrencilerin sosyo-demografik özellikleri ile öğrenmede öğrenci memnuniyeti ve özgüven ölçeği alt boyutları puanları arasında istatistiksel olarak anlamlılık bulunmamıştır ( $p > 0,05$ ). Sonuç olarak simülasyon eğitiminin 1. sınıf diyaliz ve anestezi öğrencilerinde öğrenme ile ilgili memnuniyet ve özgüvenlerinin artırılmasında etkili olduğu bulunmuştur.

**Anahtar Kelimeler:** Öğrenci, özgüven ve memnuniyet, simülasyon eğitimi

## **DETERMINING OF THE EFFECT OF SIMULATION TRAINING ON SELF-CONFIDENCE AND SATISFACTION IN HEALTH SERVICES VOCATIONAL SCHOOL STUDENTS**

### **Abstract**

This study is a retrospective and descriptive study conducted to determine the effect of simulation use on the self-confidence and satisfaction of first-year Dialysis and Anesthesia students of the Vocational School of Health Services. The students were given a theoretical explanation of vascular access and blood collection practices and a simulation practice was performed. Student Information Form, Student Satisfaction in Learning and Self-Confidence Scale were used as data collection tools. In the study, values at  $p < 0.05$  were considered statistically significant. In the study, the average score of the students in the satisfaction with current learning subscale of the student satisfaction and self-confidence scale in learning was found to be  $4.44 \pm 0.401$ , and the average score of the self-confidence in learning subscale was  $4.52 \pm 0.354$ . There was no statistical significance between the socio-demographic characteristics of the students and the scores of the student satisfaction and self-confidence scale sub-dimensions in learning ( $p > 0.05$ ). As a result, it was found that simulation training was effective in increasing the satisfaction and self-confidence of first-year dialysis and anesthesia students.

**Keywords:** Student, self-confidence and satisfaction, simulation training

# OSMANLI DÖNEMİ MİNYATÜRLERİNDEKİ MOTİFLER KULLANILARAK DİJİTAL DESEN TASARIMLARI OLUŞTURULMASI

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## Özet

Minyatür, bir metin de anlatılanları görsel olarak destekleyen, çiziminde perspektif kullanılmayan, figürlerin profilden çizildiği ve önem sırasına göre büyüdüğü bir resim türüdür. İlk minyatürlerin Mısır’ da papirüsler üzerine yapıldığı düşünülmektedir. Türk minyatür sanatını, İslam öncesi minyatür sanatı ve İslam sonrası minyatür sanatı olarak ayırmak mümkündür. Bu araştırmanın amacı; Osmanlı Dönemi minyatür eserlerini desen özellikleri açısından inceleyerek, elde edilen motiflerden kumaş yüzey tasarımları oluşturmaktır. Çalışma kapsamında elde edilen motifler dijital ortamda çizilerek raportlama işlemleri ile kumaş desenleri oluşturulmuştur. Çalışmada nitel araştırma kapsamında olgu çalışması yöntemi kullanılmıştır. İki aşamalı olarak planlanan araştırmanın ilk bölümünde Osmanlı dönemi minyatür eserlerindeki süslemeler desen, motif özellikleri açısından incelenmiştir. Belgesel tarama yöntemi ile elde edilen veriler analiz edilerek araştırmanın ikinci aşaması uygulamalı olarak geliştirilmiştir. Osmanlı dönemine ait 16 adet minyatür sanatı eseri amaçlı örnekleme tekniği kullanılarak araştırmaya dâhil edilmiştir. Araştırma sonucunda geleneksel süsleme unsurlarını barındıran minyatür eserlerden 16 adet motif elde edilerek her motiften bir kumaş deseni oluşturacak şekilde 140 cm x 140 cm karelerde raportlama işlemi gerçekleştirilmiştir. Kaynaklara dayanan minyatür eserlere ulaşılması konusundaki yaşanan güçlük dikkate alındığında minyatürlerin ve süsleme özelliklerinin arşivlenmesi, bu kültürel süsleme özelliklerinden yola çıkılarak yeni tasarım kompozisyonlarına ulaşılması, tasarım sektöründe kültürel kaynaklar kullanılarak özgün tasarımları oluşturulmasına örnek teşkil etmesi açısından araştırma önem taşımaktadır.

**Anahtar Kelimeler:** Minyatür Sanatı, Osmanlı Dönemi Minyatür Eserleri, Süsleme, Dijital Desen Tasarımı.



## **CREATING DIGITAL PATTERN DESIGNS USING MOTIFTS IN OTTOMAN PERIOD MINIATURES**

### **Abstract**

Miniature is a type of painting that visually supports what is explained in a text, does not use perspective in its drawing, and figures are drawn in profile and enlarged according to their order of importance. It is thought that the first miniatures were made on papyrus in Egypt. It is possible to divide Turkish miniature art into pre-Islamic miniature art and post-Islamic miniature art. The purpose of this research; The aim is to create digital surface designs from the motifs obtained by examining the miniature works of the Ottoman Period in terms of their pattern features. The motifs obtained within the scope of the study were drawn digitally and digital patterns were created by reporting processes. In the study, case study method was used within the scope of qualitative research. In the first part of the research, which was planned in two stages, the decorations in the miniature works of the Ottoman period were examined in terms of pattern and motif features. The second phase of the research was developed practically by analyzing the data obtained through the documentary scanning method. 16 miniature works of art from the Ottoman period were included in the research using the purposeful sampling technique. As a result of the research, 16 motifs were obtained from miniature works containing traditional ornamental elements and the reporting process was carried out in 140 cm x 140 cm squares to create a digital pattern from each motif. Considering the difficulty in accessing miniature works based on sources, the research is important in terms of archiving the miniatures and their ornamental features, reaching new design compositions based on these cultural ornamental features, and setting an example for creating original designs using cultural resources in the design sector.

**Keywords:** Miniature Art, Ottoman Era Miniature Works, Ornament, Digital Pattern Design.

## OSMANLI İZNIK EVANİLERİNDE HAYVAN TASVİRLERİ

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### Özet

Osmanlı kaynaklarında duvar çinisinin adı “kaşi”, kullanım seramiği ise genellikle “evani” olarak adlandırılmaktadır. Türk seramik ustaları “çini” genel tanımını özetleyici biçimde kullanmışlar; çini tabak, çini vazo, duvar ya da yer çinisi olarak türetilmiş terimler, sırlanmış ve pişirilmiş “malzeme” tek bir anlamda toparlanmıştır. Türk çini sanatının en görkemli dönemi olarak bilinen 16. Yy. da en önemli merkez İznik olmuştur. Osmanlı dönemi İznik çinilerinde bitkisel motifler, stilize çiçekler, geometrik ve hayvan motifleri dönemin her safhasında özellikle mimari yapılardaki duvar çinilerinde ve evani dediğimiz kullanım eşyalarında görülmektedir. Hayvan motifleri natüralist üslubun gerisinde kalmış gibi görünse de aksine İslamiyet öncesi ve sonrası toplumların dini inançlarının gelişmesi ve ifadesi bakımından zenginlik katmıştır. Hayvansal motiflerin Orta Asya’ya dayanan kökeni Anadolu Selçuklularıyla beraber Anadolu topraklarına gelmiş ve varolan kültürle harmanlanarak kendine özgü bir üslup meydana getirmiştir. Selçuklularda mimari yapı süslemesi olarak ağırlıklı duvar çinilerinde ve gündelik kullanım seramiklerinde hayvansal motifler kullanılmıştır. 16. Yüzyıl Osmanlı mimari yapılarındaki duvar çinilerinde hayvansal motiflere rastlanmamaktadır. Evanilerde ise Selçuklu çini sanatında görüldüğü kadar yaygın olmasa da geyik, tavşan, kuş, at, boğa, aslan gibi doğada varolan hayvanlar ve ejderha, zümrüdü anka, grifon, sfenks, harpy gibi mitolojik kökenli hayvan motiflerinin kullanıldığı ve uygulandığı görülmektedir. Çalışmada 16. Yüzyıl Osmanlı evanilerinde ki tabiat kaynaklı hayvanlar ve mitolojik hayvanlar tespit edilerek sınıflandırılmış, bitkisel kompozisyonların içerisinde ki kullanım şekilleri renk, desen ve kompozisyon açısından değerlendirilmiştir.

**Anahtar Kelimeler:** Evani, İznik, Osmanlı Çini, Hayvansal Motifler

## ANIMAL DETAILS IN OTTOMAN NICE EVANS

### **Abstract**

In Ottoman sources, wall tiles are called 'kasi', while domestic ceramics are usually called 'evani'. Turkish ceramic masters used the general definition of 'tile' in a summarising way; the terms derived as 'tile plate', 'tile vase', 'wall or floor tile', glazed and fired 'material' were gathered in a single meaning. Iznik was the most important centre in the 16th century, which is known as the most glorious period of Turkish tile art. In the Iznik tiles of the Ottoman period, floral motifs, stylised flowers, geometric and animal motifs are seen at every stage of the period, especially in the wall tiles in architectural structures and in the utensils called evani. Although animal motifs seem to have lagged behind the naturalistic style, on the contrary, they have added richness in terms of the development and expression of religious beliefs of pre and post-Islamic societies. The origin of animal motifs dating back to Central Asia came to Anatolian lands with the Anatolian Seljuks and blended with the existing culture to create a unique style. During the Seljuk period, animal motifs were mainly used in wall tiles and daily use ceramics as architectural ornaments. In 16th century Ottoman architectural structures, animal motifs are not found in wall tiles. Although not as common as in Seljuk tile art, it is seen that animal motifs such as deer, rabbit, bird, horse, bull, lion and mythological animal motifs such as dragon, Phoenix, griffon, sphinx, harpy were used and applied in evanis. In this study, animals of natural origin and mythological animals in 16th century Ottoman evanis were identified and classified, and their use in floral compositions was evaluated in terms of colour, pattern and composition.

**Keywords:** Evani, Iznik, Ottoman Tiles, Animal Motifs

## XV. YÜZYIL BABA NAKKAŞ ÜSLUBUNUN GÜNÜMÜZ TEMSİLCİSİ ÇİNİ SANATÇISI MEHMET KOÇER

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### **Özet**

Fatih Sultan Mehmet'in İstanbul'u fethi ile yeni bir çağ başlamış, İstanbul bilim, sanat, ticaret merkezi olması yolunda önemli adımlar atılmıştır. Fatih Sultan Mehmet döneminden inşası başlayan Topkapı sarayı bünyesinde kurulan Ehli Hiref Teşkilatına bağlı imparatorluğun bütün sanat ve zanaat faaliyetlerini yürütmek üzere nakkaşhane kurulmuştur. Nakkaşhanenin başında bir baş nakkaş yer almakta ve yapılanlar baş nakkaşın kontrolünde gerçekleşmektedir. Fatih Sultan Mehmet döneminde baş nakkaş Özbek asıllı nakkaş Mehmet diğer adı ile Baba Nakkaş olmuştur. Kendisine ait motif ve kompozisyon anlayışı ile bir döneme imza atan Baba Nakkaşın üslubu, sadece baş nakkaş olduğu XV. yy da değil günümüze kadar yapılan her sanat ve zanaat işlerinde uygulama alanı bulmuş, çini sanatında da genelde evanilerde, az da olsa duvar çinilerinde kullanılmıştır. Kütahya'da yaşayan günümüz çini sanatçısı Mehmet Koçer, mavi beyaz Baba Nakkaş üslubu çini eserleri ile tanınmış, devlet sanatçısı unvanına sahip bir sanatçıdır. Çini sanatıyla ilgili araştırma ve inceleme yaptığı dönemlerde Baba Nakkaş'ın eserleri ve üslubu Mehmet Koçer'in dikkatini çekmiştir. Baba Nakkaş üslubuna özel bir ilgi duymuş, öncelikle sanatçının motif ve kompozisyonlarını özümsemek adına çizimler ve tasarımlar yapmıştır. Motiflerde kullandığı üslup Baba Nakkaş olmakla birlikte tasarımlar özgündür ve sanatçının şahsına aittir. Çalışmamızda Sanatçı Mehmet Koçer'e ait eserler motif, kompozisyon ve renk değerleri bakımından incelenmiş, Baba Nakkaş döneminde yapılan eserler ile karşılaştırılarak üsluba yapmış olduğu katkılar değerlendirilmiştir.

**Anahtar Kelimeler:** Çini, Baba Nakkaş, Mehmet Koçer

## **XV. CENTURY BABA NAKKAS STYLE'S PRESENT-DAY REPRESENTATIVE TILE ARTIST MEHMET KOÇER**

### **Abstract**

With the conquest of Istanbul by Fatih Sultan Mehmet, a new era began and important steps were taken to make Istanbul a centre of science, art and trade. Nakkaş Hanane was established to carry out all the art and craft activities of the empire under the Ehli Hiref Organisation established within the Topkapı Palace, the construction of which started during the reign of Fatih Sultan Mehmet. At the head of the Nakkaş Hanane, there is a chief nakkaş and the works are carried out under the control of the chief nakkaş. During the reign of Sultan Mehmet the Conqueror, the chief nakkaş was the Uzbek-born nakkaş Mehmet, also known as Baba Nakkaş. The style of Baba Nakkaş, who signed a period with his own motif and composition understanding, has found application not only in the XVth century, when he was the chief nakkaş, but also in every art and craft work done until today, and in tile art, it has been used generally in evanis and to a lesser extent in wall tiles. Mehmet Koçer, a contemporary tile artist living in Kütahya, is an artist with the title of state artist, known for his blue and white Baba Nakkaş style tile works. The works and style of Baba Nakkaş attracted the attention of Mehmet Koçer during the periods when he was researching and studying tile art. He took a special interest in Baba Nakkaş's style and made drawings and designs in order to assimilate the artist's motifs and compositions.

**Keywords:** Tiles, Baba Nakkas, Mehmet Kocer

# MIMARLIK EĞİTİMİNDE YAPAY ZEKA İLE DESTEKLENEN VERİ TABANLI KARAR ALMA

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## **Özet**

Mimarlık eğitimi, analitik düşünme ile yaratıcı sürecin birleştiği disiplinlerarası bir alandır. Yapay zekanın mimarlık eğitimine entegrasyonu ile veri tabanlı karar alma süreçlerini giderek daha fazla keşfetmektedir. Gelişen yapay zeka teknolojileri, mimarlık eğitiminde farklı bakış açıları getirmektedir. Yapay zeka araçları, mimarlık eğitiminde tasarım derslerinin veri tabanlı karar alma süreçlerini etkilemiştir. Bu çalışma, yapay zeka araçları öğrencilerin mimarlık eğitiminin tasarım derslerinde yaratıcı potansiyelini nasıl etkilediği, nasıl yeniden şekillendireceğini ele alır. Yapay zeka destekli tasarım araçları, öğrencilere alternatif çözümler üretme, tasarım süreçlerini hızlandırma ve daha kapsamlı analizler yapma imkânı tanımaktadır. Bununla birlikte, kişiselleştirilmiş öğrenme modelleri, öğrencilerin bireysel öğrenme stillerine uygun olarak özelleştirilmiş ders içerikleri ve geri bildirimler sağlamaktadır. Bunun yanı sıra, veri tabanlı karar alma süreçleri, sürdürülebilirlik, enerji verimliliği ve malzeme seçimi gibi önemli tasarım kararlarının daha isabetli bir şekilde alınmasına katkı sağlamaktadır. Ancak, bu teknolojilerin eğitime entegrasyonu, yaratıcı düşüncenin ve sezgisel tasarımın gölgede kalması riskini de beraberinde getirmektedir. Bu bağlamda, bu çalışma hem Yapay zekanın sunduğu fırsatları hem de potansiyel sınırlamaları ele alarak, mimarlık eğitiminde veri tabanlı karar almanın gelecekteki rolünü tartışmayı amaçlamaktadır. Eğitimcilerin, veri ve yapay zeka ile dengeli bir tasarım pedagojisi oluşturarak, hem analitik hem de yaratıcı süreçleri desteklemesi önem arz etmektedir.

**Anahtar Kelimeler:** Yapay zeka, mimarlık eğitimi, veri tabanlı karar alma, tasarım optimizasyonu, eğitim teknolojileri

# YÜKSEKÖĞRETİMDE UZAKTAN EĞİTİM ARACILIĞIYLA VERİLEN ORTAK ZORUNLU YABANCI DİL (5İ) DERSLERİNDE KULLANILAN DİJİTAL ÖĞRETİM MATERYALLERİ HAKKINDA ÖĞRENCİ DENEYİMLERİ

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## Özet

Gelişen teknoloji ve yaşanan bilimsel yenilikler ile birlikte diğer kamu ve kuruluşlarda olduğu gibi yükseköğretim kurumlarında da başlayan dijital dönüşüm süreci kapsamında, birçok üniversitede ortak zorunlu (5İ) dersleri uzaktan eğitim aracılığıyla yürütülmeye başlamıştır. 5İ dersleri; Yüksek Öğretim Kurumu'nun 2547 sayılı Yükseköğretim Kanununun 5. Maddesinin birinci fıkrasının (1) bendinde belirtilen Atatürk İlkeleri ve İnkılâp Tarihi, Türk Dili ile Yabancı Dil dersleridir. Uzaktan eğitimin temel unsurlarından biri olan öğretim materyalleri, uzaktan eğitim tarihi boyunca basılı kitaplardan başlayarak günümüz teknolojisiyle birlikte artık dijital bir hale evrilmiştir. Uzaktan eğitimdeki dijital öğretim materyalleri Word, PDF, Powerpoint belgesi ve video gibi çoklu ortam medyaları olabilmektedir. Bu araştırmanın amacı üniversitelerde ortak zorunlu yabancı dil (5İ) derslerinde kullanılan dijital öğretim materyalleri hakkında öğrenci deneyimlerini belirlemektir. Bu araştırma kapsamında Kayseri Üniversitesi'nde öğrenim gören ve ortak zorunlu yabancı dil (5İ) derslerini alan öğrencilerin görüşleri incelenmiştir. Çalışmada tarama modeli kullanılmıştır. Araştırmanın çalışma grubunu 1629 öğrenci oluşturmaktadır. Çalışmanın verileri araştırmacı tarafından geliştirilen çevrimiçi anket formu aracılığı ile toplanmıştır ve veriler SPSS 22.0 paket programı ile analiz edilmiştir. Araştırma sonucunda, öğrencilerin çoğu uzaktan eğitim aracılığıyla yürütülen yabancı dil derslerinde kullanılan dijital öğretim materyallerinin çeşitliliğinin dersleri daha akıcı hale getirdiğini düşünmektedir. Araştırmanın diğer bir sonucuna göre, öğrencilerin büyük çoğunluğu uzaktan eğitim platformuna yüklenen dijital öğretim materyallerine kolaylıkla erişebildiklerini düşünmektedir. Öte yandan öğrenciler dijital öğretim materyallerinin dersin seviyesine uygunluğu hususunda ise kararsız kalmışlardır. Conversely, the students expressed reservations regarding the suitability of digital teaching materials for the course level.

**Anahtar Kelimeler:** uzaktan eğitim, yabancı dil, öğretim materyali



## **STUDENT EXPERIENCES ON DIGITAL TEACHING MATERIALS USED IN COMMON COMPULSORY FOREIGN LANGUAGE (5i) COURSES DELIVERED THROUGH DISTANCE EDUCATION IN HIGHER EDUCATION**

### **Abstract**

In the context of the digital transformation process that has commenced in higher education institutions and other public and private organizations in response to new technologies and scientific innovations, several universities have begun the implementation of compulsory (5i) courses through distance learning. 5i courses include Atatürk's Principles and History of the Turkish Revolution, Turkish Language, and Foreign Language courses outlined in subparagraph (1) of the first paragraph of Article 5 of the Higher Education Law No. 2547 of the Higher Education Council. As one of the fundamental components of distance education, teaching materials have undergone a significant transformation from their traditional printed format to a digital one, enabled by technological advancements. In distance education, digital teaching materials may be multimedia, including Microsoft Word or PDF documents, PowerPoint presentations, and videos. The objective of this study is to ascertain the experiences of students concerning digital teaching materials employed in common compulsory foreign language (5i) courses at universities. Using a survey model, this study analyzed the opinions of students studying at Kayseri University and taking common compulsory foreign language (5i) courses. The research study group comprises 1,629 students. The data were collected via an online questionnaire developed by the researcher and analyzed using the SPSS 22.0 package program. The research findings indicate that most students perceive the use of a diverse array of digital teaching materials in foreign language courses delivered through distance education to enhance the fluidity of the learning process. A further study has revealed that most students believe they can readily access the digital teaching materials uploaded to the distance education platform.

**Keywords:** distance learning, foreign language, teaching material

## “KİTABI-DƏDƏ QORQUD” DASTANINDA ARXAİKLƏŞƏN ÇOXMƏNALI VƏ OMONİM SÖZLƏR

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### **Xülasə**

Böyük bir tarixi dövr ərzində dilin poetikasında baş vermiş dəyişiklikləri, oxşar və fərqli cəhətləri üzə çıxarmaq üçün geniş araşdırmalar aparılmış, müxtəlif tədqiqat əsərləri yazılmışdır. “Kitabi-Dədə Qorqud” dastanı bu tədqiqat əsərlərinin zəngin qaynağı olmuşdur. “Kitabi\_Dədə Qorqud” dastanının dilində müasir ədəbi dil üçün köhnəlmiş, arxaik hesab edilən bəzi çoxmənalı və omonim sifətlər vardır. Bu sifətlərin linqvistik cəhətdən araşdırılması mühüm əhəmiyyət kəsb edir, çünki “KDQ” ədəbi dilimizin zənginləşməsində əsas rol oynayır. Bəzi arxaik sifətlərin araşdırılması, unudulmuş semantikalarının üzə çıxarılması, mənə çalarlarının araşdırılması əsrlərin dərinliklərinə enmək deməkdir. Bu sözlər hal-hazırda dilin passiv fonduna keçsə də, “Kitabi-Dədə Qorqud” üçün hər zaman işlək sözlər olmuşdur. Cəmiyyət inkişaf etdikcə həmin sözlər köhnəlmiş, lüğət tərkibinin passiv fonduna keçmişdir. Tarixən çoxmənalılığa və xüsusilə omonimliyə malik sözlər mürəkkəb inkişafa məruz qalmışlar. Xüsusilə polisemantikliyin inkişafı və divergensiyası nəticəsində bəzi omonim sifətlər meydana gəlmiş, bəziləri arxaikləşmişdir. “Dədə-Qorqud” dastanında bu tarixi inkişafı izləmək çox maraqlıdır. Tarixi inkişaf onu göstərir ki, polisemiyada sözlərin mənələrindən biri müstəqillik qazanaraq digəri isə arxaikləşməyə meyil göstərmişdir. Bu zaman müstəqillik qazanan bəzi belə sözlər “çoxmənalılıq” terminindən çıxmışdır.

Məsələn: Qara (1. rəng çaları ; 2. böyük)

1. Bir yerə ağ otağ, bir yerə qızıl otağ, bir yerə qara otağ qurdırmışdı. (1,34)

2. Qonağı gəlməyən qara evlər yıqılsa, yeg! (1,32)

**Açar sözlər:** arxaik, omonimlik, çoxmənalılıq, polisemantiklik

## ARCHAIC WORDS AND HOMONYMOUS WORDS IN "KITABI-DADE GORGUD"

### **Abstract**

Extensive studies have been conducted and various research works have been written to reveal the changes, similarities and differences in the poetics of the language during a long historical period. "Kitabi-Dada Gorgud" saga was a rich source of these research works. The language of the "Kitabi Dada Gorgud" epic contains some polysemous and homonymous adjectives, which are considered obsolete and archaic for modern literary language. The linguistic investigation of these adjectives is of great importance, because "KDQ" plays a key role in the enrichment of our literary language. Examining some archaic adjectives, uncovering their forgotten semantics, exploring shades of meaning means going down into the depths of the ages. Although these words have now passed into the passive fund of the language, they have always been working words for "Kitabi-Dada Gorgud". As the society developed, those words became obsolete and passed into the passive fund of the vocabulary. Historically, words with multiple meanings and especially homonyms have undergone complex development. In particular, as a result of the development and divergence of polysemanticism, some homonymous adjectives have appeared, and some have become archaic. It is very interesting to follow this historical development in the "Dada-Gorgud" saga. Historical development shows that in polysemy, one of the meanings of the words gained independence and the other showed a tendency to become archaic. At this time, some such words that gained independence moved away from the term "ambiguity". For example: Qara (1. color shades; 2. big) 1. Bir yerə ağ otağ, bir yerə qızıl otağ, bir yerə qara otağ qurdırmışdı. (1,34) 2. Qonağı gəlməyən qara evlər yıqılsa, yeg! (1,32)

**Keywords:** archaic, homonymy, ambiguity, polysemanticity

## İHSAN RAİF HANIM'IN ŞİİRLERİNDE AŞK TEMASI

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### Özet

Son Osmanlı vezirlerinden Köse Raif Paşa'nın kızı olan İhsan Raif Hanım, Beyrut'ta dünyaya gelmiş ve özel eğitim almış bir kadın şairdir. İlk şiirlerinde aruz veznini kullanan İhsan Raif, daha sonra hocası Rıza Tevfik sayesinde hece vezniyle tanışır. Bundan sonraki şiirlerinde bu ölçüyü kullanır. Onun âşık tarzı şiirin etkisinin görüldüğü metinlerinde samimi bir duyuşun ve lirik bir üslubun bulunduğu dikkatlerden kaçmaz. İhsan Raif şiirlerinde bireysel ve toplumsal sorunlara değinmiş; aşk, merhamet, yoksulluk, vatanseverlik, savaş gibi temaları işlemiştir. Ey Ehl-i İslam (1913), Gözyaşları (1914), Kadın ve Vatan (1915) isimli kitaplarda yer alan şiirleri onun şiir macerasını yanıstan örneklerdir. Özellikle Gözyaşları (1914) kitabı şairin bireysel konuları gerçekçilik ve romantizmi başarıyla harmanlayarak işlediğini okuyucuya gösteren bir eser olarak görülür. İhsan Raif, şiirlerinde aşkı çeşitli yönleriyle ele alır. Kimi şiirlerde aşk ve sevgili yüceltilirken kimi şiirlerde ayrılık ve sitem dillendirilir. "Aşkın Zehri", "Kınalar Yaksın", "Gel Gidelim", "Ruhumun Ayrılmaz Yoldaşına", "Hasret", "Periler", "Genç Günler", "Gözlerin", "Leblerin", "Salkımlar Altında" ve "Vurgun" gibi şiirler aşkı psikolojik yönleriyle işlediği gibi dönemi için oldukça cesur bir gerçekçiliğe ve samimiyete de sahip olan metinlerdir. Bu bildiride Türk edebiyatında hece veznini ilk kullanan kadın şairlerden biri olan İhsan Raif'in, aşk temasını işlediği şiirleri incelenerek edebiyat tarihi içindeki yeri tespit edilmeye çalışılacaktır.

**Anahtar Kelimeler:** İhsan Raif, modern Türk şiiri, aşk teması, Gözyaşları (1914)

## LOVE THEME IN İHSAN RAİF HANİM’S POEMS

### **Abstract**

İhsan Raif Hanım, the daughter of Köse Raif Pasha, one of the last Ottoman viziers, was a female poet born in Beirut and educated privately. Initially writing her poems in aruz, she later became acquainted with syllabic meter through her teacher Rıza Tevfik, which she then incorporated more into her poetry. Influenced by the minstrel style, her writing exuded a genuine sentiment and lyrical flair. İhsan Raif delved into individual and social issues in her poems, touching on themes such as love, mercy, poverty, patriotism, and war. Her notable works include the books *Ey Ehl-i İslam* (1913), *Gözyaşları* (1914), and *Kadın ve Vatan* (1915). Notably, her book *Gözyaşları* (1914) showcased her ability to address individual subjects with a blend of realism and romance. Her exploration of love in various aspects, ranging from glorification to themes of separation and resentment, is evident in poems such as “Aşkın Zehri”, “Kınalar Yaksın”, “Gel Gidelim”, “Ruhumun Ayrılmaz Yoldaşına”, “Hasret”, “Periler”, “Genç Günler”, “Gözlerin”, “Leblerin”, “Salkımlar Altında” and “Vurgun”, revealing a bold realism and sincerity for their time. This analysis will delve into İhsan Raif’s poetic works, particularly focusing on her approach to the theme of love and her significance as one of the pioneering female poets to utilize syllabic meter in Turkish literature.

**Keywords:** İhsan Raif, modern Turkish poetry, love theme, *Gözyaşları* (1914)

## 5-HİDROKSİTALİDOMİT'İN MEP VE FRONTIER ORBİTAL ANALİZİ

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### **Özet**

Yeni ilaçların geliştirilmesi, bilim insanlarının karmaşık biyolojik süreçleri bilgisayarlarda modellenmesine olanak tanıyan in-silico teknikler sayesinde büyük ölçüde hızlanmaktadır. Bilim insanları, in-silico yöntemleri kullanarak moleküllerin birbirleriyle nasıl etkileşime gireceğini tahmin edebilir, bu da pahalı ve zaman alıcı laboratuvar testlerine olan ihtiyacı ortadan kaldırır. Bu teknikler, çeşitli bozukluklar için varsayılan genetik belirteçlerin tanımlanmasına yardımcı olduklarından genomikte çok yararlıdır. Tüm biyolojik sistemler in-silico analiz ile modellenebilir ve geleneksel deneysel yöntemlerle elde edilmesi genellikle zor olan bilgiler elde edilebilir. Makine öğrenimi ve in-silico tekniklerinin bir araya gelmesiyle bu disiplin bir devrim geçirerek kişiye özel tedavi yaklaşımlarına ve daha kesin tahminlere kapı açmıştır. Dolayısıyla diyebilirizki yeni ilaç tasarımlarının ortaya konulmasında in silico yöntemler vazgeçilmezdir. Bu çalışmada, 5-hydroxythalidomide molekülünün optimizasyonu Gaussian 09W paket programı kullanılarak gerçekleştirilecek olup sonrasında molekülün hedefini oluşturabilecek potansiyel reseptörler in-silico metotlarla test edilecektir.

**Anahtar Kelimeler:** Hidroksitalidomid, DFT, İn-Siliko

## MEP AND FRONTIER ORBITAL ANALYSIS OF 5-HYDROXYTHALIDOMIDE

### **Abstract**

The development of novel drugs is greatly accelerated by in-silico techniques, which allow scientists to model intricate biological processes on computers. Scientists can anticipate how molecules will interact with one another using in-silico methods, which eliminates the need for expensive and time-consuming lab tests. These techniques are very useful in genomics, since they aid in the identification of putative genetic markers for various disorders. Entire biological systems may be modeled by in-silico analysis, yielding insights that are frequently hard to get through conventional experimental methods. The discipline has undergone a revolution with the incorporation of machine learning and in-silico techniques, opening the door to customized treatment approaches and more precise forecasts. Therefore, we can say that in silico methods are indispensable in the development of new drug designs. In this study, the optimization of the 5-hydroxythalidomide molecule will be carried out using the Gaussian 09W package program, and then potential receptors that may constitute the target of the molecule will be tested by in-silico methods.

**Keywords:** Hydroxythalidomide, DFT, In-Silico



## FELSEFİ SAĞALTIM İLE SORU SORMANIN İYİLEŞTİRİCİ GÜCÜ

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### **Özet:**

21. yüzyılda insan bilim ve teknolojinin imkanlarından sonuna kadar faydalanırken, dev bir sanal ekrana dönüşen hayatı da bir yandan sorgulamaktadır. Çünkü insan doğası gereği düşünen bir varlık olduğunu bilir, mekanik bir varlık olmadığının farkındadır. İnsan hayatın içinde kendisine sunulan her türlü imkânı sonuna kadar kullanmayı tercih eder, bunu yapmasındaki temel amaç mutlu olmaktır. Bu nedenle Rumi “Can konağını aramadaysan, cansın...Neyi arıyorsan O’sun sen.” demiştir. Mutluluk arayışı insanı diğer varlıklardan ayıran bir özellik ve insanın kendine yaklaşması yani kendini tanıma sanatıdır. Bugün mutluluğun imkânı ve sınırları her bireye göre değişmektedir. Bir gerçek var o da: Bütün insanlık için geçerli tek bir gerçeklik olmadığıdır. İnsan için mutluluk aranmalıdır. Oysa bütün cevap o aradıklarımızda gizlidir. Yaşamı algılarımız üzerinde yorumladığımızı ve algının insan yaşamının yönünü nasıl etkilediğini biliyoruz. Öyle bir çağdayız ki bilim ve teknoloji algılarımızın kontrolünü bizden çekip almakta ve başka bir yöne savurmaktadır. İnsan iradesi gücünü yitirmektedir. Felsefe insanı her daim düşünmeye ve yaşamı anlamlandırmaya davet eder. Onun sorgulayıcı yönü elimizde sahip olduklarımızın bizim için ne kadar geçerli olduğunu ya da gerçeklik payını ölçecek kadar iddialıdır. Algılarımızın geçerliliğini doğruluğunu bize ispatlar. Aradığımızın ne olduğunu yani bizi kendimize buldurur. Felsefe soru sorar? Bu yönüyle hakikati anlamaya odaklanır. Hakikat bir bütündür, iyileştiricidir. İnsanın yaşam içinde kaybettiği anlam kaybını yeniden bütünsel olarak sağlıklı bir biçimde ortaya koyar. Son dönem yaşamlara bakıldığında insan zihni için kronik parçalanmışlıkların arttığı ve bütünü yorumlayamadığı görülmektedir. Bu anlamda insan huzursuz olmakta ve bir tatminsizlik yaşamaktadır. Felsefe bu tatminsizliği soru sorarak analiz eder, sebeplerini anlamaya çalışır ve sonrasında bir anlam inşası olanağı sağlar. Soru sormanın iyileştirici gücü tam da burada devreye girer. Bazen insan için tek bir soru hakikate ulaşmada temel olabilir. Hakikatin iyileştirici yönüne ulaşmanın yöntemi de insanın kendisine karşı dürüst olmasıyla ilgilidir. Bir eylemi yapıyor olmak ve onu neden yapıyor olduğunu bilmek insanın kendisine dürüstçe yaklaşmasıdır. “Yardım ediyorum ama neden?”, bu sorunun altında kişinin pek çok cevabı olabilir. Ortaya çıkan cevap ile insan kendi gerçekliğine bir adım daha yaklaşır ve kendine dürüst olmanın huzurunu yaşar. Mutlulukta bu anlamda dış dünyadan daha çok değil, kendini keşfetmenin gücünde saklıdır. İç dünyamızdaki algımızın her nereye ise dış dünyamız oraya doğru evirilecektir. Bu çalışma iç dünyamızın sıhhatini sorularla ayırtmak ve doğru yöne nasıl evrilmesi gerektiğine dairdir. Bunun iyileşmeye nasıl katkı sağladığı üzerine bir çalışmadır.

**Anahtar Kelimeler:** Felsefe, İyileşme, Soru Sorma, Kendini Tanıma, Hakikat, Rumi.

## THE HEALING POWER OF ASKING QUESTIONS WITH PHILOSOPHICAL THERAPY

### **Abstract**

In the 21st century, while making full use of the possibilities of science and technology, people also question the life that has turned into a giant virtual screen. Because man knows that he is a thinking being by nature, he is aware that he is not a mechanical being. Human beings prefer to use every opportunity offered to them in life to the fullest, and their main purpose in doing so is to be happy. This is why Rumi said, "If you seek the mansion of life, you are life...Whatever you seek, you are that." The pursuit of happiness is a characteristic that distinguishes human beings from other beings and is the art of getting closer to oneself, in other words, the art of self-knowledge. Today, the possibilities and limits of happiness vary according to each individual. There is one truth: There is no single reality valid for all humanity. Happiness is sought for human beings. But the answer lies in what we are looking for. We know that we interpret life through our perceptions and how perception affects the direction of human life. We are in such an age that science and technology are taking control of our perceptions away from us and throwing them in another direction. The human will is losing its power. Philosophy always invites people to think and make sense of life. Its questioning aspect is assertive enough to measure the validity or reality of what we have. It proves to us the validity of our perceptions. It makes us find what we are looking for, that is to say, ourselves. Philosophy asks questions? In this respect, it focuses on understanding the truth. Truth is a whole, it is healing. It reveals the loss of meaning that human beings have lost in life in a holistically healthy way. When we look at recent lives, it is seen that chronic fragmentation has increased for the human mind and it is unable to interpret the whole. In this sense, people become restless and experience dissatisfaction. Philosophy analyzes this dissatisfaction by asking questions, tries to understand its causes and then provides the opportunity to construct meaning. This is where the healing power of asking questions comes into play. Sometimes a single question can be the basis for reaching the truth. The method of reaching the healing aspect of truth has to do with being honest with oneself. To be doing an action and to know why one is doing it is to be honest with oneself. "I help, but why?", there may be many answers to this question. With the answer that emerges, one gets one step closer to one's own reality and experiences the peace of being honest with oneself. In this sense, happiness lies in the power of self-discovery rather than the outside world. Wherever our perception in our inner world is, our outer world will evolve towards it. This study is about separating the health of our inner world with questions and how it should evolve in the right direction. It is a study on how this contributes to healing.

**Keywords:** Philosophy, Healing, Questioning, Self-knowledge, Truth, Rumi.

# DİŐ HEKİMLERİNDE POSTÜRAL ALIŐKANLIK VE FARKINDALIK DÜZEYİNİN KAS İSKELET SİSTEMİ PROBLEMLERİ, AĐRI ŐİDDETİ, YORGUNLUK VE YAŐAM KALİTESİ DÜZEYİ İLE İLİŐKİSİ

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## Özet

Bu çalıŐmanın amacı, diŐ hekimlerinin postür bilinci ve alışkanlıkları ile kas iskelet sistemi problemleri, ağrı Őiddeti, yorgunluk ve yaŐam kalitesi arasındaki iliŐkiyi araŐtırmaktır. Bu çalıŐma, meslekte en az bir yılını doldurmuş, aktif olarak çalıŐan ve araŐtırmaya katılmaya gönüllü yaŐ ortalaması 33.76±9.31 yıl olan 103 diŐ hekimi üzerinde gerçekteŐirildi. Katılımcılara, Google Forms aracılıĐı ile Sosyodemografik bilgi formu, Postüral alışkanlık ve farkındalıĐı belirlemek için Postüral Alışkanlıklar ve Farkındalık ÖlçeĐi (PAFÖ), kas iskelet sistemi problemlerini için Nordic Kas İskelet Sistemi Anketi (NKİSA), yorgunluk düzeyi için Yorgunluk Őiddet ÖlçeĐi (YŐÖ) ve yaŐam kalitesi için ÇalıŐanlar için YaŐam Kalitesi ÖlçeĐi (ÇYKÖ) ve ağrı Őiddeti için Sayısal Ağrı Skalası (SAS) deĐerlendirmeleri uygulandı. PAFÖ duruŐ alışkanlıkları farkındalıĐı alt boyutu dıŐında diĐer PAFÖ alt boyutlar ile YŐÖ, NKİSA ve SAS skoru arasında anlamlı iliŐkilerin olduĐu görüldü ( $p<0,05$ ). ÇYKÖ tükenmiŐlik düzeyi ile PAFÖ tüm alt boyutlarında istatistiksel olarak anlamlı iliŐki saptandı ( $p<0,05$ ). YŐÖ düzeylerine PAFÖ duruŐu bozan faktörlerin farkındalıĐı ( $\beta=-0,51$ ,  $p=0,01$ ) ve ergonomi farkındalıĐı ( $\beta=-0,38$ ,  $p=0,001$ ) düzeylerinin anlamlı olarak etki ettiĐi görüldü. PAFÖ duruŐu bozan faktörlerin farkındalıĐı ( $\beta=-0,14$ ,  $p=0,01$ ) ve genel PAFÖ düzeylerinin ( $\beta=-0,28$ ,  $\beta=-0,38$ ) SAS skoruna en önemli etki eden deĐiŐkenler olduĐu belirlendi. ÇYKÖ tükenmiŐlik düzeyine PAFÖ duruŐu bozan faktörlerin farkındalıĐının ( $\beta=-0,24$ ,  $p=0,01$ ) ve toplam skorunun ( $\beta=-0,32$ ,  $p=0,03$ ) anlamlı olarak etki ettiĐi görüldü. NKİSA tüm alt boyut skorlarına PAFÖ duruŐu bozan faktörlerin farkındalıĐı ve toplam skorunun anlamlı bir Őekilde etki ettiĐi görüldü ( $p<0,05$ ). Bu bulgular ıŐıĐında, postüral farkındalıĐı yüksek olan diŐ hekimlerinin daha az kas-iskelet sistemi problemi, ağrı, yorgunluk yaŐadıĐı ve daha yüksek bir yaŐam kalitesine sahip olduĐu belirlendi.

**Anahtar Kelimeler:** DiŐ hekimi, postüral deformite, ergonomik davranıŐlar, yaŐam kalitesi

## THE RELATIONSHIP BETWEEN POSTURAL HABITS AND AWARENESS LEVEL AND MUSCULOSKELETAL SYSTEM PROBLEMS, PAIN SEVERITY, FATIGUE AND QUALITY OF LIFE LEVEL IN DENTISTS.

### Abstract

This study aims to investigate the relationship between dentists' posture awareness and habits, musculoskeletal problems, pain severity, fatigue, and quality of life. This study was conducted on 103 dentists, who have been actively working for at least one year and voluntarily participated, with an average age of  $33.76 \pm 9.31$  years. Participants were evaluated using a sociodemographic information form via Google Forms, the Postural Habits and Awareness Scale (PHAS) to determine postural habits and awareness, the Nordic Musculoskeletal Questionnaire (NMQ) for musculoskeletal problems, the Fatigue Severity Scale (FSS) for fatigue level, the Quality of Life Scale for Workers (QLSW) for quality of life, and the Numerical Pain Scale (NPS) for pain severity. Significant relationships were found between the PHAS sub-dimensions, except for the PHAS postural habits awareness sub-dimension, and the QLSW, NMQ, and NPS scores ( $p < 0.05$ ). A statistically significant relationship was found between the PHAS all sub-dimensions and the burnout level of the QLSW ( $p < 0.05$ ). The PHAS awareness of factors disrupting posture ( $\beta = -0.51$ ,  $p = 0.01$ ) and ergonomics awareness ( $\beta = -0.38$ ,  $p = 0.001$ ) were found to significantly affect FSS levels. The PHAS awareness of factors disrupting posture ( $\beta = -0.14$ ,  $p = 0.01$ ) and total PHAS levels ( $\beta = -0.28$ ,  $\beta = -0.38$ ) were determined to be the most significant variables affecting NPS score. The PHAS awareness of factors disrupting posture ( $\beta = -0.24$ ,  $p = 0.01$ ) and the total PHAS score ( $\beta = -0.32$ ,  $p = 0.03$ ) were found to significantly affect the burnout level of the QLSW. The PHAS awareness of factors disrupting posture and the total score significantly affected all sub-dimension scores of the NMQ ( $p < 0.05$ ). In light of these findings, it was determined that dentists with high postural awareness experience fewer musculoskeletal problems, pain, and fatigue, and have a higher quality of life.

**Keywords:** Dentist, postural deformity, ergonomic behaviors, quality of life

# TÜRKİYE'DE İDRAR KAÇIRMA KONUSUNDA FİZYOTERAPİ VE REHABİLİTASYON TEZLERİNİN ANALİZİ

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## Özet

**Çalışmanın Arka Planı:** Üriner inkontinans dünya çapında yaygın olarak görülen istemsiz idrar kaçırma olarak tanımlanmaktadır. Farklı popülasyonlarda görülebilen üriner inkontinans altta yatan patofizyolojik mekanizmalara göre çeşitli şekillerde sınıflandırılmaktadır. Hastaların yaşadığı semptomlar kişinin yaşam kalitesini sosyal, fiziksel ve psikolojik yönlerden etkileyebilmekte, ciddi ekonomik yük oluşturmaya devam etmektedir. Üriner inkontinansın multifaktöryel olması, yaygın görülmesi, kişisel ve toplumsal etkileri gibi nedenlerden dolayı bu konu güncel bir halk sağlığı sorunudur. Literatürde üriner inkontinans üzerinde çok fazla sayıda tanımlayıcı ve tedavi çalışmalarının yapıldığı görülmekte ve hala araştırılmaya devam edilmektedir. Üriner inkontinans konusunda ülkemizde yapılmış fizyoterapi ve rehabilitasyon tezlerinin incelenmesi bilimsel yayınların şekillenmesinde etkili olacaktır

**Amaç:** Bu çalışmanın amacı, Yükseköğretim Kurulu Ulusal Tez Veri Tabanında Türkiye'de üriner inkontinans üzerine yapılan fizyoterapi ve rehabilitasyon tezlerinin analiz edilmesidir.

**Yöntem:** Araştırmanın çalışma grubunu Yükseköğretim Kurulu Ulusal Tez Veri Tabanında yer alan üriner inkontinans üzerine konusu bulunan toplam 48 lisansüstü tez oluşturmaktadır. 2019-2023 tarih aralığında yürütülmüş tez çalışmaları analiz edildi. Çalışmalar "üriner inkontinans" anahtar kelimesi kullanılarak tarandı.

**Bulgular:** Kadın, erkek, çocuk ve yaşlı gibi farklı kitleler ile çeşitli hastalık popülasyonlarında (serebral palsy, multipl skleroz, lumbal disk hernisi, kardiyopulmoner rahatsızlıklar vs.) üriner inkontinans üzerine odaklanan çalışmaların yürütüldüğü gözlemlendi. Yapılan 48 tezin 10'unun (%20,8) doktora tezi, 38'inin (%79,1) ise yüksek lisans tezi olduğu görüldü. Yayın yılları incelendiğinde 2019 yılında 9, 2020 yılında 2, 2021 yılında 13, 2022 yılında 10, 2023 yılında 14 tezin yayınlandığı tespit edildi. Yüksek lisans tezlerinin 23'ünün (%60,5) tanımlayıcı çalışmalar olduğu, 15'inin (%39,4) ise tedavi çalışmaları olduğu belirlendi. Doktora tezlerinin tümünün tedavi etkinlik çalışmaları olduğu tespit edildi.

**Sonuç:** Fizyoterapi ve rehabilitasyon alanında üriner inkontinans üzerinde yapılmış ve Yükseköğretim Kurulu Ulusal Tez Veri Tabanında kayıtlı olan lisans üstü tezlerin genelinin yüksek lisans tezi olduğu rapor edilmiştir. Son zamanlarda farklı hastalık grupları ve popülasyonlarda üriner inkontinans konusuna odaklanan yayınlanmış tez çalışmalarının sayısında artış görülmektedir.

**Anahtar kelimeler:** Üriner inkontinans, Fizyoterapi, Tezler

## ANALYSIS OF PHYSIOTHERAPY AND REHABILITATION THESES ON URINARY INCONTINENCE IN TURKEY

### Abstract

**Background of the Study:** Urinary incontinence is defined as involuntary urinary leakage, which is common worldwide. Urinary incontinence, which can be seen in different populations, is classified in various ways according to the underlying pathophysiological mechanisms. The symptoms experienced by patients can affect the quality of life of the individual in social, physical and psychological aspects and continue to create a serious economic burden on health systems. Urinary incontinence is a current public health problem due to its multifactorial nature, widespread prevalence, and personal and social effects. In the literature, a large number of descriptive and treatment studies on urinary incontinence have been conducted and are still being investigated. Analyzing the theses on urinary incontinence in physiotherapy and rehabilitation from our nation can significantly influence the development of scientific papers.

**Objective:** The aim of this study was to analyze the physiotherapy and rehabilitation theses on urinary incontinence in Turkey in the National Thesis Database of the Council of Higher Education.

**Method:** The study group of the research consisted of a total of 48 postgraduate theses on urinary incontinence in the National Thesis Database of the Council of Higher Education. Thesis studies conducted between 2019-2023 were analyzed. The studies were scanned using the keyword “urinary incontinence”.

**Results:** It was observed that studies focusing on urinary incontinence were conducted in different populations such as women, men, children and the elderly and in various disease populations (cerebral palsy, multiple sclerosis, lumbar disc herniation, cardio pulmonary disorders, etc.). Of the 48 theses, 10 theses (20.8%) were doctoral theses and 38 (79.1%) were master's theses. When the publication years were analyzed, it was determined that 9 theses were published in 2019, 2 in 2020, 13 in 2021, 10 in 2022, and 14 in 2023. It was determined that 23 (60.5%) of the master's theses were descriptive studies and 15 (39.4%) were treatment efficacy studies. It was determined that all of the doctoral theses were treatment efficacy studies.

**Conclusion:** It was reported that most of the postgraduate theses on urinary incontinence in the field of physiotherapy and rehabilitation registered in the National Thesis Database of the Council of Higher Education were master's theses. Recently, there has been an increase in the number of published thesis studies focusing on urinary incontinence in different disease groups and populations.

**Keywords:** Urinary incontinence, Physiotherapy, Theses

## ÇİFTLİK HAYVANLARI YETİŞTİRİCİLİĞİNDE TOPALLIĞIN ETKİLERİ

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### Özet

Topallık, çiftlik hayvanlarının yaşadığı en önemli refah sorunlarından biridir. Son yıllarda yapılan çalışmalar da topallığın, büyükbaş ve küçükbaş yetiştiriciliğinde en önemli problemlerden biri olduğunu göstermiştir. Yapılan birçok çalışma yetiştiricilerin; et verimi, süt verimi, üreme problemleri ile sürü yönetiminde hayvanların sürüden çıkarılmasına kadar varılabilecek sorunlarla karşılaştıklarını bununda birçok ekonomik kayıplara neden olduğunu belirtmiştir. Topallıkla birlikte ortaya çıkan tedavi masrafları ile hayvanların kondisyonlarındaki düşüşler, üremedeki problemler, et ve süt veriminin azalması gibi nedenlerle işletme gelirleri düşecek ve ülkemiz hayvancılığı doğrudan olumsuz bir şekilde etkilenecektir. Topallık, işletmelerde uygun olmayan zemin ve barınak yapıları, beslenme sorunları, rasyon içeriğinin ani değişimi, soğuk ve sıcak stresi, hayvanların uzun süreler ayakta kalması, ıslak, çamurlu, gübre ve idrar dolu kaygan zeminler, kalitesiz altlıkların kullanılması, hayvanların istenmeyen fiziksel temasları ve işletme içerisindeki kesici ve delici malzemeler gibi nedenlerden ötürü sürü içerisinde sıklıkla gözlemlenebilmektedir. Hayvanların tırnak bakımlarının düzenli bir şekilde yapılması, uygun zemin ve barınak yapılarının kullanılması, hayvana zarar verecek fiziksel etkenlerin ortadan kaldırılması, stres faktörlerinin ortamdan uzaklaştırılması, uygun bakım ve besleme, ani rasyon değişimlerinden kaçınmak, hayvanların vakit geçirdiği alanların temizliği, sürekli gözlem ve topallık skrolama gibi değerlendirmeler ile topallığı sürü içerisinde azaltmak hem işletme hem de ülke ekonomisi açısından önemlidir. Ayrıca son zamanlarda özellikle yurtdışında topallık tespiti için kullanılan akıllı detektörler, adım sayarlar, ivmeölçerler ve sensörlerde işletmelerde anormal davranışların azaltılması ile birlikte topallık tespiti için kullanılan yeniliklerdendir. Bu çalışmada ülkemizde topallıkla ilgili çalışmalar irdelenmiş, sorun ve çözüm önerileri tartışılmıştır.

**Anahtar Kelimeler:** Topallık, Sürü Yönetimi, Büyükbaş, Küçükbaş, Yetiştiricilik



## THE EFFECTS OF LAMENESS IN LIVESTOCK FARMING

### **Abstract**

Lameness is one of the most important welfare problems experienced by farm animals. Recent studies have shown that lameness is one of the most important problems in cattle and sheep breeding. Many studies have indicated that breeders face meat yield, milk yield, reproductive problems and problems in herd management that can lead to the removal of animals from the herd, which causes many economic losses. Due to the treatment costs associated with lameness, decreases in the condition of animals, problems in reproduction, decreases in meat and milk yields, enterprise revenues will decrease and our country's animal husbandry will be directly affected in a negative way. Lameness can be frequently observed in herds due to reasons such as inappropriate floor and shelter structures, nutritional problems, sudden changes in ration content, cold and heat stress, standing for long periods of animals, wet, muddy, slippery floors full of manure and urine, use of poor quality litter, unwanted physical contact of animals, and cutting and piercing materials in the enterprise. It is important for both the enterprise and the country's economy to reduce lameness in the herd with regular nail care, use of appropriate floor and shelter structures, elimination of physical factors that will harm the animal, removal of stress factors from the environment, proper care and feeding, avoiding sudden ration changes, cleaning the areas where animals spend time, continuous observation and lameness scoring. In addition, smart detectors, pedometers, accelerometers and sensors, which have recently been used for lameness detection especially abroad, are among the innovations used for lameness detection along with the reduction of abnormal behaviors in enterprises. In this study, studies on lameness in our country were examined and problems and solutions were discussed.

**Keywords:** Lameness, Herd Management, Cattle, Small Ruminant, Breeding

## *Echinophora tenuifolia* YAĞININ BİYOKİMYASAL BİLEŞENLERİNİN GC-MS/HEADSPACE YÖNTEMİ İLE ARAŞTIRILMASI

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### **Özet**

*Echinophora* cinsi Umbelliferae familyasında olan bir bitki çeşitidir. Akdeniz'den Afganistan'ın doğusuna kadar her yerde yetişen bu bitkinin çeşitli türlerinin kimyasal yapısı iyi bir şekilde araştırılmıştır. Bu bitkiler İran'da gıda koruyucu ve baharat gibi çeşitli nedenlerle kullanılmaktadır. *Echinophora tenuifolia* yerel alan Türkçe'de “çörtük”, “çördük”, “tarhana out” ve “tursu otu” olarak anılmaktadır. Elde edilen taze ve kurutulmuş *Echinophora tenuifolia*, halk hekimliğinde yaraları, mide ülserini ve sindirim sorunlarını iyileştirmek için kullanılmaktadır. Ayrıca süt ürünleri, et ve çorbaları tatlandırmak için de kullanılır. Biyokimyasal bileşenleri incelemek için GC-MS/headspace analizi yapıldı. Bu nedenle örnekler, Tunceli ilinin Çemişgezek ilçesinden toplandı. Gölgede kurutulmuş *Echinophora tenuifolia* örnekleri bir IKA blender kullanılarak öğütülmüştür. Öğütülmüş materyal 0.5 gram tartıldıktan sonra 25 mL Chromacol 20-HSV şişesi kullanılarak GC-MS cihazına yüklenmiştir. Boşluk koşulları: 90 dk boyunca flakon Triplus RSH körleme fırınında 130 °C'ye ısıtılmıştır. Isıtılan şişe GC-MS'ye 2.5 mL hacminde enjekte edilmiştir. Elde edilen çalışma sonuçlarına göre, en yüksek miktar  $\alpha$ -Pinen ve L-Phellandrene (C<sub>10</sub>H<sub>16</sub>) konsantrasyonu bulunmuştur. Diğer maddeler arasında  $\alpha$ -Terpinolene, l-limonene, sabinene ve boranemethyl sulfide (C<sub>2</sub>H<sub>9</sub>BS) yer almaktadır. Sonuçlarda bulunan biyoaktif bileşiklerde yüksek miktarlarda antioksidanlar mevcuttur. Özellikle, Limonen, çeşitli hastalıklarla bağlantılı sinyal yollarını modüle edebilir. Tespit edilen biyobileşenler ilaç sanayide, kozmetik ve gıda koruyucu tatlandırıcı olarak kullanılabilir. Bu maddelerin özelliklerini tam olarak anlamak için hem in vivo ve in vitro çalışmalar yapılması gerekmektedir.

**Anahtar Kelimeler:** *Echinophora tenuifolia*, Biyokimyasal Bileşenler, GC-MS/Headspace, L-Phellandrene (C<sub>10</sub>H<sub>16</sub>),  $\alpha$ -Pinene, l-limonen

## INVESTIGATION OF BIOCHEMICAL COMPONENTS OF *Echinophora tenuifolia* OIL BY GC-MS/HEADSPACE METHOD

### Abstract

The family Umbelliferae includes the genus *Echinophora*. Grown throughout the Mediterranean to eastern Afghanistan, this plant's various species' chemical makeup has been well investigated. These plants are employed in Iran for a variety of reasons, such as preservatives and spices in cuisine. In Turkish, *Echinophora tenuifolia* is referred to locally as "çörtük," "çördük," "tarhana out," and "tursu otu." Folk medicine uses *Echinophora tenuifolia*, both fresh and dried, cure wounds, stomach ulcers, and digestive issues. It is also used to flavor dairy items, meat, and soups. Therefore, the samples were collected from Çemişgezek district of Tunceli province. Shade-dried the samples of *Echinophora tenuifolia* were ground using an IKA blender. After weighing out 0.5 grams of ground material, it was fed into the GC-MS device using a 25 mL Chromacol 20-HSV vial. Conditions of the cavity: For ninety minutes, the vial was heated to 130 °C in a Triplus RSH blanking oven. The heated vial was injected into the GC-MS at a volume of 2.5 mL. The highest concentration of  $\alpha$ -Pinene and L-Phellandrene (C<sub>10</sub>H<sub>16</sub>) was found. Additional substances included  $\alpha$ -Terpinolene, l-limonene, sabinene, and boranemethyl sulfide (C<sub>2</sub>H<sub>9</sub>BS). High quantities of antioxidants are present in the bioactive compounds that were found in the results. They offer numerous health-promoting qualities. In particular, Limonene may modulate signaling pathways linked to various diseases. The biocompounds, cosmetic, and food preservation sectors can also employ the discovered chemicals as flavorings. Studies both in vivo and in vitro are required to fully comprehend these substances' characteristics.

**Keywords:** *Echinophora tenuifolia*, Biochemical Components, GC-MS/Headspace, L-Phellandrene (C<sub>10</sub>H<sub>16</sub>),  $\alpha$ -Pinene, l-limonene

# YAPAY ZEKANIN ACİL TIP ENTEGRASYONU: KAPSAMLI BİR GENEL BAKIŞ

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## Özet

Acil tıp, sağlık hizmetlerinde hızlı karar alma ve kritik müdahalelerin ön saflarında yer almaktadır. Son yıllarda yapay zeka (AI) teknolojilerinin ortaya çıkışı, acil tıbbi uygulamaların çeşitli yönlerini geliştirmek için umut verici çözümler sundu. Bu özet, yapay zekanın acil tıba entegrasyonuna ilişkin kısa ve kapsamlı bir genel bakış sağlamayı, potansiyel uygulamalarını ve etkisini açıklamayı amaçlamaktadır. Bu özet, mevcut literatürü sentezlemekte ve yapay zeka uygulamalarının acil tıpta kullanımını gösteren örnekleri analiz etmektedir. İnceleme, teşhis desteği, triyaj sistemleri, tıbbi görüntüleme analizi, gerçek zamanlı hasta izleme ve tedavi planlaması gibi çeşitli alanları kapsamaktadır. Yapay zeka algoritmaları, acil tıpta birden fazla alanda sayısız fayda sunar. Örneğin, görüntü analizi algoritmaları radyolojik görüntülerdeki anormallikleri etkili bir şekilde tespit ederek hızlı tanı ve önceliklendirme kararlarına yardımcı olabilir. Üstelik yapay zeka destekli sistemler, kişiselleştirilmiş tedavi planları oluşturmak için hasta verilerinden yararlanabilir ve böylece klinik karar alma süreçlerini artırabilir. Yapay zekanın entegrasyonu, acil tıbbi bakımda devrim yaratma, potansiyel olarak hasta sonuçlarını ve sağlık hizmeti sunum verimliliğini artırma konusunda büyük umut vaat ediyor. Ancak başarılı uygulama, algoritma güvenilirliği, doğruluğu, veri gizliliği ve etik hususlarla ilgili zorlukların ele alınmasını gerektirir. İleriye dönük olarak, yapay zeka araştırmacıları, sağlık profesyonelleri ve politika yapıcılar arasındaki işbirlikçi çabalar, acil tıpta yapay zekanın tüm potansiyelinden yararlanmak ve onun hasta bakımı üzerindeki dönüştürücü etkisini gerçekleştirmek için zorunludur. Yapay zeka araştırmaları, yüksek kaliteli eğitim verileri sağlayan, farklı modeller arasında karşılaştırma için bir referans noktası görevi gören ve uluslararası rekabet fırsatı sağlayan büyük ve açık veri setlerinin geliştirilmesinden önemli faydalar gördü. Önemli sorunları çözmek için finansal teşvikler sağlayan uluslararası yarışmalarla birlikte, ücretsiz olarak erişilebilen yüksek kaliteli büyük veri setleri oluşturmaya yönelik devam eden çabalar, acil tıba fayda sağlayabilir. Yapay zeka sistemlerini çalışan klinik ortamlara uygulamanın en iyi yollarını belirlemek önemli bir zorluktur. Yapay zeka sistemlerinin başlangıçta klinisyenlerin yerine geçmek yerine klinik karar destek araçları olarak uygulanması muhtemeldir. Sınırlamalara rağmen mevcut yapay zeka teknikleri, çok çeşitli klinik alanlarda iyi tanımlanmış sorunları çözme konusunda oldukça yeteneklidir. Bu tür sistemler acil hasta bakımının birçok yönünü geliştirme potansiyeline sahiptir. Yapay zeka teknolojisinin yetenekleri büyük olasılıkla zaman içinde gelişecektir ve bu tür çözümlerin uygulamaya entegrasyonu, yüksek kaliteli sağlık hizmetlerinin daha verimli ve doğru şekilde sunulması yoluyla hastalara, doktorlara ve topluma fayda sağlama potansiyeline sahiptir.

**Anahtar Kelimeler:** yapay zeka (AI), acil tıp, hasta, algoritma güvenilirliği, veri gizliliği

## INTEGRATING ARTIFICIAL INTELLIGENCE INTO EMERGENCY MEDICINE: A COMPREHENSIVE OVERVIEW

### **Abstract**

Emergency medicine stands at the forefront of rapid decision-making and critical interventions in healthcare. In recent years, the advent of artificial intelligence (AI) technologies has offered promising solutions to enhance various facets of emergency medical practice. This abstract aims to provide a concise yet comprehensive overview of the integration of AI into emergency medicine, elucidating its potential applications and impact. This abstract synthesizes existing literature and analyzes examples showcasing the utilization of AI applications in emergency medicine. The review encompasses diverse areas including diagnostic support, triage systems, medical imaging analysis, real-time patient monitoring, and treatment planning. AI algorithms offer a myriad of benefits across multiple domains within emergency medicine. For instance, image analysis algorithms can efficiently detect abnormalities in radiological images, aiding in swift diagnosis and triage decisions. Moreover, AI-driven systems can harness patient data to generate personalized treatment plans, thereby augmenting clinical decision-making processes. The integration of AI holds immense promise for revolutionizing emergency medical care, potentially enhancing patient outcomes and healthcare delivery efficiency. However, successful implementation necessitates addressing challenges about algorithm reliability, accuracy, data privacy, and ethical considerations. Moving forward, collaborative efforts between AI researchers, healthcare professionals, and policymakers are imperative to harness the full potential of AI in emergency medicine and realize its transformative impact on patient care. AI research has seen significant benefit from the development of large and open data sets that provide high-quality training data, act as a benchmark for comparison between different models, and provide the opportunity for international competition. Ongoing efforts to create large freely accessible high-quality data sets, with international competitions providing financial incentives to solve important problems may benefit emergency medicine. A significant challenge is determining the best ways to implement AI systems into working clinical environments. It is likely that AI systems will be implemented initially as clinical decision support tools rather than replace clinicians. Despite limitations, current AI techniques are very capable at solving well defined problems across a wide range of clinical domains. Such systems have the potential to augment many aspects of emergency patient care. The capabilities of AI technology will very likely improve over time, and the integration of such solutions into practice has potential to benefit patients, physicians, and the public through more efficient and accurate delivery of high-quality healthcare.

**Keywords:** artificial intelligence (AI), emergency medicine, patient, algorithm reliability, data privacy

# ZİHİNSEL YETERSİZLİĞİ OLAN ÖĞRENCİLER İÇİN BİLGİSAYAR DESTEKLİ FEN EĞİTİMİ: DUYU ORGANLARI

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## **Özet**

Zihinsel yetersizlik, bireylerin bilişsel işlevlerinde yaşadığı sınırlılıklar nedeniyle öğrenme, problem çözme ve sosyal becerilerde zorluk yaşamasına neden olan bir durumdur. Eğitimde bu öğrencilerin ihtiyaçlarını karşılayabilmek, onları anlamak ve öğrenme süreçlerine uygun yöntemler geliştirmek oldukça önemlidir. Fen bilimleri dersi, bu öğrencilerin çevrelerini tanıma ve anlama becerilerini geliştirmelerine katkı sağlayan önemli bir alanı oluşturur. Mevcut çalışmada, zihinsel yetersizliği olan öğrencilere fen bilimleri dersinde duyu organlarının bilgisayar destekli öğretim yöntemiyle öğretiminin etkisi incelenmesi amaçlanmıştır. Bu amaç doğrultusunda tek denekli araştırma yöntemlerinden yoklama evreli çoklu yoklama modeli kullanılmıştır. Araştırmanın katılımcıları Mersin ilinde özel eğitim sınıfında ortaokul düzeyinde üç zihinsel yetersizliği olan öğrenci oluşturmaktadır. Öğretim süresince öğrencilerin düzeyine uygun hazırlanan bilgisayar etkinlikleri kullanılmış ve veriler araştırmacı tarafından hazırlanan ölçü bağımlı ölçme araçları ve çalışma kağıtları ile toplanmıştır. Elde edilen veriler grafiklerle gösterilerek yorumlanmıştır. İzleme oturumlarının sonucunda öğrenmenin kalıcılığının devam ettiği görülmüştür. Sonuç olarak bilgisayar destekli bireyselleştirilmiş öğretim yöntemi, zihinsel yetersizliği olan öğrencilerin fen bilimleri derslerinde başarılarını arttırabilecek etkili bir yöntemdir. Bu yöntemin sunduğu etkileşimli ve görsel materyaller, özellikle soyut kavramların somutlaştırılması açısından önemli bir rol oynamaktadır. Bu bağlamda, zihinsel yetersizliği olan öğrencilere fen bilimleri derslerinde bilgisayar destekli bireyselleştirilmiş öğretim yöntemlerinin daha yaygın kullanılması, bu öğrencilerin öğrenme süreçlerine olumlu katkılar sağlayacaktır. Yalnızca belirli bir öğrenci grubuyla çalışma gerçekleştirildiği için farklı düzeyde zihinsel yetersizliği olan öğrenciler için sonuçların genellenmesi çalışmanın sınırlılığını oluşturmaktadır. Ayrıca bilgisayar destekli öğretimin etkisi, öğretmen becerileri ve teknolojik altyapı gibi dış faktörlerden etkilenebilir. Gelecekte yapılacak çalışmalarda zihinsel yetersizliği olan öğrenciler için hazırlanmış bilgisayar destekli öğretim materyalleri çeşitlendirilebilir. Öğretmenlerin bu yöntemleri kullanabilmeleri için gerekli eğitim ve teknoloji desteği sağlanabilir. Son olarak öğrencilerin bireysel öğrenme hızlarına uygun yazılımlar geliştirilebilir.

**Anahtar Kelimeler:** Zihinsel yetersizlik, özel eğitim, bilgisayar destekli eğitim, fen eğitimi, duyu organları, çoklu yoklama modeli

## COMPUTER-ASSISTED SCIENCE EDUCATION FOR STUDENTS WITH INTELLECTUAL DISABILITIES: SENSORY ORGANS

### **Abstract**

Intellectual disability is a condition that causes individuals to experience difficulties in learning, problem solving and social skills due to limitations in cognitive functions. In education, it is very important to meet the needs of these students, to understand them and to develop appropriate methods for their learning processes. Science course constitutes an important area that contributes to the development of these students' ability to recognise and understand their environment. In the present study, it was aimed to examine the effect of teaching sensory organs to students with intellectual disabilities in science course with computer assisted instruction method. For this purpose, the probe phase multiple probe model, one of the single-subject research methods, was used. The participants of the study consisted of three students with intellectual disability at middle school level in a special education class in Mersin province. During the teaching period, computer activities prepared in accordance with the level of the students were used and the data were collected with measurement-dependent measurement tools and worksheets prepared by the researcher. The data obtained were interpreted by showing them with graphs. As a result of the follow-up sessions, it was observed that the retention of learning continued. In conclusion, computer-assisted individualised instruction method is an effective method that can increase the success of students with intellectual disabilities in science courses. The interactive and visual materials provided by this method play an important role especially in terms of concretising abstract concepts. In this context, more widespread use of computer-assisted individualised instruction methods in science courses for students with intellectual disabilities will make positive contributions to the learning processes of these students. Since the study was carried out with only a certain group of students, generalisation of the results for students with different levels of intellectual disability constitutes the limitation of the study. In addition, the effect of computer-assisted instruction may be affected by external factors such as teacher skills and technological infrastructure. In future studies, computer-assisted instruction materials prepared for students with intellectual disabilities can be diversified. Necessary training and technology support can be provided for teachers to use these methods. Finally, software suitable for students' individual learning speeds can be developed.

**Keywords:** Intellectual disability, special education, computer assisted instruction, science education, sensory organs, multiple probe model

## ERKEN ÇOCUKLUK EĞİTİMİNDE ÇOK KÜLTÜRLÜ ÇALIŞMALAR ÜZERİNE BİR ARAŞTIRMA

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### Özet

Eđitimde çok kültürlülük, erken çocukluk döneminin hem teorik hem de pratik meselelerinde yeni bir kavram olmamakla birlikte, farklı kültürel gruplarla daha etkileşimli ilişkiler kurmaya yönelik duyulan gereksinimin artması nedeniyle günümüzde daha da önem kazanmıştır. Bu kavram temelinde, tüm bireylerin kültürel farklılıklarının farkında olmayı ve buna dayalı olumlu tutum geliştirmeyi hedefleyen eşit ve adil bir eğitimi ifade eder. Bu konudaki araştırmalar, özellikle erken çocukluk dönemindeki çok kültürlülük anlayışının mümkün olan en erken dönemde farkındalıklara saygı ve buna bađlı olumlu sosyal duygusal gelişimi desteklenmesi sebebiyle giderek daha önemli hale gelmektedir. Bu araştırmada, uluslararası alanda son yıllarda yapılan erken çocukluk eğitiminde çok kültürlülük konulu akademik çalışmaların dağılımının; araştırmanın türü, amacı, katılımcı özellikleri, örneklem türü, veri toplama araçları, veri analiz yöntemi, bulgular ve tartışma gibi alt başlıklar açısından bütüncül bir bakış açısıyla incelenmesi amaçlanmıştır. İlgili anahtar kelimeler belirlenerek, Web of Science (WOS) indeksli son çalışmalar, veri kaynađı olarak alınmış ve betimsel içerik analizi yöntemiyle analiz edilmiştir.

**Anahtar kelimeler:** Çok kültürlü eğitim, erken çocukluk, içerik analizi



## **A RESEARCH ON MULTICULTURAL STUDIES IN EARLY CHILDHOOD EDUCATION**

### **Abstract**

Multicultural education, while not a new concept in the theoretical and practical issues of early childhood education, has gained increased importance today due to the growing need for more interactive relationships with different cultural groups. This concept fundamentally refers to an equal and fair education that aims to be aware of the cultural differences of all individuals and to develop positive attitudes based on this awareness. Research on this topic has become increasingly important, especially in early childhood education, due to the need to support respect for awareness and positive socio-emotional development as early as possible. This study aims to review and examine the distribution of recent academic studies conducted internationally in terms of aim, research method, participants, data collection tools, data analysis, findings and discussion from a holistic perspective. To this end, pertinent keywords were identified, and recent studies indexed in the Web of Science (WOS) were utilized as data sources, subsequently analysed through descriptive content analysis.

**Keywords:** Multicultural education, early childhood, content analysis

# KÜÇÜK ve ORTA ÖLÇEKLİ İŞLETMELERDE ERP SİSTEMLERİNİN STOK YÖNETİMİ ÜZERİNDEKİ ETKİLERİ: BAŞARI FAKTÖRLERİ VE ZORLUKLAR

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## Özet

Küçük ve orta ölçekli işletmeler (KOBİ'ler), ekonomik sistemin önemli bir parçasını oluşturur ve genellikle yerel ekonomilere büyük katkı sağlar. Ancak, bu işletmeler, büyük ölçekli firmalara kıyasla sınırlı kaynaklar ve daha az kurumsal destek ile faaliyet gösterirler. Stok yönetimi, KOBİ'lerin operasyonel verimliliği ve finansal sağlığı açısından kritik bir faktördür. Doğru bir stok yönetimi, maliyetlerin kontrol edilmesine, müşteri memnuniyetinin sağlanmasına ve genel işletme performansının artırılmasına yardımcı olur. Bu çalışma, küçük ve orta ölçekli işletmelerde (KOBİ), ERP sistemlerinin stok yönetimi üzerindeki etkilerini incelemeyi amaçlamaktadır. ERP sistemlerinin, stok yönetiminde sağladığı avantajlar, karşılaşılan zorluklar ve bu zorlukların üstesinden gelme stratejileri üzerinde durulacaktır. ERP programlarının işletmeler için verimlilik artışı, veriye dayalı karar alma, maliyet tasarrufu, müşteri memnuniyetini artırma ve gelişmiş raporlama gibi avantajları vardır ve firmalar bu avantajları kullanarak rekabet avantajı elde edebilmektedirler. ERP kullanımının bu tür avantajları olduğu gibi, proje yönetimi sırasında başlangıç maliyeti, eğitim karmaşıklığı, çalışanın yeni programı kabullenmesi gibi zorluklarda işletmenin göz önünde bulundurması gereken süreçlerdir. Ayrıca bu çalışma X Motorsiklet adlı bir KOBİ işletmesi örneği üzerinden ERP sistemlerinin stok yönetimindeki rolünü incelemektedir. X Motorsiklet firması Türkiye'de faaliyet gösteren ve çeşitli büyüklük ve renklerde ürünler üreten bir firmadır. Şirket, büyüyen müşteri taleplerini karşılamak ve stok yönetimindeki verimsizlikleri gidermek amacıyla bir ERP sistemi uygulamaya karar vermiştir. Bu ERP programının uygulanması ile birlikte stok oranlarında ciddi iyileştirme görülürken, çalışan verimliliğinde de artış olmuştur. Bütün bunlar işletme performansını ve müşteri memnuniyetini arttırmıştır.

**Anahtar Kelimeler:** ERP, KOBİ, Stok Yönetimi

## **THE IMPACT of ERP SYSTEMS on INVENTORY MANAGEMENT in SMALL and MEDIUM-SIZED ENTERPRISES: SUCCESS FACTORS and CHALLENGES**

### **Abstract**

Small and medium-sized enterprises (SMEs) play a crucial role in the economic system and often contribute significantly to local economies. However, these businesses operate with limited resources and less institutional support compared to large-scale firms. Inventory management is a critical factor for the operational efficiency and financial health of SMEs. Proper inventory management helps in controlling costs, ensuring customer satisfaction, and enhancing overall business performance. This study aims to examine the impact of ERP systems on inventory management in small and medium-sized enterprises (SMEs). It will focus on the advantages provided by ERP systems in inventory management, the challenges encountered, and strategies to overcome these challenges. ERP programs offer benefits such as increased efficiency, data-driven decision-making, cost savings, improved customer satisfaction, and advanced reporting, allowing firms to gain a competitive advantage. However, there are also challenges associated with ERP use, including initial project costs, training complexity, and employee acceptance of the new system, which businesses need to consider during the implementation process. Additionally, this study examines the role of ERP systems in inventory management through the example of X Motorsiklet, a SME. X Motorsiklet is a company operating in Turkey that produces products in various sizes and colors. The company decided to implement an ERP system to address growing customer demands and inefficiencies in inventory management. With the implementation of this ERP program, significant improvements were observed in inventory levels and increased employee productivity. These improvements have enhanced the company's performance and customer satisfaction.

**Keywords:** ERP, SME, Inventory Management

# BİRLEŞİK KRALLIK İŞÇİ PARTİSİ VE FİLİSTİN SORUNU: JEREMY CORBYN VE KEIR STARMER'IN SONU OLMAYAN BİR ÇATIŞMAYA YÖNELİK DÜŞÜNCELERİNİN KARŞILAŞTIRILMASI

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## Özet

Bilindiği üzere, İsrail'in bağımsızlığını ilan ettiği 1948'de, Birleşik Krallık'ta Clement Attlee'nin başbakanlığındaki İşçi Partisi iktidardaydı. Bu yönüyle Filistin sorununun farklı bir aşamaya geçmesinde, İşçi Partisi'nin büyük bir sorumluluğu bulunmaktaydı. Zaman içerisinde İşçi Partisi liderlerinin, Filistin sorununa bakış açılarında farklılıklar olmakla birlikte, 2015 ve 2020 yılları arasında İşçi Partisi'nin lideri olan Jeremy Corbyn, Filistin'i en çok destekleyen İşçi Partisi lideri olmuştur. Corbyn, İsrail'i işgalci olarak nitelendirmiş ve Filistin'deki işgalinin sonlandırılması gerektiğine inandığını dile getirerek, iktidara gelmesi durumunda tam bağımsız Filistin'in Birleşik Krallık tarafından tanınacağını açıkça ortaya koymuştur. Birleşik Krallık'ta gerçekleştirilen 2019 genel seçimlerinde Corbyn'in yaşadığı tarihi başarısızlık sonrasında İşçi Partisi lideri olan Keir Starmer'ın da Filistin'e yönelik destek verdiği belirtilmelidir. Starmer'ın 2024 genel seçimleri sonrasında Birleşik Krallık Başbakanı olmasıyla, verilen bu destek önem kazanmıştır. Starmer, İsrail'e karşı Corbyn kadar sert bir söylem kullanmasa da seçim kampanyasında bu soruna ve Filistin'e olan desteğine çok kez değinmiştir. 7 Ekim 2023'te İsrail'in Gazze'ye düzenlediği saldırıların sonrasında yaşananlar, Starmer'ı Filistin'e verilen/verilecek olan destek üzerinden dış politikada baskı altına almış durumdadır. Bu noktada söylemleri üzerinden iki liderin Filistin politikalarını karşılaştıracak olan bu çalışma, Corbyn'in söylemlerinin daha net ve sert olmasına rağmen Starmer'ın Filistin'e verdiği desteğin koşullara bağlı olduğunu ortaya koyma amacındadır. Starmer başbakan olarak dış politikada daha dikkatli davranmasının etkisiyle, bağımsız bir Filistin devletinin tanınmasının barış sürecinin bir parçası olarak gerçekleşmesi gerektiğine inanmaktadır. Bunun bir sonucu olarak çalışma, Starmer'ın ihtiyatlı politikası ve Filistin'in tanınması hususunda özellikle partisi içerisinde daha ağır eleştirilerle karşılaşacağı iddiasındadır.

**Anahtar Kelimeler:** Jeremy Corbyn, Keir Starmer, Birleşik Krallık Dış Politikası, Filistin, İsrail.

## **THE UK LABOUR PARTY AND THE PALESTINIAN QUESTION: COMPARING JEREMY CORBYN AND KEIR STARMER'S THOUGHTS ON AN ENDLESS CONFLICT**

### **Abstract**

As it is known, in 1948, when Israel declared independence, the Labour Party was in power in the United Kingdom (UK) under the prime ministership of Clement Attlee. In this respect, the Labour Party had a huge responsibility in taking the Palestinian Question to a different stage. Although there have been differences in the views of the Labor Party leaders on the Palestine question over time, Jeremy Corbyn, the leader of the Labor Party between 2015 and 2020, was the leader who most supported Palestine. Corbyn described Israel as an occupier and stated that the occupation of Palestine should end. Besides, Corbyn clarified that if he came to power, the UK would recognize an independent Palestine. After Corbyn's historic defeat in the 2019 general elections, Keir Starmer became the leader of the Labour Party. Starmer had previously expressed support for Palestine but his support gained significance when he became the Prime Minister of the UK in the 2024 general elections. Although Starmer was not as harsh on Israel as Corbyn, he frequently highlighted this issue and his support for Palestine during his election campaign. The events following Israel's attacks on Gaza on October 7, 2023, have put Starmer under pressure in foreign policy over the support given/to be given to Palestine. At this point, this study compares the policies of the two leaders on Palestine through their statements. The study aims to reveal that while Corbyn's statements are clear and harsh, Starmer's support for Palestine is conditional. Because of his cautious approach to foreign policy, he believes that recognition of an independent Palestinian state should be part of the peace process. However, this study suggests that Starmer will face harsh criticism, especially within his party, due to his cautious policy and stance on recognizing Palestine.

**Keywords:** Jeremy Corbyn, Keir Starmer, UK Foreign Policy, Palestine, Israel.

# MUKAYESELİ DÜNYA TARİHİ DERSİNDE ANARŞİ KARŞITLIĞINDA OTOKRASI: ÜÇÜNCÜDALGA DENEYİ UYARLAMASI, TEHLİKELİ OYUN

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## **Özet**

Üçüncü Dalga (Almanca: Die Welle, İngilizce: The Third Wave), deneyi, tarih Öğretmeni Roy Jones tarafından “Mukayeseli Dünya Tarihi” dersinin bir başlığı olan Nazi Almanya’sı konusunda, Pal Alto, Kaliforniya’daki Cubberley High School’da lise ikinci sınıf öğrencileri üzerinde yürütülmüştür. Demokratik toplulukların bile faşizme bağımsız olmadıklarını göstermeyi amaçlayan deneyde “Üçüncü Hare” adını verdikleri ve demokrasiyi bertaraf için bir hareket başlatıldı. Hareket demokrasinin bireyselliği vurgulamasından dolayı engel teşkil ettiğini ve hareketin “mihenk noktası” olarak “disiplinden, birlikten, hareketten ve gururdan gelen güç” parolası/mottosu benimsemiştir. Deney üzerine 1981 tarihli bir film ve aynı tarihli bir kitap da yazılmıştır/ yazılmaya ve uyarlanmaya devam edilmiştir, bu araştırmada ise 2008 yapımı Dennis Gansel tarafından yönetilen ve başrollerinde Jürgen Vogel, Max Riemelt ve Jennifer Ulrich yer aldığı film üzerinden analizler yapılmıştır. Film, 9 Mayıs, 2008’de Türkiye’de vizyona girmiş ve İstanbul Uluslararası Film Festivali’nde “Jüri Özel Ödülü’ne layık görülmüştür. Filmin konusu ise yıllardır “anarşizm” konusunda ders veren fakat, yeni dönemde “otokrasi” dersi için görevlendirilen Rainer Wenger (Jurgen Vogel) isimli öğretmenin dersi ilgi çekici hale getirebilmek için uyguladığı bir deneyle başlar. Toplumun dinamiğini oluşturan genç bireylerin üzerinde otokratik bir sosyal grubun oluşturulabileceğini ispatlamaya çalışan öğretmen kendini grubun lideri kabul eder ve öğrencilerini bireysellikten çıkarıp gruplaşma ruhunu tetikler, herkes bir grubun üyesidir artık ortak bir kıyafet stilleri ve selamlaşmaları vardır. Dalga üyeleri yoğun olarak gruba bağlanma motivasyon geliştirmişler ve kendilerini dışındaki tüm bireyleri yok kabul etmişlerdir ve sonunda deneyde öğrencilerin beklenmedik bir şiddet göstermesi karşısında, kontrol edilmeyeceği için sonuçlandırılmıştır.

**Anahtar Kelimeler:** Otokrasi, Anarşi, Deney, Kitle Kültürü, Kollektif Bilinç

## **AUTOCRACY IN OPPOSITION TO ANARCHY IN A COMPARATIVE WORLD HISTORY CLASS: ADAPTATION OF THE THIRD WAVE EXPERIMENT, THE WAVE**

### **Abstract**

The Third Wave (German: Die Welle) experiment was carried out by history instructor Roy Jones on sophomore students at Cubberley High School in Pal Alto, California. The experiment focused on the subject of Nazi Germany and was done as part of his "Comparative World History" curriculum. The experiment was conducted to demonstrate that even democratic nations can be susceptible to fascism, and it involved the initiation of a movement, referred to as the "Third Wave," with the intention of undermining democracy. The movement acknowledges that democracy is hindered by its focus on individualism and has embraced the motto "strength from discipline, unity, action, and pride" as the fundamental principle of the movement. A 1981 film and a book on the experiment have also been written and adapted, and in the present study we analyzed the 2008 film directed by Dennis Gansel and starring Jürgen Vogel, Max Riemelt and Jennifer Ulrich. The film was released in Türkiye on May 9, 2008, and awarded the "Special Jury Prize" at the Istanbul International Film Festival. The film follows Rainer Wenger (Jurgen Vogel), a teacher who has been lecturing on "anarchism" for years but has been assigned to teach "autocracy" in the new semester. In an attempt to demonstrate the formation of an autocratic social group among young individuals who shape society's dynamics, the teacher assumes the role of the group's leader. By fostering a sense of collectivism, the teacher encourages his students to transcend their individuality and become members of a cohesive group. This is achieved through the adoption of a shared dress code and standardized greetings. The members of the Wave exhibited a strong sense of group attachment and disregarded the existence of anyone outside their group. However, the experiment had to be ended due to the inability to contain a sudden outbreak of violence among the students.

**Keywords:** Autocracy, Anarchism, Deney, Mass Culture, Collective Consciousness

## FRANSICO GOYA'NIN BASKI RESİMLERİNDE GERÇEĞİN İZDÜŞÜMÜ GOYA'NIN HAYALETLERİ

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### Özet

Sinema tarihinin unutulmaz filmleri Guguk Kuşu, Amadeus, Aydaki Adam ve Bırak Güneş İçeri Girsin gibi filmlere imza atmış, yönetmen Miloš Forman'ın 2006 çıkışlı Goya'nın Hayaletleri (İngilizce özgün adı Goya's Ghosts) filmi, ressam Francisco José de Goya y Lucientes'in biyografisinin anlattığı kadar, İspanya'nın kanlı dönemlerini, devlet işleyişlerini, dini baskılarla oluşan toplumsal buhranları, engizisyon mahkemelerini, ölümü ve umudu ve kişiler özelinde çaresizliği, dönemin en ünlü ressamının gözünden dramatize eder. Javier Bardem, Natalie Portman, Stellan Skarsgård ve Randy Quaid'ın başrollerinde olduğu film, seyirciyi 1792 İspanya'sına taşır, Orta çağ Avrupası'ndan kalma Cadılar ve Cadı Avı sürdürülenlerin izlerini taşıyan bir grubun karşısında Fransız Devrimi'nin özgürlükçü fikirlerini savunan bir kaosun ortasında "saray ressamı" olan Goya'nın portrelerine yansır. Yaşadığı dönemin, (1746-1828) son dönem 18. yüzyıl ve erken dönem 19. yüzyıl, en önemli sanatçılarından biri olarak kabul edilen Goya, resimleri, çizimleri ve gravürleri ile çağdaş tarihsel çalkantıları somutlaştıran, dönemin yorumcusu olarak kabul edilir. "Madrid Ayaklanmasında Kurşuna Dizilenler," "Çıplak ve Giyinik Maya," "Halk İçin Diğer Yasalar," "Cadıların Ayini," "3 Mayıs 1808," "Engizisyon Sahnesi," "Savaşın Felaketleri" ve "Aklın Uykusunu Canavarlar Yaratır" eserleri Goya'nın başyapıtları arasında yer alırken bu dönemde halkın içerisinde Engizisyonun casusları dolaşır, Hıristiyan inancına aykırı saydıkları söz ve davranışları kilise yetkililerine bildirirler, Goya bu durumun Engizisyon uygulamalarının tanıklarındandır, portresini yaptığı, ilham perisi olarak kabul ettiği genç ve güzel bir kız olan Inés'in mahkeme tarafından tutuklanıp, işkence edilmesine karşın bağışlanması için verdiği savaş, onun resimlerine karamsar, karanlık ve acı dolu yansır. Modern sanatın başlangıcı kabul edilen dışavurumculuktan, gerçeküstücülüğe ve fantastik gerçekliğe kadar birçok yaklaşıma öncülük ettiği kabul edilen Goya'nın gravür tekniğini kullanımının detaylı aşamaları verilen filmde, ressamın çevresinde yaşanan felaketlere sessiz kalmadığı "Savaşın Felaketleri" ve "Kaprisler" ve evinin duvarlarına yaptığı "Kara Resimler" baskı serilerinde tepkisini dile getirir.

**Anahtar Kelimeler:** Goya, Modern Sanat, İspanya Tarihi, Engizisyon



## THE PROJECTION OF REALITY IN FRANCISCO GOYA'S PRINT PAINTINGS GOYA'S GHOSTS

### **Abstract**

Directed by Miloš Forman, acclaimed director of such unforgettable films in cinema history as *One Flew Over the Cuckoo's Nest*, *Amadeus*, *Man on the Moon* and *Hair*, *Goya's Ghosts* was released in 2006. The film, in addition to the biography of the painter Francisco José de Goya y Lucientes, vividly dramatizes and portrays the turbulent era of Spain, the functioning of the government, the societal turmoil resulting from religious persecution, the Inquisition, mortality and optimism, and the anguish experienced by individuals, all seen from the perspective of the renowned artist of that time. Starring Javier Bardem, Natalie Portman, Stellan Skarsgård and Randy Quaid, the film brings the audience to 1792 Spain, reflecting in the portraits of Goya, a "court painter" in the midst of chaos, who advocates the libertarian ideas of the French Revolution against a group carrying the traces of medieval Europe's witches and witch hunts. Regarded as one of the most prominent artists of his time (1746-1828), the late 18<sup>th</sup> and early 19<sup>th</sup> centuries, Goya is widely acknowledged as an interpreter of the period, embodying contemporary historical upheavals through his paintings, drawings and engravings. Goya's masterpieces include "The Executions," "The Naked Maja and The Clothed Maja," "Other Laws by the People or Beast Absurdity," "Witches' Sabbath (The Great He-Goat)," "The Third of May 1808," "The Inquisition Tribunal," "The Disasters of War" and "The Sleep of Reason Produces Monsters". During this period, spies employed by the Inquisition were actively gathering information from the public and providing detailed reports to the church authorities regarding any comments or actions that they deemed to be in opposition to the Christian faith. Goya observed and documented the practices of the Inquisition during this period. The artist's portrayal of Inés, a youthful and exquisite young woman whom he saw as his source of inspiration, along with his relentless pursuit of her forgiveness despite enduring incarceration and torture by the court, is evident in his paintings through a somber, gloomy, and agonizing perspective. Goya, a pioneering artist known for his contributions to expressionism, surrealism, and fantastic reality, provides a comprehensive account of his utilization of the etching technique in the film. In this series of prints titled "Disasters of War," "Whims," and "Black Paintings," Goya expresses his response to the surrounding calamities by creating intricate etchings on the walls of his residence.

**Keywords:** Goya, Modern Art, History of Spain, Inquisition

# ANA METAL SANAYİNDE İŞGÜCÜ VERİMLİLİĞİ VE YABANCI SERMAYENİN PAYI

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## **Özet**

Bu çalışmada ana metal sanayinde faaliyet gösteren firmalarda yabancı sermaye payının işgücü verimliliği üzerine etkileri araştırılmıştır. Dışa açıklık unsurları olarak firmanın uluslararası piyasalarla ekonomik ilişkilerinin göstergelerinden biri olan yabancı sermayenin payı göz önünde bulundurulmuştur. Çalışma verileri anket yöntemiyle temin edilmiştir. Yabancı sermayenin payına göre oluşturulan gruplar arasında işgücü verimliliği farklılıklarının analizinde tanımlayıcı istatistikler ve T Testi'nden yararlanılmıştır. Analiz sonuçlarına göre; ana metal sanayinde yabancı sermayenin payının işgücü verimliliğini etkilemediği tespit edilmiştir.

**Anahtar Kelimeler:** Ana Metal Sanayi, İşgücü Verimliliği, Yabancı Sermaye Payı

**JEL Kodları:** L25, L61, F10

## **LABOR PRODUCTIVITY AND SHARE OF FOREIGN CAPITAL THE FIRMS IN THE BASIC METAL INDUSTRY**

### **Abstract**

In this study, the effects of the foreign capital of the firms operating in the basic metal industry on labor productivity have been investigated. Share of foreign capital, which are indicators of the firm's economic relations with international markets, have been taken into consideration as elements of outward openness. The study data has been provided by the survey method. Descriptive statistics and the T test have been used in the analysis of labor productivity differences between groups formed according to foreign capital. According to the results of the analysis; it has been determined that the share of foreign capital has not had an affect labor productivity.

**Keywords:** Basic Metal Industry, Labor Productivity, Share of Foreign Capital

**JEL Codes:** L25, L61, F10,

## **FACTORS AFFECTING MOTHER-BABY ATTACHMENT AND NURSING CARE**

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### **Abstract**

Mother-baby attachment is the process of bonding and developing a bond, defined as the mutual relationship between a mother and her baby. It is a process that begins during pregnancy and continues during the birth and postpartum period. The mother's gestational age, number of births, whether the pregnancy was planned, delivery type, social support level, stress level, harmony with the spouse, past birth experiences, receiving adequate care, the mother's approach to the baby and breastfeeding status are shown among the factors that play a role in mother-baby attachment. It is reported that secure attachment is very important for healthy infant development and that this issue should be addressed by health professionals. For this purpose, the review was conducted to examine the factors affecting mother-baby attachment and the nursing approaches. It is important for nurses and midwives to evaluate mother-baby attachment in their care practices starting from the prenatal period. It is stated that a strong mother- baby attachment during pregnancy motivates health practices such as receiving prenatal care, healthy nutrition, regular sleep habits and facilitates the mother's adaptation to the parenting role. In the postpartum period, early breastfeeding, positive mother-infant interaction, skin-to-skin contact and sufficient social support are shown as among the factors that can positively affect the mother- baby attachment process. It is emphasized that nurses are in a good position to provide educational support and that trainings given to mothers on topics such as baby care, breastfeeding, skin-to-skin contact, mother-baby interaction and parenting role can be beneficial. Therefore, it is recommended that nurses evaluate the factors that can affect the mother-baby attachment process, use their education and counseling role to ensure mother- baby attachment and continue the process.

**Keywords:** Birth, Mother-Baby Attachment, Nurse.

# KRONİK KORONER ARTER HASTALARINDA FRAGMENTE QRS İLE İNFLAMATUAR BELİRTEÇLER ARASINDAKİ İLİŞKİNİN KARŞILAŞTIRILMASI

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## Özet

Dar veya geniş QRS kompleksi ile birlikte rutin EKG'de sıklıkla QRS kompleksi parçalanmaları görülebilmektedir. Parçalanmış QRS kompleksleri (fQRS), büyük bir koroner arter bölgesine karşılık gelen iki bitişik derivasyondaki çeşitli RSR' modelleri ( $\geq 1$  R' veya S dalgasında veya R dalgasında çentiklenme) olarak tanımlanır. Önceki çalışmalarda fQRS, artan morbidite ve mortalite, ani kardiyak ölüm ve tekrarlayan kardiyovasküler olaylarla ilişkilendirilmiştir. fQRS ile kardiyak fibrozis arasındaki nedensel ilişki gösterilmiştir ancak fQRS gelişimi için farklı mekanizmaların olup olmadığı kapsamlı bir şekilde araştırılmamıştır. Biz bu çalışmada kronik koroner arter hastalığı (KAH) olan hastalarda fQRS ile inflamatuvar belirteçler arasındaki ilişkiyi karşılaştırmayı amaçladık. Bu retrospektif çalışmaya kardiyoloji polikliniğine başvuran kronik KAH nedeniyle koroner anjiyografi yapılmış 190 hasta dahil edildi. Yakın zamanda akut koroner sendromu tanısı olan, önemli organik kapak hastalığı olan, herhangi bir QRS morfolojisine sahip ve QRS süresi  $\geq 120$  ms olan hastalar ile kalıcı kalp pili bulunan hastalar çalışma dışı bırakıldı. fQRS grubunda fQRS olmayan gruba göre CRP, WBC, nötrofil/lenfosit oranı (NLR) ve CRP/albumin oranı anlamlı olarak daha yüksek gözlenirken negatif akut faz reaktanı olan albumin anlamlı olarak daha düşük izlenmiştir (all  $p < 0,05$ ). Çok değişkenli analizde ise fQRS bağımsız prediktörü olarak NLR'yi bulduk (OR: 3,020 (1,568-5,088);  $p=0,014$ ). Receiver operating characteristic' eğrisi analizinde ise NLR'nin  $\geq 2,8$  olmasının %79,4 sensitivite ve %67,8 spesifite ile fQRS'i öngördürebileceğini saptadık (fQRS için eğri değerinin altındaki alan 0,777; %95 GA: 0,382-0,933;  $p < 0,001$ ). Hücresel düzeyde inflamasyonun son etkisi olarak ortaya çıkabilen parçalanmış QRS, kronik KAH hastalarında farklı nedensel mekanizmalar yoluyla artan kardiyak riski temsil edebilir. Ayrıca EKG'deki fragmentasyonlar, artmış inflamatuvar durumları ve olası kronik enfeksiyonları nedeniyle araştırılması ve tedavi edilmesi gereken hastaların belirlenmesinde yararlı olabilir.

**Anahtar kelimeler:** Fragmente QRS, kronik koroner arter hastalığı, inflamatuvar belirteçler, nötrofil/lenfosit oranı.

## COMPARISON OF THE RELATIONSHIP BETWEEN FRAGMENTED QRS AND INFLAMMATORY MARKERS IN CHRONIC CORONARY ARTERY DISEASE PATIENTS

### Abstract

QRS complex fragmentation can often be seen on routine ECG along with narrow or wide QRS complexes. Fragmented QRS complexes (fQRS) are defined as various RSR' patterns ( $\geq 1$  R' or notching in the S wave or R wave) in two adjacent leads corresponding to a large coronary artery territory. Previous studies have associated fQRS with increased morbidity and mortality, sudden cardiac death, and recurrent cardiovascular events. A causal relationship between fQRS and cardiac fibrosis has been demonstrated, but whether different mechanisms for the development of fQRS exist has not been extensively investigated. We aimed to compare the relationship between fQRS and inflammatory markers in patients with chronic coronary artery disease (CAD). This retrospective study included 190 patients who applied to the cardiology outpatient clinic and underwent coronary angiography due to chronic CAD. Patients with a recent diagnosis of acute coronary syndrome, significant organic valve disease, any QRS morphology, QRS duration  $\geq 120$  ms, and patients with permanent pacemakers were excluded from the study. In the fQRS group, CRP, WBC, neutrophil/lymphocyte ratio (NLR) and CRP/albumin ratio were significantly higher than in the non-fQRS group, while albumin, a negative acute phase reactant, was significantly lower (all  $p < 0.05$ ). In multivariate analysis, we found NLR to be an independent predictor of fQRS (OR: 3.020 (1.568-5.088);  $p = 0.014$ ). The receiver operating characteristic curve analysis found that  $NLR \geq 2.8$  could predict fQRS with 79.4% sensitivity and 67.8% specificity (AUC for fQRS 0.777; 95% CI: 0.382-0.933;  $p < 0.001$ ). fQRS, which may occur as an end effect of inflammation at the cellular level, may represent increased cardiac risk in patients with chronic CAD through different causal mechanisms. Furthermore, fragmentations on the ECG may be useful in identifying patients who should be investigated and treated due to their increased inflammatory state and possible chronic infections.

**Keywords:** Fragmented QRS, chronic coronary artery disease, inflammatory markers, neutrophil/lymphocyte ratio.

## AKUT BİR ANTIİNTİHAR İLAÇ OLARAK: KETAMİN

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### Özet

Geleneksel olarak analjezi için kullanılan dissosiyatif bir anestezi olan ketamin, son zamanlarda majör depresif bozukluğu (MDD) olan hastalarda, özellikle de tedaviye dirençli depresyonu (TRD) olan hastalarda hızlı antidepresan ve antisuisidal etkileri nedeniyle dikkat çekmektedir. Bu çalışma, klinik ortamda tek doz ketamin infüzyonu (40 dakika boyunca 0,5 mg/kg) alan unipolar depresyonu olan 70 hastada ketaminin antisuisidal etkinliğini retrospektif olarak değerlendirmektedir. Tedaviden önce ve tedaviden 24 saat sonra intihar düşüncesindeki değişiklikleri değerlendirmek için Montgomery-Asberg Depresyon Derecelendirme Ölçeği İntihar maddesi (MADRS-S) kullanılmıştır. Sonuçlarımız, ketamin uygulamasından 24 saat sonra tüm hastalar ve tüm alt gruplar (kadın ve erkek, Antidepresan direnci (AD)(+) ve (-), İntihar Girişimi(+) ve(-)) için MADRS-S puanlarında önemli bir azalma olduğunu göstermektedir ve bu da antisuisidal etkilerinin hızlı bir şekilde başladığını göstermektedir. MADRS-S puanlarındaki azalma cinsiyetler arasında istatistiksel farklılık göstermemiştir ancak antidepresan direnci olmayan hastalarda direnci olanlara kıyasla daha fazlaydı ( $p < 0,05$ ). Benzer şekilde, intihar girişimi öyküsü olmayan hastalarda daha önce girişimi olanlara kıyasla intihar düşüncesinde daha belirgin bir azalma görülmüştür ( $p < 0,05$ ). Bu bulgular ketaminin hızlı etkili antidepresan ve antisuisidal özelliklerini desteklemekte ve özellikle semptomların hızlı bir şekilde hafifletilmesinin kritik olduğu acil durumlarda MDD için terapötik bir müdahale olarak potansiyelini vurgulamaktadır. Bu çalışma, ketaminin şiddetli, tedaviye dirençli depresyonu olan hastalar için etkili bir tedavi seçeneği olabileceğine dair artan kanıtlara katkıda bulunmaktadır. Gelecekteki araştırmaların, dozaj protokollerinin optimize edilmesine, etki mekanizmalarının anlaşılmasına ve ketaminin terapötik faydalarının zaman içinde sürdürülmesine yönelik stratejiler geliştirilmesine odaklanması gerekmektedir.

**Anahtar kelimeler:** Depresyon, Ketamin, İntihar, Akut antisuisidal

## AS AN ACUTE ANTISUICIDAL AGENT: KETAMINE

### **Abstract**

Ketamine, a dissociative anesthetic traditionally used for analgesia, has recently gained attention for its rapid antidepressant and antisuicidal effects in patients with major depressive disorder (MDD), particularly those with treatment-resistant depression (TRD). This study retrospectively evaluates the antisuicidal efficacy of ketamine in 70 patients with unipolar depression who received a single-dose ketamine infusion (0.5 mg/kg over 40 minutes) in a clinical setting. The Montgomery-Asberg Depression Rating Scale Suicide item (MADRS-S) was used to assess changes in suicidal ideation before treatment and 24 hours post-treatment. Our results demonstrate a significant reduction for all patients and all subgroups (female and male, Antidepressant resistance (AR)(+) and AR(-), Suicide Attempt(+), and SA(-)) in MADRS-S scores 24 hours after ketamine administration, suggesting a rapid onset of antisuicidal effects. The decrease in MADRS-S scores did not differ significantly between genders, but was greater in patients without antidepressant resistance compared to those with resistance ( $p < 0.05$ ). Similarly, patients without a history of suicide attempts showed a more pronounced decrease in suicidal ideation compared to those with previous attempts ( $p < 0.05$ ). These findings support ketamine's rapid-acting antidepressant and antisuicidal properties, highlighting its potential as a therapeutic intervention for MDD, particularly in emergency settings where rapid symptom alleviation is critical. This study adds to the growing evidence that ketamine could serve as an effective treatment option for patients with severe, treatment-resistant depression. Future research should focus on optimizing dosing protocols, understanding the mechanisms of action, and developing strategies to sustain ketamine's therapeutic benefits over time.

**Keywords:** Depression, Ketamine, Suicide, Acute antisuicidal



# ORTAÖĞRETİMDE OKUL TERK NEDENLERİNİN DEĞERLENDİRİLMESİ VE OKUL SOSYAL HİZMETİ BAĞLAMINDA ÇÖZÜM ÖNERİLERİNİN SUNULMASI

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## Özet

Bu çalışmanın amacı, ortaokulda öğrenci terk nedenlerini incelemek, bu terk durumlarının önüne geçmek için ne gibi önlemler alınabileceğine dair öneriler sunmak ve bu bağlamda okulu terk eden bireylerin, neden okulu terk ettiğine dair görüşlerini okul sosyal hizmet bağlamında ortaya koymaktır. Çalışmada nitel araştırma modeli kullanılmıştır. Araştırmanın örneklemini ortaokulu terk etmiş 13 kişi oluşturmaktadır. Araştırmada kartopu örneklem tekniği kullanılmıştır. Araştırmanın verileri görüşme tekniği aracılığıyla toplanmış olup katılımcılar ile yarı yapılandırılmış görüşme formları aracılığıyla "derinlemesine mülakat" gerçekleştirilmiştir. Araştırmanın nitel boyutundan elde edilen bulgular kapsamında; iki ana tema oluşturulmuştur. Bunlar “öğrencilerin okul ekosisteminde karşılaştıkları problemler” ve “sorun-gereksinim ekseninde alınabilecek önlemler” ana temalarıdır. Öğrencilerin okul ekosisteminde karşılaştıkları problemler; mikro, mezzo ve makro bağlamı olmak üzere alt temaya ayrılmıştır. Bulgular kısmındaki ikinci ana tema olan, sorun-gereksinim ekseninde alınabilecek önlemler ise kendi içerisinde; uzman desteği, sosyal yardım desteği, insan odaklı yaklaşımı benimseyen okul sistemi, aile danışmanlığı desteği olarak 4 alt temaya ayrılmıştır. Araştırma sonucunda; öğrencileri okulu bırakmaya iten faktörlerin tek boyutlu olmadığı, aksine mikro düzeyden makro düzeye kadar her bir boyutu içeren çok boyutlu bir süreci içerdiği tespit edilmiştir. Sonuç olarak okulu terk eden bireylerin okula devamlarını sağlamak için okul sosyal hizmetine ihtiyaç duyulduğu görülmüştür.

**Anahtar Kelimeler:** Okul Terki, Ortaöğretim, Okul Sosyal Hizmeti

## **EVALUATION OF THE REASONS FOR SCHOOL DROPOUT IN SECONDARY EDUCATION AND OFFERING SOLUTIONS IN THE CONTEXT OF SCHOOL SOCIAL WORK**

### **Abstract**

The purpose of this study is to examine the reasons for student dropout in secondary school, to offer suggestions on what precautions can be taken to prevent these dropouts, and in this context, to present the opinions of individuals who dropped out of school about why they dropped out in the context of school social work. A qualitative research model was used in the study. The sample of the study consists of 13 people who dropped out of secondary school. Snowball sampling technique was used in the study. The data of the study was collected through the interview technique and "in-depth interviews" were conducted with the participants through semi-structured interview forms. Within the scope of the findings obtained from the qualitative dimension of the study; two main themes were created. These are the main themes of "problems students encounter in the school ecosystem" and "measures that can be taken in the problem-need axis". The problems students encounter in the school ecosystem are divided into sub-themes as micro, mezzo and macro contexts. The second main theme in the findings section, measures that can be taken in the problem-need axis, is; It is divided into 4 sub-themes as expert support, social assistance support, school system that adopts a human-centered approach, family counseling support. As a result of the research; It has been determined that the factors that push students to drop out of school are not one-dimensional, but rather include a multi-dimensional process that includes every dimension from the micro level to the macro level. As a result, it has been seen that school social service is needed to ensure that individuals who drop out of school continue their education.

**Keywords:** School Dropout, Secondary Education, School Social Service

## İDRAR KAÇIRMA OLAN KADINLARDA BELİRTİ ŞİDDETİ, BAŞA ÇIKMA STRATEJİLERİ VE YAŞAM KALİTESİ ARASINDAKİ İLİŞKİ

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### Özet

Bu araştırma ile üriner inkontinansı (Üİ) olan kadınlarda Üİ şiddeti, baş etme yöntemleri ve yaşam kalitesi arasındaki ilişkinin incelenmesi amaçlanmıştır. Tanımlayıcı ve ilişki arayıcı tipteki bu çalışma, 340 Üİ tanılı kadın ile yürütülmüştür. Verilerin toplanmasında “Katılımcı Tanılama Formu”, “İnkontinans Şiddet İndeksi”, “Üriner İnkontinansla İlaç Dışı Başetme Yöntemi Kullanım Sıklığı Ölçeği” ve “İnkontinans Yaşam Kalitesi Ölçeği” kullanılmıştır. Verilerin değerlendirilmesinde Mann-Whitney U testi, Kruskal-Wallis testi ve spearman korelasyon testi uygulanmıştır. Araştırma kapsamındaki kadınların İnkontinans Şiddet İndeksi puan ortalaması  $6.5 \pm 3.3$ , Üriner İnkontinansla İlaç Dışı Başetme Yöntemi Kullanım Sıklığı Ölçeği puan ortalaması  $40.8 \pm 15.1$  ve İnkontinans Yaşam Kalitesi Ölçeği puan ortalaması  $65.2 \pm 22.8$ 'dir. Kadınların İnkontinans Şiddet İndeksi ile İnkontinans Üriner İnkontinansla İlaç Dışı Başetme Yöntemi Kullanım Sıklığı Ölçeği puan ortalaması arasında pozitif yönde orta düzeyde anlamlı bir ilişki bulunmuştur ( $r=.531$ ,  $p<0.001$ ). Kadınların İnkontinans Yaşam Kalitesi Ölçeği ile Uluslararası İnkontinans Şiddet İndeksi ( $r=-.540$ ,  $p<0.001$ ) ve Üriner İnkontinansla İlaç Dışı Başetme Yöntemi Kullanım Sıklığı Ölçeği ( $r=-.794$ ,  $p<0.001$ ) puan ortalamaları arasında negatif yönde orta/yüksek düzeyde anlamlı bir ilişki bulunmuştur. Araştırma kapsamındaki kadınların Üİ şiddeti arttıkça, baş etme yöntemlerini kullanma sıklığı artmakta ve yaşam kalitesi azalmaktadır. Ayrıca yaşam kalitesi azaldıkça baş etme yöntemlerini kullanma sıklığı artmaktadır.

**Anahtar Kelimeler:** Üriner inkontinans, üriner inkontinans şiddeti, baş etme yöntemleri, yaşam kalitesi

## RELATIONSHIP BETWEEN SYMPTOM SEVERITY, COPING STRATEGIES, AND QUALITY OF LIFE IN WOMEN WITH URINARY INCONTINENCE

### **Abstract**

This study aimed to examine the relationship between urinary incontinence (UI) severity, coping strategies, and quality of life in women with UI. This descriptive and correlational study was conducted with 340 women diagnosed with UI. Data were collected using the “Participant Description Questionnaire”, the “Incontinence Severity Index”, the “The Frequency of the Use of Non-medication Coping Strategies for Urinary Incontinence Questionnaire Form”, and the “Incontinence Quality of Life Scale”. Mann-Whitney U test, Kruskal-Wallis test, and Spearman correlation test were used in the evaluation of the data. The mean Incontinence Severity Index score of the women in the study was  $6.5 \pm 3.3$ , the mean The Frequency of the Use of Non-medication Coping Strategies for Urinary Incontinence Questionnaire Form score was  $40.8 \pm 15.1$ , and the mean Incontinence Quality of Life Scale score was  $65.2 \pm 22.8$ . A moderate, significant positive correlation was found between the women's Incontinence Severity Index scores and the The Frequency of the Use of Non-medication Coping Strategies for Urinary Incontinence Questionnaire Form scores ( $r = .531$ ,  $p < 0.001$ ). A significant negative correlation of moderate to high strength was found between the women's Incontinence Quality of Life Scale scores and both the International Incontinence Severity Index scores ( $r = -.540$ ,  $p < 0.001$ ) and the The Frequency of the Use of Non-medication Coping Strategies for Urinary Incontinence Questionnaire Form scores ( $r = -.794$ ,  $p < 0.001$ ). As the severity of UI increased among the women in the study, the frequency of coping strategy use increased, while quality of life decreased. Additionally, as quality of life decreased, the frequency of coping strategy use increased.

**Keywords:** Urinary incontinence, urinary incontinence severity, coping strategies, quality of life

## HASSAS CİLT VE TÜY YAPISINA SAHİP KEDİLER İÇİN ÖZEL FORMÜLE EDİLMİŞ BİR BESLENME ÇÖZÜMÜ: PRO PLAN DERMA CARE CAT

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### Özet

Kedilerin deri ve tüy sağlığı, genel sağlıklarının ve yaşam kalitelerinin korunmasında önemli bir rol oynar. Özellikle hassas deri ve tüy yapısına sahip kediler, uygun bir beslenme programı ile desteklenmeleri gereken özel ihtiyaçlara sahiptir. Bu doğrultuda geliştirilen Pro Plan Derma Care Cat, kedilerin deri ve tüy sağlığını desteklemek amacıyla Omega-3 ve Omega-6 yağ asitleri, vitaminler ve mineraller gibi zengin içeriklerle formüle edilmiştir. Pro Plan Derma Care Cat'in formülasyonu, kedilerin deri sağlığını desteklemek ve tüy kalitesini artırmak için özenle seçilmiş bileşenlere dayanmaktadır. Omega-3 yağ asitleri, anti-enflamatuar özellikleriyle deri onarımını desteklerken yangı olgularını da azaltmaya yardımcı olur. Omega-6 yağ asitleri, vitamin ve mineral kompleksleri epitel dokunun yenilenmesini destekleyerek, tüylerin parlak ve güçlü olmasını sağlamaktadır. Somon gibi yüksek kaliteli protein kaynaklarından elde edilen antioksidanlar ve vitaminler, kedilerin bağışıklık sistemini güçlendirmeye de katkıda bulunur. Geleneksel kedi mamaları genellikle genel beslenme ihtiyaçlarına odaklanırken, Pro Plan Derma Care Cat, hassas deri ve tüy yapısına sahip kedilerin özel gereksinimlerine çözüm sunar. Ürün formülasyonu, beslenme uzmanları ve veteriner hekimler tarafından desteklenmiş, laboratuvar testleri ve bilimsel araştırmalarla doğrulanmıştır. Pro Plan Derma Care Cat'in, kedilerin deri ve tüy sağlığını desteklemesi, bağışıklık sistemlerini güçlendirmesi ve genel sağlıklarını iyileştirmesi hedeflenmiştir. Bu özellikleriyle ürün, hassas deri ve tüy yapısına sahip kediler için ideal bir beslenme alternatifi sunmaktadır.

**Anahtar Kelimeler:** Hassas cilt, Tüy sağlığı, Omega-3 yağ asitleri, Omega-6 yağ asitleri, Beslenme.

## **A SPECIALLY FORMULATED NUTRITIONAL SOLUTION FOR CATS WITH SENSITIVE SKIN AND HAIR STRUCTURE: PRO PLAN DERMA CARE CAT**

### **Abstract**

The skin and coat health of cats play a vital role in maintaining their overall well-being and quality of life. Cats with sensitive skin and coat have specific needs that require support through an appropriate nutritional regimen. Developed with this purpose in mind, Pro Plan Derma Care Cat is formulated with a rich blend of Omega-3 and Omega-6 fatty acids, vitamins, and minerals to support cats' skin and coat health. The formulation of Pro Plan Derma Care Cat is based on carefully selected ingredients to enhance skin health and improve coat quality in cats. Omega-3 fatty acids help reduce itching and inflammation due to their anti-inflammatory properties, while Omega-6 fatty acids, along with vitamins and minerals, support the regeneration of skin cells, contributing to a shinier and stronger coat. Antioxidants and vitamins derived from high-quality protein sources, such as salmon, help strengthen the immune system of cats. Unlike traditional cat foods that generally focus on overall nutritional needs, Pro Plan Derma Care Cat provides a targeted solution for cats with sensitive skin and coat. The product formulation has been developed with the support of nutrition experts and veterinarians and validated through laboratory testing and scientific research. Pro Plan Derma Care Cat aims to support cats' skin and coat health, strengthen their immune system, and improve their overall health. With these features, the product offers an ideal nutritional alternative for cats with sensitive skin and coat.

**Keywords:** Sensitive skin, Coat health, Omega-3 fatty acids, Omega-6 fatty acids, Nutrition.

## DETERMINATION OF SOIL-BORNE FUNGAL DISEASE AGENTS IN STRAWBERRY PRODUCTION AREAS OF YOZGAT PROVINCE

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### **Abstract**

Strawberry is one of the most consumed products among berries. It is a cosmopolitan plant due to its importance in human health and its use in the food industry. In the last decade, Yozgat province has realized a remarkable increase in strawberry production areas due to its ecological conditions. However, for several years, it has been observed that strawberry production has been limited by biotic disease agents, especially soil-borne fungal or fungus-like agents. In order to solve this problem reported by farmers, a survey study was conducted in Boğazlayan, Merkez/Yozgat, Sarıkaya, Sorgun and Yerköy districts of Yozgat between March and July 2024. Strawberry plants showing yellowing, wilting, root and root collar rot disease symptoms were collected. Both infected and healthy tissues were obtained from the root and root collar of the samples. These samples were immersed in 1% sodium hypochlorite for 5 min. and then rinsed 3 times in sterile distilled water. The samples were then allowed to dry in a sterile cabinet and incubated for 5 days at  $23\pm 1^{\circ}\text{C}$  in PDA medium containing 0.1% streptomycin. At the end of this period, the hyphae developing from the tissues were removed from the ends and pure subcultures were obtained. As a result of isolation and morphological identification studies, it was determined that *Fusarium oxysporum*, *Fusarium solani*, *Rhizoctonia solani*, *Rhizoctonia bataticola* and *Phytophthora citrophthora* caused root and root collar rot disease in strawberry production areas in Yozgat. Among these pathogens, the highest isolated species was *F. oxysporum*, followed by *R. solani*, *F. solani*, *R. bataticola* and *P. citrophthora*.

## BASINÇLI HAVA SİSTEMLERİNDE ENERJİ VERİMLİLİĞİ VE DEBİMETRELERİN KATKISI

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### Özet

Basınçlı hava sistemleri, endüstriyel süreçlerin vazgeçilmez bir parçası olarak enerji tüketiminde önemli bir yer tutmaktadır. Ancak bu sistemlerin verimli kullanımı, enerji tüketimini optimize ederek işletme maliyetlerini düşürme ve çevresel etkileri minimize etme açısından büyük bir potansiyele sahiptir. Bu bağlamda, basınçlı hava sistemlerinde enerji verimliliğini artırmak için debimetrelerin kullanımı önem kazanmaktadır. Debimetreler, hava akışını ölçerek kaçakların tespit edilmesi, sistem performansının izlenmesi ve enerji tüketiminin optimize edilmesi gibi birçok avantaj sunar. Basınçlı hava debimetreleri, çeşitli prensiplere göre çalışan farklı türlerde cihazlar olarak karşımıza çıkmaktadır. Termal kütle, vortex, diferansiyel basınç, ultrasonik, Coriolis ve türbin debimetreleri, hava akışını ölçmek için en sık kullanılan yöntemler arasında yer alır. Farklı debimetre türlerinin seçimi, işletmelerin enerji verimliliğini artırma, maliyet tasarrufu sağlama ve çevresel etkileri azaltma konusundaki stratejilerine bağlı olarak yapılmaktadır. Basınçlı hava debimetrelerinin enerji verimliliği üzerindeki katkıları, enerji tüketiminin izlenmesi ve optimize edilmesi, kaçakların tespit edilmesi ve önleyici bakım faaliyetlerinin etkinleştirilmesi gibi faktörlerle doğrudan ilişkilidir. Sürekli izleme, sistemin performansını anlık olarak takip etmeyi mümkün kılmakta ve operasyonel verimliliği artırmaktadır. Ayrıca, toplanan verilerin analiz edilmesi, veri tabanlı kararların alınmasına ve gelecekteki yatırımların daha doğru planlanmasına olanak tanır. Bunun yanı sıra, debimetrelerin montajı sırasında doğru konumlandırma, uyumlu malzeme seçimi, uygun elektriksel bağlantılar ve düzenli bakım gibi unsurlar cihazların doğru ve güvenilir ölçümler yapabilmesi için kritik öneme sahiptir. Sonuç olarak, basınçlı hava sistemlerinde debimetrelerin kullanımı, enerji verimliliğini artırmak ve işletme maliyetlerini düşürmek için güçlü bir araç sunmaktadır. Çeşitli debimetre türlerinin avantajlarının doğru değerlendirilmesi ve montaj kurallarına uyulması, endüstriyel uygulamalarda bu sistemlerin etkinliğini artırmaktadır. Bu sayede işletmeler hem enerji tüketimlerini optimize etmekte hem de sürdürülebilirlik hedeflerine katkıda bulunmaktadır.

**Anahtar Kelimeler:** Debimetreler, Endüstriyel Verimliliği Artırma, Enerji Tüketimi



## **ENERGY EFFICIENCY AND CONTRIBUTION OF FLOWMETERS IN COMPRESSED AIR SYSTEMS**

### **Abstract**

Compressed Air Systems, as an indispensable part of industrial processes, hold a significant place in energy consumption. However, the efficient use of these systems has great potential to optimize energy consumption, reduce operating costs, and minimize environmental impacts. In this context, the use of flow meters to improve energy efficiency in compressed air systems is gaining importance. Flow meters provide several advantages, such as detecting leaks, monitoring system performance, and optimizing energy consumption by measuring air flow. Compressed air flow meters come in various types, operating on different principles. Thermal mass, vortex, differential pressure, ultrasonic, Coriolis, and turbine flow meters are among the most commonly used methods for measuring air flow. The choice of different types of flow meters is based on the strategies of businesses to enhance energy efficiency, achieve cost savings, and reduce environmental impacts. The contributions of compressed air flow meters to energy efficiency are directly related to factors such as monitoring and optimizing energy consumption, detecting leaks, and enabling preventive maintenance activities. Continuous monitoring makes it possible to track system performance in real time and increase operational efficiency. Additionally, analyzing the collected data allows for data-driven decision-making and more accurate planning of future investments. Furthermore, during the installation of flow meters, elements such as proper positioning, compatible material selection, suitable electrical connections, and regular maintenance are critical to ensuring accurate and reliable measurements. In conclusion, the use of flow meters in compressed air systems offers a powerful tool to enhance energy efficiency and reduce operating costs. Proper evaluation of the advantages of various types of flow meters and adherence to installation guidelines increase the effectiveness of these systems in industrial applications. In this way, businesses optimize their energy consumption and contribute to their sustainability goals.

**Keywords:** Flowmeters, Industrial Efficiency Improvement, Energy Consumption.

## METAVERSE: YENİ BİR İLETİŞİM MECRASI OLARAK ALGILAR

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### Özet

İletişim ve etkileşimde önemli bir rol oynayan dijital mecralar dünya çapında ağ teknolojilerinin gelişimi ile hızla yaygınlaşmıştır. Dünya üzerinde milyonlarca kullanıcısı bulunan ve sosyal medya mecraları olarak adlandırılan dijital platformlar, gelişmekte olan yeni teknolojilerle birlikte çoğalırken aynı zamanda çeşitlenmektedir. Bugün dünya genelinde üç yüz milyon adede yakın kişi sosyal medya kullanıcısıdır. Nispeten yeni teknolojilerden olan blokzincir teknolojisinin gelişimine paralel ortaya çıkan yeni bir iletişim mecrası da Metaverse olarak adlandırılan platformlardır. Metaverse platformları merkezizsiz data yönetimine imkan veriren kişisel veri gizliliği ve anonim iletişim kurma imkanının yanı sıra sanal gerçeklik (VR), artırılmış gerçeklik (AR) ve diğer dijital teknolojileri bir araya getirerek kullanıcılar için sürükleyici deneyimler sunan yeni bir mecra olarak öne çıkmaktadır. Bu çalışma, Türkiye'deki Metaverse platformlarına dair algılara odaklanarak yeni bir iletişim mecrası olarak potansiyellerini araştırmayı amaçlamaktadır. Metaverse kullanıcılarının bu mecrayı günlük yaşamlarına entegre etmelerini ardındaki etkili faktörleri anlamayı hedefleyen bu nicel araştırma anket yöntemi ile toplanan verilerin analizi ile bu sorulara yanıt ararken Metaverse platformlarının benimsenmesiyle ilgili ekonomik, eğitimsel ve kullanılabilirlik gibi engellerin yanı sıra bu süreçteki fırsatları da toplanan veriler üzerinden tartışmaktadır. Araştırma bulguları -Türk kullanıcılar arasında Metaverse platformlarına yönelik önemli bir farkındalık olmasına rağmen, günlük kullanımın sınırlı olduğunu göstermektedir. Türkiye örneğinde Metaverse platformlarına dair çok yüksek oranda bilinirlik olduğu gözlemlenmiştir. Araştırma katılımcılarının büyük çoğunluğu Metaverse platformlarını iletişim amaçlı deneyimlememiş olmakla birlikte, Metaverse kullanıcılarının da günlük düzenli kullanım yapmadıkları tespit edilmiştir. Araştırma kapsamında Metaverse kullanıcılarının ağırlıklı olarak bu platformları oyun ve eğlence amaçlı kullandıkları görülmüştür. Araştırma bulgularından kullanıcıların bu platformlara katılımındaki öncelikli motivasyonu hakkında net bir veri sağlanamamıştır. Metaverse platformları sahip olduğu güvenilir ve gizlilik özellikleri ile kullanıcılara yeni bir ekonomi modeli sunmaktadır. Türkiye örneğinde gerçekleştirilen bu araştırma bulguları Metaverse platformları ve altyapısındaki blokzincir teknolojisinin avantajları ve kullanımı konusunda yeterli düzeyde bilgi sahipliği olmadığı ortaya koymaktadır. Benzer şekilde potansiyel kullanıcıların algısında sanal gerçeklik ve artırılmış gerçeklik cihazları ile birlikte kullanım gerekliliğine dair oluşmuş ön yargılar ve bu cihazların yüksek maliyetleri Metaverse platformlarına olan ilginin önündeki engellerden biri olarak öne çıkmaktadır. Metaverse platformlarının yeni bir iletişim mecrası olarak ve daha geniş çapta benimsenmesinin sağlanması için bu çalışma ile gelecek araştırmalar için odaklanılabilecek faktörler ortaya koyulmuştur. Ekonomik, eğitimsel ve kullanılabilirlik engellerinin göz önünde bulundurulacağı ve daha geniş evrene sahip araştırmalar Metaverse platformlarının yeni bir iletişim mecrası olarak gelişimini destekleyecek araçlar olacaktır. Farkındalık ile benimsenme arasındaki boşluğu anlamlandıracak yeni araştırmalar Metaverse platformları ile beraber merkezizsiz iletişimin önünü açarak yeni bir kapsayıcı iletişim ekonomisinin gelişimini destekleyecektir.

**Anahtar Kelimeler:** Dijital iletişim, Yeni iletişim teknolojileri, Metaverse, Algı araştırması

## THE METAVERSE: PERCEPTIONS AS A NEW COMMUNICATION MEDIUM

### Abstract

Digital media, which play an important role in communication and interaction, have rapidly spread with the development of network technologies world wide web. Digital platforms, which have millions of users around the world and are called social media channels, are increasing and diversifying at the same time with the new technologies that are developing. Today, nearly three hundred million people worldwide are social media users. A new communication channel that has emerged in parallel with the development of blockchain technology, which is one of the relatively new technologies, is the so-called Metaverse platforms. Metaverse platforms stand out as a new medium that offers immersive experiences for users by combining virtual reality (VR), augmented reality (AR) and other digital technologies, as well as personal data privacy and anonymous communication that enables decentralized data governance. This study aims to focus on perceptions of Metaverse platforms in Turkey and explore their potential as a new communication medium. This quantitative research aims to understand the influential factors behind Metaverse users' integration of this medium into their daily lives. It analyzes the data collected through a survey methodology to answer these questions and discusses the barriers to Metaverse adoption such as economic, educational and usability barriers as well as opportunities in this process. The research findings show that although there is a significant awareness of Metaverse platforms among Turkish users, daily usage is limited. There is a very high level of awareness of Metaverse platforms in the Turkish sample. While the majority of the research participants have not experienced Metaverse platforms for communication purposes, it was also found that Metaverse users do not make regular daily use. Within the scope of the research, it was observed that Metaverse users predominantly use these platforms for gaming and entertainment purposes. The research findings do not provide clear data on the primary motivation of users to participate in these platforms. Metaverse platforms offer a new economic model to users with their trustworthy and privacy features. The findings of this research conducted in the Turkish sample reveal that there is a lack of sufficient level of knowledge about the advantages and use of blockchain technology in Metaverse platforms and infrastructure. Similarly, the prejudices formed in the perception of potential users regarding the necessity of using virtual reality and augmented reality devices and the high costs of these devices stand out as one of the obstacles to the interest in Metaverse platforms. In order to ensure the wider adoption of Metaverse platforms as a new communication medium, this study has identified factors that can be focused on for future research. Research that takes into account economic, educational and usability barriers, and that has a wider population, will be tools to support the development of Metaverse platforms as a new communication medium. New research that will make sense of the gap between awareness and adoption will support the development of a new inclusive communication economy by paving the way for decentralized communication with Metaverse platforms.

**Keywords:** Digital communication, New communication technologies, Metaverse, Perception research

## PANORAMA MÜZELERİNDE TEKNOLOJİNİN ROLÜ: BURSA 1326 PANORAMA MÜZESİ ÜZERİNE BİR İNCELEME

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### Özet

Müzeler, kültürel ve sanatsal değerlerin korunması ve sergilenmesi amacıyla tarih boyunca evrim geçirerek günümüze ulaşmıştır. Bu süreçte açık hava müzeleri, arkeoloji müzeleri, bilim müzeleri ve çağdaş sanat müzeleri gibi çeşitli türler ortaya çıkmıştır. Panorama müzeleri ise 360 derecelik kesintisiz resim sanatıyla tanınan bir müze türüdür. İlk olarak gezici çadırlarda sergilenen panorama sanatı, zamanla müzelere entegre edilmiş ve dairesel formuyla biçim ve içerik açısından hakimiyet kurmuştur. Günümüzde bu müzeler, savaş, kent ve doğa sahneleri ile ziyaretçilere üç boyutlu deneyimler sunmaktadır. İnsana yardımcı olabilecek teknikler anlamından türeyen teknoloji ise dünyada sergileme alanında, üç boyutlu anlatım tekniklerini daha ileriye taşıyan bir araç olarak kullanılmaktadır. Bu kapsamda teknoloji, panorama müzelerini geleceğe taşınmasında ve ziyaretçi deneyimlerinin zenginleştirilmesinde önemli bir rol oynamaktadır. “Değişen Müze ve Müzecilikte Sergilemenin Teknolojinin Boyutunun İncelenmesi: Bursa Panorama Müzesi Örneği” başlıklı yüksek lisans tezine dayanmakta olan bu çalışma; dünyada uygulanan sergileme teknolojilerini ve Bursa'nın çağdaş müzelerinden biri olan Bursa 1326 Müze ve Etkileşim Merkezi'ni incelemektedir. Çalışmanın amacı, Bursa 1326 Panorama Müzesi üzerinden katılımcı deneyimlerin ve çağdaş sergileme tekniklerinin artırılmasına yönelik öneriler sunmaktır. Dünya çapında kullanılan sergileme teknolojileri ve sistem gereksinimleri ile çağdaş müzecilik ilkelerine uygun hazırlanan öneriler, müze kabuğunun sadece bir mimari öge olmasının ötesinde sergilemeye dahil olabileceğini vurgulamaktadır. Bu öneriler, yalnızca Bursa 1326 Panorama Müzesi için değil, benzer müzeler için de uygulanabilir niteliktedir. Çalışma, Türkiye'nin kültürel, sanatsal ve tarihi mirasını müzelerde teknoloji ile entegre ederek geleceğe taşımanın yollarını göstermektedir. Bu yönüyle çalışmanın; panorama müzelerinin, müze mimarisinin ve çağdaş müzeciliğin gelişimine katkı sağlayabileceği düşünülmektedir.

**Anahtar Kelimeler:** Çağdaş müzecilik, müze mimarisi, panorama müzesi, panorama sanatı, teknoloji

## **THE ROLE OF TECHNOLOGY IN PANORAMA MUSEUMS: A STUDY ON THE BURSA 1326 PANORAMA MUSEUM**

### **Abstract**

Museums have evolved throughout history to preserve and exhibit cultural and artistic values, leading to the emergence of various types such as open-air museums, archaeological museums, science museums, and contemporary art museums. Panorama museums are a type of museum known for their 360-degree continuous painting art. Panorama art, initially displayed in big mobile tents, eventually integrated into museums, establishing dominance in form and content with its circular shape. Today, these museums offer visitors three-dimensional experiences with views of war, urban life and nature. Technology, derived from the meaning of techniques that can assist people, is used worldwide as a tool that advances three-dimensional display techniques in the field of exhibition. In this context, technology plays a significant role in carrying panorama museums into the future and enriching visitor experiences. This study, based on the master's thesis titled "Analyzing of Exhibition's Technology Extend in Changing Museum and Museology: Bursa Panorama Museum", examines display technologies applied worldwide and Panorama 1326 Museum and Interaction Center, one of Bursa's contemporary museums. The study aims to provide recommendations to enhance visitor experiences and contemporary display techniques through Bursa 1326 Panorama Museum. Display technologies and system requirements used worldwide, along with recommendations prepared in accordance with contemporary museology principles, emphasize that the museum shell can be more than just an architectural element and can be part of the exhibition. These recommendations are applicable not only to Bursa 1326 Panorama Museum but also to similar museums. The study shows the ways to carry Turkey's cultural, artistic and historical heritage into the future by integrating it with technology in museums with the suggestions it presents. In this respect, the study is believed to contribute to the development of panorama museums, museum architecture and contemporary museology.

**Keywords:** contemporary museology, museum architecture, panorama museum, panorama art, technology

# **IMPACT ASSESSMENT OF SIDEROPHORE PRODUCING BACTERIA AND L-TRYPTOPHAN ON NUTRITIONAL COMPOSITION, ANTIOXIDANT ACTIVITY, AND VOLATILE COMPOUNDS OF POTATO**

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## **Abstract**

Many nutritional and phytopathogenic issues have a major effect on potato crop production. Researching the microorganisms already present in the potato rhizosphere and then proposing a selective screening to identify potentially growth-promoting strains and PGRs is crucial in this regard. The current experiment was conducted to evaluate the impact of siderophore producing rhizobacteria along with L-tryptophan on antioxidant activity, nutritional composition, volatile compounds, and stability properties of potato. Pre-isolated well characterized *Bacillus simplex* and *Acinetobacter calcoaceticus* alone and in combination with L-tryptophan significantly enhanced the plant nutritional and antioxidant characters under natural field conditions. A significant increase in starch content, total dietary fiber, reducing sugar and carbohydrate content was observed through inoculation with plant growth promoting rhizobacteria. The current approach can be used to overcome the nutritional issues of potato crops along its defense system against diseases.

**Keywords:** potato, nutrition, antioxidant, volatile compounds

## **EXTENSION IN SHELF LIFE OF SUGARCANE JUICE WITH THE IMPLEMENTATION OF AN INTEGRATED APPROACH**

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### **Abstract**

Crop production plays a crucial role in Pakistan's agricultural sector and holds a central position in the country's overall economic framework. Sugarcane juice (SCJ) is a beverage that is both economically viable and extensively consumed, commonly available from roadside sellers in several countries during the sugarcane harvesting season. This study aimed to ascertain a sugarcane variety with a high yield that is well-suited for juice production, as well as to enhance the manufacturing and preservation techniques for bottled sugarcane juice to guarantee widespread client approval. The results of the investigation revealed a significant decline in pH values, ranging from 5.46 to 2.34, along with a noteworthy decrease in total soluble solids, ranging from 22.9% to 18.2%. The research results revealed a significant increase in titrated acidity, ranging from 0.54 to 2.39 mg of citric acid per 100 ml. The composition of the beverages impacted the presence of phytochemicals, namely the total phenolic content (TPC) ranging from 2.10 to 4.90 mg gallic acid equivalents (GAE) per 100 ml, and the total flavonoid content (TFC) ranging from 3.26 to 3.93 mg quercetin per ml. One of the treated drinks, referred to as C2, was determined to be sensorially acceptable. On the other hand, it is noteworthy that the beverage formulation containing C5, exhibited the highest degree of general approval among participants. Additionally, this formulation showcased the most advantageous nutritional composition.

**Keywords:** Sugarcane, Beverage, Shelf life, Phenolics

## **COVID-19: UNPRECEDENTED SOCIAL CHALLENGES BEFORE HUMANITY IN INDIA**

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### **Abstract**

The Corona- crisis is very likely to keep us engage for at least two years to be observed by a moderate re-establishing of economy. Although, it is not equivalent to the Black death in the 14<sup>th</sup> century or the 1918 flu pandemic (“Spanish flu”), the Corona-virus (COVID-19) pandemic has become crucial challenge or dare to humans. The lockdown measures will cause an enormous recession (economic decline), much powerful than the worldwide financial calamity with substantial long-term negative outcomes for government bill and the flexibility of government activities. The responsibility for the next generation has therefore considerably expanded or increased above the vast challenges and problems globally. The Corona- crisis is shattering our societies and is a great challenge against humanity. During this pandemic, because of lockdown everyone is far away from their social environment. Social environment has been ruined badly. Everyone is alone and they feel frightened. Social distancing almost ruined all the unity of our country. Lots of rumours and misconceptions have been spreading all over in India. From this crisis lots of Social challenges have presented in front of us. This lockdown open up all the weaknesses of our country. The reputation of this country is on the danger level. Infact the humanity is in danger. Humanity is the main gift of Indians but because of this pandemic, it is going to destroy by some destroying elements like rumours, hate speech, fake news and misconceptions. Due to the pandemic, economic, political, psychological, mental, religious, environmental and social challenges faced by the world. Due to the epidemic some good news in relation to the environmental challenges like air quality become clean and very good. Environmental pollution has been decreased. There are lots of challenges due to the Corona-virus crisis but this paper only discuss about short description of COVID-19 – Unprecedented Social Challenges before Humanity in Indian context.

**Keywords:** Corona-virus, COVID-19, Spanish flu, Epidemic and Pandemic, Corona- crisis, Social challenge, humanity.



## CONCLUSIONS ON THE FORMATION OF THE ACTIVE COMPONENT OF ECOLOGICAL CULTURE THROUGH MUSEUMS

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### **Abstract**

The study on the formation of the active component of ecological culture through museums has revealed significant findings. Both analytic and intervention study designs demonstrate that museum-based ecological education programs and interactive exhibits markedly enhance visitors' environmental awareness, knowledge, and pro-environmental behaviors. In the analytic study, visitors showed a significant increase in environmental knowledge and behaviors post-visit, with sustained effects observed three months later. The results highlight the pivotal role museums play in raising environmental consciousness. Controlling for variables such as age, education, and prior knowledge, the museum visits emerged as a strong predictor of improved ecological understanding and proactive environmental actions. Engagement metrics from the intervention group, including longer time spent at exhibits and higher participation rates in interactive components, suggest that immersive and hands-on experiences are crucial in fostering an active ecological culture. The increased behavioral intentions and reported changes at the three-month follow-up reaffirm the long-term benefits of such educational interventions. In conclusion, museums serve as vital platforms for promoting ecological culture. By integrating interactive and educational elements into their exhibits, museums can significantly influence visitors' environmental awareness and behaviors, contributing to the broader goal of sustainability. These findings advocate for the continued and expanded use of museums as educational tools to foster a deeper ecological consciousness and motivate sustainable actions among the public.

## **ADVANCES AND CHALLENGES IN WATER DESALINATION IN MOROCCO: A SUSTAINABLE SOLUTION FOR WATER SCARCITY**

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### **Abstract**

Morocco, a country characterized by its arid and semi-arid climate, faces significant challenges related to water scarcity. With increasing population pressure and climate change exacerbating water shortages, the need for alternative and sustainable water sources has become more pressing than ever. Desalination, the process of removing salts and other impurities from seawater and brackish water, has emerged as a viable solution to address these challenges. This paper explores the current state of water desalination in Morocco, highlighting recent technological advancements, such as reverse osmosis and multi-stage flash distillation, which have made desalination more energy-efficient and economically feasible. The study examines existing desalination plants across the country, focusing on their operational capacities, energy consumption, and environmental impacts. Special attention is given to the Noor Ouarzazate Solar Complex, which integrates renewable energy into the desalination process, offering a sustainable model for future projects. Moreover, the paper addresses the socio-economic and environmental challenges associated with desalination, including the high costs, energy demands, and potential impacts on marine ecosystems. The analysis considers the potential of integrating desalination with renewable energy sources, such as solar and wind, to mitigate these challenges and promote a more sustainable approach to water management. By evaluating the successes and limitations of current desalination practices, this paper aims to contribute to the ongoing discourse on sustainable water management in Morocco. It offers recommendations for improving the efficiency and sustainability of desalination technologies, with the goal of ensuring long-term water security for the nation.

**Keywords:** Water Desalination; Sustainable Water Management; Renewable Energy; Climate Change Adaptation

# NANOPARTICLE-MEDIATED GENE SILENCING STRATEGIES IN TREATMENT OF ARECA NUT INDUCED ORAL SQUAMOUS CELL CARCINOMA

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## **Abstract**

Oral squamous cell carcinoma (OSCC), a widespread and virulent type of cancer, forms on the oral cavity's mucosal epithelium and makes up about 90% of oral cancers and affects how one looks, speaks, swallows, and tastes. It is often linked to the consumption of areca nut, a carcinogen that is widely used in many parts of Asia. According to the Global Cancer Observatory, estimates suggest a 40% increase in the incidence of OSCC by the year 2040. Traditional OSCC treatments such as chemotherapy, surgery and radiotherapy come with considerable drawbacks including toxicity and the risk of recurrence. The advent of nanotechnology presents a hopeful alternative, particularly through the use of nanoparticles for gene silencing. This approach employs nanoparticles to carry small interfering RNA (siRNA) or short hairpin RNA (shRNA), CRISPR/Cas systems for editing mutated gene sequences, and antisense oligonucleotides aimed at cancer genes to suppress their activity, effectively turning off their expression and halt tumor progression. The small size and customizable surface of nanoparticles allow for enhanced cell penetration, increased stability, and precise targeting of cancer cells, thereby reducing unintended effects. This study outlines the latest advancements in nanoparticle technologies, including exosomes, liposomes, dendrimers, and gold nanoparticles, for gene silencing applications in OSCC. Furthermore, it delves into the issues concerning the stability, effectiveness of delivery, and potential immunogenicity of these nanoparticle systems. By combining nanoparticle-mediated gene silencing with current treatment methods, there is potential for creating more efficient and less harmful therapies for OSCC caused by areca nut usage, ultimately those are revolutionary strategies that have the ability to greatly influence treatment, and comprehension of OSCC.

**Keywords:** Oral Squamous cell carcinoma (OSCC); CRISPR-Cas9; small interfering RNA (siRNA); short hairpin RNA (shRNA); Nanoparticles.

## NATURAL MODULATION OF THE INTESTINAL MICROBIOME IN PATIENTS WITH CELIAC DISEASE

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### **Abstract**

Background Celiac disease, is an autoimmune intestinal disease induced by gluten in genetically susceptible individuals. Gluten is a common ingredient in daily diet and is one of the main environmental factors to induce celiac disease. Evidence supports the hypothesis that changes in both the composition and function of the intestinal microbiome are associated with celiac disease. Intestinal permeability is an additional element involved in celiac disease pathogenesis, as a “leaky gut” might initiate the early phases of innate immune activation following the exaggerated trafficking of undigested gluten fragments from the intestinal lumen to the lamina propria. Objective Diet is the main factor to regulate the composition and function of intestinal microbiome. In celiac disease Deniplant nutraceuticals, and gluten-free pasta could modulate the immune system through intestinal microbiome. Adhering to gluten free diet could be an effective method for treating celiac disease. Materials and methods The worldwide prevalence of celiac disease ranges between 1-2% in the general populatio, with most patients remaining undiagnosed due to the subtle or multiform clinical manifestations of the disease. Celiac disease can present at any age with a broad range of intestinal and extra-intestinal symptoms. Results These findings raised doubts about another celiac disease paradigm that suggested that genetic background and dietary gluten intake were necessary and sufficient to develop the disease. For those who are gluten intolerant, we have created gluten-free pasta. Conclusion Celiac disease onset can occur years after gluten introduction into the diet. Deniplant nutraceuticals, and gluten-free pasta were used for patients with celiac disease.

**Keywords:** celiac disease, intestinal microbiome, gluten-free pasta

**THE IMPORTANCE AND IMPLEMENTATION OF HUMAN- COMPUTER  
INTERACTION IN EDUCATION: A SURVEY ON EVOLVING INNOVATIONS IN  
CLASSROOM MANAGEMENT**

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**Abstract**

The invention and use of emerging technologies in modern day classroom is dynamically reshaping the educational landscape. In recent times, the integration of Artificial Intelligence and immersive technologies is directed towards optimizing human interaction with computer systems. Human-Computer Interaction (HCI) is an innovational initiative orchestrated to facilitate learning, foster engagement and cater for the unique needs of various learners. The study of Fleck et al. (2009) shows that desktop computer can detect direct interaction with its interface in order to model collaborative learning process. The study of Fleck, et al. (2009) shows that desktop computer can detect direct interaction with interface in order to model collaborative learning process. This paper is a descriptive survey on the applications of Human-Computer Interaction (HCI) in education. The paper underscores the importance of the innovations in HCI with educational needs and highlights some of the challenges confronting HCI. In order to gather vital data that will be used in the paper discussion, drafted questions were administered to respondents using online Google form questionnaire instrument. The information collected was subjected to reliability analysis. Conclusively, the paper affirms that HCI has significantly improved students learning experience.

**Keywords:** Human-Computer Interaction, Evolving Innovations, Classroom Management.

## **THE THERAPEUTIC EFFECTS OF DENIPLANT NUTRACEUTICALS ON THE GUT MICROBIOME IN PATIENTS WITH PSORIASIS**

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### **Abstract**

Background A growing body of evidence highlights that intestinal dysbiosis is associated with the development of psoriasis. The gut–skin axis is the novel concept of the interaction between skin diseases and microbiome through inflammatory mediators, metabolites and the intestinal barrier. The gut microbiome affects skin homeostasis through its influence on the signaling pathways that coordinate epidermal differentiation. The objective of this study was to synthesize current data on the Deniplant natural modulator of the gut microbiome in patients with psoriasis. Materials and methods All studies confirmed the association of psoriasis and gut microbiota dysbiosis. We describe the recent advances regarding the interplay between gut microbiota and the skin. Thus, the microbiome can be considered an effective therapeutical target for treating this disorder. Results This presentation provides a detailed and comprehensive systematic study regarding gut microbiome in patients with psoriasis. These results are supported by clinical observations based on a case serie showing improvement in psoriatic skin lesions after Deniplant natural modulator. It is still not clear whether psoriasis is an effect or a cause of the observed disbalance between beneficial and pathogenic microbes. In this context, the study provides very interesting results, showing significantly greater changes in the gut microbiome of patients with psoriasis treated Deniplant natural modulator. Conclusion There is a significant association between alterations in gut microbial composition and psoriasis. Intestinal dysbiosis is a state of imbalanced gut microbiome that eventually has a negative impact on skin function and integrity. Deniplant natural modulator is a potential therapeutic strategy in patients with psoriasis

**Keywords:** dysbiosis, microbiome, psoriasis, gut-skin axis, gut barrier, Deniplant nutraceuticals

# **FUNDAMENTAL PRINCIPLES OF MECHANICAL VENTILATION SYSTEMS AND THEIR CLASSIFICATIONS IN CONVENTIONAL ENGINEERING PRACTICES**

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## **Abstract**

Mechanical ventilation systems (MVSs) play a crucial role in maintaining indoor air quality and thermal comfort in buildings. However, the lack of understanding of the fundamental principles of MVSs in conventional engineering practices has led to suboptimal design and operation of these systems. This has resulted in poor indoor air quality, discomfort, and energy inefficiency in buildings. This study addressed the key principles of MVSs and their application in engineering practices. The methodology for this study involved a comprehensive review of existing literature on MVSs and the key principles that govern their design and operation. This included research articles, technical reports, and industry guidelines on ventilation system design and installation. The study also involved site visits to buildings with mechanical ventilation systems to assess their performance in actual conditions. Interactive sessions were also held with building owners, facility managers, and HVAC engineers to gather insights on the challenges and opportunities in MVS design and installation. The findings of this study reveal that while conventional engineering practices provide a solid foundation for designing and installing MVSs, there are several areas for improvement. One key finding is that the design and installation of ventilation systems often do not consider the specific needs and usage patterns of building occupants. This can lead to improper ventilation rates and poor indoor air quality. Additionally, maintenance and operation of ventilation systems are often overlooked, leading to decreased system efficiency and increased energy consumption. The study suggests that the adoption of advanced technologies such as smart ventilation controls and energy recovery systems, can offer ideal solutions to improve the performance of MVSs. It is imperative for the engineering community to prioritize conventional norms and trainings in the field of mechanical ventilation systems to ensure sustainable and healthy indoor environments.

**Keywords:** Mechanical ventilation systems, Thermal comfort, Air quality, Engineering practices.

# EKONOMİK İŞLETMELERİN FİNANSAL PERFORMANSINI DEĞERLENDİRMEDE VE GELİŞTİRMEDE İÇ DENETİMİN ETKİNLİĞİ

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## Özet

Bu çalışma, ekonomik işletmelerde mali performansın değerlendirilmesi ve iyileştirilmesinde iç denetimin kritik rolünü araştırmakta, özellikle Souf Un Şirketi'ne odaklanmaktadır. Araştırmanın birincil amacı, iç denetimin bir kuruluşun mali çerçevesindeki güçlü ve zayıf yönleri belirleme ve ele alma konusunda nasıl temel bir mekanizma olarak işlev gördüğünü göstermektir. Bu şekilde, iç denetim işletmenin genel verimliliğine, sürdürülebilirliğine ve piyasa rekabetçiliğine katkıda bulunur. Çalışma, hem nitel hem de nicel araştırma yöntemlerini birleştirerek tanımlayıcı ve analitik bir yaklaşım benimsemektedir. Araştırmanın başlangıcında, iç denetimin temel kavramlarını, tanımlarını, hedeflerini, türlerini ve onu yöneten standartları özetleyen kapsamlı bir literatür taraması sunulmaktadır. Çalışma ayrıca kârlılık, yatırım getirisi (ROI), maliyet yönetimi ve kaynak tahsisi gibi çeşitli mali performans göstergelerini de incelemektedir. Bu göstergeler, katı iç denetim uygulamalarının ne ölçüde etkilediğini anlamak için eleştirel bir şekilde analiz edilmektedir. Araştırmanın pratik bölümünde, çalışma Souf Un Şirketi'nde iç denetimin uygulanmasına odaklanmaktadır. Bu bölüm, iç mali raporların ayrıntılı bir analizini ve şirketin kilit yetkilileriyle yapılan derinlemesine görüşmeleri içermektedir. Ayrıca, belirli bir dönem boyunca şirketin mali tablolarının kapsamlı bir incelemesini de içermektedir. Bu analizden elde edilen bulgular, belirlenmiş standartlar ve en iyi uygulamalar doğrultusunda sistematik iç denetim uygulamasının şirketin mali performansında önemli iyileştirmeler sağladığını göstermektedir. Bu iyileştirmeler, artan kârlılık, kaynak kullanımında verimlilik artışı ve daha iyi maliyet yönetimi gibi çeşitli alanlarda kendini göstermektedir. Sonuç olarak, çalışma, iç denetimin sadece bir uyum gereksinimi olmadığını; aksine, bir organizasyonu mali başarıya doğru önemli ölçüde ilerletebilecek stratejik bir araç olduğunu ortaya koymaktadır. Araştırma, iç denetimin potansiyel faydalarını tam anlamıyla gerçekleştirebilmek için üst yönetimin güçlü desteğinin gerekliliğini vurgulamaktadır. Ayrıca, diğer ekonomik işletmelere, etkili iç denetim sistemleri aracılığıyla mali performanslarını artırma konusunda pratik öneriler sunmaktadır.

**Anahtar Kelimeler:** İç Denetim, Mali Performans, Ekonomik İşletmeler, Kârlılık, Maliyet Yönetimi



## **THE EFFECTIVENESS OF INTERNAL AUDITING IN EVALUATING AND ENHANCING THE FINANCIAL PERFORMANCE OF ECONOMIC ENTERPRISES**

### **Abstract**

This study delves into the critical role of internal auditing in evaluating and enhancing the financial performance of economic enterprises, with a specific emphasis on the Souf Flour Company. The primary aim of the research is to demonstrate how internal auditing can function as an essential mechanism for identifying and addressing both strengths and weaknesses within an organization's financial framework. By doing so, internal auditing contributes to the overall efficiency, sustainability, and competitiveness of the enterprise in the marketplace. The study employs a descriptive and analytical approach, integrating both qualitative and quantitative research methods. Initially, the research presents an extensive review of the literature, outlining the key concepts of internal auditing, including its definitions, objectives, types, and the standards that govern it. The study further explores various financial performance indicators such as profitability, return on investment (ROI), cost management, and resource allocation. These indicators are critically analyzed to understand the extent to which they are influenced by the implementation of rigorous internal auditing practices. In the practical segment of the research, the study focuses on the application of internal auditing within the Souf Flour Company. This section involves a detailed analysis of internal financial reports, coupled with in-depth interviews with key company officials. The research also includes a comprehensive examination of the company's financial statements over a specified period. The findings from this analysis indicate that the systematic application of internal auditing, in line with established standards and best practices, results in substantial improvements in the company's financial performance. These improvements are reflected in various areas, including increased profitability, enhanced efficiency in resource utilization, and better cost management. Ultimately, the study concludes that internal auditing is far more than a mere compliance requirement; it is a strategic tool that can significantly propel an organization toward financial success. The research underscores the necessity for strong support from top management to fully realize the potential benefits of internal auditing. Furthermore, the study offers practical recommendations for other economic enterprises looking to enhance their financial performance through effective internal auditing systems.

**Keywords:** Internal Auditing, Financial Performance, Economic Enterprises, Risk Management, Corporate Governance.

## **FOSTERING STORYTELLING EMPOWERS STUDENTS WITH LEARNING DISABILITY IMPROVES COMMUNICATION SKILLS IN THE MODERN ERA**

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### **Abstract**

The modern study fosters storytelling empowers students with learning disability (SWLD) improves communication skills in the modern era. Everyone benefits when SWLDs use stories to improve their communication and empowerment skills. Storytelling allow SWLD to work on their pronunciation and communication skills. Improving one's sentence form, fluency, and vocabulary can be achieved with this activity. The ability to follow and understand stories can be honed by listening to and comprehending them. The learning process can be more interesting and effective when SWLD actively participates in writing and sharing personal experiences. As a result, students are more actively involved and can establish deeper connections to the content. Stories provide SWLD with a wonderful outlet for self-expression and empowerment. Narratives help people remember what they've said by giving their ideas a structure. Those who suffer from SWLD and have trouble with sequencing and organization would profit substantially from this. Storytelling allows SWLD to better understand and empathize with diverse individuals and their experiences. Improve your communication skills and emotional intelligence using this method. By opening up about their highs and lows, SWLD can grow emotionally and gain insight into themselves. As SWLDs evaluate and build stories, choosing plot twists and character behaviours, they practice critical thinking. Motivate SWLD to share their stories aloud in private or small-group sessions. Your SWLD may benefit from visual aids and prompts as they work to structure their stories. Give SWLD the option to type their story instead of writing it; this will allow individuals to be more comfortable with writing to express themselves. When SWLD has trouble developing story ideas, try using prompts and story starters. The prompts can be in the form of text, images, or even stories. Collaborate on creating and performing a narrative as part of group storytelling exercises with SWLD. Improving your communication skills and ability to work well with others are two outcomes of this. Using stories to draw connections can assist SWLD in understanding how what they learn in class applies to real life. Teachers can motivate their SWLD foster personal development, and inspire storytelling to improve communication skills in the modern era.

**Keywords:** Fostering, Storytelling, Empowerment, Students with Learning Disability, Improvement, Communication Skills, and Modern Era

## **DETERMINANTS OF BONE MINERAL DENSITY IN FEMALE ELITE MASTERS ATHLETES: A CROSS-SECTIONAL STUDY**

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### **Abstract**

The purpose of this study was to identify the determinants of bone mineral density (BMD) in female elite masters athletes. The specific aim of the study analyzed the interaction of BMD with factors such as long-term exercise with different osteogenic index, dietary patterns, body tissue composition, number of fractures in all life, and biological factors. The study included female athletes in the master's category. The results were analyzed in 3 categories of sports competition: endurance athletes (EA), speed-power athletes (SPA), and throwing athletes (TA). BMD of the forearm in two points: distal (dis) and proximal (prox) was measured by dual-energy X-ray absorptiometry (Swissray-USA, Norland Medical Systems). Body tissue composition was measured by bioelectrical impedance analysis. Biological factors, such as the age of menarche and status of menopause, past fractures were rated based on interviews. Dietary patterns and dairy product consumption were assessed by the Food Frequency Questionnaire. The results of the covariance analyses between BMD and selected parameters indicated that the main parameters affecting BMD dis were: age at menopause (small effect:  $\eta^2 = 0.03$ ), number of fractures in all life (small effect:  $\eta^2 = 0.05$ ), number of dairy product per day (small effect:  $\eta^2 = 0.05$ ), type of dietary pattern (small effect:  $\eta^2 = 0.04$ ) and sport competition (small effect:  $\eta^2 = 0.03$ ). BMD prox was affected by: age at menarche (medium effect:  $\eta^2 = 0.096$ ), age at menopause (large effect:  $\eta^2 = 0.12$ ), number of fractures in all life (small effect:  $\eta^2 = 0.02$ ), dairy product (large effect:  $\eta^2 = 0.13$ ), type of dietary pattern (small effect:  $\eta^2 = 0.04$ ) and sports competition (medium effect:  $\eta^2 = 0.06$ ). In EA and SPA dietary patterns with high intake of fruit, vegetables, dairy products, whole grains, poultry, fish, nuts, and legumes determined higher mean BMD. In contrast, in the TA group dietary patterns with lactose-free, and gluten-free diets determined higher mean BMD.

**Keywords:** bone mineral density, sports competition, dietary patterns, body tissue composition, fractures, biological factors

## **ASSESSING CARE FOR THE AGED IN CONTEMPORARY NIGERIA: ANY HELP FROM PROVERBS 14:30-31**

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### **Abstract**

This article assesses the rate of care that those ageing get from the children and family members. In Nigeria, there are limited resources and support systems available for ageing individuals. In contemporary Nigeria, the aged are considered liabilities and witches and wizards. The family members see them as burdens. No one wants to take them into their homes, including their biological children. It is not surprising that their deaths are caused by a lack of care and support. Thus, this study sorts answers from Proverbs 14:30–31. Existing literature has not adequately explored the challenges that the elderly go through in light of the Old Testament. This study utilised the narrative method with data gotten from twenty (N = 20) purposively selected informants and analysed using content analysis. Emerged themes include: a) physical abuse; b) psychological abuse; c) social isolation; and d) conflict escalation. Encouraging your elderly parents to participate in health and fitness programs is a great way to promote their physical and mental well-being. It's important to provide your elderly parents with financial and legal support. With the right tools, knowledge, and support network, you can help your parents age gracefully and live a happy, comfortable life.

**Keywords:** Aged, Elderly, Nigeria, Abuse care, Proverbs

# **AUGMENTATIVE-ALTERNATIVE COMMUNICATION AS A REHABILITATIVE AND EDUCATIONAL APPROACH TO SUPPORT COMMUNICATION AND SOCIAL INTERACTION IN AUTISM SPECTRUM DISORDER**

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## **Abstract**

The objective of this study is to explore in a qualitative analysis the application of Augmentative and Alternative Communication (AAC) among individuals diagnosed with Autism Spectrum Disorder (ASD). It aims to provide an insight on how the innovative methodologies employed facilitate the social integration of individuals with autism and, how AAC techniques have the potential to alter challenging behaviors that typically arise from the ASDs difficulty in accurately articulating and conveying their feelings and experiences to others. We measured the efficiency of ACC early interventions based on the systematic observation of daily activities of four moderate ASD adult case studies. AAC is recognized as an invaluable instrument for individuals diagnosed with ASD across various life contexts, attributable to its predominant reliance on visual communication tools, which ideally aligns with the strengths and challenges frequently experienced by individuals with ASD. Our observations data found that during the implementation of AAC at the level of expressive communication enhances interpersonal relationships with psychosocial staff and peers by fostering the development of social skills. Furthermore, it enabled individuals with ASD to attain a more comprehensive understanding of their surroundings and the habitual practices associated with them including a better relationship with their parents. Our findings also revealed that using AAC interventions for individuals with ASD facilitates enhanced control over their surroundings, thereby minimizing the likelihood of engaging in maladaptive behaviors, such as intense anger or aggression. AAC serves as a proactive measure to mitigate negative behaviors and alleviate anxiety in ASD subjects. In conclusion, we recommend utilizing ACC strategies in ASD individuals as tailored professional skills to enable them in acquiring both verbal and non-verbal communication skills. This intervention enhances their ability to interpret and engage with the communicative efforts of others, thereby facilitating their understanding of pragmatic aspects, which pertain to the social dimensions of communication. For individuals with autism, the integration of AAC can significantly enhance their functional communication capabilities, offering essential support for language development in those lacking symbolic language. For health professionals, psychosocial staff and educators, AAC serves as a valuable tool in aiding them toward a proactive approach with ASD. It also helps in understanding and exercising choice, competencies and improvement of interpersonal skills.

**Keywords:** Augmentative and Alternative Communication, Autism Spectrum Disorder, psycholinguistic interventions, health and education services, proactive approaches

## **DOES NATIONALITY IMPACT ON THE CONSUMPTION OF ORGANIC FOODS?**

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### **Abstract**

In this study, the main aim is to examine the effect of respondents' nationality on their health care awareness, by consuming organic foods. In this way, 333 participants were involved, most of them were Indians (n = 100), Albanians (n = 85), Algerians (n = 53), Georgians (n = 50), and Turkish (n = 45). The data were collected through an online survey in two stages, during 2022, and between December 29 and August 22, 2024. The findings revealed that Indians and Georgians are less aware compared to other participants regarding the consumption of organic foods. (Sig: 0.000<0.05).

**.Keywords:** Organic foods, Consumer behavior, Green marketing.

## **CHALLENGES HINDERING INDIA'S PROGRESS TOWARD A FIVE-TRILLION-DOLLAR ECONOMY**

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### **Abstract**

We often discuss India's aspiration to become a five-trillion-dollar economy, as it is expected to drive both economic and social development by increasing employment opportunities and raising incomes, ultimately helping to alleviate poverty. Ideally, this outcome aligns with the trickle-down theory, which suggests that when resources are available at higher levels, the benefits will eventually reach the lower levels of society, solving issues like poverty and unemployment. India's aspiration to become a five-trillion-dollar economy faces several foundational challenges. Here's an overview of some of the basic problems that need to be addressed for this goal to be achievable like Economic Inequality, unemployment and underemployment, Educational and Skill Deficit, Agricultural Challenges, Healthcare Challenges, Fiscal Deficit and Public Debt, Environmental Sustainability and Global Economic Conditions etc. However, past and present experiences show that such policies have not been particularly effective in addressing these problems in India. Instead, inequality has grown faster, and neither unemployment nor poverty has significantly declined. As India aims for rapid economic growth, large investments will be necessary, leading to greater reliance on capital- and technology-intensive industries, which are less labor-intensive. As a result, issues of unemployment, poverty, and inequality are likely to persist. Although, India's potential to reach the five-trillion-dollar economy mark depends on its ability to address these challenges through coordinated policy efforts, innovation, and investment in human capital and infrastructure.

**Keywords:** Trillion \$ Economy, Poverty, Economic Inequality, Unemployment, Growth rate.

# **ENHANCED PERFORMANCE OF ALL-SOLID-STATE LITHIUM BATTERIES WITH INNOVATIVE GLASS-CERAMIC ELECTROLYTES**

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## **Abstract**

In contrast to traditional lithium batteries that use liquid electrolytes, all-solid-state lithium batteries offer enhanced safety, longer cycle life, higher energy density, and reduced packaging and circuitry needs. Among various solid electrolyte options, glass ceramics have shown great promise. We have developed an innovative glass-ceramic material by incorporating a newly introduced metal oxide dopant into its crystalline phase, achieved through precise control of crystallization using melt-quenching techniques. Our study of crystallization kinetics revealed a three-dimensional nucleation mechanism with spherical particle growth, exhibiting an



activation energy of  $165 \text{ kJ mol}^{-1}$ . X-ray diffraction (XRD), Rietveld refinement, and transmission electron microscopy with selected area electron diffraction and high-resolution transmission microscopy (TEM-SEAD-HRTM) confirmed the presence of the desired doped phase. Additionally, TEM images showed that the crystallites are surrounded by a glassy phase, indicating the formation of dense, pore-free glass ceramics. These materials demonstrated excellent mechanical properties and impressive ionic conductivity ( $4 \cdot 10^{-4} \text{ S/cm}$  at room temperature) with low electronic conductivity ( $8 \cdot 10^{-8} \text{ S/cm}$ ), as confirmed by UV-visible spectroscopy. Our synthesized material outperforms conventional ceramics, glasses, and glass ceramics in terms of solid electrolyte performance, offering a cost-effective and streamlined production process with significant potential for large-scale manufacturing and commercial use.

# CHEMICAL MODELING OF NOX REDUCTION IN A CU-ZEOLITE SCR CATALYST

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## **Abstract**

With the continuous rise in energy consumption and fossil fuel usage, coupled with the alarming risks associated with the pollutants they emit, research into pollution control and removal has become imperative. Fossil fuel combustion releases pollutants such as nitrogen oxides (NO<sub>x</sub>), sulfur oxides (SO<sub>x</sub>), carbon monoxide (CO), and volatile organic compounds (VOC) into the atmosphere through exhaust systems. Among these, nitrogen oxides are particularly significant due to their role in photochemical processes that contribute to the depletion of the ozone layer, the formation of photochemical smog, and the occurrence of acid rain. One of the most advanced methods for reducing nitrogen oxide emissions is selective catalytic reduction (SCR), which offers several benefits, including operation over a broad temperature range, low energy usage, high selectivity, and cost-effectiveness. The focus of this study is to simulate the chemical reactions occurring within an SCR catalyst, using a reduction mechanism and modeling the reaction rates for NO oxidation on copper-zeolite catalysts. The investigated catalyst features a copper-zeolite structure with chabazite, where ammonia first reacts with the catalyst, followed by a subsequent reaction with NO<sub>x</sub>, ultimately producing water and nitrogen. The proposed model demonstrates a strong ability to predict the complex behavior of NO oxidation reactions, considering the effects of variables such as NO, H<sub>2</sub>O, NO<sub>2</sub>, O<sub>2</sub>, feed compositions, and temperature conditions. This kinetic model provides a comprehensive understanding of the SCR process and its effectiveness in removing nitrogen oxides from emissions, offering insights that could help optimize performance in real-world applications.

**Keywords:** SCR catalyst, copper-zeolite, ammonia, kinetic modeling, NO oxidation.

# SOLVING FRACTIONAL DIFFERENTIAL EQUATIONS WITH SEMI-ANALYTICAL METHODS

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## **Abstract**

In recent years, iterative techniques such as the Variational Iteration Method (VIM) and its modifications, including the Akbari Ganji Method (AGM) and the Homotopy Perturbation Method (HPM), have garnered significant interest as effective methods for solving nonlinear differential equations. This paper focuses on the application of VIM, AGM, and HPM specifically to nonlinear fractional differential equations, which pose unique challenges. A primary issue addressed in this study is the appearance of redundant terms during the computation process, as well as the increased computational time required due to repeated calculations when seeking series solutions. The theoretical frameworks of VIM, AGM, and HPM are thoroughly discussed, and practical examples are provided to demonstrate their functionality and application. Furthermore, these methods are compared to highlight their differences and advantages in various contexts. The results of this analysis indicate that, due to their accuracy, efficiency, and strong convergence properties, VIM, AGM, and HPM are highly suitable for tackling nonlinear problems, particularly in the context of fractional differential equations. The study provides evidence that these methods can significantly reduce computational complexity while maintaining precise solutions. In conclusion, VIM, AGM, and HPM stand out as powerful analytical tools, especially in addressing the difficulties posed by nonlinear and fractional differential equations, making them ideal candidates for further exploration in both theoretical research and practical applications.

**Keywords:** Fractional, Nonlinear differential equations, VIM, AGM, HPM.

# NUMERICAL SIMULATION OF THE GEOMETRICAL EFFECTS OF THE REVOLVING SPRING TURBULATOR ON THE IMPROVEMENT OF HEAT TRANSFER IN TUBULAR HEAT EXCHANGERS

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## **Abstract**

Heat exchangers play a critical role in optimizing heat transfer between two or more fluid flows across a variety of engineering systems. This research emphasizes the use of passive methods to enhance heat transfer efficiency. Passive techniques aim to induce rotation within the fluid flow, thereby disturbing the boundary layer and increasing the effective surface area and stagnation time, which in turn raises the heat transfer coefficient. One of the key passive methods discussed in this study is the rotary flow technique, which introduces or enhances rotational flow or secondary flow alongside the axial flow within the channel. This approach can be applied to both single-phase and two-phase flows in heat exchangers. The study specifically focuses on the geometrical parameters of turbulators, examining the effects of two different shapes, circle-shaped and square-shaped turbulators, on heat transfer. The research investigates the influence of these geometrical parameters and turbulator size within a Reynolds number range of 6000 to 24000. The findings reveal that increasing the size of the turbulator

enhances the heat transfer performance by more than 13% at constant Reynolds numbers. However, the performance coefficient tends to decrease by about 6% as Reynolds numbers increase. Additionally, the study indicates that a smaller turbulator size leads to a reduction in the Nusselt number. In contrast, the installation of a square-shaped turbulator in the heat exchanger results in an increase in the Nusselt number by approximately 8%. These results underscore the significance of turbulator design and size in improving heat transfer efficiency in heat exchangers.

**Keywords:** Tube heat exchangers, Turbulent flow, Spring wire, Swirl generator, Corrugated tube.

# INVESTIGATION OF SAVONIUS VAWTS WITH HELIX BLADES RELATED TO RENEWABLE WIND ENERGY BASED ON ANALYTICAL AND NUMERICAL APPROACHES

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## **Abstract**

This study presents, for the first time, the extraction of nonlinear partial differential equations for Vertical Axis Wind Turbines (VAWTs) with Savonius rotors featuring helix blades of varying heights. A comprehensive three-dimensional analytical and numerical analysis has been conducted on this type of wind turbine. The fluid flow around the turbine is characterized as three-dimensional, unsteady, incompressible, and occurring at low velocities. The governing equations, which include the continuity and momentum equations, form a set of nonlinear partial differential equations that are solved using the Akbari-Ganji Method (AGM). The study investigates the velocity and pressure components of the fluid flow at different heights of the wind turbine. The results derived from AGM are compared with those obtained from the Finite Element Method (FEM) and FlexPDE, providing validation for the analytical approach. The findings demonstrate that the helix shape of the turbine blades, along with the aluminum material of the shaft, significantly enhances the performance of the turbine by increasing the velocity and reducing the pressure. These results highlight the efficiency of the helical blade design in improving fluid dynamics and overall turbine performance. The analysis provides valuable insights into the impact of blade geometry on the aerodynamic properties of VAWTs, offering potential for optimization in future wind turbine designs.

**Keywords:** Akbari-Ganji's Method (AGM), FEM, Helix blade, VAWTs savonius, Wind energy.

# INVESTIGATING MHD NANOFUID FLOW UNDER THE INFLUENCE OF JOULE HEATING AND CHEMICAL REACTIONS IN PARALLEL ROTATING DISK

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## Abstract

This study investigates the combined effects of magnetohydrodynamic (MHD) convection and Joule heating on the flow of hybrid nanofluids in a porous medium between two parallel rotating disks under radiative conditions. The governing partial differential equations (PDEs) are transformed into ordinary differential equations (ODEs) using appropriate similarity transformations and then solved using the Akbari-Ganji Method (AGM), which is an effective approach for solving nonlinear problems. The analysis includes the impact of various parameters on velocity, temperature, and concentration profiles. Additionally, the simultaneous effects of key parameters on the skin friction coefficient, Nusselt number, and Sherwood number are explored through three-dimensional diagrams and statistical analysis using ANOVA. The findings reveal that the temperature profile improves as the magnetic parameter ( $M$ ) increases. Moreover, the Nusselt number shows a positive correlation with the parameter  $B_1$ , increasing with its rise. Conversely, an increase in the  $M$  value is associated with a higher skin friction coefficient, while an increase in  $B_1$  leads to a reduction in skin friction. The results

also indicate that a simultaneous increase in the Schmidt number ( $Sc$ ) and the chemical reaction parameter ( $Cr$ ) enhances the Sherwood number ( $Sh$ ). These outcomes provide valuable insights into the behavior of hybrid nanofluid flows in porous media under the influence of MHD and radiative effects, with potential applications in various engineering fields.

**Keywords:** ANOVA analysis, porous medium, AGM, FEM, Magnetohydrodynamic flow



# **IDENTIFICATION OF ACTIVITY-MODULATING FRAGMENTS OF THIAZOLE DERIVATIVES AS POTENTIAL DHODH INHIBITORS USING SMILES-BASED QSAR: IN-SILICO STUDY**

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## **Abstract**

Dihydroorotate dehydrogenase (DHODH) plays a crucial role in synthesizing essential pyrimidine nucleotides necessary for DNA and RNA production, thereby influencing cell growth and proliferation. Any disruption in this synthesis deprives cells of the necessary nucleotides, hindering their replication and proliferation. This study investigated a series of thiazole derivatives for their DHODH inhibitory activity, using the Monte Carlo optimization method to develop a QSAR model. This model not only explained the variation in activity but also predicted the efficacy of newly non-synthesized compounds. The study included Molecular Docking, Molecular Dynamics (MD) simulations, and Density Functional Theory (DFT) studies. The Monte Carlo optimization results (Split-1, Split-2, Split-3) identified specific molecular fragments and promoters responsible for altering inhibitory activity, guiding the design of new thiazole derivatives with enhanced inhibitory effects. Molecular docking analysis within the DHODH enzyme's active site revealed that residues ARG 136, LEU 46, PRO 52, and TYR 356 were involved in binding the newly designed thiazoles. Furthermore, MD simulations demonstrated the stability and sustainability of these interactions. DFT analysis explained the molecular docking interactions, showing hydrogen bond formation between each designed ligand and the protein through regions of positive and negative electrostatic potential. Additionally, non-polar regions in the compounds facilitated hydrophobic interactions with the protein.

**Keywords:** Cancer, Autoimmune Disorders, Infectious Diseases, Monte Carlo, DHODH, Molecular Docking, Dynamic Simulation

## THE IMPACT OF EDUCATION RESEARCH ON PROMOTING SUSTAINABILITY AND INCLUSIVITY IN STUDENT LEARNING ENVIRONMENT

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### **Abstract**

Education research plays a crucial role in shaping learning environments that foster sustainability and inclusivity among students. This paper examines the multifaceted impact of educational research on creating environments conducive to sustainable practices and inclusive learning experiences. The descriptive survey research design was adopted. Three research questions and three hypotheses guided the study. Population of the study comprised 400 academic staff (Lecturers) of Ignatius Ajuru University of Education, Port Harcourt. Sample size was 300 selected using the stratified random sampling technique. Instrument for data collection was a questionnaire titled: "Impact of Education Research on Promoting Environment for Students Learning Experience Questionnaire" (IERPESLEQ). The reliability coefficient of the instrument was determined using test-retest and yielded a reliability coefficient of 0.72 ( $r = 0.72$ ). The research questions were answered with mean and standard deviation, while the hypothesis was tested using the independent t-test. The result of the study revealed that incorporating sustainability and inclusivity into the curriculum has shown positive impacts on academic achievement, engagement, and motivation. The study recommended that lecturers in the university system should facilitate interdisciplinary collaboration among educators, researchers and stakeholders to develop innovative approaches for promoting sustainability and inclusivity in students learning environments.

**Keywords:** Sustainability education, research and student learning environment

## EFFECT OF CATECHINS ON THE SLIMMING ACTIVITY OF RABBITS

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### **Abstract**

Epigallocatechin-3-gallate (EGCG) are bioactive molecules exhibiting a lot of scientific attention due to their multiple biological activities. EGCG functions as a powerful antioxidant, preventing oxidative damage in healthy cells, and is considered the most significant tea catechin because it has the highest free radical scavenging activity. Analytical results by LC-MS identified 4 catechins : EGCG, EGC and ECG. This extract allows us to identify the presence of therapeutic molecule so-called EGCG revealed by LC-MS (Up to 60.1 %). Catechins reduce considerably or prevent the increase of the physical weight to the male thin and obese subjects and the females. On the basis of the in-vivo effects, the loss of the weight of which is  $460 \pm 125.19\text{g}$  during 56 days, when the maximum weight loss of rabbit is 613g. the components of the EGCG could be useful for the treatment of the obesity.

**Keyword :** Catechins, Antioxidant, green tea, on rabbit, obesity, slimming activity,

**ELABORATION AND CHARACTERIZATION OF A NATURAL COMPOSITE  
MATERIAL BASED ON COLLOIDAL PARTICLES OF MICROCRYSTALLINE  
CELLULOSE COATED WITH MODIFIED STARCH**

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**Abstract**

Physicochemical and rheological analyses were realized on microcrystalline cellulose (MCC) of colloidal grade, coated with octenyl succinic anhydride (OSA) starch. The objective was to prepare a biobased material (OSA-Cel), with new characteristics relating to both surface activity and viscosity. The chemical structures of MCC, OSA-starch and OSA-Cel were studied using FT-IR and XRD analyses, and their surface aspects were determined by surface tension measurements. From the results obtained, it was noticed that the FT-IR spectra showed great similarity between the characteristics of the crude MCC and those of OSA-Cel. Analysis by XRD showed a peak that was attributed to the crystalline phase of the cellulose. Furthermore, it was shown that OSA-starch interacts notably with MCC. The rheological properties at different concentrations of OSA-Cel showed the same behavior as that of MCC, a three-region viscosity profile (thinning, shear thickening and an infinite shear plateau).

**Keywords:** microcrystalline cellulose, OSA-starch, composites, surface tension, rheology

**INNOVATION OF CUMIN LEAVES (*Plectranthus amboinicus spreng*) AND GARLIC (*Allium sativum*) ENHANCEMENT TO AGRIBUSINESS VARIANT OF ODORLESS SALTED DUCK EGGS**

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**Abstract**

The scarcity or excess supply chain of food products forces us to continue diversifying to maintain food security and resilience. Eggs are one of the commodities that support this goal because of their high nutritional content and practicality for consumption. However, the odor smell of duck eggs is often the cause of the lack of public interest in consuming duck eggs. Its nutritional content is higher than chicken eggs. One alternative is to use cumin leaves (*Plectranthus amboinicus* SPRENG). Cumin leaves can eliminate the odor smell of duck eggs because they have a distinctive bioflavonoid, phenol, and essential oil content. Garlic with its allicin and antibiotic content. These substances are thought to be able to reduce the level of fishiness and eliminate pathogens in duck eggs. The study was conducted to create an innovation in making odorless salted duck eggs enriched with cumin leaves and garlic. The study used a descriptive and exploratory method of a Randomized Block Design experiment repeated three times. The odor smell of salted duck eggs was significantly reduced and preferred at 1 g/1 egg. Consumer taste also increased rapidly when salted duck eggs were enriched with garlic. Salted eggs enriched with cumin leaves and garlic are of higher quality and preferred than conventional salted eggs. There are other advantages, such as duck eggs being more durable and of better quality. This finding provides new business opportunities and appetizing product variants.

**Keywords:** Diversification, Food security, Duck eggs, taste

## ENERGY CRISIS – MASS MEDIA COVEREGE

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### **Abstract**

World economies have past through numerous depressions/ crises social, economical, political, military, ecological, energy, moral. In the light of the 2022 energy crisis the aim of our presentation is to analyze the ways in which this crisis has been mediatized in Romanian and interational mass media. The energy crisis of 2021-2022 is different from other crises, because, on the one hand, it follows a global health crisis, namely the COVID 19 pandemic. On the other hand, it is different from previous crises in its overall impact on activity of production and distribution worldwide not just locally or regionally. Having an exploratory character, our presentation aims to: (1) determin the specific particularities of the mediatization of the energy crisis (from its genesis to how it unfolds) and (2) make a typology of the narratives developed in the mass media with reference to the current energy crisis.

**Keywords:** energy crisis, mass media coverage, jurnalism

## **SOCIETY, ENERGY AND DIGITAL TRANSITION**

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### **Abstract**

On 25 September 2015, at the United Nations Sustainable Development Summit, it was adopted the 2030 Agenda for Sustainable Development. The document was developed by United Nations as a 'blueprint' for the present and future of people and the planet. Through this agenda by all UN member states there are 17 goals, 169 global targets and 232 indicators for measuring the progress in achieving the targets. The goals cover all human existence in its social and environmental interdependences, from economic well-being to gender equality, from individual production and use of energy to industry and economic growth. Focusing on the 7th goal – 'affordable and clean energy' – this presentation will highlight the social sustainability of a pushing for a green future that should be achieved by 2030.

**Keywords;** social sustainability, energy, future

# **A REVIEW OF URBAN FLOODS AND UNCONTROLLED WASTE DISPOSAL: ANALYSIS OF THEIR OCCURRENCE AND CONSEQUENCES**

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## **Abstract**

Urban floods and indiscriminate waste disposal are growing environmental challenges that significantly impact urban areas, particularly in developing countries. Flooding in developing nations is caused by a variety of factors, including unchecked rapid population expansion, inadequate preparedness, lack of political will, heavy precipitation, building on streams, sea level rise, soil moisture regime, and dam operations, particularly near borders. This review explores the interconnectedness between poor waste management practices and the increasing frequency of urban flooding. Improper disposal of solid waste, including plastics and other non-biodegradable materials, often clogs drainage systems, leading to blockages that exacerbate flood risks during heavy rainfall. The study examines the occurrence of such floods and their social, economic, and environmental consequences, highlighting the role of ineffective waste management policies and infrastructure. Furthermore, it identifies key strategies to mitigate the impacts, including improving waste management systems, enhancing urban planning, and promoting public awareness. The findings emphasize the need for integrated approaches to address both waste disposal and flood prevention in urban settings.

**Keywords:** Urban floods, Indiscriminate waste disposal, Solid waste management, Drainage blockages, Flood risk, Environmental impact, Waste management policies



# **ASSESSMENT OF POST-STROKE NEUROCOGNITIVE DISORDERS IN PATIENTS ADMITTED TO THE SPECIALIZED HOSPITAL ESTABLISHMENT IN ANNABA-ALGERIA-**

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## **Abstract**

Post-stroke neurocognitive disorders, also known as cognitive dysfunction after a stroke, are alterations in mental functions that occur after a stroke. These disorders can manifest themselves in different ways, depending on the area of the brain affected and the extent of the damage. Symptoms can include difficulties with memory, concentration, reasoning, problem solving, as well as alterations in language and spatial perception. Our research is based on the study of patients with post-stroke neurocognitive disorders and treated at the polyclinic May 8, 1945 - Annaba, Algeria. By examining sociodemographic and socioeconomic data, cognitive disorders by applying an MMSE test to 20 people who are given collected at a staff office. We performed a one-month (between February 26 and March 26) cross-sectional descriptive statistical study, with a retrospective single-center analysis, on the registered cases of stroke.

We found a significant prevalence of ischemic stroke in the examined patients, compared to hemorrhagic stroke. The studied cohort highlights several crucial points, including the strong female predominance and the majority age group over 65 years. The predominant risk factors include arterial hypertension. In conclusion, our study highlights a wide range of cognitive impairments in patients with stroke, with memory disorders, agnosia, apraxia and sleep disorders, seriously impacting their quality of life.

**Keywords:** Ischemic stroke, Hemorrhagic stroke, Cognitive disorders, MMSE test, Risk factors.

**APPLICATION OF GEOMETRIC AVERAGE MODEL FOR IDENTIFYING HIGH MINERALIZATION ZONES USING GAMMA-RAY SPECTROMETRY DATA IN THE BOKE BAUXITE DISTRICT, REPUBLIC OF GUINEA**

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**Abstract**

The identification and delineation of zones with high mineralization potential are critical for discovering valuable mineral deposits. Various methodologies have been employed to pinpoint areas subjected to alteration processes, including the analysis of airborne gamma-ray spectrometry data, which has consistently produced accurate and reliable results. In this study, gamma-ray spectrometry was utilized for the first time in the Boke region of north-western Republic of Guinea, a renowned global bauxite district. Data were systematically collected, processed, and mapped to produce concentration maps for potassium (K), thorium (eTh), and uranium (eU). The generation of abundance ratios and the F parameter facilitated the identification of regions with elevated potassium concentrations, which serve as indicators of potential alteration zones associated with bauxite mineralization. The analytical results from the K/eU and K/eTh ratios, along with the F parameter and potassium concentration map, were integrated using geometric average model. This model synthesized the resulting informative maps into a comprehensive mineral prospectivity map, which is instrumental for guiding mineral exploration. The study identified three high-prospectivity areas: the Ordovician at Pita, the Silurian at Telimele, and the Devonian at Faro. Preliminary prospecting in these delineated regions suggests the presence of significant potential, warranting further advanced exploration.

**Keywords:** Gamma-Ray Spectrometry, Bauxite Mineralization, Potassium Concentration, Geometric average Model, Mineral Prospectivity Map

# **APPLICATION OF INNOVATIVE TECHNOLOGIES IN THE SYSTEM OF HABILITATION OF CHILDREN WITH PSYCHOLINGUISTIC DELAYED DEVELOPMENT**

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## **Abstract**

In recent years, Ukraine has seen an increase in the overall number of children with delayed psycholinguistic development. Early detection of medical and pedagogical risk factors for developmental disorders in children makes it possible to begin adequate rehabilitation activities promptly. For children with special needs to have optimal development conditions, they must systematically receive rehabilitation services in an inclusive environment; otherwise, the previously achieved progress may be lost, and the psycho-emotional state may deteriorate. Rehabilitation activities using computer gaming equipment can be very effective for children with different developmental delays since they combine the entertainment element of the game with scientifically based medical and pedagogical methods. This work aimed to develop an algorithm for rehabilitating children with delayed psycholinguistic development with differentiated use of the interactive system "BRYOLIGHT" based on a comprehensive study of the child's individual characteristics. It consists of the following modules:

- 1) Kinect system on a 65-inch LCD panel for developing gross motor skills.
- 2) Leap Motion system for developing fine motor skills.
- 3) Interactive floor and wall.
- 4) Interactive sandbox.
- 5) Interactive panel.
- 6) Speech therapy mirror

With the help of the above modules, it is possible to obtain a large number (more than 50) of interactive effects. But for their optimal use, first of all, it is necessary to study each child's individual needs at the evidentiary level. A typical comprehensive study consists of:

1. Diagnostics of the cognitive sphere

2. Diagnostics of the emotional-volitional sphere of the child
3. Diagnostics of speech skills
4. Evaluation of functional communication
5. Evaluation of speech perception

Special attention is paid to the examination of psycho-verbal development. The state of the articulatory apparatus, general characteristics of speech, the level of grammatical speech, the state of phonemic perception, and the state of sound speech are examined.

Based on the results of the comprehensive examination, an integral indicator of the child's functional state is formed with the identification of the features of functioning that require correction. The most effective modules for the use of the interactive system 'Bryolight' in this case and the corresponding practical methods for their implementation are determined.

**Keywords:** delayed psycholinguistic development, habilitation, interactive systems

**SYNTHESIS OF A NOVEL HETEROCYCLIC COMPOUNDS AS EFFICIENT  
INHIBITOR FOR CARBON STEEL CORROSION IN ACIDIC MEDIUMS:  
SURFACE MORPHOLOGY AND ELECTROCHEMICAL STUDIES**

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**Abstract**

The inhibition effectiveness of carbon steel (CS) in 1M HCl by C4-SHOP has been examined using electrochemical impedance spectroscopy (EIS), potentiodynamic polarization (PPD), and weight loss measurements at 298 K. The results indicate that the inhibition efficiency ( $\eta$  %) increases with the concentration of inhibitor C4-SHOP reaching maximum values of 85 % at the optimal concentration ( $5.10^{-3}$  M) according to PPD analysis. PPD results suggest that inhibitor C4-SHOP act as mixed-type inhibitors. Furthermore, the inhibitor follow the Langmuir adsorption isotherm for monolayer adsorption. Scanning electron microscopy (SEM) analysis of CS has also been conducted and discussed. Theoretical calculations and molecular dynamics (MD) simulations show good agreement with the experimental results for the inhibitor C4-SHOP under study.

**Keywords:** Corrosion, inhibitor, heterocyclic, organic, compound, carbon steel.

## COUNTING OF LATTICES HAVING NULLITY UP TO TWO

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### **Abstract**

In 2020 Bhavale and Waphare introduced the concept of a nullity of a poset as nullity of its cover graph. Recently, Bhavale proved that if a lattice of nullity  $k$  contains  $r$  reducible elements then  $2 \leq r \leq 2k$ . In 2003 Pawar and Waphare counted all non-isomorphic lattices with  $n$  elements having nullity one, containing exactly two reducible elements. Recently, Bhavale and Aware counted all non-isomorphic lattices on  $n$  elements having nullity two, containing up to three reducible elements. In this paper, we count up to isomorphism the class of all lattices on  $n$  elements, containing exactly four reducible elements. This covers counting of all non-isomorphic lattices on  $n$  elements having nullity up to two.

## **DETERMINANTS OF HEALTH BEHAVIORS AMONG POLISH RESIDENTS: THE ROLE OF ECONOMIC AND SOCIAL FACTORS**

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### **Abstract**

In recent years, many human populations have been subjected to prolonged, highly stressful conditions. These periods expose populations to a unique and unplanned biological-historical experiment. Such crises result in an increased and chronic sense of threat to health and life. These phenomena are often accompanied by profound social changes, a complete transformation of daily life, and significant economic and financial repercussions. Over the past half-century, Poland has undergone a series of substantial economic, social, and biological changes, which have had a noticeable impact on living conditions. The aim of this study was, and continues to be, the assessment of the direction and strength of relationships between social, economic, and environmental factors, and selected indicators of the biological well-being of the population. The study also focused on assessing changes over time in basic health behaviors among Poles and to what extent these changes were influenced by socioeconomic status and periods of crisis. The data for the analyses came from population studies of adult Polish men and women collected through various research projects. Health behaviors of Polish citizens, strongly linked to education levels, were found to be a key predictor of differences in the biological condition of the population. Persistent social gradients in numerous biological traits result from unequal living conditions experienced by individuals during different stages of development. Educational attainment continues to be a key determinant of these unequal living conditions in Poland. Therefore, less-educated social groups should be considered target groups for health promotion and health education programs.

**Keywords:** stress, Biological Well-Being, men, women, Poland

**THE EFFECT OF MANAGEMENT SYSTEM ON SOME HAEMATOLOGICAL  
PARAMETERS OF LAYER CHICKEN AT LABANA FARM, ALIERO, KEBBI  
STATE, NIGERIA**

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**Abstract**

Poultry Management refers to the husbandry practices that help to maximize the efficiency of production. This study was conducted to evaluate the effect of different management systems on the haematological parameters of layer chickens. Three systems: Battery Cage (BC), Deep Litter (DL) and Semi-Intensive (SI) were evaluated. Nine layer chickens, aged eight weeks, three from each system were randomly selected for blood sampling. Blood was collected from the wing vein, once a week for four weeks and analyzed using standard procedures, for haematological parameters (PCV, Hb and MCHC). It was observed that the blood parameters of the three systems were within the normal standard values. However, there were slight differences among the three systems. PCV of SI ( $23.67 \pm 1.90b$ ) was slightly higher than DL ( $23.17 \pm 2.35b$ ) and BC ( $21.92 \pm 4.98a$ ). Hb of DL ( $7.83 \pm 1.03a$ ) was higher than BC ( $7.70 \pm 1.03a$ ) and SI ( $7.67 \pm 0.01a$ ). MCHC of BC ( $33.60 \pm 0.97a$ ) was higher than DL ( $33.10 \pm 2.99b$ ) and SI ( $32.46 \pm 0.71a$ ). It was concluded that there was no significant association between the management systems and blood parameter range of layer chickens in Labana farm. Therefore, other factors such as risk of diseases, sanitation, costs, should be considered in deciding which system to adopt.

**Keyword:** Management System, Haematological Parameter, Layer Chickens, Labana Farm, Aliero.



## RESISTANCE STATUS OF ANOPHELES GAMBIAE (*sensu lato*) TO PYRETHROID INSECTICIDES IN ARGUNGU L. G. A., KEBBI STATE, NIGERIA

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### **Abstract**

The study was carried out to investigate the resistance status of *Anopheles gambiae* sl mosquitoes in five selected wards of Argungu LGA, Kebbi State Nigeria, against three pyrethroid insecticides (Deltamethrin, Alphacypermethrin and permethrin) with concentration of 12.5 µg/bottle each. Larvae and pupae of *Anopheles* mosquito were sampled from the selected wards and reared to adults in the Research Laboratory of the Department of Animal and Environmental Biology, Kebbi State University of Science and Technology, Aleiro, Nigeria. Emerged adults of 2 to 3 days old and non-blood fed were tested for resistance using CDC bottle bioassay susceptibility protocol. Results showed that the local mosquitoes were resistant to the two pyrethroid (Alphacypermethrin and permethrin), but were fully susceptible to Deltamethrin. To ascertain the level of resistance of mosquitoes, they were exposed to Alphacypermethrin and permethrin plus piperonyl butoxide (PBO) as a synergist test. The essence of synergist test was to cut the enzymatic influence that might have caused the resistance of mosquitoes against the insecticides. The intensity of resistance was tested by exposing the mosquitoes to x2, x5, and x10 concentrations. The level of resistance of mosquitoes was found to be so high against permethrin as mosquitoes from all the sampling sites were only susceptible (100% mortality) at x 10, but susceptible to Alphacypermethrin at X2 concentration. Based on the result of this study, future vector control programme should take into consideration the deployment of nets that are treated with Alphacypermethrin or Deltamethrin combined with PBO (PBO based nets) in the study area or increase the concentration of the two insecticides used in this study on long lasting nets after their safety to human is assured. Also, to reduce level of mosquito resistance against insecticides, arbitrary use of fertilizers must be controlled in addition to efforts in environmental sanitation in the study area.

**Keywords:** *Anopheles*, Mosquito, Insecticide, Resistance, Pyrethroid, Argungu

# **DEVELOPMENT AND IMPLEMENTATION OF AN INDEPENDENT INVENTORY MANAGEMENT SYSTEM: A CASE STUDY OF DAN AGGO PLAZA**

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## **Abstract**

Effective inventory management is crucial for any business, particularly in commercial settings where accurate stock control is essential. This study focuses on the inventory management issues at Dan Aggo Plaza, which currently relies on outdated manual systems. These issues include inaccurate stock levels, frequent item losses, and inefficiencies in inventory tracking, leading to higher operational costs and lower customer satisfaction. The study's primary goal is to design, develop, and implement a customized stand-alone inventory management system for Dan Aggo Plaza. This system aims to automate inventory tracking, provide real-time data, and improve stock accuracy, thereby reducing human error and enhancing efficiency. The research involves evaluating the plaza's current practices, developing an intuitive inventory system, and seamlessly integrating it into existing operations. Key features of the system include secure login, session management, and an easy-to-use interface. The system was evaluated based on improvements in inventory accuracy, efficiency, and user satisfaction, showing significant benefits in inventory control, cost reduction, and customer satisfaction. This study's findings are valuable not only for Dan Aggo Plaza but also for other businesses with similar challenges, emphasizing the importance of adopting modern technological solutions to optimize operations and support growth.

**Keywords:** Inventory Management, Stock Control, Automation, Real-time Data, Operational Efficiency, Technological Solutions

# CHAOTIC DYNAMICS OF CONFORMABLE MATURITY-STRUCTURED CELL POPULATION MODELS

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## **Abstract:**

This study aims to investigate the chaotic dynamics of a maturity-structured cell model described by a partial differential equation using conformable calculus, an extension of the classical Lasota equation. To analyze the chaotic behavior of the model, we first adapt certain linear chaos criteria within the conformable calculus framework. This adjustment is essential, as the solution generates a modified semigroup, known as a  $c_0$ - $z$ -semigroup, instead of the classical one. By applying the conformable extension of chaos, we effectively demonstrate the chaotic nature of the model's solution.

**Keywords:** Chaos; hypercyclicity; conformable fractional calculus; fractional partial differential equation;  $z$ -semigroup; fractional admissible weight function.

## **BUSINESSES AS CARRIERS OF ECONOMIC DEVELOPMENT AND LEGAL INFRASTRUCTURE - CASE STUDY IN KOSOVO**

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### **Abstract**

The purpose of the paper is to identify the impact of laws on the activity of businesses, as an important factor for the economy of the state. Businesses are the main bearers of economic development in each country, as well as in Kosovo, they contribute in various ways to the reduction of unemployment, the development of production, technological advancement, the distribution of investments, the strengthening of competition, the development of innovation, the growth of income per capita, the growth of the Gross Domestic Product (GDP) and the demographic development of the country, but not only. For this reason, supporting businesses with legal infrastructure is imperative. The strategic objective of local institutions should be the continuous improvement of the business development environment, identifying the areas that should be supported with economic/fiscal policies depending on the priorities set by the state. Kosovo has an economy in transition, research has identified several economic areas for legal support, such as the circular economy, entrepreneurship and innovation, agriculture and livestock, tourism and the labor market, care must always be taken to maintain the state-business balance. In this direction, the law-enforcement institutions, and especially the courts, have a big role, from the research carried out in Kosovo, unsatisfactory results have emerged, because there are delays in the treatment of court cases, there are few choices of disputes with extrajudicial methods, there are policy implications in justice, there is unequal treatment of the parties in the procedure, there is a lack of transparency as well as other cases that negatively affect business development trends, for this reason, this research aims to identify the areas needed for improvement. The research was carried out in the second quarter of 2024, the data collection method through the questionnaire was used in the research, some local institutional reports and some international reports were analyzed. Conclusions and recommendations are based on real facts and are useful for all stakeholders in the business field.

**Keywords:** Business, Law, Economic/Fiscal Policy, Circular Economy, Court, etc.

# **IMPACT OF ECONOMIC GROWTH AND FDI ON INCOME INEQUALITY IN INDIA: A STUDY OF THE WIDENING**

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## **Abstract**

In this research paper, the relationship between economic growth (GDP per capita Growth rate), FDI (Net FDI inflow % of GDP minus Net FDI outflow % of GDP), and income inequality (Gini Index) in India over the period from 1991-2019 is investigated by using the Autoregressive Distributed Lag (ARDL) model, with a specific focus on the period following economic liberalization. By analyzing data spanning nearly three decades, the findings reveal that while both Foreign Direct Investment (FDI) and GDP growth have accelerated at a rapid pace, their impact on income inequality has been minimal, with only a negligible decrease observed. Moreover, the analysis shows no significant long-term relationship between FDI and income inequality. These results suggest that despite the strong economic growth, the benefits have not been equitably distributed across the population, challenging the assumption that increased FDI and GDP growth automatically lead to a reduction in income inequality.

JEL: D31, E01, E21, O15, Q28

**KEYWORDS:** India, Income Inequality, Economic Growth, FDI.

# ASSESSING THE IMPACT OF GENDER INEQUALITY ON ECONOMIC DEVELOPMENT IN INDIA: A STUDY ON THE ECONOMIC CONSEQUENCES OF GENDER DISPARITY

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## **Abstract**

This study examines the impact of gender disparity on Economic growth. The research utilizes Gross Domestic Product Growth Rate (GDPG) as the dependent variable, with the Gender Inequality Index (GII), Gender Parity Index (GPI), as independent variables. Data for GDP and GPI were obtained from the World Bank Development Indicators, while GII data were sourced from the World Bank Open Data, covering the period from 1991 to 2022. A time series analysis was conducted using the Autoregressive Distributed Lag (ARDL) model to assess both short-term and long-term relationships among these variables. The findings reveal that in the short run, neither gender inequality in education nor GII has a statistically significant impact on economic growth. However, the long-run analysis tells a different story: GII shows a significant and negative impact on economic growth, underscoring the importance of addressing gender inequality as part of India's long-term economic strategy. This study highlights the critical need for sustained efforts to promote gender equality, to unlock India's full economic potential.

**Keywords:** Gender disparity, Labor force participation, Economic growth, female education

## LEVERAGING CHATGPT FOR EFFICIENT EVALUATION AND FEEDBACK IN THE EDUCATIONAL SETTING

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### **Abstract**

The integration of artificial intelligence (AI) into the education sector has evolved from utilizing information and communication technologies to enhance teaching and learning processes. In November 2022, the introduction of an AI-driven chatbot named ChatGPT marked a significant development. This chatbot has the capability to generate coherent and informative responses akin to those produced by humans in response to user inputs. ChatGPT demonstrates its versatility as a potential supporter of open education, offering assistance, guidance, and feedback to self-directed learners, thereby boosting their motivation and engagement. This paper aims to comprehensively examine the aforementioned aspects and explore the potential applications of ChatGPT in educational frameworks. Specifically, the objectives include advocating for the integration of ChatGPT in educational contexts and providing educators with a variety of methodologies and approaches to ensure the thoughtful and effective incorporation of ChatGPT in pedagogical or research endeavours. Through these efforts, the paper aims to stimulate an informed discussion about the utilization of ChatGPT in education. It outlines essential strategies and methodologies that should be concurrently employed when incorporating ChatGPT services in educational settings.

**Keywords:** AI in Education, ChatGPT, Educational Technology, Pedagogical Integration.

# **EXPERIMENTAL INVESTIGATIONS ON STRENGTH AND DURABILITY PROPERTIES OF BAMBOO AND STEEL FIBRE REINFORCED CONCRETE**

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## **Abstract**

In recent times, the high cost and general shortage of reinforcing steel in many parts of the world has led to increasing interest in the possible use of alternative locally available materials for the reinforcement of concrete. This is case especially in the developing countries where about 80% of population lives in villages. This has led to research on several non-ferrous reinforcing materials in structural concrete and also steel, cement, synthetic polymers and metal alloys used for construction activities are energy intensive as well as cause environmental pollution during their entire life cycle. In this context, use of bamboo which is fast growing and ecologically friendly material for structural applications especially in a tropical country like India is being considered as quite appropriate and also bamboo is a natural material which has great appeal in terms of availability and ease of use in the rural and farming communities in developing world. The study aims at exploring ways of making the use of bamboo as building material in reinforced concrete as simple, efficient and cost-effective for rural area construction. And our main aim is to study, compare the results of the compressive strength, split tensile strength, durability property of concrete mix of M30 grade that is plain cement concrete, wooden fiber reinforced concrete and steel fiber reinforced concrete with aspect ratio of 40 and varying fiber content percentage like 1%, 2%, 3% fiber content.

**Keywords:** Structures, Concretes, Water, Reinforcement, Life cycle, M30 grade and Bamboo



## **FOUR-LEGGED UNCONTROLLED INTERSECTION IMPROVEMENT IN AN URBAN AREA**

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### **Abstract**

Uncontrolled intersections can be a major source of traffic congestion, accidents, and delays. Without any traffic control devices, drivers may have difficulty navigating through the intersection safely and efficiently. This can result in confusion, frustration, and even collisions between vehicles or with pedestrians. To address these issues, it is often necessary to improve the intersection by adding traffic control measures such as traffic signals, road markings, and signs. One way to do this is by converting the uncontrolled intersection into a controlled intersection. In our research project mentioned above, the uncontrolled intersection was developed as a rotary and signalized intersection. A rotary, also known as a roundabout, is a type of intersection where traffic flows in a circular pattern around a central island. This design helps to slow down traffic and reduce the risk of collisions. By adding traffic signals, the flow of traffic can be regulated even further, providing additional safety and efficiency benefits. To evaluate the effectiveness of this approach, the capacity of the rotary and signalized intersection was compared. Capacity refers to the maximum number of vehicles that can pass through the intersection per unit of time, and is an important measure of intersection performance. This means that the improved intersection was able to accommodate more traffic.

**Keywords:** Road accidents, Experimental research, Excessive speed, Traffic calming and speed of vehicles

## UNLOCKING THE SECRETS OF HUMAN ANATOMY

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### **Abstract**

Human anatomy is a intricate and fascinating field that has captivated scientists and scholars for centuries. Despite significant advances in medical technology and research, the human body remains a mysterious entity, with many of its functions and processes still not fully understood. This article provides an in-depth exploration of human anatomy, examining the complex relationships between systems, organs, and tissues. We delve into the latest research and discoveries, uncovering the secrets of the human body, from the intricate neural networks of the brain to the remarkable regenerative properties of the skin. By analyzing the interplay between structure and function, we gain a deeper understanding of the incredible complexity and beauty of human anatomy. This knowledge has far-reaching implications for medical research, education, and practice, enabling us to develop new treatments, improve surgical techniques, and enhance our overall understanding of human health and disease.

**Keywords:** Human Anatomy, Systems Biology, Regenerative Medicine, Neuroanatomy, Medical Research, Anatomical Education

## A COMPARATIVE STUDY OF MULTI-OBJECTIVE SOLID TRANSPORTATION PROBLEM SOLUTIONS UNDER UNCERTAIN ENVIRONMENTS

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### **Abstract**

In this paper, we proposed the mathematical model of multi-objective multi-commodity solid transportation problem (MOMC-STP) using fuzzy parameters in uncertain environments. All fuzzy parameters are involved in this mathematical model is form of trapezoidal fuzzy number, and converted this mathematical model into crisp form using the  $\alpha$ -cut method. Then, the crisp mathematical model is solved to obtain the compromise solution using the fuzzy programming method (FPM), interactive fuzzy goal programming method (IFGPM) and Fermatean fuzzy programming method (FFPM) for the integer and non-integer solutions. At last, the results obtained, integer and non-integer, from the three approaches are compared. It is noticed that the solutions obtained by FPM and IFGPM are the same and FFPM more reliable and best approach to gives it better solution of the proposed problem.

**Keywords:** Solid transportation problem;  $\alpha$ -cut approach, Trapezoidal fuzzy number; Fuzzy programming; Interactive fuzzy goal programming.

## UNHEARD NARRATIVES OF PUBLIC SCHOOL TEACHERS' COFFEE CONSUMPTION

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### **Abstract**

Teachers are fundamental to the educational system. They have a pivotal role in shaping students' intellect by sharing knowledge and fostering critical thinking. Nevertheless, despite being perceived as resilient, autonomous, and purpose-driven individuals by those around them, they encounter struggles that impede their effectiveness due to overwhelming paperwork, classroom management issues, administrative responsibilities, and the nature of their work. As a result, one of the ways they cope to alleviate stress is by turning to coffee and making it a part of their routine. This phenomenology study explored the unheard narratives of public school teachers' frequency of coffee consumption, motivation, and impact on their daily routine. Ten (10) key informants were selected using purposive sampling to participate in the study. A structured interview guide was used to gather information from the participants regarding the study's inquiries, and a Focus Group Discussion (FGD) was implemented as an approach to data collection. Using Colaizzi's approach, themes emerged after the data analysis. The study revealed that the aroma, antioxidants, and warm feelings were the themes that drove teachers to consume coffee. Also, coffee provides an extra boost of energy, a brighter mood, and a sense of fulfillment as it is perceived to contribute to the daily routine of teachers. It is concluded that coffee secures a spot in the daily habits of teachers as it gives them the alertness and activeness needed to begin their day effectively.

**Keywords:** Coffee, Public School Teacher, Motivation, Daily Routine, Phenomenology

## A NOVEL APPROACH TO CHROMIUM POLLUTION CONTROL: MAGNETITE/CARBON QUANTUM DOTS

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### **Abstract**

Magnetic carbon dots (Fe<sub>2</sub>O<sub>3</sub>/N-CQDs) were synthesized using a green and efficient microwave process from sugarcane bagasse. These magnetic carbon dots effectively removed and reduced hexavalent chromium (Cr(VI)) from wastewater. Compared to carbon dots without iron oxide (N-CQDs), Fe<sub>2</sub>O<sub>3</sub>/N-CQDs exhibited superior Cr(VI) removal (93.86% vs. 91.73%) and reduction capabilities. FTIR analysis confirmed the presence of magnetic iron oxide (Fe-O) within the N-CQDs, while XRD analysis interestingly revealed the presence of elemental iron (Fe(0)) alongside the iron oxide. Additionally, TGA/DTG analysis showed a significantly higher weight residue ( $\Sigma$ RW) for Fe<sub>2</sub>O<sub>3</sub>/N-CQDs compared to N-CQDs alone, suggesting enhanced thermal stability due to the Fe<sub>2</sub>O<sub>3</sub> component. Furthermore, Fe<sub>2</sub>O<sub>3</sub>/N-CQDs exhibited enhanced fluorescence compared to N-CQDs, suggesting their potential as promising chemosensors for future applications. In summary, this study successfully developed magnetic carbon dots with excellent Cr(VI) removal and reduction properties, demonstrating their potential for environmental remediation and sensing applications. The incorporation of Fe<sub>2</sub>O<sub>3</sub> into the carbon dots not only enhanced their removal and reduction efficiency but also improved their thermal stability and fluorescence properties. These findings highlight the potential of magnetic carbon dots as versatile and effective materials for various environmental and sensing applications.

**Keywords:** Magnetite/Carbon Quantum Dots, Microwave Synthesis, Chromium Removal, Fluorescence Enhancement, Water Treatment.

# **POLYMERIC MEMBRANES FOR DESALINATION USING MEMBRANE DISTILLATION: A REVIEW**

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## **Abstract**

Membrane distillation (MD) is considered an emerging technology for seawater desalination. The hydrophobic polymers commonly used for this process are polytetrafluoroethylene (PTFE), polyvinylidene fluoride (PVDF), and polypropylene (PP). An ideal membrane for MD should exhibit characteristics such as high liquid entry pressure, low fouling rate, high permeability, and excellent mechanical resistance. Polymeric membranes, being more cost-effective than ceramic membranes, are considered a more affordable alternative and have dominated the research conducted so far on membrane distillation (MD). This review aims to provide a brief introduction to MD, summarize the research efforts to achieve the desired properties in polymeric membranes used in MD for desalination purposes and focus on the fabrication methods for these membranes .

**Keywords:** Membrane distillation, direct contact membrane distillation DCMD, desalination, polymeric membranes

**INHIBITION OF THE JANUS KINASE PROTEIN (jak1) BY THE A. PYRETHRUM ROOT EXTRACT FOR THE TREATMENT OF VITILIGO PATHOLOGY. DESIGN, MOLECULAR DOCKING, ADME-TOX, MD SIMULATION AND IN-SILICO INVESTIGATION**

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**Abstract**

This study focuses on the therapeutic efficacy of A. pyrethrum in the treatment of vitiligo, a chronic inflammatory disorder that is known to cause psychological distress and increase susceptibility to autoimmune diseases. In particular, JAK inhibitors have emerged as promising candidates for the treatment of immune dermatoses, including vitiligo. Our investigation focuses primarily on the anti-vitiligo potential of A. pyrethrum root extract, specifically targeting N-alkyl amides. Computational methods were used to apply Density Functional Theory (DFT), which is used to meticulously scrutinize molecular properties, while

comprehensive ADME-Tox evaluations for each molecule contribute to a nuanced understanding of their therapeutic viability. Remarkable drug-like properties are revealed. Molecular docking analysis probes ligand interactions with the JAK1 key site, with all compounds showing significant interactions. In particular, molecule 6 shows the most interactions with key inhibitory residues. Molecular dynamics simulations over 500 ns further confirm the importance and sustainability of these interactions observed in molecular docking, favoring DFT and electrostatic potential (ESP) results obtained with subtle differences. Both molecules 6 and 1 in terms of energy; however, in terms of stability, the complex with molecule 6 outperforms the others. The distribution of electron-rich oxygen atoms and electron-poor regions within the heteroatom-bonded hydrogens is elucidated by DFT analyses. Remarkably, the N-alkyl amides extracted from *A. pyrethrum* roots have similar compositions. Comparable DFT and electrostatic potential (ESP) results are obtained with subtle differences. These results highlight the considerable potential of *A. pyrethrum* root extracts as a natural remedy for the treatment of vitiligo.

**Keywords:** *A. pyrethrum*, N-alkyl-amides, JAK1, DFT, ADME-Tox, and Molecular docking



## THE ROLE OF THE INDONESIAN PAWN CENTER (pgi) IN IMPROVING THE COMMUNITY'S ECONOMY

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### **Abstract**

This research aims to assess the role of the Indonesian Pawn Center in improving the community's economy, with a focus on the economic and social impacts resulting from the pawn services provided. The research method involved secondary data analysis from the Indonesian Pawn Center's annual report as well as a survey of 200 borrowers at several main branches. The research results show that pawn services have provided easier access to credit for low-income people, increased capital for small businesses, and contributed to increased income and social welfare. In conclusion, the Indonesian Pawn Center plays a significant role in strengthening the community's economy by providing affordable and inclusive financing alternatives.

**Keywords:** Indonesian Pawn Center, community economy, pawn services, credit access, increasing income.

## **EFFECTS OF WATER STRESS ON AGRONOMIC AND PHYSIOLOGICAL PARAMETERS IN CHILI CROPS**

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### **Abstract**

Water stress is an essential abiotic element influencing chili crop development and yield (*Capsicum* spp.). This review provides insights into how these stress factors affect growth, production, and quality by examining chili plants' physiological and agronomic responses under water stress. Changes in photosynthesis, stomatal conductance, osmotic adjustment, and reactive oxygen species (ROS) metabolism are among the physiological reactions to water stress. Water stress has an agronomic impact on fruit quality, output, and plant water use efficiency. It is imperative to comprehend these reactions to create measures to reduce the negative consequences of water stress by breeding, agronomic practices, and technological interventions.

**Keywords;** Water stress, drought tolerance, yield reduction, water use efficiency, stress adaptation.

## **SETTING UP OF SOLAR TUBEWELLS IN WATERLOGGED AREAS OF DISTRICT T.T. SINGH, PUNJAB, PAKISTAN**

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### **Abstract**

This project addresses the critical issue of waterlogging in T.T. Sing, Punjab, Pakistan, through the deployment of solar-powered tubewells. The study area is strategically located between the Haveli irrigation canal and the Trimu-Sidhnai link canal, with the former being lined and the latter unlined, influencing the area's hydrology. The primary objectives are to lower the water table to reclaim soil, utilize the pumped water for irrigating nearby areas, and reduce carbon emissions by converting existing electric and diesel tubewells to solar energy. To date, 39 solar tubewells have been installed, including 37 units with a capacity of 7.68 KW and 2 units with a capacity of 5.54 KW, each with a delivery pipe discharge of 4-5 inches. By transitioning from diesel/electric to solar, the project has achieved an annual reduction of approximately 156.42 tons of CO<sub>2</sub> emissions, translating to a cumulative carbon sequestration of 469.26 tons over the project's duration. In terms of economic benefits, the annual carbon balance and carbon budget have shown significant savings. Assuming a carbon credit market price of \$76 per ton of CO<sub>2</sub>, the project results in annual savings of \$11,891.92 and cumulative savings of \$35,675.76 over three years. This initiative not only offers a sustainable solution to water management in agricultural zones but also significantly contributes to carbon budgeting and reduction efforts, exemplifying the integration of renewable energy into agricultural practices.

**Keywords:** Solar Tubewells, Waterlogging, Carbon Emissions, Diesel to Solar Conversion, Carbon Budgeting, Sustainable Agriculture.

## **PROMOTION OF GRAM CULTIVATION THROUGH SMART CLIMATE AGRICULTURE TECHNOLOGIES IN THE THAL AREA OF PUNJAB, PAKISTAN**

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### **Abstract**

This project aims to enhance gram cultivation in the Thal region of Punjab, Pakistan, utilizing smart climate agriculture technology. The Thal region, spanning the districts of Jhang, Mianwali, Bhakkar, and Khushab, is characterized by hot summers, mild winters, and an average annual rainfall of 300-400 mm. Despite its fertile soil, the region faces challenges such as limited rainfall and sandy dune terrain, which hinder optimal yields. Under natural rainfall conditions, average gram production in the Thal region is about 400 kg per acre. Without sufficient rainfall, production can drop significantly to less than 50 kg per acre. To address these challenges, we installed portable and semi-portable sprinkler irrigation systems powered by 10.4 kW tier-I solar systems, covering 1500 acres. This intervention led to a 1.4-fold increase in gram production compared to the regional average under natural rainfall conditions.

#### **Yield Improvements:**

Average gram production per acre with natural rainfall in the Thal region: 400 kg/acre (source: Pakistan Agricultural Research Council)

Average gram production per acre with sprinkler irrigation: 550 kg/acre

Total yield improvement per acre: 550 kg - 400 kg = 150 kg

Total yield increase: 550 kg/acre x 1500 acres = 825,000 kg

#### **Economic Gains:**

Net income gain: PKR 82,500,000 (PKR 100/kg x 825,000 kg)

Gross income gain: PKR 123,750,000 (PKR 150/kg x 825,000 kg)

#### **Environmental Impacts:**

Reduced carbon emissions: 1,500 tons CO<sub>2</sub> equivalent per year, achieved by replacing diesel irrigation with solar power.

Annual carbon balance: With a carbon credit market price of \$76 per ton of CO<sub>2</sub>, the annual economic value of reduced emissions is \$114,000 (1,500 tons x \$76/ton).

Soil conservation: Reduction in soil erosion and degradation due to controlled irrigation practices.

**Keywords:** Gram Cultivation, Smart Climate Agriculture, Solar Irrigation, Thal Region, Water Conservation, Carbon Emissions, Soil Conservation, Agricultural Productivity.

# **ASSESSING THE PSYCHOMETRIC PROPERTIES OF THE PERCEIVED STRESS SCALE FOR TEACHERS IN MOROCCO**

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## **Abstract**

Teachers frequently endure significant emotional and physical stress, which can lead to various challenges both in their professional and personal lives. This study seeks to assess the psychometric properties of the Perceived Stress Scale (PSS) among teachers in Morocco. The sample includes 544 teachers from public schools in Morocco. Statistical analysis of the PSS revealed that Bartlett's test yielded significant results, indicating that the correlations between variables were suitable for factor analysis. The quality of the extraction values was favorable, suggesting that the items were well-represented by the extracted components. High item loadings on the primary component show that all items substantially contribute to measuring perceived stress. Furthermore, the scale demonstrated excellent reliability, reflecting a high level of internal consistency among the items.

**Keywords:** Perceived Stress Scale, teachers, Morocco, psychometric properties,

# THE EVALUATION OF THE SOCIAL FUNCTIONING OF SCHIZOPHRENIA PATIENTS FOLLOWED UP IN THE HEALTH CENTER MY EL HASSAN OF KENITRA, MOROCCO

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**Aboubaker El HESSNI**

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## **Abstract**

Background Difficulties in interacting in and adapting to the social world are the central complaint faced by patients with schizophrenia. These people are often socially isolated, unemployed and may find it difficult to live independently. Aim this study aims to evaluate the social functioning of schizophrenic patients and to highlight the various factors associated with the alteration of the social functioning of schizophrenic patients. Methods We conducted a prospective descriptive and analytical study of a population of 72 patients with schizophrenia. These are patients between 19 and 59 years old, clinically stabilized, diagnosed, and followed at the My EL Hassan health center in Kenitra (Morocco). Symptom assessment is measured using a standardized Positive and Negative Syndrome Scale (PANSS), and social functioning is assessed using a Social Functioning Questionnaire (SFQ). Results Statistical analysis shows that of 72 schizophrenic patients, 33.3% had good social functioning, 59.7% had moderate social functioning, while 6.9% of patients had altered social functioning (the average score of all SFQ items less than 2.4). 6.9% with altered social functioning, are patients aged 19 to 49, were male ( $p < 0.35$ ), come from urban areas ( $p < 0.17$ ), without professional activity ( $p < 0.00$ ), and have a progressive onset of the disease ( $p < 0.31$ ). 5.5% ( $n=4$ ) of them were single ( $p < 0.12$ ), caught this disease at an age greater than or equal to 20 years, and have the mixed type of symptoms (positive/negative) ( $p < 0.15$ ). The altered social functioning of our patients is correlated to five factors: professional activity ( $p < 0.00$ ), family situation ( $p < 0.03$ ), family care ( $p < 0.02$ ), family awareness ( $p < 0.01$ ), and the negative subtype of psychotic symptomatology ( $p < 0.02$ ). Conclusion this study underlines the interest in psychosocial treatment as specific care, which would complement symptomatic treatment and improve the social functioning of patients with schizophrenia.

**Keywords:** Schizophrenia, Social functioning, Quality of life, Social interactions, SFQ

# THEORETICAL ANALYSIS OF MIXED CONVECTIVE RAREFIED GAS FLOW IN A VERTICAL MICROCHANNEL WITH FLOW REVERSAL AND CUBIC DENSITY-TEMPERATURE VARIATION

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## **Abstract**

This article investigates the role of cubic density-temperature variation on mixed convection flow in a vertical microchannel with wall porosity. Unlike in previous studies where the quadratic Boussinesq approximation is employed, in this current article, the Boussinesq approximation (C.B.A) in the buoyancy term is introduced to the momentum equation and solved analytically by method of undetermined coefficients. A comparative study between the quadratic Boussinesq approximation (Q.B.A) and the proposed model is carried out. Results show that the role of C.B.A is to decrease fluid velocity as well as skin-friction. In fact, the skin-friction at the microchannel walls would have been inaccurately computed should the C.B.A had not been considered. In addition, the interval of no-reverse flow formation at the walls is decreased due to the inclusion of C.B.A.

**Keywords:** Mixed convection flow; rarefied gas; microchannel; flow reversal; cubic density-temperature variation.



## **A FOTV MODEL BASED-BILEVEL APPROACH FOR NOISE REMOVAL**

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### **Abstract**

In this study, we propose a novel approach to image denoising using a bilevel framework that incorporates fractional order derivatives. The key innovation is the formulation of a bilevel problem that integrates total fractional order variations. To evaluate the performance of our method, we carry out numerical experiments on images with different characteristics and varying noise levels. We highlight the sensitivity of fractional order derivatives using established metrics. Our numerical results show that the proposed approach outperforms existing models in terms of efficiency and robustness against noise.

**Keywords:** Bilevel; Image denoising; fractional derivative; descent gradient.

# **THE INFLUENCE OF SERVICE QUALITY ON UNIVERSITY BRAND EQUITY: INSIGHTS FROM STUDENTS' PERCEPTIONS**

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## **Abstract**

This study investigates the influence of service quality dimensions on the brand equity of selected universities and examines how overall service quality contributes to brand equity. A survey was conducted with 400 students from two university campuses in Delhi NCR, using the SERVPERF scale for measurement. The data were analyzed through inferential statistical methods, particularly multiple regression analysis, with SPSS. The results show that Tangibles and Empathy are key positive factors shaping students' views of their institution's brand equity, with overall service quality playing a vital role in predicting brand equity.

## **NANO-ENCAPSULATION: PROBING QUATERTHIOPHENE WITH INFRARED SPECTROSCOPY IN SWCNTS.**

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### **Abstract**

By integrating molecular dynamics (MD) and density functional theory (DFT), we explore the Infrared (IR) spectra of hybrids formed by single-walled carbon nanotubes (SWCNTs) encapsulating the quaterthiophene molecule (4T). We calculate the IR spectra for both SWCNTs and the 4T molecule before and after encapsulation. A detailed analysis of the nanoconfinement effect on the IR spectra reveals significant modifications in the intermolecular interactions between 4T and SWCNTs in the hybrid systems (4T@SWCNTs), particularly with optimized diameters. Notably, the most pronounced changes are observed in the low-wavenumber range, and our calculations indicate a potential charge transfer from the SWCNTs to the confined 4T. These findings provide valuable insights for interpreting the experimental IR spectra of these hybrids.

**Keywords:**SWCNT ,DFT study; Infrared (IR) spectra

## **ACUTE AND SUBACUTE TOXICITY OF ETHANOLIC EXTRACT OF ROSMARINUS OFFICINALIS IN FEMALE WISTAR RATS**

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### **Abstract**

Rosmarinus officinalis (Rosemary), an aromatic plant rich in phenolic antioxidant compounds, is widely used in traditional medicine by Moroccan population. The aim of this study was to assess the acute and subacute oral toxicity of ethanolic extract of Rosmarinus officinalis in Wistar rats. In the acute toxicity study, 30 rats were divided into 5 groups (control, 1000 mg/kg, 2500mg/kg, 3500 mg/kg, and 5000 mg/kg dose). Similarly, in the subacute toxicity study, 30 rats were divided into 5 groups (control, 200mg/kg, 300mg/kg, 500mg/kg and 1000mg/kg dose). The sub-acute toxicity study aimed to identify the NOAEL dose, by following the same signs of toxicity, hematological parameters, biochemical parameters, markers of oxidative stress, and histological analyses were evaluated. The results showed that no significant differences were observed in acute and sub-acute toxicity parameters (body weight, food, water), nor acute toxicity was any mortality observed, suggesting that the LD50 is greater than 5000 mg/kg. The sub-acute toxicity study showed no significant differences in hematological, biochemical, and histological parameters, while the extract increased CAT levels and decreased NO in the liver and kidney. These results indicate that the extract is non-toxic up to the doses tested. plant extract exerts antioxidant activity, manifested by a decrease in nitric oxide levels and an increase in the level of the antioxidant enzyme catalase (CAT) in the liver and kidneys

**Keywords:** Rosmarinus officinalis, hematological analysis, acute and subacute toxicity, catalase (CAT), nitric oxide (NO)

## **ASSESSMENT OF FAMILY SUPPORTING FOR MOROCCAN PRIMARY SCHOOL STUDENTS WITH AUTISM**

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### **Abstract**

Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by deficits in social communication and by repetitive and restricted behaviors and interests. This diagnosis results in major changes for all family members and in the child's school career. The current study aims to assess the state of autistic primary school students and their family support in the province of Sale, Morocco. 102 children attending a special class in primary school. Recruitment was done in partnership with the teachers from the delegation of Sale as well as a consent offering services to families with a child with ASD. Participants all completed a questionnaire with sociodemographic questions, as well as five self-assessment scales including situational instructions and adapted for parents of children with ASD. The results do not indicate any significant difference in the mothers' quality of life and the child's academic level. However, the areas least affected are professional activities and relationships for mothers whose child attends primary school and personal development, as well as relationships with the young person for those whose child attends school. Thus, it would be beneficial to develop family support for stress and emotion management, correction of dysfunctional cognitions and problem solving. Family support enhances parents to assess their autistic children, help them to better insert in the society by solving problems and adjusting coping strategies used.

**Keywords :** Autism, primary school students, life quality, mother, Sale, Morocco.

## **ECONOMIC MIGRATION AND FACING THE COMMUNIST GOVERNMENT IN THE DIASPORA (1961-1990)**

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### **Abstract**

Albanian patriotic colonies (Albanian economic diaspora) in various countries around the world played a significant role in the Albanian National Movement and in shaping events in Albania. However, they were also constantly targeted by the interference of foreign state agencies. On the other hand, as scholar Robert Pichler points out, most of the migrant workers had different stances on political issues compared to political emigrants. They had a different approach to the political system, although most were critical of it. These differences between the two groups would lead to controversies and conflicts among them, as well as attempts to unify their positions. The same author, referring to reports between economic and political emigration from Yugoslavia, distinguished between emigrations in Western Europe and those across the Atlantic. He emphasizes that in Europe, the discovery and influence of the Yugoslav government over emigration were stronger, making relations between labor migrants and political emigrants more covert. Meanwhile, in countries across the Atlantic, a stronger reference occurred between radical nationalist circles and economic migrants. He highlights as a factor for these dynamics the influence of churches and respective religious institutions, which were outside the influence of the Yugoslav communist regime. However, he notes that for the Albanian case, the influence of churches was weaker compared to homologous institutions among emigrants from other nationalities. Thus, according to him, Albanian nationalist groups like the Ballists and Zogists developed a relatively lesser and less structured influence compared to their Serb, Croatian, etc., counterparts. This gap was filled by ideologically leftist groups, among which the most notable was the "People's Movement of Kosovo." Another cause for the vitality of these groups was the "distorted perception they had of the mother state."

**Keywords:** migrants, economic diaspora, radical movements, political parties

# STATISTICAL INSIGHTS INTO THE VALIDITY AND RELIABILITY OF THE PERCEIVED STRESS SCALE FOR MOROCCAN TEACHERS

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## **Abstract**

Teachers frequently endure significant emotional and physical stress, which can lead to various challenges both in their professional and personal lives. This study seeks to assess the psychometric properties of the Perceived Stress Scale (PSS) among teachers in Morocco. The sample includes 544 teachers from public schools in Morocco. Statistical analysis of the PSS revealed that Bartlett's test yielded significant results, indicating that the correlations between variables were suitable for factor analysis. The quality of the extraction values was favorable, suggesting that the items were well-represented by the extracted components. High item loadings on the primary component show that all items substantially contribute to measuring perceived stress. Furthermore, the scale demonstrated excellent reliability, reflecting a high level of internal consistency among the items.

**Keywords:** Perceived Stress Scale, teachers, Morocco, psychometric properties,

## INFLUENCE OF SEASONAL FEEDING PRACTICES ON THE REPRODUCTIVE CYCLES OF FEMALE CAMELS

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### **Abstract**

This study assessed the effects of seasonal feeding practices on the reproductive cycles of female camels by comparing two dietary regimens across different seasonal conditions. A total of 120 female camels were monitored over a year, divided into two groups: one group fed a diet based on local seasonal forage and another group receiving a supplemented diet. Results indicated that camels on seasonal forage had an average estrous cycle length of  $28.5 \pm 1.2$  days, while those on supplemented diets had a shorter cycle length of  $27.0 \pm 0.8$  days ( $p < 0.05$ ). Conception rates were significantly higher in the supplemented diet group at 80% (48/60) compared to 65% (39/60) in the seasonal forage group ( $p < 0.01$ ). Additionally, camels on supplemented diets experienced a 15% reduction in anestrus and a 10% decrease in reproductive disorders. Seasonal variations caused a 20% drop in conception rates during the dry season among the seasonal forage group. These findings underscore the substantial impact of nutritional management on reproductive efficiency in female camels, and the seasonal feeding practices significantly impact the reproductive cycles of female camels. Supplemented diets lead to more consistent estrous cycle lengths and higher conception rates, highlighting the importance of nutritional management in optimizing reproductive performance. Future studies should explore specific dietary components that contribute to these improvements and their long-term effects on camel reproduction.

**Keywords:** Seasonal feeding practices, female camels, estrous cycle, conception rates, nutritional management, reproductive disorders.



## **PROFESSIONAL RISK MAPPING IN THE INTENSIVE CARE UNIT OF HASSAN II HOSPITAL IN SETTAT, MOROCCO.**

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### **Abstract**

The intensive care unit (ICU) is a highly specialized and often stressful hospital environment, where rapid and accurate decision-making is essential. However, this setting also entails significant occupational hazards for healthcare professionals, particularly in terms of exposure to pathogens, excessive workload, and emotional pressure. Managing these risks effectively is crucial to ensuring patient safety and staff well-being. The main aim of this study is to identify, assess, and map the specific occupational risks associated with the intensive care unit, focusing on their influence on the safety of patients and healthcare professionals. In the context of action research, the aim of the study is to develop specific risk management strategies and evaluate their effectiveness in improving the safety and quality of care in the ICU. This research problem poses essential questions about how to improve occupational risk management in a particular intensive care setting such as the ICU, taking into account the specific challenges faced by healthcare staff and the demands of patient safety. It also provides an opportunity to explore new approaches to risk mapping and intervention, with considerable potential to influence clinical practice and care safety. The tool used to conduct this action research is FMEA, or Failure Mode, Effect, and Criticality Analysis, a methodical approach used to identify, analyze, and evaluate potential failures in a product, process, or system. The aim of this method is to prevent failures by identifying the types of failure, and assessing the consequences of these failures and their importance, which is characterized by the frequency of occurrence, the severity of the effects, and the detectability of the failures. By taking the crisis situation into account, it is possible to prioritize the corrective measures required to reduce the most significant risks.

**Keywords:** ICU; FMEA; Occupational risks; Health workers.

# IDENTIFICATION AND APPLICATION OF DRYWOOD TERMITE (*Cryptotermes cavifrons* Banks) GUT MICROBIOTA FOR PLASTICS BIODEGRADATION

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## **Abstract**

Plastic has recently become the focus of global attention due to high accumulation in the environment which consequently threatens man and the ecosystem. This research identified drywood termites' gut microbiota and explored their potential for plastic biodegradation. Termite samples were collected from dead and decaying woods and polythene bags from disposal sites around Dutse, Jigawa state, Nigeria. Homogenized termite's guts were cultured on Nutrient agar, incubated at 37 °C for 24 hours and biochemical tests performed on different isolates. Two plastic categories; high-density polyethylene (HDPE) and low-density polyethylene (LDPE) were cut into pieces, weighed and aseptically transferred into prepared nutrient broth with  $1.0 \times 10^5$ ,  $1.0 \times 10^4$ ,  $1.0 \times 10^3$ ,  $1.0 \times 10^2$  and  $1.0 \times 10^1$  microbial cultures while another treatment without microbes was maintained as control and plastic percentage weight loss was calculated after 30 days. Analysis of variance and Student T-test were used to test the difference among and between treatments. Three bacterial species capable of degrading plastics were identified viz; *Bacillus cereus*, *Enterobacter hormaechei* and *Pseudomonas aeruginosa*. The control treatment had the lowest percentage weight loss of  $1.38 \pm 0.81\%$  while in *Bacillus cereus*, the highest was  $17.24 \pm 7.31\%$  in  $1.0 \times 10^5$  LDPE treatment, *Enterobacter hormaechei* had the highest efficacy of  $11.40 \pm 2.31\%$  in  $1.0 \times 10^5$  LDPE and *Pseudomonas aeruginosa* had the highest efficacy of  $5.01 \pm 3.15\%$  in  $1.0 \times 10^4$  LDPE with a significant difference ( $P < 0.05$ ) among treatments. Identified bacterial strains were more efficient on LDPE with *Bacillus* and *Enterobacter* having a linear relationship with it, giving an auspicious indication and possibility of their use in plastic clean-up.

**Keywords:** Plastic; Drywood termite; Gut microbiota; Biodegradation

## ANTI-INFLAMMATORY AND ANALGESIC PROPERTIES OF BASIL (*Ocimum basilicum*) OIL IN RHEUMATOID ARTHRITIS TREATMENT

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### **Abstract**

Rheumatoid arthritis (RA) is a long-term disease in which the immune system attacks the joints, causing pain, swelling, and damage over time. While conventional treatment can help, it often has side effects when used for too long. This led people to search for natural remedies like basil oil (*Ocimum basilicum*). Basil oil contains natural compounds such as eugenol, linalool, and methyl chavicol, which reduce inflammation and pain. These compounds work by blocking chemicals in the body such as TNF- $\alpha$ , IL-1, and IL-6 that cause inflammation in RA. They also reduce the production of other substances called prostaglandins, which are involved in pain and swelling. Basil oil's antioxidants help fight free radicals that can make inflammation worse. Basil oil may also relieve pain by affecting pain receptors, including TRPV1 and opioid receptors, and reducing inflammation in nerves by reducing the release of certain pain-causing substances. Basil oil is generally safe when applied to the skin in a diluted form, but it can cause skin irritation in some people. Another compound in basil oil, estragole, can cause harm if used in large amounts, although this is rare when used topically. Basil oil has the potential to help reduce pain and inflammation in rheumatoid arthritis (RA), making it a possible natural adjunct to standard treatment. However, more research is needed to confirm its safety and effectiveness, especially in human trials. Although generally safe when used properly, some side effects such as skin irritation may occur. The long-term effects of basil oil are still unclear. Further studies are needed to fully explore its benefits in the treatment of RA.

**Keywords:** Rheumatoid arthritis, Basil oil, Anti-inflammatory, Analgesic, Eugenol, Cytokines, Complementary therapy

# **PSYCHOLOGICAL ASSESSMENT OF SOCIAL SUPPORT IN PATIENTS WITH PERSISTENT CHRONIC DISEASE FOLLOWED UP AT PROVINCIAL HOSPITAL OF KENITRA, MOROCCO**

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## **Abstract**

Current research is expanding our understanding of the influences of social support on health. Many epidemiological studies have focused on further linking measures of social support to physical health outcomes. A few studies are now moving into new areas, such as focusing on health links with the receipt and provision of support. Researchers are also interested in highlighting relevant pathways, including potential biological (i.e., inflammation) and behavioral (i.e., health behaviors) mechanisms. Interventions to apply basic research on the positive effects of social support are also widespread. Although the long-term effects of such interventions on physical health remain to be determined, these interventions hold promise for influencing quality of life in many populations with chronic disease. A total of 170 patients with chronic disease at El-Idrissi Hospital, with a mean age of 51.51 years were included. Participants responded to the Questionnaire of Sociodemographic Variables (Q-SV), SF-36 Health-Related Quality of Life Scale–version 1.1, and MOS-SSS. This study involved 38.1% of patients with heart disease, 36.9% with diabetes and 25% with respiratory insufficiency. The mean total score of availability is  $11.37 \pm 0.56$ , with a minimum of 6 people on whom the subjects can rely and a maximum of 27 people on whom the patients can trust. the median is 11 people. the calculation of percentiles allows to define the limits of which we have no idea. furthermore, 25% of the subjects declared to have been supported by less than 7 people; 50% between 7 and 12 people and 25% declared to have been supported by more than 12 people.

**Keywords:** social support, emotional support, physical health, well-being, Kenitra, Morocco.

## **EPIDEMIOLOGICAL PROFILE OF BACTERIAL MENINGITIS IN CHILDREN UNDER 12 YEARS OF AGE IN THE KENITRA REGION, MOROCCO**

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### **Abstract**

**Abstract Introduction:** Bacterial meningitis in children, constitutes a serious public health problem in Morocco. The aim of this work was to describe the epidemiological, bacteriological and evolutionary profile of bacterial meningitis in patients admitted to the Cherif Idrissi Hospital of kenitra. **Methods:** This is a retrospective study of children with meningitis with an average age of less than  $5.55 \pm 0.25$  years (minimum= 1 year and less; maximum= 12 years), from 2010 to 2018. **Results:** We collected 200 cases. The median age was 6 years, with a male predominance. The main germs isolated were Neisseria meningitidis (25%) and Streptococcus pneumoniae (33.5%). The case fatality rate was estimated at 8%. The results of our study have confirmed the important lethality of meningitis. Therefore, the health authorities must organize diagnosis and treatment campaigns especially in the environment at risk and make sure to carry out epidemiological studies around each case, and chemoprophylaxis for contacts, in order to reduce the mortality rate related to this pathology, without forgetting the fight against meningitis in an endemic country like ours.

**Keywords:** Epidemiology, Bacterial Meningitis, Neisseria Meningitides, Streptococcus Pneumonia, Kenitra Hospital, Morocco.

# EXISTENCE RESULTS FOR SOME DEGENERATE NONLINEAR ELLIPTIC EQUATIONS IN WEIGHTED ANISOTROPIC SOBOLEV SPACE

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## **Abstract**

In this article we establish some properties and Lemmas in weighted anisotropic Sobolev spaces. As an application, we study the following strongly and non-coercive elliptic problem  $Au + g(x,u,\nabla u) = f$  in  $\Omega, u = 0$  on  $\partial\Omega$ .

where the data  $f(x)$  is assumed to be in  $L^1(\Omega)$ . We prove both the existence and regularity of renormalized solutions for our elliptic equation in anisotropic weighted Sobolev space  $W_0^{(1,p^{\vec{\alpha}})}(\Omega, \omega^{\vec{\alpha}})$ .

**Keywords:** Anisotropic weighted Sobolev spaces, strongly nonlinear equation, renormalized solutions.

## A REVIEW ON PHARMACOLOGICAL ACTIVITIES OF CARICA PAPAYA LINN

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### **Abstract**

Papaya (*Carica papaya* L) belongs to plantae kingdom and family caricaceae. It comprised of different parts which include roots, leaves, fruits, flowers, seeds, latex and bark. Medicinal applications of plants derivatives from natural products have wide range of pharmacological significance. The properties of papaya parts are well acknowledged in traditional system of medicine, nutritional values and also as food all over the world. The plant is rich as powerful antioxidants in vitamin A, vitamin C and Vitamin E. It is also a good source of minerals such as magnesium, potassium calcium, phosphorus, iron and sodium. Previous literatures suggested that the plant contains digestive enzyme called papain, which is responsible for the treats causes of allergies, sports injuries and trauma. Almost all nutrients found in papaya improve the cardiovascular system and protect against heart attack, stroke and also prevent colon cancer. Each parts of papaya have its own medicinal application which makes the plant a dietary supplement. The leaves of papaya can be used to treat fatal diseases, the juice from the leaves helps improved white blood cell, repair liver and normalizes blood clotting. The fruit of papaya is a good source of nutrients such as Vitamin B, vitamin C, fibre and many more. Seed which is black in colour with more medicinal application compared to other parts of the plant. The seeds have antimicrobial activity and can prevent kidney failure. The root juice is used by some Asian countries in the treatment urinary infections. Papaya has a wide range of pharmacological activities such as anticancer activity, anti-inflammatory effect, antimicrobial activity, antifungal activity, anti-fertility activity, diuretic activity, anti-hypertensive activity, anthelmintic, anti-malarial activity, anti-ulcer activity, antioxidant activity and many more activities. This overview covers some pharmacological actions and uses of different parts of the plant.

**Keywords:** Payaya, Medicinal applications, Plants, Pharmacological activities, Antioxidants.

## **CONTINENTAL AQUACULTURE IN ALGERIA (regions of el oued): SOCIO-ECONOMIC AND ENVIRONMENTAL IMPACTS**

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### **Abstract**

Continental aquaculture is an important economic activity in southern Algeria. The four farms visited in Tougourt produce significant quantities of fish, including tilapias, with values ranging from 150 kg to 6 tonnes, through semi-intensive production systems. The farms are operated by owners aged between 40 and 50 years, with a background in aquaculture or engineering, and have between 2 and 8 years of experience in breeding ornamental and food fish. The farms occupy surfaces of 1.5 to 2 hectares and are not self-sufficient in terms of food resources. They do not receive subsidies, except for the sixth farm. However, the farms occasionally benefit from state agency dissemination. The impacts of continental aquaculture on local communities are varied, including job creation, improved living conditions, and contribution to food security. Continental aquaculture in Algeria has also had an impact on employment and labor in aquaculture farms, as well as on trade and supply chains. The studied socio-economic impacts include job creation, skills development, innovation promotion, modification of relations with suppliers and customers, and impact on food prices and availability. In summary, continental aquaculture in Algeria has positive socio-economic impacts, such as job creation and innovation promotion. However, it is also important to consider the implications for sustainable development, particularly in terms of environmentalism and social sustainability.



## **SPIRITUAL MESSAGE IN THE SONG “GALA BUNGA MATAHARI”: REFLECTION OF QURANIC VERSES IN MUSIC**

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### **Abstract**

This research was conducted in connection with the release of a song entitled “Gala Bunga Matahari” by Sal Priadi. In this study, the researcher took the research focus on how people understand and interpret the spiritual message in the song “Gala Bunga Matahari” which is inspired by the verse of the Qur'an. The purpose of this research is to find out how people respond to the release of the song and how they interpret the spiritual message and what effect it has on their views on Islam. This research used descriptive qualitative research methods with data collection using interview techniques and sampling using purposive sampling techniques. The results showed that since the release of this song on June 14, 2024, it has received quite high enthusiasm from the public as evidenced by the number of viewers on Sal Priadi's Youtube channel which reached 3 million viewers. This song was inspired by several verses of the Qur'an including QS. Muhammad: 15, QS. Al-Hijr: 45-48, QS. Al-Waqiah: 35-38, and QS. al-Isra: 44. People interpret this verse as a form of expressing longing for loved ones who have died. The use of the Qur'anic verse interpretation in the song makes the listener immersed in the meaning of the song and gives a strong spiritual touch.

**Keywords:** Spiritual Message, Gala Bunga Matahari, Quranic Verses, and Music .

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**Keywords:** Epidemiology, Bacterial Meningitis, Neisseria Meningitides, Streptococcus Pneumonia, Kenitra Hospital, Morocco.

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## **Abstract**

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**Keywords:** social support, emotional support, physical health, well-being, Kenitra, Morocco.

## NATIONAL RESPONSE ON THE CLIMATE CHANGE THREATS: IMPLICATIONS FOR SUSTAINABLE ECONOMIC GROWTH IN PAKISTAN

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### **Abstract**

Climate change represents a profound challenge to global stability, with Pakistan, in particular, facing acute risks due to its climatic vulnerabilities and socio-economic context. This study examines Pakistan's national response to climate change and its implications for sustainable economic growth. Through a comprehensive analysis of climate policies, adaptation frameworks, and mitigation initiatives, this paper evaluates the effectiveness of Pakistan's strategies in addressing climate-induced threats. Utilizing a mixed-methods approach, the study integrates qualitative analyses of policy documents with quantitative assessments of economic indicators. The research reveals that while significant progress has been made in policy formulation and international collaboration, critical deficiencies remain in implementation, funding, and institutional capacity. These shortcomings undermine the country's ability to achieve sustainable economic growth while managing the adverse effects of climate change. The study offers policy recommendations aimed at enhancing Pakistan's climate resilience, including the strengthening of institutional frameworks, the enhancement of public and private sector engagement, and the expansion of international partnerships. By addressing these gaps, Pakistan can better align its economic development with climate sustainability objectives, ensuring a more resilient and equitable future. Strengthening these areas is essential for aligning Pakistan's economic development with its climate objectives and ensuring long-term sustainability.

**Keywords:** Climate change, Climatic vulnerabilities, Strengthening, Sustainable economic growth,

# LEVERAGING ANT COLONY OPTIMIZATION FOR IMPROVED MPPT IN PHOTOVOLTAIC SYSTEMS UNDER DYNAMIC CONDITIONS

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## **Abstract**

This paper explores the application of Ant Colony Optimization (ACO) as an innovative approach to Maximum Power Point Tracking (MPPT) in photovoltaic (PV) systems, particularly under dynamic and challenging environmental conditions. ACO, inspired by the foraging behavior of ants, offers a robust optimization framework capable of efficiently navigating complex energy landscapes characterized by partial shading and fluctuating irradiance levels. The study examines how ACO can be effectively employed to enhance the performance of MPPT by accurately identifying the Global Maximum Power Point (GMPP), even in the presence of multiple local maxima. Through extensive simulations, the research demonstrates that ACO-based MPPT algorithms exhibit superior adaptability and accuracy compared to conventional methods, such as Perturb and Observe (P&O) and Incremental Conductance (INC). The findings highlight ACO's ability to maintain high tracking efficiency while minimizing energy losses and reducing the convergence time. Additionally, the paper discusses the potential of hybridizing ACO with other optimization techniques to further enhance its performance in real-time applications. The results indicate that leveraging ACO for MPPT in PV systems not only improves energy output but also contributes to the development of more reliable and efficient solar energy solutions, addressing the growing need for sustainable and resilient energy systems.

# ADAPTIVE ENERGY HARVESTING TECHNIQUES FOR SOLAR ARRAYS IN VARIABLE SHADING ENVIRONMENTS

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## **Abstract**

This research addresses the critical challenge of optimizing photovoltaic (PV) system efficiency under partial shading conditions, a common issue that significantly reduces the power output of solar panels. The study introduces a novel hybrid Maximum Power Point Tracking (MPPT) algorithm that combines Genetic Algorithm (GA) and Particle Swarm Optimization (PSO) to accurately and swiftly track the Global Maximum Power Point (GMPP) in PV systems. Traditional MPPT methods often struggle to differentiate between local and global maxima in shaded conditions, leading to suboptimal energy harvesting. By integrating the exploration capabilities of GA with the exploitation strength of PSO, the proposed hybrid algorithm ensures a more reliable and efficient tracking process. Extensive simulations under various shading patterns demonstrate that the hybrid algorithm not only enhances the accuracy of MPPT but also significantly reduces the convergence time compared to standalone methods. The results indicate that this approach can substantially increase the overall energy output of PV systems, particularly in environments with frequent and complex shading scenarios. This work contributes to the ongoing development of advanced MPPT techniques, offering a promising solution for enhancing the performance and reliability of solar energy systems.

## **EVALUATION OF BAMBOO-DERIVED MICROCRYSTALLINE CELLULOSE AS A BINDER AND DISINTEGRANT IN TABLET PREPARATION**

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### **Abstract**

Microcrystalline cellulose (MCC) is a refined, partially depolymerized cellulose derived from glucose units. It is widely used across various industries, particularly in pharmaceutical, due to its excellent binding, disintegrating, and stabilizing properties, making it a key component in tablet formulations. Beyond the pharmaceutical field, MCC is also employed in cosmetics, food, and composite materials. Traditionally sourced from wood pulp and cotton linters, increasing global demand for MCC has increased global interest in sustainable, non-wood alternatives, such as bamboo. Researchers are actively exploring such sources to reduce the environmental impact of MCC production. The current study focuses on evaluating the tableting properties of MCC extracted from a bamboo species and comparing it with commercial MCC, Avicel PH 101. The extracted MCC was tested for physical appearance, weight uniformity, hardness, friability, disintegration, and tensile strength. Both tablet batches met Pharmacopoeia standards, demonstrating uniform weight, appropriate hardness, friability, and suitable disintegration times, confirming their pharmaceutical relevance. Notably, the tablets from the extracted MCC powders exhibited strong binding properties, with a hardness of around 8 kg force, which is slightly higher than the commercial MCC, suggesting enhanced potential as a tablet binder. Furthermore, the extracted MCC showed shorter disintegration time compared to commercial MCC (MCC-6), making it a promising option for formulations requiring rapid disintegration. These results underscore the potential of bamboo-derived MCC as an effective, sustainable alternative in pharmaceutical applications.

**Keywords:** Microcrystalline Cellulose (MCC), sustainable, pharmaceuticals, Avicel PH 101, binder, disintegrant

## **EFFECT OF DIGITALIZATION ON ADVANCING PSYCHOLOGY FOR SUSTAINABLE DEVELOPMENT IN IMO STATE UNIVERSITY**

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### **Abstract**

Digitization has greatly impacted the field of psychology, providing new tools and methods for research and analysis. Using digital technology, psychologists can collect in an accurate way. This led to progress in the understanding of human behavior and opened up new possibilities for sustainable development in education. This study investigated the effects of digitization on advancing psychology for sustainable development at Imo State University Owerri. The study was guided by two research questions and two hypotheses. The study adopted a quasi-experimental research design. The population included 500 lecturers in Imo State University. The sample for this study consisted of 200 (100 male and 100 female) educators from Imo State University using a stratified random sampling technique. The researcher developed and used the Psychology Advanced Test (PAT) for data collection, which was validated using measurement and evaluation experts. A reliability coefficient of 0.87 was obtained for the PAT using the Kuder-Richarson 21 method. Research questions were answered using mean and standard deviation, while hypotheses were tested using t-test and two-way ANOVA at 0.05 level of significance. The findings revealed that there was a significant difference between the mean scores of educators exposed to mHealth and educators exposed to traditional personal therapies in psychology for sustainable development. Gender was also found to be significant in average exposure to mobile health (mHealth). The study recommended that higher institutions support researchers around the world who help monitor the effectiveness of interventions aimed at promoting sustainable behaviour.

**Keywords:** Digitalization, advancement, psychology, and sustainable development



# **POWER DYNAMICS AND PSYCHOLOGICAL CONTROL IN HAROLD PINTER'S THE BIRTHDAY PARTY: A STUDY THROUGH FRENCH AND RAVEN'S POWER THEORY**

**Misbah LIAQAT**

Superior campus for university programme mandi baha u din pakistan

## **Abstract**

The aim of this research paper is to analyze Harold Pinter's *The Birthday Party* through the lens of French and Raven's Power Theory, which identifies five types of power: legitimate, coercive, reward, expert, and referent. In the play, power dynamics heavily influence the characters' relationships and actions. Goldberg and McCann, who come to confront Stanley, use coercive power through threats and intimidation to control him. They also use legitimate power by claiming to represent some higher authority, making their control seem more official. Meg and Petey, on the other hand, show different types of power. Meg uses reward power by giving Stanley attention and affection, while Petey has very little power and is mostly passive. In the end, Stanley's mental breakdown reflects how power can be destructive when used without clear reasons. Through these power struggles, Pinter shows how authority and control affect individuals and relationships.

**Keywords:** Power Theory, coercive power, legitimate power, reward power, authority, Harold Pinter, *The Birthday Party*, relationships, control, psychological impact.

## **EFFECT OF DIFFERENT TEACHING METHOD IN PROMOTING PSYCHOLOGICAL LITERACY AMONG UNDERGRADUATE STUDENTS**

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### **Abstract**

This paper examined the effect of different teaching methods in promoting psychological literacy among undergraduate students. The study adopted a Quasi-experimental research design. The study was guided by two research questions and two hypotheses were formulated. The study was conducted in the Obio/Akpor Local Government Area of Rivers State in Nigeria. The population of the study comprised 400 students from the Faculty of Education of the University of Port Harcourt Rivers State. The simple sampling technique was used to obtain 90 students from two intact classes. The experimental groups were taught using the demonstration method while the control groups were taught using the lecture method. The instrument for data collection was 20 item multiples choices titled Psychology Achievement Test (PAT) and Kuder-Richarson (K-R 20) was used to obtain a reliability index of 0.87. The research questions were answered using mean and standard deviation while the null hypotheses were tested using Analysis of Covariance (ANCOVA) at a 0.05 level of significance. The findings of the study revealed that the collaboration method fosters a deeper understanding and application of psychological principles compared to traditional lectures. Experiential learning methods including simulations and role-playing exercises enhance students' ability to relate theoretical concepts to real-world scenarios. It was recommended that teachers should regularly assess the effectiveness of teaching methods through student feedback, assessment data, and observation. Use evidence-based practices to refine teaching strategies and adapt them to meet the evolving needs of undergraduate students.

**Keywords:** Teaching methods, Psychological literacy, and Undergraduate

## **EFFECT OF ASSESSMENT METHOD ON ACADEMIC PERFORMANCE OF STUDENTS IN CERTIFICATION PROGRAM IN RIVERS STATE UNIVERSITY**

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### **Abstract**

The success of certification programs is strongly influenced by the evaluation methods used. Different evaluation techniques can vary and affect the overall success of these programs. The study investigated the effect of the assessment method on the academic performance of students in a certificate program at Rivers State University. The study was conducted at Rivers State University, Port Harcourt. This study adopted a quasi-experimental research design. The population of the study consists of 1,200 students enrolled in the certificate programs (Weekend Programme) at Rivers State University. The study sample consisted of 300 students, and stratified random sampling was used to ensure representation across different certificate programs, genders, and academic levels. Students were divided into different groups according to the assessment method used (group A: digital/online assessment, group B: project assessment, and group C: final exam assessment). The data collection instrument used in this study was the "Student Assessment Performance Test (SAPT). The SAPT contains 30 items that were designed based on a 30-item multiple-choice test. A consistency reliability coefficient of 0.73 was tested using Kuder-Richardson reliability. The device was validated by measurement and evaluation experts. Research questions were answered using mean and standard deviation. The results of this study will be beneficial for educators and students. as it will help improve the teaching and learning process and ultimately lead to better academic performance Gender differences in academic performance are influenced by the type of assessment method used in certificate programs. Female students generally perform better in online/digital and project-based assessments where organization, engagement, and collaboration are key. In contrast, male students tend to excel in final exams, where performance is often linked to their ability to handle stress and pressure. It was recommended that lecturers try to employ workers. different assessment methods to ensure a fair and comprehensive assessment of the abilities of all students that takes into account different strengths and learning styles.

**Keywords:** Assessment method, Academic Performance, Certification Program

# **MACHINE LEARNING-BASED STATISTICAL ANALYSIS OF PATHOLOGICAL VOICE ACROSS MULTIPLE DATASETS WITH COMPARATIVE EVALUATION USING REAL-TIME DATA**

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## **Abstract**

This study offers an in-depth statistical analysis of pathological voice data across multiple datasets using advanced machine learning techniques, complemented by a comparative evaluation with real-time data. The detection and classification of voice pathologies are critical for early diagnosis and intervention, significantly contributing to improved vocal health outcomes. The primary objective of this research is to assess the efficacy of various machine learning models in accurately identifying pathological voices by analyzing established datasets alongside real-time data, thereby providing insights into the practical applicability and challenges of these models in real-world scenarios. The research methodology includes several key stages, beginning with the preprocessing of diverse voice datasets, such as the VOICED and Saarbruecken Voice Database, which are renowned for their comprehensive pathological voice samples. Preprocessing steps address common issues like variability, noise, and class imbalance. Following this, feature extraction techniques, such as Mel-frequency cepstral coefficients (MFCCs), jitter, shimmer, and harmonic-to-noise ratio (HNR), are employed to capture essential characteristics of voice signals that distinguish between healthy and pathological conditions. A range of machine learning algorithms, including Support Vector Machines (SVM), Random Forests, Convolutional Neural Networks (CNN), and Deep Neural Networks (DNN), are utilized to build predictive models. The study places significant emphasis on comparing the performance of these models when applied to controlled datasets versus their application to real-time data, which inherently presents greater variability and unpredictability. The results reveal notable differences in model accuracy and robustness, highlighting the challenges faced in translating machine learning solutions from a controlled experimental setting to a dynamic, real-world environment. The findings of this study emphasize the importance of model adaptability and the need for enhanced feature selection and data augmentation techniques to improve the generalizability of machine learning models in voice pathology detection. By providing a comprehensive comparison of model performance across diverse datasets and real-time applications, this research contributes valuable insights into the development of more reliable and effective automated diagnostic tools for voice pathologies, with potential implications for their clinical deployment.

**Keywords:** Voice pathology, Machine Learning, Predictive Models, Statistical Analysis

# ANALYTICAL SOLUTIONS TO $\xi$ -CAPUTO FRACTIONAL INITIAL VALUE PROBLEMS VIA MODIFIED LAPLACE TRANSFORM

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## **Abstract**

This work generalizes the modified Laplace transform for a piecewise continuous function with  $\xi(t)$ -exponential order, which simplifies to the fundamental generalized Laplace transform for  $a = e$ . We applied this transformation to solve ordinary differential equations with generalized fractional derivatives.

**Keywords:** Laplace transform, generalized fractional derivatives, Cauchy problem.

# ART FORGERY AND LEGAL PROTECTIONS: SAFEGUARDING AUTHENTICITY IN THE ART MARKET

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## **Abstract**

The declaration of authenticity plays a crucial role in the art market, as it guarantees the legitimacy of transactions, helps maintain transparency, and ensures that copyright is respected. Art forgery not only damages the honour and reputation of the artist, even after their death, but also undermines the integrity of the art market, which relies fundamentally on the circulation of accurate information. The Italian legislator has taken significant steps to ensure comprehensive protection for the integrity of the art market by defining four distinct criminal offenses. These include the material falsification of artwork, encompassing actions such as counterfeiting, alteration, and reproduction of a piece. In addition, the commercialization and sale of forged works, as well as the possession or importation of such works with the intent to sell, are addressed. The law also criminalizes the authentication of forged artworks and the accreditation of forgeries through declarations, expert opinions, publications, or the application of stamps or labels. Law No. 22 of 2022 further strengthened these protections by increasing penalties, with prison sentences ranging from one to five years and fines between €3,000 and €10,000. In this context, artificial intelligence has become a valuable tool in the fight against art forgery, already being employed through convolutional neural networks (CNNs) and image recognition technology for the authentication and attribution of artworks. This contribution will explore notable cases related to this issue, including the historic 1929 Hahn v. Duveen case, which debated the freedom of expression of art critics, and more recent controversies, such as Rubens' "Samson and Delilah", owned by the National Gallery of London, and the contentious dispute surrounding Raphael's "De Brecy Tondo". In a world where the authenticity of art is increasingly challenged, the synergy between legal frameworks and advanced technologies like AI proves essential in preserving the honor of artists and ensuring the trust and transparency upon which the art market depends.

**Keywords:** Art; Artificial Intelligence; Forgeries; Authentication of Artwork; New Technologies.

## QUASI-EQUILIBRIUM PROBLEMS IN TOPOLOGICAL SPACES

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### **Abstract**

In this talk, we handle quasi-equilibrium problems (QEP) and Minty quasi-equilibrium problems (MQEP) without making any assumptions about the domain or the related bifunctions' convexity. Our approach is based on the concepts weak continuity and triangle inequality, cyclically monotone and cyclically antimonotone properties for bifunctions.

**Keywords:** Quasi-equilibrium Problem, Set-valued mapping, transfer Lower Continuous, Cyclically Antimonotone.

# **OPTIMIZATION OF CONDITIONS FOR METHYL ORANGE DYE REMOVAL USING ACTIVATED CARBON FROM CORK OAK FRUIT: BOX-BEHNKEN RESPONSE SURFACE APPROACH.**

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## **Abstract**

This study optimized adsorption conditions for the removal of methyl orange dye using activated carbon derived from cork oak fruit. The activated carbon was extensively characterized using X-ray diffraction, Fourier-transform infrared spectroscopy, and scanning electron microscopy coupled with energy-dispersive X-ray spectroscopy. Adsorption experiments were conducted by varying the adsorbent dose, pH, contact time, and initial dye concentration. A Box-Behnken design combined with response surface methodology was used to optimize the experimental conditions. The experimental results closely matched the model predictions, which were validated by analysis of variance. The identified optimal conditions were 0.1 g of adsorbent, a contact time of 3 hours, and an initial dye concentration of 60 mg/L, achieving a removal efficiency of 89.27%. This study highlights the effectiveness of low-cost activated carbon for dye removal from textile wastewater and provides a comprehensive understanding of the adsorption process through both experimental and theoretical approaches.

**Keywords:** Response surface methodology – Activated carbon – adsorption – Cork oak fruit – Box-Behnken design.



# IMPACT OF FLUID-STRUCTURE INTERACTION ON HEAT TRANSFER IN A WAVY L-SHAPED ENCLOSURE WITH A MOVEABLE BAFFLE

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## **Abstract**

This research investigates the interaction between fluid flow and structural elements, along with heat transfer dynamics, within a wavy L-shaped enclosure that includes a flexible baffle, using COMSOL Multiphysics for simulation. The study examines various factors such as the maximum von Mises stress, streamlines, isotherms, average Nusselt number, and dimensionless temperature across different values of elasticity modulus ( $109 \leq E \leq 5 \times 10^{10}$ ), Rayleigh number ( $103 \leq Ra \leq 106$ ), baffle length ( $0.05 \leq B \leq 0.25$ ), and Prandtl number ( $0.71 \leq Pr \leq 13.2$ ). The results demonstrate varying temporal behaviors in thermal and flow characteristics, with notable effects stemming from changes in these key parameters. Specifically, increases in the Rayleigh number and Prandtl number, along with longer baffle lengths, enhance heat transfer efficiency and raise the maximum von Mises stress. This increase in stress indicates higher mechanical loads on the baffle, highlighting the necessity for careful selection of material properties and design parameters to maintain structural integrity under diverse thermal and flow conditions. This study emphasizes the importance of optimizing these parameters to balance thermal performance and structural stability in applications involving fluid-structure interactions.

**Keywords:** Fluid-Structure Interaction (FSI), Heat Transfer Dynamics, Flexible Baffle, Wavy Cavity, COMSOL Multiphysics

## **VERNACULAR ARCHITECTURE: A MODEL FOR LOW-ENERGY SOLUTIONS IN ARID CLIMATES.**

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### **Abstract**

The view from vernacular architecture which accommodates traditional building practices presents a rich paradigm for creating low-energy solutions in desert regions. In this paper, findings are explored about how over time, vernacular methods of construction solve the problems of climatic conditions prevalent in desert like conditions, high temperatures, low availability of water resources and issues of thermal comfort. Igloo and sculptured right roof work, use of local material like adobe and stone, passive solar heated building, use of thermal inertia, and natural ventilation are methods of Move which the research work shows how they minimize the use of mechanical equipment for heating and cooling. Solutions from Practice Cases For example, the case of the architecture of the traditional houses in the M'zab Valley (Algeria) was tested and drawn as a model that exhibits great performance; including aspects like ventilated walls and thick thermal mass Facility generating performance that lowers indoor temperatures over the harsh sunny temperatures by more than 10°C. Besides reviewing practicality and sustainability of these strategies, the paper highlights the cultural relevance of embodied in vernacular architecture architecture that manifests the culture, belief, experience, and knowledge of people living in a particular place. The paper discusses how these methods matter more in the current era of global warming to consider environmentally friendly low-energy modern buildings models. The study thus and underscores the necessity of incorporating the aspects of vernacular architecture in the practice of contemporary design. This research thus recommends policies for enabling the adoption of such low-energy strategies in an effort to realign existing and future architectures to combat the negative impacts of climate change disasters. Finally, the paper asserts that with this principle of integrating the past with the future, vernacular architecture can greatly contribute to establishing people's architecture of the future that would be built with environmentally sustainable and efficient technologies.

**Keywords:** Vernacular Architecture; Arid Climates; Low-Energy Solutions; Thermal Comfort; Sustainable Development.

## **URBAN PLANNING CHALLENGES ARISING FROM SPATIO-TEMPORAL DYNAMICS OF INFORMAL HOUSING.**

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### **Abstract**

In regard to the informal housing settlements, understanding the temporal dynamics is crucial to comprehend the factors that shape these zones and their effects on cities. Housing, propelled by pressures from urbanization, rigid policies regarding tenures and housing, and different classes of economic status, remains a major problem to traditional city planning, which was developed from tenures and dual zoning laws. Thus, this research seeks to explore the growth and expansion of informal housing sector, existence in urban centres, and effects of economic factors, social relationships, and roles of government. This paper discusses the issue stating that successful land use plays an important role in the economies' development while taking care of the natural environment; such centers are the Pearl River Delta and Ankara. The paper's study shows that informal housing links with challenges of population density, forgotten infrastructure, and diminished service delivery in ordinary existence, in the city. These are developmental structures and based on evidence they are growing or shrinking in size thus require flexible planning which will suit the dynamism of these societies. Also, the study probes into the social factors of informal dwellings such as health and affordable shelters. Admitting their capabilities of controlling the areas they occupy may help introduce more efficient and people-oriented planning strategies in the future. The study concludes that community participation in planning and decisions regarding their future is crucial to support sustainable cities' development. Future research directions in this field have consisted of the involvement of the residents of these informal structures in the construction of such areas, the effects of constructing and occupying such developments on the environment, and the economic benefits of such settlements. There is also a need for subsequent research to analyze changes in informal settlements in order to develop projections regarding other parts of cities. In this way, this research intends to improve current knowledge of how formal and informal areas are connected with each other for the possibility to build better, more sustainable, fair, and responsive cities.

**Keywords:** Informal Housing; Spatio-Temporal Patterns; Urban Planning; Sustainable Development; Urbanization.

# COPPER OXIDE NANOPARTICLE SYNTHESIS FOR PHOTOCATALYTIC EFFICIENCY

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## **Abstract**

Today, wastewater treatment and the sanitation of potable water supplies are major concerns. Among the most recent advances in water treatment, advanced oxidation processes (AOPs) offer effective solutions for the mineralization of toxic organic molecules in aqueous media. One such process is heterogeneous photocatalysis, which involves a photo-sensitized reaction based on the adsorption of light radiation by a catalyst, typically a semiconductor like CuO. This method has the advantage of not introducing chemical compounds other than CuO into the medium to be treated. In this study, copper oxide (CuO) nanoparticles were synthesized using a simple co-precipitation method. The synthesis involved heating the reaction mixture at 80°C, specifically for photocatalytic applications. The resulting nanopowder underwent microstructural characterization using X-ray diffraction (XRD) and scanning electron microscopy (SEM). XRD analysis confirmed the formation of the CuO monoclinic phase, with an average grain size of the CuO crystallites measured at 30 nm. SEM images revealed a three-dimensional flower-like morphology, indicating that the structure was successfully prepared for subsequent degradation of methylene blue (MB) in photocatalytic tests. The study highlights the synthesis procedure and detailed characterization of CuO nanoparticles, demonstrating their potential effectiveness in photocatalytic applications, particularly in the degradation of organic pollutants in water. The results suggest that the synthesized CuO nanoparticles, with their unique microstructure, are promising candidates for enhancing the efficiency of photocatalytic processes in environmental remediation.

**Keywords:**CuO NPs, X-ray diffraction, SEM; Photocatalytic

# **PERSONALIZED LEARNING IN VIRTUAL LEARNING ENVIRONMENTS: ENHANCING STUDENT ENGAGEMENT THROUGH TECHNOLOGICAL INTEGRATION**

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## **Abstract**

This paper explores the growing significance of personalized learning in virtual learning environments, emphasizing the role of technological advancements in fostering student engagement. Drawing from an extensive review of recent literature, the study highlights how personalized learning frameworks, supported by tools like AI, learning analytics, and immersive technologies, create tailored educational experiences that address individual learner needs. The paper also investigates the affective and motivational factors driving successful personalization, the challenges of implementation, and the evolving role of educators in these dynamic settings. This analysis underscores the transformative potential of personalized learning in enhancing student outcomes and engagement while identifying key obstacles that institutions must address to ensure effective adoption. Emerging trends and future directions, including AI-driven models and gamification, are also explored as pathways to further innovation in personalized learning environments.

**Keywords:** Personalized Learning; Virtual Learning Environments; Student Engagement; Educational Technology

## **AN ECONOMETRIC ANALYSIS OF FACTORS AFFECTING THE DEMAND FOR HIGHER EDUCATION IN ALBANIA.**

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### **Abstract**

In this paper, the demand for higher education in Albania is analyzed and modeled. The analyzed factors on the demand for higher education are demographic and economic. By analyzing the enrollment rate of students in primary, secondary and higher cycles, government expenditure on education and using simple and multiple regression analysis, the direction of the influence of the factors will be found. The decrease in births in the country, demographic movements have a negative impact on the demand for higher education. R studio on secondary data is used to evaluate the models.

**Keywords:** Demand for higher education, Enrollment Secondary, forecasting

## RELATIONSHIP BETWEEN STRESS AND TEACHER JOB SATISFACTION IN IMO STATE MUNICIPAL

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### **Abstract**

The relationship between stress and teacher job performance is a crucial aspect of understanding the dynamics within educational settings. This study focuses on the relationship between stress and teacher job satisfaction in the Imo State. The correlation design was used for this study and the population consists of 3105 three thousand hundred five respondents who were gotten in public senior secondary schools in Owerri, Imo state. The sample of the study was 353 and Taro yamane was used. A simple random sampling technique was employed. The instrument used for data collection was a twenty-item structured questionnaire on a 4-point Likert type developed and validated by experts in measurement and evaluation. The questionnaire was titled "Challenges of e-learning platform in secondary schools in Rivers State (CEPSSR)". The instrument was validated and Cronbach alpha was used to determine the instrument's reliability index, which yielded 0.87. Three research questions and three hypotheses were used for the study. A Pearson product moment correlation was used to answer the research questions and hypothesis. The findings show that the relationship between stress and teacher job satisfaction is often inversely proportional. High levels of stress can lead to decreased job satisfaction among teachers, as it can affect their overall well-being, job performance, and morale. This, in turn, can lead to teacher burnout, high turnover rates, and a negative school culture. It was recommended to encourage collaboration among teachers to share lesson plans, teaching materials, and instructional resources, reducing the burden of individual workload

**Keywords:** Stress and Teacher Job satisfaction

## EFFECTS OF FLOOD ON RURAL LIVELIHOOD ACTIVITIES AMONG RURAL HOUSEHOLDS IN ATIBA LOCAL GOVERNMENT OYO STATE, NIGERIA

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### **Abstract**

The effects of floods on rural livelihood activities among rural households have significant implications for food security, income generation, and overall well-being in rural communities. Floods, resulting from extreme weather events or inadequate water management, can devastate agricultural lands, destroy infrastructure, and disrupt local economies. Thus, the study was carried out to determine the effects of flood on rural livelihood activities among rural households in Oyo State, Nigeria. A multistage sampling procedure was used to select 120 respondents for the study and data collected through questionnaire were analyzed using both descriptive and inferential statistics. The result shows that majority (75.0%) of the respondents were male, majority had mean age of  $41 \pm 12$  years, majority (75.0%) of the respondents were married, majority (65.8%) had formal education, majority (55.8%) of the respondents were Christians, majority had mean farming experience of  $13 \pm 9$  years, mean household size of  $6 \pm 3$  members, majority (64.2%) of the respondents uses both family and hired labour for their farming activities, had mean monthly income of  $\text{N}39,000 \pm 20,000$ , majorly cultivate cassava (55.0%), had mean farm size of  $4 \pm 2$  acres and majority (72.5%) were farming for both commercial and subsistence purposes. Excessive rain (1.99) was the major cause of flood in the study area. Relocation from river banks with highest mean of 1.70 was the most effectively coping strategy used by the respondents and poor road network with highest mean of 1.90 was the major consequences faced by the respondents. On on-farm activities, most of the respondents were involved in the production of cassava (55.0%) before the flood but reduced to 52.5% of the respondents involving in cassava production after the flood. Involvement in livelihood activities was high (52.5%) before flood while it was higher (60.8%) after the occurrence of flood. A significant relationship existed between sex ( $\chi^2=11.521$ ,  $p=0.001$ ), source of labour ( $\chi^2=42.143$ ,  $p=0.000$ ), scale of farming ( $\chi^2=42.139$ ,  $p=0.000$ ), monthly income ( $r=-0.549$ ,  $p=0.000$ ), farm size ( $r=-0.347$ ,  $p=0.000$ ), causes of flood ( $r=-0.470$ ,  $p=0.000$ ) and the livelihood activities in the study area and a significant difference exists between livelihood activities engaged by the respondents before flooding and after flooding ( $t=3.983$ ,  $p=0.000$ ) in the study area. The study concluded that most of the respondents negatively felt the effect of the occurrence of flood. It is therefore recommended that rural households have access to accurate and timely information on flood risks, weather forecasts, and appropriate flood response measures.

**Keywords:** Effects, Flood, Rural livelihood activities, rural household



## DIGITALISATION OF POLYMERS IN MANUFACTURING AND DESIGN

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### **Abstract**

Industry 4.0, the final stage of the digitalisation of manufacturing rolls on Industry 5.0 and now Industry 6.0. Digitalisation unlocks powerful optimisation process as long as the complete chain is digital. An example, is the shape of a product can be optimised against a target function such as weight or strength, as materials can be placed at any point in the volume, this is particularly true of additive manufacturing technologies. One area for which digitalisation has not made an impact is with materials and in this presentation we focus on polymers. The topological optimisation mentioned previously need the material properties but these are not available in a continuous coordinate space. The so-called Ashby plots provide one type of coordinate space on modulus and strength for example, but not all of the space is annotated and there will be inaccessible properties. This work addresses the challenges of digitalisation of polymers and proposes that the map of properties should be related to what is available in the specific manufacturing process, we illustrate this with respect to extruder based 3D printing and injection moulding. This work is supported by the Fundação para a Ciência e Tecnologia (FCT) through the Project references: MIT-EXPL/TDI/0044/2021, <https://doi.org/10.54499/UIDB/04044/2023>;; PRR 2375 Bioshoes4All and PRR INOVAM C644865234-00000004.

**Keywords:** Digitalisation, polymers, Industry 4.0, 3D printing, Injection Moulding

# **CUSTOMER RELATIONSHIP MANAGEMENT TOOLS AND ORGANIZATIONAL PERFORMANCE OF COMMERCIAL BANKS IN SOUTHWEST, NIGERIA**

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## **Abstract**

The purpose of the study was to examine the extent at which customer relationship management tools influence the organizational performance of commercial banks in Southwest, Nigeria. The study was carried out using the descriptive research design of the survey type. The population of the study was six hundred and twenty-four (624) respondents which comprised all the zonal/branch, operations, human resources manager and customer care giver of five of each of the twenty-six (26) commercial banks in Southwest, Nigeria, (CBN, 2024). The sample of the study consisted of three hundred and ninety (390) respondents which was achieved through multistage sampling techniques. The study adopted a questionnaire instrument tagged 'Customers Relationship Management Tools and the Organizational Performance of Commercial Banks' (CRMPB). The reliability of the instrument was estimated at 0.80 using Chronbach's Alpha reliability method. The data collected for this study was analyzed using both descriptive and inferential statistics. All hypotheses were tested at 0.05 level of significance. This study revealed that there is significant relationship between the usage of customer relationship management tools and the organizational performance of commercial banks operating in Southwest, Nigeria; there is significant relationship between Hub Spot CRM tools and customer retention rate of commercial banks operating in Southwest, Nigeria, and there is significant relationship between Oracle CX Cloud CRM tools and cross-selling and upselling opportunities in commercial banks operating in Southwest, Nigeria. Based on the findings of the study, it was recommended that commercial bank operators should adopt the usage of CRM tools to enhance their organizational performance.

**Keyword:** Customer Relationship Management Tools, Performance, Customers' Retention, Cross-selling, Upselling

**ESTABLISHMENT OF AN IN VITRO PROPAGATION PROTOCOL OF UCB-1  
(*Pistacia atlantica* × *P. integrima*) PISTACHIO ROOTSTOCK**

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**Abstract**

UCB-1 (*Pistacia atlantica* × *P. integrima*) is an important commercial rootstock for pistachio. It has been recently introduced in Tunisia to be used commercially in some plantations due to its high growth and wide soil performances. Propagation of this rootstock by tissue culture results in many limitations and requires more optimisation of the proliferation protocol. Therefore, mainly the multiplication, rooting and acclimatization steps were studied. The multiplication step was established on POM medium enriched with 6-Benzylaminopurine (BAP), metatopolin (mT), Zeatin (ZT) and thidiazuron (TDZ) at 0, 0.5, 1, 1.5 and 2 mg/l. The rooting step was studied on media added with indole-3-butyric acid (IBA) and naphthalene acetic acid (NAA) at 0, 0.5, 1 and 1.5 mg/l. Acclimatization of vitroplants is realized on S1 (peat only) and S2 (peat + perlite) substrates. The results show that mT at 1 mg/l led to the highest shoot length (21.62 mm) and offered the best vitroplant vigour. The highest multiplication rate (2.55) of UCB-1 shoots was achieved by TDZ at 2 mg/l. The most superior leaf number (10.8) and fresh weight (4.22 g) were recorded with ZT. The lowest propagation parameters were engendered by BAP cytokine. In vitro rooting of UCB-1 vitroplantlets was successfully done on medium containing 0.5 mg IBA with highest rooting rate (50%), root number and longest roots (51.28 mm). For the acclimatization step, S1 (peat only) substrate was more efficient than S2 (peat + perlite) leading to 53% success rate.

**Keywords:** UCB-1, pistachio rootstock, cytokinins, micropropagation, rooting step.

## **FROM GENOCIDE TO EXILE: THE CHALLENGES FACED BY ROHINGYA REFUGEES IN UTTAR PRADESH, INDIA.**

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### **Abstract**

This study explores the everyday struggles of Rohingya refugees who fled violence in Myanmar and now live in Bhujpura, near Aligarh, Uttar Pradesh. Through interviews with 20 families, we found that these refugees face many challenges. They often live in hiding, constantly feeling insecure and unsafe because they lack proper legal status. Finding work is difficult, and when they do, they are paid very little compared to others. Limited support from organizations like UNHCR makes their financial situation worse, leaving them without enough resources to survive. Their children are unable to attend school due to language barriers, cultural differences, and the lack of access to education. These challenges create a difficult life for the refugees, marked by fear, economic hardship, and social isolation. This study highlights the need for better support and policies to help Rohingya refugees live more securely and with dignity in their new environment.

**Keywords:** Rohingya Refugees, Forced Migration, Insecurity, Employment Challenges, Cultural Barriers

## STEM ANATOMICAL PLASTICITY: A KEY FEATURE IN ESTABLISHMENT OF ERIOSCIRPUS COMOSUS (wall.) PALLA. IN DIVERSE ENVIRONMENTAL CONDITIONS

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### **Abstract**

*Erioscirpus comosus* (Wall.) Palla is a caespitose perennial sedge from the Cyperaceae family, distributed across China, Afghanistan, Vietnam, and Pakistan, particularly in the Himalayas. The species typically grows in rocky, dry areas of lower temperate or subtropical zones. To evaluate its adaptability, twenty-one populations of *E. comosus* from various ecozones in Punjab, Islamabad, and Khyber Pakhtunkhwa in Pakistan were studied to analyze their morphological and anatomical responses to different environmental conditions. The study revealed that *E. comosus* exhibits strong adaptability through significant plasticity in its morphology, particularly in the stem. This adaptability allows it to thrive in diverse environments, including cold areas such as Abbottabad, Balakot, Sheringal, and Upper Dir. Even within the same site, populations showed different morpho-anatomical and eco-physiological responses, indicating genetic variability and adaptation to local conditions. Two distinct stem shapes, Reuleaux and triangular, were found among different ecotypes, with specific modifications such as thicker epidermal layers (in Jabba and Ucchala), larger parenchymatous cells, increased sclerification (in Jahlar Road), and more vascular bundles (in Kallar Kahar). These adaptations support water conservation and efficient solute transport, enabling the species to cope with diverse environmental stresses. Populations from salt range areas like Kanhatti Garden, Neela Wahn, Jahlar, Sakesar, Ucchala, and Jabba exhibited a higher number of phytoliths in their stems compared to other regions, likely aiding in structural support and water retention. This study suggests that *E. comosus* possesses strong adaptability to varied environmental conditions, with its stem anatomy playing a critical role in its survival. The research is significant because it is the first to focus on the stem anatomy of *E. comosus*, highlighting its ability to modify its morphology in response to environmental challenges across different habitats in Pakistan.

**Keywords:** Ecotypes, Environmental heterogeneity, Subtropical, Phytoliths, Sclerification.

# **A COMPREHENSIVE OVERVIEW OF ULTRASOUND AS A SUSTAINABLE TECHNOLOGY FOR WASTEWATER TREATMENT**

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## **Abstract**

The volume of contaminants released into aquatic environments has risen considerably over recent decades. The textile industry, domestic wastewater, agribusiness [1], pharmaceuticals, and personal care products are the primary contributors to this increase in water pollution [2]. Ultrasound is increasingly recognized as a green technology for wastewater purification, offering an eco-friendly alternative to conventional treatment methods. It works by generating high-frequency sound waves that induce cavitation, leading to the formation and collapse of microbubbles. This process creates localized extreme conditions that generate reactive species like hydroxyl radicals, which degrade pollutants in water [3] [4]. In this presentation, we will provide a comprehensive overview of ultrasound as a sustainable technology for wastewater treatment. We will explain the mechanisms underlying ultrasound technology, detailing how high-frequency sound waves induce cavitation to enhance pollutant degradation. Additionally, we will examine various applications of ultrasound in wastewater management, and we will present statistical findings from previous studies to illustrate its effectiveness and potential. This in-depth analysis aims to highlight the benefits and advancements of ultrasound technology in achieving more efficient and eco-friendly water treatment solutions.

## **SHESHIELD: ENHANCING IOT FOR WOMEN'S SAFETY**

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### **Abstract**

SheShield is an advanced panic button based on IoT solutions for enhancing women's safety in the form of a vehicle accessory. The device has integrated WiFi, Bluetooth, and GPS module. It uses the GSM platform of the mobile phone connected to the device for signal transmission. The device uses LoRaWAN to communicate with the Police in the absence of internet. The button can be installed on both cars and scooters when pressed, it will immediately alert the Police and the chosen contacts about the user's distress and location. At the same time, it turns on the embedded camera of the ESP32 AI Thinker for video recording and the mobile's built-in microphone to capture audio evidence and safely store and transfer it to the cloud storage. Apart from real-time tracking, the device utilizes geofencing that sends notifications to trusted contacts when the user unconsciously strays from the intended path. The web application allows users to log in, set up trusted contacts, set up routes, and customize settings. In addition, the information collected by the devices helps pinpoint locations of high risks, and the times of day or specific hours when incidents occur, as well as aid in the identification of the offenders through consumed audio and video data.

## **OPTIMIZATION OF THE OPERATIONAL CONDITIONS IN THE ULTRASOUND-ASSISTED EXTRACTION OF B-CAROTENE FROM HIMANTHALIA ELONGATA**

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### **Abstract**

*Himantalia elongata* (brown seaweed) was screened as a natural source of  $\beta$ -carotene, a carotenoid that is mainly acknowledged for being a provitamin that can be converted into vitamin A (retinol), which is essential in the regulation of different physiological functions in animals and humans. Owing the high content of  $\beta$ -carotene in *H. elongata*, this Phaeophyta has been progressively attracting the attention of researchers and biotech industry, particularly in what concerns developing methods to optimize  $\beta$ -carotene extraction, and further characterizing the bioactivity of the obtained extracts. In this work, response surface analysis was applied to optimize the operational conditions to extract  $\beta$ -carotene from *H. elongata* by ultrasound-assisted extraction (UAE). Three different conditions were tested: time (t: 5 to 55 min), power (P: 100 to 500 W), and temperature (T: 35 to 100 °C). These conditions corresponded to the analyzed independent variables X1 (t), X2 (P), and X3 (T) (with five levels for each variable), included in the optimization process, which was calculated by applying the typical circumscribed central composite design. The mathematical model design delivered twenty-eight outcome combinations: twenty-two resulting from the interaction of the selected independent variables, and six others generated from the central point. The extraction yield and the  $\beta$ -carotene content (quantified by HPLC-DAD) were used as response variables. The combination of operational conditions that maximize the content of UAE-extracted  $\beta$ -carotene were properly determined, contributing to valorize *H. elongata* as a sustainable source of this carotenoid.



## **KLOZAPININ XRONIKI İSTİFADƏSİNİN ZOLAQLI CİSİMDƏ LİPID PEROKSİDİ MƏHSULLARININ MIQDARINA TƏSİRİNİN TƏDQIQI.**

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### **Özet**

Aktuallıq. Zolaqlı cisim (lat. Corpus striatum) – böyük beyin yarımkürələrinin bazal nüvələrinə aid edilir. Beyin toxumasının horizontal və frontal kəsişməsində ağ və boz maddələrin növbələşməsi hesabına əmələ gələn nüvədir. Zolaqlı cisimin tərkibinə kapsulla ayrılan quyruqlu və lentikulyar nüvələr daxildir. Zolaqlı cisim əzələ tonusunu tənzimləyir. O, daxili orqanların fəaliyyətinin tənzimində, müxtəlif davranış hərəkətlərinin həyata keçirilməsində, şərti reflekslərin formalaşmasında mühüm rol oynayır. Bütün qeyd etdiklərimi nəzərə alaraq klozapinin xroniki təyini fonunda zolaqlı cisimdə lipid peroksidi məhsullarının (LPO) miqdarında baş verən dəyişikliyi tədqiq etməyi qarşımıza məqsəd qoyduq. Tədqiqatın material və metodları. Tədqiqatlar çəkisi 170-200q hər iki cinsdən olan 15 erkək ağ siçovul üzərində aparılmışdır. Heyvanlar 3 qrupa ayrıldıqdan sonra, birinci qrup nəzarət qrupu, digər 2 qrupda isə klozapin 10; 20 mq/kg dozada heyvanların qarın boşluğuna xroniki inyeksiya olunmaqla LPO məhsullarının miqdarına təsiri tədqiq olunmuşdur. Heyvanlara klozapinin tədqiq olunan dozalarının axırıncı qarındaxili inyeksiyasından iki saat sonra başları kəsilmiş və beyin strukturlarından zolaqlı cisim çıxarılaraq homogenat hazırlanmış və LPO məhsullarının miqdarı təyin olunmuşdur. Avropa Parlamentinin və heyvanların qorunması üzrə Avropa ittifaqının elmi-tədqiqatlar apararı zaman heyvanlarla düzgün davranmaq qaydalarına əməl olunmuşdur. Eksperimental məlumatların hesablanması üçün Studentin t-meyarı, Vilkokson-Manna-Uitninin qeyri-parametrik U-meyarı tətbiq edilmişdir. Nəticələr Microsoft Excel (Office-2010) statistik proqramın köməyi ilə işlənmişdir. Alınmış nəticələr və onların müzakirəsi. Zolaqlı cisimdən hazırlanmış homogenatda LPO məhsullarının miqdarını tədqiq edən zaman məlum olmuşdur ki, bu göstəricilərdən nəzarət qrupunun göstəriciləri ilə müqayisədə DK-nın miqdarı artdığı halda, HP-nin miqdarında azalma müşahidə olunduğu halda, MDA-nın miqdarında isə demək olar ki, dəyişiklik müşahidə olunmur. Belə ki, 10 mq/kg dozada klozapinin təsirindən

zolaqlı cisimdən hazırlanmış homogenatda DK-nın miqdarı nəzarət qrupunun göstəriciləri ilə müqayisədə 9,1%, 20mq/kq klozapinin təsirindən isə 18,2% statistik dürüst artmışdır. HP-in miqdarı 10 mq/kq klozapinin xroniki təyini fonunda 0,3%, 20 mq/kq klozapinin xroniki təyini fonunda isə 1,26% statistik qeyri-dürüst artırmışdır. Klozapinin dozadan asılı olaraq xroniki təyini fonunda MDA-nın miqdarında demək olar ki, dəyişiklik nəzərə çarpmamışdır. Əksinə MDA-nın miqdarında dozadan asılı azalma müşahidə edilmişdir. Apardığımız tədqiqatların alınmış nəticələri klozapinin prooksidant təsir effektinə malik olması ehtimalını irəli sürməyə imkan verir. Amma tədqiqatların alınmış nəticələrini təhlil edən zaman məlum olmuşdur ki, 10 və 20 mq/kq dozada ağ siçovullara xroniki təyin olunan klozapin antioksidant təsir effekti göstərmişdir. Elmi ədəbiyyatlardan bizə məlumdur ki, D2-dofamin reseptorları on birinci xromosomda kodlanmışdır, oyanan zaman sAMF-in miqdarını azaldır, kalsium kanallarını blokada etməklə kalium kanallarının açılmasına səbəb olur. Məlum nəzəriyyəyə görə, tipik neyroleptiklər postsinaptik D2-dofamin reseptorlarını blokada etməklə hüceyrədaxilinə kalsium ionlarının axınını gücləndirir, eyni zamanda monoaminoksidaza fermentini aktivləşdirməklə, dofaminin metablizmini gücləndirməklə sərbəst radikalların əmələ gəlməsini gücləndirir. Neyroleptiklər dofamin reseptorlarını blokada etməklə hüceyrə sitoplazmasında Ca-ionlarının toplanmasına səbəb olur. Bu zaman kalsium ionlarının hüceyrədən çıxarılmasına və endoplazmatik retikulumun sistinasına yığılmasına səbəb olan enerjidənasılı nasoslar blokada olduğuna görə kalsiumdanasil fosfolipaza fermenti aktivləşir. Kalsiumun sitoplazmada toplanmasının qarşısını alan mexanizmlərdən biri də mitoxondrilərin kalsiumu tutma aktivliyinin artmasıdır. Bu zaman mitoxondrilərin metabolik aktivliyi artır ki, bu da ATF-in sərfinin güclənməsinə səbəb olmaqla protonların hüceyrədən qovulmasını sürətləndirir. Krebs dövrəni pozulur. Oksigen çatışmazlığı enerji mübadiləsinin pozulmasına səbəb olmaqla sərbəstradikallı oksidləşməni stimule edir. Sərbəstradikallı proseslər hüceyrələrin membranını zədələməklə lipid peroksidi məhsullarının əmələ gəlməsini stimule edir. Əmələ gəlmiş lipid peroksidi məhsulları hüceyrə membranlarının zədələnməsini və ölümünü sürətləndirir. Atipik neyroleptiklərdən olan klozapin bu mexanizmin əksinə təsir göstərdiyinə görə antioksidant təsir effekti göstərmiş olur.

# MATHEMATICAL OPTIMIZATION OF RESOURCE ALLOCATION FOR LOW-RESOURCE SETTINGS MANAGEMENT OF DIABETES: A MULTI-OBJECTIVE APPROACH

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## **Abstract**

Particularly in low-income environments where healthcare infrastructure is poor and resources are limited, diabetes is a developing worldwide health concern. Good treatment of diabetes calls for the best distribution of few medical resources, including drugs, doctors, and diagnostic instruments. With an emphasis on balancing cost-efficiencies, patient access, and treatment effectiveness in low-resource situations, this paper presents a multi-objective optimization model to handle the complexity of resource allocation in controlling diabetes. To maximize the allocation of medical resources across many healthcare facilities, the suggested approach combines linear and nonlinear programming. The approach combines many goals, including improving patient access to treatment, lowering the total cost of care, and optimizing the efficacy of the present treatment plans. Stochastic components are included to explain illness development, patient demand, and resource availability uncertainty. Using case studies to show how various allocation policies affect diabetes management results, the paper uses real data from a few low-income areas using the model. By up to 25%, the best resource allocation tactics can lower treatment costs; by 40%, they can enhance patient access to healthcare; and by 15% they can raise general treatment success rates above existing resource allocation practices.

**Keywords:** Diabetes, Resource Allocation, Multi-Objective Optimization, Low-Resource Settings, Healthcare Management, Stochastic Optimization

# TRANSFORMING CANCER CARE: "THE INTEGRATION OF ARTIFICIAL INTELLIGENCE FOR PRECISION ONCOLOGY AND ENHANCED CLINICAL DECISION-MAKING"

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## **Abstract**

Artificial intelligence (AI) has altered oncology and holds enormous potential for transforming cancer research and treatment. AI is being applied by employing deep learning technology and machine learning algorithms at various phases of cancer diagnosis, therapy, and follow-up. Mammography scans, histopathology pictures, and other imaging modalities have shown impressive accuracy in early illness identification and prompt intervention when AI-assisted image processing is used. However, there are also disadvantages to using AI in cancer, such as problems with data quality, ethical concerns that are difficult to understand, and the need for cooperation between researchers and medical professionals. AI in oncology has the potential to significantly alter how cancer patients are treated by oncologists. Innovations in artificial intelligence (AI) are improving the effectiveness and efficiency of cancer care delivery in several ways, such as by making personalized treatment regimens possible and raising diagnostic precision. By quickly and effectively analyzing vast volumes of data, artificial intelligence, or AI, can assist physicians in making well-informed decisions that ultimately enhance patient outcomes. Despite its potential benefits, the application of AI in cancer treatment is not without its challenges. It is important to consider many considerations about data quality, regulatory compliance, accessibility of findings, interpretability of AI-produced insights, and ethical issues to ensure the ethical and responsible use of AI technology in oncology. To overcome these challenges and maximize the impact of AI on cancer therapy, collaboration across pertinent stakeholders—including researchers, medical experts, lawmakers, and tech developers—is essential. As artificial intelligence (AI) in cancer treatment advances, it offers untapped opportunities to improve patient outcomes and advance scientific understanding. Even if there are barriers to completely using AI in oncology, continued research, multidisciplinary collaboration, and a commitment to ethical norms will be necessary for innovation and improvement in AI-enabled cancer therapy.

**Keywords:** Artificial Intelligence, Machine Learning, Data Quality, Cancer care, Tailored treatment, Cancer therapy

**1ÈRE EDITION DE LA CONFÉRENCE INTERNATIONALE SUR :  
LA RÉGLEMENTATION ET LA GOUVERNANCE DE L'ACTION PUBLIC FACE À  
LA COMPLEXITÉ SOCIALE SOUS LA THÉMATIQUE : MANAGEMENT DES  
RISQUES ET DES CRISES -RISK AND CRISIS MANAGEMENT INTITULÉ DE  
L'ARTICLE : "MANAGEMENT DES RISQUES ET STRATÉGIES INNOVANTES :  
UNE SYNERGIE POUR LA COMPÉTITIVITÉ DES ENTREPRISES "**

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**Abstract**

Dans un monde où les organisations sont constamment exposées à des environnements incertains et turbulents, le management des risques et des crises est devenu une démarche essentielle pour assurer la résilience et la durabilité des entreprises. Les crises peuvent provenir de diverses sources, notamment économiques, technologiques, environnementales, sociales ou lors de la mise en place d'une stratégie d'innovation, ce qui nécessite une veille stratégique rigoureuse. Dans cet environnement de plus en plus complexe et dynamique, les entreprises reconnaissent que, l'innovation qui consiste à introduire de nouvelles idées, produits, services ou processus apportant une réponse aux besoins des clients, est essentielle pour leurs compétitivités et leurs croissances. Cependant, toute stratégie innovante est exposée à des risques inhérents qui peuvent être technologiques, financiers, opérationnels. Ainsi les entreprises qui n'ont pas une connaissance des risques de ces stratégies et ne mettent pas des actions pour y faire face risquent de ne pas atteindre les résultats escomptés. Le management des risques est un processus visant à trouver un équilibre efficace entre la réalisation de gains et la réduction des vulnérabilités et des pertes. Il fait partie intégrante des pratiques de gestion et constitue un élément essentiel de la bonne gouvernance d'entreprise. « Selon la norme ISO 31000, un risque est défini comme l'effet de l'incertitude sur les objectifs ». Cette définition englobe à la fois les risques négatifs à savoir les menaces ainsi que positifs en l'occurrence les opportunités. Le management des risques vise à identifier ces incertitudes, à évaluer leur probabilité et leur impact, et à mettre en place des stratégies pour les atténuer ou les exploiter. Le management des risques se présente alors comme un cadre structuré pour identifier, évaluer et gérer les risques associés aux stratégies innovantes, chose qui fait de cette approche un outil indispensable pour intégrer ces stratégies efficacement. L'importance de l'adoption du management des risques dans le processus d'insertion d'une stratégie, un produit ou un service innovant sur le marché réside dans sa capacité à protéger les actifs de l'entreprise, à assurer la continuité des opérations, sans pour autant être impacté par le changement de gestion vécu. Un management efficace des risques permet également d'optimiser les ressources ainsi de réduire les coûts liés aux incidents. En effet, pour un meilleur management des risques, il est nécessaire de suivre plusieurs étapes, de bien examiner la menace pour lui en définir une solution sur le long terme. Son management c'est une approche scientifique et systématique qui permet aux

entreprises de non seulement réduire les impacts négatifs des risques et des crises, mais aussi identifier et exploiter de nouvelles opportunités. Donc nous pouvons en déduire qu'une préparation rigoureuse, une réponse coordonnée, et une surveillance continue sont les clés d'un management efficace des risques et des crises. A travers, cette étude nous allons analyser les différentes stratégies d'innovation existantes pour en déduire les différents risques associés à ces innovations, le processus du management des risques à suivre pour mieux cadrer ces stratégies d'innovation et en tirer profit, et finalement nous proposons un plan d'action pour mieux réussir l'intégration d'une stratégie d'innovation dans un système de gestion d'une entreprise

**Keywords:**stratégies d'innovation, risques stratégiques, management des risques.

**THE CONCEPT OF KTS® (pol. Kompensacyjna terapia skolioz, ang. compensatory therapy of scolioses - cts) – SCIENTIFIC ASSUMPTIONS OF THE CONCEPT**

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**Abstract**

Idiopathic scoliosis is a three-plane deformity of the spine. Its unknown etiology complicates causal treatment and is a major problem for both orthopedics and physiotherapy. There are many methods of conservative treatment of scoliosis, which differ in their assumptions and therapeutic approach. A well-known treatment method is the FITS method, which was developed in Poland. The method is consistent with the SOSORT (International Society on Scoliosis Orthopaedic and Rehabilitation Treatment) assumptions. Another treatment method is the FED method, which comes from Spain. In the work with the patient, various reactions of the human body to the actions taken using both methods were observed. Initially, these were only observations and theoretical assumptions, later supported by conducted studies comparing the effect of therapy in a patient with scoliosis using both methods: FED and FITS. The result of many years of research and observation was the creation of a new model of scoliosis therapy. This is how the KTS concept was created, which is a new model of therapy for a patient with scoliosis. Its assumptions mainly concern a global view of the patient's body and the use of an inverted compensatory mechanism in scoliosis therapy.

## **STORAGE POST-HARVEST OF OPUNTIA FICUS INDICA AND ITS IMPACT ON THE EFFICIENCY OF BIO-COAGULANTS FLOCCULANTS EXTRACTED.**

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### **Abstract**

The use of bio-coagulants-flocculants made from natural plants is currently a major concern for wastewater treatment. In this study, we investigated the effectiveness of juices extracted from the rackets of *Opuntia ficus-indica* (Cactaceae) for the treatment of synthetic water rich in clay. We also examined the correlation between the storage conditions of the plants and the efficiency of the extracted bio-products. The findings of this study underline the importance of proper storage conditions for the effectiveness of bio-products in wastewater treatment. The study



followed the degradation of snowshoes over a period of 161 days in three different storage locations: open air, an anaerobic closed location, and a refrigerator at 0°C. The snowshoes stored in the open air showed the highest resistance to microbial degradation, followed by those stored in the refrigerator. However, the snowshoes kept in the closed location experienced complete degradation before day 161 was reached. The juice extracted from the rackets that resisted during the storage study was compared to the juice extracted from another racket stored in the open air in an area not protected from the weather. The results of coagulation-flocculation and settling tests showed that snowshoes that were stored in the open air without and with weather protection and that of refrigerator, give a turbidity reduction of 99, 5%, 99.43%, 99.17% and a settling rate of 27.5 cm/min, 14 cm/min, 14 cm/min respectively. The results of the tests demonstrated the strong dependence between the conditions of storage post-harvest and the efficiency of the extracted flocculant bio coagulants.

**Keywords:** *Opuntia ficus indica* – Storage – post-harvest – Coagulation – Flocculation – Settling – Turbidity - wastewater treatment.

## **OWNERSHIP MENTALITY AND STUDENTS ACADEMIC PERFORMANCE IN MATHEMATICS IN PUBLIC SCHOOLS IN IMO STATE**

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### **Abstract**

Ownership mindset is an important factor affecting student learning and has been widely studied. A social science approach was adopted. This study used a correlation research design. Three research questions and three hypotheses guided this study. The population of the study consisted of 1290 students selected from various schools as participants in Imo State. A sample size of 300 was selected using a stratified random sampling technique. The data collection tool is the questionnaire titled Ownership Mentality and Academic Performance in Mathematics Questionnaire (OMAPMQ). The reliability coefficient of this scale was determined by test-retest and the reliability result was found to be 0.72 ( $r=0.72$ ). The research questions and hypotheses were answered and tested at 0.05. Pearson product-moment correlation was used to analyze and evaluate the significance. The research results show that there is a positive relationship between intellectual ownership and students' mathematics performance, and students with creative thinking will have good mathematics skills. Also, instilling a sense of ownership in students, educators can help them become active participants in mathematics education rather than passive recipients of knowledge. The research recommended that Educators and policymakers should foster a culture of curiosity and inquiry that aims to increase students' confidence, motivation, and belief in their ability to succeed in mathematics.

**Keywords:** Ownership, Mentality, Academic Performance and Mathematics

## **IMPACT OF TRADITIONAL HERBAL MEDICINE ON MENTAL HEALTH: A DIGITAL HEALTH APPROACH**

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### **Abstract**

Traditional natural medicines have a long history in various cultures and have been used for centuries to provide holistic treatments for different health issues, including mental health conditions. This abstract explores the intersection of traditional herbal medicine and modern digital health technology to enhance our understanding and application of natural remedies in mental health care. The integration of digital health tools, such as mobile health apps, telemedicine, and wearable devices, offers a unique approach to monitor, evaluate, and optimize the use of natural medicines for mental health. Our research focuses on the effectiveness, safety, and patient outcomes associated with traditional herbal remedies for disorders like anxiety, depression, and stress-related conditions. By harnessing digital health platforms, we are able to collect real-time data on patient experiences, adherence to treatment plans, and overall effectiveness. This data-driven approach allows for personalized treatment plans, increased patient engagement, and continuous monitoring of progress. Furthermore, we address the challenges and limitations of incorporating traditional herbal medicine into modern mental health care, including regulatory issues, standardization of herbal formulations, and potential interactions with conventional medications. The role of digital health in overcoming these barriers, emphasizing its ability to enhance accessibility, provide educational resources, and support evidence-based practices. Preliminary findings suggest that digital health interventions can significantly enhance the therapeutic benefits of traditional herbal medicine, leading to improved mental health outcomes. The combination of ancient wisdom and modern technology shows promise for advancing mental health care, promoting holistic well-being, and bridging the gap between traditional and modern medical practices. This abstract underscores the importance of interdisciplinary approaches in addressing complex health challenges and lays the groundwork for future research in the evolving field of digital herbal medicine.

**Keywords:** Traditional Herbal Medicine; Digital Health; Mental Health; Personalized Treatment; Holistic Health

## STOCHASTIC PREDICTIVE CONTROL OF OFF-GRID PHOTOVOLTAIC SYSTEMS UNDER RANDOM LOAD VARIATIONS

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### **Abstract**

This work investigates the use of stochastic predictive control (SPC) for energy management in autonomous off-grid photovoltaic (PV) systems with unpredictable load behavior. The variability of renewable energy sources and irregular load consumption create significant obstacles for reliable power management in standalone PV microgrids. To address these issues, the study presents a novel method incorporating a Markov decision process (MDP) within the SPC framework. This strategy is designed to improve real-time power demand estimation and maintain a stable energy balance, thus enhancing the reliability and efficiency of autonomous PV systems with energy storage in the face of random load fluctuations. Simulation results based on real-time scenarios provide valuable insights into the feasibility and effectiveness of the proposed solution, which adapts to changing load patterns to optimize energy use while ensuring microgrid stability. Additionally, it improves microgrid performance by efficiently managing the charging and discharging cycles.

**Keywords:** Photovoltaic micro-grid system; Energy management; Stochastic predictive control; Markov decision process.

## IN VITRO CYTOTOXIC, ANTI-INFLAMMATORY, ANTIOXIDANT, AND HEMOLYTIC EFFECTS OF THE SPECIES ERYNGIUM TRIQUETRUM VAL.

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### **Abstract**

Recently, a prolific rise in the introduction, development, and advancement of herbal substances for drugs production has been observed. Indeed, several effective drugs are made from active substances of plant origin. In this context, the objective of the present study is the evolution of antioxidant, anti-inflammatory, hemolytic and cytotoxic effects of methanolic extract prepared from the medicinal species *Eryngium triquetrum*. The quantification of the total content of flavonoids, phenolic compounds and saponins was carried out using several colorimetric methods. The anti-inflammatory effect was tested using the denaturation of serum bovine albumin method. In addition, the antioxidant activity was evaluated using five different assays, including DPPH and hydroxyl radical scavenging effects, FRAP testing, copper reducing antioxidant capacity (CUPRAC), and ferric iron chelation tests. The cytotoxicity was performed according to the brine shrimp lethality test and the hemolytic test was evaluated using the erythrocyte model. According to the results, *E. triquetrum* extract is rich in several bioactive compounds with many pharmacological activities such as tannins, glycosides, flavonoids and saponins. Moderate concentrations of polyphenols, flavonoids and saponins were estimated ( $29.94 \pm 0.12$  ug eq GA/mg,  $5.61 \pm 0.41$  µg EQ/mg,  $54.18 \pm 2.71$  µgEUA/mg respectively). The crude extract showed moderate antioxidant effects in all tested methods. But strong iron reduction power was observed ( $0.13 \pm 0.02$  µg EAA/mg). The extract showed a strong anti-inflammatory effect with a percentage of 89.82% at 5 mg/ml. However, low hemolytic activity was detected (30% at 2.5 µg/mL). While, a significant cytotoxic effect was estimated with  $LD_{50} = 5.49 \pm 1.65$  µg/ml ( $p < 0.001$ ). In conclusion, the species *Eryngium triquetrum* could be an important source of bioactive compounds with potential therapeutic, pharmaceutical and nutritional applications.

**Keywords:** *Eryngium triquetrum*, antioxidant, anti-inflammatory, hemolytic and cytotoxic effects.

## **VICTIMS OF ROAD ACCIDENTS CONSIDERING THE CASE LAW OF ROMANIAN COURTS**

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### **Abstract**

According to statistics published by the Romanian Police, Romania is a country where road accidents produce a significant number of victims. In 2023, 4526 road events were recorded, with 1545 people losing their lives. In this regard, the Romanian judicial system has developed a rich jurisprudence, with both execution and suspended sentences being handed down or even deferred sentences. An important component of road accidents is also the moral and material damage that victims receive. The damage they suffer must be covered by the insurance company so that there is fair compensation between loss and gain. As a frequently settled issue in our legal system, road traffic accidents have also been a subject of great interest in specialized literature. In other words, based on significant case law, opinions have emerged in the doctrine on the problems of road accidents.

# **DEVELOPMENT AND IMPLEMENTATION OF AN INDEPENDENT INVENTORY MANAGEMENT SYSTEM: A CASE STUDY OF DAN AGGO PLAZA**

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## **Abstract**

Effective inventory management is crucial for any business, particularly in commercial settings where accurate stock control is essential. This study focuses on the inventory management issues at Dan Aggo Plaza, which currently relies on outdated manual systems. These issues include inaccurate stock levels, frequent item losses, and inefficiencies in inventory tracking, leading to higher operational costs and lower customer satisfaction. The study's primary goal is to design, develop, and implement a customized stand-alone inventory management system for Dan Aggo Plaza. This system aims to automate inventory tracking, provide real-time data, and improve stock accuracy, thereby reducing human error and enhancing efficiency. The research involves evaluating the plaza's current practices, developing an intuitive inventory system, and seamlessly integrating it into existing operations. Key features of the system include secure login, session management, and an easy-to-use interface. The system was evaluated based on improvements in inventory accuracy, efficiency, and user satisfaction, showing significant benefits in inventory control, cost reduction, and customer satisfaction. This study's findings are valuable not only for Dan Aggo Plaza but also for other businesses with similar challenges, emphasizing the importance of adopting modern technological solutions to optimize operations and support growth.

**Keywords:** Inventory Management, Stock Control, Automation, Real-time Data, Operational Efficiency, Technological Solutions

# DETERMINATION OF THE NITROGEN AND PHOSPHORUS REMOVAL PERFORMANCE OF ZEOLITE AND SAWDUST IN WASTEWATER

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## **Abstract**

Despite the rapidly increasing population, the amount of water used per person per year is rapidly decreasing. Among the elements that are effective in the pollution of water are phosphorus and nitrogen. In this study, column experiments were carried out in the laboratory environment in order to treat the phosphorus and nitrogen elements that cause pollution in the waters in which zeolite and sawdust materials are used. In the experiment, zeolite and sawdust materials were used both pure and mixed in different ratios (100% zeolite, 100% sawdust, 75% zeolite-25% sawdust, 50% zeolite-50% sawdust and 25% zeolite-75% sawdust). In the experiment, 100 cm<sup>3</sup> filter material, synthetic wastewater (10, 25 and 50 ppm) resistant to laboratory conditions, 5 ml/min flow rate can be applied. Different periods (3 rd, 6th, 12th, 24th and 48th hours) and 3 replications of samples were taken from the outlet parts of the working columns. Received samples were subjected to pH, electrical conductivity (EC), total nitrogen (TN) and total phosphorus (TP) analyzes. The highest phosphorus removal rate of 25 ppm compared to the obtained as 25.29% in the filter material consisting of 75% sawdust-25% zeolite mixture, while the responsibility of having the least phosphorus removal is 6.05% in the 100% zeolite material. The highest nitrogen removal concentration of 10 ppm was obtained as 91.05% in the filter material consisting of 75% sawdust-25% zeolite mixture, while the least nitrogen removal was obtained as 0.68% in the solution with a concentration of 10 ppm. As a result, it has been determined that the phosphorus and nitrogen removal performances of the working materials and the performance of zeolite materials in the use of sawdust are observed.

**Keywords:** Nitrogen, phosphorus, column tests, sawdust, zeolite



***FULL TEXTS***

## GÜZ ZEYTİNİ (*Elaeagnus umbellata* Thunb.) ÜZERİNE YAPILAN ÇALIŞMALAR VE FİDAN ÜRETİM DURUMU

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### Özet

*Elaeagnus umbellata*, Japon iğdesi, güz zeytini veya güz yemişi adı ile tanınan iğdegiller (Elaeagnaceae) familyasında yer almaktadır. Güz zeytini adı türün İngilizce ismi olan autumn-olive in çevirisidir. Doğu Asya'da Himalayalardan Japonya'nın doğusuna kadar geniş bir coğrafyada doğal olarak yetişmektedir. Antibakteriyel özelliği yüksek bir meyvedir. Sağlık açısından çok faydalı bir meyvedir. Prostat, pankreas kanseri gibi birçok kansere karşı koruyucu etkileri vardır. Kalp kaslarını güçlendirir, kolesterolü düşürür. Güz zeytini taze veya kurutulmuş olarak bolca tüketilmesi tavsiye edilen şifalı bir meyvedir. Güz zeytininin çekirdekleri oldukça şifalıdır ve çekirdek tadı mayhoş lezzetlidir. Çekirdekler özellikle çiğnenerek tüketilmelidir. Eski çağlarda "kutsal zeytin" olarak adlandırılmış, içeriğindeki likopen maddesi nedeniyle birçok hastalığa iyi geldiğinden kutsal kabul edilmiştir. Güz zeytini Karadeniz Bölgesi başta olmak üzere Türkiye'nin birçok bölgesinde üretilmektedir. Son yıllarda fidanları oldukça talep görmektedir. Güz zeytini meyveleri tatlı olduğundan sevilerek yenen bir meyvedir. Yumuşak peltemsi bir dokusu vardır. Güz yemişi ilk dikimden sonra yukarı doğru dik ve kuvvetli bir gelişme gösterir. Sonrasında dik dallar üzerinde ince, zarif dallar sarkar. Ağaçları 1.5-3 metre boya erişebilir ve genişlikleri de 1.2-2.4 metre kadar olabilmektedir. Burada sunulan çalışmada güz zeytini üzerine yapılan çalışmalar derlenmiş, ayrıca Türkiye'de güz zeytini fidan üretim durumu değerlendirilmiştir.

**Anahtar Kelimeler:** Güz zeytini, fidan, üretim, ekonomi

## STUDIES ON AUTUMN OLIVE TREE (*Elaeagnus umbellata* Thunb.) AND SAPLING PRODUCTION STATUS

### Abstract

*Elaeagnus umbellata* Thunb. is a species in the Elaeagnaceae family, known as autumn olive tree. The name autumn olive is the translation of the English name of the species, autumn-olive. It grows naturally in a wide geography from the Himalayas to the east of Japan in East Asia. It is a fruit with high antibacterial properties. It is a very beneficial fruit in terms of health. It has protective effects against many cancers such as prostate and pancreatic cancer. It strengthens the heart muscles and lowers cholesterol. Autumn olive is a healing fruit that is recommended to be consumed abundantly, fresh or dried. The seeds of autumn olives are quite healing and the seed tastes sour and delicious. The seeds should be consumed especially by chewing. It was called "holy olive" in ancient times and was considered sacred because it is good for many diseases due to the lycopene substance in its content. Autumn olive is produced in many regions of Turkey, especially in the Black Sea Region. In recent years, its saplings have been in high demand. Autumn olives are a fruit that is eaten with pleasure because their fruits are sweet. They have a soft, mushy texture. Autumn berries show a vertical and strong growth upwards after the first planting. Afterwards, thin, elegant branches hang down from the upright branches. The trees can reach a height of 1.5-3 meters and their width can be 1.2-2.4 meters. In the study presented here, studies on autumn olives were compiled and the autumn olive sapling production status in Turkey was also evaluated.

**Keywords:** Autumn olive, sapling, production, economy

## 1.Giriş

Japon iğdesi (*Elaeagnus umbellata* Thunb.) Elaeagnaceae familyasına ait bir tür olup, güz zeytini, kardinal zeytini olarak da adlandırılmaktadır (Dirr, 1998). İlk olarak 1830 yılında kültüre alındığı bildirilmektedir (Rehder, 1940). O yıllardan bu yana meyve olarak yetiştiriciliği çok sınırlı kalmıştır. Az bilinen bir minör meyve olan tür aynı zamanda dış mekan süs bitkisi olarak da değer bulmaktadır. *Elaeagnus umbellata* Thunb doğal yayılım alanı Çin, Kore ve Japonya'dır. Amerika'da Maine eyaletinden New Jersey'e, Pensilvanya'dan Batı ve Güneybatı Minnesota'ya ve Güney Karolina'ya kadar yayılım göstermektedir (Olsan & Barbour, 2008). Pakistan'ın Himalaya bölgelerinde geniş alanlar yapmaktadır (Sabir et al., 2003). Ayrıca Afganistan ve Hindistan'da bulunmaktadır (Parmar & Kaushal, 1982). Egzotik bir tür olarak, Amerika Birleşik Devletleri'ndeki 41 eyalette, Kanada'nın güney bölgelerinde ve Hawaii'de yetişmektedir (Wagner et al., 1989).

*Elaeagnus* cinsi 40 kadar ağaç veya çalı formu tür içermektedir. Bu türlerden sadece 3'ü yenilebilir özelliklere sahiptir (Olsan & Barbour, 2008). Güz iğdesi bu cins içinde yer alan yaprak dökken bir meyvedir. Verimsiz topraklarda da yetişmesi mümkündür. Likopence zengin meyveleri, ayrıca iyi bir antioksidan kaynağıdır. Kırmızı ve sarı renkli meyveleri, güzel çiçekleri ile peyzaj alanlarında kullanımı yaygınlaşmaktadır. Bunun sonucunda tür üzerinde yürütülen çalışmalar da artmaktadır.

## 2. Kimyasal İçerikleri ve İnsan Beslenmesi İle Sağlık Açısından Önemi

Güz zeytini insan beslenmesi ve sağlık açısından oldukça değerli içeriğe sahip bir türdür. Meyveleri A, C ve E vitaminleri, flavonoidler, diğer biyoaktif bileşikler ve temel yağ asitlerince zengindir (Khattak, 2012; Pei et al., 2015). İyi bir vitamin ve mineral kaynağıdır. Güçlü antioksidan aktiviteye sahiptir (Khattak, 2012; Pei et al., 2015). Güz zeytini meyveleri likopence domatesten daha zengindir. Bu yönüyle kansere karşı klinik özelliklerinin değerlendirilmesi önerilmektedir (Fordham et al., 2001).

Meyvelerinde SÇKM %9-11.8, titre edilebilir asitlik %2.2-2.9, pH 3.3-3.9, askorbik asit miktarı 7.7-10.1 mg/100 g arasında değişmektedir. Meyve etindeki yağ oranı % 4.8-5.1, çekirdekdeki yağ oranı ise % 5.3-5.5 arasındadır. İncelenen meyvelerde şeker oranı %7.4-7.7 olarak saptanmıştır. Meyveleri mineral elementlerden kalsiyum, magnezyum ve fosforca zengindir. Taze olarak tüketilmesinin yanı sıra gıda ve ilaç endüstrileri için hammadde olarak değer taşır. Dağlık ve ormanlık yerlerdeki yerel halkın ekonomik faaliyetleri bakımından potansiyele sahiptir (Campbell & Dawson 1989; Hussain, 2011). Meyvelerinden meyve suları, reçel ve konserve yapılabilmektedir (Facciola, 1990, Reich, 1991).

Tohumları öksürük tedavisinde uyarıcı olarak kullanılmaktadır. Tohum yağı akciğer rahatsızlıklarının tedavisinde önemlidir (Chopra et al., 1986). Güz zeytini kırmızı pigmentli meyvelerindeki likopen içeriklerinden dolayı prostat, serviks ve gastro intestinal kanser de dahil olmak üzere çeşitli kanser türlerine karşı koruyucu etki göstermektedir (Fordham et al., 2001). Kalp krizine karşı da koruyucudur (Kohlmeler et al., 1997). Meyve ekstraktlarının normal farelerde  $\alpha$ -glukozidazı inhibe ederek yemek sonrası hiperglisemiyi azaltabileceği bildirilmiştir (Kim et al., 2019).

## 3. Bitkisel Özellikleri

Güz zeytini, mevcut yılın dallarındaki küçük sürgünler üzerinde, dalın yan kısımlarında alternatif dizilişli kümeler halinde yaprakları olan çalı veya küçük ağaçlardır. Yetişkin ağaçlarının boyları çok değişken olup, 0.9-3.6 m arasında boylanabilmektedir. Mayıs-Haziran ayları arasında çiçek açmaktadır. Meyveleri Ağustos-Ekim aylarında olgunlaşır. Olgunlaşan meyveler gümüş rengine döner, olgunlaşma ilerledikçe kırmızı-pembe kahverengi pul pul kabuk oluşur. Meyveleri onları tüketen kuşlarca doğaya yayılır (Sternberg, 1982). 100 tohum ağırlığı 6.00-6.66 gramdır (Campbell & Dawson, 1989; Hussain, 2011).

Güz zeytini dinlenme isteği düşüktür. Mart ayında yapraklanma başlar (Sternberg, 1982). Yapraklar eliptik, oval-dikdörtgenimsi; 4-8 cm uzunluğunda ve 1-2.5 cm genişliğindedir. Yaprak sapları 0.5-1.0 cm uzunluğundadır (Ahmad et al., 2005). Mayıs-Haziran gibi çiçeklenme oluşur, çiçekler hoş kokuludur ve çeşitli böcekler tarafından tozlanır (Holtz, 1981). Güz zeytini hızlı gelişen bir tür olarak kaydedilmiştir; 3-5 yılda meyve vermektedir (Sternberg, 1982). Sarı ve kırmızı meyveli tipleri vardır (Şekil 1). Olgunlaşan meyvelerden kendi doğal koşullarında çekirdekler Eylül-Kasım aylarında etrafa dağılmaya başlamaktadır. Güz zeytininin çekirdekleri 6-8 mm boyundadır. Bir kilodaki tohum sayısı ortalama 62 adettir.

#### 4. Ekolojik İstekleri

4.8-6.5 pH aralığında, kumlu, tınlı ve biraz killi toprak koşullarında iyi yetişebilmektedir (Holtz, 1981). Aşırı tuzluluğa (Reed, 1992) ve kuraklığa karşı toleransı olan bir bitkidir, ancak çok kurak ve aşırı nemli topraklar yetiştiriciliğini olumsuz etkiler (Sharp, 1977). Köklerinde azotu fikse edebilen nodülleri bulunmaktadır (Sternberg, 1982; Zarger, 1980). Tam güneş alan yerlerde iyi yetişmekte, fidan gelişimi olumlu etkilenmektedir (Holtz, 1981).

Yaban örtüsü olarak değerlidir, bitkileri son derece dayanıklıdır. Özellikle su kenarı set bitkisi olarak değerlendirilebilir. Bulunduğu yerden memnun olduğunda hızla çoğalır ve istilacı durumuna geçer. Yandıktan sonra veya kesildikten sonra hızla yeniden filizlenme kapasitesi yüksektir. Aşırı yayılımı kesilerek ve ardından herbisitler ile daha etkili kontrol edilebilmektedir (Nestleroad et al., 1984).

#### 5. Çoğaltılması Konusunda Yürütülen Çalışmalar

Güz zeytini tohumları, çelikleri ve doku kültürü ile çoğaltılabilmektedir. *E. umbellata* Thunb. çok miktarda tohum üretmektedir. Her ağaç yılda 0.91-3.6 kg tohum üretir ve kg başına tohum sayısı 20.000-54.000 arasındadır. Tohumlar kuşlar tarafından yaygın olarak dağıtılır ve yüksek bir çimlenme oranına sahiptir. Embriyonun dinlenmeden çıkması için soğuk katlama gereklidir (Holtz 1981). Tohumların dinlenme isteği, genetik açılım tohumla çoğaltılması konusunda zorlayan engellerdir. Ekim öncesinde soğuk katlama tohum çimlenmesini artırmaktadır. Farklı gece/gündüz yetiştirme koşulları tohum çimlenme süresini ve çimlenme oranını etkilemekte, %95'e varan çimlenme sağlanmaktadır (Fowler, 1987). Yine sıcak su uygulamaları ile %57 çimlenme elde edilmiştir (Çelik et al. 2016). Çalışmalarda çelikleri ile çoğaltılması daha fazla karşılaşılan çoğaltma yöntemidir. Güz zeytininin çelikleri ile çoğaltılmasında çelik alım zamanının, uygulanan hormon tipi ve dozunun, köklenme koşullarının etkileri açıkça görülmektedir (Bayraktar, 2017; Çelik & Çil 2021).



Şekil 1. Kırmızı ve sarı güz zeytini meyveleri

#### 6. Güz Zeytini Fidan Üretim Durumu

Online olarak fidan satışının Türkiye genelinde dokuz farklı internet sitesinde yer aldığı belirlenmiştir. Satışa sunulan fidanların boyutları genellikle 50 cm civarı olup, tüplü fidanlardır.

Fidan satış fiyatı 69 TL ile 360 TL aralığındadır. Fidanlıklar içinde sadece bir fidanlıkta doku kültürü ile üretim yapıldığı belirtilmiş, diğer üretimler için bir detay verilmemiştir (Tablo 1).

**Tablo 1.** Türkiye’de online siteleri aracılığı ile güz yemişi fidanı satışı yapan işletmeler (2024)

Fidanlık	Fidan	Fiyat*	Üretim şekli
Tunç Botanik	40-50 cm saksılı	139 TL	Belirtilmemiş
Fidan Deposu	50 cm saksılı	145 TL	Belirtilmemiş
Fidan Diyarı	50-60 cm	150 TL	Belirtilmemiş
Gojiberry Fidanlığı	60-70 cm	90 TL	Doku kültürü
Meyve Fidanım	80 cm	75 TL	Belirtilmemiş
Artemisia	Belirtilmemiş	69 TL	Belirtilmemiş
Mut Fidanlığı	30-40 cm	139	Belirtilmemiş
Canlı Bahçe	80-100 cm	360 TL	Belirtilmemiş
Botanik Market	130-150 cm	191 TL	Belirtilmemiş

\*02.09.2024 yılı fiyatlarıdır.

Tablo 1’de görüldüğü üzere piyasaya sunulan fidanların boyları oldukça değişkendir. Fidan fiyatlarının fidan büyüklüğünden bağımsız olarak, işletmelerin kendilerince belirlendiği dikkati çekmektedir. Güz yemişi fidan üretiminin gelişmesi, kültürünün gelişmesinde de oldukça önem taşıyacaktır.

## 7. Sonuç

Güz zeytini kısıtlı ekolojik koşullara dayanımı ile öne çıkan bir meyvedir. İklim krizinin arttığı günümüzde alternatif bir minör meyve olma durumundadır. Araştırmalar hızlı toprak erozyonunun endişe verici bir tehdit haline geldiği dağlık bölgelerde çalimsı formu ile toprak erozyonunu etkili bir şekilde kontrol edebildiğini ortaya koymuştur. Biyokimyasal içeriğine bağlı olarak endüstriyel kullanımının geliştirilmesi yerel halkın ekonomik faaliyetleri için uygun bir bitki haline gelmesini hızlandıracaktır. Meyvelerin tıbbi bileşenleri, ulusal ve uluslararası ilaç endüstrileri için çok ucuz hammadde sağlayacak ve insanlığın tamamına fayda sağlayacaktır. Gıda endüstri açısından da iyi bir meyve kaynağıdır. Ticari kullanımının gelişmesi için tarımının desteklenmesi önemlidir.

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## GÜZ ZEYTİNİNİN (*Eaegnus umbellata* Thunb.) ÇELİKLE ÇOĞALTMA OLANAKLARI

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### Özet

Güz zeytini (*Elaeagnus umbellata* Thunb.) Elaeagnaceae familyasındadır. Uzun yıllardan bu yana kültüre alınmış olmasına karşın, minör meyvelerdendir. Pakistan'ın Himalaya bölgelerinden, Çin, Kore ve Japonya'ya; Kuzey Amerika kıtasında ABD ve Kanada'ya kadar yetişmektedir. Tuzluluk, kuraklık, fakir topraklar gibi farklı ekolojik koşullara dayanıklı olan türün yetiştiriciliğine ilgi artmıştır. Bu çalışmada güz zeytininin odun çeliklerinin köklenmesi üzerine IBA (2000 ve 4000 ppm) ve substratların (perlit, perlit+Hindistan cevizi torfu ve Hindistan cevizi torfu) etkileri ele alınmıştır. Çeliklerde köklenme yüzdesi (%), kök sayısı (adet/çelik), kök uzunluğu (cm) belirlenmiştir. Köklenme süresince süren çeliklerin oranı (%), oluşan sürgünlerin boyu (cm) kaydedilmiş, yaprak kuru ağırlığı (%) olarak belirlenmiştir. En iyi köklenme değerleri 2000 ppm IBA uygulanan ve perlit ortamında köklendirilen çeliklerden elde edilmiştir.

**Anahtar Kelimeler:** Güz yemişi, odun çeliği, IBA, köklendirme substratı

## CUTTING PROPAGATION POSSIBILITIES OF AUTUMN OLIVE (*Elaeagnus umbellata* Thunb.)

### **Abstract**

Autumn olive (*Elaeagnus umbellata* Thunb.) is in the Elaeagnaceae family. Although it has been cultivated for many years, it is a minor fruit. It grows from the Himalayan regions of Pakistan to China, Korea and Japan; and in the North American continent to the USA and Canada. The interest in the cultivation of this species, which is resistant to different ecological conditions such as salinity, drought and poor soils, has increased. In this study, the effects of IBA (2000 and 4000 ppm) and substrates (perlite, perlite+coconut peat and coconut peat) on the rooting of autumn olive wood cuttings were discussed. Rooting percentage (%), root number (number/cutting), root length (cm) were determined in cuttings. The ratio of cuttings that continued during rooting (%), the length of the formed shoots (cm) were recorded, and the leaf dry weight (%) was determined. The best rooting values were obtained from cuttings applied with 2000 ppm IBA and rooted in perlite medium.

**Keywords:** Autumn olive, hardwood cuttings, IBA, rooting substrate.

## 1.Giriş

Güz zeytini (*Elaeagnus umbellata* Thunb.) Elaeagnaceae familyasında yer almaktadır. 1830 yılında kültüre alınmış olmasına karşın, meyve yetiştiriciliğinde fazla yer bulamayan bir minör meyvedir (Rehder, 1940). Tür yaygın olarak Doğu Asya ve Amerika kıtasının farklı yerlerinde yetişebilmektedir. Pakistan'ın Himalaya bölgelerinde (Sabir et al., 2003), Hindistan, Afganistan, Çin, Kore ve Japonya'da yetiştiriciliği vardır; hatta Japon iğdesi olarak adlandırılmaktadır (Parmar & Kaushal, 1982). Kuzey Amerika kıtasında ekzotik bir tür olarak Amerika Birleşik Devletleri'nde ve Kanada'da yetişmektedir (Wagner et al., 1989; Wunderlin & Richard, 1996).

Aşırı tuzluluğa dayanıklı olması (Reed, 1992) ve verimsiz toprakları değerlendirmesi ile yetiştiriciliği değer kazanmaktadır. Hafif asidik topraklarda (pH:4.8), kumlu, tınlı ve hafif killi topraklara uyum sağlamaktadır (Holtz, 1981). Kuraklığa karşı toleransı olan bir bitkidir, ancak çok kurak ve aşırı nemli topraklar yetiştiriciliğini olumsuz etkiler (Allan & Steiner, 1965; Sharp, 1977).

*E. umbellata* çok miktarda tohum üretir, her ağaç yılda 0.91-3.6 kg tohum üretir ve kg başına tohum sayısı 20.000-54.000 arasındadır (Holtz, 1981). Güz zeytini tohumları kendi doğal ortamında kuşlar aracılığı ile yayılmaktadır. Tohumlarının çimlenmesi yüksektir (Nestleroad et al., 1984). Çimlendirme çalışmalarında %95'e varan başarı elde edilmiştir (Fowler, 1987). Soğuk katlama, sıcak su uygulamaları, gibberellin uygulamaları çimlenmeyi artırmaktadır (Çelik et al., 2016).

Güz zeytini tohumlarının dışında çelikleri ile de çoğalmaktadır. Yapılan bir çalışmada odun çelikleri ile vejetatif çoğaltılmıştır. Çalışma sera koşullarında yürütülmüş, çoğaltma ortamı olarak perlit kullanılmıştır. IBA ve NAA oksinlerinin 1000 ppm ve 5000 ppm dozları denenmiştir. Çalışma sonuçlarında köklenme süresi, köklenme yüzdesi, kök uzunluğu ve kök sayısı belirlenmiştir. En yüksek köklenme yüzdesi her iki hormonun 5000 ppm uygulamasından elde edilmiştir. %70 köklenme başarısı sağlanmıştır (Bayraktar et al., 2017.).

Diğer bir çalışmada ise güz zeytininin üç farklı dönemde (15 Mart, 15 Mayıs ve 15 Temmuz) alınan odun, yeşil ve yarı odunsu çelikleri materyali oluşturmuştur. Çeliklere 500 ppm, 1.000 ppm ve 2.000 ppm İndol-3-bütirik asit (IBA) dozlarından biri uygulanmıştır. Çelikler köklenme için sera koşullarında sisleme altında perlite yerleştirilmiştir. Mayıs ayında 1.000 veya 2.000 ppm IBA ile Haziran ayında 500 ppm ile alınan çelikler en yüksek köklenme oranını vermiştir (%97,33). Kök uzunluğu en iyi (11,90 cm) 500 ppm IBA içeren Mayıs çeliklerinde oluşmuştur. 1.000 ppm IBA uygulanan çeliklerden en iyi satılabilir fidanlar elde edilmiştir (Çelik & Çil 2021). Burada sunulan çalışmada güz zeytini çeliklerinin köklenmesi üzerine hormon ve köklendirme ortamının etkileri ele alınmıştır.

## 2. Materyal ve Metod

Materyal olarak Kocaeli Üniversitesi Ziraat Fakültesi Bahçesinde yer alan güz zeytininin odun çelikleri kullanılmıştır. 2000 veya 4000 ppm IBA uygulanan odun çelikleri perlit, perlit+Hindistan cevizi torfu ve Hindistan cevizi torfu içeren köklendirme ortamlarına yerleştirilmiştir. Çeliklerde düzenli aralıklarla sulama ve bakım işlemleri yapılmıştır. 50 gün sonunda çelikler buldukları ortamdan alınmıştır. Çeliklerde köklenme yüzdesi (%), kök sayısı (adet/çelik), kök uzunluğu (cm) belirlenmiştir. Ayrıca, köklendirme ortamındaki süre içinde süren çeliklerin oranı (%), oluşan sürgünlerin boyu (cm) kaydedilmiştir. Çeliklerden alınan yaprak örneklerinin yaş ağırlıkları kaydedildikten sonra, örnekler 70 °C sıcaklıkta etüvde kurutulmuş, kuru ağırlıklar (%) olarak belirlenmiştir. Çalışmadan elde edilen değerler Minitab 16 istatistik paket programı ile değerlendirilmiş, farklı gruplar Tukey testi ile belirlenmiştir.

### 3. Sonular ve Tartışma

Köklenme üzerine farklı uygulamaların etkileri istatistiksel olarak önemli bulunmuştur. Köklenme süresi sonunda en iyi köklenme oranının (%60.0) perlit ortamında köklendirilen 2000 ppm IBA uygulanmış eliklerde saėlandığı belirlenmiştir (Tablo 1). Aynı eliklerde, kök sayısı, kök boyu ve kök kuru ağırlığı daha yüksek kaydedilmiştir. alıřmada 4000 mg/L IBA uygulanan ve Hindistan cevizi torfunda köklenmeye alınan eliklerde hiç kök gelişimi olmamıştır. 2000 ppm IBA uygulanan ve Hindistan cevizi torfuna dikilen eliklerde ise köklenme oranı (10.0) ok düşük olmuştur (Tablo 1). IBA dozunun daha düşük olduėu durumda Hindistan cevizi torfunda köklenme daha başarılı olmuştur. Perlit ve torf karışımında %20.0 köklenme olmuştur (Tablo 1).

**Tablo 1.** Farklı ortam+hormon uygulamalarında güz zeytini eliklerinde köklenme durumu

Uygulama	Köklenme oranı (%)	Kök sayısı (adet)	Kök boyu (cm)	Kök kuru ağırlığı (g)
Perlit 2000 ppm IBA	60,0 a	11,87 a	5,49 a	22,9 a
Perlit 2000 ppm IBA	36,7 ab	4,83 ab	3,27 ab	22,0 a
Perlit:Torf (1:1) 2000 ppm IBA	20,0 ab	2,4 b	3,10 ab	18,3 ab
Perlit:Torf (1:1) 4000 ppm IBA	20,0 ab	2,22 b	1,14 ab	14,7 ab
Hindistan cevizi torfu 4000 ppm IBA	10,0 ab	2,17 b	0,82 ab	5,4 ab
Hindistan cevizi torfu 4000 ppm IBA	0 b	0,0 b	0,0 b	0,0 b

2000 ppm IBA uygulanarak köklendirilen eliklerde kök kalitesi daha iyi olmuştur (Şekil 1).



**Şekil 1.** Farklı ortamlarda köklendirilen güz zeytini eliklerinin kök ve sürgün gelişimi (soldan saėa)

(2000 ppm IBA+perlit; 4000 ppm IBA+perlit; 2000 ppm IBA+perlit+torf; 4000 ppm IBA+perlit+torf; 2000 ppm IBA+ Hindistan cevizi torfu; 4000 ppm IBA+Hindistan cevizi torfu).

Köklenme aşamasında tüm köklendirme ortamlarında eliklerden sürgün gelişimi olmuştur (Tablo 2). 2000 ppm ve 4000 ppm IBA uygulanan eliklerde sürme daha etkili gerçekleşmiştir. 2000 ppm IBA ile muamele edilerek perlit ortamında köklendirilen eliklerden %86.7'si sürmüştür. eliklerde oluşan sürgünler 5 cm'den kısadır (Tablo 2).

**Tablo 2.** Farklı ortam+hormon uygulamalarında köklenme sırasında güz zeytini çeliklerinde sürgün gelişimi

Uygulama	Sürme oranı (%)*	Sürgün sayısı (adet)*	Sürgün boyu (cm)*	Yaprak kuru ağırlığı (g)*
Perlit 2000 ppm IBA	86,7	2,50	3,57	32,2
Perlit + 4000 ppm IBA	76,7	1,89	3,48	31,5
Perlit:Torf (1:1) 2000 ppm IBA	30,0	1,72	2,01	22,2
Perlit:Torf (1:1) 4000 ppm IBA	63,3	1,60	1,81	30,2
Hindistan cevizi torfu 2000 ppm IBA	53,3	1,17	1,75	30,2
Hindistan cevizi torfu 4000 ppm IBA	36,7	0,80	1,20	42,6

\*Önemli değil

Önceki çalışmalarda NAA ve IBA uygulamalarının köklenme üzerinde olumlu etkileri belirlenmiştir. 5000 ppm IBA uygulanan çeliklerde köklenme artışının olması (Bayraktar et al., 2017) nedeniyle güz zeytininin yüksek hormon gereksinimi gösterebileceğini düşündürmüştür. Ancak çalışma sonuçları IBA'nın yüksek dozunun olumsuz etkilerini ortaya koymuş, 2000 ppm IBA daha etkili bir köklenme sağlamıştır. Benzer şekilde Çelik & Çil (2021, yürüttükleri çalışmada Mayıs çeliklerinde en iyi köklenmeyi 1000 ve 2000 IBA ile elde etmişlerdir. Köklendirme ortamları içinde perlit en iyi sonucu vermiştir. Perlit çeliklerin köklendirilmesinde çoğunlukla kullanılmaktadır. Farklı substratların etkileri zeytinde denenmiştir. Çalışmada kum, turba yosunu ve perlit ele alınmıştır. IBA'nın 0 ve 4000 ppm dozları uygulanmıştır. Substratların ve IBA uygulamasının etkileşimi önemli olmuştur. Zeytin odun çelikleri perlit ve kumda turba yosununa dikilenlerden daha yüksek köklenme oluşturmuştur (Hechmi et al., 2013). Diğer bir çalışmada ise Schefflera arboricola L. için köklendirme ortamı olarak perlit, perlit-hindistancevizi torfu karışımı ve kum kullanılmıştır. Perlite dikilen çelikler daha iyi köklenme vermiş, hindistancevizi torfu ile karıştırılması etkinliğini azaltmıştır. Kumun da daha az etkili bir ortam olduğu belirlenmiştir (Fatimah & Zaynab, 2015).

#### 4. Sonuç

Çalışma sonuçları güz zeytini fidanlarının çelikleriyle çoğaltılmasında başarıyı ortaya koymuştur. Bu türün yetiştiriciliğinin gelişmesi için fidan üretimi açısından önemli bir sonuçtur.

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**TARLA TARIMINDA AGROHOMEOPATİ KULLANIM OLANAĞINA BİR  
ÖRNEK: FASULYE TOHUM BÖCEKLERİ BRUCHUSLAR (*Acanthoscelides obtectus*  
Say) İLE MÜCADELE**

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**Özet**

Homeopati benzeri benzerle tedavi ilkesine dayanan doğal bir tedavi yöntemidir. Bitki hastalıkları, zararlıları ve hasarlarının mücadelesinde homeopati prensiplerinin homeopatik remedi kullanılarak yapılmasına agrohhomeopati denmektedir. Agrohhomeopati doğal, organik, biyodinamik tarımda güvenli, kimyasal içermeyen kalıcı ve etkili bir tedavi yöntemidir. Fasulye baklagiller ailesi içerisinde hastalık ve zararlılara karşı oldukça hassas bir bitkidir. Özellikle kuru tane yetiştiriciliğinde Bruchus 'lar (tohum böcekleri) tanenin gıda veya tohum olarak kullanımını engelleyecek kadar önemli zararlar verebilmektedir. Bu çalışmada tohum böcekleri ile fasulyede agrohhomeopatik yöntemle mücadele olanaklarının araştırılması amaçlanmıştır. Samsun şartlarında üretilmiş fasulyeden çıkan bruchuslardan hazırlanan ve farklı potenste olan remediler (Bruchus-C30, Bruchus-D12) ve Sulphur-C200, Allium cepa, toplam dört remedi ve kontrol parseli olmak üzere beş işlem üç tekrarlamalı tesadüf blokları deneme deseninde incelemeye alınmıştır. Remediler bitkiler çiçeklenme ve bakla bağladığı dönemde iki kez uygulanmıştır. Hasat sonrası her bir parselden alınan tohumlar iki farklı ortamda (cam kavonoz ve plastik şişe) önce 5 ay süre ağızları kapalı daha sonra üç ay ağızlarına tül geçirilerek oda şartlarında depolanmıştır. Örneklerde böcekli tane sayısı, böcekli tohumların toplam tohum ağırlığına oranı ve böcekli tohum sayılarının yüzdeleri belirlenmiştir. Yapılan varyans analizine göre remedilerin istatistikî etkisi belirlenmemiştir. Ancak gözlemlerimize göre Allium cepa ve Bruchus-D12 potens remedinin daha temiz taneler verdiği belirlenmiştir. Depolama ortamının delikli tane sayısının toplam tane sayısına oranının istatistikî farklılığı olduğu tespit edilmiştir. Tanedeki en yüksek delik sayısı 16 adet ile kontrol parselde sayılmıştır. Delikli tane sayısının toplam tane sayısına oranı % 0.83-49.4 arasında değişmiştir. Agrohhomeopati özellikle ekolojik dengenin bozulmaması, gezegenin doğal kaynaklarının gelecek nesiller için korunarak aktarılmasını temel alan doğal, organik, biyodinamik tarımda bir çıkış yolu olabilir. Sağlıklı sonuçlar verebilmek için daha fazla sayıda çalışmanın yapılması gerekmektedir. Bu deneme bu amaca hizmet için ilk tecrübemizdir.

**Anahtar Kelimeler:** Agrohhomeopati, fasulye, bruchuslar, depolama ortamı

**AN EXAMPLE OF THE USE OF AGROHOMOEOPATHY IN FIELD  
AGRICULTURE: CONTROL TO BEAN SEED WEEVILS (*Acanthoscelides obtectus*  
say)**

**Abstract**

Homeopathy is a natural treatment method based on treating like with like. Agrohomoepathy is the use of homeopathic remedies to apply the principles of homeopathy in controlling plant diseases, pests and damages. Agrohomoepathy is a safe, chemical-free, permanent and effective treatment method in natural, organic, and biodynamic agriculture. Beans are a susceptible plant to diseases and pests in the legume family. Especially in dry seed cultivation, *Bruchus* can cause significant damage to prevent the use of grain as food or seedlings. This study aimed to investigate the possibilities of combating weevil in beans with agrohomoepathic methods. A total of four remedies *Bruchus*-C30, *Bruchus*-D12, Sulphur-C200, *Allium cepa* remedies and control parcel three replications with the randomized complete block design were examined. Remedies were applied two times when the plants were in flowering and pod setting time. After harvest, the seeds taken from each parcel were stored in two types of containers (glass jar and plastic bottle) under room conditions. Firstly, the seeds were closed for five months and then covered with tulle in their mouths for three months. According to the analysis of variance, the statistical effect of remedies on all characters was not determined. However, according to our observations, it has been determined that *Allium cepa* and *Bruchus*-D12 potency remedy give cleaner seeds. It has been determined that there is a statistical difference in the ratio of the number of perforated grains to the total number of seeds in the storage medium. The highest number of holes (16 holes) in the seed was counted in the control plot. The ratio of perforated seeds to the total number of seeds varied between 0.83-49.4%. Agrohomoepathy can be a way out of natural, organic, biodynamic agriculture based on preserving the ecological balance and transferring the world's natural resources for future generations. A large number of studies are required to give healthy results. This trial is our first attempt to serve this purpose.

**Keywords:** Agrohomoepathy, bean, *Bruchus*, stored container



## Introduction

Homeopathy is a natural treatment method based on treating similar with similar. Although homeopathy was first mentioned in ancient Greek writings and during the time of Hippocrates, it was developed, named, and introduced into the literature under specific rules by German doctor Samuel Hahnemann approximately 220 years ago (1796). The law of similars, which forms the essence of homeopathy, means "a substance can cure a person suffering from a disease with symptoms similar to those it causes when given to a healthy person." Hahnemann's principles are universal and can be applied to many biological systems (Lorenzo et al., 2021). Applying homeopathy principles and using homeopathic remedies to manage plant diseases, pests, and damages is called Agrohomoepathy. Agrohomoepathy is a safe, chemical-free, permanent and effective treatment method used in natural, organic, and biodynamic farming (Mergan, 2021). Homeopathy is derived from nature, using all natural materials such as plants, animals, minerals, and microorganisms (Agah et al., 2014). The first Agrohomoepathy practices are recorded as having been initiated by Boenninghausen (1785–1864). Secondly, Darwin applied the remedies given to him by his homeopathic doctor to potted plants. Scientific studies date back to 1986 (Kaviraj, 2011). It is reported that approximately 300 homeopathic preparations with various plant species and mineral salts were tested under the guidance of Rudolf Steiner by the Austrians Eugen and Lili Kolisko in 1923 (Agah et al., 2014). In her article "The Agriculture of Tomorrow," Lili Kolisko mentions agrohomoepathy (Moodie, 2015). The common view of all these individuals is that Agrohomoepathy increases the vital force of the plant, balances the soil, and permanently cures diseases with a systemic approach without any side effects. Agrohomoepathy remedies alter the physiological activities of plants, leading to changes in enzyme concentration and activity, as well as total sugar, protein, and chlorophyll content in plants (Patel, 2022). The European Union, which we aim to join, signed the European Green Deal in 2019, aiming to make Europe the first carbon-neutral continent by 2050. While fighting climate change, the Green Deal set seven strategies to revitalize the economy, improve human health and quality of life, and protect nature (Hanedar et al., 2023). As a country striving to join the European Union and a significant exporter of agricultural products, we must develop systems that consider this. One of these systems could be Agrohomoepathy, which can potentially be a safe, chemical-free, permanent, and effective treatment method in natural, organic, and biodynamic farming (Agah et al., 2014). Since 1960, the number of studies in Agrohomoepathy has been increasing each year worldwide (Méndez et al., 2021). Applying homeopathic preparations in agriculture can contribute to environmentally friendly crop production, potentially increasing farmers' income by reducing the costs of chemical fertilizers and pesticides. However, more studies are needed to clarify its effects on agriculture (Méndez et al., 2021). Agrohomoepathy is one of the newest approaches in agricultural research (Sen et al., 2018). Highly diluted homeopathic remedies are currently used for better seed germination, soil improvement, seedling growth, flowering, fruiting, protection against diseases, and overcoming environmental stresses (Sen et al., 2018). Our region has a temperate climate. Samsun is an important province for both fresh and dry bean cultivation. In this geography, especially in low-altitude areas, the flowering period of beans coincides with temperatures ideal for insect egg-laying, causing damage that can result in the loss of up to 100% of the crop. Sulejmani (2019) reported that the average ratio of damaged bean seeds in non-sprayed warehouses in Macedonia was 42.5%. For this reason, dry bean cultivation in our region is mainly carried out in towns in the interior, where the climate is closer to continental or high-altitude areas. There are various methods for combating *Bruchus* pests, the most effective being fumigants used to treat seeds. However, these types of chemicals contain high levels of heavy metals, posing problems for human health and the environment. This study was conducted based on the idea that Agrohomoepathy could be an alternative solution to combat insect damage in beans in conventional and organic farming.

## **Materials and Methods**

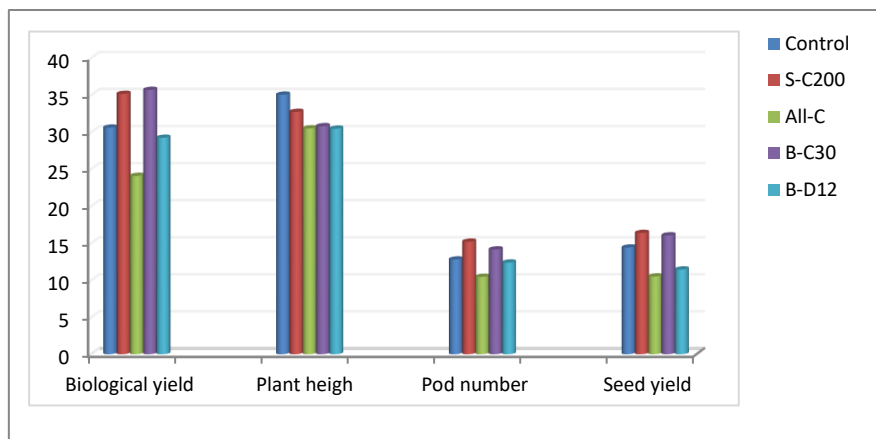
The bean seeds to be used in this study were planted on 13 May, 2022, using the Zülbiye variety at the Bafra farm of the Black Sea Agricultural Research Institute. Two of the homoeopathic remedies to be used Bruchus-C30 (B-C30), Bruchus-D12 (B-D12) were prepared from weevils collected from beans grown under Samsun conditions in the previous year at the Gülderman farm. A total of five treatments were applied, including Sulphur-C200 (S-C200) and Allium cepa (All-C) remedies, along with a control. The experiment was conducted using the randomized complete block design with three replications. The beans were planted in 4 rows with 50 cm spacing between the rows. A 1-meter distance was left between the plots and a 2-meter distance between the blocks to prevent the remedies from mixing. The remedy dose was adjusted to 2.5 ml in 5 litres of water. The remedies were applied during the flowering stage of the bean plants, with a second application at the beginning of pod formation. The remedies were administered using a clean sprayer.

The beans were harvested and threshed on the first week of September, and their plant characteristics were determined. Samples taken from each plot were stored in two different containers (glass jars and plastic bottles) with closed lids for five months, after which they were covered with tulle and stored under room conditions. When the bean sowing time arrived in 2023 (May 2023), insect measurements were made. Statistical analysis of the data was done using a randomized complete block design.

## **Findings and Discussion**

The aim of this study is to see the effect of remedies on stored seeds. However, due to the presence of sulfur in the remedies used in the experiment, not only stored seeds but also bean plant characteristics were determined. Bean sowing was carried out in May. Sulphur is the most important and broad-spectrum remedy. It is effective in cases such as weather variability (cold, humidity), fungal diseases, creeping and flying pests, neglected plants, fungal spore development, and powdery mildew symptoms (Lehner et al., 1991; Siqueira et al., 2010; Mendez et al., 2021). All-C can be used for pests and fungal and bacterial formations (Mergan, 2021). The other Bruchus remedies, explicitly derived from Bruchus weevil, are used exclusively against them.

In the dry harvest time, biological yield per plant (g), plant height (cm), number of pods in the plant, dry seed yield (g) in the plant were determined (Figure 1). As a result of the variance analysis, statistical difference was not found in the plant characteristics. This is an expected outcome because there is no concept of preventive measures in homoeopathy. Remedies are used when there are problems such as illness, pests, lack of nutrition, and stress conditions.



**Figure 1.** Some plant characteristics of beans treated with different remedies and stored in different containers

Bruchus (seed weevils) are classified into two types based on the number of generations they produce. The species observed in beans can produce multiple generations. They are seen from the first week of May in our region. These include adults that fly in from storage areas as well as those that have overwintered in natural conditions. From the second half of Jun, bean pods set, females of weevil lay their eggs on the pods during this period. They continue to reproduce in the products moved to storage. They can produce 5–6 generations per year. The emerging larvae feed inside the seeds and emerge as adults. In addition to crop loss, they also cause a reduction in germination capacity. In a laboratory study conducted in Brazil, the development of *Acanthoscelides obtectus* from egg to adulthood was examined between 16°C to 32°C. The development of *A. obtectus* was determined to be 11.1°C and 36.1°C, with an optimum temperature of 30.3°C. The maximum emergence of adults from infested seeds occurred between 20°C and 28°C (Soares, et.al. 2015).

**Table 1.** Infestation status of beans applied with different remedies and stored in a different container

Container	Remedy	perforated seed number (%)	mean number of holes per seed	max. number of holes	weight of perforated seed (%)
Plastic bottle	Control	9.22	1.14	15	14.95
	S-C200	0.83	5.98	3	6.56
	All-C	4.86	0.33	1	7.41
	B-C30	7.40	0.6	1	8.49
	B-D12	8.59	1.18	1	6.63
	<b>Mean</b>	<b>6.18 b</b>	<b>1.84</b>		<b>8.80 PI</b>
Glass jar	Control	49.40	2.48	>16	22.87
	S-C200	8.84	2.48	1	16.44
	All-C	13.35	1.48	3	20.41
	B-C30	5.70	0.04	10	22.22
	B-D12	30.30	0.83	3	30.24
	<b>Mean</b>	<b>21.44 a</b>	<b>1.46</b>		<b>22.43</b>

Insect inspections of bean seeds stored for eight months are given in Table 1. It was determined that the ratio of the number of insecticide grains to the number of grains placed in storage showed a statistical difference in the storage container. This value, which was 21.44% in glass

jars, decreased to 6.18% in plastic bottles. As seen in Table 1, the value in the control process was the highest. However, there was no statistical difference between remedy procedures. It was determined that the maximum number of holes in a single seed was 15 in a plastic bottle and more than 16 in a glass jar (Figure 2). The fact that there are so many holes in a small bean seed proves how vital the pest bruchus is for our region.

The weights of the perforated seeds were determined, and their ratio to the stored grains was calculated. This value, which was 8.8% on average when stored in plastic bottles, increased to 22.44% in glass jars. Özdem (1997) reported in Eskişehir conditions that the life cycle of *A. obtectus* is 70-80 days in the field, and while it gives one offspring in the fields, it provides three offspring per year in the stored environment.

It has been established that when the temperature rises above 20°C, the development of the insect accelerates, ancak erginlerin yaşam süresini kısalttığı belirlenmiştir. Dişi erginlerin 24-28°C arasında yumurtlamalarının en yüksek seviyeye ulaştığı belirlenirken, It was observed that adult emergence from contaminated grains was at a maximum level between 20-28°C (Soares et al., 2015). In our study, it was observed that insect damage increased rapidly due to the increase in the storage temperature in the stored seeds from March.





**Figure 2.** Photos from trial examples

### **Conclusion and Recommendations**

The increasing global population and the economic crises experienced worldwide are leading to a rise in food insecurity and food safety issues. Additionally, the extensive use of chemicals in conventional agricultural methods increases chemical pollution in agricultural products, threatening the life of all organisms and the environment. All these reasons make it necessary to seek new approaches in agriculture. In this context, Agrohomoepathy, which refers to using homoeopathic methods to combat plant diseases, pests, and damages in agriculture, emerges as a non-toxic and natural solution. Agrohomoepathy, a natural process that can eliminate environmental pollution, particularly from pesticide inputs, and does not threaten human health, could serve as a new avenue for solution. With agrohomoepathy, soil and microorganisms remain unharmed, not creating pollution in products, the environment, or water resources. Although no statistical difference was found among the remedies used against seed weevil (*Bruchus*) in our study, it was observed that All-C and B-D12 potency remedies provided the best results. Storage in plastic bottles as a storage medium has yielded healthier results. Probably in the first five months, the insects die due to air depletion in the bottle because the lids are closed.

In homoeopathy, follow-up after diagnosis and treatment is very important. If there are no results, the correct remedy was not used. If there is improvement, an additional dose can be applied. However, since seed weevils like *Bruchus* are inside the seeds, monitoring recovery during the application period is impossible. Continued studies will be beneficial, primarily by ensuring that the plant is in full bloom during the application of remedies, performing more than two applications, and testing not only soil applications but also plant applications. This is important because the conditions for using remedies in homoeopathy are crucial. Mistakes made in this process can also affect the results. In the last sentence, it can be said that homoeopathy is a new approach that will be used in agriculture.

### **Thanks and Information Note**

I would like to express my gratitude to Gülderman Farm, which prepared the *Bruchus* remedies and from which I received the first training on agrohomoepathy.

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# KARDEŞ BİTKİLERLE YETİŞTİRİLEN FASULYEDE TOHUM BÖCEĞİ (*Acanthoscelides obtectus* Say) ZARARI

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## Özet

Kardeş bitki sistemi bitkilerin sinerjistik etkilerini dikkate alarak bir arada yetiştirilmesini ifade eder. Sistem bitkilerin gölge oluşturma, toprağa besin maddesi sağlama ve dengeli kullanma, yaralı böcekleri çekme, zararlı böcekleri kaçırma özelliklerinden yararlanır. Türk mutfağının en önemli ham maddelerinden birini oluşturan fasulyenin en önemli problemlerinden biri tohum böceği olarak bilinen *Bruchus*'lardır. Bu böcekler özellikle ılıman iklim bölgelerinde fasulye yetiştirildiğinde neredeyse ürünün % 100'ünü yok edebilmektedir. Böcekler ile ilgili arazide ve depoda başarılı kimyasal mücadeleler olmakla birlikte doğa ve sağlık dostu yetiştiricilikte kardeş bitki sistemlerinden yararlanmak mümkündür. Bu çalışma kardeş bitkilerin fasulyenin tohumlarında *bruchus* zararına etkisini belirlemek amacıyla yürütülmüştür. Deneme tarla şartlarında 4 farklı kardeş bitki Mor ve Yeşil Reyhan (*Occimum bacilicum*), Kadife çiçeği (*Tagetes patula*), Aynısefa (*Calendula officinalis*) bitkileri ile birlikte ekilen Zuhul fasulye çeşidinin tohumlarıyla yürütülmüştür. Hasatları yapıldıktan sonra 2 farklı ortamda (pet şişe, cam kavanoz) 1 yıl süre ile depolanan fasulye tohumlarında *bruchus* zararları tespit edilmiştir. Delikli tane yüzdesinin kardeş bitkilerden istatistiki olarak etkilendiği tespit edilmiştir. Tohumlarda tanedeki delik sayısı, delikli tane sayısı, delikli tane ağırlığı belirlenmiştir. Delikli tane yüzdesi % 2.27-17.93 arasında değişmiştir. Tanedeki delik sayısı 1-2.1 adet olmuştur. En az böceklenme yeşil reyhan bitkisinde, en çok böceklenme ise mor reyhan ile kontrolde tespit edilmiştir.

**Anahtar Kelimeler:** fasulye, *bruchus*, kardeş bitki



## BEAN WEEVIL (*Acanthoscelides obtectus* Say) DAMAGE IN BEANS GROWN WITH SOME COMPANION PLANTS

### Abstract

The companion plant system refers to the co-cultivation of plants, considering their synergistic effects. The system takes advantage of the plants' ability to create shade, provide nutrients to the soil, and use them balanced, attracting injured insects and repelling harmful insects. One of the most critical problems with beans, one of Turkish cuisine's most important raw materials, is *Bruchus*, known as seed beetle. These insects can destroy almost 100% of the crop, especially when beans are grown in temperate climatic zones. Although there are successful chemical controls on insects in the field and in storage, it is possible to benefit from companion plant systems in nature and health-friendly cultivation. This study was carried out to determine the effect of companion plants on *bruchus* damage in bean seeds. The experiment was carried out with the seeds of the Zuhal bean variety planted together with 4 different companion plants, purple and green sweet basil (*Occimum bacilicum*), Marigold (*Calendula officinalis*) and French Marigold (*Tagetes patula*), under field conditions one year. *Bruchus* damages were detected in bean seeds stored in 2 different environments (plastic bottles, glass jars) for one year after harvesting. It was determined that the percentage of perforated seeds was statistically affected by companion plants. In seeds, the number of holes in the seed, the number of perforated seeds, and the weight of perforated seeds were determined. The percentage of perforated seeds ranged from 2.27 to 17.93. The number of holes in the seed was 1-2.1. The green basil plant detected the least infestation and the most infestation in control with purple basil. While the companion plant is used against insects in beans, at the same time, 8.2 kg of calendula, 4.5 kg of green basil, 3.7 kg of marigold and 4.7 kg of purple basil dry plant weight were obtained per decare.

**Keywords:** Bean, *Bruchus*, companion plant

## Introduction

Companion planting in gardening and agriculture is planting different crops in proximity for many different reasons, including weed suppression, pest control, pollination, providing habitat for beneficial insects, maximizing use of space, and increasing crop productivity (Frank, 1983). In companion planting systems, the aim is to use the useful properties of plants to each other and to prevent them from harming each other. The properties of plants that are harmonious and beneficial to each other, such as creating shade, providing nutrients to the soil, attracting injured insects, and repelling harmful insects, are used (Kireç, 2020). The system is based on planting compatible plants close to each other and incompatible plants far from each other. Although there are primary examples in horticulture, when applying the system, covering crops, row edges, or strip-like sowing uses mixed planting methods in field agriculture.

One of the most important edible legume pests is *Bruchus*, or seed weevil. Female beetles usually lay their eggs on the seeds of legumes. One female can lay about 50-100 eggs. The larvae hatched from the eggs begin to feed, burrowing inside the seed. The larvae complete their development by feeding inside the seed. Adult insects emerge from the seed, spread to the environment, and search for new host seeds. Temperature and humidity have an important role in the life cycle of this insect. They usually multiply faster in warm environments. A generation develops at 25°C in about 4-5 weeks (Sulejmani, 2019). *Bruchus*, which have this life cycle, are common in our region, especially in places with low altitudes.

For this reason, the people of the region do not prefer dried beans grown in the districts close to the sea; they prefer the products of the high-altitude districts of the region. In the fight against insects, fumigants work well. However, these drugs pose a health risk, and different methods need to be developed to combat them, especially in organic agriculture. Companion planting systems may be one of them. *Calendula officinalis* L. is a floral resource because it offers abundant nectar and pollen (Zhao et al., 2017).

This study used marigold, french marigold, green and purple sweet basil, which have been accepted as guardian plants since ancient times (Franch, 1986), as sister plants for tagetes beans. This study was planned with the hypothesis that when beans are grown with these plants without changing the planting norm, it is possible to get more than one product from the same area and reach healthy and insect-free seeds. The aim is to determine the status of dry bean *bruchus* insect damage grown with plants.

## Material and Method

The experiment was established in May 2021 on the land of the Black Sea Agricultural Research Institute in Bafra, using the Zülbiye bean variety. The experiment was conducted with a randomized complete block design. Purple basil (P), Green basil (G) (*Occimum bacilicum*), Marigold (*Calendula officinalis*) and French marigold (*Tagetes patula*) plants were used as companion plants and a control plot was added where only beans were sown. The companion plants were planted with seeds and became seedlings under greenhouse conditions. In the experiment, beans were sown in 4 rows with a row spacing of 50 cm in plots of 2x5 m in size. The companion plant seedlings were planted on all borders and middle, that is, between the 2nd and 3rd rows, of the plots, with the emergence of the beans in equal numbers (95 plants) in all plots. A distance of 2.5 m between blocks and 3 m between parcels was left, and cowpea was sown in these areas to screen for insect movements. The field experiment was carried out considering the cultivation techniques of beans. Following the dry harvests, the dry bean seeds were stored in 2 different environments (plastic bottle and glass jar) and kept in room conditions for about 8-9 months until the next bean sowing time. The number of insects with holes in the seeds, the number of holes in a seed, and the number of intact seeds were determined. The data

were subjected to analysis of variance and were made with the DUNCAN test with a 5% probability of grouping with statistically different features.



**Figure 1.** Photos of companion plants grown in the greenhouse

### Findings and Discussion

One hundred bean seeds were taken from the bean seeds, which were harvested in September, placed in both plastic bottles and glass jars and stored with their mouths closed. When the bean planting time (May) of 2022 approached, insect observations were made in the stored seeds. As a result of the variance analysis, the statistical effect of companion plants on the observed characteristics was not found to be significant. Still, it was determined that the storage environment statistically impacted the other features, except for the hundred seed weight of the seeds placed in storage (Table 1).

The number of holes in one of them ranged from 0-3.54 pieces. The average number was 0.37 pieces in the plastic bottle and 2.3 pieces in the glass jar. The ratio of infested seeds in 100 seeds placed in storage was 0.37% in plastic bottles and 23.81% in glass jars. This difference was found to be statistically significant. It has also been visually seen from the shrinkage of the bottle that there may be air intake in glass jars even if their lids are closed, but in plastic bottles, the air is depleted due to the inhalation of seeds and insects since the bottles are made of soft plastic. This is especially important for bruchus and contributes to their death. However, this does not mean that there are no insects in the seed. When consumption as food is considered, it is expected that the insect is not in any life form in the seed.

**Table 1.** Insect observations in experiment samples

Store media	Plants	100 seed weight	mean number of holes per seed	perforated seed number (%)	weight of perforated seed (%)
Plastic bottle	Control	34.11	0.33	0.70	1.75
	Sweet basil (P)	53.32	0.66	2.63	7.68
	Marigold	37.36	0	.86	2.70
	Sweet basil (G)	31.92	0.86	2.68	2.19
	Tagetes	30.36	0	0	5.58
	Mean	37.41	0.37 <b>b</b>	1.37 <b>b</b>	3.98 <b>b</b>
Glass jar	Control	34.5	2	8.68	5.67
	Sweet basil (P)	33.23	3.54	31.36	14.37
	Marigold	36.35	1.96	33.71	13.45
	Sweet basil (G)	31.6	0.83	1.47	2.35
	Tagetes	30.86	3.16	43.82	12.10
	Mean	33.31	2.3 <b>a**</b>	23.81 <b>a**</b>	9.56 <b>a**</b>

Marigold (*Calendula officinalis* L.), or French Marigold (*Tagetes patula*), is another medicinal herb suitable for companion planting (Franch, 1986). *Tagetes* genera of Asteraceae has almost 56 species distributed worldwide. They are usually cultivated as ornamental plants and used for medicinal purposes. Various *Tagetes* species are used to treat several health problems, including

abdominal, ear, dental, skin, gastric, emotional, nervous disorders and muscular pain (Wilén et al. 2004). *C. officinalis* can increase available resources for natural enemies used in agricultural crops, notably in greenhouses (Zhao et al. 2016). Marigold is a plant that grows between 30-60 cm in length, has pubescent branches, and annual, herbaceous orange flowers are used as food, cosmetics and dyestuffs, and its use in traditional and complementary medicine applications is increasing day by day (Ayran, ve Kan, 2022). The calendula plant's flowers are used in treating many diseases in the health sector, as well as food, cosmetics and dyestuffs (Wilén vd., 2004). They reported that marigold plant height was 33.28-35.65 cm, flower number per plant 2.70-3.63, and wet flower yield ranged between 81.5-147 kg per decare at different planting times in Konya conditions (Ayran, ve Kan, 2022). In our observations, the average number of flowers per plant in marigolds was found to be 14.2 and 34.22 cm in height (Table 2).

Sweet basil (*Ocimum basilicum* L.) species, known by the Turkish name Reyhan or Fesleğen, is a more common plant of purple-coloured types in Western and Southern Anatolia, especially in eastern provinces, where there are around 65 species around the world (Telci ve ark., 2005). Sweet basil is a pharmaceutical and aromatic plant in warm climates (Frach, 2017). In a study conducted in Ordu province, it was determined that the plant height of basil genotypes was 52.33 cm-15.66 cm, and green herbal yield was 84.00-200.33 g/plant according to the formation time (Karaca ve ark., 2017). Our green and purple basil experiment determined that the three plant characteristics examined were similar (Table 2).

**Table 2.** Some characteristics of companion plants grown together with beans

Plant	Plant height**	Flower yield (kg/da)	Biological yield ** (kg/da)
Marigold	34.22 b	22.44	142.15 a
Sweet basil (P)	46.41 a	21.97	70.24 b
Tagetes	20.16 c	22.90	51.36 c
Sweet basil (G)	47.50 a	24.98	65.16 b

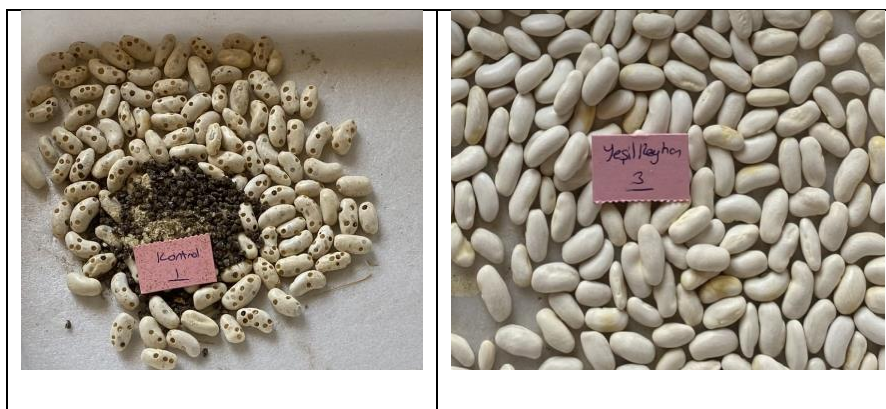
\*\* p<0.01 significant

Although there is no statistical effect of companion plants on insects in beans, we believe they are important because other products other than beans are grown in the same area. In Marigold and Frech Marigold, only the flowers were harvested, and in the case of green and purple basil, the terminal spike part was harvested, and the flower yields were determined by taking their dry weights in the air. According to the calculation, 22.44 kg of marigold, 21.97 and 24.98 kg of basil and 22.9 kg of tagetes were obtained per decare. Again, air-dried plant yields ranged between 51.36 and 142.15 kg. These values allow the grower to be a source of income other than beans (Figure 2).



**Figure 2.** Appearance of companion plants with beans grown in the field

While calendula and tagetes are among the most studied plants worldwide due to their pharmacological properties, basil is a remarkable plant in the food industry due to its aromatic properties. However, due to their insect-attracting and repellent effects, they are among the most used plants in organic and especially biodynamic farming systems. Riaza et al.(2020) reported various traditional uses in Asian countries that need to be scientifically investigated in depth, and several pharmacological activities have been reported for the *Tagetes patula*. Although there were no statistical differences between the repetitions in terms of the height of the variance in our study, it is seen that there are severe differences in terms of insecticide compared to the control (Figure 3).



**Figure 3.** Insect status in the seeds of the control and green basil plot

### **Conclusion and Recommendations**

In nature, all living things live in a balance. Although rotation is made in today's agricultural systems, a monoculture-based production model is common. These models bring many problems and create the necessity of finding solutions. The companion planting system, one of the systems that follow nature, is based on growing plants that are positively affected by each other. Companion planting systems are primarily used in horticulture around the world. However, the logic of the intercropping cultivation system in field agriculture comes from here. In our country, and especially in our region, traditional intercropping cultivation systems such as corn and beans have been studied more. In recent years, the increasing popularity of the consumption of medicinal, aromatic plants has increased the expected benefit in companion planting systems due to the properties of the aromatic ones of these plants. Their ability to attract insects, repel harmful insects, etc., is one of the reasons why we are working on the subject. Seed insects are a significant problem when dry beans, which are the most important

raw material of our food culture in our country, are grown in geographies where the altitude is low. The definitive fight against insects is without spraying with fumigants using heavy metals after harvest. However, the fact that these drugs threaten human health and the introduction of healthier and most importantly methods that will not adversely affect the sustainability of the environment will contribute to the sustainability called the fifth agricultural revolution. The proliferation of such studies will allow the grower to grow products from the same area at alternative prices, and the main product will be protected. Our work continues by standardizing storage conditions and environmental conditions. It is seen that it is suitable to store in soft PET bottles as a storage medium. The interactions of carbon dioxide in the pet and whether gas outlets are emitted from the pet should also be examined.

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## DETERMINATION OF THE EFFECT OF GRAZING ON BOTANICAL COMPOSITION IN A SOWN PASTURE

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### Abstract

This study was conducted to determine the effects of grazing on the botanical composition of a sown pasture established with different plant species. The experiment was established at the Black Sea Agricultural Research Institute Ambarköprü Research Station in the 2022-2023 growing season, and observations and measurements were taken in the second year of the experiment (2024). A mixture of orchardgrass (*Dactylis glomerata* L.), perennial ryegrass (*Lolium perenne* L.), white clover (*Trifolium repens* L.), chicory (*Cichorium intybus* L.) and plantain (*Plantago lanceolata* L.) plants was used as plant material. The pasture mixture was grazed in April, May and June, and the botanical composition changes of the species forming the mixture were determined according to the weight pre and post grazing. When the botanical composition ratios of the plants were examined. The ratio of white clover varied between 12.1-34.3%, the ratio of orchardgrass varied between 7.9-19.2%, the ratio of perennial ryegrass varied between 2.2-17.2%, the ratio of plantain was 17.2-45.1% and the ratio of chicory varied between 15.3-41.7%. From the beginning to the end of grazing, it was determined that the plant species with the sharp-decrease in botanical composition was perennial ryegrass. In addition, it was determined that the inclusion of chicory and plantain in the mixture contributed to the extension of the grazing period.

**Keywords:** sown pasture, chicory, plantain, botanical composition



## Introduction

The nutritional requirements for high-quality roughage in animals are met through forage crops cultivated in agricultural fields and from pasture and meadow areas. In our country, except for corn silage, the area of forage crops has been stable in recent years and the production amount is very limited. When climate, soil and plant characteristics are taken into account, a partial increase in feed production can be provided by improving existing pastures. In places where natural pastures cannot meet the need or their productivity is low and their structure is damaged, it is of great importance to establish sown pasture facilities in order to reduce the pressure on these areas and to provide forages. The quality of forage in pastures is largely determined by the botanical composition (Samuel and Hart, 1998). Not only legume and grass plants, but also some plants belonging to other families are important in terms of the quality of pastures (Kemp et al., 2010). Plant species such as chicory and plantain increase the digestive efficiency in the rumen due to their high content of phytochemicals (phenolic compounds, tannins, etc.) compared to commonly used plants, and also contribute to the health of animals by supporting their immune systems (Barry, 1998; Moorhead et al., 2002; Li and Kemp, 2005). The inclusion of plantain and chicory in mixtures contributes to the extension of the grazing period of the pasture (Wilson et al., 2020). This study was conducted to determine the changes in plant species in the botanical composition during lamb grazing in a pasture mixture with different plant species.

## Materials and Methods

In the study, the effect of lamb grazing on the botanical composition was investigated in a forb-based mixture that supported by TUBITAK (project number 122O241). The experiment was established at the Black Sea Agricultural Research Institute Ambarköprü Research Station in the autumn of 2022. This study was carried out in the grazing season of 2024 (Second grazing year). The soil properties of the experimental area are 1.23% organic matter, 6.8% CaCO<sub>3</sub>, 55.0 kg/da potassium, 2.0 kg/da phosphorus (P<sub>2</sub>O<sub>5</sub>). In addition, the physical structure of the experimental area is salt-free, clayey-loam and slightly alkaline (pH 7.35). The meteorological data of air temperature and precipitation during the season of the site are shown in Table 1. The highest monthly total precipitation during the grazing period was 83.7 mm in March, but the lowest was 7.8 mm in June, and the highest air temperature was 23.7 °C in June.

**Table 1.** Monthly total precipitation mean air temperature in Çarşamba from January to August, 2024)\*

Month	Precipitation (mm)	Air Temperature (°C)
January	69,9	8,7
February	24,6	10,3
March	83,7	10,2
April	8,8	16,1
May	56,7	15,8
June	7,8	23,7
July	179,6	25,9
August	86,8	24,9

\*Source Samsun Meteorological Service

In this experiment, orchardgrass (*Dactylis glomerata* L.) perennial ryegrass (*Lolium perenne* L.), white clover (*Trifolium repens* L.), chicory (*Cichorium intybus* L.) and plantain (*Plantago lanceolata* L.) were used as plant materials (Table 2).

**Table 2.** Sowing rates (%) of pasture mixtures

Common Name	Latin Name	Cultivar	Origin	Mixture Rate (%)
White clover	<i>Trifolium repens</i> L.	Nadide	Adana	15
Orchardgrass	<i>Dactylis glomerata</i> L.	Taya	Erzurum	15
Perennial ryegrass	<i>Lolium perenne</i> L.	Belida	Belçika	18.3
Chicory	<i>Cichorium intybus</i> L.	Antler	Amerika	17.3
Plantain	<i>Plantago lanceolata</i> L.	Boston	Amerika	16.1

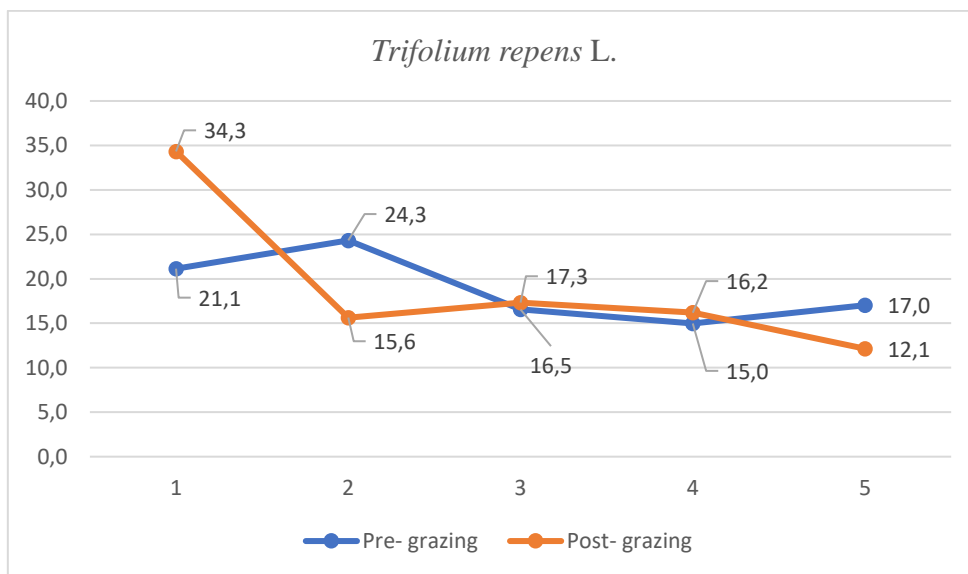
A 1 da paddock was divided into three 0,33 da paddocks to provide rotational grazing. Five rotation were performed in the grazing period. Weaned Karayaka lambs (2.5-3 months old) were used in this experiment. Three cutting were performed for each grazing paddock by using 0.25 m<sup>2</sup> quadrats post and pre grazing. Fress samples were weighed and seperated as species to determine botanical composition. Fresh samples were weighed and separated as species to determine botanical composition. The cutting dates were shown in Table 3.

**Table 3.** Cutting dates of pre and post grazing.

Grazing periods	Cutting dates	
	Pre-grazing	Post-grazing
1	10.04.2024	12.04.2024
2	20.04.2024	24.04.2024
3	3.05.2024	11.05.2024
4	22.05.2024	28.05.2024
5	11.06.2024	17.06.2024

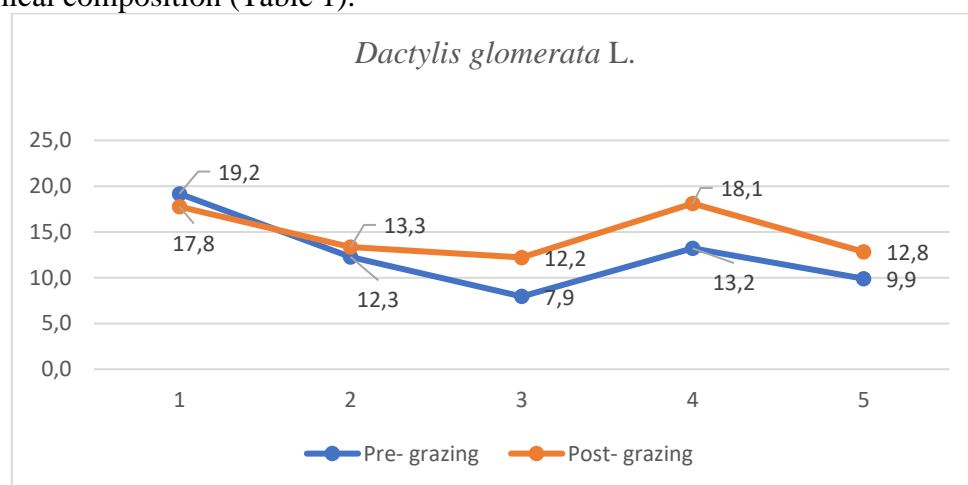
## Discussion

The effect of lamb grazing on the botanical composition in a mixture with different forage plant species was investigated. The proportions and changes of the species within the botanical composition were examined individually. White clover (*Trifolium repens* L.) is the most commonly used species among clovers for grazing purposes. It is not only resistant to grazing and trampling but also provides high-quality and nutritious forage (Pederson, 1995; Nichols et al., 2012). White clover is widely used in pasture mixtures due to its ability to fix nitrogen, rapid regrowth after grazing, natural self-regenerated capability, and high nutritional value (Açıkgöz, 2021). Considering the grazing periods, the highest proportion of white clover in the botanical composition pre-grazing was observed during the second grazing period at 24.3%, while the lowest proportion was recorded during the fifth grazing period at 17.0%. Post-grazing, the highest proportion of white clover was determined in the first grazing period at 34.3%, and the lowest in the fifth grazing period at 12.1%. White clover showed rapid growth during the first grazing period, despite the continuation of grazing (Figure 1). White clover is the first plant species preferred by lambs during grazing due to its high protein content and palatability. However, after the third grazing period, lambs preferred white clover less frequently due to its flowering stage. It has been reported that the presence of cyanogenic glycosides in white clover and the increase in these compounds during the flowering period lead to reduced preference by animals (Petrović et al., 2016). Although white clover is a grazing-resistant species with competitive characteristics, when grown alongside taller and faster-growing species, competition for light, water, and nutrients arises. Particularly in periods of limited rainfall, white clover's shallow root system puts it at a disadvantage compared to deep-rooted plants (Frame and Newbould, 1986). Therefore, to maintain the proportion of white clover in the botanical composition, grazing intensity should be reduced during periods of increased drought.



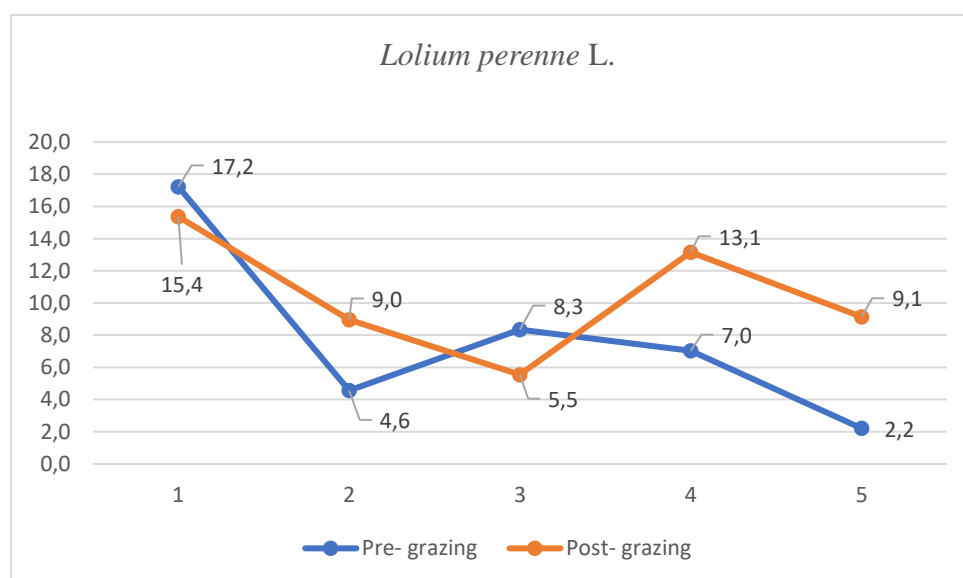
**Figure 1.** Botanical composition of pasture on offer (%) showing contributions from white clover.

Orchardgrass (*Dactylis glomerata*) is one of the earliest-growing grass forage species in spring. It forms an excellent spring pasture due to its rapid growth in cool spring months and superior tillering ability. It also creates a good mixture with legumes (van Santen and Sleper, 1996; Açıkgöz, 2021). Among grass forage species, orchardgrass has one of the highest tolerances to shade. Before grazing, the highest proportion of orchardgrass in the botanical composition was recorded in the first grazing period at 19.2%, while the lowest proportion was observed in the third grazing period at 7.9%. In the post-grazing, the highest proportion of orchardgrass was determined in the fourth grazing period at 18.1%, which was slightly higher than the initial value of 17.8% observed at the beginning of grazing (Figure 2). After the third grazing period, increased rainfall led to a renewed rapid growth tendency in orchardgrass, resulting in a higher proportion in the botanical composition during the fourth grazing period. Although orchardgrass is drought-tolerant, soil moisture significantly influences its development and spread. High soil moisture supports the development of the plant's root system and promotes its growth (Clark and Adams, 2020). However, under low soil moisture conditions, the growth rate of the plant may decrease, and its productivity may decline (Johnson et al., 2018). In this study, the low rainfall in April (8.8 mm) caused a slight decrease in the plant's proportion within the botanical composition (Table 1).



**Figure 2.** Botanical composition of pasture on offer (%) showing contributions from orchardgrass.

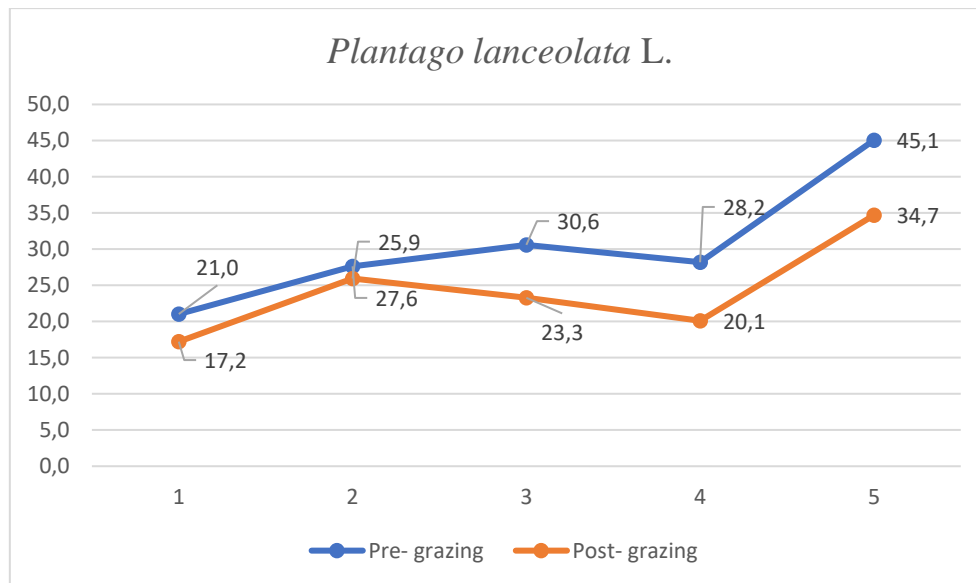
Perennial ryegrass (*Lolium perenne*) is one of the most important grass forage species in temperate regions due to its ease of establishment, rapid regrowth after cutting or grazing, and its high quality of forage (Açıkgöz, 2021). It is short-lived perennial, so it is mainly used in the establishment of short-term (3-4 years) pastures. It is widely utilized in short-term pastures and at the initial stages of long-term pastures because it produces palatable forage, maintains its palatability and nutritional value in later stages, regrows rapidly after grazing, and has a high digestibility (Jung et al., 1982; Atış and Hatipoğlu, 2008; Ogle et al., 2008). The highest proportion of perennial ryegrass in the botanical composition was observed pre-grazing, at 17.2% in the first grazing period, while the lowest proportion was recorded at 2.2% in the fifth grazing period. In the post-grazing, the highest proportion of perennial ryegrass was determined, 15.4% in the first grazing period, with the lowest proportion being 5.5% in the third grazing period (Figure 3). In addition to grazing pressure, the sharp increase in temperatures during June, reaching an average of 23.7°C, led to a lower proportion of perennial ryegrass in the botanical composition compared to other species (Table 1). Excessive reduction in soil moisture inhibits the growth of perennial ryegrass and may even lead to its drying, which becomes more pronounced during the summer season (Miao et al., 2022). Perennial ryegrass does not perform well in regions with high air temperatures and tends to withdraw from the vegetation in a short period (Blasko et al., 1995). Moreover, overgrazing weakens the root systems of perennial ryegrass, obstructs plant development, and reduces its proportion in the botanical composition (Zainelabdeen et al., 2020).



**Figure 3.** Botanical composition of pasture on offer (%) showing contributions from perennial ryegrass

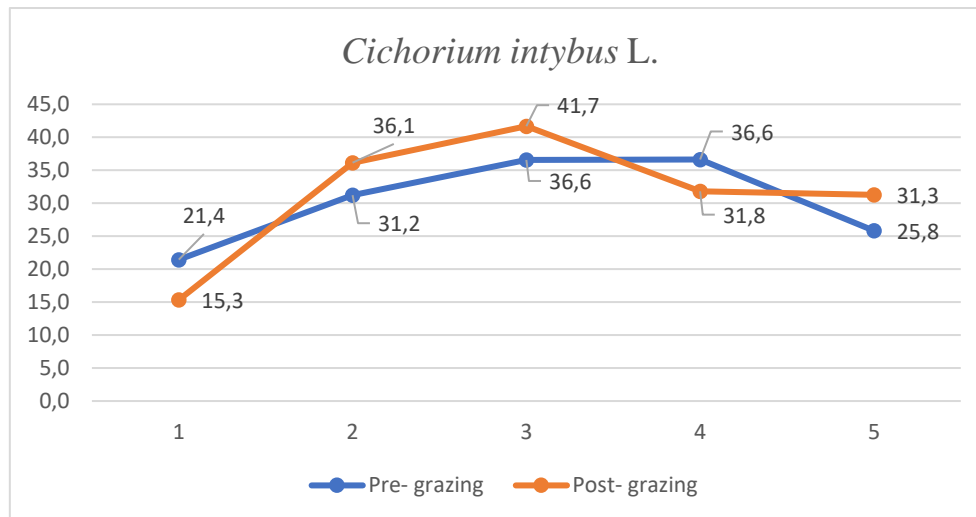
Plantain (*Plantago lanceolata*) is common in the natural pastures of Türkiye, is one of the important alternative forage species used to enhance the phytochemical diversity of forage plant mixtures (Pain et al., 2015). It can be utilized by grazing, for hay production, or as silage. It can grow any soil condition and is tolerant to drought as well as many common diseases and pests (Wilson et al., 2020). Plantain is highly palatable and preferred species by livestock. It provides high quality of forage with high mineral contents particularly calcium, magnesium, and sodium. Pasture mixtures with plantain contribute to reducing internal parasite burden in animals due to its secondary compounds with anthelmintic effects (Minnee et al., 2017; Wilson et al., 2020). The highest proportion of plantain in the botanical composition was observed before the fifth grazing period (45.1%), while the lowest proportion was recorded after the first grazing period (17.2%) (Figure 4). Due to its early spring root system development and lower susceptibility to drought, plantain is the plant species with the highest proportion in the botanical composition

at the end of grazing. Its strong root system, capable of penetrating deep into the soil, makes it a drought-tolerant plant (Pol et al., 2021). Recently, plantain has been added to pasture mixtures alongside legume and grass forage species. The primary reason for this is to enhance the nutritional value, dry matter yield, and especially the mineral content of legume + grass mixtures during the summer and autumn periods. The superior growth of plantain during the summer compared to other plants significantly supports the performance of both sheep and cattle. With proper grazing management, plantain can provide feed for cattle for about 2-5 years. It is recommended not to graze plantain during late autumn and winter, or if grazing is necessary, to maintain a stubble height of 8 cm (Cranston et al., 2015).



**Figure 4.** Botanical composition of pasture on offer (%) showing contributions from plantain

Chicory (*Cichorium intybus*) is a highly palatable forage plant, known for its high digestibility, non-structural carbohydrate content, mineral richness, drought tolerance, and its beneficial effects in preventing bloat and parasite formation in livestock. It is particularly valuable as a high-quality feed during the summer season (Barry, 1998; Athanasiadou et al., 2007). The most common application of chicory is in pasture mixtures. Under dry conditions, it produces high-nutritional-value forage in rotationally grazed pastures (Ditsch and Sears, 2007). Since its growing period exposed to summer season, when many plants in pastures either dry out or enter dormancy, chicory helps extend the period of high-quality forage availability (Kemp et al., 2002). The highest proportion of chicory in the botanical composition was observed at the end of the third grazing period (41.7%), while the lowest was recorded after the first grazing period (15.3%) (Figure 5). During the third grazing period, when rainfall was at its lowest, chicory had the highest proportion in the botanical composition. Chicory is one of the most suitable forage crops to grow with plantain thanks to its taproot system. The plant's characteristics and its secondary compounds contribute to its drought resistance, making chicory a valuable forage species for the Mediterranean climate zone. Its ability to continue growing during the summer months, when many plants either dry out or become dormant, is reported to help extend the grazing period in pastures (Molle et al., 2008).



**Figure 5.** Botanical composition of pasture on offer (%) showing contributions from chicory.

Compared to other forage species, chicory and plantain has importance to increase their proportions in the botanical composition under grazing pressure. Chicory can maintain its presence in mixtures for 4-5 years under rotational grazing conditions; however, under heavy grazing conditions, its proportion in mixtures tends to decline within 2-3 years (Hare et al., 1990). Heavy grazing conditions, especially during dry summer periods, leads to a reduction in the proportion of these plants in the botanical composition in subsequent years. To prevent rapid rarefying, it is essential to avoid grazing on rainy days and during the winter season, and to ensure that grazing is carried out with sufficient rest periods for the plants (Li et al., 1997).

### Conclusion

In this study, botanical changes of plant species in the mixture under grazing pressure were investigated. Monitoring the effects of grazing and climate factors on plants is extremely important for the sustainability of sown pastures. Since the nutritional content of each plant is different, it is extremely important to conduct similar studies in order to estimate the nutrients consumed by animals during the grazing period and to determine the grazing preferences of animals. The change in the proportions of plants in the botanical composition in the sown pastures created will help in making decisions such as reducing grazing pressure in the pasture or closing the pasture to grazing. In addition, it was concluded that plants such as chicory and plantain should be included in the mixture in order to extend the vegetation period of the sown pasture and to pass the drought period without any problems. In order to provide healthier suggestions, these studies should be carried out for at least 2-3 years.

### Acknowledge

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## IMPORTANCE OF HUMIC ACID IN AGRICULTURAL PRODUCTION AND ITS USE IN AGRICULTURE

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### **Abstract**

The problem of inadequate animal production in our country is getting worse every year and product prices are constantly increasing. Increasing the area of forage crops in agricultural system will contribute to sustainable and efficient agricultural production as well as roughage production. Forage crops should be given more place in the crop rotation systems in terms of effective and efficient use of our natural resources and sustainability of the agricultural system. Areas that we can define as marginal due to various problems can be evaluated by producing forage crops with various improvement measures. Soil quality is one of the most important elements that determine the productivity of the plants and sustainability in agriculture. The amount of organic matter it contains is one of the most important elements that determine the productivity of the soil. Our agricultural lands are mostly insufficient in terms of organic matter. It is quite difficult to add the required amount of organic matter to all our agricultural lands in a short time. For this reason, quality and yield increases can be achieved in our soils by applying humic and fulvic acid, the most active components of organic matter and humus. Humic acid is a natural substance responsible for increasing soil cation exchange capacity, regulating pH, and protecting and improving against stress factors such as salinity. Humic acid application is very effective on yield and quality, as it improves soil properties and helps convert some nutrients into forms that the plant can use. In this study, the importance of humic acid in agricultural production and its use in agriculture will be evaluated.

**Keywords:** Humic acid, soil properties, marginal lands, forage crops

## **Introduction**

While it is obvious that agricultural production should be increased in terms of quantity and quality in order to feed the increasing population in a healthy and balanced way, our production resources, agricultural lands, pastures and water resources, have been continuously decreasing over the years. In addition, our country is one of the geographies most negatively affected by climate change resulting from global warming. In recent years, agricultural drought, which has been increasing in severity and frequency, decrease in water resources, salinization in soil and water resources, excessive heat, seasonal shifts, floods and inundations not only reduce production resources but also negatively affect yield and quality. Sustainable agriculture is an important choice to reduce climate change. Agricultural soils have gradually lost their organic matter in the past centuries. One of the practices encouraged for sustainability in agriculture is to increase soil organic matter. For this, plant and animal residues such as barnyard manure, plant residues (stubble), green manure, composts and leonardite should be used intensively in our agricultural areas. However, since it is not possible to add sufficient amounts of organic fertilizer to all our soils, the productivity potential of our soils can be increased by applying much smaller amounts of humic and fulvic acids, which are the active fractions of organic matter and humus, compared to organic fertilizers. Because the main reason for the positive effects of organic fertilizers on soil properties is the many organic compounds released by the decomposition and breakdown of microorganisms in the soil and the humus whose structure is formed by humic and fulvic acids (Stevenson, 1982).

Despite the important place of agriculture in our country's economy, the consumption of animal products such as meat, milk and eggs, which are indispensable components of adequate and balanced nutrition, is far below that of developed countries. While the increase in animal production and consumption is parallel to the development level of the country, this increase is closely related to animal health and performance (Özkan, 2016). Access to quality roughage is a basic necessity for a healthy and high-performance animal husbandry. Feed costs constitute approximately 70% of the total expenses in a livestock enterprise. The amount of quality roughage needed by our animal husbandry is approximately 90 million tons of dry grass equivalent for 2023. The amount of roughage provided from forage crops and meadow pasture areas produced in field agriculture can only meet half of the need. In addition to the low productivity and insufficiency of our pasture areas, which are one of the main sources of roughage, the production of forage crops in field agriculture is also quite low (11.0%) (TUIK, 2024).

In order to meet the quality roughage needs of animals, a partial increase in roughage production can be achieved by improving existing pastures. In places where natural pastures cannot meet the need or their productivity is low and their structure is damaged, it is of great importance to establish forage crops and sown meadow-pasture facilities within field agriculture in order to reduce the pressure on these areas and to provide roughage. In addition to these, production can be made with forage crops that can best utilize these areas in marginal lands in order to reach the required quality roughage production target. This situation is also very important in terms of improving marginal areas and contributing them to the economy. It is very clear that there is a need for alternative forage crops that can be grown in agricultural areas affected by drought, salinity, acidity, wetness, ground water, stony, insufficient soil depth, excessively high or low temperatures and erosion. Although many organic resources are used for more active use of the organic matter of the soil, humic acid has become one of the leading organic soil amendment materials in recent years. The use of alternative organic matter sources such as humic acid in plant production is necessary for increasing yield, quality and economic gain, reducing the risk of environmental pollution and sustainability of soil fertility. It has been determined that humic acid, especially when used in appropriate concentrations, has positive effects on increasing

growth and development in plants, as well as eliminating the negative effects of stress factors such as salinity and drought and toxic amounts of elements (Chen and Aviad, 1990). However, sufficient studies are needed on the optimal dose for different types of forage crops.

### **Importance of Humic Acid and Its Effect on Soil Properties**

The most important factor determining the productivity of a soil is the amount of organic matter it contains. The most important element of organic matter is humus, and the most active substance of humus is humic acid. Humic substances are the most important components that show the productivity power of the soils (Pettit, R.E. 2006). Application of humic substances is extremely important in terms of obtaining maximum efficiency, quality and economic gain in plant production, keeping the risk of environmental pollution at a minimum level and sustainability of soil productivity (Chen and Avaid, 1990).

Researchers have determined that humic acid increases the permeability of cell membranes in plants (Vallini, G., et al., 1993; Valdrighi et al., 1996; Varanini et al., 1995), affects microbial activities (Mayhew, 2004); in addition, humic and fulvic acids increase the availability of nutrients by forming complex compounds with nutrients or chelating with metallic cations (Lobartini et al., 1997). They reported that humic acid has a positive effect on plant development due to the hormone-like substances in its structure (Casenave de Sanfilippo et al., 1990). They also reported that the application of humic and fulvic acids increased the enzyme activities in the seed, promoted germination, and increased the germination rate, root and shoot growth (Pagel, 1960; Dixit VK. and N.Kishore, 1967; Schnitzer and Poapst, 1967; Ali-Zade and Gadzhieva, 1977; Rauthan and Schnitzer, 1981). In addition, humic acids slow down the evaporation of water in the soil, neutralize the soil pH, and have a buffering effect in a wide pH range.

**Effect of Humic Acid on Physical Properties of Soil:** Humic acids physically improve the structure and texture of the soil. They provide soft and easily workable properties to the soil. They break up clayey and compacted soils and create a soft and permeable structure. They increase the soil's ability to hold air, the germination rate of the seed, and reduce water evaporation from the soil. This allows the microflora population in the soil to develop. They also contribute to the development of roots by aerating the soil. They darken the color of the soil, allowing it to absorb more solar energy. Since they increase water retention capacity, they provide erosion resistance and the resistance of plants to drought (Akinci, 2011; Senn and Kingman 1973).

**Effect of Humic Acid on Biological Properties of Soils:** The natural carbon (30-36%) in the humic acids allows the beneficial microorganisms of the soil to multiply and become active. The energy released as a result of the oxidation of organic carbon keeps the soil in the root area of the plant warm and increases the plant's resistance to cold and frost (Senn and Kingman, 1973). It also increases the amount of organic matter in the soil. It converts the plant nutrients (N, P, K, Ca, Mg, Fe, Zn, Mn, Cu and B etc.) into an absorbable form, maximizing their uptake by plants. Some fungi formed as a result of the biological activities of microorganisms in the soil ensure the reproduction and release of natural antibiotics into the soil. Natural antibiotics make plants more resistant to infectious diseases in the soil. Thus, pesticide consumption is reduced by providing natural protection in plants (Benz et al., 1998). They stimulate plant enzymes (H-ATP) and can also act as catalysts in biological processes. Thus, water and nutrient uptake by plants increases. Humic acids are also used as biostimulants and have a positive effect on plant growth through interactions with roots, microorganisms and soil (Du Jardin, P. 2015). Humic acids increase cell energy in the plant. They accelerate cell division, leading to plant growth, development and higher quality of the product. The sufficient intake of nutrients and

pigments by plants ensures that the plants are healthier, stronger and more resistant to external effects, and that the fruits are larger, more evenly sized, more showy, more vibrantly coloured and ripe (Duncan et al., 1981; Ay, 2015). They increase the thickness of cell walls in fruits (products), extending the life and storage period of the product. They also increase the resistance of the plant to cold, heat and physical effects (Akıncı, 2011 Duncan et al., 1981).

**Effect of Humic Acid on Chemical Properties of Soil:** One of the most important chemical properties of soil is soil pH (soil reaction). It also affects the uptake of nutrients by plants from the soil. The unique feature of humic acids is that they have a buffering effect in a wide pH range. This buffering capacity is very important for plants growing in a narrow pH range. (Stevenson, 1994). Humic acids neutralize soil pH. When soil pH is neutralized, many microelements that are bound in the soil and not taken up by plant roots become available (Yılmaz, 2007; Stevenson, 1994).

Humic acids prevent elements such as iron from crystallizing and can chelate such metals and keep them around the root in a way that the plant can easily use. Thus, they help eliminate Fe deficiency (Kulikova et al., 2005). Humic acids create an extremely important environment for the transfer of elements from the soil to the plant. The root system also has negative charges like humic acids, so the microelements bound to humic acids are separated and passed from the membrane of the root cells to the plant (Kulikova et al., 2005; Yılmaz, 2007). The biochemical feature of humic acids is that they clean the soil from harmful pollutants and toxic substances. Humic acids interact with pesticides and herbicides and form stable structures, making them harmless to plants and groundwater. They also ensure that lead, mercury, cadmium, and radioactive elements, industrial wastes, poisons and chemical substances harmful to the environment, present in the soil, are transformed from soluble to insoluble. In this way, they are prevented from being absorbed by the plant and the soil is cleaned as they settle to the bottom over time (Helal et al., 2006).

It has been determined by various studies that humic acids have a positive effect on plant growth, mineral uptake, and quality and healthy production (Ferrara et al., 2007; Salman et al., 2005; Pılanal and Kaplan, 2003; Bidegain et al., 2000). Humic substances also release CO<sub>2</sub> from CaCO<sub>3</sub> (Lime) in the soil, allowing plants to absorb carbon dioxide and use it in photosynthesis (Stevenson, 1994). They regulate soil pH by eliminating excess salinity and calcification (Yılmaz and Alagöz, 2005; Mac Carthy, 2001).

Humic acid has a chemically active character and forms soluble and insoluble complexes with various metals, minerals, and organic substances in the soil. This feature allows the plant to easily and continuously absorb nutrients. In this way, it maximizes the uptake of some macro and micro elements in the soil by the plant. It increases the cation exchange capacity of the soil and increases soil fertility (Stevenson, 1994; Mac Carthy, 2001; Yılmaz and Alagöz, 2005).

The various functional groups (carboxyl, phenolic, alcoholic, etc.) in humic molecules form complexes with metals in many different ways. These act as natural chelates. The reason why humic substances form stable complexes with metal ions is related to the functional groups on them (Stevenson, 1994). It has been determined that there is a competition between the functional groups on humic acid for the binding of metals. These functional groups form metal-organic complexes with metal ions, metal oxides, metal hydroxides and minerals (Kerndorff and Schnitzer, 1980). The cation exchange power of humic substances is considerably higher than clay minerals (Stevenson, 1994). Therefore, all necessary metals found in the soil can form chelate with humic acids.

Humic acid prevents nitrate leaching in soils and provides a guarantee for the use of plant nutrients. This is important in filtering and cleaning both drinking and irrigation water. When mixed with liquid or solid animal fertilizers, it also reduces the unpleasant odor of these fertilizers (Ay, 2015; Stevenson, 1994). In short; the fact that their application areas are so wide

and their source is from nature shows that humic acids (humic substances) have great importance in today's industry and can be used in many new areas. For this reason, humic substance associations and research centers have been established in many developed countries, especially in the USA.

### **Use of Humic Acid in Agriculture**

Our country is one of the geographies most negatively affected by climate change, which is a result of global warming, which is a problem for the whole world. In recent years, agricultural drought, which has been increasing in severity and frequency, decrease in water resources, salinization in soil and water resources, excessive heat, seasonal shifts, floods and inundations not only reduce production resources, but also negatively affect yield and quality. Sustainable agriculture is an important choice to reduce climate change. Agricultural soils have gradually lost their organic matter in the past centuries. One of the practices encouraged to combat climate change is to increase soil organic matter.

The organic matter content is reported to be low in 70.5% of our country's agricultural lands and very low in 18.04%, which is at a level that will prevent the highest efficiency in agricultural production (Sönmez et al., 2018). In addition, as a result of intensive chemical fertilization, the amount of organic matter in the soil and therefore the humus ratio decreases. The main substance of the organic material in the soil is humus. Humus is generally formed by plant parts waiting for many years under the soil and maintains the fertility of the soil in the ecological system. Humic acids constitute a large part of the components in humus. Humic substances, which cover 65-70% of the organic matter in the soil, are naturally occurring, chemically stable, have high molecular weight, are resistant to deterioration, heterogeneous and complex organic molecules with colours ranging from yellow to black (Mac Carthy, 2001). Humic acids facilitate the plant's uptake of some nutrients, vitamins and trace elements from the soil. Although many organic sources are used to increase the organic matter content of soils, in recent years humic acid has become one of the leading materials used for the active use of the organic matter content of soil and increasing the efficiency in plant production. The use of alternative organic input sources such as humic acid in plant production is necessary for increasing yield, quality and economic gain, reducing the risk of environmental pollution and sustainability of soil fertility. Humic substances are important components of the soil and while they change the physical, chemical and biological properties of the soil in terms of plant development and indirectly increase the productivity in the soil, they directly promote physiological and metabolic functions in the plant. The positive effects of humic acid on plants are related to many factors such as increased water and nutrient intake, increased usability of elements, development of the plant root system, high chlorophyll content, changes in enzyme and nucleic acid activities in the plant, protein synthesis, changes in membrane permeability, respiration and photosynthesis (Tejada and Gonzalez, 2003; Ulukan, 2008; Sabzevari et al., 2010). It ensures that plants are stronger, healthier and more durable, and that fruits are more showy, larger, of equal size and in vibrant colours. It increases seed germination, development of roots and aboveground parts and flowering (Gezgin et al., 2012). Many researchers have found that humic acid has a positive effect on plant growth and development, and when applied in low amounts, it affects development positively; however, it has been understood that it is ineffective or negative when applied in large amounts (Chen & Aviad 1990; Padem & Öcal 1999; Demir & Çimrin, 2011). Researchers have stated that humic acid helps the uptake of nutrients by increasing the permeability of the cell membrane in plants (Valdrighi et al 1996); and have reported that it has a positive effect on plant development due to hormone-like substances in their structures (Caseneva de Sanfilippo et al., 1990).

It was found that different doses of humic acid applications in fresh onion (*Allium sativum* L.) and lettuce (*Lactuca sativa* L.) increased plant fresh weight by 7.07-28.82% and 15.61-48.94%,

respectively, depending on the humic acid doses compared to the control. When the humic acid doses were evaluated, it was determined that especially 1000 ppm dose in fresh onion and 500 ppm dose in lettuce were more effective on plant development and quality (Kibar, 2022). The effects of humic acid applied to lettuce plants grown in pots at levels of 0, 130, 260 and 390 mg kg<sup>-1</sup> from the soil on plant development and nutrient content were investigated. They reported that humic acid increased the fresh and dry weights of plants, root and stem length, root fresh and dry weights, leaf area, and N, P, K, Mg, Fe, Mn and Zn contents in the leaf compared to the control (Kıran et al., 2013).

In a study conducted to investigate the effect of humic acid on the development and plant nutrient content of tomato seedlings (*Solanum lycopersicum* L.), humic acid was added to the nutrient solution at 0, 640, 1280 and 2560 mg L<sup>-1</sup> levels. It was determined that with the addition of 1280 mg L<sup>-1</sup> level of humic acid, N, Ca, Fe, Zn and Cu accumulation in the roots increased, while P, K, Ca, Mg, Fe, Mn and Zn contents increased in the shoots. When the results obtained from 2560 mg L<sup>-1</sup> humic acid application were compared to 1280 mg L<sup>-1</sup>, more N, P, K, Fe and Cu accumulation was observed in the shoots (David et al., 1994). According to the results of the study investigating the effects of different doses (0, 4, 8, 12, 16 and 20 L da<sup>-1</sup>) of TKİ-Humas (humic + fulvic acid source) + NPK applications on tomato plant nutrition, statistically significant increases were found in the N, P, Fe, Cu contents of tomato plants with increasing amounts of TKİ-Humas application, while the increases in K, Mg, Ca, Mn and Zn contents were not found to be significant (Demirtaş et al., 2014). As a result of an experiment conducted to determine the effects of different levels of humic acid applications (0, 4, 8, 12, 16 and 20 L da<sup>-1</sup> TKİ-Humas) on iron nutrition, chlorophyll amount and cell membrane permeability of tomato plants grown under field conditions, it was determined that different levels of humic acid + NPK applications increased the iron, chlorophyll a, chlorophyll b and total chlorophyll contents of leaf samples (Asri et al., 2013). In a study conducted to determine the effects of humic substance applications (0, 250, 500 and 750 mg L<sup>-1</sup>) on plant development and yield in pickling cucumber (*Cucumis sativus* L.) grown in stagnant water culture, it was reported that the yield per plant and per m<sup>2</sup> increased with humic acid application and the highest yield was obtained from 500 mg L<sup>-1</sup> humic acid application (Doğa, 2012).

In red lentil (*Lens culinaris* L.) plant, the highest grain yield among different amounts of humic acid applied to the soil (control, 2, 4, 6 and 8 L da<sup>-1</sup>) was obtained from 8 L da<sup>-1</sup> humic acid application (Öktem et al., 2017). In an experiment using different humic acid doses, it was determined that 20 mg L<sup>-1</sup> level of humic acid applied to chickpea plant increased the aboveground parts of the plant, root development and dry matter content (Ali-Zade and Gadzhieva, 1977). They stated that humic acid (10 and 100 mg L<sup>-1</sup>) applied to the nutrient solution had a positive effect on the dry weight of pea (*Pisum sativum* L.), plant nutrient element uptake and seed germination (Senesi et al., 1990). In a study conducted to determine the effects of increasing doses of humic acid (0, 40 kg da<sup>-1</sup>) and zinc (0, 2, 4 kg da<sup>-1</sup>) applications to the growing medium on the development and N, P, K contents of two different chickpea plants, it was determined that in humic acid and zinc applications, the best results were obtained in biological yield (484.83 kg da<sup>-1</sup>), grain yield 291.51 kg da<sup>-1</sup>, plant height (33.10 cm), number of pods (11.12 pieces), grain yield per plant (5.19 g), and number of grains (9.27 pieces), respectively, from 40 kg da<sup>-1</sup> humic acid application and 4 kg da<sup>-1</sup> zinc dose application (Ünsal et al., 1990). 2008).

A pot study was conducted to determine the effects of increasing doses of humic acid applications (0, 1000, 1500 and 2000 ppm) on some characteristics of maize (*Zea mays* L.) grown in a calcareous soil. The fresh and dry weights of the root and above-root parts of the maize plant and plant height increased up to a dose of 1000 ppm and decreased significantly after this dose. Although humic acid applications caused decreases in the root microelement contents of maize, this was not found to be statistically significant and as a result, it was

concluded that 1000 ppm doses were the most suitable (Demir and Çimrin, 2011). In a study conducted to determine the effects of different doses of humic acid and phosphorus applied to calcareous soil on the development of corn plants and the availability of phosphorus in the soil, 4 different doses of P (0, 20, 40, 80 mg kg<sup>-1</sup>) and 3 different doses of humic acid (0, 250, 500 mg kg<sup>-1</sup>) were applied to the soil. As a result of the study, it was determined that humic acid applications increased plant dry weight, plant P concentration, the amount of P taken up by the plant and the available P concentration remaining in the soil. They also reported that humic acid was more effective when applied together with P than when applied alone (Erdal et al., 2000). It was determined that increasing humic acid (0, 20, 40 kg da<sup>-1</sup>) applications provided significant increases in the number of grains per ear, ear length, plant length, thousand grain weight and ear number in corn plants and that these increases were highest at the 20 kg da<sup>-1</sup> humic acid dose. Researchers have stated that humic acid applications significantly affect the nitrogen, iron and manganese contents of the grain and the phosphorus, potassium, magnesium and zinc contents of the plant body (Selçuk, 2009).

The effect of humic acid on phosphorus uptake by wheat (*Triticum aestivum* L.) in alkaline soils was investigated in both pot and field experiments. It was reported that the addition of humic acid together with phosphorus to the soil significantly increased the amount of water-soluble phosphorus, thus increasing the plant's phosphorus uptake and grain yield by 25% (Wang et al., 1995). In a two-year study, the effects of humic acid (1.5 kg ha<sup>-1</sup> and 3 kg ha<sup>-1</sup>) and chemical fertilizer (N:P 30:20 kg ha<sup>-1</sup> and 60:40 kg ha<sup>-1</sup>) applications on wheat yield were investigated. In the study, it was reported that with humic acid and chemical fertilizer applications, wheat grain yield increased by 46% in the first year and 24% in the second year compared to the control, and the highest yield increase was obtained with 3 kg ha<sup>-1</sup> humic acid and 30:20 kg ha<sup>-1</sup> N:P (Khan et al., 2010).

The effects of humic acid added at levels of 0, 30, 60, 90 and 120 mg kg<sup>-1</sup> on the development and nutrient uptake of bean (*Phaseolus vulgaris* L.) plants grown in nutrient solution were investigated. The researchers reported that humic acid did not have a significant effect on the dry weight of the plant compared to the control, while it increased the N, P, Fe, Mn and Zn contents of the leaves (Sözüdoğru et al., 1996). A study was conducted to determine the effects of different nitrogen doses (0, 50, 100, 150, 200 mg kg<sup>-1</sup> N) together with different humic acid (0, 75, 150, 225, 300 mg kg<sup>-1</sup>) applications on yield components in bean. The researchers found that the applications significantly increased the amount of dry matter in the 'leaf + stem' of bean, the amount of protein in the product and the amount of total nitrogen. They state that with increasing fertilizer doses, there is a continuous increase in protein amount (Yetim and Yalçın, 2008). A study was conducted to determine the effects of humic acid and chemical fertilizers on the yield and yield components of bean plants in Konya conditions. In the field experiment, 0, 80, 160, 320 and 480 kg ha<sup>-1</sup> solid humic acid and chemical fertilizers were applied together with different amounts of nitrogen and phosphorus [0, 75% (60 kg ha<sup>-1</sup> N + 72 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub>) and 100% (80 kg ha<sup>-1</sup> N + 96 kg ha<sup>-1</sup> P<sub>2</sub>O<sub>5</sub>)]. As a result, it was determined that 160 kg ha<sup>-1</sup> humic acid + 100% chemical fertilizer application was more economical in terms of grain yield (Zengin and Karaman, 2013). In a study conducted to determine the effects of different humic acid (0, 50, 100 mg kg<sup>-1</sup>) and potassium (0, 200, 300 kg ha<sup>-1</sup>) applications on leaf area index and dry matter yield of cowpea plants, it was determined that 100 mg kg<sup>-1</sup> humic acid and 300 kg ha<sup>-1</sup> potassium application increased leaf area index and dry matter yield of cowpea plants at significant levels (Motaghi and Nejad, 2014).

A study was conducted to determine the effect of 12% potassium humate (0, 200 ml da<sup>-1</sup>) application on fresh pod yield and some characteristics of pea (*Pisum sativum* L.) varieties grown in different row spacings (20, 30, 40 cm). The study was carried out for two years in Samsun conditions. The effect of potassium humate application on the number of pods per plant

and fresh pod yield per plant was found to be statistically significant, and its effect on the dry matter ratio of grain was found to be very significant (Bozoğlu et al., 2004).

In a study conducted to determine the effects of humic acid applied to the soil at increasing levels (0, 200, 400 kg ha<sup>-1</sup>) on the development of the cotton plant, yield and yield components and nutrient element contents of the soil, they found that the effect of humic acid on the morphology, yield and some fibre quality parameters of the plant was significant and positive (Kaptan and Aydın, 2012).

A trial was carried out in 2012 in Bafra District of Samsun Province to determine the effects of increasing doses of TKİ-Hümas on grain yield and some nutrient elements contents of flag leaf and grain of Osmancık rice variety (*Oryza sativa* L.). In the trial, TKİ-Hümas was applied to the soil at levels of 0, 4, 8, 12 and 16 L da<sup>-1</sup>. In the trial, 2.25 kg da<sup>-1</sup> N, 3 kg da<sup>-1</sup> P<sub>2</sub>O<sub>5</sub> and 1.5 kg da<sup>-1</sup> K<sub>2</sub>O 15-9-20-10 fertilizer was applied at planting, and 5.25 kg N per decare in the form of ammonium sulfate (21% N) fertilizer was applied during tillering and panicle formation. According to the results of the research, TKİ-Hümas applied at increasing levels caused an increase in grain yield ranging from 9% to 30% compared to the control. In addition, TKİ-Hümas applications provided statistically significant increases in the K, Ca, S, Fe, Zn and B contents of rice plant flag leaves compared to the control (Gezgin et al., 2013).

In a study conducted in Indonesia, the effects of seed (0.5, 1, 1.5 and 2% humic acid solution), leaf (0.05 and 0.1% humic acid solution) and soil (1, 2, 3 kg ha<sup>-1</sup>) applications on pod number, grain number per pod, grain yield, biological yield and thousand grain weight of mung bean (*Vigna radiata* Wilczek) were investigated. As a result of the study, it was stated that humic acid applications in different ways (seed, leaf and soil) statistically significantly increased pod number, grain number per pod, grain yield and thousand grain weight of mung bean, but did not affect biological yield (Waqas et al., 2014). In a study conducted in two different locations, the effects of humic acid applications together with chemical fertilizers on the development, pod yield and quality of mung bean were investigated. For this purpose, 0, 1, 2 and 3 g L<sup>-1</sup> humic acid was applied from the leaves and 35%, 65% and 100% of the recommended NPK amount for the plant was applied from the soil. According to the research results, it was determined that plant height, plant dry and fresh weight, chlorophyll in the pod, pod length, pod weight and N, P, K content increased significantly depending on the humic acid applications (El-Bassiony et al., 2010).

In a study investigating the effects of humic acid application stages and doses on yield, yield components and oil content in sunflower (*Helianthus annuus* L.), it was determined that humic acid application had a positive effect on yield, yield components and oil content, however, the humic acid doses to be applied changed according to the development stages of the plants. It was determined that 18 g da<sup>-1</sup> humic acid application to the soil before planting, 12 g da<sup>-1</sup> in the 4-5 leaf stage and 6 g da<sup>-1</sup> in the miniature head formation stage increased the yield. It was stated that 18 g da<sup>-1</sup> humic acid application to the soil before planting or 12 g da<sup>-1</sup> in the 4-5 leaf stage was more effective than later application of humic acid in terms of high grain yield (Day et al., 2011). In another study on the effect of humic acid on sunflower, it was reported that humic acid applications positively affected both root and seedling development and that a dose of 60 g of humic acid per 100 kg of seed could be applied to sunflower seeds before planting (Kolsarıcı et al., 2005).

Humic acid application (1000 mg L<sup>-1</sup>) eliminated the negative effects of salinity and drought stress and increased the germination of cumin and basil seeds and root and stem growth (Haghighi et al., 2012).

Studies on humic acid application in forage crops are quite few. While forage crop cultivation is increased within field agriculture, ways to obtain more roughage from a unit area should be investigated. In addition, alternative forage crops to be grown should be selected by taking into account the characteristics of marginal areas and humic acid doses that can have a positive



effect on the yield and quality of these plants should be applied. There are many forage crops in our country's natural flora that can best utilize marginal areas and help with their rehabilitation. These plants can be listed as woodland clover (*Bituminaria bituminosa* L.), salt bush (*Atriplex* sp.), soda grass (*Salsola* sp.), medicinal burnet (*Sanguisorba* sp./*Poterium* sp.), narrow-leafed plantain (*Plantago lanceolata* L.), chicory (*Cichorium intybus* L.).

### **Conclusion and Recommendations**

One of the most important factors determining the productivity of the soil is the amount of organic matter it contains. Our agricultural lands are mostly insufficient in terms of organic matter. It is very difficult to add the required amount of organic matter to all our agricultural areas in a short time. For this reason, quality and productivity increases can be achieved in our soils by applying humic and fulvic acid, the most active components of organic matter and humus.

Humic acid is a natural substance responsible for increasing soil cation exchange capacity, regulating pH, and protecting and improving against stress factors such as salinity. Humic acid application is very effective on yield and quality, as it improves soil properties and helps convert some nutrients into forms that the plant can use.

The problem of inadequate animal production in our country is getting worse every year and product prices are constantly increasing. Increasing the area of forage crops in field agriculture will contribute to sustainable and efficient agricultural production as well as forage production. For the effective and efficient use of our natural resources and the sustainability of the agricultural system, more emphasis should be placed on forage crops within the crop rotation systems to be implemented.

Areas that we can define as marginal due to various problems can be evaluated by producing suitable alternative forage crops with various improvement measures. Studies are needed to determine appropriate humic acid doses for different forage crop species and soil characteristics. These studies need to be initiated and supported as soon as possible.

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## DETERMINATION OF EFFECTS OF HUMIC ACID APPLICATION ON GERMINATION PARAMETERS OF CORN (*Zea mays* L.)

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### Abstract

Corn (*Zea mays* L.) is an important forage plant used both as silage and grain with its high nutritional value and productivity. It can be grown as the main and second crop in field agriculture. However, various stress factors encountered in agricultural production can negatively affect corn yield. In this context, some applications are made to seeds in order to support the growth and development of plants and to increase their resistance to stress conditions in the early seedling period. In this study, 5 different doses of humic acid (0, 100, 200, 300, 400 and 500 ml/100kg seed B.A.S 18®) were applied to the seeds of two corn varieties (KEFIEROS and TAREKS644). The study was established according to the Randomized Plot Design with 3 replications. According to the results obtained, the lowest germination rate was determined as 88.33% in the control group without humic acid application, and the highest germination rate (99.00%) was determined in the 400 ml humic acid application. The highest value in terms of seedling length was determined as 8.46 cm in 500 ml humic acid application, and it was in the same statistical group as 300 and 400 ml applications. As humic acid application increased, root development increased and the highest root weight was obtained with 27.20 mg/plant in 500 ml application and was statistically in the same group as other humic acid doses (200, 300 and 400 ml). It was determined that there were differences among the corn varieties in terms of the examined characteristics. Application of humic acid to corn seeds positively affected germination power, root and shoot development. Continuing these studies in different environments will contribute positively to the development of new approaches.

**Keywords:** Corn, humic acid, germination

## **Introduction**

Corn is an important plant used in human and animal nutrition and cultivated in large areas. It is an important warm climate forage plant that produces more dry matter per unit area compared to other species, is easily harvested and is eaten with pleasure by animals. It is evaluated as a green forage yield and silage plant. In our country, corn is grown as a main or second crop. In agricultural production, when planting is planned as a second crop, it is desired for the previous crop to leave the field in a short time. 73% of the corn produced in the world and 70% of the corn produced in our country are used in animal feeding (Yıldız et al., 2017; Çevik, 2012). Access to quality roughage is a basic necessity for healthy and high-performance livestock farming. In a livestock farm, the cost of feed covers approximately 70% of the total expenses. The amount of quality roughage required by our livestock is approximately 90 million tons of dry grass equivalent for 2023. The amount of roughage provided by forage crops and meadow pasture areas produced within field agriculture can only meet half of the need. In addition to the low productivity and insufficiency of our pasture areas, which are one of the main sources of roughage, the production of forage crops within field agriculture is also quite low (13.65%) (TUIK, 2022). In order to meet our roughage needs, solutions must be found that will increase the cultivation area and production of forage crops. Corn is one of the forage crops with high yield potential, which is evaluated as silage and yield in many regions of our country. Corn cultivation area in our country has also increased rapidly in recent years. The area of corn grown for silage purposes in Turkey is approximately 5.3 million da. Total silage corn production is approximately 28.6 million tons (Kardeş, et al. 2023). With the increasing importance of corn, new improved varieties are registered and introduced to the market every year. There are many factors affecting yield and quality in silage corn production. In regions where corn will be grown as a second crop, planting depends on the previous plant leaving the field. Corn seed is an important starting material for healthy plant development, high yield per unit area and quality product. Seed germination, which affects the entire development process of plants, is an important phase involving external factors and hormones found in the plant. During seed planting and germination, problems may occur in seedling emergence due to both environmental and technical problems. In this context, some applications are made to seeds in order to support the growth and development of plants and to increase their resistance to stress conditions in the early seedling period. Humic and fulvic acids are organic soil conditioners that have positive effects on the physical, chemical and biological properties of soils and are effective on the germination, yield and quality of plant seeds. Within the scope of this study, 5 different doses of humic acid (0, 100, 200, 300, 400 and 500 ml/100kg seed BAS 18) were applied to the seeds of two corn varieties (KEFIEROS and TAREKS644).

## **Material and Method**

This study was conducted in the Seed Laboratory of the Field Crops Department of the Faculty of Agriculture at Ondokuz Mayıs University. Seeds of 2 silage corn varieties (TAREKS644 and KEFIEROS) were used in the study. 6 different doses of humic acid (0, 100, 200, 300, 400 and 500 ml/100kg seed BAS 18) were applied to the seeds. BAS 18 contains 18% humic acid + fulvic acid, 4% K<sub>2</sub>O and 10% organic matter. Humic acid doses were applied to the seeds placed in nylon bags with the help of a pipette and then the plastic bag was shaken to ensure contact with the seed. The experiment was conducted using randomized plot design with 3 replications. For each test, 50 seeds and germination paper were used. The temperature was 25 C and equal amounts of pure water was used to the processes in each irrigation. Germination power, shoot length, root weight and shoot weight were determined at the end of the 7th day. Harvested root and shoot samples were dried in the oven at 60 oC until they reached a stable weight. The data obtained as a result of the study were subjected to statistical analyzes

according to the randomized plot design in the JUMP statistical package program, and the differences between the means were controlled with the LSD test (5%).

### Findings and Discussion

In the study, characteristics such as germination power, shoot length, root and shoot dry weight were examined. In terms of germination power, the difference between doses and variety × dose interactions were found to be statistically significant, the groupings and average values of the treatments are given in Table 1. There was no statistical difference in germination power among silage corn varieties, the average germination power value of Tareks variety was determined as 93.66% and Kefieros variety as 92.99%. This rate is in accordance with the laboratory standards (85%) specified by TTSM (Şehirali and Yorgancılar, 2011).

According to the applied doses, the germination rate varied between 88.33% (Control) and 98.99% (HA 400 ml). The highest germination rate was obtained from 400 ml humic acid application and was in the same statistical group as 300 ml humic acid application. 400 ml humic acid application increased germination power by 12.06% compared to the control. When the variety x dose interaction was examined, the responses of the varieties to the humic acid doses were different (Table 1 and Figure 1). In the variety x dose interaction, the lowest germination rate was 88.33% in the control application of the Kefieros variety, and the highest was 99.33% in the 400 ml humic acid application of the Kefieros variety, and they were in the same statistical group as some other treatments (Table 1).

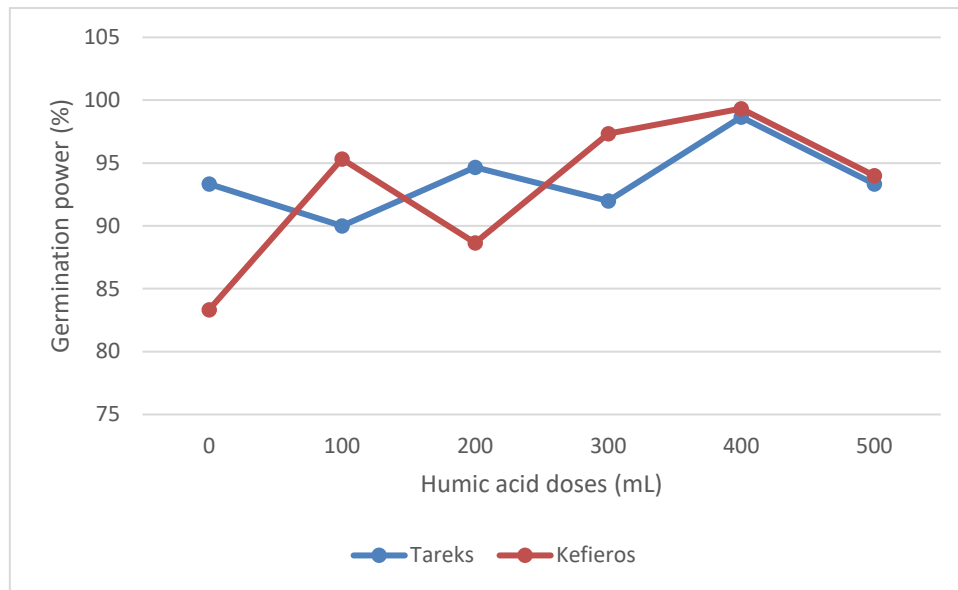
**Table 1.** Average germination power values according to humic acid doses applied to silage corn varieties (%)

Variety/Dose	0	100	200	300	400	500	Avg.
Tareks	93.33abc	90.00 cd	94.66 abc	92.00 bc	98.66 ab	93.33abc	93.66
Kefieros	83.33 d	95.33 abc	88.66 cd	97.33 ab	99.33 a	94.00abc	92.99
Avg.	88.33 C	92.66 BC	91.66 BC	94.66 AB	98.99 A	93.66 B	

CV: 4.47%

Studies have shown that humic acid has positive effects on plant physiology, plant development and nutrition (Chen et al., 2004). In addition, Türkmen et al., (2004) stated that humic acid application in tomato plants has a positive effect on germination. Rodrigues et al., (2017) determined that as humic acid doses in corn plants increase (100 - 500 ml/100 kg seeds), the germination rate increases, but the most suitable humic acid application dose is 158 ml/100 kg seeds.





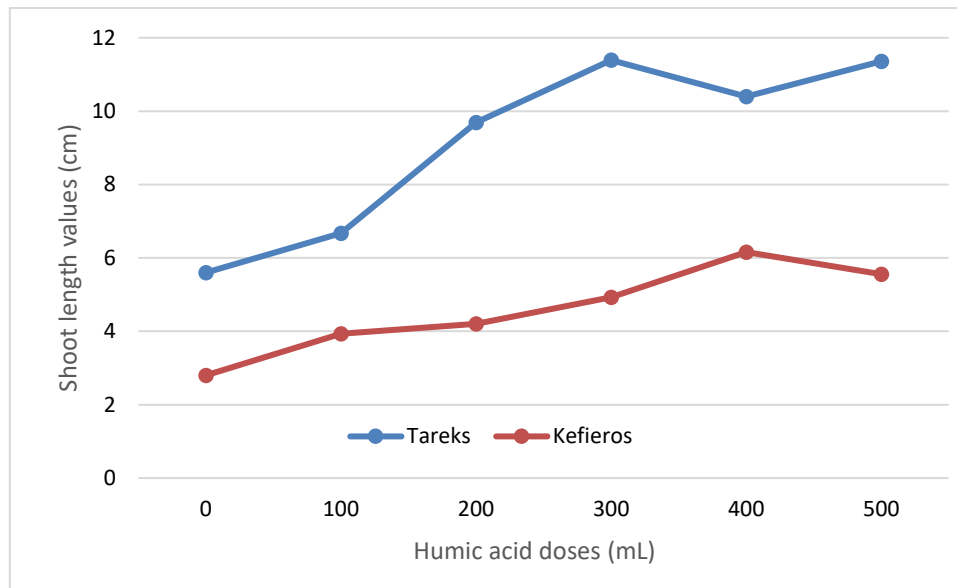
**Figure 1.** Effect of different humic acid doses on germination power in silage corn varieties.

The differences between varieties and doses for the shoot length examined in the study and the variety  $\times$  dose interactions were found to be statistically significant and the groupings and average values of the treatments are given in Table 2. Among the varieties examined, Tareks had the highest shoot length with 9.18 cm. When the averages of the shoot length obtained in different applications were examined, it was determined that the shoot length, which was 4.23 cm in the control application, increased to 8.46 cm in the 500 ml humic acid application (Table 1). According to the variety  $\times$  dose interaction, the longest shoot length was determined in the Tareks variety with 300 ml humic acid application (11.39 cm), and the 200, 400 and 500 ml humic acid applications were in the same statistical group (Table 2 and Figure 2). It has been reported that humic substances increase shoot growth during the germination process (Rosa et al., 2009; Siewerdt et al., 2000; Rodrigues et al., 2017).

**Table 2.** Average shoot length values (cm) according to humic acid doses applied to silage corn varieties

Variety/Dose	0	100	200	300	400	500	Avg.
Tareks	5.60 bc	6.67 b	9.69 a	11.39 a	10.40 a	11.36 a	9.18 A
Kefieros	2.80 d	3.93 cd	4.2 cd	4.93 bc	6.16 b	5.56 bc	4.59 B
Avg.	4.23 C	5.30 C	6.94 B	8.16 AB	8.28 A	8.46 A	

CV: 15.11%



**Figure 2.** Effect of different humic acid doses on shoot length in silage corn varieties.

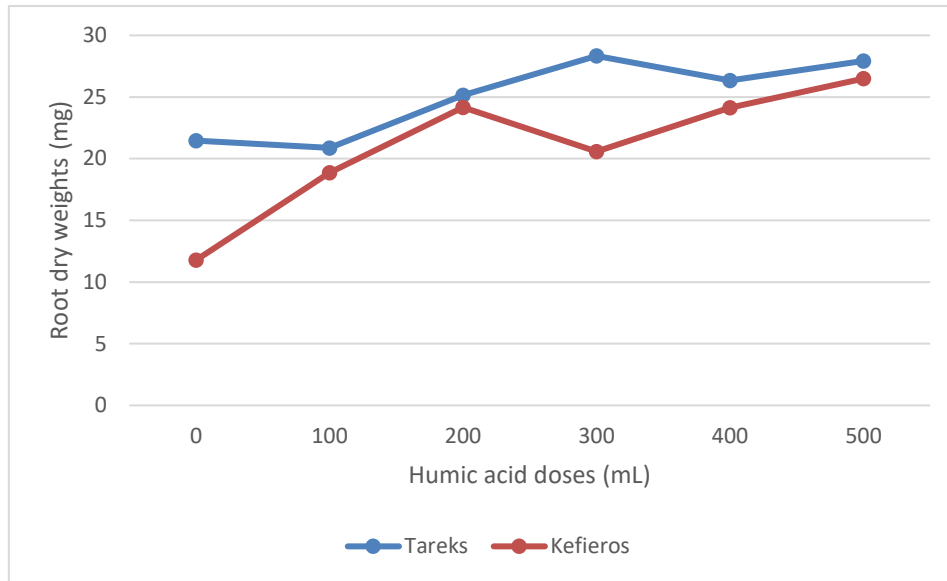
For the root weight examined in the study, the differences between the varieties, doses and variety  $\times$  dose interactions were found to be statistically significant and the groupings and average values of the treatments are given in Table 3.

Among the varieties used in the study, the highest average root dry weight (25.01 mg plant<sup>-1</sup>) was obtained from Tareks variety. Among the doses considered, the highest root dry weight was obtained from 27.20 mg plant<sup>-1</sup> with 500 ml humic acid application, and was in the same group with 400, 300 and 200 ml humic acid applications. Depending on the applied humic acid doses, the increase in dry root weight varied between 47.11 - 63.29% compared to the control. When the status of the varieties in the different applications was examined, the highest dry (28.33 mg plant<sup>-1</sup>) root weight was determined with 300 ml humic acid application in Tareks variety, and the same variety was in the same statistical group with 500 ml humic acid application in Kefieros variety with 500, 400 and 200 ml applications (Table 3 and Figure 3). In the studies, it was determined that dry root weight increased depending on the applied humic acid doses and was positively affected by humic acid application. Rodrigues et al., (2017) determined that the humic acid doses applied to corn plants increased dry root weight. Silva et al., (2000) determined that increasing humic acid doses in perennial ryegrass (*Lolium* sp.) increased dry root weight with 49.23%. Rosa et al., (2009) stated that there was a linear increase in dry root weight in tomato plants in parallel with increasing humic acid doses, and an increase of 41% was observed when compared to the control.

**Table 3.** Average root dry weights of humic acid doses applied to silage corn varieties (mg plant<sup>-1</sup>)

Variety/Dose	0	100	200	300	400	500	Avg.
Tareks	21.46 c-e	20.88 de	25.16 abc	28.33 a	26.35 ab	27.92 ab	25.01A
Kefieros	11.78 f	18.88 e	24.17bcd	20.58 de	24.14 bcd	26.49 ab	21.00 B
Avg.	16.62 C	19.88 B	24.66 A	24.45 A	25.24 A	27.20 A	

CV: 10.50%



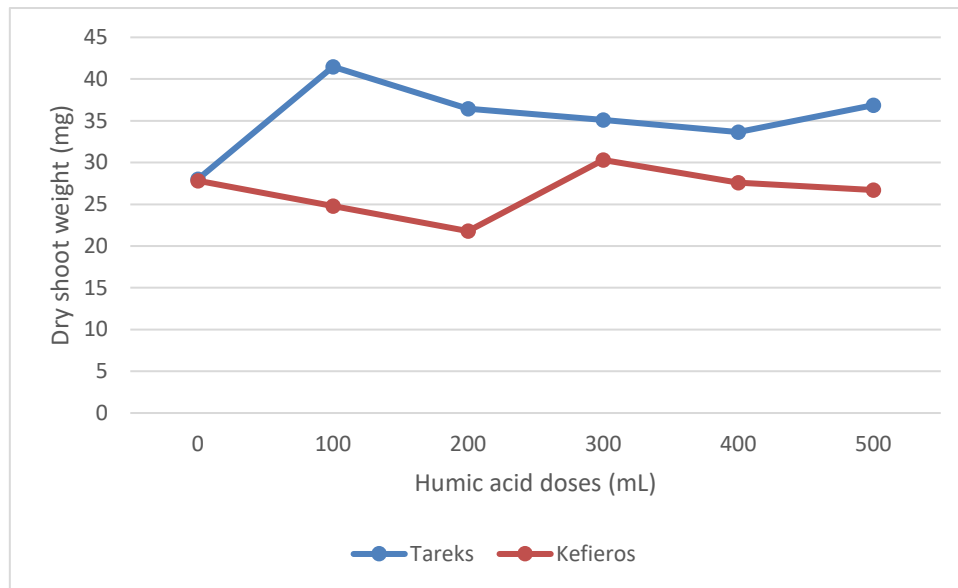
**Figure 3.** Effect of different humic acid doses on dry root weight in silage corn varieties.

The differences between varieties and variety  $\times$  dose interactions for dry shoot weight examined in the study were found to be statistically significant. No statistically significant difference was determined between the applied humic acid doses, the groupings and average values of the treatments are given in Table 4. The highest dry shoot weight (35.20 mg plant<sup>-1</sup>) among the varieties was obtained from Tareks variety. The highest dry shoot weight was determined with 33.14 mg plant<sup>-1</sup> in 100 ml humic acid application for the applied doses. The responses of varieties to humic acid doses in terms of shoot weight were different (Table 4 and Figure 4). Siewerdt et al. (2000) determined that dry shoot weight increased as humic acid doses increased in corn plants. In studies conducted on different plants, it has been reported that pre-applications increased fresh and dry shoot weight compared to the control.

**Table 4.** Average dry shoot weight values according to humic acid doses applied to silage corn varieties (mg plant<sup>-1</sup>)

Variety/Dose	0	100	200	300	400	500	Avg.
Tareks	28.01 b-e	41.48 a	36.44 abc	35.12 abc	33.67 a-d	36.89 ab	35.20 A
Kefieros	27.83 b-e	24.80 de	21.79 e	30.31 b-e	27.61 b-e	26.73c-e	26.51 B
Avg.	27.92	33.14	29.11	32.71	30.64	31.81	

CV: 19.22%



**Figure 4.** The effect of different humic acid doses on dry shoot weight in silage corn varieties

### Conclusion

In this study, different doses of humic acid (B.A.S 18®) were applied to silage corn seeds to improve seed performance and provide uniform and rapid seedling emergence. Early emergence and strong seedling growth are very important in plant production, especially in second crop production. Humic acid application to corn seeds positively affected germination power, root and stem growth. Continuation of these studies in different environments will contribute positively to the development of new approaches.

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## PROBLEMS AND SOLUTION SUGGESTIONS OF PASTURES IN AMASYA PROVINCE

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### Abstract

One of the most economical and important resources that meet the roughage needs of animals is meadows-pastures, highlands and winter pastures with natural vegetation. These natural pastures, which cover approximately 25% of our country's surface area, are among the most important renewable natural resources. However, due to continuous overgrazing and early grazing over the years, the productivity potential of these natural resources has significantly decreased, and they have largely lost their plant cover. The province of Amasya is located in the central part of the Blacksea Region and has a semi-arid climate with cool winters and hot summers. The pastureland in Amasya covers 47,716 hectares, accounting for 8.4% of the province's total area. Forage crop cultivation within field farming spans 151,760 hectares, where alfalfa, sainfoin, vetch, oats, forage peas, and silage maize are grown. The total livestock population in Amasya is 136,069 animal units (AU), and current roughage resources meet approximately 50% of the need. The percentage of animal units utilizing pastures is 22% of the total livestock population, while the rest are raised in indoor/semi-indoor farming systems. The average green forage yield of pastures is quite low (150 kg/da), and the grazing period is approximately 165 days (April 15 – October 1). In pastures of Amasya, more animals are grazed than the grazing capacity allows. The proportion of shrubs and thorny plants in pasture of Amasya vegetation is quite high. Grazing management plans should be made by considering the species of grazing animals and the order of grazing. Additionally, there are some issues related to pasture occupation and changes in land allocation purposes. Despite all the well-intentioned efforts made regarding the identification, limitation and allocation of meadow and pasture areas since the day the pasture law was enacted, it is obvious that there are deficiencies and errors in implementation.

**Keywords:** Pasture, grazing management, roughage production, Amasya

## **Introduction**

The natural vegetation of a region, as a natural structure formed by the climatic conditions of the region, is extremely important in terms of protecting soil and water, being a source of nutrients and life for living beings. Meadows and pastures are natural vegetation that have undertaken many ecological functions such as protecting and sustaining natural resources, being indispensable for wildlife, creating genetic resources with biodiversity and serving different uses, in addition to being the main roughage source for livestock. The most important of these functions is their contribution to soil conservation/erosion control and being the most important roughage source. A large part of soil loss occurs in pastures where the vegetation is weakened due to excessive grazing. One of the most economical and important sources for meeting the roughage needs of animals is meadows, pastures, highland pastures and winter pastures with natural vegetation. As a result of the excessive and early grazing that has been going on for years in our natural meadows and pastures, which constitute the most important renewable natural resources of our country and cover approximately 25% of our country's surface area, the yield potential of these natural resources has decreased a lot and they have lost a large part of their vegetation. This situation in our natural meadows and pastures negatively affects both our animal husbandry and the water and wind erosion that occurs on these areas, our soil and water resources (Ayan et al., 2020; Gökkuş, 2018). The Pasture Law was enacted on February 28, 1998 to eliminate the legal deficiency in terms of the use and protection of our meadows and pastures. One of the goals determined by this law is to improve and ensure the continuity of pastures. Despite all the well-intentioned efforts made in the determination, limitation and allocation of meadows and pastures since the day the law was enacted, it is also obvious that there are inadequacies and implementation errors in this area. In order for pastures to fulfill these duties without interruption, it is necessary to pay attention to grazing management principles while using these areas and to implement applications that change the competitive conditions such as excessive fertilization and seeding, which will cause a change in species composition, as correctly as possible. The pasture and meadow areas in our country have largely lost their qualities. Before starting rehabilitation work in pasture and meadow areas, the natural vegetation of these areas should be examined and their structural features should be revealed. In addition, high-yielding and good-quality species that have adapted to the regional conditions in the vegetation should be determined and used in the rehabilitation of natural pastures. Optimistically, only half of the quality roughage requirement can be met from the current forage crop production and meadow pasture areas. In addition to the low productivity and inadequacy of our pasture areas, which are one of the main sources of roughage, their rugged structure and vegetation consisting of short plants are not suitable for grazing of cultured animals. However, among our cattle population, which provides 93% of milk production and more than 70% of meat production, native breeds have decreased a lot and have been replaced by cultured breeds and hybrids. For these reasons, the share of pastures as a source of roughage has decreased, and the importance of forage crop production and other agricultural activities and agricultural industrial by-products has increased even more.

## **Amasya Province Geographical Location and Land Use Status**

Amasya province is located in the central part of the Black Sea region, on the Yeşilirmak River. Geographically, Amasya is located between 41° 04' – 40° 16' north latitudes and 34° 57' – 36° 31' east longitudes. Amasya has a semi-arid climate, cool in winters and hot in summers. The average temperature for many years is 13.6°C. When the average temperature values for many years are examined, it is seen that there is an increase in temperatures of 1.7°C/100 years. The average total precipitation for many years in Amasya is 461.3 mm. In addition, when the total precipitation values for many years are examined, there is an increase of 295 mm/100 years (MGM, 2021).

**Table 1.** The land asset distribution of Amasya province is given in

Land Type	Area (ha)	Ratio (%)
Agricultural Land	254.960	44.7
Meadows-Pasture Land	47.716	8.4
Forest Land	220.670	38.7
Other (Swamp, rocky areas etc.)	46.754	8.2
Total (ha)	570.100	100.0

In Amasya Province, 65.3% of the agricultural lands are dry farming and 34.7% are irrigated farming. In addition, there is 6% of arable land that is not used and 13% of fallow land. Fallow land application is mostly in Taşova, Hamamözü, Göynücek and Gümüşhacıköy districts.

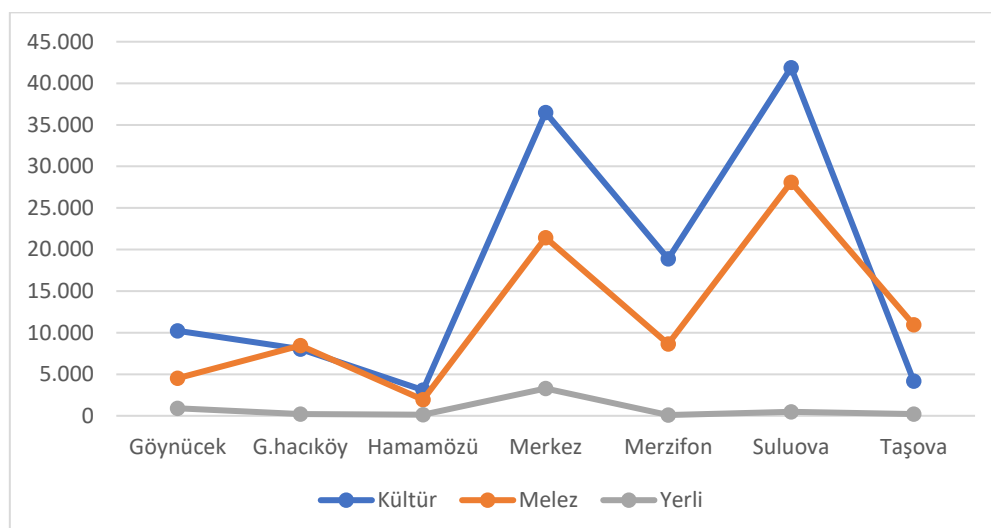
### **Amasya Province Fodder Plant Production, Meadow Pasture and Animal Wealth**

While the fodder plant planting area registered in FRS (Farmer Registration System) is 42,338.2 da, the total fodder plant planting area is stated as 151,760 da (Anonymus, 2023). Due to the multi-shareholding of the lands, farmers do not register and cannot benefit from the supports. Among the planted forage crops, silage corn (41,775 da) ranks first, and vetch/vetch+cereal (40,238 da) mixture ranks second. Other forage crops are oat (33,566 da), alfalfa (32,296 da), pea (2,973 da) and sainfoin (912 da). Amasya province meadow area is 1,919.19 da, pasture area is 316,651.39 da, and highland pastures area is 160,218.43 da. 22% of the total animal population benefits from the current pastures. The animal population is 156002.7 HB and it is seen that the highest number of cattle are in Suluova district and the Central district. In these districts, semi-open barn animal husbandry is commonly practiced. The number of culture breed animals is high in these districts. It is seen that the local breed is low/very low in all districts (Figure 1). The number of small cattle is quite high in the Central District and Taşova districts. The pasture areas of these districts are also higher and the animals are taken to the pastures in the summer months (Table 2). The majority of the small cattle are Karayaka breed sheep, the number of goats is low (20%). Except for snowy or rainy days, small cattle are taken to pasture throughout the year. The annual quality roughage need of the animals in Amasya province is approximately 711,761.0 tons. The amount of quality roughage obtained from pasture areas and forage crops grown in field agriculture is 227,564.4 tons. The amount of quality roughage produced meets 32% of the need. Although there is a large forage deficit, field crops and horticultural crops by-products are used in animal feeding. In addition, pulp and molasses from sugar factories are used. Stubble grazing is also done in agricultural lands.



**Table 2.** Forage crops cultivation area, meadow-pasture and highland pasture areas, and the number of cattle and small cattle in Amasya Province by district (Anonymus, 2024a and Anonymus, 2024b)

District	Forage Crops Planting Area (FRS) (da)	Meadows (da)	Pastures (da)	Highland pastures (da)	Cattle (number)	Small cattle (number)
Göynücek	1104,98	500,29	10.772,67	3.381,35	15.645	18.748
Gümüşhacıköy	3457,06	327,32	97.649,66	17.600,88	16.680	22.330
Hamamözü	861,535	9,38	12.916,06	22.023,7	5.152	9.010
Merzifon	7462,14	16,15	85.977,11	4.371,21	27.628	23.929
Suluova	13248,87	192,64	47.940,86	17.069,65	70.462	29.102
Merkez	13010,57	835,15	46.816,68	55.553,89	61.211	93.750
Taşova	3193,09	38,26	14.578,35	40.217,75	15.351	90.334
<b>Total</b>	<b>42.338,2</b>	<b>1.919,19</b>	<b>316.651,39</b>	<b>160.218,43</b>	<b>212.129</b>	<b>287.253</b>



**Figure 1.** Current Status of Cattle Breeds in Amasya Province According to Districts (number)

### Pasture Studies in Amasya Province

If pastures can both protect themselves within their natural life cycle and feed the animals of the local people, then there is a sustainable structure. In order for sustainability to continue, a balance must be established within a certain animal-pasture relationship. The animal and pasture relationship are complementary to each other and cannot be distinguished from each other in pasture studies. Pastures must be grazed at the right time, with the right animal species and numbers, in appropriate periods. In this way, both the sustainability of the rangeland and the maximum energy cycle in favor of animal products can be ensured. If rangeland plants provide sufficient vegetative mass for grazing animals and there are no issues in completing their life cycles, a sustainable system can be considered. In Amasya province, as in the rest of the country, rangelands are subject to uncontrolled grazing without considering the growth and development stages of the plants. One of the main reasons for the inefficient use of these rangelands is overgrazing, where the number of animals exceeds the carrying capacity of the land, and grazing occurs at inappropriate times. In many rangelands in Amasya, grazing is conducted either too early in the spring or continuously throughout the year, without regard for the growth of the plants. The sustainability and productivity of the vegetation in these

rangelands can only be maintained through conscious and well-planned grazing practices. Additionally, uncontrolled grazing prevents the achievement of the desired benefits from ongoing rangeland rehabilitation and management projects. In Amasya, identification and restriction processes have been completed for all rangelands, and the majority (83%) have also undergone allocation procedures. The limitation and allocation status of pastures by district is given in Table 3.

**Table 3.** Limitation and allocation status of pastures in Amasya districts (Anonymus, 2024a)

Land Type	Merkez	Göynücek	G.Hacıköy	Merzifon	Suluova	Taşova	Hamamözü	Total
<b>Limited Pasture Area (ha)</b>	10.321	1.138	11.564	9.121	6.310	5.483	3.494	47.716
<b>Allocated Pasture Area (ha)</b>	9.985	1.116	10.216	1.352	5.249	6.971	4.682	39.574

Pasture Management Unions have been established in 9 settlements where allocation studies have been completed. The elections of the Pasture Management Unions of the Central District Gözlek, Eski Kızılca villages, Merzifon district Sarıbuğday, Ortaova villages, Suluova district Cürlü, Deveci, Eraslan, Kapancıağılı villages, which were established in 2007, were renewed in 2022 and resumed their duties. The election work of the Çambükü Village Pasture Management Union of the Taşova District was not renewed as the court process for the cancellation of the change in allocation purpose for the establishment of an Organized Industrial Zone (OIZ) in the relevant village is ongoing. Pasture Management Unions should be established as soon as possible in the villages where they have not been established and the active operation of the pasture management unions should be ensured. Article 19 of the Pasture Law states that “Pasture Management Unions” shall be established in the relevant villages and municipalities for the protection of pastures, summer pastures and winter pastures. In a study conducted on the sustainability of improved pastures in Turkey, it was reported that the Pasture Management Associations, which should be established in the villages where pasture improvement works have started in accordance with the Pasture Law, have not been established in a large part of the areas where the study was conducted. It is also reported that the established Pasture Management Associations are unable to carry out their activities. (Cevher at al., 2016). In 2023, under Article 14 of the Pasture Law No. 4342, the following requests for changes in allocation purposes were made:

- One request for 97 decares of land for a single parcel under subsection a,
- Six requests for a total of 331.87 decares of land under subsection c,
- Two requests for 77 decares of land under subsection d,
- One request for 99 m<sup>2</sup> of land under subsection j,
- One request for a total of 72.04 decares of land across 10 parcels under subsection i.

The related processes for a total of 676.87 decares are ongoing in 2023.

In a pasture area where the allocation purpose change was made in 2019, there is 1 file that has been completed and processed within the scope of the recycling contract. Upon the request of the General Directorate of Mining Affairs, the transactions were completed within the scope of Article 14/a of the Pasture Law No. 4342 on the grounds of construction of a coal mine operating in a total area of 159 decares within the borders of Oğulbağı village of Suluova District in the areas of 0/1 (30.4 da), 0/35 (4.6 da), 0/36 (4.8 da), 0/38 (8.6 da), 0/471 (18.6 da), 0/472 (60.4 da) and within the scope of the recycling projects of the relevant parcels in 2023, sloping, seed bed preparation, seed sowing and fertilizing operations were carried out by the relevant company. Pasture improvement works in Amasya province started in 2004 and 18 pasture improvement projects have been completed. There are currently 4 ongoing pasture improvement projects. As a result of observations and studies, there are problems regarding the

sustainability of the improved pastures. Most of the pastures return to their former state after approximately 5-6 years. In these areas, grazing management planning should be carried out and implemented together with the improvement work.

**Table 4.** Pasture improvement projects implemented and ongoing in Amasya province (Anonymus, 2024a)

Project	Project Number	Project Area (da)	Project Year
Applied Project	18	34.016	2004-2020
Ongoing Project	4	1.880	2023-2027
Total	22	35.426	2004-2024

In order to increase the productivity of pasture areas in Amasya province, pasture improvement and management projects have been implemented from the Ministry budget since 2004. Improvement methods vary according to the current status of the pasture. Vegetation studies and measurements are carried out for each pasture section. In pastures where the decreases vegetation is weak (15% and below), sown pasture establishment is decided. In addition, in areas where the rate of shrubs and thistle is very high, first of all, cleaning is carried out and seed beds are prepared. In this method, barley, wheat, annual grass or vetch + cereal mixture is planted as pioneer plants in the first 1-2 years. In these areas, it can be evaluated by mowing + grazing or only grazing, considering the plant development. In the 2nd or 3rd year, a mixture is created with perennial pasture plants considering the soil and climate conditions in the pastures, and mowing + grazing is carried out in the first year. In rangelands where declining plant species are prevalent, thistle and shrub clearing is carried out through mowing, and aeration is performed in some areas. Fertilization is also applied based on the plant species comprising the vegetation and the results of soil analyses. In rangelands undergoing rehabilitation, watering troughs, shelters, and scratching posts are constructed. Additionally, training sessions on both rangeland rehabilitation and forage crop cultivation within field agriculture are provided by the personnel of the Provincial Directorate of Agriculture. The rangelands in Amasya province can be classified into three categories: lowland rangelands, dry rangelands, and highlands. Given the total amount and seasonal distribution of rainfall in the province, the plant growth period is quite short in certain areas. Due to grazing pressure, the vegetation in many rangelands has significantly diminished, leaving them vulnerable to erosion. In lowland rangelands, the vegetation cover ranges from 60% to 75%, while in dry rangelands it is between 30% and 50%, and in highlands it varies from 40% to 70%, depending on the slope and flatness of the terrain. The plant species found in the rangeland areas are provided in Tables 5 and 6.

**Table 5.** Some Important Plant Species in Terms of Contribution to Vegetation in Bekdemir Village Dry Pasture in Amasya Province (Anonymus, 2024a).

Poaceae	Legumes	Others
Cynodon dactylon	Trifolium repens L.	Tanacetum microphyllum L.
Brachypodium pinnatum	Onobrychis armena Bois.	Sherardia arvensis L.
Aegilops neglecta	Medicago minima L.	Taraxacum hypenum L.
Paspalum paspaloides	Trifolium resupinatum L.	Geranium asphodeloides Burm.
Hordeum murinum	Medicago falcata L.	Plantago lanceolata L.
Avena fatua	Astragalus bicolor	Stellaria media L.
Bromus tectorum	Vicia cracca	Holosteum umbellatum L.
Poa prastensis L.		Cichorium inthybus L.
Festuca ovina		Carthamus lanatus L.
Bothriochloa ischaemum L.		Euphorbia helioscopia L.
Agropyron desortorum		Polygonum cognatum

**Table 6.** Some Important Plant Species in Terms of Contribution to Vegetation in Çayırözü Village Lowland Pasture in Amasya Province (Anonymus, 2024a)

Poaceae	Legumes	Others
Poa pratensis L.	Trifolium resupinatum L.	Bellis perennis L.
Alopecurus myosuroides Hudson.	Trifolium hybridum L.	Eryngium bilardieri L.
Cynodon dactylon L.	Medicago minima L.	Ranunculus muricatus L.
Lolium perene L.	Onobrychis armena Bois.	Plantago major L.
Poa annua L.	Trifolium repens L.	Carex divulsa Stokes.
Agrostis castellana Boiss	Lotus corniculatus L.	Centaurea carduiformis DC.
Paspalum paspalodes Scribn.	Trifolium pratense L.	Rumex acetosella L.
Poa pratensis L.		Cyperus rotundus L.
Aegilops neglecta		Taraxacum farinosum L.
Hordeum murinum		Myosotis laxa L.
Avena fatua		Linum hirsutum L.
Lolium rigidum		Anchusa officinalis L.
Poa trivialis L.		Euphorbia aleppica L.
Festuca rubra L.		Polygonum cognatum

In lowland rangelands, particularly in areas where cattle are predominantly grazed, the proportion of thistles and shrubs has increased. In these areas, it is necessary to implement grazing plans, carefully consider grazing rotations, and utilize goats, which tend to prefer and consume thistles and shrubs, for grazing. In Amasya province, the goat population has increased over the last five years, and as of 2023, goats constitute 20.67% (59,386) of the total small ruminant population (Anonymus, 2024).

Some thistle and shrub-formed plants identified in the pastures of Amasya province:

*Eryngium campestre* L.

*Carthamus lanatus* L.

*Artemisia absinthium* L.

*Cirsium sipyleum* CA.

*Centaurea carduiformis* DC.

*Ruscus aculeatus* L.

*Smilax excelsa* L.

*Rubus* sp.

*Rosa canina* L.

*Scolymus hispanicus* L.

*Paliurus spina – cristi* Miller

*Crataegus* sp.

*Ligustrum vulgare* L.

*Ilex aquifolium* L.

*Ulmus* sp.

*Fraxinus excelsior* L.

Especially in the lowland grasslands, as a result of intensive grazing when the soil is moist, the soil becomes compacted and the plant root zone cannot be ventilated sufficiently. As a result, plants cannot develop good roots and the vegetation grows short and weak.

### **Conclusions and Recommendations**

- In rangeland ecosystems, climate, soil, vegetation, and animal factors interact to form an integrated system.
- In Turkey, which has 15 distinct climatic regions with significantly varying ecological characteristics and numerous microclimates within each region, the floristic composition of pastures and meadows is highly diverse.
- The characteristics of the vegetation and regional climate conditions should be carefully examined, and grazing management and rangeland rehabilitation projects should be planned accordingly.
- The rehabilitation efforts conducted so far have yielded successful results. However, to maintain the sustainability of these efforts, raising awareness among producers is crucial to achieving long-term success.
- Rangeland Management Unions should be promptly established in villages where they have not yet been formed, and they must function actively.
- Grazing plans should be prepared for rangelands, and producers must adhere to these plans. Shepherd training programs can be organized to contribute to the successful implementation of grazing plans.
- In some villages, the decline in population, particularly among the young and dynamic segment, has led to a decrease in livestock numbers, altering grazing pressure on the rangelands.
- The changes in rangeland vegetation caused by this situation should be studied, and future strategies for managing these rangelands should be discussed.
- In light of the predicted agricultural drought caused by global warming, efforts to develop drought-resistant varieties of forage crops and rangeland plants should be accelerated.
- To meet the roughage needs during periods when rangelands are closed to grazing, the proportion of forage crops grown within field farming systems must be increased.
- Considering the diverse needs of rural populations and the trend of migration from rural to urban areas, training programs should include experts such as sociologists.

Additionally, initiatives to encourage young farmers should be implemented, and establishing Farmer Clubs for the education of farmers' children and social activities could be considered.

- Besides being a vital source of roughage, rangelands play a crucial role in the conservation and sustainability of plant and animal genetic resources. It is essential to consistently emphasize and communicate this importance to broader audiences to raise awareness and secure public support for rangeland conservation.

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## **YEM BITKİSİ TURBA BITKİSİNİN ÇİMLENMESİNİ VE FİDE OLUŞUMUNU ARTIRMADA MANYETİK ALAN UYGULAMASININ POTANSİYELİ**

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### **Özet**

Tarım biyoteknolojisindeki son gelişmeler, mahsul verimliliğini ve kalitesini artırmak için invazif olmayan yöntemlerin araştırılmasına odaklanmıştır. Bu tür umut verici yaklaşımlardan biri, büyümeyi teşvik etmek ve verim özelliklerini iyileştirmek amacıyla tohumlara manyetik alanların (MA) uygulanmasıdır. Fakat manyetik alan uygulamaları uygulanan bitki türüne uygulama şiddeti ve süresine bağlı olarak farklı etkiler oluşturmaktadır. Bu amaçla her bitki için özel araştırmalar yapılarak değerlendirilmelidir. Bu çalışma, yem bezelyesi tohumlarına manyetik alan uygulamasının potansiyelini inceleyerek, çimlenme ve fide özellikleri üzerindeki etkilerini değerlendirmektedir. Çalışmada, ekim öncesinde farklı yoğunluklardaki (0, 0.5, 0.7, 0.9 ve 1 T) 10 dk manyetik alanlara maruz bırakılan yem bezelyesi tohumları kullanılmıştır. Tohumlar tamamen kontrollü şartlarda petrilere ekilerek 3 tekerrürlü olarak yetiştirilmiştir. 8 gün sonra hasat işlemi gerçekleştirilmiştir. Manyetik alanla muamele edilen bitkilerde çimlenme oranı, sürgün ve kök boyu, yaş ve kuru ağırlık, kontrol grubuyla karşılaştırmalı olarak değerlendirilmiştir. Sonuçlar, manyetik alan uygulamasının çimlenme oranlarını önemli ölçüde artırabileceğini ve erken bitki büyümesini hızlandırabileceğini göstermektedir. Özellikle, 0.9 dozunda çimlenme oranı %100'e ulaşmış ve kök gelişimi ile biyokütle ağırlığında en yüksek değerler gözlemlenmiştir. Ancak, manyetik alan dozunun artmasıyla sürgün boyu ve yaş ağırlıkta azalma meydana gelmiştir. Bu bulgular, manyetik alanın düşük ve orta düzeyde (0.5 - 0.9 T) bitki büyümesi üzerinde olumlu etkileri olduğunu, ancak daha yüksek dozların bitki gelişimini baskılayabileceğini göstermektedir. Bu sebeple 0.9 T yem bezelyesi için uygun görülmüştür. Bulgular, manyetik alanların, yem bezelyesi verimliliğini artırmak için çevre dostu ve sürdürülebilir bir araç olarak kullanılabilirliğini öne sürmekte, hem hayvan yemi hem de gıda üretimi endüstrileri için potansiyel faydalar sunmaktadır.

**Anahtar Kelimeler:** Manyetik alan; yem bezelyesi; çimlenme oranı; fide kalitesi.



## THE POTENTIAL OF MAGNETIC FIELD APPLICATION ON FORAGE PEAS TO ENHANCE GERMINATION AND SEEDLING PARAMETER

### Abstract

Recent advancements in agricultural biotechnology have focused on exploring non-invasive methods to enhance crop productivity and quality. One such promising approach is the application of magnetic fields (MF) on seeds to stimulate growth and improve yield characteristics. However, magnetic field applications have different effects depending on the type of plant applied, the intensity and duration of the application. Therefore, special research should be conducted for each plant. This study investigates the potential of magnetic field treatment on forage pea seeds, evaluating its impact on germination ratio and seedling parameters. In the study, forage pea seeds exposed to magnetic fields of different intensities (0, 0.5, 0.7, 0.9 and 1 T) for 10 min before planting were used. Seeds were sowing in petri under completely controlled conditions and grown with 3 replications. The trial was harvested after 8 days. Germination ratio (%), shoot length (cm), root length (cm), fresh weight (g) and dry weight (g) in plants treated with magnetic field were evaluated in comparison with the control group. The results indicate that magnetic field treatment can significantly improve germination rates and accelerate early plant growth. Specifically, the 0.9 T resulted in a 100% germination rate, and the highest values for root development and biomass weight were observed at this dose. However, as the magnetic field dose increased, shoot length and fresh weight decreased. These findings suggest that low to moderate magnetic field doses (0.5 - 0.9 T) have positive effects on plant growth, whereas higher doses may inhibit development. For this reason, 0.9 T was deemed suitable for feed peas. The findings suggest that magnetic fields could serve as an eco-friendly and sustainable tool to enhance forage pea productivity, potentially offering benefits for both animal forage and food production industries.

**Keywords:** Magnetic field; forage pea; germination ratio; seedling quality.

## Introduction

The germination and seedling stages are critical milestones in the plant's life cycle. Providing optimal conditions and strong development during these stages significantly enhances plant productivity and product quality. Conversely, weak development at these stages can lead to long-term yield losses, reduced quality, and economic damage to the plant. Therefore, ensuring optimal growth conditions during the germination and seedling phases is essential for achieving high-quality and productive crop yields in plant production.

Enhancing sustainability and productivity in agriculture has become one of the most critical challenges of the modern era. With the increasing global population and the negative impacts of climate change, developing more efficient and eco-friendly agricultural practices is essential. In this context, the application of magnetic fields has emerged as a promising agricultural innovation, demonstrating positive effects on plant growth and development. All substances have magnetic properties. A magnetic field arises when electric charges are displaced, i.e. when there is a circulation of electric current. A magnetic force also acts on charges moving in a magnetic field. The higher the current, the higher the resulting magnetic field. As with the electric field, the magnetic field strength decreases rapidly with distance. The first experimental observations of magnetic fields generated by currents were made by Oersted in 1820. Later experiments by Biot-Savart and Ampere resulted in relations that give the value of the magnetic field at a point in the space around a conductor through which current flows [Griffiths 1942].

Magnetic field effects on plants have been studied extensively, particularly concerning seed germination rates, growth acceleration, biomass production, and crop quality. Research suggests that MF treatments may enhance water uptake in plant cells, accelerate metabolic processes, regulate enzyme activities, and increase plant resilience to stress conditions. Although the underlying mechanisms of magnetic field action on plants are not yet fully understood, the observed benefits suggest that MF technology could play a significant role in advancing agricultural productivity (Bhardwaj et al. 2012).

Forage pea (*Pisum sativum* spp. arvense L.) is a valuable leguminous crop used both for human consumption and as animal feed due to its high protein content and rich nutritional value (Sayar and Han, 2016). However, challenges in forage pea cultivation, including environmental stress factors and limited yield potential, have prompted the exploration of new methods to improve crop performance. Magnetic field applications offer a potentially effective solution for enhancing forage pea seed yield and quality.

Seeds can be exposed to static magnetic fields for a certain period of time before planting. In this way, researchers observed that flax, buckwheat, sunflower and pea seeds produced earlier and stronger seedlings when exposed to magnetic fields (Gubbels, 1982). Abdul Latef et al. (2020) determined that the MF treatment they applied to lettuce plants significantly increased the total soluble sugars, total soluble proteins and total free amino amounts depending on the intensity and duration of the treatment. They also stated that ROS and oxidative damage were improved at a level with MF applications.

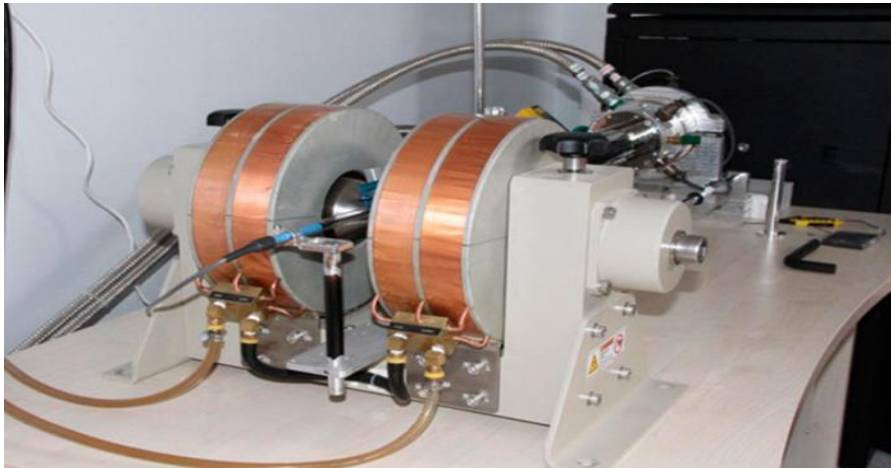
Our study, forage pea seeds exposed to magnetic fields of different intensities (0, 0.5, 0.7, 0.9 and 1 T) for 10 min before planting were used. The aim of this study is to investigate the effects of different magnetic field doses on plant growth parameters such as germination, root and shoot development, and fresh and dry biomass weight. This research seeks to contribute to a deeper understanding of the potential role of magnetic fields in plant growth and to identify the optimal magnetic field doses for promoting plant development.

## Materials and Methods

Plant material consisted of variety 'Özkaynak' of forage pea (*Pisum sativum* spp. arvense L.). The seeds were subjected to Hall Effect Measurement System (HEMS) at 0, 0.5, 0.7, 0.9, 1.1 T intensities and for 10 minutes. HEMS is a system that combines a wide magnetic resistance

range, high voltage capability, high magnetic field, and wide temperature range to provide the best electronic transport measurement systems available today (Figure 1). The study were performed under fully controlled climate room (light, temperature and humidity) at the Agriculture of Faculty of YOBU.

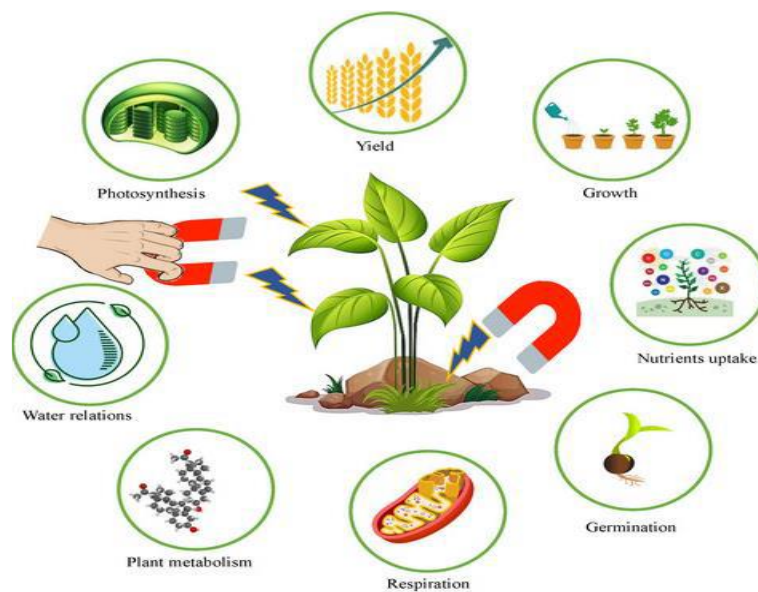
Blotting papers were filled into petri dish. In the experiment established in the randomized plots design with 3 replications, 10 seeds were planted in each petri. After the planting process, irrigation was done regularly to the field capacity. The experiment was harvested on the 28th day. 15 cc of pure was given to each petri dish and the petri dishes were tightly closed with parfirm. Each petri dish was determined as 1 replication. The trial was terminated after 8 days. Germination ratio (%) was determined by counting every day until the 4th day after sowing and, shoots rising at least 2cm were counted as germinated. Seedling characters (shoot and root length; cm; seedling fresh and dry weight ;g;) were determined in 8. days after sowing. Fresh weight was determined by weighing all plants in the petri dish. For dry weight, samples were dried at 60°C in oven until the constant weight separately for each pot. The results obtained were evaluated by drawing graphs with SR plot.



**Figure 1.** Hall effect measurement system (HEMS) (1.4 Tesla).

### **Findings and Discussion**

Plants, like all living organisms, are influenced by magnetic fields from their environment as well as their own magnetic fields during their life processes. At the same time, external MF applications on plants are consciously used today (Figure 2) to improve seed quality, increase yield by increasing seedling growth and overall development, and address deficiencies in seed types through breeding (Pietruszewski, 1993; Ahmet, 2003; Hafeez et al., 2022). The effect of MF applications on plants vary based on species differences, magnetic field intensities, and exposure durations. Additionally, the response of plant species to magnetic fields varies depending on the seed preparation method and seed characteristics (Dhawi et al., 2009). Our study, forage pea seeds exposed to magnetic fields of different intensities (0, 0.5, 0.7, 0.9 and 1 T) for 10 min before planting were used. Seeds were sowing in petri under completely controlled conditions and grown with 3 replications. The trial was harvested after 8 days. Germination ratio (%), shoot length (cm), root length (cm), fresh weight (g) and dry weight (g) in plants treated with magnetic field were evaluated in comparison with the control group. Table 1 shows the effects of different magnetic field doses applied to seeds on germination rate, shoot length, root length, fresh weight, and dry weight.

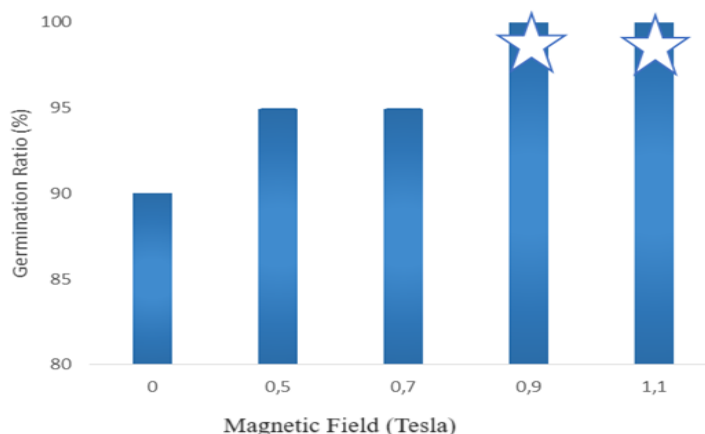


**Figure 2.** The effect of magnetic field on plants in different ways (Hafeez et al.2022).

**Table 1.** Germination and seedling parameters in magnetic field applied forage pea.

Magnetic Dose	Field	Germination (%)	Ratio	Shoot Length (cm)	Root Length (cm)	Fresh Weight (g)	Dry Weight (g)
0		90		1.08	2.53	2.53	1.48
0.5		95		1.82	5.13	5.13	1.42
0.7		95		1.37	5.38	5.38	1.39
0.9		100		1.83	6.43	6.43	1.66
1.1		100		1.32	4.65	4.65	1.69

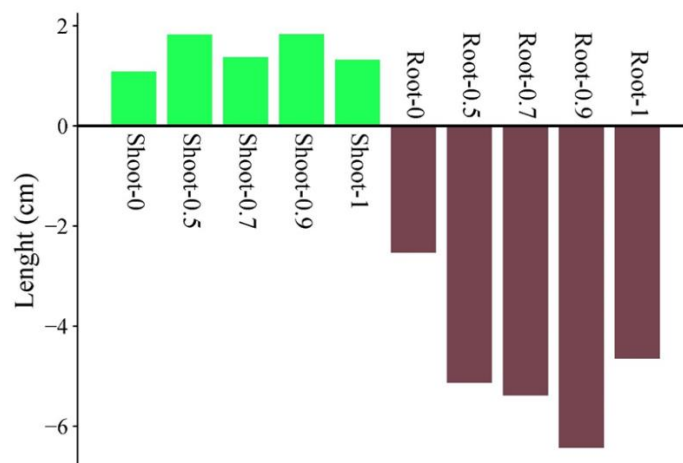
As the magnetic field dose increases, there is an observed increase in the germination rate. Notably, the 0.9 and 1.1 doses resulted in a 100% germination rate, indicating that the magnetic field has a positive impact on seed germination (Figure 3).



**Figure 3.** Change in germination rate in forage pea seeds exposed to magnetic field

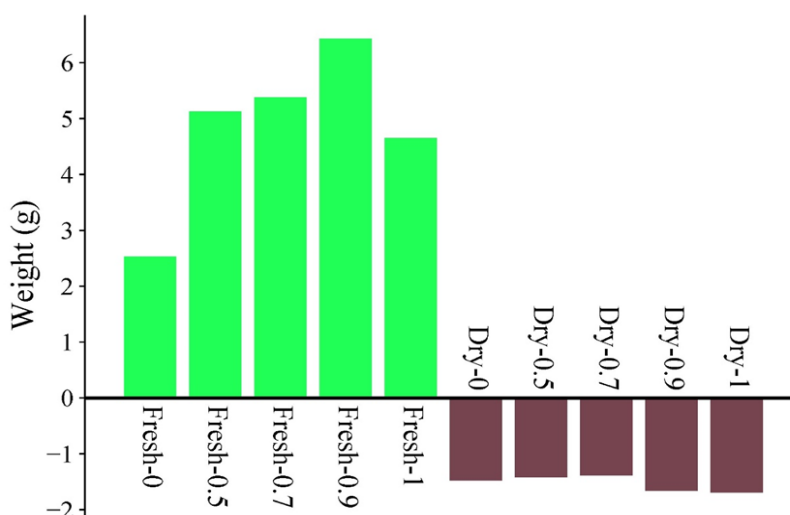
The highest shoot length was observed at the 0.5 T (1.82 cm). However, the shoot length decreases at the 0.9 and 1.1 T doses. This suggests that beyond a certain threshold, the magnetic field may negatively affect shoot growth.

Root length shows an increase with the magnetic field dose. The highest root length (6.425 cm) was recorded at the 0.9 T, indicating that the magnetic field positively influences root development (Figure 4).



**Figure 4.** Change in shoot and root length in forage pea seeds exposed to magnetic field

Fresh weight follows a similar pattern to root length, showing an increase up to the 0.9 T, where the maximum fresh weight is observed. However, at the 1.1 dose, the fresh weight decreases. Dry weight also reaches its peak at the 0.9 T but shows a slight increase at the 1.1 T, indicating a plateau (Figure 5).



**Figure 5.** Change in fresh and dry length in forage pea seeds exposed to magnetic field

MF interacts with seeds and plants and accelerates metabolism, leading to better germination. Primary and secondary metabolites, enzyme activities, nutrient and water uptake are reprogrammed to promote plant growth and yield under favorable conditions. Its benefits in agricultural production were first recognized by Savostin in 1930 when height increase and germination were observed in wheat under MF. Audus (1960) and Pittman (1977) also studied the strong magnetotropic effect on root development. MF affects the normal tendency of Fe and Co atoms and utilizes their energy to continue the translocation of microelements in root meristems, which leads to increased plant growth (Mericle et al., 1964). Different doses of MF change root biomass, stem girth and leaf size. Also, root growth is more sensitive to MF than shoots (Kato et al., 1989; Smith et al., 1966). Pretreatment of seeds by MF resulted in increased seedling growth, seed viability and crop yield (Pieturszewski, 1999). MF accelerates growth by triggering protein synthesis and activates root tropism by altering the intracellular movement of amyloplasts in the statocyst of root cap cells (Pieturszewski, 1999). A positive effect on seed germination, nutrient uptake, flowering and crop yield can be obtained by applying MF (Souza-

Torres et al. 2011). MF treatments also affect plant metabolism including free radicals and stimulate the activity of proteins and enzymes to increase seed viability (Morar et al. 1993). It has been reported that MF applied with pretreatment generally has positive effects on many properties such as plant germination, root and shoot growth, dry matter weight (Yinan et al., 2005; Esitken and Turan, 2004). In short, MF occurs when the electric charges of the magnetic property found in all substances are displaced, that is, when there is an electric current circulation. The higher the displacement current, the higher the resulting MF. This increases the temperature in the plants depending on the duration and frequency of the MF process (Vaezzadeh et al., 2006), and this increase may change the germination and seedling properties of the plant.

### **Conclusion and Recommendations**

In this study, the forage pea seeds that exposed to magnetic fields of different intensities (0, 0.5, 0.7, 0.9 and 1 T) for 10 min before planting were investigated. The results suggest that low to moderate magnetic field applications (0.5 - 0.9 doses) have positive effects on the germination rate, root development, and biomass weight of plants. However, considering both germination and seedling parameters, it is recommended to apply MF at 0.9 T for 10 minutes for forage pea. However, at higher doses (1.1 and above), these effects diminish, indicating that excessive exposure to the magnetic field might inhibit plant growth. These findings highlight the importance of carefully calibrating magnetic field doses for optimal plant growth and development. Further research is warranted to optimize treatment parameters, including magnetic field strength and exposure duration, to maximize benefits. These results open avenues for broader application of magnetic field technologies in agriculture, especially for enhancing germination and seedling characteristics, which are the basis for increasing yield and quality of leguminous crops like forage peas.

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## N719 BOYASINA FARKLI KOADSORBENTLER EKLENEREK BOYA DUYARLI GÜNEŞ PİLLERİNİN VERİMLİLİĞİNİN ARAŞTIRILMASI

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### Özet

Boyayla duyarlılaştırılmış güneş pilleri (DSSC'ler), düşük maliyetleri, zayıf aydınlatma koşullarındaki verimlilikleri ve görünür ışık spektrumundaki emilimleri nedeniyle son zamanlarda kapsamlı bir şekilde araştırılmaktadır. Çalışmamızda DSSC'ler flor katkılı kalay oksit (FTO) cam alttaşlar üzerine üretilmiştir. DSSC'ler görünür bölgede şeffaflığın sağlanması için geniş bant aralıklı ( $E_g > 3$  eV) oksit yarıiletkenlerin kullanılmasını gerektirir. Bu nedenle fotoelektrot üretiminde yaygın olarak tercih edilen  $TiO_2$  (titanyum dioksit) oksit yarıiletkeni kullanılmıştır. Fotoelektrotu hassaslaştırmak için Ruthenizer 535-bisTBA (literatürde N719 olarak da bilinen DSSC'ler için en iyi rutenyum boyalarından biri) kullanılmıştır. DSSC'lerin enerji üretme aşaması sırasında, oksidatif duyarlılaştırıcılar, özellikle elektrolitteki redoks çiftlerinin oksitleyici türleri, elektronların istenmeyen rekombinasyon reaksiyonlarına neden olur. Bunlardan kaynaklanan akım kayıplarını önlemek için birçok yöntem kullanılmıştır. Bu yöntemlerden biri, duyarlılaştırıcı boyayla birlikte farklı türdeki yardımcı adsorbanların kullanılmasıdır. Bu çalışmada N719 boya çözeltilerine yardımcı adsorban olarak 1-naftalinik asit (NAA), İndol-3-asetik asit (IAA) ve İndol-3-bütanik asit (IBA) ilave edildi ve  $TiO_2$  fotoelektrot duyarlılaştırıldı. Üretilen fotoelektrotlar FTO üzerine püskürtme yöntemiyle kaplanan Pt arka elektrotlarla birleştirildi. Her bir güneş pilinin temel parametreleri karşılaştırmalı olarak incelenmiş ve sırasıyla N719 boya, N719/NAA, N719/IAA ve N719/IBA kullanılan piller için 3.13, 4.38, 0.95 ve 0.21 güç dönüşüm verimleri elde edilmiştir. Sonuçlar, NAA'nın  $TiO_2$  yüzeyine IAA ve IBA'ya göre daha etkili bir şekilde bağlandığını ve NAA'nın aynı zamanda boyanın duyarlılığını da arttırdığını göstermiştir.

**Anahtar Kelimeler:** DSSC; yardımcı adsorban; N719; güç dönüşüm verimi.

## INVESTIGATION OF THE EFFICIENCY OF DYE-SENSITIZED SOLAR CELLS BY ADDING DIFFERENT COADSORBENTS TO N719 DYE

### Abstract

Dye-sensitized solar cells (DSSCs) have recently been extensively investigated due to their low cost, efficiency in poor illumination conditions, and absorption in the visible light spectrum. In our study, DSSCs were produced on fluorine-doped tin oxide (FTO) glass substrates. DSSCs require the use of wide band gap ( $E_g > 3$  eV) oxide semiconductors to provide transparency in the visible region. For this reason,  $\text{TiO}_2$  (titanium dioxide) oxide semiconductor, which is widely preferred in photoelectrode production, was used. Ruthenizer 535-bisTBA (one of the best ruthenium dyes for DSSCs also known as N719 in the literature) were used for sensitize the photoelectrode. During the energy-generating phase of DSSCs, oxidative sensitizers, especially oxidizing species of redox couples in the electrolyte, cause undesirable recombination reactions of electrons. Many methods have been used to prevent current losses resulting from these. One of these methods is the use of different types of co-adsorbents along with the sensitizing dye. In this study, 1-naphthalinic acid (NAA), Indole-3-acetic acid (IAA) and Indole-3-butanic acid (IBA) were added to N719 dye solutions as co-adsorbents and  $\text{TiO}_2$  photoelectrode was sensitized. The produced photoelectrodes were combined with Pt back electrodes coated on FTO by sputtering method. The basic parameters of each solar cell were examined comparatively and power conversion efficiencies of 3.13, 4.38, 0.95 and 0.21 were obtained for the cells using N719 dye, N719/NAA, N719/IAA and N719/IBA, respectively. The results were showed that NAA bound to the  $\text{TiO}_2$  surface more effectively than IAA and IBA and that NAA also increased the sensitivity of the dye.

**Keywords:** DSSC; co-adsorbent; N719; power conversion efficiency.

## Introduction

Technological developments in the world have increased the need for energy day by day, and interest in renewable energy sources has increased in order to meet this need. The most sustainable of these resources is solar energy. The sun is an important source of life and energy for living beings. Electricity generation from solar radiation energy is one of the rapidly developing research areas. DSSCs have recently been extensively researched as an exciting energy source of the future due to their low cost, use in poor lighting conditions and absorption in the visible light spectrum. A DSSC with a conversion efficiency of 7.1% was first obtained by Grätzel and O'Regan in the early 90s (İldeş et al., 2022; O'Regan & Gratzel, 1991). The structure of this system is based on wide band gap dye-sensitive semiconductors that are widely distributed on the surface and lead to absorption (Ghassemi et al., 2010; İldeş et al., 2022). Combining a nanocrystalline oxide film with a dye-sensitized material with a broad absorption band enables the use of a broader spectrum of sunlight. In this way, light absorption in a wide spectrum range from the UV range to the visible range can be achieved (Grätzel, 2003). In DSSCs, wide bandgap oxide semiconductors ( $E_g > 3$  eV) should be used for transparency in the visible range (Grätzel, 2003; İldeş et al., 2022). The effectiveness of DSSCs depends on the surface area, crystal structure and structural properties of the semiconductor, i.e. electron transfer kinetics. There are a number of bandgap suitable semiconductor materials being investigated for DSSCs. In general, various semiconductor such as  $TiO_2$ ,  $SnO_2$ ,  $Fe_2O_3$ ,  $ZnO$ ,  $CdS$  and  $CdSe$  (Hagfeldt et al., 1992) have been used as photoelectrodes in studies to improve the electrical energy production properties of the photon. Among these, titanium oxide is the strongest semiconductor materials for DSSC. The reasons why  $TiO_2$  is preferred are its chemical stability, abundance, non-toxicity, cheapness, biological compatibility, and use in paints and health products (İldeş et al., 2022). In study, transparent  $TiO_2$  material was preferred as the semiconductor material. In DSSCs,  $TiO_2$  provides a large surface for the absorption of dye and captures the electrons coming from the excited dye and transfers these electrons to the substrate material (İldeş et al., 2022). Various dye syntheses can be used for DSSCs. Dye types used in DSSCs include ruthenium (Ru), osmium (Os), perylenes, pentacene coordination compounds cyanines, polypyridyls, porphyrins, phthalocyanines, coumarins and indolines. These red and black dyes are standard base compounds for the development of other dyes and their components used in DSSCs. In general, ruthenium (Ru) compounds gave the best results in research. However, their difficulty in synthesis, expensive starting materials and low molar extinction coefficients have led to the search for new alternatives.

In order to prevent the spontaneous quenching of excited electrons in dyes, it is important to coat the dyes on  $TiO_2$  as a single layer without coalescence or aggregation (Heping Shena et al., 2010). Some undesirable electron recombination reactions may occur during the energy production phase of DSSCs. Many methods have been used to prevent current losses caused by these. One of these methods is the use of different types of co-adsorbents together with sensitizer dyes. The layer formed by dyes and co-adsorbent formed with precise designs enables the correction of surface structures (Şahingöz et al., 2023). Many types of materials such as carboxyl acids, malonic acids and acetic acid derivatives (auxins) have been investigated as additional absorbers for sensitizing dyes (Zhang et al., 2007; Lim et al., 2011). Some of these chemicals are IAA (Indole-3-acetic acid), IBA (Indole-3-Butyric Acid), NAA (1-naphthaleneacetic acid), 4-CPA (P-Chlorophenoxyacetic Acid) and 2,4-D (2,4-dichlorophenoxyacetic acid) (Şahingöz et al., 2023). Substances of the auxin group can be produced both naturally and synthetically. These are natural hormone structures that play a role in cell division, differentiation, root growth, vascular development, fruit development and plant shoot bending towards light (Xue et al., 2020; Huang et al., 2008; Heping Shena et al., 2010). In this study, auxin derivatives NAA, IAA and IBA were used as co-adsorbents due to the sensitivity of these materials to sunlight. Auxin derivatives are hormones that provide growth

in plants. NAA is one of the naphthalene derivatives used as a regulator in plant growth and is widely used in agriculture, medicine and forestry fields, etc. (Huang et al., 2008; Xue et al., 2020; Heping; Shena et al., 2010). IAA is a very abundant and well-known plant hormone. It is used to increase productivity in plants, improve product quality and increase crop yield. IBA, which is among the auxin group growth regulators, is the most effective and widely used root hormone in the world; IBA can trigger rooting (İzgi, 2020). The DSSCs were produced using Pt as the back electrode. Then, the basic parameters of these DSSCs were examined comparatively.

### Materials and Methods

In this study, powdered co-adsorbents NAA, IAA, and IBA were purchased from Sigma-Aldrich. Ruthenium 535-bisTBA (N719) dye, Solaronix brand, was purchased. Pure water at 18.2 MΩ was used for cleaning and solution preparation. Merk brand t-butanol was used in the study. Pt coated on FTO was used as the back electrode. In this study, TiO<sub>2</sub> electrodes coated on FTO were used as photoelectrodes. The auxin derivatives were added to the N719 dye solution as co-adsorbents at different rates. First of all, for NAA, which we have abundantly, studies were carried out using N719/NAA in the ratios (10:1,10:2,10:3) according to the literature, and since the best results were obtained in the ratio of 10:1, other auxin derivatives were prepared in this ratio. In this study, firstly 0.5 mM N719 dye alone was used as dye solution for control. Then, the solution was prepared by adding 0.05 mM NAA (50:50 V), acetonitrile and t-butanol into 0.5 mM N719. The TiO<sub>2</sub> film was left in the solution containing this dye at a temperature of 300 K for two days. The photoelectrode removed from the paint was first washed with ethanol and then left to dry at room temperature for 30 minutes. The same procedures were carried out for the solutions prepared by adding 0.05 mM IAA (50:50 V) and 0.05 mM IBA (50:50 V) into 0.5 mM N719. The Pt coated on FTO by sputring method was used as the counter electrode. The electrodes were then joined using 50 μm thick sealing at 110<sup>0</sup>C. As the final process, liquid electrolyte HI-30 was injected by opening a small hole in the counter electrodes and DSSCs productions were completed (Figure 1).

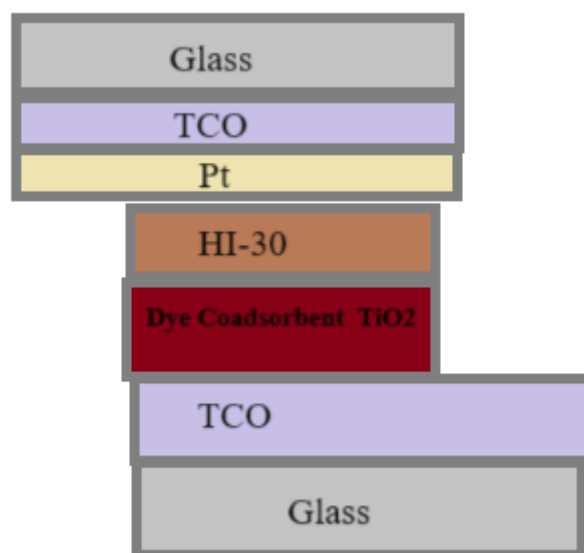
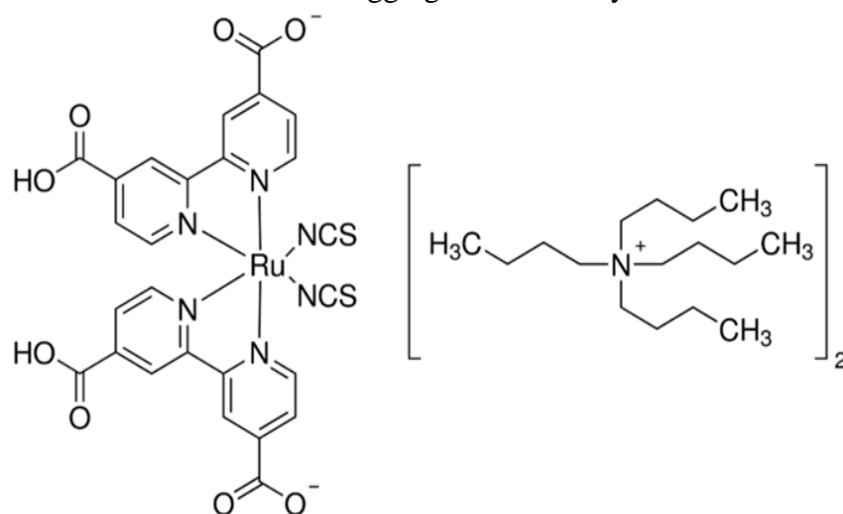


Figure 1. DSSC Schematic Display

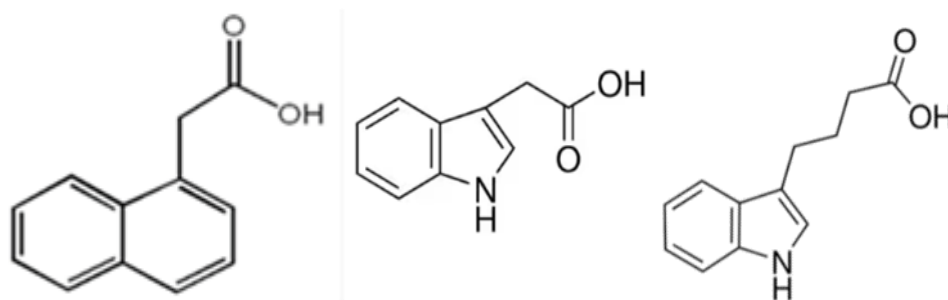
### Findings and Discussion

The molecular structures of N719 dye, NAA, IAA, and IBA are given in Figure 2 and Figure 3 respectively. The dye sensitizer in DSSC usually follows the spectral region in visible light

(400-700 nm). In DSCCs, it is important that the dyes are adsorbed on TiO<sub>2</sub> in a single layer without coalescence or aggregation to prevent self-extinguishing of dye electrons excited by sunlight (Şahingöz et al., 2023). Studies have been carried out by adding various co-adsorbents to the dye solution to reduce cohesion or aggregation of the dyes.

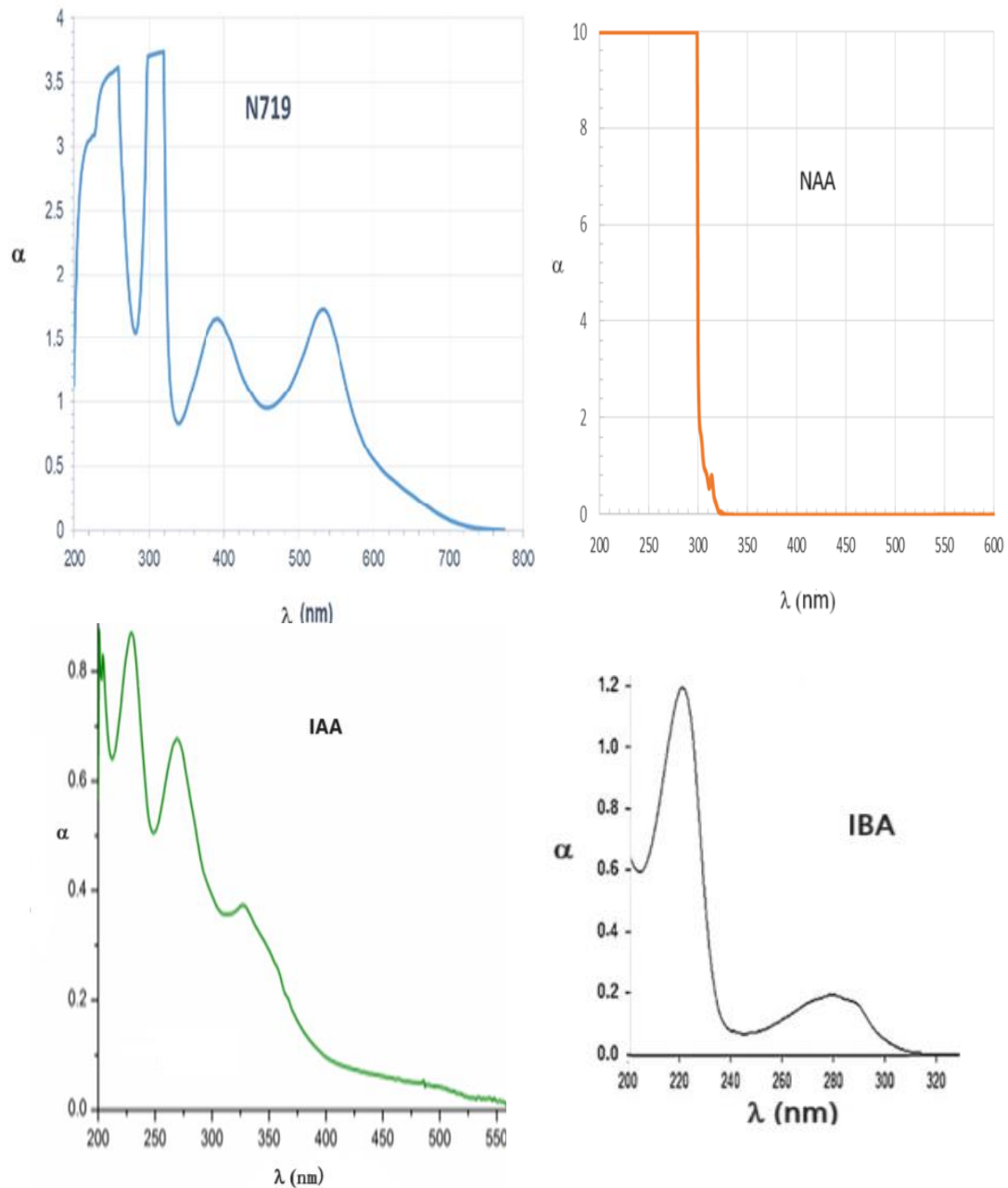


**Figure 2.** Molecular structure of the N719 (Di-tetrabutylammonium cis-bis(isothiocyanato)bis(2,2'-bipyridyl-4,4'-dicarboxylato) ruthenium (II) dye



**Figure 3.** Molecular structures of the NAA, IAA, and IBA

Figure 4 show the absorbance curves obtained from the Uv-vis measurements of the N719 dye solution prepared with ethanol in the 200-800 nm wavelength range. Here, a decrease in the absorbance of the dye is seen, especially in the 200-300 nm Uv region. There is good absorption in the visible region. Figure 4 shows the absorbance curve of NAA prepared in ethanol. It is seen that NAA absorbs light especially in the UV region. Similar results are seen in the values of IAA and IBA prepared in ethanol solution.



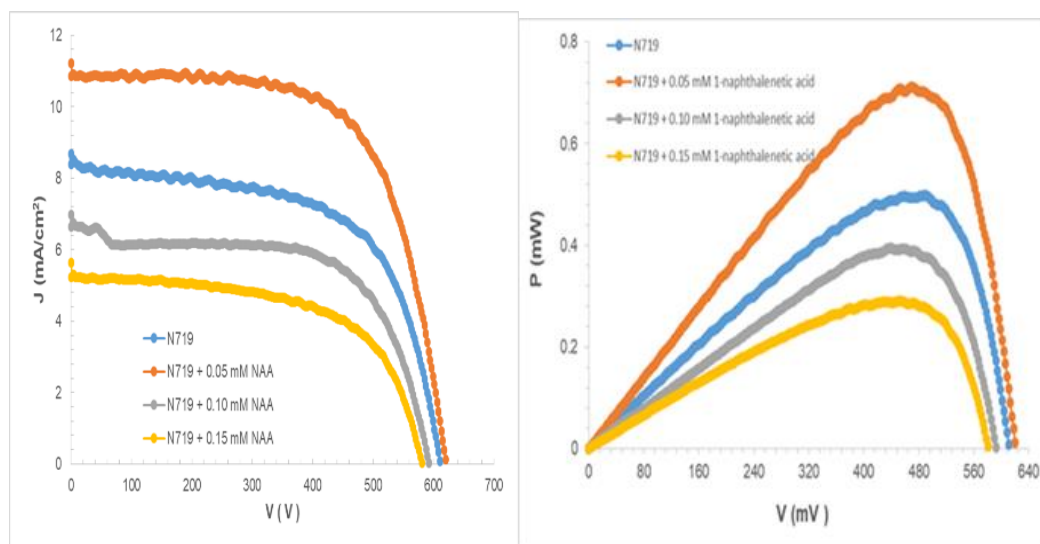
**Figure 4.** Absorbance plots of the dye, NAA, IAA, and IBA

The J–V and P–V measurements of DSSCs fabricated using co-adsorbents NAA, IAA and IBA measured at AM 1.5 simulated illumination are shown in Figure 5, Figure 6 and Figure 7, respectively. The Filling Factor (FF) is a variable used to define the maximum output power of a PV cell based on open circuit voltage ( $V_{oc}$ ) and short circuit current ( $I_{sc}$ ). As series resistance increases, FF decreases. Power conversion efficiency ( $\eta$ ) refers to the part of solar energy that can be converted to electricity by PV effect. The solar cell parameters as  $I_{max}$ ,  $V_{max}$ ,  $V_{oc}$ ,  $I_{sc}$  values, filling factor (FF) and power conversion efficiency ( $\eta$ ) of DSSC were calculated using the following equations (İldeş et al., 2022; Şahingöz et al., 2023)

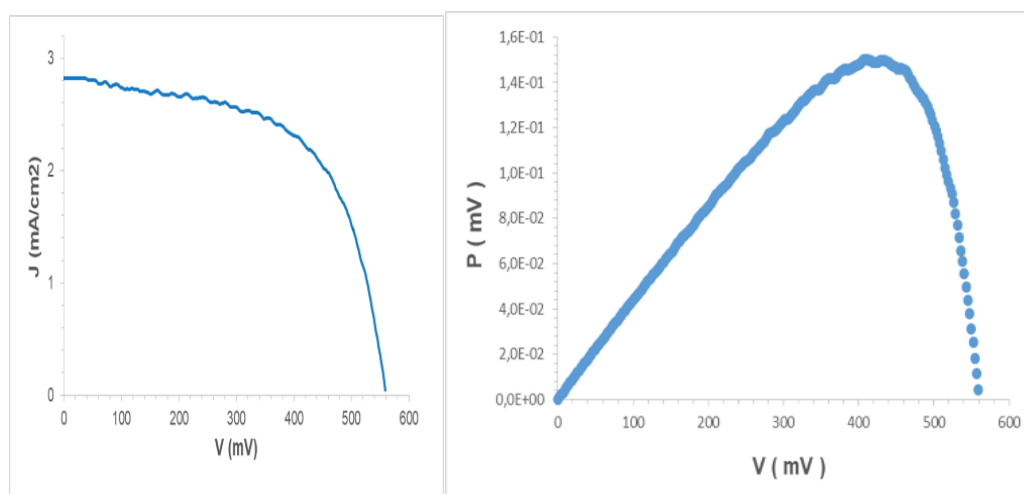
$$FF = (V_{max} I_{max}) / V_{oc} I_{sc} \quad (1)$$

$$\eta = (V_{oc} I_{sc} FF) / P_{input} \quad (2)$$

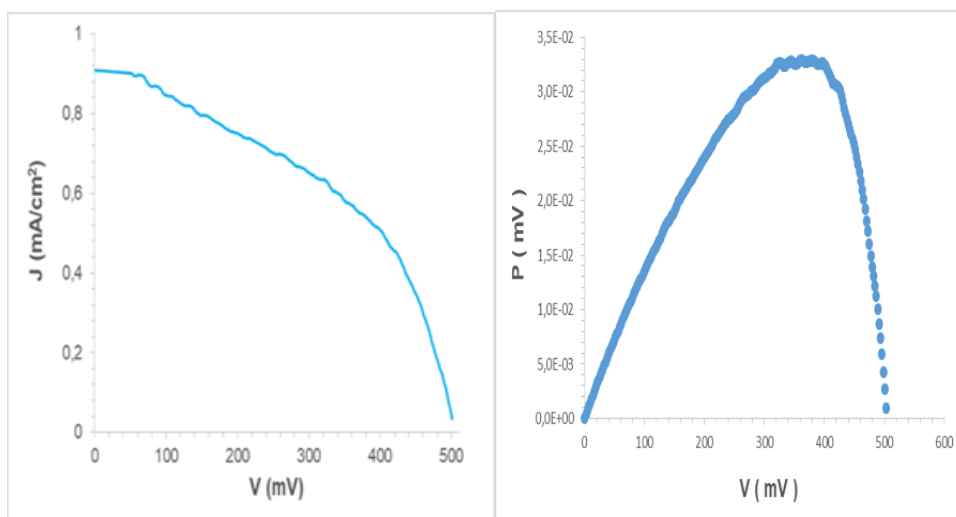
When the basic parameters obtained using Figure 5 (Table 1) are examined, it has shown photocurrent and photo voltage increase as expectations. Photovoltaic parameters obtained for DSSC using IAA and IBA as additional absorbers in Figure 6 and Figure 7 are examined, it is seen in Table 1 that photovoltaic parameters decrease contrary to expectations. This decrease also decreases efficiency. When the literature is examined, these results are attributed to the fact that N719/IAA and N719/IBA mixtures cannot provide good coating on the  $\text{TiO}_2$  surface (Toor et al., 2016; Shen et al., 2011; Ardakani et al., 2019). The change in photovoltaic parameters for different acetic acid derivatives is seen in Figure 8.



**Figure 5.** J-V and P-V curves of DSSCs with different rate NAA



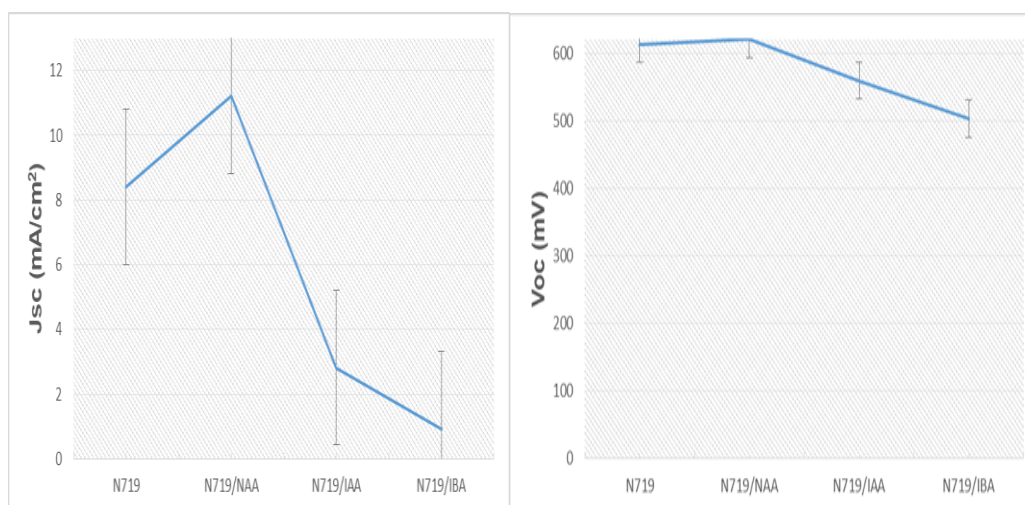
**Figure 6.** J-V and P-V curves of DSSCs with IAA



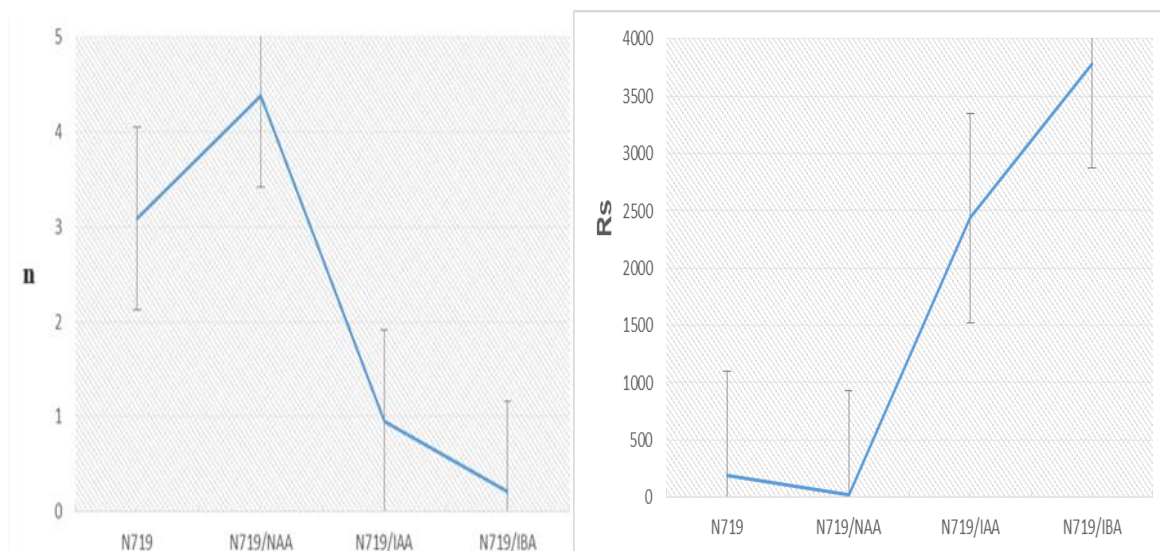
**Figure 7.** J-V and P-V curves of DSSCs with IBA

**Table 1.** Photovoltaic parameters for DSSCs produced with NAA, IAA and IBA

Photovoltaic parameters	N719 Dye	(10:1) N719 Dye and co-adsorbent NAA	(10:1) N719 Dye and co-adsorbent IAA	(10:1) N719 Dye and co-adsorbent IBA
$J_{sc}$ (mA/cm <sup>2</sup> )	8.40	11.22	2.82	0.91
$V_{oc}$ (mV)	613	620	559	503
$I_{max}$ (mA)	1.012	1.473	0.354	0.086
$V_{max}$ (mV)	491	478	424	381
FF (%)	0.60	0.63	0.60	0.44
$\eta$ (%)	3.09	4.38	0.95	0.21







**Figure 8.** Variations of solar cell parameters according to properties of the Co-adsorbent

The use of co-adsorbents in DSSC provides better packing compared to the sensitizer alone and is expected to improve the results by forming hybrid monolayer. It is also believed to provide more effective insulating barrier against reverse electric charge migration from  $\text{TiO}_2$  conduction band to liquid electrolyte solution (Wang et al., 2003). In this study, it was observed that when dye and NAA were coated together on  $\text{TiO}_2$  surface in DSSCs, photocurrent and photo voltage were improved together. The increase in photo voltage is attributed to the reduction of recombination between injected electrons and  $\text{I}^{3-}$  ions (Wang et al., 2003). As a result, it was observed that coating N719 dye and NAA on  $\text{TiO}_2$  semiconductor in certain ratios improved the power conversion efficiency of DSSCs. However, since they were not well coated on the  $\text{TiO}_2$  surface, N719/IAA and N719/IBA could not improve the results. As seen in Table 2, it is seen that the results vary according to the dye or co-adsorbent used in different studies in the literature. The most commonly used Ruthenium dye derivatives and their effects on efficiency are given in Table 2. As seen in Table 2, Chenodeoxycholic acid, diphenylphosphinic acid, 3,4,5-Tris(dodecyloxy) benzoic acid, Azobenzencarboxylic acid and NAA increase the DSSC efficiency with N719 dye, while Indole-3-acetic acid and Indole-3 butyric acid decrease the DSSC efficiency. In addition, it is seen that NAA has an improving effect on N719 dye, while it has a decreasing effect on D908 dye (Matsuyoshi et al., 2013).

**Table 2.** Comparison of the effects of different co-adsorbents and dyes on DSSC efficiency in various research studies

Co-adsorbents	Dye	n (Dye)	n (Dye and co-adsorbent)	References
Chenodeoxycholic acid	N719	4.98	5.70	Toor vd., 2016
diphenylphosphinic acid	N719	5.10	5.74	Shen vd., 2011
3,4,5-Tris(dodecyloxy) benzoic acid	N719	1.81	2.13	Toor vd., 2016
Azobenzencarboxylic acid	N719	4.30	5.20	Ardakani vd., 2019
Cyclopropylacetic acid	D908	6.90	6,90	Matsuyoshi vd, 2013
1-Naphthylacetic acid	D908	6.90	6.80	Matsuyoshi vd, 2013
1-Naphthylacetic acid (NAA)	N719	3.09	4.38	This study
İndol-3-asetik asit (IAA)	N719	3.09	0.95	This study
İndole-3 bütirik asit (IBA)	N719	3.09	0.21	This study

### **Conclusion and Recommendations**

In our study, when N719 dye was used alone,  $J_{sc}$ ,  $V_{oc}$ , FF and power conversion efficiency for  $0.16 \text{ cm}^2$  DSSC were obtained as  $8.40 \text{ mA/cm}^2$ ,  $613 \text{ mV}$ ,  $60\%$  and  $3.09$ , respectively. NAA was added to the dye as an additional absorber since the best result was obtained at a ratio of 10:1 in our previous studies. It was observed in the literature that photocurrent and photo voltage were improved when dye and acetic acid derivatives were used together on the  $\text{TiO}_2$  surface. This is due to the suppression of recombination of injected electrons and  $\text{I}_3^-$  ions. When N719/NAA mixture was used,  $J_{sc}$ ,  $V_{oc}$ , FF and efficiency for  $0.16 \text{ cm}^2$  DSSC were obtained as  $10.85 \text{ mA/cm}^2$ ,  $619 \text{ mV}$ ,  $66\%$  and  $4.43$ , respectively. As expected, it was observed that both photocurrent and photovoltage increased, thus increasing the efficiency of DSSC. For  $0.16 \text{ cm}^2$  DSSC using another auxin derivative IAA,  $J_{sc}$ ,  $V_{oc}$ , FF and efficiency were obtained as  $2.82 \text{ mA/cm}^2$ ,  $559 \text{ mV}$ ,  $60\%$  and  $0.95$ , respectively. For  $0.16 \text{ cm}^2$  area DSSC using another auxin derivative IBA,  $J_{sc}$ ,  $V_{oc}$ , FF and efficiency were obtained as  $0.91 \text{ mA/cm}^2$ ,  $503 \text{ mV}$ ,  $44\%$  and  $0.21$ , respectively. It was observed that photocurrent and photo voltage decreased in these two cases and the efficiency decreased accordingly. This result was attributed to the fact that IAA and IBA did not provide tight packing on the  $\text{TiO}_2$  surface together with N719. When the studies in the literature were examined, it was seen that different additional absorbers did not give the same results in different dye types. Improving results can be obtained for another dye and photoanode with IAA and IBA. In this sense, the studies can be repeated with different dyes and photoelectrodes.

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## THE IMPORTANCE OF SOIL ANALYSES IN SUSTAINABLE AGRICULTURE

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### **Abstract**

Sustainable agriculture is a farming method that focuses on protecting the natural resources of the soil and using this method for sustainable production. Soil analyses are considered an important element of sustainable agriculture. Soil analyses measure the amount of nutrients, minerals and other important components found in the soil. These analyses provide information about the current state of the soil, helping to detect the lack of nutrients necessary for the growth of plants and other organisms. Soil analyses also measure soil acidity and soil structure, helping to identify soil problems that negatively affect plant growth. Thus, necessary measures can be taken to deal with these problems. Soil analyses also guide farmers in choosing appropriate plants and growing techniques. In addition, suitable fertilizer types and amounts can be determined according to the analysis results. As a result, soil analyses are an indispensable part of sustainable agriculture. These analyses help conserve natural resources and increase soil fertility. It prevents unnecessary use of fertilizers in agricultural areas, reduces environmental pollution and allows farmers to increase their income. According to the report prepared by The Banks Association of Türkiye (2023); 24 million hectares of land, which constitutes approximately one-third of Turkey's 78-million-hectare surface area, is arable agricultural land, and this makes sustainable agriculture necessary in the face of an increasing population from year to year.

**Keywords:** Plant Nutrition, Soil Analysis, Sustainable Agriculture, Organic Matter

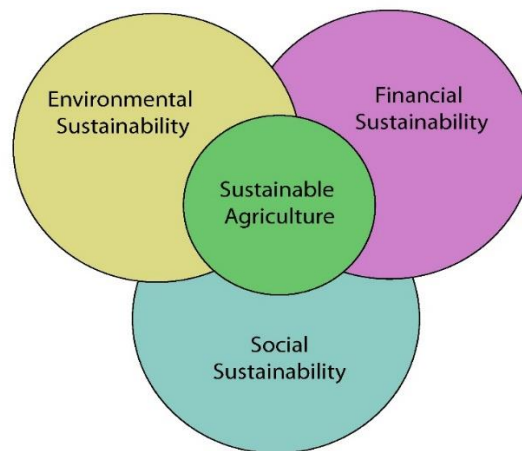
## 1. Soil

Soil is a thin layer covering the surface of the land, composed of a mixture of rocks and decomposition products of organic matter. While soil hosts various living organisms in and on it, it provides a habitat for plants and functions as a food source. It also contains water and air in certain proportions. Soil, which we will describe as a three-dimensional entity; It performs important functions such as growth of plant roots, storage of nutrients and retention of water. With these characteristics, soil is a fundamental component of the ecosystem (Akalan, 1988). Soil is the basic element of agricultural activities and supports crop production with the mineral substances it contains. However, soils under continuous intensive agriculture may become inadequate in nutrients over time, their organic matter content decreases and soil quality may deteriorate. In order to prevent this situation and maintain soil fertility, it is important to analyze and define the physical, chemical and biological properties of soils in the best possible way.

## 2. Sustainability in Agriculture

Sustainability in agriculture is a model of agriculture that is environmentally, socially and financially efficient, renewable, conserves natural resources, meets the needs of society and considers the needs of future generations. In this model, production activities focus on the sustainable use of natural resources, environmental protection and mitigation of global problems such as climate change. In addition, preventing the use of chemicals harmful to public health, ensuring social justice and economic sustainability are among the important elements of sustainability in agriculture. Below is a diagram of sustainable agriculture (Figure 1).

What is Sustainable Agriculture ?



**Figure 1.** Sustainable agriculture.

Sustainability is an important element for the long-term success of the agricultural sector. Soil analysis ensures that efficient agricultural practices are maintained and helps to conserve natural resources. When soil is not properly managed, productivity can decline, problems such as soil erosion and desertification can occur, and biodiversity loss can occur. This threatens agricultural production and food security. The principle of sustainability is important for the balanced use of natural resources and for leaving a healthy land legacy to future generations. Soil analysis is a fundamental part of sustainable agriculture. A proper soil analysis helps reduce environmental impacts while increasing efficiency in agricultural production.

## 3. Ecological Agriculture

Ecological agriculture is an environmentally friendly and sustainable agricultural model that protects natural resources. This model is based on principles such as sustainable use of natural

resources, protection of soil quality, supporting biodiversity, reducing the use of chemical fertilizers and pesticides, and providing natural living conditions for animals.

Ecological farming is characterized by the reduction or complete elimination of the use of chemical inputs. Therefore, organic methods such as farmyard manure, green manure, vermicompost or compost are preferred for fertilization. In addition, practices such as supporting insects, weeds, birds and other beneficial creatures and using natural methods to control pests are also important elements of ecological agriculture.

The goals of ecological agriculture include increasing soil fertility, improving food quality, increasing farmers' incomes and ensuring the sustainable use of natural resources.

Soil analysis is an important tool that supports the success of ecological agriculture.

Here are some points that explain the relationship between ecological agriculture and soil analysis:

**Nutrient Management:** In ecological farming methods, organic fertilizers and nutrients obtained from natural sources are preferred over chemical fertilizers. Soil analysis determines the nutrient content of the soil and allows the correct determination of the nutrients needed by plants. This supports proper nutrient management and the use of organic fertilizers.

**Organic Matter Management:** An important element of ecological agriculture is to maintain and increase soil organic matter content. Soil analysis determines the amount of organic matter, allowing to control the level of humus and other organic matter in the soil. This increases the water-holding capacity of the soil, improves soil structure and promotes biological activity.

**Pest Management:** Ecological agriculture uses solutions based on natural methods instead of chemical pesticides to combat pests and diseases. Soil analysis allows to assess plant health and the presence of beneficial organisms in the soil. Thus, it provides information for the effective use of natural enemies and the application of biological control methods against pests.

**Soil Health and Biodiversity:** Another goal of ecological agriculture is to maintain soil health and biodiversity. Soil analysis is used to assess soil health and determine microbial diversity in the soil. This information helps to better plan and manage ecological farming practices.

**Erosion Control:** Ecological agriculture takes measures to prevent or minimize soil erosion. Soil analysis assesses soil structure, water holding capacity and erosion risk to determine appropriate soil amendments to prevent erosion. This supports soil fertility and sustainable agricultural practices by reducing soil erosion.

There is a strong relationship between ecological agriculture and soil analysis. Soil analysis supports the basic principles of ecological agriculture, helping to improve soil health, nutrient management, organic matter management, pest management, biodiversity and erosion control. In this way, ecological agriculture achieves sustainability goals and conserves natural resources.

## 4. Soil Analysis

### 4.1. Definition and Purpose of Soil Analysis

Soil analyses are analyses carried out under laboratory conditions to determine various physical, chemical and biological properties of soils such as texture, pH, salinity, lime, nutrient content (MEB, 2015).

According to another definition, soil analysis is the physical, chemical and biological analysis methods applied to the soil under laboratory conditions in order to determine the structure of the soil and the amount of plant nutrients it contains, to increase the amount and quality of the

product to be grown in the soil, to determine the need for fertiliser, to prevent the barrenness of the soils in the long term (MEB, 2015).

Soil analysis aims to determine the nutrients that the soil needs for healthy plant growth by measuring various parameters such as pH value, salinity, organic matter content, nutrients. This process helps to determine the nutrients required for soil fertility and plant growth.

Soil analysis helps to make the soil fertile in the right way, increase plant growth, prevent diseases and obtain a better product. In addition, by obtaining information about the chemical properties of the soil, it also helps to determine the correct fertilisation and soil regulation practices.

Soil analysis is a method used to determine soil properties. While physical analysis examines properties such as soil texture, structural condition, water holding capacity, chemical analysis evaluates soil parameters such as pH value, nutrient content, salinity. In addition, biological analysis evaluates microorganism activities, humus content and biodiversity in the soil.

Soil analysis is carried out in special laboratories. The results of the analysis are used to determine which nutrients the soil needs. Therefore, soil analysis is an important step to make the soil healthy and to make a more efficient agriculture.

Agricultural soil analysis is carried out for the following purposes:

- Determination of soil nutrient content and nutrient supply power to plants,
- Determination of the type and amount of fertiliser to be applied,
- Determination of the source of nutritional disorders in soil
- Diagnosis and reclamation of salty, sodium areas,
- Land survey and classification,
- Determination of the type of plant to be grown,
- Drainage problems and solutions.

(Öztürk, 2021).

The aim of soil analyses is to determine the amount of plant nutrients in soils and to determine the type and amount of fertiliser required by the plants to be grown in those soils. In this way, it is aimed to find the right answers to questions such as which fertiliser, how much, when and how it should be applied. In order to carry out agricultural activities, it is important to comply with the results of soil analysis carried out by experts. Fertilisation and other agricultural activities carried out without complying with the results of soil analyses often lead to harmful results. Especially unconscious use of fertilisers, financial losses, plants with low resistance to diseases, low yield values that cannot meet the needs of the increasing population, agricultural soils with decreasing organic matter every year, pollution of the environment (soil, water and air), deteriorating ecological balance and deterioration of human health. For these reasons, soil analysis has become inevitable (Bellitürk, 2010).

#### **4.2. Importance of Soil Analysis**

The main objective in agriculture is to obtain the highest possible yield and quality product from cultivated lands. Achieving this goal is possible first of all by taking a series of cultural measures to increase the productivity of soils. Fertilisation takes the first place among these cultural measures. If the nutrients removed from the soil by plants are added to the nutrients washed away by rain and irrigation waters and lost by erosion, the cultivated soils become poorer in nutrients from year to year. The plant nutrients removed from the soil must be added to the soil by fertilisation. For this purpose, the nutrient content of the soil must first be determined.

Soil analysis is to determine the type and amount of fertiliser required by the plants to be grown in those soils by determining the amount of plant nutrients in the soils. Soils are analysed chemically in the laboratory established for this purpose and the amount of plant nutrients (Nitrogen, Phosphorus, Potassium, Magnesium and Calcium etc.) are measured. In order for



the plant to grow and give a good product, the amount of fertiliser to be given is determined by determining which nutrients are deficient. The types of fertilisers needed by the soil, the application times of fertilisers and the application method of fertilisers are prepared in a report and delivered to the farmer. With the fertilisation to be made in accordance with the report, the nutrients needed by the plants are added to the soil. This prevents nutrient deficiencies and excesses, and also prevents the misuse of fertilisers.

As soils are used unconsciously, assuming that they are an unlimited resource of the world, their productivity will gradually decrease. Soil analyses are the most important method to determine the capacity of soil to provide nutrients to plants. For this reason, regardless of the size of the agricultural land, we should definitely have our agricultural soils analysed in order to avoid undesirable situations and to leave fertile soils for future generations (Bellitürk, 2010).

### **4.3. Soil Analysis Laboratories**

Soil analysis is usually carried out in soil analysis laboratories. These laboratories have the necessary tools and equipment to determine the physical, chemical and biological properties of the soil.

Those who want to have soil analysis first take samples from their land and then take these samples to the laboratory for analysis. When taking soil samples, more accurate results can be obtained by taking samples from different depths and different parts of the soil. Soil samples should be stored properly and taken to the laboratory for analysis as soon as possible.

Soil analysis laboratories are located mainly in agricultural regions and universities. They usually offer soil analysis services and can prepare soil analysis reports to determine what nutrients the soil needs. These reports help farmers and gardeners to increase crop yields by more accurately determining the nutrients their plants need.

Burdur Soil and Irrigation Water Analysis Laboratory is seen in the photo below (Figure 2).



**Figure 2.** Burdur Soil and Irrigation Water Analysis Laboratory (Anonymous, 2024).

## **5. The Relationship Between Soil Quality Management And Soil Analysis**

Soil quality management is a set of strategies and practices to improve the productivity, health and sustainability of soils. This management approach includes objectives such as preventing soil erosion, increasing the amount of organic matter, optimizing soil fertility, improving water holding capacity and regulating nutrient cycling in the soil.

The starting point of the soil quality management process is soil analysis. Determining soil properties and nutrient content is important to understand where improvements need to be made.



Soil analysis contributes to long-term planning and management of agricultural activities. By assessing soil properties, the results of the analysis provide information on which plant species can be grown, which fertilizers should be used and how soil amendments should be made.

## **6. The Impact Of Soil Analysis On Plant Nutrition Strategies**

Soil analysis has a significant impact on plant nutrition and fertilization strategies.

**Determination of Nutrient Needs:** Soil analysis assesses the nutrient needs of plants by determining the amount and status of nutrients in the soil. According to the analysis results, deficiency or excess of nutrients in the soil is determined. Thus, appropriate fertilization strategies are developed for the correct and balanced nutrition of plants.

**Optimization of Fertilization Program:** Soil analysis plays an important role in determining the amount and composition of fertilizer to be used for plant nutrition. According to the results of the analysis, deficient nutrients are supplemented with fertilizers or excess elements are limited. In this way, the nutritional needs of plants are met and productivity is increased by creating the right fertilization programs.

**Improving Fertilizer Efficiency:** Soil analysis provides important information to improve fertilizer efficiency. Based on the results of the analysis, fertilization strategies are created that focus on and target the nutrients that plants need. In this way, fertilizers are used more efficiently and waste is prevented.

**Phosphorus and Nitrogen Management:** Soil analysis has a major impact on the management of important nutrients, especially phosphorus and nitrogen. Phosphorus is an essential element for plant growth and development and soil analysis ensures that phosphorus is applied at the correct level. Nitrogen is a critical element for plant growth, but its overuse can cause environmental problems. Soil analysis helps to determine the nitrogen needs of plants and to apply nitrogen at the right time and in the right amounts.

**Soil Acidity and pH Management:** Soil analysis determines the acidity and pH level of the soil. pH level affects the ability of plants to absorb nutrients. According to the results of soil analysis, the pH level can be adjusted and an environment suitable for the nutritional needs of plants is created.

**Balancing Nutrients:** Soil analysis helps to balance the nutrients that plants need. According to the results of the analysis, the deficient elements in the plant are determined and fertilization strategies are adjusted accordingly. In this way, plants have balanced access to all nutrients and problems caused by nutrient deficiencies are prevented.

**Reducing Fertilizer Costs:** Soil analysis optimizes fertilizer use by more precisely determining the nutrient needs of plants. Based on the results of the analysis, fertilizers are applied in the right amounts and at the right time. This helps reduce fertilizer costs and enables farmers to use their resources more efficiently.

**Reducing Environmental Impacts:** Soil analysis contributes to reducing environmental impacts by helping to prevent excessive fertilizer use and nutrient losses. Based on the results of the analysis, the nutrients needed by the plants are added to the soil through targeted and optimized fertilization. This prevents the release of excess fertilizer into the environment and contributes to reducing negative impacts such as water pollution.

**Increased Productivity and Quality:** Soil analysis increases productivity and product quality by ensuring that the nutritional needs of plants are accurately met. Based on the results of the analysis, appropriate fertilization strategies are applied to eliminate plant deficiencies and ensure optimal nutrition. This promotes healthy plant growth, increases yields and improves product quality.

Soil analysis contributes to the optimization of plant nutrition and fertilization strategies and the development of sustainable agricultural practices. This makes it possible to use soil resources more efficiently, reduce environmental impacts and increase agricultural productivity.

## **7. The Effect Of Soil Analysis On Pest And Disease Management**

Soil analysis has a significant impact on the management of diseases and pests.

**Assessing Disease and Pest Risk:** Soil analysis is used to assess the possible risk of diseases and pests. Based on the results of the analysis, information on the presence and density of pathogens or harmful organisms in the soil is obtained. This information is important for planning disease and pest management strategies.

**Identification of Diseases and Pests:** Soil analysis helps to identify the species and genus of disease agents or harmful organisms in the soil. This information helps to select and apply the right treatment methods. Different diseases or pests can be controlled by different methods, so accurate diagnosis and identification is important.

**Preventing the Spread of Diseases and Pests:** Soil analysis helps to identify the potential for disease and pest spread. Especially for soil-dwelling pathogens, preventive measures can be taken based on the results of the analysis. For example, the use of disease-infected plant material can be avoided or disease-resistant plant varieties specific to the region can be selected.

**Increasing Plant Resilience:** Soil analysis supports healthy plant growth and immunity by assessing the nutrient needs of plants. Healthy plants are more resistant to diseases and pests. Based on the results of soil analysis, the deficient nutrients of plants can be supplemented by fertilization and plant resistance can be increased.

**Chemical Control and Optimization of Pesticide Use:** Soil analysis enables optimization of the pesticides used in chemical control of diseases and pests. According to the results of the analysis, the timing and dose of spraying can be determined based on the presence of the disease or pests. This reduces unnecessary pesticide use and minimizes environmental impacts.

**Early Detection of Diseases and Pests:** Soil analysis enables early detection of diseases and pests.

**Improving Cultural Practices:** Soil analysis contributes to the development of cultural practices for disease and pest management. According to the results of the analysis, appropriate cultural practices can be determined by evaluating factors such as pH level, organic matter content and moisture level in the soil. For example, regulating soil pH can prevent the occurrence of plant diseases and pests.

**Selection of Direct Control Methods:** Soil analysis helps in the selection of direct control methods for disease and pest management. Based on the results of the analysis, methods that

are effective against diseases or pests are determined. These methods may include natural methods such as biological control, integrated pest management, ecological balance. Soil analysis contributes to the development of long-term management strategies for diseases and pests. Based on the results of the analysis, sustainable methods and strategies for controlling plant diseases and pests can be established. This is important to ensure control of diseases and pests and to prevent future problems.

## **8. Contribution Of Soil Analysis To Water Management And Erosion Control**

Soil analysis makes important contributions to water management and erosion control.

**Determination of Water Holding Capacity:** Soil analysis helps to determine the water holding capacity of the soil. Based on the results of the analysis, information is obtained about the water holding capacity, water permeability and drainage properties of the soil. This information is important for planning irrigation programs and irrigation management. Soils with low water-holding capacity may require more frequent irrigation, while soils with high water-holding capacity may be better able to adjust irrigation frequency and quantity.

**Determination of Irrigation Water Requirement:** Soil analysis helps to determine the irrigation water requirement of plants. According to the results of the analysis, appropriate irrigation programs and irrigation amounts are planned, taking into account the root system and water retention capabilities of the plants. This ensures the efficient use of irrigation water and contributes to the efficient use of water resources.

**Soil Moisture Management:** Soil analysis contributes to soil moisture management. Based on the results of the analysis, the amount of water needed by plants is determined and irrigation schedules are adjusted accordingly. Soil analysis also provides information on the development of the root system of plants and their ability to retain water, which helps plants to use water more efficiently.

**Erosion Control:** Soil analysis is an important tool for erosion control. Based on the results of the analysis, erosion-sensitive areas or soils can be identified. Appropriate measures can be taken to prevent erosion in these areas, such as the selection of erosion-resistant plant varieties, sustainable tillage methods and the creation of erosion control structures. Soil analysis has an important role in determining strategies to reduce the risk of erosion.

## **9. The Importance Of Soil Analysis In Sustainable Agriculture Practices**

Soil analysis is an important tool for sustainable agricultural practices.

**Efficient Fertilization:** Soil analysis accurately assesses the nutritional needs of plants by determining the level of nutrients in the soil. This helps to avoid unnecessary fertilizer use. Proper fertilization ensures that plants get the nutrients they need, increases productivity and minimizes the environmental impact of excessive fertilizer use.

**Water Management:** Soil analysis helps plan irrigation schedules and irrigation quantities by assessing soil water holding capacity and water drainage characteristics. This ensures efficient use of irrigation water, contributing to the conservation of water resources and preventing waste.

**Soil Health and Fertility:** Soil analysis determines the effects on soil health and fertility by evaluating factors such as pH level, organic matter content and soil structure. Based on the

results of the analysis, the levels of nutrients or organic matter deficient in the soil can be determined and soil fertility can be increased by correcting them at the appropriate level.

**Pest Management:** Soil analysis plays an important role for disease and pest management. Based on the results of the analysis, effective control strategies against pests can be developed. Accurate diagnosis and identification enable the selection of appropriate control methods and reduces the unnecessary use of pesticides in chemical control.

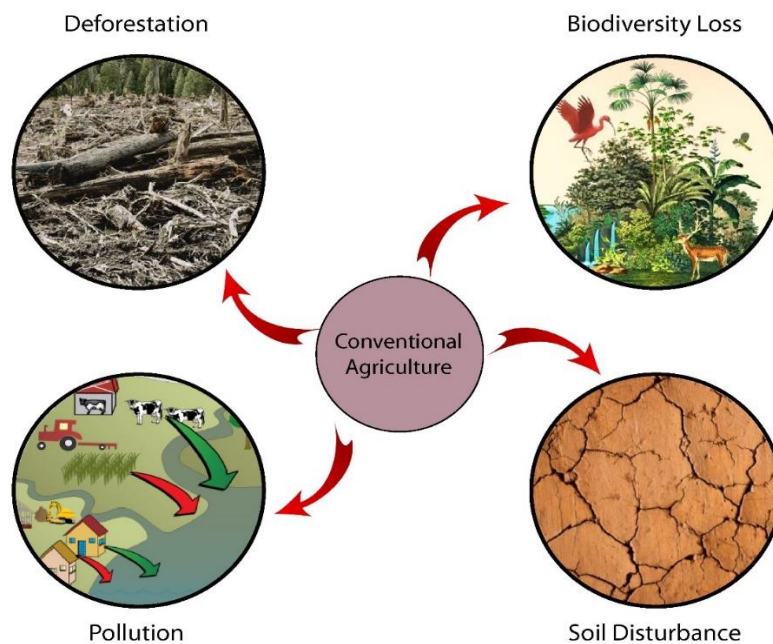
**Minimizing Environmental Impacts:** Soil analysis helps to minimize environmental impacts. Based on the results of the analysis, the correct fertilization and irrigation programs can be planned, thus preventing environmental pollution and overuse of water resources.

**Long Term Planning:** Soil analysis contributes to long-term agricultural planning. Based on the results of the analysis, strategies such as soil improvement, erosion control, plant variety selection can be determined. This is an important step for planning and implementing sustainable agricultural practices. Soil analysis helps to reduce the environmental impacts of agricultural activities and enables the right measures to be taken to protect and improve soil fertility and quality. Furthermore, soil analysis helps to ensure the continuity of sustainable agricultural practices by providing data for future agricultural planning and resource management.

As a result, soil analysis is considered an essential element of sustainable agricultural practices. Accurate and regular soil analysis helps to make informed decisions in areas such as efficient fertilization, water management, soil health and pest management. This provides significant advantages in terms of environmental sustainability, soil fertility, protection of water resources and the quality and quantity of agricultural production.

## 10. The Difference Between Traditional and Sustainable Agriculture

Some environmental problems of conventional agriculture are shown as follows (Figure 3).



**Figure 3.** Some environmental problems of conventional agriculture.

## **11. Conclusions and Recommendations**

Soil analysis is a necessary process in order to plant the right product in the right soil, to make a balanced fertilization in order to obtain high quality and high yields, and has very useful results.

Soil analysis is highly recommended to ensure the success of agricultural activities and product efficiency. Soil analysis helps to assess soil health and optimize agricultural practices.

If fertilizer is applied without soil analysis, the following will occur:

- a) Too much or too little fertilizer may be applied.
- b) The wrong type of fertilizer may be applied to the soil.
- c) Fertilizer can be applied at the wrong time and in the wrong way
- d) Environmental pollution occurs.
- e) Economic losses occur.

As a result, there are many negative effects of not performing soil analysis. Therefore, it is very important to make soil analysis in order to make correct agricultural practices.

It is always a necessity to carry out studies to improve the accuracy, efficiency and practical applicability of soil analysis.

### **The following studies can be carried out to improve soil analysis in the future:**

#### **Improvement of Analysis Methods:**

Efforts should be continuously made to make the methods used in soil analysis increasingly faster, more precise and reliable. For example, analysis processes can be improved through the use of new technologies or the refinement of traditional methods.

**Determination of Nutrient Deficiencies:** Soil analysis is used to detect nutrient deficiencies in soil. Therefore, it is important to develop methods to ensure accurate and precise analysis of plant nutrients. In addition, studies can be conducted on soil analyses combined with plant nutrient analyses to determine nutrient needs for different plant species. Soil analysis should not be limited to nutrient content. Methods should be developed to enable a more comprehensive analysis of other important soil properties such as soil structure, organic matter content, pH level, water holding capacity. This will help to better assess soil health and fertility. Soil analysis should help adapt agricultural practices to local conditions. Determining analysis standards and reference values specific to regions and plant species would help to interpret analysis results more effectively and adapt farming methods to local needs. It is important that data from soil analyses are effectively managed and shared. Standardized analysis protocols and data formats ensure that soil analysis results can be compared and integrated. This facilitates information sharing between researchers, agronomists and farmers. In addition to the parameters traditionally measured in soil analysis, it is also important to develop new analysis parameters. For example, new parameters such as determining the level of microbial activity in soil or biochemical analyses reflecting the quality of organic matter in soil can help to assess soil health and fertility in a more comprehensive way. The development of fast and portable analyzers for agriculture makes soil analysis practical and user-friendly. Such devices enable farmers to take instant measurements in the field and quickly get results. Integrating data from soil analysis with artificial intelligence and data analytics methods enables the development of more comprehensive and intelligent soil management strategies. This supports decision-making by providing farmers with more information and recommendations. Appropriate soil sampling strategies should be used to ensure accurate soil analyses. For example, it is important that soil sampling sites are representative and that standard sampling protocols are followed. Further

research and optimized methods for determining factors such as sampling depth, number and frequency are needed. It is important to provide more education and awareness to farmers on the importance of soil analysis, how to conduct it and how to interpret the results. Training programs can be organized by universities, soil scientists, agronomists and local agricultural organizations. As a result, farmers who fully implement the fertilization recommendations specified in the analysis report by having their soil analyzed will undoubtedly support sustainable agriculture by making a significant contribution to both themselves and the country's economy.

**Acknowledgements:**

This work was supported by Research Fund of the Tekirdağ Namık Kemal University. Project number NKUBAP.03.YL.23.527. On the other hand, this study has been prepared from a part of master's thesis titled "SCIENTIFIC EVALUATION OF SOIL ANALYSIS REPORTS PREPARED BY SOME LABORATORIES IN OUR COUNTRY" by author Doruk AYDOĞAN (Supervisor of Master Thesis: Korkmaz BELLİTÜRK).

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## EKONOMİK ANALİZ VE ETKİNLİK ÜZERİNE AKADEMİK EĞİLİMLER: BİBLİYOMETRİK BİR ÇALIŞMA

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### Özet

Bu çalışma ile tarımsal alanda “Ekonomik Analiz (Economic Analysis)” ve “Etkinlik (Efficiency)” konularında yapılan çalışmaların bibliyometrik analiz ile değerlendirilmesi amaçlanmıştır. Bu amaç için Scopus veri tabanı taranmış ve 1742 eser analize dahil edilmiştir. Ekonomik analiz ve etkinlik konularında yapılan çalışmaların yıllara göre dağılımına bakıldığında, en fazla çalışmaların 2021 (122 çalışma), 2022 (125 çalışma), 2023 (103 çalışma) ve 2024 (117 çalışma) yıllarında yapıldığı belirlenmiştir. Sonuçlar çalışmaların %86,85’inin araştırma makalesi, %6,60’ının kongre bildirisi, %4,54’ünün derleme makale, %1,32’sinin kitap-kitap bölümü ve %0,69’unun da diğer çalışmalardan (Kongre derlemesi, not, editöryal yazı) oluştuğunu göstermiştir. En fazla eser veren araştırmacılar Danilo Simões, Silvia Martínez Llorens, Kurt A. Rosentrater, Ganesh K. Kumar, Luigi Pari, Alessandro Suardi ve Haroldo Carlos Fernandes’tir. ABD 338 eser ile bu alanda en fazla çalışmaya sahip ülke iken, ABD’yi sırasıyla Çin, Hindistan ve Brezilya takip etmektedir. Türkiye 51 eser ile 188 ülke arasında 10. sırada yer almıştır. “Ekonomik Analiz (Economic Analysis)” kelimesi 1742 eserin 215’inde, “su kullanım etkinliği (Water use Efficiency)” 52’sinde, “ekonomik etkinlik (Economic Efficiency)” 49’unda, “ekonomi (Economics)” kelimesi 47’sinde ve “etkinlik (Efficiency)” kelimesi 46’sında kullanılarak en fazla kullanılan anahtar kelimeler olmuştur. Yapılan çalışmaların ana yayın kaynakları Biomass and Bioenergy, Water, Agricultural Water Management, Ecological Indicators ve Industrial Crops and Products dergileridir. Alanda en yüksek atıf alan yazar André P.C. Faaij, dergi Biomass and Bioenergy, ülke ABD olmuştur.

**Anahtar Kelimeler:** Tarım, Ekonomik analiz, Etkinlik, VOSviewer



## ACADEMIC TRENDS ON ECONOMIC ANALYSIS AND EFFICIENCY: A BIBLIOMETRIC STUDY

### **Abstract**

This study evaluated the “Economic Analysis” and “Efficiency” studies in the agricultural field by bibliometric analysis. For this purpose, the Scopus database was searched, and 1742 studies were included in the analysis. Looking at the distribution of studies on economic analysis and efficiency by year, it was determined that most studies were carried out in 2021 (122 studies), 2022 (125 studies), 2023 (103 studies), and 2024 (117 studies). The results showed that 86.85% of the studies were research articles, 6.60% were conference papers, 4.54% were review articles, 1.32% were book-book chapters, and 0.69% were other studies (conference review, note, editorial). Danilo Simões, Silvia Martínez Llorens, Kurt A. Rosentrater, Ganesh K. Kumar, Luigi Pari, Alessandro Suardi, and Haroldo Carlos Fernandes were the researchers who published the most studies. The USA had the highest number of studies in this field, with 338, followed by China, India, and Brazil. Türkiye ranked 10<sup>th</sup> among 188 countries with 51 studies. “Economic Analysis” was used in 215 out of 1742 studies, ‘Water use Efficiency’ in 52, ‘Economic Efficiency’ in 49, ‘Economics’ in 47, and ‘Efficiency’ in 46. The main publication sources of the studies are Biomass and Bioenergy, Water, Agricultural Water Management, Ecological Indicators, and Industrial Crops and Products. The most highly cited author was André P.C. Faaij, the journal was Biomass and Bioenergy, and the country was the USA.

**Keywords:** Agriculture, Economic analysis, Efficiency, VOSviewer

## **Giriş**

Ülke ekonomileri açısından en önemli sektörler tarım, sanayi ve hizmet sektörleri olmakla birlikte, tarım sektörü gıda güvencesi, ekonomik kalkınma ve çevresel sürdürülebilirlik açısından ön plana çıkmaktadır. Tarihsel olarak değerlendirildiğinde tarım sektörü, özellikle GSYİH ve istihdama önemli ölçüde katkıda bulunduğu gelişmekte olan ülkelerde ekonomik büyümenin temel taşı olmuştur. Ayrıca tarım, iklim değişikliği ve nüfus artışı nedeniyle giderek daha fazla tehdit altında olan gıda güvencesinin ayrılmaz bir parçasıdır. Dünya nüfusunun 2050 yılına kadar yaklaşık 9,7 milyara ulaşacağı ve bunun da gıda üretiminde önemli bir artış gerektireceği öngörülmektedir (Nguyen vd., 2020). Bu talep, verimliliği korurken değişen iklim koşullarına uyum sağlaması gereken tarım sistemleri üzerinde ek bir baskı oluşturmaktadır. Örneğin, Rial-Lovera ve arkadaşları, iklim değişikliğinin Birleşik Krallık tarımı üzerindeki etkilerini tartışarak, çevresel değişikliklerin verimliliği ve kaynak kullanım etkinliğini önemli ölçüde etkileyeceğini belirtmektedir (Rial-Lovera vd., 2016). Benzer şekilde, Sinha ve arkadaşları da tarımsal uygulamaların sera gazı emisyonlarına katkıda bulunduğunu, bunun da iklimi etkileyerek gıda üretimi çabalarını daha da karmaşık hale getirdiğini belirtmektedir (Sinha vd., 2023).

Tarımın yukarıda sayılan önemi ve artan nüfusun gelecekte beslenmesi endişesi bu alanda yapılan çalışma sayısının artmasına neden olmuştur. Bir taraftan değişen iklim koşullarına uyum sağlayan bitki ve hayvan ıslahı çalışmaları başlatılırken diğer taraftan birim alandan alınan ürün miktarının artırılmasına yönelik çalışmalara hız verilmiştir. Tüm bu gelişmeler doğal kaynakların tahribatına neden olmaktadır. Bu nedenle işletmelerin maliyetlerini ve kaynak kullanım etkinliklerini bilmeleri, gelecekle ilgili plan yapmalarına imkan tanımakta ve doğal kaynakların sürdürülebilirliğine katkı sunmaktadır.

Tarımsal alanda ekonomik ve etkinlik analizi çalışmaları, sektörde verimliliğin, sürdürülebilirliğin ve genel ekonomik uygulanabilirliğin artırılmasında çok önemli bir rol oynamaktadır. Bu analizler, kaynak tahsisi, risk yönetimi ve tarımsal uygulamaların optimizasyonuna ilişkin öngörüler sağlar ve dünya nüfusunun artan gıda taleplerini karşılamak için gereklidir. Ayrıca, ekonomik analizin çiftlik yönetimi uygulamalarına entegre edilmesi, tarımsal üretim sistemlerinin karmaşıklığını önlemek için gereklidir. Malcolm'un çalışmasında çiftlik yönetiminde ekonomik okuryazarlık eksikliğinin yanlış yönlendirilmiş karar alma süreçlerine yol açabileceği ileri sürülmüş ve tarımsal uygulamalarda ekonomik ilkelerin sağlam bir şekilde anlaşılması gerekliliğinin altı çizilmiştir (Malcolm, 2004).

Bibliyometrik analiz, çeşitli alanlardaki bilimsel literatürü değerlendirmek ve haritalamak için güçlü bir araçtır. Yayın kalıplarını, atıf metriklerini ve araştırmacılar arasındaki işbirliği dinamiklerini analiz etmek için nicel teknikler kullanarak araştırma konularının evrimi ve disiplinlerin entelektüel yapısı hakkında öngörüler sağlayan bir analiz şeklidir. Bu metodoloji son yıllarda, özellikle akademik çalışmalarda araştırma kalitesini ve üretkenliğini değerlendirmek için bir araç olarak ilgi görmüştür (Allen vd., 2009; Aksnes & Rip, 2009). Dirik ve arkadaşları bibliyometrik analizin literatür taramasından farklı olarak bir alanın güncel durumunu ortaya koymada kullanılan ve yazılımlar yardımıyla görsel olarak akademik eğilimleri takip etmeyi kolaylaştıran analitik bir yol olduğunu vurgulamıştır (Dirik vd., 2023). Bibliyometrik analizin başlıca avantajlarından biri, belirli alanlarda ortaya çıkan eğilimleri ve bilgi boşluklarını belirleme yeteneğidir.

Bu çalışmada tarımsal alanda ekonomik analiz ve etkinlik konularında yapılan çalışmaların bir bibliyometrik analizi yapılmıştır.

## **Materyal ve Metot**

Çalışmada Scopus veri tabanından elde edilen veriler kullanılmıştır. Sosyal bilimler alanına dayalı çalışmalara daha fazla yer verdiği gerekçesiyle Scopus veri tabanı seçilmiştir. Scopus veri tabanında, 21.09.2024 tarihinde, makale başlığı, özet ve anahtar kelimelerde (Article title,

Abstract, Keywords), ekonomik analiz ve etkinlik ("economic analysis" AND efficiency) kelimeleri, konu alanı Tarım ve Biyoloji Bilimleri (Agricultural and Biological Sciences) olarak sınırlandırılarak tüm tarih ve belgelerde aratılmıştır. Sonuç olarak analize uygun 1742 çalışmaya ulaşılmış ve çalışmaya ait veriler CSV formatında elde edilmiştir.

Bibliyometrik analizin yapıldığı çeşitli programlar ve yazılımlar geliştirilmiştir. Bu analizde başta VOSviewer olmak üzere R programında Bibliometrix paketi, BibExcel, Pajek ve SciMat programları kullanılmaktadır. Kullanım kolaylığı, görsel arayüzü ve ücretsiz olması nedeniyle bu çalışmada VOSviewer (versiyon 1.6.20) paket programı tercih edilmiştir.

## Araştırma Bulguları ve Tartışma

### Yayın türleri ve yılları

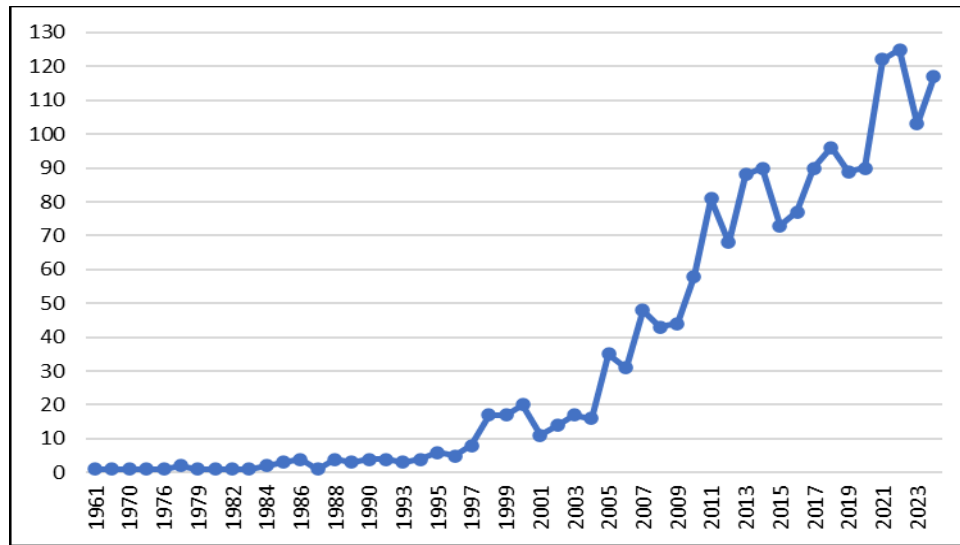
Analize konu edilen 1742 çalışmanın yayın türüne göre dağılımı Çizelge 1’de verilmiştir. Ekonomik analiz ve etkinlik konularında yapılan çalışmaların ağırlıklı çoğunluğu (%86,85) araştırma makalesidir.

**Çizelge 1.** İncelenen çalışmaların yayın türleri

Yayın Türü	Yayın Sayısı	Oran (%)
Araştırma Makalesi	1513	86,85
Kongre Bildirisi	115	6,60
Derleme Makale	79	4,54
Kitap-Kitap Bölümü	23	1,32
Diğer*	12	0,69
Toplam	1742	100,00

\*Kongre derlemesi, kısa anket, not, editoryal yazı

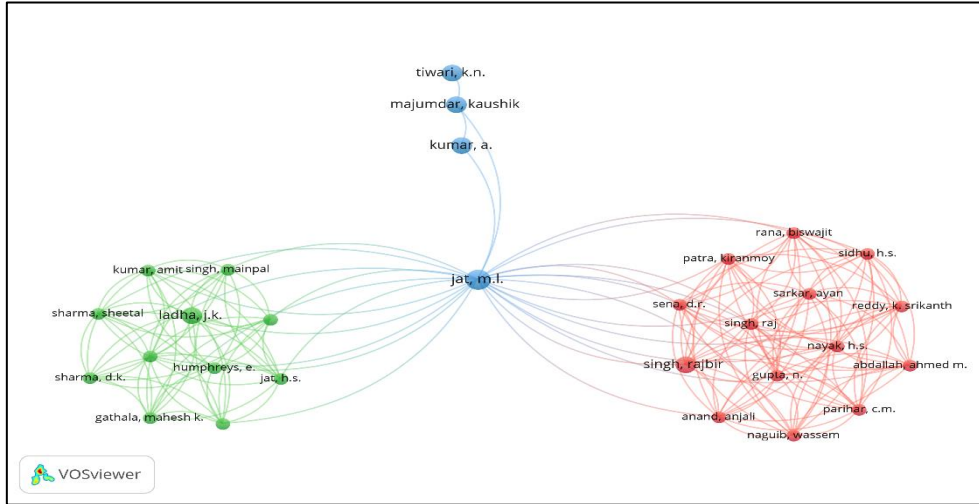
Scopus veri tabanında taranan ekonomik analiz ve etkinlik konusunu ele alan en eski çalışma 1961 yılına aittir. Konu ile ilgili çalışma sayısının özellikle 2000’li yıllardan sonra arttığı, en yüksek sayısına 125 çalışmayla 2022 yılında ulaşıldığı, 2024 yılında 21 Eylül tarihi itibarıyla 117 çalışma yapıldığı belirlenmiştir (Şekil 1).



**Şekil 1.** İncelenen çalışmaların yıllara göre dağılımı

## Yazarlar arası iş birliği analizi

Yazarların iş birliği analizi için programa yazarlar için en az 1 belge ve 1 atıf kriteri girilerek analiz yapılmıştır. Analizde amaç birbiriyle iş birliği yapan yazarları tespit etmektir. Analiz sonuçları toplam 7141 yazardan 6212'sinin girilen kriteri sağladığını göstermiştir. Girilen kriterlere göre birbiriyle en fazla ilişkili yazar iş birliği haritası Şekil 2'de verilmiştir. Üç farklı kümede 29 yazar arasında 175 bağlantı olduğu belirlenmiştir. En fazla atıf alan ve en fazla eser veren yazarların iş birliği haritasında olmadığı görülmektedir.



Şekil 2. Yazar iş birliği haritası

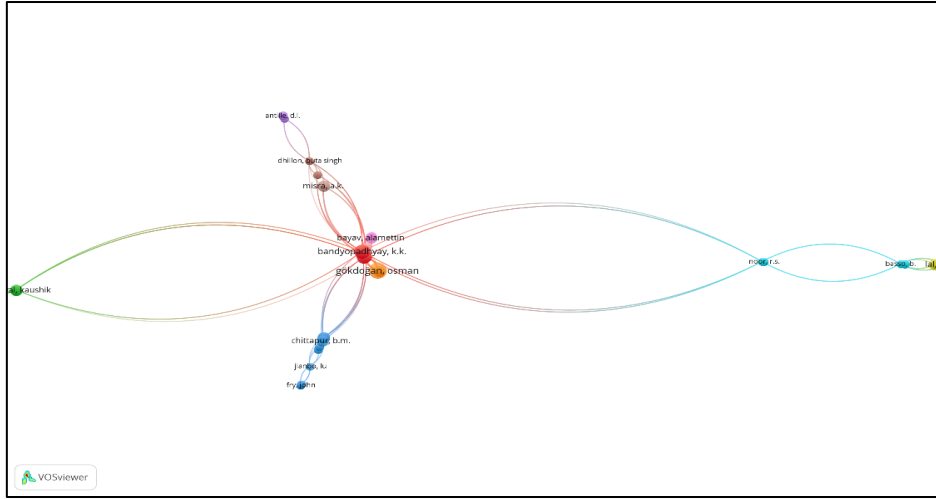
## Yazar yayın ve atıf analizi

Alanda en fazla eser veren yazarların başında Danilo Simões (6 eser) gelmektedir. Danilo Simões'i 5'er eserle Silvia Martínez Llorens ve Rosentreter Kurt A., 4'er eserle Ganesh K. Kumar, Luigi Pari, Alessandro Suardi, Haroldo Carlos Fernandes, Paulo Torres Fenner ve Osman Gökdoğan takip etmektedir. Çizelge 2 en fazla atıf alan yazarları göstermektedir. Atıf sayısı aynı olan yazarların ortak yayın yaptığı belirlenmiştir. Çalışmaya konu alan ekonomik analiz ve etkinlik konusunda üç yayının yazarları atıf sıralamasında ön sıralara taşımıştır.

Çizelge 2. Ekonomik analiz ve etkinlik konusunda en fazla atıf alan yazarlar

Yazar	Atıf Sayısı
André P.C. Faaij	1601
Carlo N. Hamelinck	1352
Geertje van Hooijdonk	1352
Dilpreet S Bajwa	716
Sreekala D. Bajwa	716
Ghasideh Pourhashem	716
Al Habib Ullah	716
Kuan-Hung Lin	610
Meng-Yuan Huang	610
Wen-Dar Huang	610
Ming-Huang Hsu	610
Zhi-Wei Yang	610
Chi-Ming Yang	610

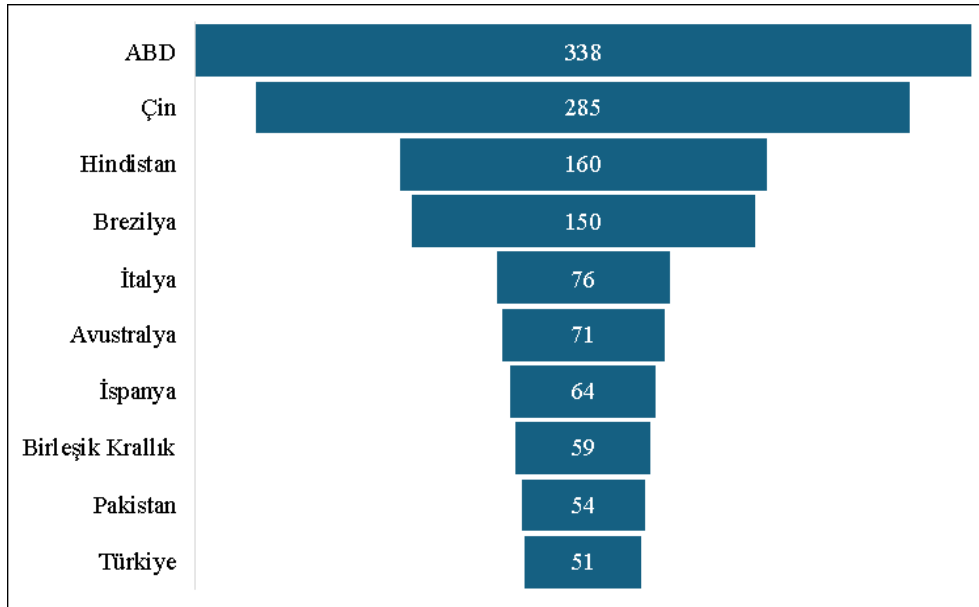
Yazarların atıf ağlarını belirlemek için VOSviewer programına en az 1 belge ve 1 atıf kriteri girilmiştir. Analiz sonuçlarına göre birbirleriyle en fazla bağlantılı olan 148 yazar olduğu, bu yazarların 15 kümede 707 bağlantı ve toplam 775 bağlantı gücüyle bağlantılı olduğu belirlenmiştir (Şekil 3).



Şekil 3. Yazarların atıf ağ haritası

### Ülkelerin yayın ve atıf analizi

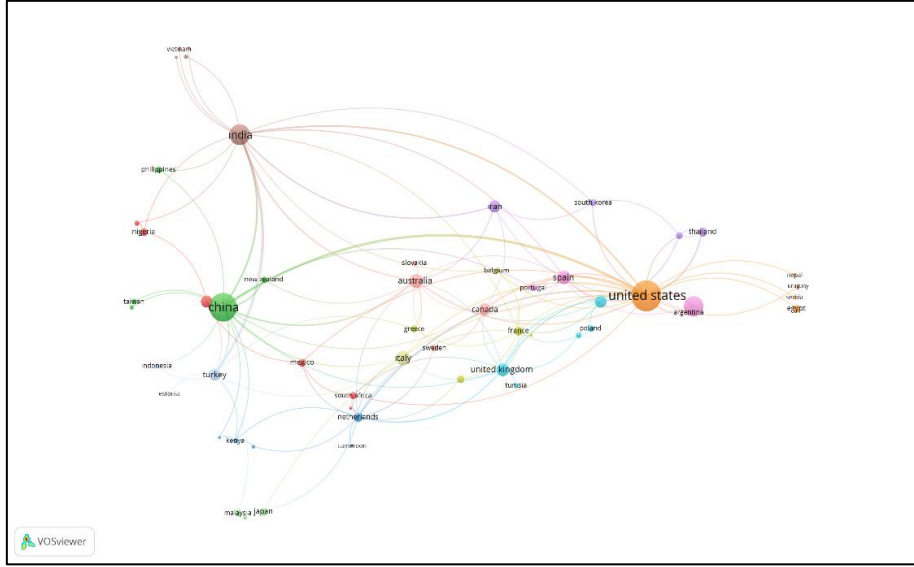
Çalışmaya konusunda yapılan yayın bakımından ilk ona giren ülkeler ve bu ülkelere ait yayın sayısı Şekil 4’te verilmiştir. ABD en fazla yayına sahip ülke iken, ABD’yi Çin, Hindistan ve Brezilya takip etmektedir. Türkiye 51 yayın sayısı ile onuncu sırada yer almıştır.



Şekil 4. Ülkelere göre yapılan yayın sayıları

Ülkelerin atıf sıralamasında ilk sırada ABD (11438 atıf) bulunmaktadır. ABD’yi 6021 atıf sayısı ile Çin, 2939 atıf sayısı ile Hindistan, 2826 atıf sayısı ile Avustralya, 2775 atıf sayısı ile Birleşik Krallık, 2749 atıf sayısı ile Hollanda, 2623 atıf sayısı ile İspanya, 2433 atıf sayısı ile Brezilya, 2238 atıf sayısı ile İtalya ve 1609 atıf sayısı ile Almanya takip etmektedir. Türkiye 673 atıf sayısı ile 20. sırada yer almaktadır.

Ülkelerin ağ haritası oluşturulurken programa en az 1 belge ve 1 atıf kriteri girilmiştir. Belirlenen kriterlere 117 ülkenin uyduğu, ancak oluşturulan ağ haritasında daha sade bir görüntü yakalamak için programın önerdiği 56 ülke kabul edilmiştir. Aralarında en fazla ilişki bulunan 56 ülkenin 13 kümede 122 bağlantı oluşturduğu ve toplam 198 bağlantı gücü tespit edilmiştir (Şekil 5). Ülkelerin yayın başına atıf sayısına bakıldığında 47 atıf ile Birleşik Krallık başı çekerken, 41 atıf ile İspanya ikinci sırada, 39,8 atıf ile Avustralya üçüncü sırada yer almıştır. Türkiye’nin yayın başına ortalama atıf sayısı 13,2’dir.



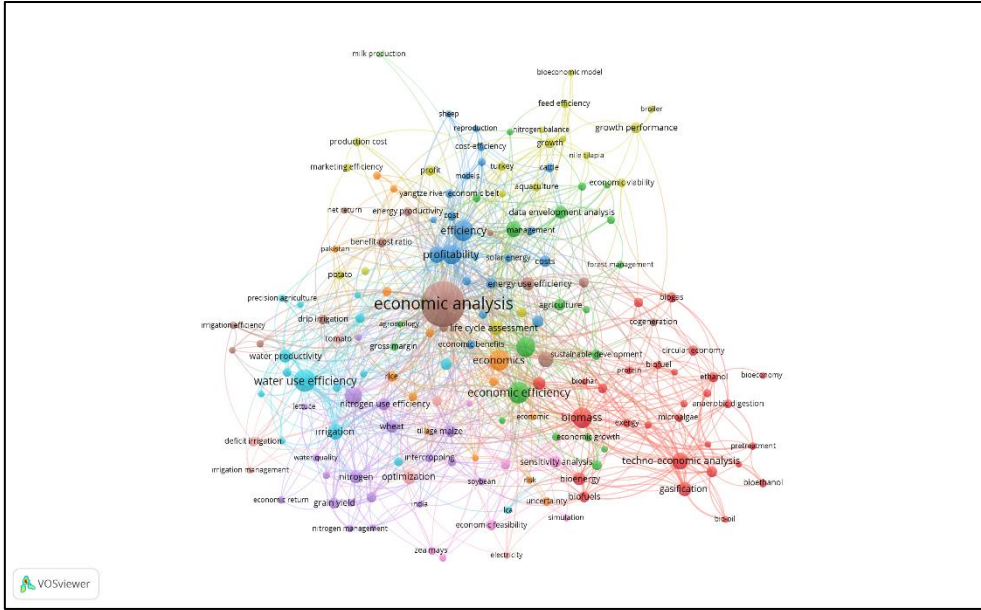
Şekil 5. Ülkelerin atıf ağ haritası

### Anahtar kelime analizi

Çalışmaya konusunda yapılan çalışmalarda en fazla kullanılan anahtar kelimeler incelenmiştir. Çalışma konusu olan ekonomik analiz ve etkinlik çalışmalarının bibliyometrik analizi için Scopus veri tabanından indirilen veriler başlık, özet ve anahtar kelimelerde arandığından en fazla kullanılan anahtar kelimelerin başında “ekonomik analiz” ve “etkinlik” kelimelerinin bulunması kaçınılmazdır. Ancak kullanılan anahtar kelimelerin sıklığı ve hangi anahtar kelimelerle en fazla kullanıldığına bilinmesi, bu konuda gelecekte çalışacak araştırmacılar için yol gösterici olacaktır.

Analiz yapılırken kullanılan anahtar kelimenin minimum kullanılma sayısı 5 olarak belirlenmiştir. Çalışmaya konu olan 1742 çalışmada toplam 5287 farklı anahtar kelime kullanılmıştır. En az 5 defa kullanılan anahtar kelime sayısı 165'tir. 165 anahtar kelime 11 kümede, 925 bağlantı ve toplam 1229 bağlantı gücüne sahiptir.

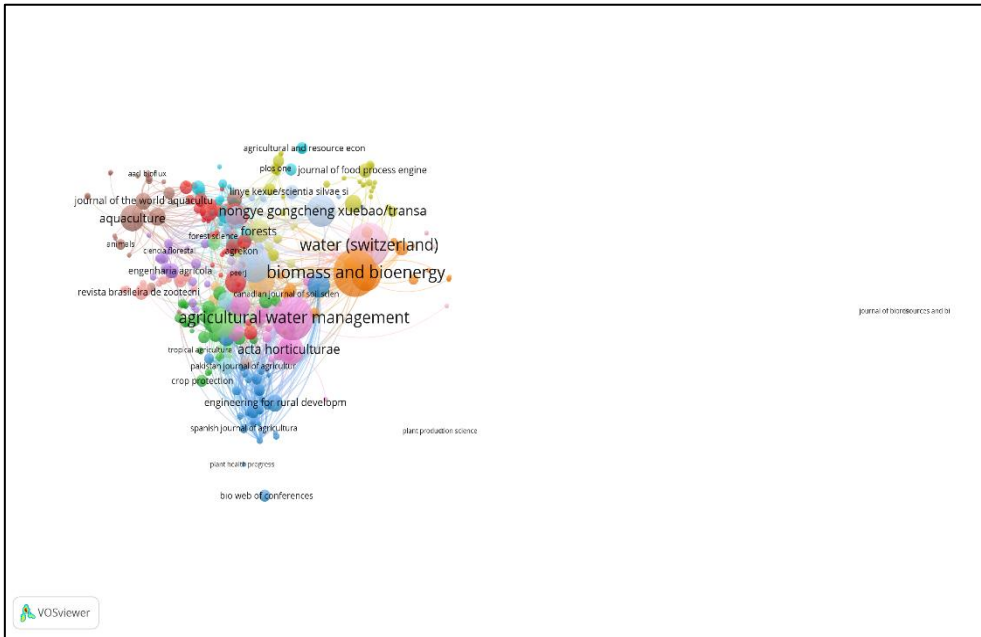
Ekonomik Analiz (Economic Analysis) kelimesi 215 çalışmada anahtar kelime olarak kullanılarak en fazla kullanılan anahtar kelime olmuştur. Ekonomik analiz anahtar kelimesi çoğunlukla fayda-masraf oranı, net gelir, enerji verimliliği, enerji kullanım etkinliği, yenilenebilir enerji ve damla sulama anahtar kelimeleriyle kullanılmıştır. Su Kullanım Etkinliği (Water use Efficiency) 52 kullanımla en fazla kullanılan ikinci anahtar kelime olurken, Ekonomik Etkinlik (Economic Efficiency) 49 kullanımla üçüncü, Ekonomi (Economics) 47 kullanımla dördüncü, Etkinlik (Efficiency) 46 kullanımla beşinci sırada yer almıştır.



Şekil 6. Anahtar kelime haritası

### Yayın kaynakları analizi

Çalışmaya konu olan 1742 çalışma 550 farklı kaynakta yayınlanmıştır. Bu kaynakların bibliyografik bağlantı analizi yapılırken en az 1 eser ve 1 atıf kriteri sağlanması istenmiştir. 468 kaynağın istenen şarta uyduğu belirlenmiştir. Çalışmaların ana yayın kaynakları Biomass and Bioenergy (75 çalışma), Water (66 çalışma), Agricultural Water Management (64 çalışma), Ecological Indicators (43 çalışma), Industrial Crops and Products (35 çalışma), Nongye Gongcheng Xuebao/Transactions of the Chinese Society of Agricultural Engineering (34 çalışma), Agricultural Systems (28 çalışma), Acta Horticulturae (27 çalışma), Field Crops Research (23 çalışma) ve Aquaculture (23 çalışma) dergileridir. Bu kaynakların bağlantı haritası Şekil 7’de sunulmuştur.



Şekil 7. Yayın kaynaklarının ağ haritası

## **Sonuç**

Son yıllarda yaşanan pandemi ve iklim deęişiklikleri tarımsal üretimin önemini daha ciddi boyutlarda ortaya koymuştur. Özellikle kaynakların etkin kullanılması ve üretim planlaması açısından, üretim maliyetinin bilinmesi ve etkin girdi kullanımının sağlanması sürdürülebilirliğin sağlanması açısından önemlidir. Bu da ekonomik analiz ve etkinlik konularında yapılan çalışmaların yapılmasını zorunlu kılmaktadır.

Bu çalışmada tarımsal alanda ekonomik analiz ve etkinlik kavramlarını içeren çalışmaların bibliyometrik bir analizi yapılmıştır. Scopus veri tabanını esas alan analizler sonucunda çalışma başlangıç yılının 1961'e dayandığı, konu ile ilgili yapılan çalışma sayısında son yıllarda artış sağlandığı belirlenmiştir. Toplamda ulaşılan 1742 çalışmanın çoğunluğunun araştırma makalesi olduğu, atıf ve yayın sayısında ABD'nin en önde yer aldığı tespit edilmiştir. Türkiye bu alanda yayın ve atıf sayısında gerilerde kalmıştır. Atıf sayısında önde gelen yazarların eser sayısında ilk sıralarda yer almadığı, fazla eseri olan yazarların da atıf listesinde ön sıralarda yer almadığı gözlemlenmiştir.

Çalışmanın bu konuda çalışacak araştırmacılara yol gösterici niteliğe sahip olduğu düşünülmektedir. Ancak okuyucular tarafından çalışmanın Scopus veri tabanıyla sınırlı kaldığı unutulmamalıdır.



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## TÜRKİYE'DE KÜMES HAYVANCILIĞININ MEVCUT DURUMU VE GELİŞİMİ

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### Özet

Bu çalışmada dünyada önde gelen ülkelerde ve Türkiye’de kümes hayvancılığının mevcut durumu, üretim seyirinin gelişimi ve Türkiye özelinde kümes hayvancılığının dış ticaret dengesinin ortaya koyulması amaçlanmıştır. Üretim ve ticaret verilerine basit indeks hesabı yapılarak yıllar itibariyle değişim tespit edilmiştir. Çalışmanın ana materyalini ikincil veriler oluşturmuştur. Veriler, Türkiye İstatistik Kurumu (TÜİK), Birleşmiş Milletler Gıda ve Tarım Örgütü (FAO) ve Uluslararası Ticaret Örgütü (TRADEMAP)’den elde edilmiştir. Ayrıca konuyla ilgili ulusal ve uluslararası bilimsel yayınların ve sektör raporlarından da yararlanılmıştır. Araştırma bulgularına göre incelenen 2000-2022 yılları arasında dünya tavuk sayısının %72,35, ördek sayısının %13,50, kaz sayısının %31,75 arttığı, hindi sayısının ise %1,62 azaldığı belirlenmiştir. Türkiye’de ise tavuk sayısı artmış (%39,32), kaz ve hindi sayısı neredeyse aynı kalmış ve ördek sayısı (%51,25) azalmıştır. Tavuk, ördek ve kaz üretiminde Çin ilk sırada yer alırken, hindi üretiminde ABD ilk sırada yer almaktadır. Türkiye ise dünya kaz üretiminde sekizinci, tavuk üretiminde on birinci, hindi üretiminde on ikinci, ördek üretiminde ise otuz dokuzuncu sırada yer almaktadır. Türkiye, canlı kümes hayvanları ve kümes hayvanları eti dış ticaretinde fazla vermektedir. Son on yılda canlı kümes hayvanları dış ticaret fazlası ortalaması 28 milyon dolar, kümes hayvanları eti dış ticaret fazlası ortalaması ise 607 milyon dolardır. Kümes hayvanları dış ticaretinin ülke ekonomisine katkısı her yıl ortalama 600-700 milyon dolardır. Artan dünya nüfusu, değişen tüketici talepleri doğrultusunda Türkiye’nin canlı kümes hayvanları ve kümes hayvanları eti üretimi ve ihracatındaki büyümenin gelecek yıllarda da devam edeceği düşünülmektedir.

**Anahtar Kelimeler:** Kümes Hayvanları, Tavuk, Ördek, Kaz, Hindi, Türkiye

## CURRENT SITUATION AND DEVELOPMENT OF POULTRY FARMING IN TÜRKIYE

### **Abstract**

This study aimed to reveal the current situation of poultry farming in Türkiye and leading countries worldwide, the development of the production course, and the foreign trade balance of poultry farming in Türkiye. Simple index calculation was applied to the production and trade data to determine the change over the years. Secondary data constituted the main material of the study. Data were obtained from the Turkish Statistical Institute (TurkStat), the Food and Agriculture Organization of the United Nations (FAO), and the International Trade Organization (TRADEMAP). Relevant national and international scientific publications and sector reports were also used. According to the research findings, the number of chickens, ducks, and geese increased by 72.35%, 13.50%, and 31.75%, respectively, while the number of turkeys decreased by 1.62% between 2000 and 2022. In Türkiye, the number of chickens increased (39.32%), geese and turkeys remained almost the same, and ducks decreased (51.25%). China ranked first in chicken, duck, and goose production, while the USA ranked first in turkey production. Türkiye ranked eighth in goose production, eleventh in chicken production, twelfth in turkey production, and thirty-ninth in duck production. Türkiye had a surplus in foreign trade of live poultry and poultry meat. In the last ten years, the average foreign trade surplus in live poultry has been 28 million dollars, and the average in poultry meat has been 607 million dollars. The contribution of poultry foreign trade to the national economy is 600-700 million dollars annually. In line with the increasing world population and changing consumer demands, the growth in Türkiye's live poultry and poultry meat production and exports is expected to continue in the coming years.

**Keywords:** Poultry, Chicken, Duck, Goose, Turkey, Türkiye

## Giriş

Kümes hayvanlarının (tavuk, ördek, kaz, hindi) insan sağlığı için besleyici olması, lezzet ve kısa sürede hazırlanıp sofralara getirilmesi bakımından birçok insan tarafından tercih edilmektedir (Vukasovič, 2010). İnsanların günlük protein ihtiyaçları karşılama önemli yeri olan hayvansal gıdalara olan talep her geçen gün artmaktadır. Artan gıda talebini karşılamak için kümes hayvancılığı sektörü de büyümektedir (Yenilmez ve Uruk, 2014). Bu sektör, insanlara ve ülkelere sosyal, ekonomik ve sağlık alanlarında birçok fayda sağlamaktadır (Keskin ve Güneş, 2003).

Son yirmi yıl ortalamasına göre dünya kümes hayvanları içerisinde tavuğun oranı %92,38, ördeğin oranı %4,90, kazın oranı %1,55 ve hindinin oranı %1,17'dir. Türkiye'de ise tavuğun oranı %98,42, hindinin oranı %1,10, kazın oranı %0,33 ve ördeğin oranı %0,15'dir (FAO, 2024; TÜİK, 2024). Türkiye'de kümes hayvancılığı sektörünün neredeyse tamamını tavukçuluk sektörü oluşturmaktadır. Sürekli gelişen, ihracatı yükselen, yoğun istihdam sağlayan ve tarımı destekleyen yönüyle ekonomiye katma değer sağlamaktadır (Çiçekgil ve Yazıcı, 2016).

Bu çalışmada, dünya ve Türkiye'de kümes hayvancılığının mevcut durumu, üretim seyrinin gelişimi ve Türkiye'de kümes hayvancılığının dış ticaret dengesi irdelenmiştir.

## Materyal ve Metot

Çalışmanın ana materyalini oluşturan ikincil veriler; Türkiye İstatistik Kurumu (TÜİK), Birleşmiş Milletler Gıda ve Tarım Örgütü (FAO) ve Uluslararası Ticaret Örgütü (TRADEMAP)'den elde edilmiştir. Ayrıca araştırma konusuyla ilgili bilimsel yayınlardan da faydalanılmıştır. Kümes hayvancılığına ilişkin veriler çeşitli çizelgeler ve şekillere dönüştürülerek, dünyada ve Türkiye'deki gelişimi incelenmiştir. Üretim ve ticaret verilerine basit indeks hesabı yapılarak yıllar itibarıyla değişim ortaya koyulmuştur.

## Araştırma Bulguları ve Tartışma

Dünyada tavuk sayısı 2000-2004 yılları ortalamasına göre 15 milyar 412 milyon olup 2022 yılında %72,35 artarak 26 milyar 562 milyona yükselmiştir. Tavuk üretiminde ilk sırada yer alan Çin'de ise aynı tarihlerde 3 milyar 818 milyon olan tavuk sayısı %35,82 artarak 5 milyar 185 milyona yükselmiştir. Tavuk sayısı, ikinci sırada yer alan Endonezya'da 3,23 kat artarak 3 milyar 482 milyona, üçüncü sırada yer alan Pakistan'da 5,27 kat artarak 1 milyar 725 milyona ve dördüncü sırada yer alan Brezilya'da %77,20 artarak 1 milyar 586 milyona yükselmiştir. Dünya tavuk sayısı bakımından on birinci sırada yer alan Türkiye'de ise 2000-2004 yılları ortalaması 259 milyon adet olup 2022 yılında %39,32 artarak 361 milyona yükselmiştir (Çizelge 1).

Dünyada ördek sayısı 2000-2004 yılları ortalamasına göre 992 milyon olup 2022 yılında %13,50 artarak 1 milyar 126 milyona yükselmiştir. Ördek üretiminde ilk sırada yer alan Çin'de ise aynı tarihlerde 650 milyon olan ördek sayısı %5,06 artarak 683 milyona yükselmiştir. Ördek sayısı, ikinci sırada yer alan Vietnam'da %24,57 artarak 83,7 milyona, üçüncü sırada yer alan Bangladeş'te %84,06 artarak 63,8 milyona ve dördüncü sırada yer alan Endonezya'da %68,12 artarak 58,3 milyona yükselmiştir. Dünya ördek sayısı bakımından otuz dokuzuncu sırada yer alan Türkiye'de ise 2000-2004 yılları ortalaması 886 bin adet olup 2022 yılında %51,25 azalarak 432 bine düşmüştür (Çizelge 1).

Dünyada kaz sayısı 2000-2004 yılları ortalamasına göre 278 milyon olup 2022 yılında %31,75 artarak 366 milyona yükselmiştir. Kaz üretiminde ilk sırada yer alan Çin'de ise aynı tarihlerde 224 milyon olan kaz sayısı %42,33 artarak 319 milyona yükselmiştir. Kaz sayısı, ikinci sırada yer alan Mozambik'te %95,68 artarak 15,4 milyona, üçüncü sırada yer alan Myanmar'da 7,5 kat artarak 4,8 milyona yükselmiş ve dördüncü sırada yer alan Rusya'da %41,12 azalarak 3,6 milyona gerilemiştir. Dünya kaz sayısı bakımından sekizinci sırada yer alan Türkiye'de ise ilgili

yıllar arasında pek değişim görülmemiştir. 2000-2004 yılları ortalaması 1 milyon 377 bin olup 2022 yılında %0,68 artarak 1 milyon 386 bine yükselmiştir (Çizelge 1).

Dünyada hindi sayısı 2000-2004 yılları ortalamasına göre 260 milyon olup 2022 yılında %1,62 azalarak 256 milyona gerilemiştir. Hindi üretiminde ilk sırada yer alan ABD’de ise aynı tarihlerde 89,6 milyon olan hindi sayısı %21,87 azalarak 70 milyona gerilemiştir. Hindi sayısı, ikinci sırada yer alan Şili’de %24,37 artarak 26,8 milyona yükselmiş, üçüncü sırada yer alan Fransa’da %57,43 azalarak 15 milyona gerilemiş ve dördüncü sırada yer alan Polonya’da 3,22 kat artarak 15 milyona yükselmiştir. Dünya hindi sayısı bakımından on ikinci sırada yer alan Türkiye’de ise 2000-2004 yılları ortalaması 3 milyon 585 bin olup 2022 yılında %2,38 artarak 3 milyon 670 bine yükselmiştir (Çizelge 1).

**Çizelge 1. Dünyada kümes hayvancılığı üretiminin gelişimi (Bin adet)**

Tür	Sıra	Ülkeler	2000-2004	2005-2009	2010-2014	2015-2019	2020	2021	2022	İndeks*
Tavuk	1	Çin	3.818.000	4.665.000	4.781.734	4.975.672	5.125.583	5.155.530	5.185.477	135,82
	2	Endonezya	1.078.350	1.256.068	1.646.485	3.009.315	3.570.142	3.195.600	3.482.427	322,94
	3	Pakistan	327.180	481.220	734.920	1.112.980	1.443.000	1.578.000	1.725.000	527,23
	4	Brezilya	895.079	1.113.401	1.263.956	1.404.816	1.478.424	1.528.032	1.586.048	177,20
	11	Türkiye	259.186	281.187	257.277	336.039	379.349	391.394	361.096	139,32
		Dünya	15.411.658	18.161.437	20.486.104	23.957.785	25.844.599	25.964.665	26.561.634	172,35
Ördek	1	Çin	650.200	720.200	698.366	698.455	687.808	685.441	683.075	105,06
	2	Vietnam	67.192	69.182	77.554	75.046	86.563	82.003	83.700	124,57
	3	Bangladeş	34.688	39.101	45.722	53.950	59.716	61.746	63.845	184,06
	4	Endonezya	34.708	36.592	46.657	53.417	56.570	56.570	58.352	168,12
	39	Türkiye	886	509	381	471	560	540	432	48,75
	Dünya	992.355	1.087.555	1.109.245	1.125.600	1.131.874	1.122.700	1.126.276	113,50	
Kaz	1	Çin	224.171	283.600	290.365	306.826	317.164	319.654	319.060	142,33
	2	Mozambik	7.872	8.706	15.158	14.334	14.870	15.170	15.404	195,68
	3	Myanmar	640	1.287	2.215	4.055	4.688	4.788	4.800	750,00
	4	Rusya	6.131	10.381	13.139	5.861	3.620	3.466	3.610	58,88
	8	Türkiye	1.377	986	748	1.000	1.374	1.478	1.386	100,68
		Dünya	278.169	340.067	354.391	360.718	365.009	36.5837	366.478	131,75
Hindi	1	ABD	89.600	86.000	81.400	79.200	74.000	72.000	70.000	78,13
	2	Şili	21.580	27.700	31.600	27.355	27.601	27.221	26.840	124,37
	3	Fransa	35.404	26.523	22.372	19.857	18.498	17.521	15.070	42,57
	4	Polonya	4.647	6.682	9.014	12.804	17.608	15.256	14.967	322,09
	12	Türkiye	3.585	3.117	2.836	3.693	4.798	4.704	3.670	102,38
		Dünya	259.981	259.346	263.725	269.331	265.236	260.736	255.767	98,38

Kaynak: FAO, 2024

\*2000-2004=100

İncelenen yıllar itibariyle dünya toplam tavuk sayısının oranı, ilk sırada yer alan Çin’de %24,77’den %19,52’ye gerilemiştir. Bu oran ikinci sırada yer alan Endonezya’da %7,00’den %13,11’e, üçüncü sırada yer alan Pakistan’da %2,12’den %6,49’a ve dördüncü sırada yer alan Brezilya’da %5,81’den 5,97’ye çıkmıştır. Türkiye’de ise %1,26 ile %1,68 arasında değişmekte olup 2022 yılında %1,36 olarak gerçekleşmiştir (Çizelge 2).

Dünya toplam ördek sayısının oranı, ilk sırada yer alan Çin’de %65,52’den %60,65’e gerilemiştir. Bu oran ikinci sırada yer alan Vietnam’da %6,77’den %7,43’e, üçüncü sırada yer alan Bangladeş’te %3,50’den %5,67’ye, dördüncü sırada yer alan Endonezya’da ise %3,50’den %5,18’e çıkmıştır. Türkiye’de ise %0,03 ile %0,09 arasında değişmekte olup 2022 yılında %0,04 olarak gerçekleşmiştir (Çizelge 2).

Dünya toplam kaz sayısının oranı, ilk sırada yer alan Çin’de %80,59’dan %87,06’ya, ikinci sırada yer alan Mozambik’te %2,83’den %4,20’ye, üçüncü sırada yer alan Myanmar’da ise %0,23’den %1,31’ yükselmiştir. Dördüncü sırada yer alan Rusya’da ise %2,20’den %0,99’a, Türkiye’de de %0,49’dan %0,38’e gerilemiştir (Çizelge 2).

Dünya toplam hindi sayısının oranı, ilk sırada yer alan ABD’de %34,46’dan %27,37’ye gerilemiştir. Bu oran ikinci sırada yer alan Şili’de %8,30’dan %10,49’a çıkmıştır. Üçüncü sırada yer alan Fransa’da %13,62’den %5,89’a gerilemiştir. Dördüncü sırada yer alan

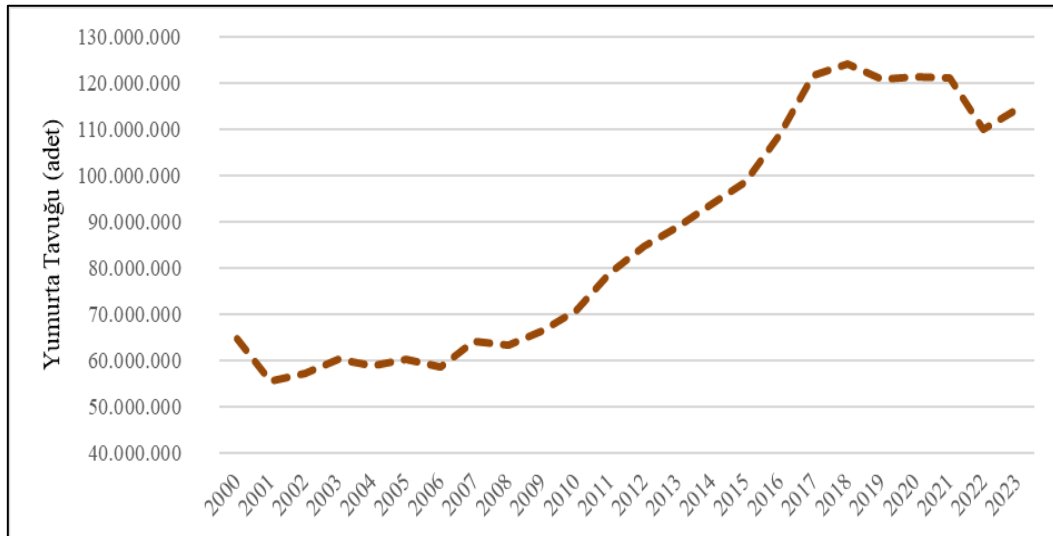
Polonya’da ise %1,79’dan %5,85’e, Türkiye’de de %1,38’den %1,43’e yükselmiştir (Çizelge 2).

**Çizelge 2.** Dünyada kümes hayvancılığı üretiminin gelişimi (%)

Tür	Sıra	Ülkeler	2000-2004	2005-2009	2010-2014	2015-2019	2020	2021	2022
Tavuk	1	Çin	24,77	25,69	23,34	20,77	19,83	19,86	19,52
	2	Endonezya	7,00	6,92	8,04	12,56	13,81	12,31	13,11
	3	Pakistan	2,12	2,65	3,59	4,65	5,58	6,08	6,49
	4	Brezilya	5,81	6,13	6,17	5,86	5,72	5,89	5,97
	11	Türkiye	1,68	1,55	1,26	1,40	1,47	1,51	1,36
		Dünya	100,00	100,00	100,00	100,00	100,00	100,00	100,00
Ördek	1	Çin	65,52	66,22	62,96	62,05	60,77	61,05	60,65
	2	Vietnam	6,77	6,36	6,99	6,67	7,65	7,30	7,43
	3	Bangladeş	3,50	3,60	4,12	4,79	5,28	5,50	5,67
	4	Endonezya	3,50	3,36	4,21	4,75	5,00	5,04	5,18
	39	Türkiye	0,09	0,05	0,03	0,04	0,05	0,05	0,04
		Dünya	100,00	100,00	100,00	100,00	100,00	100,00	100,00
Kaz	1	Çin	80,59	83,40	81,93	85,06	86,89	87,38	87,06
	2	Mozambik	2,83	2,56	4,28	3,97	4,07	4,15	4,20
	3	Myanmar	0,23	0,38	0,63	1,12	1,28	1,31	1,31
	4	Rusya	2,20	3,05	3,71	1,62	0,99	0,95	0,99
	8	Türkiye	0,49	0,29	0,21	0,28	0,38	0,40	0,38
		Dünya	100,00	100,00	100,00	100,00	100,00	100,00	100,00
Hindi	1	ABD	34,46	33,16	30,87	29,41	27,90	27,61	27,37
	2	Şili	8,30	10,68	11,98	10,16	10,41	10,44	10,49
	3	Fransa	13,62	10,23	8,48	7,37	6,97	6,72	5,89
	4	Polonya	1,79	2,58	3,42	4,75	6,64	5,85	5,85
	12	Türkiye	1,38	1,20	1,08	1,37	1,81	1,80	1,43
		Dünya	100,00	100,00	100,00	100,00	100,00	100,00	100,00

Kaynak: FAO, 2024

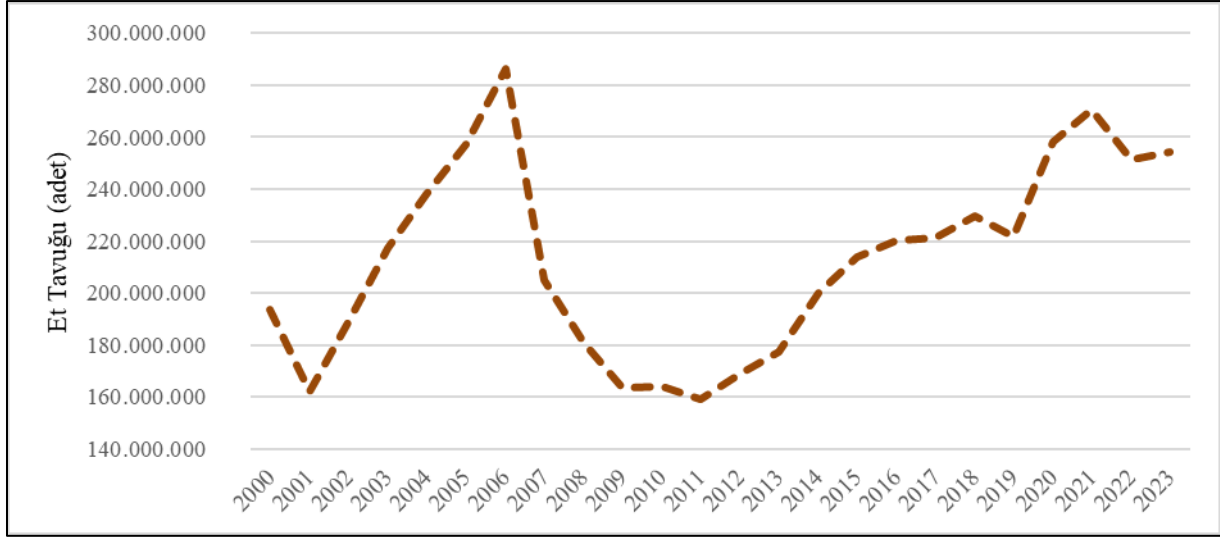
Türkiye’de 2000 yılından itibaren yumurta tavuğu sayısı incelendiğinde, 55 milyon adet ile 124 milyon adet arasında değiştiği belirlenmiştir. Özellikle 2006 yılından 2018 yılına kadar yumurta tavuğu sayısı düzenli artış göstermiştir. 2018 yılından itibaren 2022 yılına kadar ise düşüş söz konusudur. İncelenen son yıl ise bir önceki yıla göre %4,25 artarak 114 milyon 476 bin adet olarak gerçekleşmiştir (Şekil 1).



**Şekil 1.** Türkiye’de yumurta tavuğu sayısı (TÜİK, 2024)

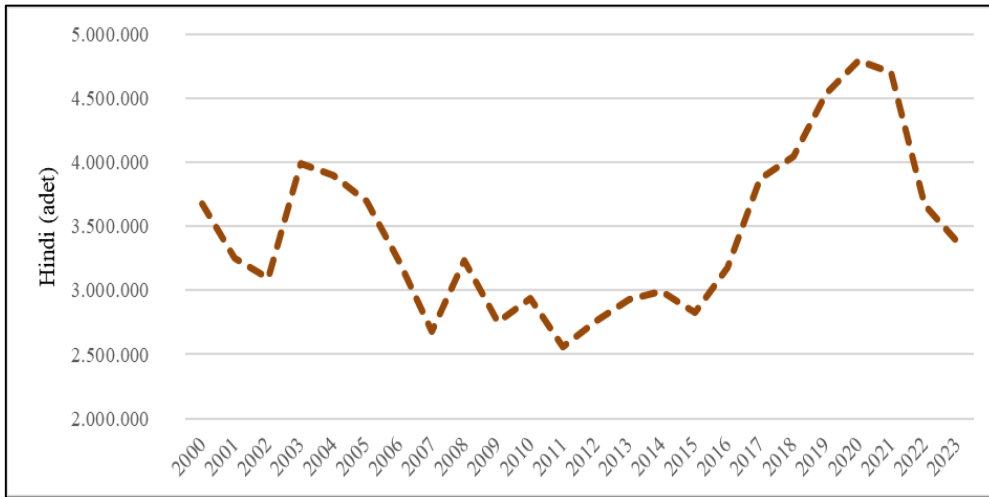
Türkiye’de 2000 yılından itibaren et tavuğu sayısı incelendiğinde, 159 milyon adet ile 286 milyon adet arasında değiştiği belirlenmiştir. Özellikle 2006 yılından zirve yapan et tavuğu sayısı 2011 yılına kadar düşmüştür. Bunun sebebi ilk defa 2003 yılında Uzak Doğu’da ortaya

çıkan kuş gripinin (avian influenza, H5N1), 2005 yılında Türkiye’de görülmesiyle milyonlarca kanatlın itlaf edilmesidir (Sarnıç, 2006). 2011 yılından itibaren ise artış eğilimi görülmektedir. İncelenen son yıl ise bir önceki yıla göre %1,14 artarak 254 milyon 148 bin adet olarak gerçekleşmiştir (Şekil 2).



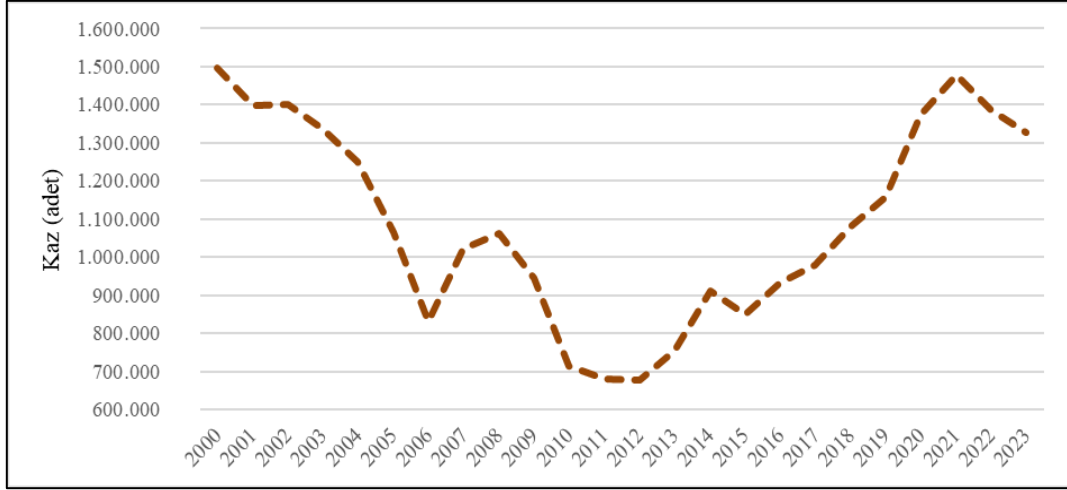
Şekil 2. Türkiye’de et tavuğu sayısı (TÜİK, 2024)

Türkiye’de 2000 yılından itibaren hindi sayısı incelendiğinde, 2,5 milyon ile 4,8 milyon arasında değiştiği belirlenmiştir. 2000 yılından 2015 yılına kadar hindi sayısı dalgalı bir seyir izlemiş olup bu tarihten 2021 yılında kadar düzenli artış göstermiştir. 2021 yılından itibaren ise hindi sayısı düşmeye başlamıştır. İncelenen son yıl hindi sayısı 3 milyon 379 bin adet olarak gerçekleşmiştir (Şekil 3).



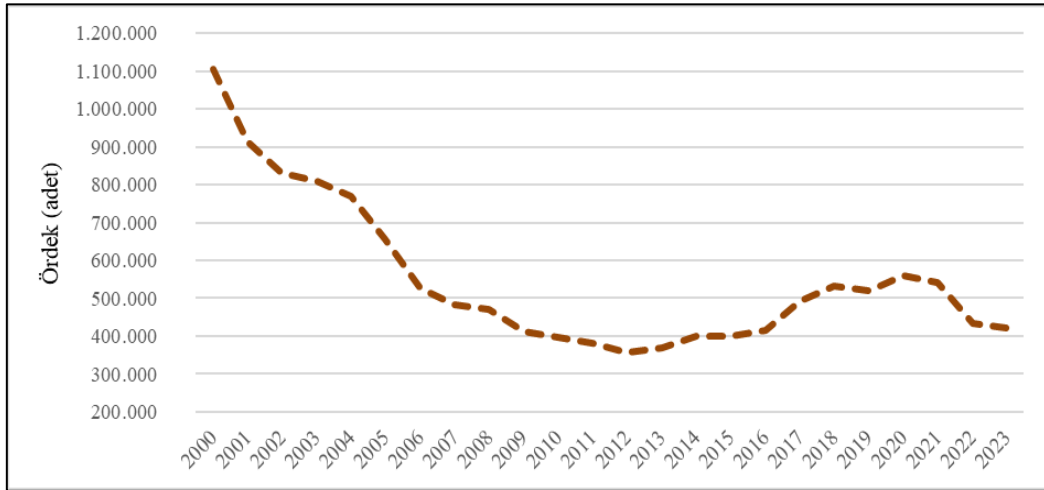
Şekil 3. Türkiye’de hindi sayısı (TÜİK, 2024)

Türkiye’de 2000 yılından itibaren kaz sayısı incelendiğinde, 676 bin adet ile 1,5 milyon adet arasında değiştiği belirlenmiştir. En yüksek değer 2000 yılından 1,5 milyon adet ile en düşük değer ise 2012 yılında 676 bin adet olarak gerçekleşmiştir. Kaz sayısı 2000 yılından 2006 yılına kadar düzenli olarak azalmış, 2007-2008 yıllarında yükselmiş, 2008’den 2012’ye kadar tekrar azalmış, 2012’den 2021 yılına kadar düzenli artmıştır. 2021 yılından itibaren ise kaz sayısı düşmeye başlamıştır. İncelenen son yıl kaz sayısı 1 milyon 328 bin adet olarak gerçekleşmiştir (Şekil 4).



Şekil 4. Türkiye’de kaz sayısı (TÜİK, 2024)

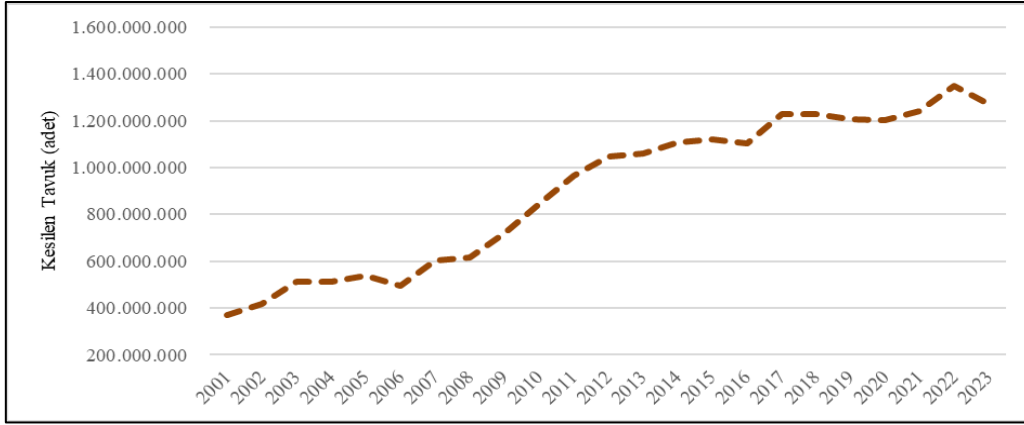
Türkiye’de 2000 yılından itibaren ördek sayısı incelendiğinde, 357 bin adet ile 1,1 milyon adet arasında değiştiği belirlenmiştir. En yüksek değerine ulaştığı 2000 yılından, en düşük değerini gördüğü 2012 yılına kadar düzenli olarak azalmıştır. Bu tarihten 2020 yılına kadar artış görülse de incelenen son üç yılda düşüş eğiliminin devam ettiği belirlenmiştir. 2023 yılında ördek sayısı 420 bin adet olarak gerçekleşmiştir (Şekil 5).



Şekil 5. Türkiye’de ördek sayısı (TÜİK, 2024)

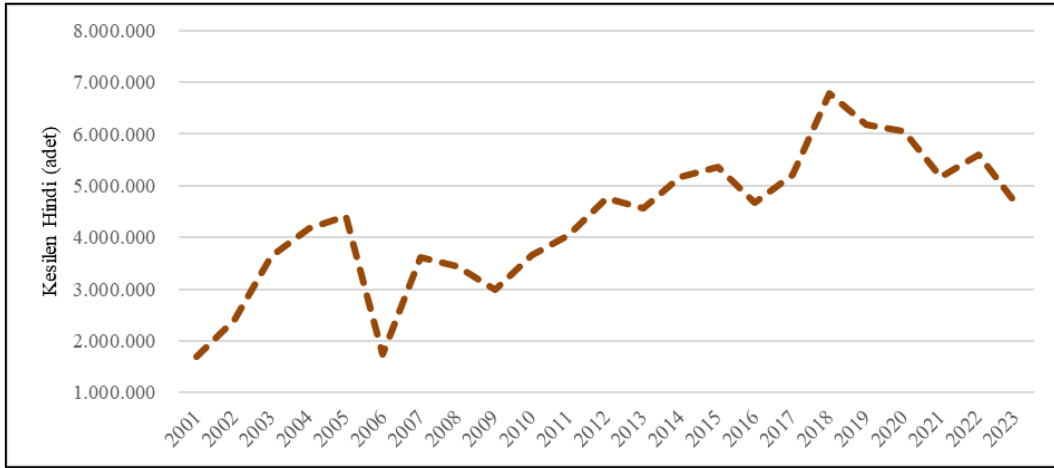
Türkiye’de kesilen tavuk sayısı 2001 yılında 371 milyon adet olup 2023 yılında 3,42 kat artarak 1 milyar 270 milyon adete yükselmiştir. İncelenen yıllar itibariyle kesilen tavuk sayısında düzenli artış olduğu görülmektedir (Şekil 6).





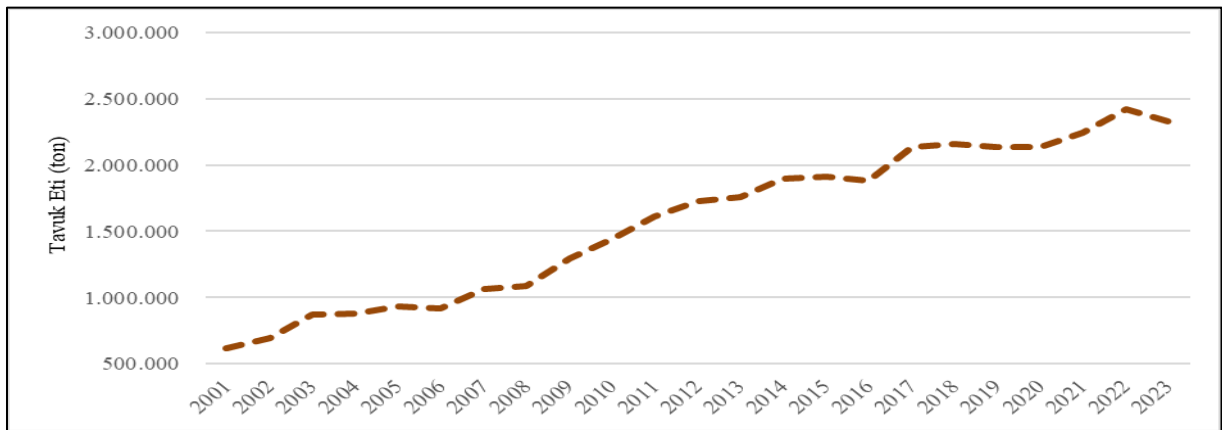
Şekil 6. Türkiye’de kesilen tavuk sayısı (TÜİK, 2024)

Türkiye’de kesilen hindi sayısı 2001 yılında 1 milyon 707 bin olup 2023 yılında 2,74 kat artarak 4 milyon 680 bine yükselmiştir. En yüksek değerine 6 milyon 779 bin adet ile 2018 yılında ulaşmış olup bu tarihten itibaren düşüş eğilim görülmüştür. İncelenen yıllar itibariyle kesilen hindi sayısında dalgalı bir artış olduğu görülmektedir (Şekil 7).



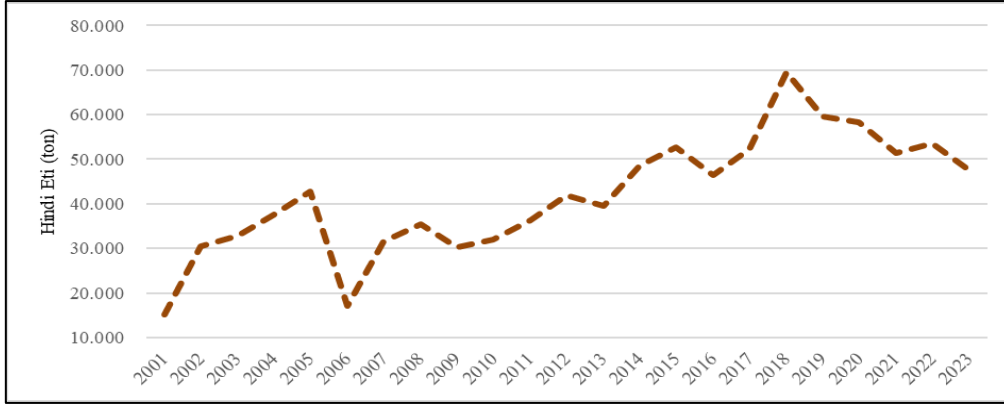
Şekil 7. Türkiye’de kesilen hindi sayısı (TÜİK, 2024)

Türkiye’de tavuk eti üretimi 2001 yılında 615 bin ton olup 2023 yılında 3,79 kat artarak en yüksek değerine, 2 milyon 329 bin tona yükselmiştir. İncelenen yıllar itibariyle tavuk eti üretimi düzenli olarak artan bir eğilim göstermektedir (Şekil 8).



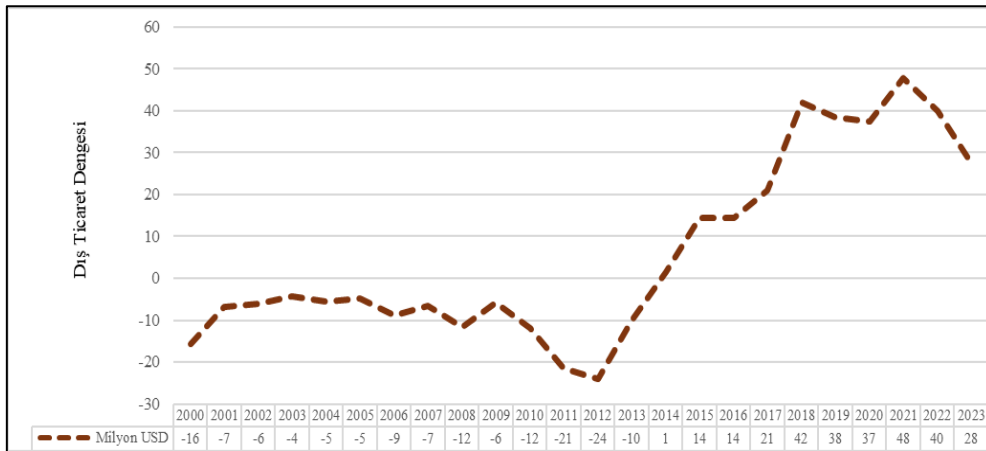
Şekil 8. Türkiye’de tavuk eti üretimi (TÜİK, 2024)

Türkiye’de hindi eti üretimi 2001 yılında 15 bin ton olup 2023 yılında 3,15 kat artarak 47 575 tona yükselmiştir. İncelenen yıllar itibariyle hindi eti üretimi 2018 yılına kadar dalgalı artan bir seyir izlemiş bu tarihten sonra ise azalan bir seyir izlemiştir. En yüksek değerine 69 536 ton olarak 2018 yılında ulaşmıştır (Şekil 9).



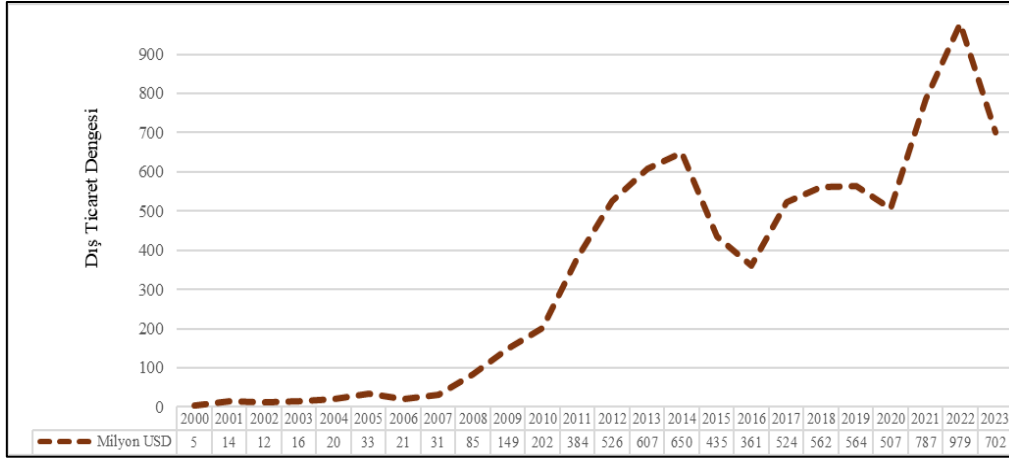
Şekil 9. Türkiye’de hindi eti üretimi (TÜİK, 2024)

İncelenen yıllar itibariyle Türkiye’nin canlı kümes hayvanları dış ticaret açığı 2000 yılından 2013 yılına kadar devam etmiştir. 2000 yılında 16 milyon dolar, 2012 yılında 24 milyon dolar, 2013 yılında 10 milyon dolar dış ticaret açığı vermiştir. Bu tarihten sonra ise canlı kümes hayvanları dış ticareti fazla vermeye başlamıştır. 2021 yılında 48 milyon dolara çıkan dış ticaret fazlası 2022 yılında 40 milyon dolar, 2023 yılında ise 28 milyon dolar olarak gerçekleşmiştir (Şekil 10).



Şekil 10. Türkiye’nin canlı kümes hayvanları dış ticaret dengesi (TRADEMAP, 2024)

İncelenen yıllar itibariyle Türkiye’nin kümes hayvanları eti dış ticareti fazla vermiştir. 2000 yılından 5 milyon dolar olan dış ticaret fazlası 2014 yılında 650 milyon dolara kadar çıkmış ve bu tarihten 2016 yılına kadar düşmüştür. 2017 yılından itibaren tekrar artışa geçen dış ticaret fazlası 2022 yılında en yüksek değeri olan 979 milyon dolara yükselmiştir. 2023 yılında ise 702 milyon dolar olarak gerçekleşmiştir (Şekil 11).



Şekil 11. Türkiye'nin kümes hayvanları eti dış ticaret dengesi (TRADEMAP, 2024)

### Sonuç ve Öneriler

Bu çalışmada dünyada ve Türkiye'deki kümes hayvancılığının mevcut durumu, dünya üretiminde önde gelen ülkelerde ve Türkiye'de üretim seyrinin gelişimi ve Türkiye'de kümes hayvancılığının dış ticaret dengesi üzerine bir inceleme yapılmıştır. Tarım sektörü içerisinde kümes hayvancılığı üretimi; artan dünya nüfusu, değişen tüketici talepleri karşısında giderek önemli bir hal almaktadır. Diğer protein kaynağı etleri göre kümes hayvanlarının daha ucuz ve ulaşılabilir olması tüketiciler için önemli bir faktördür. Türkiye, dünya kaz üretiminde sekizinci, tavuk üretiminde on birinci, hindi üretiminde on ikinci, ördek üretiminde ise otuz dokuzuncu sırada yer almaktadır. Canlı kümes hayvanlarında ve kümes hayvanları eti dış ticaretinde ise dış ticaret fazlası verilmekte ve ülkeye döviz girişi sağlanmaktadır. Türkiye'de kümes hayvanları sayısında dönemsel azalışlar yaşansa da genel olarak artış eğilimindedir. Kümes hayvanları eti üretiminde ise mutlak artış söz konusudur. Türkiye'nin canlı kümes hayvanları ve kümes hayvanları eti üretimi ve ihracatındaki büyümenin gelecek yıllarda da devam edeceği düşünülmektedir.

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## ZEYTİNDE AŞI UYUŞMAZLIĞINDA FENOLİK BİLEŞİKLERİN ÖNEMİ VE ROLÜ

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### Özet

Zeytin (*Olea europaea* L.) ağaçlarının yetiştiriciliğinde aşılama, genetik çeşitliliği artırmak, hastalık direncini sağlamak ve verimi optimize etmek için yaygın bir yöntemdir. Zeytin yetiştiriciliğinde aşı uyumsuzluğu, üretim verimliliğini olumsuz etkileyen önemli bir sorun olarak karşımıza çıkmaktadır. Aşılı bitkilerde fenolik bileşikler ve flavonoidler gibi ikincil metabolitlerin rolü kritik bir öneme sahiptir. Kateşin ve epikateşin gibi fenolik maddelerin aşı bölgesinde birikmesi, uyumsuzluk belirtilerinin başlangıcı olarak kabul edildiği görülmektedir. Bu bileşiklerin yüksek oranlarda bulunması, başarısız aşılama işlemlerinin erken biyokimyasal göstergelerinden biri olarak değerlendirilmektedir. Sonuç olarak, zeytinde aşı uyumsuzluğunun önlenmesi ve erken teşhisi için fenolik bileşiklerin izlenmesi ve bu bileşiklerin birikimini azaltacak stratejilerin geliştirilmesi büyük önem taşımaktadır. Bu doğrultuda, fenolik profillerin analiz edilmesi, genetik çalışmaların yapılması ve uygun ziraat uygulamalarının benimsenmesi, aşı uyumsuzluğunun etkilerini minimize etmek için gerekli adımlardır. Gelecekteki araştırmalar, biyokimyasal yöntemlerin daha geniş bir ölçekte uygulanmasını ve zeytin ağaçlarının aşı uyumsuzluğuna karşı dayanıklılığını artırmayı hedeflemelidir.

**Anahtar Kelimeler:** Zeytin (*Olea europaea* L.), aşı uyumsuzluğu, fenolik bileşikler

## IMPORTANCE AND ROLE OF PHENOLIC COMPOUNDS IN GRAFT INCOMPATIBILITY IN OLIVE TREES

### **Abstract**

Grafting in olive (*Olea europaea* L.) tree cultivation is a common method used to enhance genetic diversity, provide disease resistance, and optimize yield. Graft incompatibility in olive cultivation poses a significant issue that adversely affects production efficiency. The role of secondary metabolites such as phenolic compounds and flavonoids is critical in grafted plants. The accumulation of phenolic substances like catechin and epicatechin in the graft region is considered an early indicator of incompatibility symptoms. High concentrations of these compounds are evaluated as early biochemical markers of unsuccessful grafting processes. Therefore, monitoring phenolic compounds and developing strategies to reduce their accumulation is essential for preventing and early diagnosing graft incompatibility in olives. Analyzing phenolic profiles, conducting genetic studies, and adopting appropriate agricultural practices are necessary steps to minimize the impacts of graft incompatibility. Future research should aim to apply biochemical methods on a broader scale and enhance the resistance of olive trees to graft incompatibility.

**Keywords:** Olive (*Olea europaea* L.), graft incompatibility, phenolic compounds

## GİRİŞ

Zeytin ve zeytinyağı, insan beslenmesi ve sağlığı açısından önemli tarım ürünleri arasındadır. Bu nedenle, dünya genelinde olduğu gibi ülkemizde de zeytin yetiştiriciliğine olan ilgi giderek artmaktadır. Ayrıca, Akdeniz'in kutsal ağacı olarak bilinen zeytinin gen merkezlerinden birinin Antalya-Hatay-Mardin-Maraş üçgeninde bulunduğu kabul edilmektedir. Zeytin, en iyi gelişme koşullarını Akdeniz iklim kuşağında bulur.

Zeytin (*Olea europaea* L.) yetiştiriciliğinde aşı uygulamaları, zeytin ağaçlarının genetik çeşitliliği artırmak-iyileştirmek, hastalık direncini sağlamak ve verimi optimize etmek için yaygın olarak kullanılan bir yöntemdir. Ancak, aşı uygulamaları sırasında bazı durumlarda anaç ve aşı materyali arasında uyumsuzluklar meydana gelir. Anaç ve aşı materyali arasında uyumsuzluklar meydana gelir ve bu durum bitkisel gelişimi olumsuz yönde etkiler. Bu uyumsuzluklar, bitkisel gelişimi olumsuz yönde etkileyebilir ve üretim kayıplarına yol açabilir. Aşı uyumsuzluğu, bitkilerin fizyolojik ve morfolojik özelliklerinde çeşitli değişikliklere neden olabilir; Büyüme geriliği, yaprak anormallikleri, yara ve kallus oluşumu ve vasküler anormallikler gibi etkilere neden olur. Bu olumsuzlukları gidermek için kullanılan yöntemlerinden biride biyokimyasal analizlerdir ki bunlardan en önemlisi de fenol bileşiklerdir. Bu bağlamda, zeytin ağaçlarında aşılı bitkilerde fenolik bileşikler ve flavonoidler gibi ikincil metabolitlerin rolü kritik bir öneme sahiptir.

Fenolik bileşikler, bitkilerde bulunan ve çeşitli biyolojik işlevleri olan organik bileşiklerdir. Bitkilerde antioksidan, antimikrobiyal ve anti-inflamatuar özelliklere sahip olmalarıyla bilinirler. Fenolik bileşikler, bitkilerin stres koşullarına karşı savunmalarını güçlendirir ve hücre zararı azaltır (Rice-Evans et al., 1997). Aşı uyumsuzluğu durumunda fenolik bileşiklerin rolü, bitkilerin stres yanıtlarını ve hücre zararı savunmalarını anlamak açısından kritik bir öneme sahiptir. Aşı yüzeylerinde; hücrelerin birbirini tanıması, hücre döngüsünün sağlanması, hücre bölünmesi, hücre farklılaşması ve plasmodesmata gelişimi gibi bazı aşamalara gereksinim olmaktadır (Pina vd., 2009). Ayrıca söz konusu alanda fenolik bileşikler gibi ikincil maddeler de yoğun olarak bulunmaktadır (Bennett vd Wallsgrave, 1994; Errea vd., 2000; Mng'omba vd., 2008). Fenolik bileşiklerin aşı uyumsuzluğundaki rolleri incelenmeye başlanmıştır. (Errea, 1998). Aşı bölgesinde biriken kateşin ve diğer fenolik maddeler, uyumsuzlukla ilişkili ilk biyokimyasal tepkiler olarak değerlendirilmektedir (Cooman vd., 1996). Musacchi ve arkadaşları (2000), aşı birleşme noktasında biriken epikateşinin başarısız aşılamaı gösterdiğini bildirmiştir. Errea ve ekibi (2001), fenolik maddelerin uyuşur kombinasyonlarda aşı yüzeyinin %10'undan azını kapladığını, uyuşmaz kombinasyonlarda ise bu oranın belirgin şekilde yüksek olduğunu göstermiştir. Bu durum, fenolik bileşiklerin aşı uyumsuzluğunun önemli bir belirteci olduğunu ortaya koymaktadır. Benzer şekilde, peroksidaz izoenziminin lignin oluşumundaki rolü üzerine yapılan çalışmalar, fenolik bileşiklerin ve izoenzimlerin aşı uyumsuzluğundaki etkileşimlerini vurgulamaktadır (Gaspar vd., 1982). Zarrouk ve arkadaşları (2010), aşı uyumsuzluğu ile ilgili hücre zarı düzeyindeki aşı yüzeylerindeki değişimleri inceledikleri çalışmalarında; kambiyum hücrelerindeki düzensizlik, vasküler dokuların farklılaşmasının düşük olması, floem ve ksilem hücrelerinin çoğalmaması ve aşılamaıdan 5 ay sonra aşı yüzeyinde fenolik bileşiklerin birikmesi gibi bulgulara ulaşmışlardır.

Fenolik bileşikler, bitkilerde stres yanıtları, hastalık direnci ve hücre zarı savunma mekanizmalarında önemli bir rol oynadığı görülmektedir. Bu makalede, zeytinde aşı uyumsuzluğunda fenolik bileşiklerin rolü ve etkileri detaylı bir şekilde incelenmiştir.

### A. Aşı Uyuşma Durumlarında Fenolik Bileşikler Rolü ve Önemi

Fenolik bileşikler, aşı uyumsuzluğunda birkaç önemli rol oynayabilir

## 1. Kimyasal Bariyerler Oluřturma

Fenolik bileřikler, bitkiler arasında kimyasal bariyerler oluřturabilir ve ařılamanın başarılı olmasını engelleyebilir. Bu bileřikler, ařılanan doku ile anaç arasındaki uyumsuzlukları artırabilir ve doku birleřimini engelleyebilir (Paniagua et al., 2010).

## 2. Ařı Uyuřma ve Savunma Mekanizmaları:

Dayanıklı anaçlar ile ařılanan zeytin çeřitlerinde, fenolik bileřikler ve flavonoidlerin üretimi artar. Bu artış, bitkilerin patojen saldırısına karřı daha güçlü bir savunma geliřtirmesini saęlar. Fenolik bileřikler, bitkilerin savunma mekanizmalarını güçlendirebilir. Ařı uyumsuzluęu sırasında, savunma mekanizmalarının güçlendirilmesi, bitkilerin doku uyumsuzluęunu daha iyi tolere etmelerine yardımcı olabilir (Fukushima et al., 2014).

**Örnek:** Ařılı bitkilerde artan polifenol oksidaz (PPO) ve peroksidaz (POD) aktiviteleri, fenolik bileřiklerin oksidasyonunu hızlandırarak savunma tepkilerini güçlendirir.

## 3. Antioksidan Aktivite

Fenolik bileřiklerin antioksidan aktiviteleri, ařı uyumsuzluęu sırasında oksidatif stres azaltabilir. Oksidatif stres, doku uyumsuzluęuna yol açabilecek serbest radikallerin birikimine neden olabilir. Antioksidan fenolik bileřikler, bu süreci azaltabilir ve ařı uyumsuzluęunu hafifletebilir (Pietta, 2000).

## 4. Stres Yanıtları:

- Fenolik Bileřiklerin Artışı:** Ařı uyuřmazlıęı, bitkilerde stres yanıtlarının tetiklenmesine neden olabilir. Bu yanıtlar genellikle fenolik bileřiklerin artışı ile iliřkilidir. Fenolik bileřiklerin artışı, stres altındaki bitkilerde savunma tepkimelerini destekler ve hücrel hasarı sınırlar.
- Oksidatif Stres ve Savunma:** Ařı uyuřmazlıęı durumunda oluřan oksidatif stres, bitkilerde serbest radikal birikimine yol açar. Fenolik bileřikler, bu serbest radikalleri nötralize ederek oksidatif stresin etkilerini azaltır.

## 5. Lignifikasyon:

- Lignin Sentezi:** Fenolik bileřikler, lignin sentezini teřvik eder. Lignin, bitki hücre duvarlarının güçlendirilmesinde ve bitkilerin çeřitli stres kořullarına karřı dayanıklılıęının artırılmasında önemli bir rol oynar.
- Ařı Yeri Stabilizasyonu:** Lignifikasyon, ařı yerindeki hücrel yapının güçlendirilmesini saęlar. Bu, ařı uyumsuzluęu nedeniyle oluřabilecek mekanik ve biyolojik sorunlara karřı bitkilerin dayanıklılıęını artırır.

## 6. Hücre Duvarı Güçlendirme:

**Hücre Duvarı Bileřenleri:** Fenolik bileřikler, hücre duvarı bileřenlerinin sentezini ve düzenlenmesini etkiler. Bu bileřenler arasında lignin, selüloz ve hemiselüloz bulunur.

**Hücre Duvarı Stabilizasyonu:** Fenolik bileřiklerin artışı, hücre duvarının güçlenmesine ve stabilizasyonuna katkıda bulunur. Bu, bitkilerin stres kořullarına karřı daha dayanıklı hale gelmesini saęlar.

## 7. Ařı Uyuřmazlıęı Durumları:

Uyumlu olmayan ařı kombinasyonlarında, fenolik bileřiklerin ve flavonoidlerin yetersiz üretimi veya etkin olmayan daęılımı, patojenin bitkide daha kolay yayılmasına neden olabilir. Bu durum, ařılı bitkilerde zayıf savunma tepkilerine ve hastalığın daha řiddetli seyretmesine yol açar.



**Örnek:** Uyumlu olmayan anaç-aşı kombinasyonlarında, fenolik bileşiklerin düşük seviyelerde kalması, bitkisel savunma mekanizmalarının zayıf olmasına neden olur.

## **8. Pratik Uygulamalar ve Araştırma Yönleri:**

Fenolik bileşikler ve flavonoidlerin üretimini artırmak için bitkisel biyoteknoloji yöntemleri kullanılabilir. Genetik mühendislik ve moleküler biyoloji teknikleri ile bu bileşiklerin sentezini düzenleyen genler modifiye edilebilir.

**Öneri:** Genetik olarak modifiye edilmiş zeytin çeşitleri, fenolik bileşikler ve flavonoidlerin yüksek üretimi ile daha dayanıklı hale getirilebilir. Bu, *Verticillium* solgunluğuna karşı sürdürülebilir bir çözüm olabilir.

## **B. Fenolik Bileşiklerin Analizi**

### **1. Kimyasal Analizler**

**HPLC (Yüksek Performanslı Sıvı Kromatografisi):** Fenolik bileşiklerin ayrıştırılması ve nicel analizi için kullanılır. Bu analizler, fenolik bileşiklerin aşı uyumsuzluğu üzerindeki etkilerini incelemek için önemlidir (Cao et al., 1997).

**GC-MS (Gaz Kromatografisi-Kütle Spektrometrisi):** Uçucu fenolik bileşiklerin analizinde kullanılır ve bu bileşiklerin yapısal karakterizasyonunu sağlar.

**ELISA ve Spectrophotometric Methods:** Fenolik bileşiklerin miktarını ve aktivitesini belirlemek için kullanılır.

### **2. Biyolojik Testler**

Fenolik bileşiklerin bitki dokusu üzerindeki etkilerini değerlendirmek için biyolojik testler yapılabilir. Bu testler, fenolik bileşiklerin aşı uyumsuzluğu üzerindeki etkilerini belirlemek için kullanılır (Siddiqui et al., 2008).

### **3. Moleküler Analizler**

Genetik ve moleküler analizler, fenolik bileşiklerin bitkilerdeki etkilerini anlamak için kullanılabilir. Gen ekspresyonu ve protein düzeyindeki değişiklikler incelenebilir (Miller et al., 2007).

### **4. Uygulama ve Denemeler:**

**Deneyel Tasarımlar:** Aşı uyumsuzluğu durumunda fenolik bileşiklerin etkilerini belirlemek için kontrollü deneyler ve saha testleri yapılır. Bu testlerde, aşı ve aşısız bitkiler arasında fenolik bileşiklerin konsantrasyonları karşılaştırılır.

## **C. Aşı Uyuşmazlığında Fenolik Bileşiklerin Yönetimi ve İyileştirme Yöntemleri**

Fenolik bileşiklerin aşı uyumsuzluğuna olan etkilerini yönetmek ve iyileştirmek için çeşitli stratejiler geliştirilebilir:

### **Anaç ve Kalem Seçimi**

Fenolik bileşiklerin konsantrasyonlarını dikkate alarak anaç ve kalem seçimi yapılabilir. Uyumlu fenolik profillere sahip anaç ve kalemlerin seçilmesi, aşı uyumsuzluğunu azaltabilir (Cao et al., 1997).

### **Kimyasal Tedavi**

Fenolik bileşiklerin etkilerini modüle edebilecek kimyasal tedaviler kullanılabilir. Bu tedaviler, aşı uyumsuzluğunu azaltabilir ve bitkilerin sağlığını iyileştirebilir (Siddiqui et al., 2008).

### **Genetik Yetiştirme Programları**

Fenolik bileşiklerin etkilerini azaltabilecek genetik özelliklere sahip zeytin çeşitleri geliştirilebilir. Genetik mühendislik ve seleksiyon yöntemleri, aşı uyumsuzluğunu yönetmek için kullanılabilir (Miller et al., 2007).

### **Çevresel Faktörlerin Yönetimi**

Fenolik bileşiklerin üretimini etkileyen çevresel faktörlerin yönetilmesi önemlidir. Su stresi, besin eksiklikleri ve diğer çevresel stres faktörleri, fenolik bileşiklerin seviyelerini etkileyebilir ve aşı uyumsuzluğunu artırabilir (Pietta, 2000).

## Sonuçlar

1. **Fenolik Bileşiklerin Birikimi:** Fenolik bileşiklerin, özellikle kateşin ve epikateşin gibi maddelerin, aşı bölgesinde birikmesi uyuşmazlık belirtilerinin başlangıcı olarak gözlemlenmiştir (Cooman vd., 1996; Musacchi vd., 2000).
2. **Yüksek Fenolik Madde Oranı:** Uyuşmaz kombinasyonlarda fenolik madde oranının yüksek olması, bu maddelerin aşı uyuşmazlığında önemli bir rol oynadığını göstermektedir. Errea ve ekibi (2001), bu oranın uyuşur kombinasyonlarda %10'dan az olduğunu belirtmiştir.
3. **Fenolik Maddelerin İlk Tepkileri:** Aşı bölgesinde fenolik maddelerin birikmesi, uyuşmazlık durumunda ortaya çıkan ilk biyokimyasal tepkilerden biridir. Bu tepkiler, aşı uyuşmazlığının erken teşhisinde kullanılabilir.
4. **İzoenzim Etkileşimleri:** Peroksidaz izoenziminin lignin oluşumundaki rolü, aşı uyuşmazlığı ile izoenzimlerin etkileşimlerinin önemini vurgulamaktadır (Gaspar vd., 1982).
5. **HücreSEL Düzeyde Değişimler:** Kambiyum hücrelerinde düzensizlik, vasküler dokulardaki düşük farklılaşma, floem ve ksilem hücrelerinin çoğalmaması gibi hücreSEL düzeydeki değişimler, aşı uyuşmazlığının önemli göstergeleridir (Zarrouk vd., 2010).
6. **Aşı Sonrası Fenolik Birikim:** Aşılama 5 ay sonra aşı yüzeyinde fenolik bileşiklerin birikmesi, başarısız aşılama işleminin bir göstergesi olarak kabul edilmiştir (Zarrouk vd., 2010).
7. **Fenolik Profil Analizleri:** Aşı uyuşmazlığına yatkın zeytin çeşitlerinin fenolik profil analizleri, uyuşmazlık riskini önceden tahmin etmek için kullanılabilir.
8. **Genetik ve Fenolik İlişki:** Fenolik bileşiklerin birikiminde genetik faktörlerin rolü, belirli zeytin çeşitlerinin aşı uyuşmazlığına olan yatkınlığını açıklayabilir.
9. **Fenolik Maddelerin Enzimatik Faaliyetleri:** Fenolik bileşiklerin peroksidaz ve diğer ilgili enzimler üzerindeki etkileri, aşı uyuşmazlığı mekanizmalarını anlamada önemli ipuçları sunmaktadır.
10. **Fenolik Bileşiklerin Yıkımı:** Fenolik bileşiklerin yıkımı veya dönüştürülmesi, aşı uyuşmazlığının azaltılmasında potansiyel bir strateji olarak değerlendirilebilir.

## Öneriler:

1. **Erken Teşhis ve İzleme:** Fenolik bileşiklerin erken teşhisi için rutin fenolik profil analizleri yapılmalı ve uyuşmazlık belirtileri olan aşı bölgeleri düzenli olarak izlenmelidir.
2. **Fenolik Madde Azaltıcı Yöntemler:** Fenolik bileşiklerin birikimini azaltacak yöntemler araştırılmalı ve geliştirilmeli, bu sayede aşı uyuşmazlığının önlenmesi hedeflenmelidir.
3. **Genetik Çalışmalar:** Aşı uyuşmazlığına yatkın çeşitlerin genetik özellikleri üzerinde çalışmalar yapılmalı ve fenolik bileşiklerin birikimini etkileyen genler tespit edilmelidir.
4. **Enzimatik Aktivite Araştırmaları:** Peroksidaz ve diğer ilgili enzimlerin fenolik bileşiklerle etkileşimleri detaylı olarak incelenmeli ve bu enzimlerin aktivitelerini düzenleyici yöntemler geliştirilmelidir.
5. **Fenolik Profil Standartları:** Aşı uyuşmazlığına yatkınlık değerlendirmesi için fenolik profil standartları belirlenmeli ve zeytin çeşitleri bu standartlara göre sınıflandırılmalıdır.
6. **Kimyasal Analiz Teknikleri:** Fenolik bileşiklerin tespiti ve miktarının belirlenmesi için ileri kimyasal analiz teknikleri kullanılmalı ve bu tekniklerin etkinliği artırılmalıdır.
7. **Ziraat Uygulamaları:** Fenolik madde birikimini azaltıcı ziraat uygulamaları geliştirilmeli ve aşılama öncesi bu uygulamaların etkileri değerlendirilmelidir.

8. **Çeşit Seçimi:** Aşılama da kullanılacak zeytin çeşitlerinin fenolik profilleri dikkate alınmalı ve uyumsuzluk riski düşük çeşitler tercih edilmelidir.
9. **Mikroklima Etkileri:** Fenolik bileşiklerin birikiminde çevresel faktörlerin rolü araştırılmalı ve uygun mikroklima koşulları sağlanarak aşu uyumsuzluğu minimize edilmelidir.
10. **Eğitim ve Bilinçlendirme:** Zeytin yetiştiricileri ve aşu uzmanları, fenolik bileşiklerin rolü hakkında bilgilendirilmeli ve bu konuda eğitim programları düzenlenmelidir

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## VERTİCİLLİUM SOLGUNLUĞUNA KARŞI DELİCE ZEYTİN ANAÇLARININ SEÇİMİ VE ÖZELLİKLERİ

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### Özet

Verticillium solgunluğu, zeytin ağaçları üzerinde önemli ekonomik kayıplara yol açan ve dünya genelinde yaygın olarak görülen bir hastalıktır. Hastalığın etkeni olan *Verticillium dahliae* Kleb. mantarıdır. Verticillium solgunluğuna karşı dayanıklı delice zeytin anaçlarının kullanımı, zeytin üretiminde hastalık kontrolü ve sürdürülebilirliği sağlama açısından etkili bir çözüm sunmaktadır. Delice zeytin (*Olea europaea* var. *sylvestris*) anaçları, Verticillium solgunluğuna karşı doğal dayanıklılık gösteren özellikleriyle öne çıkar. Delice zeytin anaçlarının seçiminde: Genetik çeşitlilik, fizyolojik ve morfolojik özellikler, ekolojik uyum ve dayanıklılık testleri önemlidir. Bu anaçların doğal dayanıklılık özellikleri, düşük bakım gereksinimleri ve geniş adaptasyon kabiliyeti, zeytin yetiştiriciliğinde önemli avantajlar sağlar. Gelecekteki çalışmalar, delice zeytin anaçlarının genetik çeşitliliğini ve hastalığa karşı direnç mekanizmalarını daha ayrıntılı olarak incelemeli ve bu bilgileri zeytin yetiştiriciliğinde uygulamalı olarak kullanmalıdır.

**Anahtar Kelimeler:** Verticillium dahliae, Delice zeytin Anacı, Tolerans ve Direnç

## SELECTION AND CHARACTERISTICS OF WILD OLIVE ROOTSTOCKS AGAINST VERTICILLIUM WILT

### **Abstract**

Verticillium wilt is a widespread disease causing significant economic losses in olive trees worldwide. The causative agent of the disease is the fungus *Verticillium dahliae* Kleb. Utilizing wild olive rootstocks resistant to Verticillium wilt presents an effective solution for disease control and sustainability in olive production. Wild olive (*Olea europaea* var. *sylvestris*) rootstocks are notable for their inherent resistance to Verticillium wilt. The selection of wild olive rootstocks involves considering genetic diversity, physiological and morphological characteristics, ecological adaptability, and resistance tests. The natural resistance traits of these rootstocks, along with their low maintenance requirements and broad adaptability, offer significant advantages in olive cultivation. Future research should focus on a more detailed examination of the genetic diversity and resistance mechanisms of wild olive rootstocks and apply this knowledge practically in olive cultivation.

**Keywords:** *Verticillium dahliae*, Wild Olive Rootstock, Tolerance and Resistance

## Giriş

Zeytin yetiştiriciliği, dünya genelinde hem ekonomik hem de kültürel açıdan büyük bir öneme sahiptir. Verticillium solgunluğu, toprak kökenli bir mantar olan *Verticillium dahliae* Kleb. tarafından neden olunan ve zeytin ağaçlarını (*Olea europaea* L.) etkileyen en yıkıcı hastalıklardan biridir. Bu hastalık, dünya genelinde zeytin yetiştiriciliğinde önemli ekonomik kayıplara yol açmaktadır ve etkileri hem üretim miktarını hem de ağaçların sağlığını ciddi şekilde tehdit etmektedir. Verticillium solgunluğu, zeytin ağaçlarının köklerinden girerek damar sistemine yayılan Verticillium dahliae mantarının neden olduğu bir hastalıktır. Hastalık, mantarın toprağa bulaşmış tohumlar, enfekte olmuş bitki kalıntıları veya tarım ekipmanları ile taşınması sonucu yayılabilir. Enfeksiyon, sıcak ve nemli koşullarda daha hızlı gelişir ve bu nedenle, sıcak Akdeniz iklimine sahip bölgelerde zeytin yetiştiriciliği yapan çiftçiler için büyük bir tehdit oluşturur (Tsror, 2011). Verticillium solgunluğunun belirtileri, enfeksiyonun şiddetine ve ağacın yaşına bağlı olarak değişiklik gösterebilir. Yaygın semptomlar arasında yapraklarda sararma, kıvrılma ve dökülme; dallarda nekrotik lekeler, ve sonuç olarak ağaçların genelinde solgunluk ve ölüm görülebilir. Bu semptomlar, diğer abiyotik ve biyotik stres faktörlerinin etkileriyle karıştırılabilir, bu nedenle doğru tanı için laboratuvar analizleri gereklidir (Porras Soriano et al., 2003; Yolageldi ve ark., 2003; Báidez ve ark., 2007; Gramaje et al., 2013; Sanei ve ark., 2017).

Verticillium solgunluğunun ekonomik etkileri oldukça ciddidir. Hastalığın neden olduğu verim kaybı, zeytin üreticileri için büyük mali kayıplara yol açar. Enfekte ağaçların tedavisi ve hastalığın yayılmasını önlemek için alınan önlemler de ek maliyetler yaratır. Ekolojik açıdan, hastalığın yayılması, zeytin yetiştirilen bölgelerdeki bitki örtüsünü olumsuz etkileyebilir ve biyolojik çeşitliliği azaltabilir (Tjamos et al., 2000; López-Escudero ve ark., 2010; López-Escudero and Mercado-Blanco 2011). Verticillium solgunluğuna karşı etkili kontrol ve yönetim stratejileri arasında, dayanıklı zeytin çeşitlerinin kullanımı, uygun tarım uygulamaları ve biyolojik kontrol yöntemleri bulunmaktadır. Dayanıklı anaçların kullanımı, hastalığın yayılmasını önlemek için önemli bir yöntemdir. Ayrıca, toprak dezenfeksiyonu ve rotasyon uygulamaları gibi kültürel önlemler de hastalık yönetiminde etkilidir (Bubici ve Cirulli 2011 Jiménez-Díaz et al., 2012; Arias-Calderón ve ark., 2015; Maldonado-González ve ark., 2015). Delice zeytin (*Olea europaea* var. *sylvestris*), yabani bir zeytin türü olup zeytin yetiştiriciliğinde önemli rol oynayan bir anaç VE Verticillium solgunluğuna karşı doğal direnç gösteren özellikleriyle dikkat çeker. Delice zeytin anaçları, zeytin ağaçlarının verimliliğini ve hastalıklara karşı direncini artırmak amacıyla kullanılır. Dayanıklı anaçlar ile farklı zeytin çeşitlerinin aşılınması, hastalığın kontrolünde önemli bir stratejidir (Erten ve Yildiz, 2011; Bubici and Cirulli, 2012; García-Ruiz ve ark., 2015; Jiménez-Fernández ve ark., 2016; Palomares-Rius ve ark., 2016; Montes-Osuna, ve Mercado-Blanco, 2020; D'íaz-Rueda ve ark., 2022). Bu anaçlar, genetik çeşitlilikleri, fizyolojik ve morfolojik özellikleri, ekolojik uyum yetenekleri ve dayanıklılıkları nedeniyle önemlidir. Delice zeytin anaçlarının seçimi, hastalık kontrolü ve zeytin üretiminde sürdürülebilirlik açısından büyük avantajlar sağlar.

Verticillium solgunluğuna karşı dayanıklı delice zeytin (*Olea europaea* var. *sylvestris*) anaçlarının kullanımı, hastalığın kontrolü ve zeytin üretiminde sürdürülebilirliği sağlama açısından büyük bir öneme sahiptir. Bu makalede, delice zeytin anaçlarının seçimi ve özellikleri hakkında detaylı bilgi sunulacaktır.

### 1. Delice Zeytin Anaçlarının Seçimi ve Özellikleri

Delice zeytin (*Olea europaea* var. *sylvestris*), yabani bir zeytin türü olup zeytin yetiştiriciliğinde önemli rol oynayan bir anaçtır. Delice zeytin anaçları, zeytin ağaçlarının verimliliğini ve hastalıklara karşı direncini artırmak amacıyla kullanılır. Bu anaçların seçimi ve kullanımı, zeytin yetiştiriciliğinde sürdürülebilirliği sağlamak için kritik öneme sahiptir. Delice zeytin anaçlarının genetik çeşitliliği, fizyolojik ve morfolojik özellikleri, ekolojik uyum yetenekleri ve dayanıklılıkları, zeytin yetiştiriciliğinde önemli avantajlar sağlar. Bu özellikler ile ilgili farklı

çalışmalar yapılmış olup aşağıdaki kısa ve öz sonuçlar çıkarılmıştır (Erten ve ark., 2007; Barranco, 2010; Derviş ve ark., 2007; Derviş ve ark., 2010; Xu ve ark., 2012; Castaño ve Avilés, 2013; Zhou ve ark., 2013; Jiménez-Gasco ve ark., 2014; Trapero ve ark., 2015; Jiménez-Díaz ve ark., 2017; Varo-Suárez ve ark., 2018; D'Orazio ve ark., 2019; Yıldız ve ark., 2020; Cardoni ve ark., 2022; Serrano-García ve ark., 2023)

### **1.1.Genetik Çeşitlilik**

#### **Genetik Varyasyon ve Dayanıklılık**

Delice zeytin anaçlarının genetik çeşitliliği, bu türün farklı çevresel koşullara adaptasyon yeteneğini artırır ve hastalıklara karşı direncini güçlendirir. Genetik çeşitlilik, farklı dayanıklılık genlerinin varlığı ve bu genlerin kombinasyonları sayesinde sağlanır. Bu çeşitlilik, zeytin ağaçlarının sağlığını korumak ve hastalıklara karşı direnç geliştirmek için önemli bir faktördür. Genetik analizler, bu anaçların hastalıklara karşı direnç potansiyelini belirlemek için kullanılır ve direnç genlerinin tespiti, bu anaçların seçiminde önemli rol oynar (Trujillo et al., 2014).

#### **Moleküler Biyoloji Teknikleri**

DNA markörleri ve moleküler biyoloji teknikleri, delice zeytin anaçlarının genetik analizlerinde yaygın olarak kullanılır. Bu teknikler, hastalıklara karşı direnç genlerinin varlığını ve varyasyonlarını belirlemek için kullanılır. Genetik analizler, zeytin ağaçlarının hastalıklara karşı direnç geliştirmesine yardımcı olur ve bu bilgilerin uygulamalı olarak kullanılmasını sağlar (Fabbri et al., 2004).

### **1.2.Fizyolojik Özellikler**

#### **Kök Sistemi ve Su Alımı**

Delice zeytin anaçları, güçlü bir kök sistemine sahip olur ve derin ve yaygın bir gelişme gösterir. Delice zeytin anaçlarının kök sistemleri, su ve besin maddelerine daha iyi erişim sağlayarak bitkilerin stres koşullarına karşı dayanıklılığını artırır. Güçlü kök sistemi, aynı zamanda toprağın mikroflora yapısını zenginleştirir ve yararlı mikroorganizmaların çoğalmasını destekler. Derin kök sistemleri, kuraklık gibi çevresel stres faktörlerine karşı direnç sağlar ve bitkilerin su alım kapasitesini artırır. Bu özellik, delice zeytin anaçlarının zorlu çevresel koşullarda bile başarılı bir şekilde yetişmesini sağlar (Rosati et al., 2013).

#### **Yaprak ve Kabuk Özellikleri**

Delice zeytin anaçlarının yaprak ve kabuk özellikleri, hastalıklara karşı direnç sağlamak için önemlidir. Yoğun yaprak yapısı ve kalın kabuk, mantar ve diğer patojenlerin bitkiye girişini zorlaştırır. Bu özellikler, bitkilerin sağlığını korur ve hastalıklara karşı doğal bir bariyer oluşturur. Yaprakların su tutma kapasitesi ve kabuk kalınlığı, bitkilerin çevresel stres faktörlerine karşı dayanıklılığını artırır (Barranco et al., 2010).

### **1.3.Morfolojik Özellikler**

#### **Büyüme ve Gelişme**

Delice zeytin anaçlarının büyüme ve gelişme özellikleri, zeytin yetiştiriciliğinde önemli bir faktördür. Bu anaçlar, hızlı büyüme ve yüksek verim potansiyeli ile dikkat çeker. Ayrıca, yoğun dallanma ve yaprak yapısı, bitkilerin fotosentez kapasitesini artırır ve bu da verimliliği olumlu yönde etkiler. Morfolojik özellikler, delice zeytin anaçlarının seçilmesinde önemli bir kriterdir (Santos-Antunes et al., 2005).

#### **Meyve Kalitesi ve Verim**

Delice zeytin anaçlarının meyve kalitesi ve verim özellikleri, Meyve büyüklüğü, yağ içeriği ve lezzet gibi faktörler, delice zeytin anaçlarının seçilmesinde önemli rol oynar ve zeytin üreticileri için büyük önem taşır. Bu anaçlar, yüksek kaliteli ve bol verimli meyveler üretme kapasitesine sahiptir. Meyve büyüklüğü, yağ içeriği ve lezzet gibi faktörler, delice zeytin anaçlarının tercih edilme sebepleri arasındadır. Ayrıca, bu anaçların meyve olgunlaşma süresi, zeytin hasat zamanını etkiler ve bu da üretim planlamasında önemli bir rol oynar (Fabbri et al., 2004).



#### **1.4. Ekolojik Uyum ve Adaptasyon**

Delice zeytin anaçları, farklı toprak tiplerine ve iklim koşullarına uyum sağlama yeteneğine sahiptir. Bu adaptasyon kabiliyeti, özellikle kurak ve yarı kurak bölgelerde zeytin üretimi için önemli bir avantaj sağlar. Anaçların geniş adaptasyon aralığı, zeytin yetiştiriciliğinde sürdürülebilirliği artırır.

##### **Çevresel Koşullara Uyum**

Delice zeytin anaçlarının geniş ekolojik uyum yetenekleri, çeşitli toprak ve iklim koşullarında başarılı bir şekilde yetişmelerini sağlar. Bu anaçlar, düşük bakım gereksinimleri ve dayanıklılıkları sayesinde zorlu çevresel koşullara kolayca adapte olabilirler. Ekolojik uyum yetenekleri, bu anaçların çeşitli coğrafi bölgelerde yaygın olarak kullanılabilmesini sağlar (Martin et al., 2015).

##### **Toprak ve İklim Koşulları**

Delice zeytin anaçları, farklı toprak ve iklim koşullarına adapte olabilen özelliklere sahiptir. Bu anaçlar, hem kurak hem de nemli ortamlarda başarılı bir şekilde yetişebilirler. Toprak yapısına ve besin maddesi içeriğine karşı duyarlılıkları, delice zeytin anaçlarının seçilmesinde önemli bir faktördür. Bu anaçlar, zorlu toprak koşullarında bile sağlıklı ve verimli bir şekilde yetişebilirler (Barranco et al., 2010).

##### **Düşük Bakım Gereksinimi:**

Delice zeytin anaçları, düşük bakım gereksinimleri ve yüksek canlılık oranları ile bilinir. Bu özellik, tarımsal üretim maliyetlerini azaltır ve çevresel sürdürülebilirliği destekler. Anaçların doğal dayanıklılığı, kimyasal mücadele yöntemlerine duyulan ihtiyacı azaltarak ekolojik dengeyi korur.

#### **1.5. Hastalıklara Karşı Direnç**

##### **Verticillium Solgunluğuna Karşı Direnç**

Verticillium solgunluğu, zeytin ağaçları için büyük bir tehdit oluşturan ciddi bir hastalıktır. Delice zeytin anaçlarının bu hastalığa karşı doğal direnç göstermesi, zeytin yetiştiriciliğinde önemli avantajlar sağlar (Jiménez-Díaz et al., 2012).

##### **Diğer Patojenlere Karşı Direnç**

Delice zeytin anaçlarının, yalnızca Verticillium solgunluğuna değil, diğer patojenlere karşı da dirençli olması gereklidir. Bu anaçların geniş spektrumlu direnç özellikleri, zeytin ağaçlarının genel sağlığını ve uzun ömürlülüğünü artırır (Santos-Antunes et al., 2005).

#### **Geleceğe Yönelik Araştırma İhtiyaçları**

##### **Genetik ve Biyoteknolojik Araştırmalar**

Delice zeytin anaçlarının genetik çeşitliliği ve direnç mekanizmaları üzerine daha fazla araştırma yapılması gerekmektedir. Genetik mühendislik ve biyoteknoloji tekniklerinin kullanılması, hastalıklara karşı daha dirençli zeytin çeşitlerinin geliştirilmesine katkı sağlayabilir. Ayrıca, genetik analizler ve moleküler biyoloji teknikleri, bu anaçların hastalıklara karşı direnç potansiyelini belirlemek için önemlidir (Jiménez-Díaz et al., 2012).

##### **Ekolojik Adaptasyon Çalışmaları**

Delice zeytin anaçlarının ekolojik adaptasyon yeteneklerinin daha detaylı incelenmesi gerekmektedir. Farklı toprak ve iklim koşullarında bu anaçların performansını değerlendirmek, zeytin yetiştiriciliğinde sürdürülebilirliği sağlamak için kritik öneme sahiptir. Ekolojik adaptasyon testleri, bu anaçların çeşitli çevresel koşullara uyum yeteneklerini belirlemek için kullanılır (Santos-Antunes et al., 2005).

Delice zeytin anaçları, zeytin yetiştiriciliğinde hastalık kontrolü ve sürdürülebilirlik sağlama açısından büyük önem taşımaktadır. Bu anaçların genetik çeşitliliği, fizyolojik ve morfolojik özellikleri, ekolojik uyum yetenekleri ve dayanıklılıkları, zeytin üretiminde önemli avantajlar sunar. Gelecekteki araştırmalar, bu anaçların genetik ve ekolojik özelliklerini daha ayrıntılı olarak incelemeli ve hastalıklara karşı daha etkili mücadele yöntemleri geliştirmelidir.

## Sonuçlar

1. **Genetik Çeşitlilik ve Direnç:** Delice zeytin anaçlarının genetik çeşitliliği, Verticillium solgunluğuna karşı doğal direnci artırmak için kritik bir faktördür. Çeşitlilik, hastalığa karşı direnç genlerinin varlığını ve etkisini artırır.
2. **Fizyolojik Özellikler:** Derin ve yaygın kök sistemleri, su ve besin maddelerine erişim sağlayarak bitkilerin stres koşullarına karşı dayanıklılığını artırır. Bu özellikler, Verticillium solgunluğuna karşı direnci güçlendirir.
3. **Morfolojik Özellikler:** Yüksek büyüme hızına ve yoğun dallanmaya sahip delice zeytin anaçları, daha iyi verim ve hastalıklara karşı doğal bir koruma sağlar. Ayrıca, meyve kalitesi ve verim potansiyeli de önemli bir seçim kriteridir.
4. **Ekolojik Uyum:** Delice zeytin anaçlarının farklı toprak ve iklim koşullarına uyum yetenekleri, zeytin yetiştiriciliğinde başarılı olmalarını sağlar. Bu uyum, hastalıklara karşı dayanıklılığı artırır ve çevresel stres faktörlerine karşı direnci güçlendirir.
5. **Hastalıklara Karşı Direnç:** Verticillium solgunluğuna karşı dirençli delice zeytin anaçları, zeytin ağaçlarının sağlığını korur ve üretkenliğini artırır. Diğer patojenlere karşı direnç de önemlidir, çünkü bu anaçlar genel bitki sağlığını iyileştirir.
6. **Verimlilik ve Meyve Kalitesi:** Verimli ve yüksek kaliteli meyve üreten delice zeytin anaçları, zeytin üretiminde ekonomik fayda sağlar. Meyve büyüklüğü, yağ içeriği ve lezzet gibi faktörler, anaç seçiminde dikkate alınmalıdır.
7. **Düşük Bakım Gereksinimleri:** Düşük bakım gereksinimleri, delice zeytin anaçlarının zeytin yetiştiriciliğinde sürdürülebilirlik sağlama yeteneğini artırır. Bu, hem zaman hem de maliyet tasarrufu sağlar.
8. **Genetik ve Biyoteknolojik Araştırmalar:** Genetik çeşitlilik ve direnç mekanizmaları üzerine yapılan araştırmalar, daha etkili ve dirençli anaçların geliştirilmesine katkı sağlar. Genetik mühendislik ve biyoteknoloji tekniklerinin kullanılması, bu süreçte önemli bir rol oynar.
9. **Ekolojik Adaptasyon Çalışmaları:** Farklı toprak ve iklim koşullarında delice zeytin anaçlarının performansını değerlendirmek, sürdürülebilir zeytin yetiştiriciliği için kritik öneme sahiptir. Bu çalışmalar, anaçların çeşitli çevresel koşullara uyum yeteneklerini belirler.
10. **Uzun Vadeli Performans:** Delice zeytin anaçlarının uzun vadeli performansı, hastalıklara karşı dayanıklılığı ve genel bitki sağlığını belirler. Bu anaçların uzun ömürlü ve dayanıklı olması, zeytin ağaçlarının sürekliliğini sağlar.

## Öneriler

1. **Genetik Çeşitliliğin Korunması:** Delice zeytin anaçlarının genetik çeşitliliğini korumak ve artırmak için genetik kaynakların korunması ve araştırılması teşvik edilmelidir. Çeşitli genetik kaynaklar, hastalıklara karşı direnç potansiyelini artırabilir.
2. **Fizyolojik Özelliklerin Değerlendirilmesi:** Delice zeytin anaçlarının kök sistemi ve su-besin alım kapasiteleri detaylı bir şekilde değerlendirilmelidir. Bu özellikler, anaçların stres koşullarına karşı dayanıklılığını artırabilir.
3. **Morfolojik Özelliklerin İzlenmesi:** Yüksek verim ve meyve kalitesi sağlayan anaçların seçimi önemlidir. Morfolojik özellikler, bitkilerin sağlık durumu ve ekonomik faydası üzerinde doğrudan etkili olabilir.
4. **Ekolojik Uyum Testleri:** Delice zeytin anaçlarının farklı toprak ve iklim koşullarına uyum yeteneklerini belirlemek için kapsamlı ekolojik uyum testleri yapılmalıdır. Bu testler, anaçların geniş adaptasyon kabiliyetlerini belirler.

5. **Hastalık Yönetimi Stratejileri:** Verticillium solgunluğuna karşı dirençli anaçların kullanımı teşvik edilmelidir. Ayrıca, diğer patojenlere karşı direnç özelliklerinin geliştirilmesi de önemlidir.
6. **Düşük Bakım Gereksinimlerinin Avantajlarından Yararlanma:** Düşük bakım gereksinimlerine sahip anaçların avantajlarından yararlanarak, üretim süreçlerinde maliyet ve iş gücü tasarrufu sağlanabilir.
7. **Biyoteknolojik Araştırmaların Desteklenmesi:** Genetik mühendislik ve biyoteknoloji alanındaki araştırmalar desteklenmeli ve bu tekniklerin uygulanabilirliği değerlendirilmelidir. Bu, hastalıklara karşı dirençli yeni anaç türlerinin geliştirilmesine yardımcı olabilir.
8. **Uzun Vadeli Performans Analizleri:** Delice zeytin anaçlarının uzun vadeli performansını izlemek için düzenli analizler yapılmalıdır. Bu analizler, anaçların uzun ömürlü ve dayanıklı olup olmadığını belirlemeye yardımcı olur.
9. **Eğitim ve Bilinçlendirme:** Zeytin üreticileri ve araştırmacılar, delice zeytin anaçlarının seçim kriterleri ve avantajları hakkında bilgilendirilmelidir. Eğitim ve bilinçlendirme çalışmaları, anaçların etkili bir şekilde kullanılmasını sağlar.
10. **Sürdürülebilir Yetiştiricilik Uygulamaları:** Delice zeytin anaçlarının seçiminde sürdürülebilirlik ön planda tutulmalıdır. Çevresel etkileri minimize eden ve uzun vadeli başarı sağlayan yetiştiricilik uygulamaları teşvik edilmelidir.

Bu derlemede, delice zeytin anaçlarının Verticillium solgunluğuna karşı etkili bir şekilde kullanılmasını sağlayarak zeytin yetiştiriciliğinde verimliliği artırmak ve sürdürülebilirliği sağlamak amacıyla rehberlik edecektir.

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# STRİGOLAKTON VE MİKORİZA UYGULAMALARININ 110R/NARİNCE AŞI KOMBİNASYONUNDAKİ FİDANLARIN AZOT KLOROFİL FLAVONOL VE ANTOSİYANİN İÇERİKLERİ ÜZERİNE ETKİSİ

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## Özet

Bu çalışmada, 110R anacı üzerine aşılı Narince üzüm çeşidine ait asma fidanlarına dikim öncesi ve sonrası ayrı ayrı ve birlikte uygulanan Strigolakton (GR24) ve mikoriza (ERS, Endo Roots Soluble)'nın fidanların azot, klorofil, flavonol ve antosiyanin içerikleri üzerine etkisi incelenmiştir. Aşılama işlemi Pedallı omega şeklinde kesit açan makinelerden yararlanılarak mart ayı içerisinde yapılmıştır. Aşılama sonrası parafınleme, katlama, kaynaştırma, talaş temizliği ve ikinci parafınleme işlemleri yöntemine uygun olarak gerçekleştirilmiştir. Çelikler, dikim öncesi 1 µM, 5 µM ve 10 µM GR24 içeren solüsyonlarda 1 saat, ERS solüsyonunda ise 1 dk bekletildikten sonra, 1:1 oranında torf-perlit karışımı içeren bir litre hacimli siyah polietilen torbalara dikilmiştir. Kontrol grubu hariç olmak üzere, dikimden 21 gün sonra, fidanlara topraktan kök kısmına şırıngalarla; 1 µM, 5 µM ve 10 µM GR24 (5 ml) ile 30 ml mikoriza uygulanmıştır. Deneme, Tesadüf Parselleri deneme desenine göre 3 tekerrürlü ve her tekerrürde 5 aşılı fidan olacak şekilde kurulmuştur. Uygulama sonrası fidanların gelişmelerini tamamlamaları beklenmiş ve yaprağa herhangi bir zarar vermeden klorofil içeriğini ve polifenol indekslerini ölçen bir yaprak klipsi sensörü olan Dualex® Sensörü (ForcaA, Orsay, Fransa) ile azot denge indeksi (ADİ), klorofil, flavonol ve antosiyanin içerikleri belirlenmiştir. Çalışma sonucunda ADİ değeri, 135.6 dx (Dualex indeksi) ile 293.3 dx aralığında; klorofil değeri 19.4 µg/cm<sup>2</sup> ile 24.0 µg/cm<sup>2</sup> aralığında; flavonol değeri 0.11 dx ile 0.24 dx aralığında ve antosiyanin değeri ise 0.13 dx ile 0.14 dx aralığında değişim göstermiştir.

**Anahtar Kelimeler:** *Vitis vinifera* L. cv. Narince, anaç, kalem, fidan gelişimi

## EFFECTS OF STRIGOLACTONE AND MYCORRHIZAL TREATMENTS ON NITROGEN CHLOROPHYLL FLAVONOL AND ANTHOCYANIN CONTENTS OF SAPLINGS IN 110R/NARINCE GRAFTING COMBINATION

### Abstract

In this study, the effects of strigolactone (GR24) and mycorrhiza (ERS, Endo Roots Soluble) applied separately and together to grapevine saplings of Narince grape variety grafted onto 110R rootstock before and after planting on nitrogen balance index (NBI), chlorophyll, flavonol and anthocyanin contents of saplings were investigated. Grafting process was carried out in March using pedal omega-shaped sectioning machines. After grafting; paraffining, folding, fusing, sawdust cleaning and second paraffining processes were carried out in accordance with the method. Cuttings were kept in 1  $\mu$ M, 5  $\mu$ M and 10  $\mu$ M GR24 solutions for 1 hour and in ERS solution for 1 minute before planting and then planted in one-liter black polyethylene bags containing 1:1 peat perlite mixture. 21 days after planting, 1  $\mu$ M, 5  $\mu$ M and 10  $\mu$ M GR24 (5 ml) and 30 ml mycorrhiza were applied to the root part of the saplings through the soil with syringes except for the control group. The experiment was conducted according to the Randomized Plots Design with 3 replications and 5 grafted saplings in each replication. After the application, the saplings were waited to complete their development and the NBI, chlorophyll, flavonol and anthocyanin contents were determined with Dualex® Sensor (ForcaA, Orsay, France), which is a leaf clip sensor that measures chlorophyll content and polyphenol indices without any damage to the leaves. As a result of the study, NBI value was between 135.6 dx (Dualex index) and 293.3 dx; chlorophyll value was between 19.4  $\mu$ g/cm<sup>2</sup> and 24.0  $\mu$ g/cm<sup>2</sup>; flavonol value varied between 0.11 dx and 0.24 dx and anthocyanin value varied between 0.13 dx and 0.14 dx.

**Keywords:** *Vitis vinifera* L. cv. Narince, rootstock, scion, sapling development



## Giriş

Dünyada ve ülkemizde bağ alanlarının filoksera ile bulaşık olması, bağcılıkta Amerikan asma anacı kullanımını zorunlu kılmaktadır. Günümüzde yaygın olarak kullanılan anaçların köklenme yeteneklerinin nispeten düşük olması en önemli dezavantajdır. Yetersiz bir köklenme, su ve besin elementi alımını sınırlanmakta, büyüme ve gelişmeyi olumsuz etkilemekte, biyotik ve abiyotik stres koşullarına dayanımı azaltmaktadır.

Yapılan çalışmalar, bitkilerde kök gelişiminin sağlanması bakımından fitohormonların kullanımını ön plana çıkarmaktadır. Strigolaktonlar (SL'ler), bitkilerde her yerde bulunan yeni bir fitohormondur (Gomez-Roldan vd., 2008; Umehara vd., 2008). Strigolaktonların, son yıllarda bitkilerde adventif kök oluşumunu, primer ve lateral kök gelişimini, kök tüylerinin uzamasını ve bitki toprak mikroorganizmaları arasındaki simbiyotik ilişkiyi teşvik ettiği bildirilmektedir (Polat vd., 2023).

Günümüzde yeni biyolojik materyaller kullanarak, asma fidanı üretimi geliştirilmeye çalışılmakta, bu amaçla bağcılıkta mikorizal preparasyonlar kullanılmaktadır (Korkutal vd., 2020). Bu fungusların toprak yapısını düzenledikleri, havalanmasını sağladıkları, bitki kök büyümesini ve dağılımını teşvik ederek su ve besin maddelerini absorbe etmelerini sağladıkları (Gavito vd., 2005; Hawkes vd., 2008) ve su alımının düzenlenmesinde etkin oldukları bildirilmektedir (EI Tohamy vd., 1999). Mikoriza bitkinin daha fazla su ve besinden yararlanmasını sağlarken, bitkiden karbon almakta, bunun karşılığında topraktan aldığı besin maddeleri ve suyu bitkiye ulaştırmaktadır. Mikoriza, bitki kök yüzeyi ve kök dokuları ile hücre ve hücreler arası boşluklara yerleşerek, yaşamlarını bitki köklerinde devam ettirir. Kök yüzeyinde yoğun fungal örtü ve çok sayıda hif oluşarak, bitki kökünün ulaşamadığı yerlere ulaşır. Bu sayede kökün alım gücü normale göre 40 kata kadar artar.

Son yıllarda, SL aracılı kök gelişiminde, mikorizal funguslarla simbiyotik ilişkiler dikkati çekmektedir (Claassens ve Hills, 2018). SL'ler, mikoriza simbiyozunun kurulması ve parazitik yabancı otların tohum çimlenmesi için rizosferik sinyal molekülleri olarak kritik bir rol oynamalarına rağmen, etkileşimleri hakkında sınırlı veri mevcuttur. Son yıllarda yapılan çalışmalar, arbüsküler mikorizal fungusların (AMF) konak bitkilere su alımı uygulaması ve asmanın besin durumunu iyileştirmek için temel faktörler olan P ve N gibi besinlerin emiliminin artırılması gibi temel ekosistem hizmetleri sağlayabileceğini göstermektedir (Aguilera vd., 2022).

Dualex® Sensörü (ForcaA, Orsay, Fransa), son yıllarda özellikle modern tarım uygulamalarında bitki sağlığını ve verimliliğini artırmak için kullanılan ve bitkilerdeki azot denge indeksi (ADİ), klorofil, flavonol ile antosiyanin gibi bileşenlerin anlık ve tahribatsız bir şekilde ölçülmesini sağlayan taşınabilir bir cihazdır. Bitkinin yaprağındaki bileşenleri ışık soğurma ve yansıtma prensiplerine göre analiz ederek hızlı sonuçlar sunmaktadır.

SL'lerin ve mikorizal fungusların köklenme üzerine olumlu etkilerinden yola çıkarak planlanan bu çalışmada, 110R anacı üzerine aşılı Narince üzüm çeşidine ait fidanlara dikim öncesi ve dikim sonrası uygulanan SL ve mikorizal preparasyonun, tüplü fidanların Azot denge indeksi (ADİ), klorofil, flavonol ve antosiyanin içerikleri üzerine etkileri Dualex® Sensörü (ForcaA, Orsay, Fransa) kullanılarak belirlenmiştir.

## Materyal ve Yöntem

Çalışma, Van Yüzüncü Yıl Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Bölümü ve Tokat Gaziosmanpaşa Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Bölümü'nde yürütülmüştür. Tokat bağlarından alınan Narince ve 110R Amerikan asma anacı çelikleri, %80-95 nem ve 0-4 °C' de soğuk hava deposunda muhafaza edilmiştir (Becker, 1971). Aşılama işlemi, mart ayı içerisinde pedallı omega şeklinde kesit açan makinelerden yararlanılarak yapılmıştır. Aşılama sonrası aşı materyalleri, 74-76°C' de parafinle muamele edildikten sonra çam talaşı olan kasalara konularak kaynaştırma (çimlendirme) odasına bırakılmıştır. Kaynaştırma odası

koşulları: 3 gün 28-29 °C, 15 gün 25-26 °C ve 3 gün 22-24 °C; nem oranı % 85-95; 6-12 saatte bir havalandırma (Çelik, 1983) olacak şekilde düzenlenmiştir. Kaynaştırma odasından çıkarılan kasalarda, iri talaşlar alınıp kallus etrafında renk dönüşümünün olduğu zamana kadar materyaller kasada 3-6 gün kadar bekletilmiş ve daha sonra ikinci parafinleme işlemleri yönetime uygun şekilde yapılmıştır. Tüplü fidan üretimi için kap materyali olarak bir litre hacimli 12 x 20 cm ebatlarında %2 UV katkılı siyah polietilen tüplere 1:1 oranında torf perlit karışımı konulmuştur.

Çalışmada sentetik bir SL olan GR24 ve suda çözünen formülasyona sahip %23.5 toplam canlı organizma içeren Endo Roots Soluble (ERS) mikorizal preparasyon kullanılmıştır. GR24 ve mikoriza uygulamaları dikim öncesi ve sonrası yapılmıştır. Çalışmada yapılan uygulamalar Çizelge 1’de, kullanılan mikorizal preparasyon içeriği ise Çizelge 2’de sunulmuştur.

**Çizelge 1.** GR24 ve mikoriza uygulamaları

1. Grup	Kontrol
2. Grup	1 µM GR24 uygulaması (dikim öncesi 1 saat bekletme)
3. Grup	5 µM GR24 uygulaması (dikim öncesi 1 saat bekletme)
4. Grup	10 µM GR24 uygulaması (dikim öncesi 1 saat bekletme)
5. Grup	1 µM GR24 uygulaması (dikim öncesi 1 saat bekletme + dikim sonrası 5 ml köklere şırınga ile enjekte) + ERS (dikim öncesi 1 dk bekletme + dikim sonrası 30 ml köklere şırınga ile enjekte)
6. Grup	5 µM GR24 uygulaması (dikim öncesi 1 saat bekletme + dikim sonrası 5 ml köklere şırınga ile enjekte) + ERS (dikim öncesi 1 dk bekletme + dikim sonrası 30 ml köklere şırınga ile enjekte)
7. Grup	10 µM GR24 uygulaması (dikim öncesi 1 saat bekletme + dikim sonrası 5 ml köklere şırınga ile enjekte) + ERS (dikim öncesi 1 dk bekletme + dikim sonrası 30 ml köklere şırınga ile enjekte)
8. Grup	ERS (dikim öncesi 1 dk bekletme + dikim sonrası 30 ml köklere şırınga ile enjekte)

**Çizelge 2.** Mikorizal preparasyon ve içeriği

Aktif bileşenler	Hareketsiz bileşenler
Glomus intraradices 25	Humic Acids %28.70
Glomus mosseae 24	Cold Water Kelp Extracts %18.0
Glomus aggregatum 24	Ascorbic Acid (Vitamin C) %12.0
Glomus clarum 1	Amino Acids %6.0
Glomus monosporus 1	Myo-Inositol %2.5
Glomus deserticola 1	Surfactant %2.5
Glomus brasilianum 1	Thiamine (Vitamin B1) %1.75
Glomus etunicatum 1	Alpha-tocopherol (Vitamin E) %1.00
Gigaspora margarita 1	

Fidanlar 35-40 cm uzunluğa ulaştığında, Dualex® Sensörü (ForcaA, Orsay, Fransa) ile ölçümler, her grup için 25 adet farklı yaştaki yaprak (genç, orta ve yaşlı) esas alınarak yapılmıştır. Yaprakların hasar görmemiş olmalarına dikkat edilmiş, çok yaşlı ve çok genç yapraklar dikkate alınmamıştır. Yapraklarda, Dualex indeksi (dx) cinsinden azot denge indeksi (ADİ), flavonol ve antosiyanin değerleri ile klorofil değeri (µg/cm<sup>2</sup>) belirlenmiştir. Elde edilen veriler varyans analizine tabii tutulduktan sonra, farklı grupları belirlemede Asgari Önemli Fark (LSD) yöntemi kullanılmıştır.

### **Bulgular ve Tartışma**

İncelenen özellikler için uygulamalara göre tanımlayıcı istatistikler ve karşılaştırma sonuçları Çizelge 3’te sunulmuştur.

**Çizelge 3.** ADİ, klorofil, flavonol ve antosiyanin değerleri bakımından tanımlayıcı istatistikler ve karşılaştırma sonuçları

Uygulama	ADİ	Klorofil	Flavonol	Antosiyanin
1. Grup	134.0 b	19.4	0.11	0.14
2. Grup	154.7 b	22.6	0.17	0.13
3. Grup	232.2 ab	24.0	0.16	0.13
4. Grup	189.0 ab	21.9	0.19	0.13
5. Grup	293.3 a	21.0	0.19	0.13
6. Grup	291.3 a	23.2	0.17	0.13
7. Grup	168.8 b	20.2	0.16	0.13
8. Grup	135.6 b	23.2	0.24	0.14
LSD (0.05)	120.7	ÖD	ÖD	ÖD

Farklı harfi alan gruplar arası fark önemlidir (p<0.05)

ADİ değeri bakımından uygulamalar arasında istatistik olarak önemli fark bulunurken, diğer özellikler bakımından fark önemli bulunmamıştır. ADİ değeri kontrol grubunda en düşük (135.6 dx) değeri alırken 5. grupta (1 µM GR24 uygulaması (dikim öncesi 1 saat bekletme + dikim sonrası 5 ml köklere şırınga ile enjekte) + ERS (dikim öncesi 1 dk bekletme + dikim sonrası 30 ml köklere şırınga ile enjekte) en yüksek (293.3 dx) değeri almıştır. Bu beklenen bir durumdur. Azot eksikliğinde köklerden sızan SL'ler AMF tarafından algılanır ve simbiyoz oluşturmak için gerekli bir adım olan hifal dallanmasına neden olur. AMF'ler, fosfat ve azot gibi inorganik besinler elde etmede bitkiye yardımcı olduklarından, eksikliği durumunda SL seviyelerinin artışı bitki için hayati bir tepkidir (Seto vd., 2012; Naseer vd. 2024). Klorofil değeri, 19.4 µg/cm<sup>2</sup> ile kontrol grubunda en düşük olmuştur. En yüksek değer ise 24.0 µg/cm<sup>2</sup> ile 3. grupta (5 µM GR24'de dikim öncesi 1 saat bekletme) elde edilmiştir. Bu durumun kontrol grubunda gözlenen azot eksikliğinden kaynaklandığı düşünülmektedir. Zira azot eksikliği koşulları altında uygulanan GR24, azot eksikliğinin göstergesi olan klorofil içeriğindeki azalmaları bastırmıştır (Ito vd., 2015). Flavonol değeri, 0.11 dx ile en düşük kontrol grubunda belirlenirken, en yüksek (0.24 dx) dikim öncesi ve dikim sonrası ERS uygulamasının yapıldığı 8. grupta belirlenmiştir. Bitkiler, AMF tarafından kolonize edildiğinde, flavonoidlerin deseni önemli ölçüde değişmektedir (Morandi vd., 1996; Vierheilig vd., 1998). İlginç bir şekilde, flavonoidlerin AMF'nin farklı simbiyotik öncesi aşamaları üzerindeki etkisine benzer şekilde, farklı AMF'ler tarafından üretilen köklerdeki flavonoid deseninin değişimleri de belirli bir AMF mantar cinsi ve türü özgüllüğü sergilemektedir (Steinkellner vd., 2007). Kök penetrasyonu ve AMF'nin erken oluşumu sırasında, köklerde bir dizi flavonoidin orta seviyeleri tespit edilirken, kök kolonizasyonunun daha sonraki bir aşamasında, diğerlerinin yanı sıra bol miktarda çökmüş arbüsküllerle karakterize edilen, fitoaleksin ve medikarpin gibi yüksek seviyelerde flavonoidler bildirilmiştir (Larose vd., 2002). Antosiyanin değeri ise 0.13 dx (kontrol) ile 0.14 dx (2.,3.,4.,5.,6., 7. ve 8. grup) arasında değişim göstermiştir. Ferrero vd., (2018), üzümde tek başına GR24 ile muamele edilmiş meyvelerde antosiyanin birikiminde, kontrol grubu ile hiçbir fark olmadığını veya çok az olduğunu bildirmişlerdir. Diğer bir çalışmada ise mikoriza uygulamalarının çilek meyvelerinde antosiyanin içeriğini artırdığı saptanmıştır (Castellanos-Morales vd., 2010). Araştırma bulgularının literatür ile uyumlu olduğu söylenebilir.

### **Sonuç**

Bu çalışma sonucunda, 110R/Narince aşı kombinasyonundaki asma fidanlarına dikim öncesi ve sonrası ayrı ayrı ve birlikte uygulanan Strigolakton (GR24) ve mikoriza (ERS, Endo Roots Soluble)'nin fidanların sağlığı ve besin tedariki hakkında bilgi sağlayan azot, klorofil, flavonol ve antosiyanin değerleri Dualex® Sensörü (ForcaA, Orsay, Fransa) kullanarak hızlı ve yaprağa zarar vermeden belirlenebilmiştir. SL'ler ve AMF'ler arasındaki ilişki, bitki-mikroorganizma etkileşimlerinin önemli bir bileşenidir ve özellikle tarımsal üretimde ve ekosistem işleyişinde kritik bir rol oynar. Bu ilişkinin sürdürülebilir tarım uygulamaları için potansiyel faydalar sunacağı açıktır. Gelecek çalışmalarda, özellikle abiyotik stres (örneğin kuraklık ve düşük fosforlu toprak) koşullarına karşı bu ilişkiden yararlanılabilecek çalışmaların yapılması önerilmektedir.

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## ERCİŞ ÜZÜM ÇEŞİDİNİN DOĞAL POLİEMBRİYONİ FREKANSININ BELİRLENMESİ ÜZERİNE BİR ÖN ÇALIŞMA

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### Özet

Asmalarda poliembriyoni (PE) genetik ve sitolojik anlamda dikkat çeken bir konudur. Şimdiye kadar asmada doğal haploid çeşitlere rastlanmamış olması, bu konuya olan ilgiyi daha da artırmaktadır. Bu çalışmada Van ve yöresinin otokton üzüm çeşidi olan Erciş üzüm çeşidinin poliembriyoni frekansı ilk kez belirlenmiştir. Bu amaçla 2023 bağbozumu yılında Van ili Erciş ilçesinin Bayramlı köyünden temin edilen üzümlerden alınan tohumlar +4 °C' de yaklaşık 3 ay katlama işlemine tabi tutulduktan sonra, bitki doku kültürü tekniklerinden yararlanılarak çimlendirilmiştir. Çalışma tesadüf parselleri deneme desenine göre 5 tekerrürlü ve her tekerrürde 35 adet petri kabı ve her petri kabında 5 ya da 6 adet tohum olacak şekilde kurgulanmıştır. Çimlenme oranı ile poliembriyoni oranının saptanması amacıyla belirli aralıklarla sayımlar yapılmış ve ekimden 15 gün sonra tohumlarda ilk çimlenme görülmüştür. Çalışma sonucunda ekilen 890 adet tohumdan 372 adedi çimlenmiş ve çimlenme oranı %41.79 olarak belirlenmiştir. Çalışmada 1 adet poliembriyoni oluşumu gözlenmiş buna göre Erciş üzüm çeşidinin çimlenmeye alınmış toplam tohum sayısına göre değerlendirilen PE oranını (PEO1) %0.11, çimlenen tohum sayısına göre PE oranı (PEO2) ise %0.27 olarak bulunmuştur. Yapılan kromozom çalışmaları sonucunda köklerde  $2n=38$  kromozom belirlenmiş ve bitkiciklerin diploid olduğu gözlenmiştir.

**Anahtar Kelimeler:** *Vitis vinifera* L., tohum, çimlenme, poliembriyoni, haploidi, kromozom

## A PRELIMINARY STUDY ON DETERMINATION OF NATURAL POLYEMBRYONY FREQUENCY OF 'ERCIŞ' GRAPE VARIETY

### Abstract

Polyembryony (PE) in grapevines is a genetically and cytologically intriguing subject. The fact that no natural haploid varieties have been encountered in grapevines so far further increases the interest in this subject. In this study, the polyembryony frequency of Erciş grape variety, which is an autochthonous grape variety of Van and its region, was determined for the first time. For this purpose, seeds obtained from grapes in Bayramlı village of Erciş district of Van province in the 2023 vintage year were subjected to a stratification process at +4 °C for approximately 3 months and then germinated using plant tissue culture techniques. The study was designed according to the randomized plot experimental design with 5 replications and 35 petri dishes in each replication and 5 or 6 seeds in each petri dish. Counts were made at certain intervals to determine the germination rate and polyembryony frequency, and the first germination occurred in the seeds 15 days after sowing. As a result of the study, 372 of the 890 seeds planted germinated and the germination rate was determined as 41.79%. In the study, 1 polyembryony formation was observed; accordingly, the PE ratio (PEO1) of the Erciş grape variety, evaluated according to the total number of seeds taken to germination, was found 0.11%, and the PE ratio (PEO2) according to the number of germinated seeds was found 0.27%. As a result of the chromosome study,  $2n=38$  chromosomes were determined in the roots and the plantlets were observed to be diploid.

**Keywords:** *Vitis vinifera* L., seed, germination, polyembryony, haploidy, chromosome.



## Giriş

Asma tohumlarında genellikle tek bir embriyo bulunur. Bu duruma "monoembriyoni" adı verilmektedir. Bir tohumda birden fazla embriyonun bulunması ise "poliembriyoni" olarak tanımlanmaktadır. Bu terim "poli-"(çok) ve "embriyon"(gelişmekte olan organizma) kelimelerinin birleşmesiyle oluşmuştur (Johansen 1950; Ünal 1988; Ağaoglu 1999). Bitkilerde bu durum ya bir ya da birden fazla embriyonik kesenin döllenenmesinden ya da embriyoların embriyonik kesenin dışında oluşmasından kaynaklanmaktadır. Önceleri anormal bir özellik olduğu düşünülen poliembriyoninin bahçe bitkilerinde arzu edilen bir karakter olduğu kabul edilmektedir (Kishore, 2015). Poliembriyoni ile ilgili ilk bulgular 1719 yılında Antoni Van Leeuwenhoek tarafından bir portakal tohumundan birden fazla fide oluşması sonucu ortaya atılmıştır (Bouman ve Boesewinkel, 1969). Poliembriyoninin sadece birkaç türde olduğu bilinirken, günümüzde 59 angiosperm familyasına ait 144 cinsin yaklaşık 244 türünün poliembriyoni sergilediği bilinmektedir (Kishore, 2015).

Asma (*Vitis vinifera* L.)'da ise poliembriyoni (PE) üzerine bilinen ilk çalışma Negrul (1934) tarafından yapılmıştır. Negrul (1934), bir Rus çeşidi olan Nimrang'da ikiz bitki oluşumu gözlemlemiş ve asmada poliembriyonik tohumlara rastlanabileceğini belirtmiştir (Bouquet, 1980). Fransa'da 1975 yılından itibaren Bordo'daki bağlarda yetiştirilen *Vitis vinifera* çeşitlerinde sistematik bir PE tohum ve haploid bitki taraması başlatılmıştır (Bouquet, 1978).

Ülkemizde ise asmada poliembriyoni üzerine yapılan çalışmalar yok denecek kadar azdır. Poliembriyoni genetik kontrol altında şekillenmekte olup bir çeşit karakteristiğidir. Ülkemiz asmanın anavatanı ve bağcılık kültürünün merkezi olduğu için çok zengin bir asma gen kaynağına sahiptir. Bunlardan biri olan Van ilinin otokton üzüm çeşidi Erciş üzüm çeşidinin poliembriyonik bir çeşit olup olmadığı bilinmemektedir. Bu çalışmanın amacı Erciş üzüm çeşidinin genetik olarak poliembriyoniye yatkın olup olmadığını belirlemektir.

## Materyal ve Yöntem

Çalışma, 2023-2024 yılları arasında Van Yüzüncü Yıl Üniversitesi, Ziraat Fakültesi, Bahçe Bitkileri Bölümü'nde yürütülmüştür. Araştırma materyali olarak Erciş üzüm çeşidi kullanılmıştır (Şekil 1). Araştırma materyalini oluşturan Erciş üzüm çeşidine ait üzümler 2023 bağbozumu yılında Van ili Erciş ilçesinin Bayramlı köyünden temin edilmiştir.



Şekil 1. Erciş üzümü

### **Tohumların çıkarılması ve muhafazası**

Tohumlar tane etlerinden ayrılarak (960 adet) çıkarılmıştır. Daha sonra su ile yıkanarak meyve eti ve tane kabuğundan temizlenmiş ve mantari hastalıklara karşı fungusitle dezenfekte edilmiştir. Tohumlar iyice kurutulmuş, gerekli ölçüm ve tartım işlemleri yapılmıştır. Doğrudan güneş almayan, gölge bir yerde, kurutma kâğıtlarının üzerinde kurutulan tohumlar katlama öncesine kadar oda sıcaklığında muhafaza edilmiştir.

### **Katlama**

Tohumların bünyelerinde yer alan çimlenmeyi engelleyici maddelerin parçalanması, fizyolojik gelişmelerin tamamlanması ve soğuklama isteklerinin karşılanarak kısa sürede dinlenmeden çıkmalarına yardımcı olmak amacıyla buzdolabında +4 °C' de yaklaşık 3 ay (Akkurt vd. 2013) katlama işlemi gerçekleştirilmiştir. Katlama süresini tamamlayan tohumlar, yıkanarak mantari enfeksiyonlara karşı fungusitle yeniden dezenfekte edilmiştir. Bu tohumlar daha sonra suda yüzdürme testine alınmıştır. Yüzdürme testinde; çöken tohumlar (embriyo gelişimi tamamlanmış) ve yüzen tohumlar (embriyo gelişimi tamamlanmamış ya da eksik) ayrılmış ve kayıt altına alınmıştır.

### **Tohumların ekilmesi ve çimlendirilmesi**

MS (Murashige ve Skoog 1962) hazır temel besi ortamından litreye 4.4 g tartılarak 30 g sükröz ve pH 5.7-5.8'e ayarlandıktan sonra 8 g agar eklenmiş ve 20 dk otoklavda sterilizasyon işlemi gerçekleştirilmiştir. Besi ortamına enfeksiyon riskine karşılık antibiyotik ilave edilerek petri kaplarına dökülmüş ve soğumaya bırakılmıştır. Canlı tohumlar fungusit ve sodyum hipoklorit ile dezenfekte edildikten sonra petri kaplarına ekilmiştir.

Deneme tesadüf parselleri deneme desenine göre 5 tekerrürlü, her tekerrürde 35 adet petri kabı ve her petri kabında 5 ya da 6 adet tohum olacak şekilde yürütülmüştür. Belirli aralıklarla yapılan gözlemlerde çimlenme oranı ve poliembriyoni oranının saptanması amacıyla sayımlar yapılmış elde edilen sayım sonuçlarında çimlenme ve poliembriyoni oranları aşağıdaki gibi belirlenmiştir (Bilir, 2002):

Çimlenme oranı (%);

Çimlenme oranı (%) = [Çimlenen tohum sayısı / Çimlenmeye alınan tohum sayısı] x 100

Çimlenmeye alınmış toplam tohum sayısına göre değerlendirilen PE oranı (%);

PEO1 (%) = [Poliembriyonik tohum sayısı / Çimlenmeye alınan tohum sayısı] x 100

Çimlenen tohum sayısına göre PE oranı (%);

PEO2 (%) = [Poliembriyonik tohum sayısı / Çimlenen tohum sayısı] x 100

### **Kromozom sayımı**

Kromozom sayımları Najafi (2009)'a göre gerçekleştirilmiştir.

**Örnek alma:** MS besin ortamlarında gelişen genç kök uçları (1.5-2 cm) materyal olarak kullanılmıştır.

**Ön İşlem:** %1'lik  $\alpha$ -bromonaftalin içerisinde 4 °C (buzdolabı) da 3 saat bekletilmiştir.

**Tespit:** Kökler Karnoy 1 (3:1 Etanol: Glasial Asetik Asit) çözeltisinde 24 saat oda sıcaklığında bekletilmiştir.

**Hidroliz:** Kökler 60 °C, 1N HCl içerisinde 20 dakika hidroliz edilmiştir.

**Boyama:** Kök uçları %2'lik Aceto-Orsein ile boyanmıştır (boyanmış kökler, 4 °C da bekletilmiştir).

**Ezme:** Boyamadan en az 10 gün sonra kök uçlarının 1-2 mm'lik büyüme meristemlerinin koyu pembe rengine boyandığı görüldükten sonra bu kısımlar jilet ile kesilerek lam üzerine alınmış ve çok küçük parçalara bölünmüştür. Bu parçacıklar üzerine lamel kapatılarak daha sonra bir kurşun kalemin arkası ile lamele hafif hafif vurulmuştur. Kurutma kâğıdı arasına alınan preparata bir elin başparmağı ile kuvvetle bastırılarak, bu şekilde hazırlanan preparatlar mikroskopta incelenmeye alınmıştır.

**Mikroskopla gözlem:** Hazırlanmış preparatlar, 4, 10, 40 ve 100 numaralı merceklerle gözlemlenip, fotoğrafları mikroskop fotoğraf makinesi ile hazırlanmıştır.

## Bulgular ve Tartışma

Canlılık testi olarak kullanılan yüzdürme yöntemi sonrasında, 960 tohumdan 890 adedi suyun dibine çökmüş, 70 adedi ise suyun yüzeyine çıkmıştır. Sayım sonuçlarına göre çimlenme ve poliembriyoni oranları Çizelge 1’de verilmiştir.

**Çizelge 1.** Tohumlarda çimlenme ve poliembriyoni sonuçları

Ekilen Tohum Sayısı (Adet)	Çimlenen Tohum Sayısı (Adet)	Çimlenme Oranı (%)	Poliembriyonik Tohum Sayısı (Adet)	PEO1 (%)	PEO2 (%)
890	372	41.79	1	0.11	0.27

Çizelge 1’de görüldüğü üzere, doku kültürü tekniklerinden yararlanılarak ekilen 890 adet tohumdan 372’si çimlenmiş olup, çimlenme oranı %41.79 olarak belirlenmiştir. Çalışmada 1 adet poliembriyoni oluşumu gözlenmiş (Şekil 2), buna göre Erciş üzüm çeşidinin çimlenmeye alınmış toplam tohum sayısına göre değerlendirilen PE oranını (PEO1) %0.11, çimlenen tohum sayısına göre PE oranı (PEO2) ise %0.27 olarak hesaplanmıştır.

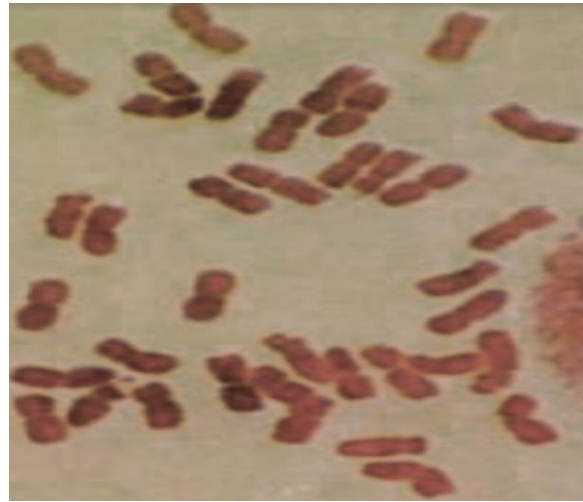


**Şekil 2.** Erciş üzüm çeşidinde poliembriyoni

Bouquet (1980)’den alıntılandığına göre Thevenot (1972), Fransa’da Alsace bölgesindeki bağlarda yetiştirilen Muscat Ottonel, Auxerrois, Pinot noir, Risling, Gewurtztraminer, Chasselas, Silvaner, Pinot gris ve Müller-Thurgau çeşitlerine ait yaklaşık 720.000 tohumda çeşitlere bağlı olarak %0 ile %0.13 oranları arasında PE tespit etmiştir. Muscat Ottonel çeşidine ait tohumlarda poliembriyonik yapıya rastlanmazken, Pinot noir’da %0.13, Pinot gris’de %0.10 oranında PE görülmüştür. Tüm çeşitlerde hesaplanan PE ortalama olarak %0.05 olarak kaydedilmiştir. Ancak hiçbirinde haploid yapıya rastlanmamıştır. Araştırmacı yaptığı bu çalışmada özellikle Rising ve Auxerrois çeşitlerinde birbirinden oldukça farklı poliembriyonik yapılar gözlemlemiş ve ekolojik ve çevresel etmenlerin PE üzerine yüksek oranda etkisi olabileceğini saptamıştır. Bouquet (1980) tarafından 35 çeşit üzerinde yapılan çalışmalarda doğal PE frekansı %0 ile %0.35 arasında değişkenlik göstermekle birlikte, Vitis vinifera’da doğal PE ortalama %0.054 olarak tespit edilmiştir. En yüksek PE oranı %0.348 ile Merlot, %0.235 ile Grenache noir %0.117 ile Pinot noir çeşitlerinde gözlenirken Chenin, Silvaner ve

Traminer gibi bazı çeşitlerde ise poliembriyoniye rastlanmamıştır. Buradan hareketle asmalarda poliembriyonin genetik kontrol altında ve bir çeşit karakteristiği olduğu ifade edilmektedir. Bilir (2002), Kalecik karası, Hasandede, Narince ve Pinot noir çeşitlerinin çimlenmiş tohumlarında %0.044 ile % 0.082 arasında doğal poliembriyoni frekansı tespit etmiştir. En yüksek poliembriyoni oranı Emir çeşidinde %0.082 olarak gözlenirken, Hasandede'de % 0.044, Kalecik karası ve Pinot noir'de %0.049, Narince'de % 0.059 olarak görülmüştür. Çeşitlerin tamamında görülen poliembriyoni frekansı % 0.057 olarak belirlenmiştir. Ergönül vd. (2024), üç farklı tohum yapısına sahip (çekirdeksiz, boş çekirdekli ve stenospermokarpik çekirdeksiz) üzüm çeşitlerinin embriyo kültüründe poliembriyoni oluşum frekanslarını incelemiş, buna göre, stenospermokarpik çekirdeksiz üzüm çeşitleri kullanıldığında, diğerlerine göre poliembriyoni oluşturma eğiliminin daha yüksek olduğunu tespit etmişlerdir. Stenospermokarpik çekirdeksiz bir üzüm çeşidi olan 'Tekirdağ Misketi' yetiştirme kombinasyonunda ana ebeveyn olarak kullanıldığında %7.5 oranında poliembriyoni oluşturmuştur. Diğer yandan, boş tohum olarak bilinen 'Bozcaada Çavuşu' çeşidinin ıslah kombinasyonunda ana ebeveyn olarak kullanılması durumunda, en düşük poliembriyoni oranı (%1.74-2.06 arasında) tespit edilmiştir. Bulgular, Thevenot (1972), Bouquet (1980) ve Bilir (2002) tarafından yapılan çalışmalar sonucunda elde edilen bulgularla desteklenmektedir.

Yapılan kromozom çalışması sonucunda köklerde  $2n=38$  kromozom belirlenmiş ve bitkiciklerin diploid olduğu gözlenmiştir.



Şekil 3.  $2n=38$  kromozom

### Sonuç ve Öneriler

Bu çalışma ile Erciş üzüm çeşidinin genetik olarak poliembriyoniye yatkın olduğu belirlenmiştir. Ancak bitkiciklerde haploidi durumu belirlemek amacıyla yapılan kromozom sayımı sonrasında bitkiciklerin diploid olduğu görülmüştür. Çalışma, bir ön çalışma niteliğinde olup, gelecek çalışmalarda daha fazla tohum ile çalışılması ve çimlenmeyi uyarıcı uygulamaların kullanılması önerilmektedir.

### Teşekkür

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# GENEL ÖZELLİKLERİ İLE İSTATİSTİKTE ENSTRÜMENTAL DEĞİŞKENLER

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## Özet

Bilimsel çalışmalarda, değişkenler arasındaki ilişki incelenmek istendiğinde, bu ilişkiyi belirlemek üzere modeller oluşturulabilir. Başta istatistik ve ekonometri olmak üzere, sağlık bilimleri, epidemiyoloji ve diğer birçok disiplinlerde, nedensel (sebeup-sonuç) ilişkilere dayalı modeller oluşturulmakta ve bunların analizlerinin yapılması istenmektedir. Nedensel ilişkileri analiz etmede, standart (çoklu) regresyon analizi yaygın kullanılan analiz yöntemlerinden birisidir. Ancak bu analiz yönteminin uygulanabilmesi için bazı varsayımlar veya ön şartlar gereklidir. Bu varsayımlardan birisi de bağımsız değişkenlerin hatasız ölçülmüş olduğu varsayımdır. Enstrümental değişken (Instrumental variables, IV) yöntemleri veya Enstrümental değişken (IV) analizi, temel varsayımların karşılanmış olması koşuluyla, ölçülemeyen (unmeasured) veya karıştırıcı (confounding) etkileri ele almak için yaygın olarak kullanılmaktadır. Bu çalışmada, istatistik analizlerdeki enstrümental değişkenler genel özellikleriyle açıklanarak, konunun anlaşılmasına katkı sağlamak amacıyla bir uygulama yapılmıştır. Uygulamada materyal olarak hipotetik veri seti kullanılmıştır. Hipotetik veri seti 4 değişkenden oluşmuştur. Bebeklerde doğum ağırlığı bağımlı değişken olarak alınmış, anne yaşı ise bağımsız değişken olarak alınmıştır. Hamilelikte günlük sigara kullanımı (X, adet) ile bebek doğum ağırlığı arasındaki ilişki için sigara fiyatı (TL/adet) enstrümental değişken olarak alınmıştır. Çalışma sonucunda enstrümental değişken analizinin, varsayımlarının sağlanması durumunda, güçlü analiz yöntemlerinden birisi olduğu, ancak varsayımlara karşı duyarlı olduğu vurgulanmıştır. Ayrıca enstrümental değişken analizinin etkinliğinin, enstrümental değişkenler ile endojen değişkenler arasındaki ilişkinin derecesi ile yakından ilişkili olduğu ve bu değişkenler arasında zayıf ilişki olması durumunda, tahminlerin standart hatasının büyüyeceği ve bunun sonucunda da güven aralığının genişleyebileceğine dikkat çekilmiştir.

**Anahtar Kelimeler:** Hausman testi, karıştırıcı etki, eksojen değişken, endojen değişken, nedensellik

## **INSTRUMENTAL VARIABLES IN STATISTICS WITH GENERAL CHARACTERISTICS**

### **Abstract**

In scientific studies, when the relationship between variables is to be examined, models can be formed to determine this relationship. In many disciplines, especially statistics and econometrics, health sciences, epidemiology and others, models based on causal (cause-effect) relationships are formed and their analysis is requested. In analyzing causal relationships, standard (multiple) regression analysis is one of the widely used analysis methods. However, some assumptions are required for the application of this analysis method. One of these assumptions is to measure independent variables without error. Instrumental variables (IV) methods or Instrumental variable (IV) analysis are widely used to address unmeasured or confounding effects, provided that the basic assumptions are met. In this study, an application was performed to contribute to the understanding of the subject by explaining the general characteristics of instrumental variables in statistical analyses. A hypothetical data set was used as material in the application. The hypothetical data set consisted of 4 variables. Birth weight and mother's age were considered dependent and independent variables, respectively. Cigarette price (TL/piece) was taken as the instrumental variable for the relationship between daily cigarette consumption (X, pieces) during pregnancy and baby birth weight. As a result of the study, it was emphasized that instrumental variables analysis is one of the powerful analysis methods if its assumptions are met, however it is sensitive to assumptions. It was also noted that the effectiveness of instrumental variables analysis is closely related to the degree of relationship between instrumental variables and endogenous variables and that in case of a weak relationship between these variables, the standard error of the estimates will increase and as a result, the confidence interval may widen.

**Keywords:** Hausman test, confounding effect, exogenous variable, endogenous variable, causality



## Giriş

Bilimsel çalışmalarda, birçok değişken arasındaki ilişki incelenmek istendiğinde, bu ilişkiyi belirlemek üzere modeller oluşturulabilir. Başta istatistik ve ekonometri olmak üzere, sağlık bilimleri, epidemiyoloji ve diğer birçok disiplinlerde, nedensel (sebeup-sonuç) ilişkilere dayalı modeller oluşturulmakta ve bunların analizlerinin yapılması istenmektedir. Nedensel ilişkileri analiz etmede, standart (çoklu) regresyon analizi yaygın kullanılan analiz yöntemlerinden birisidir. Ancak bu analiz yönteminin uygulanabilmesi için bazı varsayımların veya ön şartların sağlanması gerekmektedir. Bu varsayımlardan birisi de bağımsız değişkenlerin hatasız ölçülmüş olduğu varsayımdır. Enstrümantal değişken (Instrumental Variable, IV) yöntemleri veya Enstrümantal değişken (IV) analizi, temel varsayımların karşılanmış olması koşuluyla, ölçülemeyen (unmeasured) veya karıştırıcı (confounding) etkileri ele almak için yaygın olarak kullanılmaktadır (Ertefaie ve ark., 2017). Daha genel bir ifade ile Enstrümantal değişkenler (IV), regresyon modeline dahil edilen açıklayıcı değişken veya değişkenlerin (endojen) hata terimiyle ilişkili olduğu durumlarda kullanılmaktadır. Zira bu durumda, En Küçük Kareler (EKK) yönteminin kullanılması ile yanlı ve tutarsız sonuçlar elde edilebilmektedir.

Bu çalışmada, istatistik analizlerdeki Enstrümantal değişkenler genel özellikleriyle açıklanarak, konunun anlaşılmasına katkı sağlamak amacıyla bir uygulama yapılmıştır.

## Materyal ve Yöntem

Çalışmada uygulama materyali olarak hipotetik veri seti kullanılmıştır. Hipotetik veri seti 4 değişkenden oluşmuştur. Bebeklerde doğum ağırlığı (Y, g) bağımlı değişken olarak alınmış, Anne yaşı ise bağımsız değişken olarak alınmıştır. Hamilelikte günlük sigara kullanımı (X, adet) ile Bebek doğum ağırlığı arasındaki ilişki için Sigara fiyatı (TL/adet) enstrümantal değişken olarak alınmıştır. Bu değişkenler için (n=80) tanımlayıcı istatistikler Çizelge 1’de verilmiştir.

**Çizelge 1.** Özelliklere ait tanımlayıcı istatistikler

	Ort.	St. Sapma	Min.	Mak.
Bebek doğum ağırlığı (kg)	3,065	0,758	1,238	4,616
Sigara kullanımı (Adet/Gün)	8,910	4,855	2	20
Birim fiyat (TL/Adet)	3,230	1,328	1,064	6,656
Anne yaşı (Yıl)	29,05	4,146	23	37

Enstrümantal değişkenler (IV), modele dahil edilen bağımsız veya açıklayıcı değişkenlerin hata terimiyle ilişkili olduğu durumlarda kullanılmaktadır.

**Endojen (içsel) Değişken (Endogenous Variable):** Araştırmacının kurmuş veya varsaymış olduğu modelde, bağımlı olan veya açıklanmaya çalışılan değişkeni ifade eder. Bu değişkenin değerleri, modeldeki diğer değişkenlere göre değişir veya değerleri diğer değişkenler tarafından belirlenebilir.

**Eksojen (dışsal) değişken (Exogenous Variable):** Araştırmacının kurmuş veya varsaymış olduğu modelde, dışsal olarak belirlenen değişkeni ifade eder. Bu değişkenin değerleri, modelin veya analizin dışında verilir. Diğer bir ifade ile değeri modeldeki diğer değişkenlere göre değişmeyen veya değerleri model tarafından belirlenemeyen değişkeni ifade eder.

Notasyonlar:

Y: Bağımlı değişken veya cevap değişkeni,

X: Endojen veya içsel değişken

Z: X ile doğrusal ilişkili olan Eksojen veya dışsal değişken

$\alpha$  ve  $\gamma$ : Regresyon sabitleri

$\beta$  ve  $\delta$ : Regresyon katsayıları

$\varepsilon$  ve  $\eta$ : Hata terimleri



Basitlik ve açıklama kolaylığı için yalnızca bir enstrümantal değişkenin alındığı varsayalım. Bu durumda, enstrümantal tahmin (IV estimation) için basit doğrusal regresyon modelleri aşağıdaki iki eşitlikten oluşur.

$$Y = \alpha + \beta X + \varepsilon \quad (1)$$

$$X = \gamma + \delta Z + \eta \quad (2)$$

Bu durumda X'in Y üzerine etkisi için asimptotik olarak yansız tahmini;

$$\hat{\beta}_{IV} = \frac{\frac{1}{n-1} \sum_{i=1}^n (Z_i - \bar{Z})(Y_i - \bar{Y})}{\frac{1}{n-1} \sum_{i=1}^n (Z_i - \bar{Z})(X_i - \bar{X})} = \frac{\hat{\sigma}_{Z,Y}}{\hat{\sigma}_{Z,X}} \quad (3)$$

olarak yazılır. Eşitlikte  $\hat{\sigma}_{Z,Y}$ , Z ve Y değişkenleri arasındaki,  $\hat{\sigma}_{Z,X}$  ise Z ve X değişkenleri arasındaki kovaryansın örnekten tahminidir. Eşitliğin payındaki terim, enstrümantal değişkenin cevap değişkeni (bağımlı değişken) üzerine etkisini belirtirken, paydasındaki terim ise X değişkeni verildiğinde enstrümantal değişkenin etkisini ifade etmektedir (Angrist ve ark., 1996; Martens ve ark., 2016)

Enstrümantal değişken tahminleri genel formuyla;

$$\mathbf{b}_{IV} = (\mathbf{Z}'\mathbf{X})^{-1}\mathbf{Z}'\mathbf{y}$$

$$\text{Var}(\mathbf{b}_{IV}) = \sigma^2(\mathbf{Z}'\mathbf{X})^{-1}\mathbf{Z}'\mathbf{Z}(\mathbf{X}'\mathbf{Z})^{-1}$$

$$\hat{\mathbf{X}} = \mathbf{Z}[(\mathbf{Z}'\mathbf{Z})^{-1}\mathbf{Z}'\mathbf{X}] \text{ ve}$$

Buradan Z matrisi,  $\hat{\mathbf{X}}$  matrisi ile yer değiştirdiğinde;

$$\mathbf{b}_{IV} = (\hat{\mathbf{X}}'\mathbf{X})^{-1}\hat{\mathbf{X}}'\mathbf{y}$$

$$= [\mathbf{X}'\mathbf{Z}(\mathbf{Z}'\mathbf{Z})^{-1}\mathbf{Z}'\mathbf{X}]^{-1}\mathbf{X}'\mathbf{Z}(\mathbf{Z}'\mathbf{Z})^{-1}\mathbf{Z}'\mathbf{y}$$

$$= [\mathbf{X}'(\mathbf{I} - \mathbf{M}_2)\mathbf{X}]^{-1}\mathbf{X}'(\mathbf{I} - \mathbf{M}_2)\mathbf{y}$$

$$= (\hat{\mathbf{X}}'\hat{\mathbf{X}})^{-1}\hat{\mathbf{X}}'\mathbf{y}$$

olarak yazılır. Bu tahmin iki adımlı süreci içerir. Birinci adımda endojen değişkenler bağımlı değişken olarak varsayılarak, eksojen değişkenlerle regresyon eşitliği hesaplanır. İkinci adımda ise birinci adımdaki tahmin edilen değerler kullanılarak regresyon eşitliği hesaplanır. Bu enstrümantal değişken süreci ise İki aşamalı en küçük kareler (2SLS veya TSLS) olarak bilinir (Becker, 2010).

Enstrümantal değişkenin tahmin amaçlı kullanılabilmesi için üç varsayımın ya da ön şartın sağlanması gerekmektedir. Bunlardan birincisi enstrümantal değişken ile endojen ya da içsel değişken arasında yüksek korelasyon bulunmalıdır. Aksi takdirde (3) no'lu eşitlikte paydaki terim kullanışsız olacak ve sonuç tanımsız olacaktır. İkinci varsayım ise enstrümantal değişken ile içsel değişken, başka değişkenler tarafından etkilenmemelidir. Diğer bir ifadeyle enstrümantal değişken ile  $\eta$  arasındaki korelasyon sıfır olmalıdır.

Enstrümantal değişken için üçüncü varsayım en önemlisidir. Bu varsayım, enstrümantal değişken ile hata  $\varepsilon$  arasında bir korelasyon olmaması gerektiğini belirtir. (Bu varsayım bundan sonra ana varsayım olarak anılacaktır). Bu, enstrümantal değişkenin diğer değişkenlerle ilişkisi yoluyla sonucu doğrudan ve dolaylı olarak etkilememesi gerektiği anlamına gelir. Bu varsayımın geçerli olup olmadığı, yalnızca teorik olarak tartışılabilir, deneysel olarak test edilemez.

Bu üç varsayım aşağıdaki gibi özetlenebilir:

1)  $\rho_{Z,X} \neq 0$ , Enstrümantal değişken (IV) ile endojen değişken arasındaki korelasyon sıfırdır (yoktur).

2)  $\rho_{Z,\eta} = 0$ , Enstrümantal değişken (IV) ile X'i açıklayan diğer faktörler (hata) arasında korelasyon yoktur.

3)  $\rho_{Z,\varepsilon} = 0$ , Enstrümantal değişken (IV) ile Y'yi açıklayan diğer faktörler (hata) arasında korelasyon yoktur. (Temel varsayım).

Çalışmada uygulama için Stata (ver: 14) istatistik paket programı kullanılmıştır.

## Bulgular ve Tartışma

**Çizelge 2.** Özellikler arası korelasyon katsayıları

	Bebek doğum ağırlığı	Sigara kullanımı	Birim fiyat	Anne yaşı
Bebek doğum ağırlığı	1	-0,779**		
Sigara kullanımı	-0,779**	1		
Birim fiyat	0,399**	-0,522**	1	
Anne yaşı	-0,893**	0,708**	-0,388**	1

\*\* :  $p < 0.01$

**Çizelge 3.** Regresyon analizi özet sonuçları

		Değişkenler (n=80)	Katsayı	St. Hata	p	% 95 Güven aralığı [Alt Sınır – Üst Sınır]		
Enstrümantal Regresyon	Sigara (Adet / Gün)	-0.333	0,0261	0,203	-0,0847	0,0180	Wald Ki-kare = 396 p = 0,001 R <sup>2</sup> = % 83.81 RMSE = 0,303	
	Anne Yaşı (Yıl)	-0,136	0,0232	0,001	-0,181	-0,090		
	Regresyon sabiti	7,307	0,465	0,001	6,395	8,217		
Standart Regresyon	Sigara (Adet/Gün)	-0,048	0,011	0,001	-0,07	-0,027	F = 136,06 p = 0.001 R <sup>2</sup> = % 84.2 RMSE = 0,307	
	Anne Yaşı (Yıl)	-0,125	0,012	0,001	-0,149	-0,102		
	Birim Fiyat	-0,016	0,031	0,605	-0,07	0,045		
	Regresyon sabiti	7,189	0,323	0,001	6,545	7,853		

Bağımlı değişken: Bebek doğum ağırlığı (Kg), Açıklayıcı (Eksojen) değişken: Anne yaşı (Yıl)  
Endojen değişken: Sigara tüketimi (Adet/Gün), Enstrümantal değişken: Birim fiyat (TL/Adet)  
RMSE: Hata kareler ortalamasının karekökü  
Durbin (score) Ki-kare = 13.32 (p = 0.0003)  
Wu-Hausman F(1,78) = 15.58 (p = 0.0002)

Modele Sigara kullanımı (Adet/Gün) endojen değişken olarak alınmıştır. Bu değişken için endojenlik testi yapıldığında ( $H_0$ : Değişken(ler) eksojendir);  $H_0$  test hipotezinin ret edildiği görülmüştür. Buna göre, Sigara kullanımı (Adet/Gün) değişkeninin eksojen değişken olmadığı ve modelde endojen değişken olarak alınmasının doğru karar olduğu söylenebilir. Modele enstrümantal değişken olarak alınan Sigara birim fiyatının, Sigara kullanımı (Adet /Gün) için zayıf bir enstrümantal değişken olup olmadığını test etmek üzere ( $H_0$ : Enstrümantal değişken zayıftır) yapılan Birinci aşama regresyon analizi sonucunda (Çizelge 3)  $H_0$  test hipotezinin ret edildiği görülmüştür. Buna göre, Sigara birim fiyatının, Sigara kullanımı (Adet /Gün) değişkeni için zayıf bir enstrümantal değişken olmadığı ve modelde enstrümantal değişken olarak alınmasının doğru karar olduğu söylenebilir.

**Çizelge 4.** Birinci aşama regresyon analizi özet tablosu

Değişken	R <sup>2</sup>	R <sup>2</sup> Düz	R <sup>2</sup> Kısmi	F(1,77)	p
Sigara (Adet/Gün)	0,5727	0,5616	0,1440	12,9572	0,0006

Minimum özdeğer istatistiği = 12,9572

Standart regresyon analizinin uygulanabilmesi için bazı varsayımlar veya ön şartlar gereklidir. Bu varsayımlardan birisi de bağımsız değişkenlerin hatasız ölçülmüş olduğu varsayımdır. Enstrümantal değişkenler, temel varsayımların sağlanması koşuluyla, ölçülememiş veya karıştırıcı değişkenlerin bulunduğu durumda kullanılabilir. Ertefaie ve ark. (2017), ölçülemeyen ve/veya karıştırıcı değişkenlerin varlığı durumunda, modele uygun enstrümantal değişkenlerin alınması ile yapılan analiz sonucunda, yansız tahminlerin elde edilebileceğini, ancak standart hataların ise bir miktar yüksek olma eğilimi gösterebileceğini belirtmişlerdir.

Enstrümantal değişkenlerle yapılan analizin en önemli avantajı, ölçülemeyen ve/veya karıştırıcı değişkenlerin olduğu veya bağımsız değişkenlerin hatasız ölçülemediği durumlarda kullanılabilmesidir. Ancak, bu avantajına rağmen, modele dahil edilen enstrümantal değişkenlerin, endojen değişkenle zayıf ilişkili olması durumunda, standart hatalar büyümekte ve bunun sonucunda da daha geniş güven aralıkları elde edilebilmektedir (Ertefaie ve ark., 2017).

Becker, (2016), uygun enstrümantal değişkenlerin; nedensellik ilişkisini belirlemede yardımcı olacağını, modelden çıkarılan değişkenlerden kaynaklanan yanlılığı belirleyebileceği ve ölçüm hatası içeren değişkenler olması durumunda kullanılabileceğini vurgularken, uygun enstrümantal değişkenleri bulmanın zor olduğunu, tahmin edilen etkinin popülasyona genellenemeyeceğini, tahmin edilen etkilerin farklı enstrümantal değişkenler kullanıldığında değişeceğini ve küçük örneklerde ve zayıf ilişkilerde enstrümantal değişken tahminlerinin yanlı olabileceğini vurgulamıştır. Bollmann ve ark. (2019) ise Regresyon modellerinde endojen (içsel) değişken olduğu durumda veya açıklayıcı değişkenler ile hata teriminin korelasyonlu olduğu durumlarda, İki aşamalı en küçük kareler regresyonu (2SLS veya TSLS) gibi enstrümantal değişkenlerle yapılan tahminlerin daha yansız ve daha tutarlı olabileceğini belirtmişlerdir.

### **Sonuç ve Öneriler**

Enstrümantal değişken analizinin, varsayımların sağlanması durumunda, güçlü analiz yöntemlerinden birisi olduğu söylenebilir. Ancak varsayımlara karşı duyarlıdır. Enstrümantal değişken analizinin etkinliği, enstrümantal değişken ile endojen değişken arasındaki ilişkinin derecesi ile yakından ilişkilidir. Bu değişkenler arasında zayıf ilişki olması durumunda, tahminlerin standart hatası büyümekte ve bunun sonucunda da daha geniş güven aralıkları elde edilmektedir.

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## İSTATİSTİKTE MODERATÖR VE MEDIATÖR DEĞİŞKENLER

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### Özet

Bu çalışmada, moderatör ve mediatör değişken kavramlarının genel özelliklerine değinilmesi ve bu değişkenlerin birbirleriyle benzerlik ve farklılıklarının açıklanması amaçlanmıştır. Bilimsel çalışmalarda, değişkenler arasındaki ilişkilerin modellenmesinde, bağımlı ve bağımsız değişken kavramları sıklıkla kullanılan iki kavramdır. Genel bir ifade ile herhangi bir çalışmada, araştıracının cevap veya yanıt almak istediği veya tahmin etmek istediği değişken, Bağımlı değişken olarak adlandırılırken, bu değişkene etkili olabileceği varsayılan değişken ise Bağımsız değişken olarak adlandırılır. Benzer şekilde, özellikle sebep-sonuç ilişkisine dayalı modellerde, araştıracının varsaymış veya tasarlamış olduğu ilişki yapısına göre de moderatör (düzenleyici) ve mediatör (aracı) değişken kavramları bulunmaktadır. Bu iki değişkenin her ikisi de sembolik olarak 'M' harfi ile gösterilmekte ve yorumlamaları da birbirine benzerlik göstermektedir. Bu nedenle araştırmacılar veya yazarlar da çoğunlukla bu kavramlar arası farkı belirlemede güçlük yaşamaktadır. Moderatör değişken, iki değişken arasındaki ilişkiyi yönlendiren veya etkileyen, diğer bir ifade ile ilişkinin gücünü ve/veya yönünü değiştiren değişkendir. Mediatör veya aracı değişken ise bağımsız değişken ile bağımlı değişkenler arasındaki ilişkiyi doğrulamak veya kolaylaştırmak üzere modele eklenen üçüncü değişkeni ifade eder. Mediatör değişken, bağımlı ve bağımsız değişkenler arasında, nasıl bir aracılık (kısmı veya tam aracılık) bağlantısı olduğunu ve ne tür bir ilişki olduğunu gösterir. Mediatör değişken, nedensellik diyagramında, modeldeki bağımsız değişkenden etkilenir ve kendisi de bağımlı değişkeni etkiler.

**Anahtar Kelimeler:** Düzenleyici değişken, aracı değişken, nedensellik, kısmi aracılık, tam aracılık

## MODERATOR AND MEDIATOR VARIABLES IN STATISTICS

### **Abstract**

This study aims to address the general characteristics of the concepts of moderator and mediator variables and to explain the similarities and differences between these variables. In scientific studies, the concepts of dependent and independent variables are two concepts frequently used in modeling the relationships between variables. In general terms, in any study, the variable that the researcher wants to get a response or wants to predict is called the dependent variable, while the variable that is assumed to be effective on this variable is called the independent variable. Similarly, especially in models based on cause-effect relationships, there are the concepts of moderator and mediator variables according to the relationship structure that the researcher has assumed or designed. Both of these two variables are symbolically represented by the letter 'M' and their interpretations are similar to each other. For this reason, researchers or writers often have difficulty in determining the difference between these concepts. The moderator variable is the variable that directs or affects the relationship between two variables, in other words, changes the strength and/or direction of the relationship. The mediator variable refers to the third variable added to the model to verify or facilitate the relationship between the independent variable and the dependent variables. The mediator variable shows what kind of mediation (partial or full mediation) there is between the dependent and independent variables and what kind of relationship it is. The mediator variable is affected by the independent variable in the model in the causality diagram and itself affects the dependent variable.

**Keywords:** Moderator variable, mediator variable, causality, partial mediation, full mediation

## Giriş

Bilimsel çalışmalarda, değişkenler arası ilişkinin modellenmesinde, bağımlı ve bağımsız değişken kavramları sıklıkla kullanılan iki kavramdır. En genel anlamıyla, herhangi bir çalışmada, araştırmacının cevap veya yanıt almak istediği veya tahmin etmek istediği değişken, bağımlı değişken olarak adlandırılırken, bu değişkene etkili olabileceği varsayılan değişken ise bağımsız değişken olarak adlandırılır. Diğer bir ifade ile herhangi bir bağımsız değişken tarafından etkilenen değişken bağımlı değişken, bağımlı değişkenin pozisyonunu, durumunu, statüsünü veya aldığı değeri değiştiren değişken ise bağımsız değişken olarak ifade edilir. Böylece araştırmacılar, bağımsız değişkendeki değişime bağlı olarak, bağımlı değişkende ne kadarlık bir değişim olacağını ve bu değişimin istatistik olarak önemli olup olmadığını test etmek isterler.

Benzer şekilde bilimsel çalışmalarda, özellikle sebep-sonuç ilişkisine dayalı modellerde, araştırmacının varsaymış veya tasarlamış olduğu ilişki yapısına göre de moderatör (düzenleyici) ve mediatör (aracı) değişken kavramları bulunmaktadır. Bu iki değişkenin her ikisi de sembolik olarak 'M' harfi ile gösterilmekte ve yorumlamaları da birbirine benzerlik göstermektedir. Bu nedenle araştırmacılar veya yazarlar da çoğunlukla bu kavramlar arası farkı belirlemede güçlük yaşamaktadır.

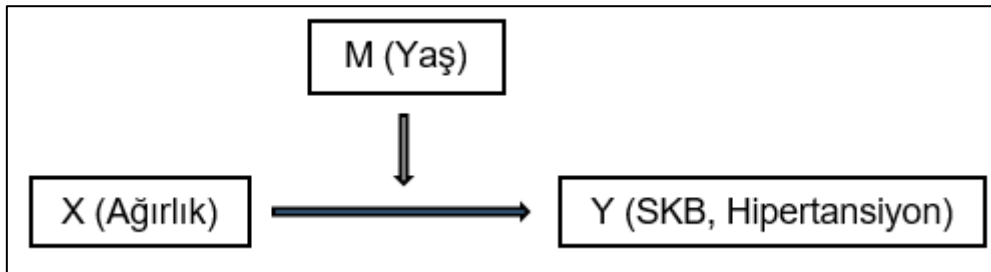
Bu bağlamda, ele alınan bu çalışmada, moderatör ve mediatör değişken kavramlarının genel özelliklerine değinilmesi ve bu değişkenlerin birbirleriyle benzerlik ve farklılıklarının açıklanması amaçlanmıştır.

## Materyal ve Yöntem

En genel ve basit anlamıyla, moderatör değişkenler, bağımsız değişken sıfatıyla, etkilerinin diğer bağımsız değişkenlere eklenmesi ile bağımlı değişkeni etkileyen değişkenler olarak ifade edilebilir. Genel olarak, "ne zaman?" ve "hangi değişken için?" sorularına cevap almak üzere bu değişkenlerin etkisi incelenir.

M ile gösterilen değişkenin, moderatör değişken olup olmadığına karar verebilmek için bu değişkenin bazı özellikleri taşıyor olması gerekmektedir. Bunlardan birisi moderatör değişken ile X ve Y değişkenleri arasında bir nedensellik ilişkisi olmamalıdır. Diğer bir ifade ile moderatör değişken, X ve Y değişkenlerinin bir sonucu olmamalıdır. İkinci özellik ise X ile moderatör değişken arasında yüksek korelasyon olmaması gerekir. Genel olarak, 0.80 ve üzeri korelasyon olması durumunda çoklu bağlantı etkisi ortaya çıkabilir.

Ağırlık (kg) ile Sistolik kan basıncı (mmHg) veya Hipertansiyon arasındaki ilişkiye, Yaşın (Yıl) etkili olabileceği düşünülerek, diğer bir ifade ile Yaşın bu iki değişken arasındaki ilişkiyi değiştireceği düşünülerek, Yaşın moderatör (düzenleyici) değişken olarak eklenmesi ile moderatör veya düzenleyici etki için model Şekil 1'deki gibi gösterilebilir.



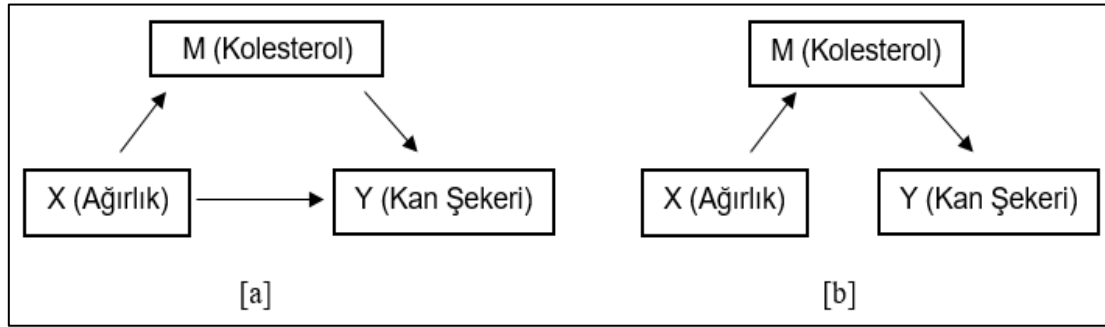
Şekil 1. Basit moderatör değişken şeması

Şekil 1'de görüldüğü üzere, X bağımsız değişkeni ile Y bağımlı değişkeni arasında bir ilişki tanımlanmış ve M ile gösterilen üçüncü bir değişkenin ise bu ilişkiyi etkilediği varsayılmıştır. M değişkeni, X ile Y arasındaki var olan ilişkiyi artırabilir, azaltabilir veya ilişkinin yönünü değiştirebilir. Bu şekilde tanımlanan bir ilişki yapısında, X ile Y arasındaki ilişkinin yönünü ve

derecesini deęiřtiren, M deęiřkeni moderatör (düzenleyici) deęiřken olarak tanımlanır (Hayes, 2022).

Mediatör veya aracı deęiřken, bağımsız deęiřken ile bağımlı deęiřkenler arasındaki iliřkiyi doęrulamak veya kolaylařtırmak üzere modele eklenen üçüncü deęiřkeni ifade eder. Mediatör deęiřken, bağımlı ve bağımsız deęiřkenler arasında, nasıl bir aracılık (kısmı veya tam aracılık) baęlantısı olduęunu ve ne tür bir iliřki olduęunu gösterir. Mediatör deęiřken, nedensellik diyagramında, modeldeki bağımsız deęiřkenden etkilenir ve kendisi de bağımlı deęiřkeni etkiler.

Nedensellik iliřkisi içerisinde, Aęırlığın (kg) Kan řekeri (mg/dL) üzerine etkili olduęu varsayılımsın. Bu durumda Aęırlık artışı sebep, Kan řekeri ise sonuç deęiřkeni olarak alınabilir. Kolesterol düzeyi (mg/dL) mediatör veya aracı deęiřken olarak tanımlandığında; Tam aracılık etkisi [a] ve Kısmi aracılık [b] etkisi için model řekil 2'deki gibi oluřturulabilir.



Şekil 2. [a]: Kısmi aracılık modeli, [b]: Tam aracılık modeli

## Bulgular ve Tartışma

Moderatör deęiřken, iki deęiřken arasındaki iliřkiyi yönlendiren veya etkileyen, dięer bir ifade ile iliřkinin gücünü ve/veya yönünü deęiřtiren deęiřkendir (Baron ve Kenny, 1986). Böylece, moderatör deęiřken, genel anlamıyla iki deęiřken arasındaki iliřkiyi yönlendirebilir, dięer bir ifade ile iliřkinin yönünü deęiřtirebilir veya bu iliřkinin derecesini artır veya azaltabilir (Anonymous, 2024). Moderatör deęiřkenin bulunduęu modelde, iki deęiřken arasındaki iliřkiye etki ettięi ve bu iliřkinin yönünü ve/veya derecesini deęiřtirdięi varsayılan bir deęiřken söz konusudur. Moderatör deęiřken, sürekli bir deęiřken olabileceęi gibi kategorik bir deęiřken de olabilir. Moderatör deęiřkenin kategorik olması durumunda, X ve Y arasındaki iliřki, M'nin farklı seviyelerinde deęiřiklik gösterecektir.

Herhangi bir M deęiřkeninin, moderatör deęiřken olup olmadığını belirlemek üzere; X ile M deęiřkenlerinin çarpımı olarak ifade edilen ve etkileşim (interaksiyon) terimi olarak adlandırılan bir deęiřken üretilir. Üretilen bu terimin Y deęiřkeni üzerine etkisinin, istatistik olarak önemli olup olmadığı test edilir ve bu test sonucunda M deęiřkeninin moderatör deęiřken olup olmadığına karar verilir (Bennett, 2000).

Moderatör deęiřken, aralarında iliřki olduęu varsayılan iki deęiřken arasına eklenmesiyle, üçüncü bir deęiřken olarak veya iliřkinin bir parçası olarak bu iliřkiyi güçlendirebilir zayıflatabilir veya iki deęiřken arasındaki iliřkinin yönünü deęiřtirebilir.

Moderatör deęiřken, kalitatif veya kantitatif deęiřken, dięer bir ifade ile sürekli veya kategorik deęiřken olabilir (Ro, 2012). Sürekli deęiřken olması durumunda, moderatör deęiřkenin deęiřimi ile iliřkinin nasıl deęiřtięi incelenirken, kategorik deęiřken olması durumunda, bu kategorik deęiřkenin farklı seviyelerinde, iliřkinin deęiřiřip deęiřiřmedięi incelenir.

Mediatör deęiřkenler, nedensel etkilerin dięer bir ifade ile sebep-sonuç etkisinin anlaşılması ve güçlendirilmesine yardımcı olabilir. Benzer řekilde arařtırıcılar, faktörlerin çıktı (output, cevap veya yanıt) deęiřkeni üzerinde belirli bir etkisinin olup olmadığını belirlemek üzere mediatör deęiřkenlerden yararlanabilirler.



Mediatör deęişkenin modele dahil edilmesi ile baęımlı ve baęımsız deęişkenler arasında hesaplanan korelasyon katsayısı, bu deęişkenin modele dahil edilmedięi durumdaki hesaplanan korelasyon katsayısından daha yüksek olma eğilimindedir. Aracılık analizi, bir bakıma modelde mediatör deęişken kullanılıp kullanılmayacağını test eder.

Moderatör ve mediatör deęişkenler arasındaki farkın iyi anlaşılabilmesi için moderatör ve mediatör kavramlarının iyi anlaşılması gerekir. Mediatör deęişken, sebep-sonuç ilişkisi çerçevesinde tanımlanan iki deęişken arasındaki ilişkinin yönüne ve derecesine etki ettięi varsayılarak, bu deęişkenler arasındaki ilişkiye baęlanan ve ilişkiyi niçin ve nasıl etkiledięi belirlenmeye çalışılan deęişkeni ifade eder. Oysaki moderatör deęişken kavramında, genellikle nedensellik (sebe-sonuç) yoktur ve iki deęişken arasındaki ilişkiyi etkiledięi veya bu ilişkinin yönünü ve derecesini deęiştirdięi varsayılan üçüncü bir deęişkenin etkisi incelenir (MacKinnon, 2011). Böylece aslında moderatör ve mediatör deęişkenler arasındaki farklılık, araştıracının tanımlamış olduęu ilişki yapısına baęlıdır. Bennett (2000), moderatör ve mediatör deęişkenleri, baęımsız deęişken ile sonuç deęişkeni arasındaki ilişkiyi etkileyen deęişkenler olarak tanımlamış ve bu iki kavramın uygulamalarda birbiri yerine yanlış kullanıldığını vurgulamıştır.

### **Sonuç ve Öneriler**

Moderatör ve mediatör deęişkenler, araştıracıların deęişkenler arasındaki ilişki yapısını tanımlamada ve bu yapıya üçüncü deęişken veya deęişkenlerin etkisi olup olmadığını belirlemede araştıracılar için kullanışlı olabilir. Bunun için Standart doğrusal regresyon analizinden yararlanılabilir veya SPSS'e baęlı olarak çalışılan PROCESS eklentisi (makrosu) kullanılabilir.

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## İDEAL TOPOLOJİK UZAYLARDA BAZI SÜREKLİLİK TİPLERİ

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### Özet

Bu çalışmada, ideal topolojik uzaylarda yeni süreklilik türleri tanımlanmış ve bu türlerin özellikleri ayrıntılı bir şekilde incelenmiştir. Bu yaklaşım, bazı yeni tanımlanan küme çeşitlerinin kullanılmasıyla gerçekleştirilmiştir. İlk olarak,  $\gamma$ -pre-I açık kümeler incelenmiş ve bu kümeler yardımıyla sürekli ve irresolute fonksiyonlar oluşturulmuş, ilgili teoremler formüle edilmiştir. Aynı yöntem  $\gamma$ -semi-I açık kümelere de uygulanmıştır.

**Anahtar Kelimeler:** İdeal topolojik uzaylar,  $\gamma$ -semi açık küme,  $\gamma$ -pre açık küme, süreklilik.

## SOME TYPES OF CONTINUITY IN IDEAL TOPOLOGICAL SPACES

### **Abstract**

In this study, new types of continuity in ideal topological spaces have been defined and their properties analyzed. To achieve this, some new types of sets have been utilized. Initially,  $\gamma$ -pre-I open sets were examined, and continuous and irresolute functions were constructed using these sets, along with theorems presented. This approach was also applied to  $\gamma$ -semi-I open sets.

**Keywords:** Ideal topological spaces,  $\gamma$ -semi open set,  $\gamma$ -pre open set, continuity.

## 1. Introduction

The concept of a semi-open set was first introduced by Levine (Levine, 1963), and has since been extended and utilized in various ways, generalizing several definitions in classical topology. Kasahara (Kasahara, 1979) defined an operation  $\gamma: \tau \rightarrow P(X)$  as a function from  $\tau$  to the power set of  $X$ , such that  $V \subseteq \gamma(V)$  for every  $V \in \tau$ , where  $\gamma(V)$  represents the value of  $\gamma$  at  $V$ . Each set  $\gamma(V)$  is referred to as a  $\gamma$ -open set. Moreover, if for every  $x \in V$ , there exists an open set  $U$  such that  $x \in U$  and  $\gamma(U) \subseteq V$ , then  $V$  is considered a  $\gamma$ -open set. The  $\gamma$ -interior of a subset  $A \subseteq X$  is defined by Jankovic (Jankovic, 1983), and the  $\gamma$ -closure of  $A \subseteq X$  is introduced by Ogata (Ogata, 1991). A subset  $A$  of  $X$  is called  $\gamma$ -closed if  $cl_\gamma(A) \subseteq A$ , where  $cl_\gamma(A)$  is the smallest  $\gamma$ -closed set containing  $A$ . Several key notions and properties of the  $\gamma$ -operation were detailed by (Rehman and Ahmad, 1992) and (Ahmad and Hussain, 2003). The concept of  $\gamma$ -semi-open sets was proposed by (Hussain et al, 2010), and the largest  $\gamma$ -semi-open set contained in  $A$  is termed the  $\gamma$ -semi-interior of  $A$ , as defined by Ahmad and Hussain (Ahmad & Hussain, 2005). In another study, (Hussain & Ahmad, 2007) examined closed sets under a different concept, called  $\gamma$ -s-closed sets. The study of  $\gamma$ -pre-open sets was explored by Krishnan and Balachandran (Krishnan & Balachandran, 2006) and further generalized by Hussain (Hussain, 2018).

On another note, an ideal on a topological space  $X$  is defined as a nonempty collection of subsets of  $X$  that satisfy certain conditions, and the triplet  $(X, \tau, I)$  is referred to as an ideal topological space. A local function  $(.) : P(X) \rightarrow P(X)$  with respect to  $\tau$  and  $I$  is provided by (Vaidyanathaswamy, 1945), where for a subset  $A$ ,  $A^*(I, \tau) := \{x \in X: U \cap A \notin I, \text{ for every } U \text{ neighborhood of } x\}$ . A Kuratowski closure operator  $Cl^\wedge(.)$  is then defined as the union of  $A$  and  $A^*(I, \tau)$ , as introduced by (Kuratowski, 1966) and further developed by Hayashi (Hayashi, 1964). Furthermore, the definition of  $I$ -open sets is provided by (Jankovic and Hamlett, 1992).

Recent research has concentrated on exploring novel forms of continuity within ideal topological spaces. In this study, we will introduce a new definition of continuity for the set types described by Özcan (2022) and examine its properties in detail.

## 2. Preliminaries

**Definition 2.1.** (Kasahara,1979) An operation  $\gamma: \tau \rightarrow P(X)$  is defined as a function from  $\tau$  to the power set of  $X$  such that  $A \subseteq \gamma(A)$ , for each  $A \in \tau$ , where  $\gamma(A)$  denotes the value of  $\gamma$  at  $A$ . The operation defined by  $\gamma(G) = G$ ,  $\gamma(G) = cl(G)$ , and  $\gamma(G) = intcl(G)$  are examples of the operation  $\gamma$  (Jankovic, 1979). The set of all the operations  $\gamma: \tau \rightarrow P(X)$  is denoted by  $\Omega(X)$ .

**Definition 2.2.** (Kasahara,1979,Jankovic, 1979) Let  $(X, \tau)$  be a topological space,  $\gamma \in \Omega(X)$ , and  $A \subseteq X$ . If for each  $x \in A$ , there exists an open set  $U$  such that  $x \in U$  and  $\gamma(U) \subseteq A$ , then  $A$  is called a  $\gamma$ -open set.

**Definition 2.3.** (Jankovic,1983, Ogata, 1991) Let  $(X, \tau)$  be a topological space,  $\gamma \in \Omega(X)$ , and  $A \subseteq X$ . If  $A^c$  is a  $\gamma$ -open set, then  $A$  is called a  $\gamma$ -closed set.

**Definition 2.4.** (Ahmad and Hussain, 2005) A  $\gamma$ -neighborhood of  $x \in X$  is a set  $U$  of  $X$  which contains a  $\gamma$ -open set  $V$  containing  $x$ . Clearly,  $U$  is a  $\gamma$ -neighbourhood of  $x$  if and only if  $x \in int_\gamma(U)$ .

**Definition 2.5.** (Hussain,2018) Let  $(X, \tau)$  be a topological space and  $A \subseteq X$ . Then,  $A$  is called a  $\gamma$ -pre-open set, if  $A \subseteq int_\gamma(cl_\gamma(A))$ . The family of all the  $\gamma$ -pre-open sets in  $X$  is denoted by  $PO_\gamma(X)$ .

**Definition 2.6.** (Hussain,2018) Let  $(X, \tau)$  be a topological space and  $A \subseteq X$ . Then,  $A$  is called a  $\gamma$ -pre-closed set, if  $A^c$  is a  $\gamma$ -pre-open set. Equivalently,  $A$  is called a  $\gamma$ -pre-closed set, if  $A \subseteq cl_\gamma(int_\gamma(A))$ . The family of all the  $\gamma$ -pre-closed sets in  $X$  is denoted by  $PC_\gamma(X)$ .

Note that every  $\gamma$ -open (closed) set is a  $\gamma$ -pre-open (closed) set. But the converse is not true in general (Krishnan and Balachandran,2005)

**Lemma 2.7.** (Rehman and Ahmad, 1992) Let  $(X, \tau)$  be a topological space and  $A \subseteq X$ . Then,

- i.  $cl_\gamma(A) \cap U \subseteq cl_\gamma(A \cap U)$ , for any  $\gamma$ -open set  $U$  in  $X$ .
- ii.  $int_\gamma(A \cup V) \subseteq int_\gamma(A) \cup V$ , for any  $\gamma$ -closed set  $V$  in  $X$ .

**Definition 2.8.** (Vaidyanathaswamy,1945) An ideal  $I$  on a topological space  $(X, \tau)$  is a collection of subsets of  $X$  having the following properties:

- i. if  $G \in I$  and  $H \subset G$ , then  $H \in I$
- ii. if  $G \in I$  and  $H \in I$ , then  $G \cup H \in I$

Then,  $(X, \tau, I)$  is called an ideal topological space.

**Definition 2.9.** (Vaidyanathaswamy,1945) Let  $(X, \tau, I)$  be an ideal topological space, and  $P(X)$  denote the set of all subsets of  $X$ . For a subset  $A \subseteq X$ ,  $A^*(I, \tau) := \{x \in X: U \cap A \notin I, \text{ for each neighborhood } U \text{ of } x\}$  is called the local function of  $A$  concerning  $\tau$  and  $I$ .

The local function  $A^*(I, \tau)$  is denoted by  $A^*$ , for brevity. The union of all open sets of  $X$  contained in  $A^*$  is called the interior of  $A^*$  and denoted by  $int(A^*)$ .

**Definition 2.10.** (Jankovic and Hamlett,1992) Let  $(X, \tau, I)$  be an ideal topological space and  $A \subseteq X$ . If  $A \subseteq int(A^*)$ , then  $A$  is called an  $I$ -open set.

**Theorem 2.11.** (Kuratowski,1966) Let  $(X, \tau, I)$  be an ideal topological space and  $A \subseteq X$ . For any open set  $U$ ,  $A^* \cap U = (A \cap U)^* \cap U \subseteq (A \cap U)^*$ .

### 3. $\gamma$ -PRE-I-OPEN and $\gamma$ -SEMI-I-OPEN SETS

In this section, the Kuratowski closure operator is defined  $Cl_\gamma^*(.)$  via  $\gamma$  operation.

**Definition 3.1.** (Özcan, 2022) Let  $(X, \tau, I)$  be an ideal topological space and  $\gamma \in \Omega(X)$ . For  $A \subseteq X$ , the  $\gamma$ -local function of  $A$  concerning  $\gamma$  and  $I$  is defined by  $A_\gamma^*(I, \tau) := \{x \in X: U \cap A \notin I, \text{ for each } \gamma\text{-neighborhood } U \text{ of } x\}$ .

The local function  $A_\gamma^*(I, \tau)$  is denoted by  $A_\gamma^*$ , for brevity. Moreover, the Kuratowski closure operator  $Cl_\gamma^*(.)$  is defined by  $cl_\gamma^*(A) := A \cup A_\gamma^*$ .

**Definition 3.2.** (Özcan, 2022) Let  $(X, \tau, I)$  be an ideal topological space,  $\gamma \in \Omega(X)$ , and  $A \subseteq X$ . If  $A^c$  is a  $\gamma$ -pre-I-open set, then  $A$  is a  $\gamma$ -pre-I-closed set. Equivalently,  $A$  is a  $\gamma$ -pre-I-closed set if  $A \supseteq cl_\gamma^*(int_\gamma^*(A))$ . The set of all the  $\gamma$ -pre-I-closed sets in  $X$  is denoted by  $PIC_\gamma(X)$ .

**Definition 3.3.** (Özcan, 2022) Let  $(X, \tau, I)$  be an ideal topological space,  $\gamma \in \Omega(X)$ , and  $A \subseteq X$ .

- i. The smallest  $\gamma$ -pre-I-closed set  $F$  such that  $A \subseteq F$  is the  $\gamma$ -pre-I-closure of  $A$ . The  $\gamma$ -pre-I-closure of  $A$  is defined by  $pIcl_\gamma(A) := \bigcap \{K | A \subseteq K \text{ and } K^c \in PIO_\gamma(X)\}$ .
- ii. The largest  $\gamma$ -pre-I-open set  $O$  such that  $O \subseteq A$  is the  $\gamma$ -pre-I-interior of  $A$ . The  $\gamma$ -pre-I-interior of  $A$  is defined by  $pIint_\gamma(A) := \bigcup \{O | O \subseteq A \text{ and } O \in PIO_\gamma(X)\}$ .

**Definition 3.4.** (Özcan, 2022) Let  $(X, \tau, I)$  be an ideal topological space,  $\gamma \in \Omega(X)$ , and  $A \subseteq X$ .  $A$  is called a  $\gamma$ -semi-I-open set, if there exists a  $\gamma$ -I-open set  $O$  such that  $O \subseteq A \subseteq cl_\gamma^*(O)$ .

**Example 3.5.** Let  $X = \{1,2,3,4\}$ ,  $\tau = \{\emptyset, X, \{1,2\}, \{3\}, \{1,2,3\}\}$  be a topology on  $X$ , and  $I = \{\emptyset, \{2,3\}\}$ . Moreover, let an operation  $\gamma : \tau \rightarrow P(X)$  define as follows:

$$\gamma(A) = \begin{cases} A, & c \in A \\ cl(A), & c \notin A \end{cases}$$

$A = \{1,2\}$  is a  $\gamma$ -semi-I-open set, for  $O = \{1\}$ . We obtain that  $O^* = \{1,2,4\}$  and  $cl_\gamma^*(O) = \{1,2,4\}$ , then  $O \subseteq A \subseteq cl_\gamma^*(O)$ .

For details related to these sets, see (Özcan, 2022).

### 5. $\gamma$ -PRE-I and $\gamma$ -SEMI-I CONTINUITY

**Definition 5.1.** Let  $f : (X, \tau, I) \rightarrow (Y, \sigma)$  be a function. If for each her  $\gamma$ -open set  $V$  in  $Y$ ,  $f^{-1}(V)$  is  $\gamma$ -b-I-open in  $X$ , then  $f$  is called  $\gamma$ -pre-I continuous function.

**Example 5.2.** Let  $X = \{x, y, z\}$ ,  $\tau = \{\emptyset, X, \{x\}, \{z\}, \{x, y\}, \{x, z\}\}$  ve  $I = \{\emptyset, \{y\}\}$ .

For  $b \in X$ , let the operation  $\gamma : \tau \rightarrow P(X)$  be defined as follows.

$$\gamma(A) = \begin{cases} A, & y \in A \\ \text{cl}(A), & y \notin A \end{cases}$$

Also let  $Y = \{a, b, c\}$ ,  $\sigma = \{\emptyset, Y, \{a\}, \{b\}, \{a, b\}, \{a, c\}\}$ .

For  $b \in Y$ , the operation  $\beta : \sigma \rightarrow P(Y)$  be defined as follows.

$$\beta(A) = \begin{cases} \text{cl}(A), & b \in A \\ A, & b \notin A \end{cases}$$

Then  $f : (X, \tau, I) \rightarrow (Y, \sigma)$ ,  $f = \{(x, a), (y, c), (z, b)\}$  is not  $\gamma$ -pre-I continuous.

**Theorem 5.3.** Let  $f : (X, \tau, \mathcal{J}) \rightarrow (Y, \sigma)$  be a function. Then  $f$  is  $\gamma$ -pre-I continuous function iff for each  $\gamma$ -closed set  $V$  in  $Y$ ,  $f^{-1}(V)$  is  $\gamma$ -pre-I-closed set in  $X$ .

**Proof:** ( $\Rightarrow$ ) Let  $f$  be  $\gamma$ -pre-I continuous and  $B$  be a  $\gamma$ -closed set. Then  $B^c$  is  $\gamma$ -open. Since  $f$  is  $\gamma$ -pre-I continuous, then  $f^{-1}(B^c)$  is  $\gamma$ -pre-I-open. We have that  $(f^{-1}(B))^c = f^{-1}(B^c)$  is  $\gamma$ -pre-I-open. Then  $f^{-1}(B)$  is  $\gamma$ -pre-I-closed in  $X$ .

( $\Leftarrow$ ) Let  $V$  be a  $\gamma$ -pre-I-open set. We have to prove that  $f^{-1}(V)$  is  $\gamma$ -pre-I-open. Since  $V^c$  is  $\gamma$ -pre-I-closed, then  $f^{-1}(V^c)$  is  $\gamma$ -pre-I-closed. We obtain that  $f^{-1}(V^c) = (f^{-1}(V))^c$  is  $\gamma$ -pre-I-closed, then  $f^{-1}(V)$  is  $\gamma$ -pre-I-open set. So  $f$  is  $\gamma$ -pre-I continuous.

**Definition 5.4.** Let  $f : (X, \tau, \mathcal{J}) \rightarrow (Y, \sigma)$  be a function. If for each her  $\gamma$ -pre-I -open set  $V$  in  $Y$ ,  $f^{-1}(V)$  is  $\gamma$ -pre-I- open in  $X$ , then  $f$  is called  $\gamma$ -pre-I-irresolute function.

**Theorem 5.5.** Let  $f : (X, \tau, \mathcal{J}) \rightarrow (Y, \sigma)$  be a function. Then  $f$  is  $\gamma$ -pre-I-irresolute function iff for each her  $\gamma$ -pre-I- closed set  $V$  in  $Y$ ,  $f^{-1}(V)$  is  $\gamma$ -pre-I- closed in  $X$ .

**Proof:** The proof is clear.

**Theorem 5.6.** Let  $X$  and  $Y$  be topological spaces. If the function  $f : X \rightarrow Y$  is  $\gamma$ -pre-I-irresolute , then  $f$  is  $\gamma$ -pre-I-continuous.

**Proof:** Assume that  $f$  is a  $\gamma$ -pre-I-irresolute function. Each  $\gamma$ -open set  $A$  is  $\gamma$ -pre-I-open. Since  $f$  is  $\gamma$ -pre-I-irresolute, then  $f^{-1}(A)$  is  $\gamma$ -pre-I-open. Then  $f$  is  $\gamma$ -b-I-continuous.

**Definition 5.7.** Let  $X$  and  $Y$  be topological spaces and  $f : X \rightarrow Y$  be a function. If for each  $A \subseteq X$  is  $\gamma$ -pre-I-open(closed),  $f(A)$  is  $\gamma$ -pre-I-open(closed), then  $f$  is called  $\gamma$ -pre-I-open(closed) function.

**Theorem 5.8.** Let  $X$  and  $Y$  be topological spaces and  $f : X \rightarrow Y$  be a function. Then the following conditions are equivalent.

i)  $f$  is  $\gamma$ -pre-I-closed.

ii) For  $V \subseteq X$ ,  $\text{pIcl}_\gamma(f(V)) \subseteq f(\text{pIcl}_\gamma(V))$ .

**Proof:** (i)  $\Rightarrow$  (ii) Assume that  $f$  is  $\gamma$ -pre-I-closed. For  $V \subseteq X$ , since  $\text{pIcl}_\gamma(V)$  is  $\gamma$ -pre-I-closed then  $f(\text{pIcl}_\gamma(V))$  is  $\gamma$ -pre-I-closed. We obtain that  $f(V) \subseteq f(\text{pIcl}_\gamma(V))$  and then  $\text{pIcl}_\gamma(f(V)) \subseteq f(\text{pIcl}_\gamma(V))$ .

(ii)  $\Rightarrow$  (i) Let  $U \subseteq X$  be  $\gamma$ -pre-I-closed. Then we have

$$f(U) \subseteq \text{pIcl}_\gamma(f(V)) \subseteq f(\text{pIcl}_\gamma(V))$$

Thus  $f(U) \subseteq \text{pIcl}_\gamma(f(V))$ .

**Theorem 5.9.** Let  $X, Y$  and  $Z$  be topological spaces,  $f : X \rightarrow Y$ ,  $g : Y \rightarrow Z$  be two functions and  $\text{gof} : X \rightarrow Z$  be  $\gamma$ -pre-I-closed. If  $g$  is injective and  $\gamma$ -pre-I-irresolute, then  $f$  is  $\gamma$ -pre-I-closed.

**Proof:** Let  $U \subseteq X$  be  $\gamma$ -pre-I closed. Then  $\text{gof}(U)$  is  $\gamma$ -pre-I-closed in  $Z$ . Thus  $g^{-1}(\text{gof}(U)) = f(U)$  is  $\gamma$ -pre-I-closed. It means that  $f$  is  $\gamma$ -b-I-closed.

**Definition 5.10.** Let  $f : (X, \tau, \mathcal{J}) \rightarrow (Y, \sigma)$  be a function. If for each her  $\gamma$ -open set  $V$  in  $Y$ ,  $f^{-1}(V)$  is  $\gamma$ -semi-I- open in  $X$ , then  $f$  is called  $\gamma$ -semi-I continuous function.

**Definition 5.11.** Let  $f : (X, \tau, \mathcal{J}) \rightarrow (Y, \sigma)$  be a function. If for each her  $\gamma$ -pre-I -open set  $V$  in  $Y$ ,  $f^{-1}(V)$  is  $\gamma$ -pre-I- open in  $X$ , then  $f$  is called  $\gamma$ -pre-I-irresolute function.

**Theorem 5.12.** Let  $f : (X, \tau, \mathcal{J}) \rightarrow (Y, \sigma)$  be a function. Then  $f$  is  $\gamma$ -pre-I-irresolute function iff for each her  $\gamma$ -pre-I- closed set  $V$  in  $Y$ ,  $f^{-1}(V)$  is  $\gamma$ -pre-I- closed in  $X$ .

**Theorem 5.13.** Let  $X$  and  $Y$  be topological spaces. If the function  $f: X \rightarrow Y$  is  $\gamma$ -pre-I-irresolute, then  $f$  is  $\gamma$ -pre-I-continuous.

**Proof:** Assume that  $f$  is a  $\gamma$ -b-I-irresolute function. Each  $\gamma$ -open set  $A$  is  $\gamma$ -pre-I-open. Since  $f$  is  $\gamma$ -pre-I-irresolute, then  $f^{-1}(A)$  is  $\gamma$ -pre-I-open. Then  $f$  is  $\gamma$ -b-I-continuous.

**Definition 5.14.** Let  $X$  and  $Y$  be topological spaces and  $f: X \rightarrow Y$  be a function. If for each  $A \subseteq X$  is  $\gamma$ -pre-I-open(closed),  $f(A)$  is  $\gamma$ -pre-I-open(closed), then  $f$  is called  $\gamma$ -pre-I-open(closed) function.

### Conclusion

If a topology is defined on a set, the concept of continuity can be discussed. Continuity, as defined using open sets, can also be defined using closed sets. In this study, certain types of continuity previously defined in topological spaces have been transferred to ideal topological spaces. This demonstrates that other continuity concepts can also be similarly extended and examined in ideal topological spaces.



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## TOPOLOJİK TASARIMLA TARLA BİTKİ SULAMASINDA SU VERİMLİLİĞİ

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### Özet

Artan dünya nüfusuna paralel olarak gıda talebinin karşılanması tarımsal ürünlerde birim alanda verim artışını kaçılmaz hale getirmiştir. Tarımsal üretim verim, su kullanımı ve gübreleme gibi iyi bakım teknikleri ile ölçülen önemli bir parametredir ve bu verimlilik, modern tarım teknikleri ile artırılabilir. Ancak iklim değişikliği ve çevresel faktörler, tarımsal üretim verimini doğrudan etkileyebilir, bu nedenle sürdürülebilir tarım uygulamalarının benimsenmesi önemlidir. Kuraklık, tarımsal üretkenliği ciddi şekilde etkileyen bir sorundur, çünkü su kıtlığı bitki gelişimini ve verimini doğrudan etkiler. Sulama sistemleri, bu sorunu hafifletmek için tasarlanmıştır, ancak etkili bir sulama yönetimi gerektirir. Su kaynaklarının verimli kullanımı, sulama tekniklerinin optimize edilmesi ve su tasarrufu sağlayan yöntemlerin uygulanması, kuraklık koşullarında tarımsal üretkenliği sürdürmeye yardımcı olabilir. Bu bağlamda, doğru sulama stratejileri ve teknolojileri, kuraklığın olumsuz etkilerini en aza indirmek için kritik öneme sahiptir. Topolojik optimizasyon, tarımsal sulama sistemlerinin etkinliğini artırmak için kullanılan ileri bir matematiksel ve mühendislik tekniğidir. Bu yöntem, suyun bitki köklerine en verimli şekilde ulaşmasını sağlamak amacıyla sulama ağlarının optimal tasarımını gerçekleştirir. Tarımsal sulamada, su kaynaklarının sınırlı olduğu ve maliyetlerin önemli olduğu göz önüne alındığında, topolojik optimizasyon, suyun daha eşit dağıtılmasını ve su israfını azaltmayı amaçlar. Bu yaklaşım, sulama sistemlerinin tasarımında yenilikçi çözümler sunarak, hem ekonomik hem de çevresel sürdürülebilirliği artırabilir. Sonuçta, maksimum verimlilik ve minimum maliyetle su kaynaklarını yönetilebilmektedir.

**Anahtar Kelimeler:** Su kıtlığı; topoloji; sulama sistemleri; tarımsal üretim.

## WATER EFFICIENCY IN FIELD CROP IRRIGATION THROUGH TOPOLOGICAL DESIGN

### **Abstract**

In parallel with the increasing world population, meeting the demand for food has made the increase in yield per unit area of agricultural products inevitable. Agricultural production yield is an important parameter measured by good maintenance techniques such as water use and fertilization, and this efficiency can be increased with modern agricultural techniques. However, climate change and environmental factors can directly affect agricultural production yield, so it is important to adopt sustainable agricultural practices. Drought significantly impacts agricultural productivity by limiting water availability, which affects plant growth and yield. Irrigation systems are designed to mitigate this issue but require effective management. Efficient water use, optimization of irrigation techniques, and the adoption of water-saving methods are crucial to maintaining agricultural productivity under drought conditions. In this context, proper irrigation strategies and technologies are essential to minimize the adverse effects of drought. Topological optimization is an advanced mathematical and engineering technique utilized to enhance the efficiency of agricultural irrigation systems. This method focuses on the optimal design of irrigation networks to ensure that water reaches plant roots in the most effective manner. Given the constraints of limited water resources and significant costs in agriculture, topological optimization aims to achieve more equitable water distribution and reduce water wastage. By providing innovative solutions in the design of irrigation systems, this approach seeks to improve both economic and environmental sustainability. The ultimate goal is to manage water resources with maximum efficiency and minimum cost, thereby enhancing agricultural productivity and sustainability.

**Keywords:** Water scarcity; topology; irrigation systems; agricultural production.

## **Introduction**

Agricultural irrigation is a critical component of modern farming, crucial for sustaining crop yields and ensuring food security, especially in regions prone to water scarcity. Traditional irrigation systems, while effective to some extent, often suffer from inefficiencies that lead to water wastage and suboptimal crop growth. As climate change intensifies and droughts become more frequent, the need for more efficient irrigation methods becomes increasingly urgent.

Topological optimization, an advanced computational technique used primarily in structural engineering and material science, has emerged as a promising approach to address these challenges in irrigation systems. This method involves optimizing the layout and configuration of irrigation networks to maximize water distribution efficiency while minimizing resource use and costs. By applying topological optimization principles, it is possible to design irrigation systems that not only reduce water waste but also adapt dynamically to varying water availability and crop needs.

The application of topological optimization to agricultural irrigation involves modeling the irrigation network as a complex system of interconnected components. Through iterative computational processes, the optimal configuration is determined, taking into account factors such as terrain, soil characteristics, and crop requirements. This approach can lead to significant improvements in water use efficiency, reduced operational costs, and enhanced crop yields. By integrating cutting-edge optimization techniques into irrigation system design, we aim to provide solutions that are both economically viable and environmentally sustainable, addressing one of the most pressing challenges in modern agriculture.

## **Efficient Water Use And Yield Enhancement Methods In Field Crops**

Field crops are the cornerstone of agricultural production worldwide and in Turkey, playing a crucial role in several aspects, food security (wheat, corn, rice, and barley), economic contribution, industry and processed products (sugar beets, cotton, and soybeans) and sustainability and climate change. For these reasons, field crops are a fundamental part of global agricultural systems and play a key role in food security. In general, field crops make up the majority of agricultural production both globally and in Turkey. Globally, field crop production accounts for approximately 70-75%, while in Turkey this proportion is between 65-70% (TUIK, 2024).

Water use in agriculture is a significant factor, consuming a large portion of global water resources. Field crops, which are grown over extensive areas, can suffer considerable losses if water is not used efficiently. As water resources become scarcer and agricultural land expands, the need for efficient water use and yield enhancement in modern agricultural production processes is becoming increasingly important.

Globally, a significant portion of water use is dedicated to agricultural production. Approximately 70-75% of the world's water usage is attributed to agriculture. This highlights the substantial demand that agriculture places on water resources and underscores the importance of effective water management in farming. Most of this water is used for irrigation, plant growth, and crop yield enhancement. Efficient water use and conservation practices are crucial for maintaining the sustainability of water resources.

Efficient water use refers to the optimal utilization of water, ensuring that it is not wasted and is used in the most productive manner possible. Water scarcity directly affects the growth rate, biomass, and ultimate yield of crops. Therefore, efficient water management is crucial for improving the yield of field crops, especially in regions experiencing water shortages. The design and management of irrigation systems play a key role in ensuring efficient water use. Traditional irrigation methods often result in water loss through evaporation or deep percolation into the soil, preventing crops from receiving the necessary amount of water, leading to yield

loss (Ürün, 2024). New technologies and strategies, such as topological optimization, improve water distribution, allowing for better management of water to meet crop needs.

Another essential aspect of increasing yield is ensuring that crops utilize water in the most efficient way possible. Several agronomic and engineering-based strategies can help achieve this (McDermid et al. 2023);

-Precision Irrigation Techniques: Precision agriculture practices enable water to be delivered directly to the crop root zone, enhancing water use efficiency. For instance, drip irrigation systems provide water directly to the root area of plants, minimizing water loss and optimizing plant growth.

-Enhancing Soil Water Retention Capacity: Practices such as adding organic matter, improving soil structure, and mulching can increase the soil's ability to retain water, enhancing the availability of water for crops. These methods reduce evaporation and ensure that water remains available in the root zone for longer periods.

-Genetic and Biotechnological Approaches: The development of drought-resistant crop varieties is another way to enhance yield. These crops maintain optimal growth even under water-limited conditions, reducing the impact of water scarcity on yield.

Designing Irrigation Networks with Topological Optimization: Topological optimization involves designing irrigation networks that ensure water reaches crops in the shortest possible route with minimal losses. This method improves irrigation efficiency, reducing water waste and optimizing crop yield.

Efficient water use and yield enhancement strategies in field crops play a crucial role in ensuring sustainability in agricultural production. Water scarcity is a significant limiting factor that directly impacts agricultural yield, making it essential to improve irrigation systems, apply precision farming techniques, and use genetically drought-resistant crop varieties to enhance productivity. In this context, innovative approaches such as topological optimization can revolutionize agricultural irrigation by making water use more efficient and contributing to increased yields.

## **Irrigation Systems In Field Crops**

Irrigation systems are fundamental to modern agriculture, facilitating the controlled supply of water to crops and enhancing agricultural productivity. The choice of irrigation method is influenced by various factors including soil characteristics, climate, crop types, and water availability. This comprehensive overview provides an in-depth analysis of the principal irrigation systems employed in agricultural practices.

### **1. Surface irrigation systems**

Surface irrigation is the traditional water application method in the world (Figure 1). About 84% of the world uses the surface irrigation method to irrigate the crops (USDA 2019).

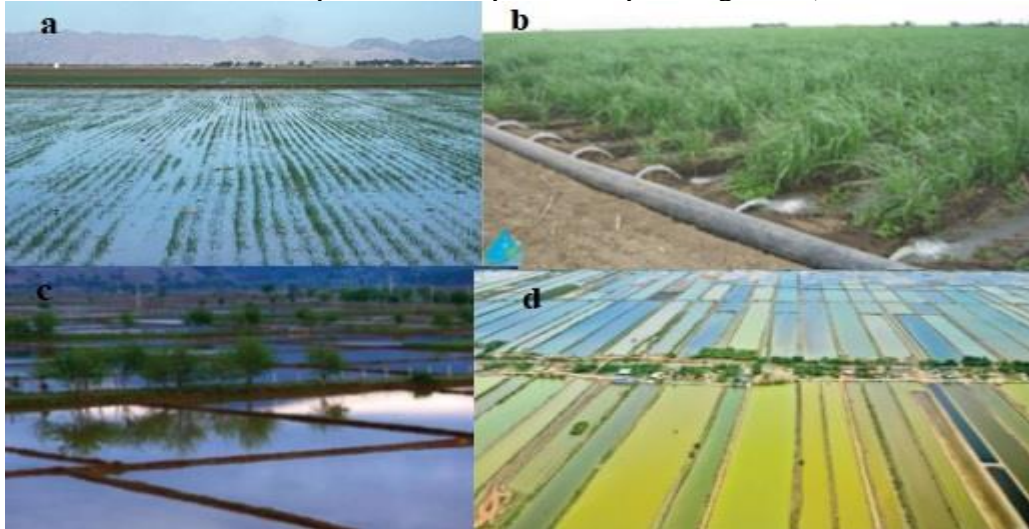
a. Flood Irrigation Method: It is the method where water is left to spread randomly over the field from the field head channels. Since it is not possible to irrigate every part of the field equally with this method, it is the method with the lowest efficiency. While the area of use should be very limited, it is done to avoid labor in regions where irrigation culture is low.

b. Furrow Irrigation Method: It is suitable for corn, sunflower, cotton, fruits and vegetables planted in rows by giving irrigation water to furrows opened in the direction of the slope between the plant rows. It is applied in medium and heavy textured soils with high water retention capacity. The slope in the irrigation direction is less than 1%. In sloped lands, furrows are opened parallel to the leveling curves.

c. Pan Irrigation Method: It is applied in the irrigation of fine textured soils where the land slope is flat and close to flat. High flow irrigation water is applied to the pans and it is ensured to cover the pan in a short time. The water that is pooled in the pan enters the soil over time and

is stored in the plant root zone. Irrigation is done for plants grown at frequent intervals, especially rice and fruit gardens.

d. Long Pan (border) Irrigation Method: In the long pan irrigation method, the field parcel is divided into narrow and long strips by making parallel banks in the direction of the dominant slope. The width of these strips varies between 3-30 m and their lengths vary between 100-800 m. In this method, water is not pooled in the pans as in pan irrigation (Gamal et al. 2023).



**Figure 1.** Surface irrigation methods (a) flood, (b) furrow, (c) pan and (d) border irrigation

## 2. Pressurized Irrigation Methods

a. Drip Irrigation Method: Drip irrigation is the process of distributing the irrigation water to be used to the soil surface within the plant root area after it is filtered by the elements in the established drip irrigation system, with or without soluble fertilizer. The initial cost of the drip irrigation system is high for small farmers, but it is easy to automate the system to minimize labor. Numerous studies worldwide have reported that drip irrigation systems provide significant water savings (up to 50%) compared to flood irrigation in wheat, rice, corn and other crops. (Parthasarathi et al. 2018).

b. Sprinkler Irrigation Method: Sprinkler irrigation method is a method in which water is taken from the source at a certain pressure and transmitted to the field through a closed system and sprayed into the atmosphere in the form of droplets. Since this method has very different features and system capacity, it can be used in every soil that can be irrigated for many plants.

c. Micro Sprinkler Irrigation Method: In this method, the water taken from the source is sprayed into the atmosphere and soil by smaller sprinklers called sprinklers, closer to the plant body.



**Figure 2.** Drip irrigation (a,b) and micro sprinkler (c,d) irrigation installed in the field

### **Topological Optimization Approaches In Irrigation**

Topological optimization is a mathematical method used to optimize the distribution of materials within a design space. While this approach is commonly used in engineering and structural design, it can also be applied to the design of irrigation systems in agriculture. The impact of topological optimization on irrigation systems focuses on improving water distribution and efficiency.

#### **1. Design Criteria**

Determining design criteria for applying topological optimization to irrigation systems is fundamental to a successful optimization process. These criteria may include (Sinha and Dhanalakshmi, 2022):

##### **2.1. Water Distribution Efficiency**

The design should ensure that water is distributed evenly across all areas. This is crucial for ensuring that each plant receives adequate water in the irrigation field. The system design aims to minimize losses due to evaporation, leakage, or overflow. This ensures more efficient use of water. Optimizing water flow paths ensures that water is effectively directed to the target areas. This can enhance the performance of the irrigation system.

##### **2.2. Plant Requirements**

Different plants require varying amounts of water. The design should ensure that water is distributed appropriately based on each plant's water requirements. The soil's ability to absorb and retain water should be considered in the irrigation design. Water application strategies are determined based on soil type. Water requirements may change depending on the growth stages of plants. The design should be flexible to accommodate these changes.

#### **2. Simulation and Analysis**

Simulation and analysis are critical steps for evaluating the performance of irrigation systems and testing the effectiveness of optimized designs Biswas et al., (2021),

##### **2.1. Simulation Tools**

Computational Fluid Dynamics (CFD): This technique is used to model water flow. CFD simulations allow for detailed examination of water flow in various sections of the irrigation system.

Fluid Dynamics Simulations: These simulations analyze how water moves and distributes across the soil. This helps evaluate the efficiency of water reaching plants.

Artificial Intelligence and Machine Learning: These technologies, used in optimization processes, can enhance the design process through data analysis and predictive capabilities.

## **2.2. Performance Analysis**

Water Efficiency: Optimized designs are evaluated in terms of their ability to increase water efficiency. The effectiveness of water use is analyzed.

Efficiency Comparisons: Differences between traditional irrigation methods and optimized designs are compared. This helps determine the impact on water savings and plant growth.

Cost-Benefit Analysis: A cost-benefit analysis is conducted to assess the feasibility and economic impacts of the design. This helps determine the practicality of the design.

## **2.3. Future Scenarios**

Scenario Analysis: Different water usage scenarios are simulated to test the performance of the irrigation system. This helps assess the design's resilience to variable conditions.

Dynamic Optimization: Dynamic optimization is performed considering changes in water needs and soil water retention capacity. This contributes to the long-term performance improvement (Liu et al., 2018).

The topological optimization approach is a powerful tool for achieving more efficient water use in irrigation systems. Carefully determining design criteria and effectively using simulation tools are critical for enhancing water efficiency and improving agricultural productivity. This approach can contribute to optimizing irrigation systems and promoting sustainable agricultural practices. Topological optimization applications in irrigation systems use various methods to improve the efficient distribution of water and the overall performance of the system (Anthony et al., 2014). Here are some topological methods and studies used in this field:

Optimal irrigation network design method involves optimizing the design of irrigation networks using topological optimization techniques. The goal is to ensure effective distribution of water. By optimizing the layout and connections of the water distribution network, water is delivered evenly to all plants, reducing water waste and improving efficiency. In some agricultural regions in the United States, irrigation networks designed using topological optimization have addressed distribution imbalances and increased crop yields.

Topological optimization is used in the design of drip irrigation systems to optimize the placement of emitters and the flow paths of water (Nvss et al., 2019). Ensures that drip points are placed optimally and that water reaches each plant in sufficient quantities. Additionally, adjustments are made according to soil infiltration rates. In Israel, applications of topological optimization in drip irrigation systems have significantly reduced water use and improved crop productivity. In the Maharashtra state of India, flow dynamics simulations have been utilized to optimize irrigation systems. These simulations have enabled more effective water distribution and improved system performance.

Topological optimization is integrated with flow dynamics simulations to analyze how water moves and distributes across the terrain. Performance of the irrigation system is evaluated through simulations of water flow paths, allowing for design improvements if necessary. In some large irrigation projects in India, flow dynamics simulations have been used to enhance the efficiency of irrigation systems (Ayamga et al, 2021). In California, topological optimization techniques have been used to improve the design of irrigation networks. This has resulted in more equitable water distribution and increased crop yields.

Advanced mathematical techniques and algorithms are employed to optimize the design of irrigation systems. These techniques optimize the distribution of water and minimize losses. They also enhance the flexibility of the irrigation system. In several agricultural projects across European countries, advanced optimization techniques have resulted in water savings and increased efficiency.



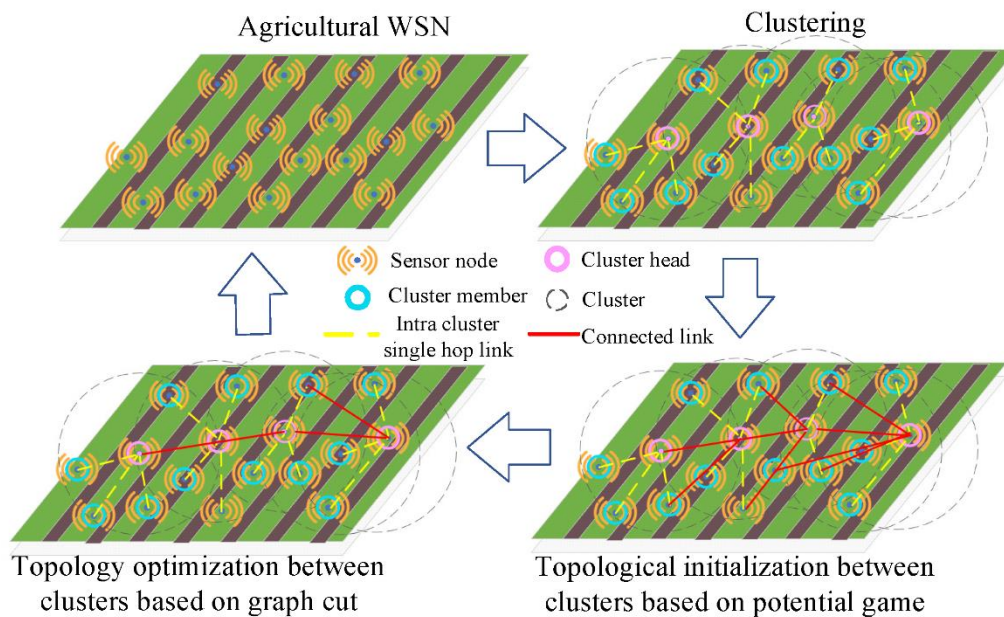
In the research (Ragab et al. 2022), a smart center-pivot irrigation and fertilization system was designed and implemented (Figure 3). The control system and subsystems were designed and explained. ESP32 was used as a microcontroller, and it was programmed using Arduino C. Internet of Things (IoT) and cloud server technologies were used to make the operation of this system smarter and more reliable. MQTT protocol was used to send and receive data from sensors to the web or mobile applications and vice versa. The data is monitored through mobile and web applications in real-time. In our proposed system we fixed several problems like the waste of water and the huge amount of wasted water so, they can know that their system's smartness comes from that it can decide whether it can start the irrigation process or not and also the needed amount of water depending on the needs of the Corp for water and also committing to the needs and the schedule for irrigating the plant itself and the number of fertilizers that are needed for the Corp itself and important thing that the system irrigation process can be blocked if like if there was raining it won't rain and the connectivity is very high and also we can use the system in manual mode.



**Figure 3.** Mobile Application's Design Flowchart (Ragab et al. 2022)

In order to meet the reliable transmission requirements of WSN in a complex agricultural environment, Wu et al. (2022) were studied the 2-connected fault-tolerant topology construction method based on clustering topology (Figure 4). By dividing the network into single hop effective clusters, similar sensed data are integrated to reduce redundant energy consumption. Considering the residual energy, node density, and expected lifetime, the double price function for CHs is constructed. When the residual energy is greater than the threshold, the price function  $u_1$  that can comprehensively optimize the network is used. Otherwise, the price function  $u_2$  with the goal of reducing the transmit power is adopted. Based on the double price function, this paper utilizes the potential game theory to initialize the topology between clusters. Then, cut vertex detection is used to eliminate the redundant links in the initial-inter cluster topology, which also ensures that the inter-cluster network is at least 2-connected. The fault-tolerant topology between clusters is conducive to the reliable transmission of important data. By comparing with different topology control methods, it is verified that this algorithm

can reduce the average transmit power, balance the energy consumption and effectively prolong the network lifetime.



**Figure 4.** Hybrid topology diagram to Wu et al. (2022) studies

A 16-year field experiment analyzed the impact of seven different irrigation schedules (ranging from W0M0 to W4M3, representing irrigation events in the wheat (W) and maize (M) seasons, each 75 mm) on water consumption, groundwater levels, total grain yield, water productivity (WP), irrigation water productivity (IWP), and marginal benefits in a winter wheat–summer maize double cropping system (Yang et al., 2022). The results showed that as irrigation input increased, total water consumption (ETa) also increased, with soil water storage contributing up to 30% of ETa for winter wheat under water deficit conditions. Pre-sowing soil moisture was crucial in enhancing annual yield and WP for both wheat and maize. Groundwater levels declined the least under rainfed conditions (W0M0) and the most under intensive irrigation (W4M3). The relationship between yield and irrigation followed a quadratic curve, with yields increasing up to a point and then stabilizing, while average annual WP decreased with more irrigation. Among the irrigation schedules, W2M1 was found to be the most balanced, optimizing groundwater sustainability, maintaining grain production, and improving water use efficiency.

The study evaluated three advanced deep learning models—LSTM, 1D-CNN, and ConvLSTM—to predict daily ETo over a seven-day period using weather data from three stations on Prince Edward Island, Canada (Farooque et al., (2022). The ConvLSTM model outperformed the others, achieving the lowest root mean square error (RMSE) values in calibration and validation. These results suggest that the ConvLSTM model is particularly effective in providing accurate ETo forecasts, which can aid in sustainable water management and irrigation planning.

Several studies have demonstrated the effectiveness of topological design in improving water efficiency in field crop irrigation. For example, the application of optimized drip irrigation networks has resulted in significant water savings while maintaining or even improving crop yields. In one study, a topologically optimized irrigation system reduced water use by up to 30% compared to traditional methods, without compromising the productivity of maize crops. Similarly, the use of computational fluid dynamics (CFD) in the design of irrigation networks has allowed for the simulation of various water distribution scenarios, leading to the

development of highly efficient systems tailored to specific field conditions. These systems not only improve water use efficiency but also reduce operational costs associated with water pumping and energy consumption.

While topological design offers substantial benefits, its implementation is not without challenges. The initial design process can be complex, requiring detailed knowledge of field conditions, crop water requirements, and hydraulic principles. Additionally, the integration of advanced technologies, such as sensors and automation systems, is essential for real-time monitoring and adjustment of water distribution, adding to the cost and complexity of the system.

Future research should focus on developing more accessible tools and methodologies for topological design in irrigation, making it easier for farmers to adopt these systems. Additionally, the potential for integrating topological design with precision agriculture technologies should be explored to further enhance water efficiency and crop productivity.

### **Conclusion**

Topological design offers an innovative approach to achieving more efficient water use in irrigation systems. While traditional irrigation methods often lead to uneven water distribution and waste, topological design ensures that water is distributed more evenly and effectively across the field. This approach not only enhances water efficiency but also optimizes agricultural productivity, improving plant health and yield. Integrating topological design into field crop irrigation promotes agricultural sustainability and contributes to the conservation of water resources. This design approach is particularly crucial in regions facing water scarcity, as it allows for optimal use of water resources, helps maintain groundwater levels, and supports sustainable soil management. Moreover, reducing the energy required for water transportation lowers the operational costs of irrigation systems and minimizes environmental impacts.

The widespread adoption of topological design in agricultural irrigation promises long-term economic and environmental benefits. By embracing such advanced design techniques, farmers and water management experts can achieve higher yields with less water. Additionally, this approach is expected to play a significant role in addressing challenges such as climate change and increasing water demand. In the future, integrating topological design with other innovative agricultural technologies could further enhance water efficiency and set a new standard in agricultural production. In this context, collaboration between academic research and practical applications is vital to fully realize the potential of topological design and maximize water efficiency in agriculture.

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## ANTEPFISTIĞI (*Pistacia vera* L.)'NDA PERİYODİSİTE VE BUDAMANIN PERİYODİSİTEYE ETKİLERİ

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### Özet

Antepfıstığı (*Pistacia vera* L.), dünya üzerinde yetiştiriciliği çok fazla olan bir meyve türüdür. Her bitkide olduğu gibi antepfıstığının da yetiştiriciliği yapılırken sorunlar ortaya çıkmaktadır. Bunlardan biri de periyodisitedir. Periyodisite meyve türlerinde görülen bir fizyolojik olay olup meyve ağaçlarının bir yıl bol meyve verirken bir sonraki yıl ya hiç ya da az meyve vermesi olarak tanımlanmaktadır. Yapılan araştırmalarda periyodisite eğilimi diğer türlere göre fazla olan antepfıstığında, bundan dolayı üretici ve tüketici özellikle pazarlamada sorunlarla karşılaşmaktadır. Pek çok farklı nedenden dolayı oluşan periyodisitenin tamamen ortadan kaldırılması mümkün olmadığı araştırmalar sonucu gözlemlenmiştir. Bunun yanında farklı uygulamalar ile en aza indirmek mümkün olduğu gözlemlenmiştir. Bu uygulamalardan biri de budamadır. Kültürel olarak en iyi sonucu veren uygulama olarak kullanılan budamada periyodisite mümkün olduğunca azaltılabilmektedir.

**Anahtar Kelimeler:** Antepfıstığı, *Pistacia vera* L., periyodisite, budama,

## PERIODICITY AND THE EFFECTS OF PRUNING ON PERIODICITY IN PISTACHIO

### **Abstract**

Pistachio (*Pistacia vera* L.) is a type of fruit with a very high number of cultivation in the world. As with every plant, problems arise during the cultivation of pistachios. One of these is periodicity. Periodicity is a physiological phenomenon seen in fruit species and is defined as fruit trees producing abundant fruit one year and either no or little fruit the next year. According to the researches, pistachio has a higher tendency to periodicity compared to other species, and therefore, producers and consumers face problems especially in marketing. It has been observed as a result of researches that it is not possible to completely eliminate periodicity caused by many different reasons. However, it has been observed that it is possible to minimize it with different practices. One of these practices is pruning. Periodicity can be reduced as much as possible in pruning, which is culturally used as the best practice.

**Keywords:** *Pistacia vera*, periodicity, Pistachio, pruning

## 1. Giriş

*Pistacia vera* L., anacardiaceae familyası içerisindeki *Pistacia* cinsine ait bir tür olup ülkemizde antepfıstığı olarak bilinmektedir. Dünyada ABD, İran, Türkiye, Çin gibi pek çok ülkede yetiştirilmektedir. Ülkemizde başta Güneydoğu Anadolu Bölgesi olmak üzere yetiştiriciliği yaygın olarak yapılan bir meyve türüdür (İkinci ve ark., 2022). Türkiye’de antepfıstığı yetiştiriciliğinin %90 gibi büyük bir bölümü bu bölgede yapılmaktadır. Bölgenin kurak ve besin elementi bakımından fakir topraklarında yetişen antepfıstıkları, bu koşullardan dolayı periyodisite eğilimi göstermektedir (Fırtına, 2011).

Periyodisite, pek çok meyve türünde görülen ürün kalitesi, verimi ve ekonomik açıdan hem üreticiyi hem de tüketiciyi etkileyen fizyolojik bir olaydır. Periyodisitenin görüldüğü meyve türlerinden biri de antepfıstığıdır. Bunun yanında antepfıstığında karşılaşılan en önemli sorunlardan biridir (Karcı ve Kafkas, 2022; Gündeşli, 2017). Antepfıstığında periyodisiteden dolayı verim her yıl aynı olmadığından düzensiz verimi de beraberinde getirmektedir. Bu durum ekonomik anlamda üreticiyi ve tüketiciyi etkilemektedir (Karcı ve Kafkas, 2022; Aslan, 2018). Meyve üretiminde karşılaşılan sorunlardan biri olan periyodisite; meyve genetiğinin yanında, beslenme, sulama, budama, gübreleme gibi bitki ihtiyaçlarının ne kadar olacağını da etkileyerek meyveye doğrudan etki eden bir faktördür. Antepfıstığında periyodisiteyi azaltmakta bu faktörlerin etkili olduğu düşünülmektedir (Köksal ve ark., 2003).

Bu çalışmada antepfıstığında da görülen, üreticiyi ve verimi etkileyen periyodisite anlaşılmasına çalışılacaktır. Bu sebeple periyodisiteye neden olan koşullar ve etmenlere değinilmiş, bununla birlikte budamanın periyodisite üzerinde ne gibi etkileri olduğuna yer verilmiştir. Daha net anlaşılması amacıyla konuyla ilgili kaynaklar derlenmiştir.

## 2. Materyal Ve Metot

### 2.1. Materyal

Bu çalışmanın materyalini ulusal veri tabanlarında yayınlanmış ve anahtar kelimesi “antepfıstığı, periyodisite, budama, antepfıstığında periyodisite ve antepfıstığında budama” olan çalışmalar oluşturmuştur. Erişilen dijital belgeler değerlendirilerek konuyu oluşturan bölümler derlenmiştir. “Antepfıstığında periyodisite ve budamanın periyodisiteye etkileri” adlı bu çalışmada nitel araştırma yöntemlerinden metin analizi ve belge incelemesi yöntemleri kullanılmıştır. Bunlardan metin analizi yöntemi; yazılı veya sözlü metinlerin içeriğinin sistemli bir şekilde analiz edilmesi, belge incelemesi yöntemi ise kullanılan yazılı materyallerin incelenmesidir.

### 2.2. Metot

Çalışmada konu ile alakalı ulusal ve uluslararası literatür gözden geçirilmiş olup detaylı bir araştırma ile konu açıklanmaya çalışılmıştır. Bu çalışmada kullanılan kaynaklara ulaşımında yükseköğretim kurumlarının veri tabanlarında bulunan çalıştay ve sektör raporları, panel ve seminer bildiri kitapları, ulusal tez merkezinde yayınlanmış yüksek lisans ve doktora tezleri, internet kaynakları, dergiler ve kitaplar kullanılmıştır. Veri tabanlarında Türkçe anahtar kelimeler ve yerler aratılarak gerekli bilgilere ulaşılmış ve söz konusu bilgiler bu çalışmada derlenerek sunulmuştur.

Çalışmanın amacı, Antepfıstığında periyodisite ve budamanın periyodisite üzerindeki etkileri ile ilgili çalışmalarını incelemek ve derleyerek literatüre tek bir çalışma ile katkı sağlamaktır.

## 3. Antepfıstığı (*Pistacia vera* L.)’Nda Periyodisite Ve Budamanın Periyodisiteye Etkileri

Ülkemizde antepfıstığı olarak bilinen *Pistacia vera* L., spindales takımı içerisindeki anacardiaceae familyasından *Pistacia* cinsine ait bir meyve türüdür. Kültüre alınan ilk meyve türlerinden olup, İlk olarak Hititler döneminde Güneydoğu Anadolu bölgesinde kültüre alındığı bilinmektedir. Bunun yanı sıra o dönemlerde kral sofralarında da yer aldığı bilinen zengin bir

meyve türü olmakta ve günümüzde de yeşil altın, meyveler kralı, altın ağaç ve kral meyvesi gibi farklı isimlerle alındığı bilinmektedir. Dioik bir tür olup sert kabuklu bir meyvedir (Aslan, 2018; Yalçın, 2020). Antep fıstığı (*Pistacia vera* L.), *Pistacia* cinsi içerisinde meyveleri tüketilen ve ekonomik değeri olan tek tür olarak nitelendirilmektedir. Antepfıstığı dışındaki diğer türler ise, Menengiç (*Pistacia terebinthus* L.), Buttum (*Pistacia khinjuk* Stocks.) ve Atlantik Sakızı (*Pistacia atlantica* Desf.)'dır (Yalçın, 2020; Fırtına, 2011).

Yakın Doğu ve Orta Asya olmak üzere dünyada iki gen merkezi bulunmaktadır. Bunlardan ilki olan ve ülkemizin de içerisinde yer aldığı Yakın Doğu Gen Merkezi, Anadolu, İran, Kafkasya ve Türkmenistan'ı kapsamaktadır. İkincisi ise Hindistan'ın kuzeyi, Pakistan, Afganistan ve Tacikistan'ı kapsamaktadır (Aslan, 2018; Anonim, 2010; Tekin ve ark., 2001).

Dünya üzerinde antepfıstığı üretimi sırasıyla İran, Amerika ve Türkiye başta olmak üzere, Suriye, Çin ve Yunanistan gibi ülkelerde yetiştirilebilmektedir. Ülkemizde ise antepfıstığı, özellikle fıstık üretimine uygun iklim koşullarına sahip Güneydoğu Anadolu Bölgesinde yetiştirilmektedir. Gaziantep, Siirt, Şanlıurfa, Kahramanmaraş ve Adıyaman başlıca antepfıstığı üretimi yapılan illerimizdir (Gündeşli, 2017; Aslan, 2018).

Ülkemizde ekonomik anlamda da önemli bir meyve türü olan antepfıstığı yetiştiriciliğinde en önemli sorunlardan biri periyodisitedir. Periyodisite; fizyolojik bir olay olup meyve ağaçlarında görülen ve ağacı bir yıl meyve verip diğer yıl ya az ya da hiç vermemesidir (Çeçan, 2022; Aslan, 2018; Karcı ve Kafkas, 2022; Gündeşli, 2017). Periyodisite çok düşük ve çok yüksek sıcaklıklarda daha fazla görülmekle birlikte verim ve kaliteyi olumsuz etkilemektedir (Aslan, 2018). Bununla birlikte antepfıstığında görülen periyodisite yıllara ve ülkelere göre üretimde farklılıkları da beraberinde getirmektedir. Ülkemizde kurak koşullarda yetiştirilmesine karşın, antepfıstığı yetiştiriciliğinde lider olan İran ve ABD'de ise sulu koşullarda ve geniş arazilerde yetiştirilmektedir. Bu nedenle ülkemizde periyodisite daha fazla görülmekte dolayısıyla ürün verimi daha az olmaktadır (Gündeşli, 2017).

Meyve yetiştiriciliğinde karşılaşılan periyodisiteye etki eden pek çok unsur bulunmaktadır. Bunların başında bitkinin genetik özellikleri, aldığı besin madde ve miktarları, sulama, gübreleme, budama gibi unsurlar bulunmaktadır. Dolayısıyla araştırmacılara göre periyodisiteye etki eden bu unsurların periyodisitenin azaltılmasında da etki ettiği açıklanmaktadır (Köksal ve ark., 2003).

Alternans olarak da bilinen periyodisite meyve ağaçlarında mutlak ve kısmi periyodisite olmak üzere iki şekilde görülmektedir. Bir yıl bol ürün verip ertesi yıl hiç ürün vermiyorsa mutlak periyodisite, ertesi yıl az meyve veriyor ise kısmi diğer adıyla oransal periyodisitedir (Aslan, 2018). Antep fıstığında periyodisite çeşide göre farklılık göstermektedir. Örneğin; Siirt ve Ohadi çeşidinde kısmi/oransal periyodisite görülürken Uzun ve Kırmızı çeşidi mutlak periyodisite göstermektedir (Aslan, 2018; Karcı ve Kafkas, 2022). Bununla birlikte yine antepfıstığında çeşit, ağaç yaşı, yetiştirme ve çevre koşulları gibi etmenlere bağlı olarak periyodisite ölçüsü farklılıklar göstermektedir. Genç ağaçlarda daha az görülebilirken daha yaşlı ve kuru ağaçlarda periyodisite daha fazla görülmektedir (İkinci ve ark., 2022). Bu farklılıkların nedeninin genetik yapısından kaynaklandığı gözlenmiştir. Yine aynı şekilde yetiştiricilikte kullanılan anacın da periyodisiteyi etkilediği bilinmektedir (Karcı ve Kafkas, 2022).

Diğer meyve türlerinin aksine antepfıstığında çiçek gözleri her yıl çok fazla oluşmaktadır. Ancak verim yılı ya da var yılı olarak adlandırılan verimin bol olduğu dönemlerde, oluşan bu çiçek gözlerinin döküldüğü görülmektedir. Bu nedenle diğer meyvelerde görülen aksine antepfıstığında oluşan periyodisite, yetersiz çiçek gözü oluşumundan dolayı değil, meyve içi dolumunun başladığı zamanda çiçek gözlerinin dökülmesinden dolayı görülmektedir. Antepfıstığında görülen periyodisite konusunda yapılan araştırmalar sonucu iki farklı görüş sunulmuştur. Bunlardan biri meyve ve çiçek gözleri arasındaki karbonhidrat-azot dolayısı ile oluşan gözlerin dökülmesidir. Diğerisi ise meyve ve ya



yapraklarda salgılanan içsel büyüme düzenleyici maddelerin neden olduğu dökülmelerdir (Karcı ve Kafkas, 2022).

Ağaçta meyve toplamı periyodisite var ve yok yılları arasında önemli ölçüde farklılık göstermektedir. Verimin fazla olduğu var yıllarında ürün fazla olmasına karşın küçük boyutlu ve meyve rengi tam olmamakla birlikte, verimin az olduğu ya da hiç olmadığı yok yıllarında ise ürün az ancak boyutları büyüktür. Bundan dolayı yok yıllarında oluşan meyvelerde fizyolojik anormallikler görülebilmektedir. Bu durumlar iki durumda da üreticiyi pazarlama açısından etkilemektedir (Aslan, 2018; Karcı ve Kafkas, 2022). Bunun yanında periyodisitenin meyvenin olgunlaşması, tutumu ve çiçek tomurcukları üzerinde de olumsuz etkileri bulunmaktadır. Hormon, besin maddeleri, karbonhidrat ve mineral maddeler, genetik özellikler gibi içsel faktörlerin yanı sıra su, sıcaklık, iklim, dışarıdan verilen alınabilir besin maddeleri gibi abiyotik ve biyotik stres faktörleri, dışsal faktörler periyodisiteye neden olan etmenlerdir (Karcı ve Kafkas, 2022; Aslan, 2018). Fıstık ağaçlarında karbonhidratın da dökülmelerde önemli rolü bulunmaktadır. Çiçek gözleri ve yapraklarda sükröz alımından sonra kök ve sürgünlerdeki nişasta eksilmesi de gözlerin dökülmesine neden olmaktadır. Meyve gelişiminde de önemli olan karbonhidratın, meyve içi dolusunda azalması dolayısıyla oluşan gözlerin karbonhidrat alamaması sonucunda dökülmesine neden olarak periyodisiteyi tetiklemektedir (Karcı ve Kafkas, 2022).

Antepfıstığı yetiştiriciliğinde karşılaşılan en önemli sorunlardan biri şüphesiz periyodisitedir. Antepfıstığında görülen periyodisitede; kurak koşullarda yetişmesinden ötürü yetersiz ve dengesiz beslenmede meyve, gözler ve yapraklar arasındaki beslenme yarışında çoğunluğu meyvenin almasından dolayısıyla da gözlerin yetersiz beslenmesinden oluşmaktadır (Fırtına, 2011). Don, kuraklık, tuz, hastalık, zararlı, stres gibi çevresel unsurların da periyodisite üzerinde önemli etkileri bulunmaktadır. Tüm stres faktörlerinin antepfıstığında periyodisiteye neden olan karagöz dökümlerini etkilediği görülmüştür. Tüm bu çevresel faktörlerin iç faktörleri etkileyerek periyodisiteyi tetiklediği gözlemlenmiştir. Yine aynı şekilde tozlanma ve dölleme üzerinde doğrudan veya dolaylı şekilde etkisi olan don ve kuraklık da periyodisiteyi arttırmaktadır (Karcı ve Kafkas, 2022).

Tüm bunları önleyebilmek amacıyla periyodisiteye karşı önlem alınması gerekmektedir. Tamamen ortadan kaldırmak mümkün olmasa da bazı uygulamalar ile antepfıstığında periyodisite azaltılabilir. Antepfıstığında düzenli olarak yapılacak gübreleme, sulama ve budama gibi işlemler ile periyodisiteyi azaltabilmek mümkündür. Bununla birlikte tarımsal alandaki yeniliklerle birlikte içsel etmenlerin periyodisiteye etkileri incelenebilmekte bunlara karşı da önlemler alınabilmektedir. Yapılabilecek kültürel uygulamalardan biri ve en önemlisi de budamadır (Kafkas ve Karcı, 2022; İkinci ve ark., 2022). Budamada yapılan çiçek salkımlarının seyreltilmesi ve bilezik alma ile çiçek gözlerinin dökümü azaltılabilir. Özellikle ülkemizde üreticiler ilkbaharda yaptıkları budamalarda çiçek salkımları 3-5 cm kadar büyüdüğünde, bir yıllık dallarda tek bir salkım kalacak şekilde elle seyreltme yapmaktadır. Bu uygulama ile periyodisiteyi azaltabilmişlerdir. Bunun yanında erken hasat yapılarak da periyodisite azaltılabilmektedir. Ancak bu durum antepfıstığında meyve çitlomasında azalmaya neden olmaktadır. Bunlara ek olarak üretici periyodisiteden kaçınmak amacıyla bazı önlemler de almaktadır. Bunlar; özellikle periyodisiteye yatkın çeşitleri mümkün olduğunca kullanmamak, uygun sulama yöntemleri uygulamak, gübreleme, hastalık ve zararlılarla mücadele etmek, yetiştirme koşullarına uygun anaç seçmek ve düzenli budama yapmaktır. (Karcı ve Kafkas, 2022; Çeçan, 2022).

Yine verimin bol olduğu yılda yapılan hasat sonrasındaki uyku döneminde yapılacak sert budamanın periyodisitede önemli rolü bulunmaktadır. Bu uygulama ile verimin az olacağı sonraki yılda oluşacak çiçek gözlerinin vejetatif büyümesi tetiklenir. Bunun yanında yapılan sert budama verime etkisi olmasa da meyve ağırlığı ve çitlama oranını olumlu yönde etki ettiği görülmektedir. Buna ek olarak antepfıstığı ağaçlarının en üst kısımlarına yapılan sert budama

işlemi sürgünlerin büyümesine etki ederek periyodisiteyi indirgediği gözlemlenmiştir. Yine budamanın yanında bilezik alma uygulamasının da antepfıstığında periyodisite azaltıcı uygulama olarak kullanıldığı bilinmektedir. Bu işlem ile karagöz dökülmeleri azaltılarak neden olduğu periyodisite de azaltılmaktadır (Karcı ve Kafkas, 2022; Çeçan, 2022). Bunun yanında periyodisite var yılında alınan meyve miktarına göre de değişikli göstermektedir. Bu nedenle periyodisitenin minimum seviyeye indirilmesi için antepfıstığında budama düzenli olarak yapılmalıdır. Budamanın amaçlarından biri de periyodisiteyi mümkün olduğunca azaltarak verimin her yıl düzenli olmasını sağlamaktır (İkinci ve ark., 2022).

#### 4. Sonuç

Ülkemizde antepfıstığı olarak bilinen *Pistacia vera* L., üretimi yaygın olarak yapılan bir meyve türüdür. Ülkemizde daha çok Güneydoğu Anadolu Bölgesinde yetiştiriciliği yapılmakla birlikte, dünya üzerinde de sırasıyla ABD, İran, Türkiye ve Çin’de yaygın olarak yetiştirilmektedir. Yetiştiriciliğinde en fazla görülen ve üreticiyi sıkıntıya sokan sorunu ise periyodisitedir.

Meyve türlerinde görülen ve fizyolojik bir olay olan periyodisite, ağaçların bir yıl bol meyve verip ertesi yıl hiç meyve vermemesi ya da az meyve vermesi olayıdır. Ülkemizde ve dünyada üretimi fazla olan antepfıstığında da karşılaşılan sorunlardan biridir. Özellikle verim dolayısıyla pazarlamada soruna neden olmaktadır. Dış pazara açılmamanın yanında, verimin bol olduğu Var yıllarında ürün bol olmasına karşın fiyatlar fazlasıyla düşük olmaktadır. Verimin az ya da hiç olmadığı Yok yıllarında ise antepfıstığı bulunamamaktadır.

Antepfıstığında görülen periyodisitenin nedenlerine bakıldığında, diğer meyve türlerinin aksine periyodisite ağacın her yıl bol ürettiği çiçek gözlerinin dökülmesinden kaynaklanmaktadır. Bir diğer neden ise antepfıstığının genetik özellikleridir. Örneğin Ohadi ve Siirt çeşitlerinde az ürün vermesi olarak tanımlanan kısmi periyodisite gösterirken, Kırmızı, Uzun ve Halebi çeşitleri ise hiç ürün vermemesi olarak tanımlanan mutlak periyodisite göstermektedir.

Genetik özelliklerinin yanında içsel ve dışsal etmenlerden dolayı da periyodisite görülmektedir. Bu faktörlerden bazıları; besin elementi eksiklikleri, iklim özellikleri, gübreleme, budama, sulama, aldığı besin madde ve miktarlarıdır. Periyodisiteyi minimum seviyeye indirebilmek bu faktörlerle mümkün olabilmektedir. Ancak tamamen ortadan kaldırmak şuan için yapılan araştırmalarla mümkün olmamaktadır.

Bu faktörlerden budama periyodisiteyi azaltabilmek için kullanılan en önemli kültürel yöntemdir. Budama ile çiçek salkımlarında seyreltme yapılarak fıstıkta periyodisiteye neden olan karagöz dökümleri azaltılabilir. Yine aynı şekilde bilezik alma yöntemi ile de bu mümkündür. Bunun yanında elle yapılan budama ve sert budamalar çiçek gözlerindeki vejetatif büyümeyi tetikleyerek periyodisitenin azaltılabilmesine olanak sağlamaktadır. Tüm bunlara ek olarak periyodisiteyi minimum seviyede tutmak için düzenli budama yapılmalıdır.

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## SANAT VE TASARIM BAĞLAMINDA GELENEKSEL ERZURUM EHRAM DOKUMASINA GENEL BİR BAKIŞ

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### **Özet**

Ehram, Erzurum ve civarında kullanılan geleneksel bir kadın giysisidir. Belirli bir tasarım aşamasından geçerek Anadolu giyim kültürüne değerli katkılar sunan ehram dokuması, bugün neredeyse kaybolma noktasına gelmiştir. Tamamı koyunyününden olan bu geleneksel dokuma, koyunyününün doğal renkleriyle ve yünün ince bir formda bükülerek dokunmasıyla elde edilmektedir. Düz ve desenli-nakışlı olarak iki türü bulunan geleneksel Erzurum ehramları, bez ayağı dokuma tekniği ile dokunmaktadır. Düz ehramlarda nakış olmazken desenli ehramlarda nakış zemin atkılarının arasına sokulan renkli yün ve pamuk ipliklerinin tezgâh üzerinde işlenmesi sonucunda elde edilir. Tezgah eninde ve iki kanat şeklinde dokunan ehram, kenar şeritlerinde haşiye adı verilen bir nakış ile desenlendirilmektedir. Haşiye nakışının yanı sıra desenli ehramlar da yollu, serpme ve kaplama olarak adlandırılan üç farklı nakış desenlendirme tekniği kullanılmaktadır. Serpme adı verilen desenlendirme de nakışlar dokumaya serpiştirilerek, yollu desenlendirme de nakışlar yol yol çizgiler halinde dokumaya işlenerek, kaplama şeklinde desenlendirme de ise nakışlar ehram yüzeyini kaplayacak şekilde desenlendirilmektedir. Çalışma da geleneksel Erzurum Ehramının dokuma özelliklerinin neler olduğu, yöredeki kullanımı, tezgah yapısı, renk ve motif-nakış özellikleri dokumanın tarihsel, sanatsal ve tasarımsal alt yapısında incelenmiştir.

**Anahtar Kelimeler:** Ehram dokuması, Erzurum, dokuma özellikleri

## A GENERAL VIEW OF TRADITIONAL ERZURUM EHRAM WEAVING IN THE CONTEXT OF ART AND DESIGN

### **Abstract**

Ehram is a women's garment that is used in Erzurum and its surroundings. Today, it has almost come to the point of extinction. It offers valuable contributions to Anatolian clothing culture by going through a certain design stage. This traditional weaving is entirely made of sheep wool and it is obtained with the natural colors of sheep wool and by twisting the wool in a thin form. There are two types as plain and patterned-embroidered. These ehrams are woven with the cloth foot weaving technique. There is no embroidery in plain ehrams, but there is embroidery in patterned ehrams, which are obtained as a result of processing colored wool and cotton threads inserted between the ground wefts on the loom. The ehram, which is woven in the width of the loom and in the form of two wings, is patterned with an embroidery called hashiye on the edge strips. Patterned ehrams are used in three different techniques, which are called path, scattering and coating. In the patterning called scattering, the embroidery is scattered on the fabric, in the path patterning, the embroidery is processed on the fabric in lines and paths, and in the covering patterning, the embroidery is patterned in a way that covers the surface of the ehram. The study also examined the weaving characteristics of the traditional Erzurum Ehram, its use in the region, the loom structure, color and motif-embroidery features in the historical, artistic and design infrastructure of the weaving.

**Keywords:** Ehram weaving, Erzurum, weaving features Erzurum

## 1. Giriş

Moda ve giysi kavramı, ulusların geçmiş ve gelecekleri arasında bir köprü görevi üstlenmiş sembolik ve kültürel unsurlarla birlikte toplumların sosyal yaşantısında gelişerek bu günkü son şeklini almıştır. Önceleri bir ihtiyaç olarak karşımıza çıkan giyim olgusu hızla gelişen teknolojiyle birlikte bir sanat ve tarz haline almış, zengin renk ve motif altyapısıyla beraber, ulusların ve toplumların sosyal yapısını da gösterir hale gelmiştir. Bu bağlamda Anadolu, Türk kültürünün ve tarihinin gelişimine yüzyıllar boyunca katkıda bulunmuş birçok sanatçı için de Türk kültür mirasına ev sahipliği yapmıştır. Anadolu da geçmişi çok eskiye dayanan ehram (ihram) dokumaları özellikle

Erzurum ve Bayburt yöresinde dokunan ve yöre kadınları tarafından dış giyimde kullanılan yöreye has bir giysi türüdür. Geleneksel Türk dokumaları arasında yer alan ehram (ihram) dokumaları, koyunyünün belli aşamalardan geçirilerek iplik haline getirilip dokunması suretiyle elde edilir. Kullanıcısının yaş ve sosyal durumunu ortaya koyan ihram dokumaları genç kızların gelinlerin orta yaş ve yaşlıların yöre içinde giyindikleri yalın, gösterişsiz bir giysi türü olduğu kadar, dokumalarda kullanılan renk ve motif çeşitliliği ile oluşturulan yüzey doku özellikleriyle de günümüz Türk moda tasarımcılarının ilgi odağı haline gelmeyi başarmıştır.

Kaynaklarına göre çeşitlilik gösteren ehram motifleri, yüzey kompozisyonuna göre serpmeye, sıralı ve kaplama olarak üç bölüme ayrılmaktadır. Bunlar; ceviz kanadı, reyhan dalı, kişniş çöpü, elma şeleği, pirinç deni, mercimek gibi bitkisel kaynaklı motifler, çark yıldızı, haşiye, antika, elmas küpe, aynalı kutnu, ceylan boynuzu, arı dala kondu, yıldızın oynayışı, uçun kuş, saat kordonu gibi figürlü, karışık ve nesneli bezemeler olarak isimlendirilmektedir. Tüm bu özellikleriyle ihram, Türk dokuma sanatının dünya kültürüne tanıtılması noktasında milli ekonomimize katkıda bulunacağı düşünülmektedir.

Çalışmanın amacı; kaybolmaya yüz tutmuş Geleneksel Türk el dokumalarından biri olan ehram (ihram) dokuma sanatını renk, motif ve dokuma teknikleri açısından inceleyerek literatüre katkı sunmaktır.

## 2. Erzurum Ehram Dokuması

Türk Sanatı gerek Anadolu'da ve gerekse Türklerin yaşamış olduğu diğer coğrafyalarda birçok eser ortaya koymuştur. Bunlar mimariden geleneksel sanatlara, resimden giyim kültürüne kadar çok çeşitli alanlarda olmuştur. İslamiyet öncesi ve sonrası Türk Sanatını ortaya koyma bakımından oldukça zengindir. Sanatın yayıldığı coğrafyalar birbirine uzak bölgeler olsa da motifler, desenler, kesimler ve birçok tasarım unsuru bugün bütünlüğünü ve birbirinin devamlılığını korumaktadır. Bunda Türkler tarafından kurulmuş ülkelerin hâkim unsur olarak sanat ve tasarıma kattıkları değerlerin de katkısı büyüktür. Hiç şüphesiz bunda diğer ülkelerden gelen sanatçıların ve zengin medeniyetlere ev sahipliği yapmış zengin Anadolu kültürü de önemli bir rol oynamıştır.

1071 Malazgirt zaferinden sonra kısa bir süre içinde Anadolu'ya hakim olan Türkler, kuvvetini kendi tarihinin derinliklerinden alan Anadolu Türk Sanatını (Aslanapa, 2017: 101) yücelterek yüksek bir sanat bırakmışlardır. Anadolu da ilk Türk mimari eserleri; Malatya, Kayseri, Sivas'da Danişmenliler (1092-1178), Mardin ve Diyarbakır'da Artuklular (1098-1234), Erzurum'da Saltuklular (1092-1202), Erzincan'da Mengücekliler (1118-1252) tarafından yapılmıştır.

Erzurum İbn-el- Esir'de "Erzen al Rum" şeklinde tanımlanmaktadır. Tarihi geçmişi beşinci yüzyıla kadar uzanan şehir, beslendiği Anadolu kültürüyle birçok alanda eser bırakmıştır. Bunlardan biri de dokumalardır. Erzurum ehram dokuması olarak bilinen bu dokuma, halkın giyim kültüründe büyük bir öneme sahip kültürel bir mirastır. Bu dokuma Erzurum kadınlarının sokakta giydikleri bir tür dış giyimdir. Ehram dokumasının dışında birçok geleneksel giysisi de yüzyıllar boyunca giyilmiş ve bugün şehrin kültürel yapısının zengin izlerini taşımaktadır.

Erzurum da uzun süren kış şartları yörede oturan halkın giyim şeklini etkilemiştir. Erzurumlu kadınlar geleneksel giysilerinin üzerine sokakta giydikleri ehram dokuması ile

tamamlamışlardır. Birçok tarihi kaynakta isminden sıklıkla bahsedilen ehram, Erzurum geleneksel kadın giyiminin önemli parçalarından biridir. İslamiyet'in emir ve yasaklarının giyim kültüründe de etkili olması ehramı hem bir inanç kültürü hem de soğuktan korunmanın bir aracı yapmıştır. Şehrin uzun tarihi geçmişi de giyim çeşitliliğini zenginleştirmiştir. Ehram tamamı koyunun saf yününden elde edilen bir dokumadır (Görsel 1).



**Görsel 1.** Erzurum Ehram dokumasının yöredeki kullanım şekli (Kayserili, 2014; Elibol ve Sari, 2021: 15).

El tezgâhında bez dokuyan kimseye “çulha” denilmektedir (TDK, 2024). Kimi yerde çulfa olarak da geçen yerele özgü bir tanımlaması da bulunmaktadır. Bugün dokuması azalmış olan ehram, yörede dokunmaya devam etmektedir. Geleneksel bir giysi olan ehram, günümüz araştırmacıları tarafından incelenmekte ve içinde bulunduğu sorunsallık araştırılmaktadır. Bu bağlamda ehram dokumasını günümüze taşıyan giysi formlarında geleneksel kimliğinin bozulmadan yaşatılması temel hedefler arasındadır.

Ehram, tamamen koyunyününden dokunmuş tek parça halinde bir giysidir. Eskiden ehramlar çulfalar tarafından sokağa dikilen 80-90 cm boyutlarındaki tezgâhlarda, ellerindeki iplik yumağını gerip ehramı dokurlardı (Dilmaç, 2013: 99). El işçiliği ile dokunan ehramın kalitesini ehramda kullanılan ipliğin inceliği belirlemektedir. Dokuması tamamlanmış bir ehram; 90-100 cm eninde olup uzunluğu beş metredir. Ölçü sistemi olarak yörede halebi denilen bir ölçülendirme ile ehram boyu ayarlanmaktadır. Ehramın dokuma ve tezgâh özellikleri şunlardır: Dokumanın atkı ve çözgü ipeinde tamamı koyunyününden olan iplik kullanılır.

İki ayaklı tezgâhta iki tarak mevcuttur. Tarak genişliği aynı zamanda dokumanın genişliğidir.

Dokumanın atkı ve çözgüsünde 1 cm<sup>2</sup>'ye en az 9, en çok 14 tel düşmektedir.

Kullanılan iplik numarası 1- 12 numara aralığındadır.

Tezgâhta; dağ, oturak, ikinci oturak, ayakça, kuşlar, kol, tüfe, mitit, mekik, masura, selman, sabitleme demiri, dehdün, ehram tarağı, tahsil değneği ve gücü adı verilen parçalar kullanılmaktadır (Görsel 2).



**Görsel 2.** Ehram tezgahı, <https://www.kenanyavuzetnografyamuzesi.org/ehram-tezgahi/>, Erişim tarihi: 01.08.2024.

Tokaç yardımıyla dövülerek temizlenen koyunyünü, tam kurutulmadan hafif nemliyken yün çubuğu yardımıyla aralıklı olarak çırpılarak yünün artıklardan ayrılarak temizlenmesi sağlanır. Çırpılarak kurutulan ehram aynı zamanda elle didilerek yünün içinde bulunduğu topaklanması engellenir ve gün ısısında yünler kurumaya bırakılır. Temizlenen koyunyünü ardından yün tarağı adı verilen geniş bir tarak yardımıyla taranır ve taraktan geçirilen yün tutamları üst üste gelecek şekilde avuç içiyle tarama işlemine devam edilir (Görsel 3-Sol). Taranan yünler sümek haline getirilir ve sümek haline getirilen yünler dokuma esnasında kullanılır. Sümek dışında kalan ve dokumada kullanılmayacak yünler, mitil denilen yorganların yapımında kullanılmak için ayrılır. Yıkanmış, ayıklanmış ve taranmış yün sümekleri, teşi (Görsel 3-Sağ) adı verilen büküm araçlarıyla iplik haline getirildikten sonra bükümü yapılan yün iplikler kelepçe adı verilen aletle teşideki iplikler sardırılarak kelep haline getirilir. Kelepler, çiriş adı verilen bir sıvıya batırılarak ipliklerin sağlamlaştırılması sağlanmaktadır. İplik haline gelen kelepçeler daha sonra dokumak üzere tezgaha alınır ve dokuma işlemine başlanır.



Görsel 3 (Sol). Yün tarağı <https://www.bayburtrehberi.com/bayburt-rehberi/bayburt-kulturu/ehram/ehram>, erişim tarihi: 08.08.2024

Görsel 3 (Sağ). Teşi <https://www.bayburtrehberi.com/bayburt-rehberi/bayburt-kulturu/ehram/ehram>, erişim tarihi: 09.08.2024

### **Ehramın Dokunması**

Ehram dokumasına haşiye adı verilen kenar kısmıyla başlanır. Pamuk ipliğiyle dokunan bu kısımda tekli ve ikili haşiye kullanılır. Bu kısımda gücülere teker teker ve sırası ile basılarak çözgü ipliklerinin araları açılır ve açılan ipliklerin arasından ahşap mekik ile atkı iplikleri geçirilir. Ehramın desenlendirilmesinde ehramda kullanılacak motif rengine göre belirlenen iplikler, gücüler yardımıyla açılan iplerin arasından geçirilerek ehram ölçüsünde dokuma



bitirilerek kesilir. Dokuması tamamlanan bu kısım ehramın tek kanadı olup aynı teknikle bir kanat daha dokunarak ehram dokuması tamamlanır (Görsel 4).



**Görsel 4.** Ehram dokuması ve kullanımı

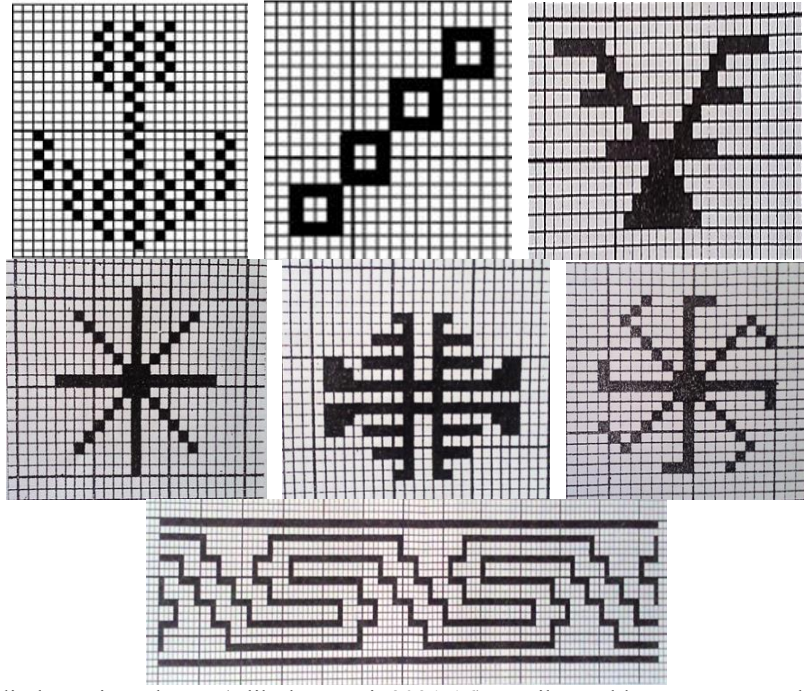
### **Ehramda Kullanılan Renkler**

Ehram dokumasında kullanılan renkler koyunun yününün saf rengidir. Ancak son yıllarda tercihen renklerde doğal boyama teknikleri de kullanılmaktadır. Bu uygulamalarda soğan kabuğu, ceviz kabuğu, ayva çekirdeği nane gibi doğal bitkiler ehram renklendirme işlemlerinde görülmektedir. Soğan kabuğuyla kiremit rengi, ayva çekirdeği ile bordo, nane ile mor, ceviz kabuğuyla ise yeşil ehram elde edilmektedir. Rengin dokuma üzerinde sabitlenmesinde de tuz ya da şap kullanılmaktadır. Bu uygulamalar sıklıkla motif renklerinde görülmektedir. Açık renkli ehramları genç kızlar tercih ederken koyu renkleri de yaşlı kadınlar tercih etmişlerdir.

### **Ehram Da Kullanılan Motifler**

Ehram dokumasında farklı motif formları kullanılmaktadır. Yöre insanı bu motiflere ehram nakışı olarak adlandırmaktadır. Bu nakışların yapılması için ehramda dokunması istenen nakış iplikleri dokuma esnasında geçirilir ve bu şekilde her sıradaki nakış deseni tamamlandıkça ayakça ile gücüler açılır ve bir sıra şeklinde nakış ipliği yerleştirilerek motife başlanır. Bu iplikler dokundukça nakış tarak yardımıyla ehramın arasına sıkıştırılır ve nakış tamamlanana kadar uygulamaya devam edilir.

Ehram dokumasında sembolik, geometrik ve bitkisel kaynaklı nakışlar kullanılmaktadır. Ceviz kanadı, reyhan dalı, hanımeli, çift pirinç, antika, makarna, yıldızın oynayışı, mercimek, hanımgöbeği, pirinç deni, kelleli-kellesiz uçan kuş, elma şeleği, beli bağlı-beli bağırsız boyun bağı, perçem tarağı, çift kartlar, elmas küpe, arı dala kondu, ceylan boynuzu, merdin küpesi gibi farklı isimlerle anılan motifler genellikle kompozisyon içinde belirli düzenlerde yerleştirilir ve sıklıkla dokumanın orta kısmında serpmeye olarak ya da kenar süsleme gibi kısımlara yerleştirilmektedir (Görsel 5). Kenarlarda kullanılan ve haşiye olarak bilinen nakışlar ise; tekli haşiye, saat kordonu, aynalı kutu, tetiksiz zincir gibi nakışlardır.



**Görsel 5.** Merdin küpesi, Makarna (Elibol ve Sari, 2021:16), Antika, Yıldızın oynayışı, Elma şeleği, Çark yıldızı, Saat kordonu

### **Sonuç**

El sanatları, toplumların ortak kimlik ve aidiyet duygusu gibi unsurlarla kendini gösteren kültürel mirasın en önemli temsilcilerinden biridir. Toplumda yaşayan bireylerin doğumundan ölümüne kadar hayatlarının her aşamasına eşlik eden adet, gelenek ve göreneklerinin bir yansıması olarak el sanatlarımızı görmekteyiz. Bunlardan biri de Erzurum’da dokunan ve yörenin tarihi ve kültürel kimliğinde önemli bir rol oynayan ehram dokumasıdır. Dokuma, sahip olduğu teknik ve estetik unsurlarıyla birlikte geçmişten günümüze oldukça zengin bir birikime sahiptir. Çulfa olarak tanımlanan ehram dokuyucuları da ehram dokuma geleneğinin taşıyıcısı ve aktarıcısı kişilerdir.

Geçmişten günümüze zengin bir motif-nakış alt yapısına sahip olan ehram dokuması, tasarım ve sanat anlayışı olan, halkın estetik duygularına tercümanlık eden önemli bir giyim kültürüdür. Halkın tarihsel kimliğini ve kültürünün bir simgesi olan ehram aynı zamanda küreselleşme ve teknolojik gelişmelerin ulusal kültüre olan olumsuz etkileri sonucunda neredeyse kaybolmaya yüz tutmuştur. Bu da kültürel ve tarihi değeri oldukça eskiye dayanan ehram dokumasının, korunmasına, yaşatılmasına ve geleceğe taşınmasına ön ayak olacak her türlü çalışmayı önemli kılmaktadır.

Geleneksel dokumalar üzerine yapılacak çalışmalar, geçmişin zenginliğini ve geleneğin birikimini geleceğe taşıması açısından önem arz etmektedir. Bu açıdan ehram dokumasının da araştırmalara konu olması böyle bir geleneksel dokumanın geçmişi ve geleceği arasındaki bağı güçlendirerek dokuma geleneğinin sürekliliğini sağlamış olacaktır.

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## ERZURUM EHRAH DOKUMASINA AİT MOTİFLERİN SANAL ORTAMDA ARŞİVLENMESİ

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### **Özet**

Geleneksel Erzurum Eham dokuması, yurdumuzun doğu bölgelerinde özellikle Erzurum, Erzincan, Gümüşhane, Bayburt'ta kadınlar tarafından sokakta kullanılan bir geleneksel giysi olup, eham dokumacılığı da bilinen en köklü el sanatlarından biridir. Kendine has araç ve gereçlerle dokunan eham, motif özellikleri açısından oldukça zengin bir çeşitliliğe sahiptir. Yüzey kompozisyonunda belirli düzenlemelerle yerleştirilen motifler genellikle geometrik, bitkisel ve figürlü olmak üzere başlıca çeşitleri bulunmaktadır. Bunlardan "saat kordonu, antika ve çark yıldızı motifleri" bölgede yaygın olarak kullanılan motifler arasındadır. Geçmişte oldukça eskilere dayanan bu dokuma, geleneksel yapısını koruyarak günümüze kadar gelebilen nadir dokumalar arasındadır. Ancak teknolojik gelişmelerle başlayan yeni giyim türleri, halkın bu dokumaya olan ilgisini düşürmüştür. Bu da Türkiye de yer alan diğer geleneksel dokumalar gibi kullanımını azaltmıştır. Çalışmada, geleneksel Erzurum Eham dokumasını gelecek nesillere aktarmak amacıyla, dokuma üzerinde kullanılan ve yörede sıklıkla kullanılan üç farklı motif sanal ortamda arşivlenmek üzere seçilmiştir. Bu motifler, çalışmanın bulguları kapsamında geleneksel görüntüleri ile dijital çizimleri karşılıklı olarak tablolar eşliğinde okuyucuya sunulmuş ve arşivlenerek gelecek nesillere aktarımı sağlanmıştır.

**Anahtar Kelimeler:** Erzurum Eham dokuması, Motif, Sanal ortam, Arşiv

## ARCHIVING OF THE MOTIFS OF ERZURUM AHRAM WEAVING IN A VIRTUAL ENVIRONMENT

### **Abstract**

Traditional Erzurum Eham weaving is a traditional garment used on the street by women in the eastern regions of our country, especially in Erzurum, Erzincan, Gümüşhane, Bayburt, and eham weaving is also one of the most well-established crafts known. Eham, which is woven with its own tools and tools, has a very rich variety in terms of motif features. The motifs placed with certain arrangements in the surface composition are usually geometric, vegetal and figural, there are main varieties. Among them, "clock cord, antique and wheel star motifs" are among the motifs Decently used in the region. This weaving, whose history dates back to quite Decrepit times, is among the rare weavings that can come up to the present day by preserving its traditional structure. However, new types of clothing, which began with technological developments, have reduced the public's interest in this weaving. This has reduced its use like other traditional weavings in Turkey. In the study, three different motifs used on weaving and frequently used in the region were selected to be archived in a virtual environment in order to transfer the traditional Erzurum Eham weaving to future generations. Within the scope of the findings of the study, these motifs were presented to the reader with traditional images and digital drawings accompanied by paintings, and archived and transmitted to future generations.

**Keywords:** Erzurum Eham weaving, Motif, Virtual environment, Archive

## Giriş

Dokumacılık yüzyıllardan beri insanoğlunun örtünme ihtiyacının doğmasıyla süregelen bir kumaş/giysi üretme yöntemidir. İklim şartlarının elverişsizliği nedeniyle Doğu Anadolu bölgesi çevresinde insanların korunma amaçlı örtünme ihtiyacından doğan Eham dokuması yüzyıllardır üretimi devam eden bir giysi türüdür. Eham dokuması, Erzurum, Bayburt ve çevresinde kadınlar tarafından kullanılan bir dış giysi türüdür. Geçmişten günümüze gelenekselliği devam eden Eham dokuması doğal koyun yününün eğirilip iplik haline gelmesiyle elde edilmektedir. Çalışmada, geleneksel eham dokumasının üzerindeki motiflerin gelecek nesillere aktarımını sağlamak amacıyla dijital ortama taşınması hedeflenmektedir.

### 1. Araştırmanın Yöntemi

Çalışmaya konu olan veriler literatür ve saha araştırması sonucu elde edilmiştir. Konunun tarihsel süreci ile ilgili ulusal ve uluslararası makaleler, lisansüstü tez çalışmaları, bildirimler ve kitap bölümleri başta olmak üzere birçok yazılı kaynak incelenmiştir. Araştırmanın görsel verileri elde etme kısmında ise, Erzurum yöresinde saha araştırması yapılarak gerekli dokumalar temin edilmiştir. Temin edilen dokumaların konu bağlamında motif özellikleri incelenmiş, fotoğraf çekimleri yapılarak çalışmaya dahil edilmiştir. İncelenen motiflerin dokuma kartları oluşturularak sanal ortamda raport çalışmaları yapılmış ve arşivlenmesi sağlanmıştır.

### 2. Eham Dokuması ve Motif Özellikleri

#### 2.1. Eham Dokuması

Atkı ve Çözü ipliği %100 koyun yününden üretilerek elde edilen Eham dokuması, Erzurum, Gümüşhane, Bayburt'ta kadınların kullandığı bir sokak giysisidir. Eham geçmişte özel el tezgahlarında "culfa" denilen dokumacılar tarafından dokunmaktaydı. Gelecek nesillere aktarılmasını sağlamak amacıyla, günümüzde geleneksel Eham dokumacılığı az da olsa devam etmektedir.

Koyun yününden elde edilen yün ipliklerinin, doğal renkleri korunarak kahverengi, siyah ve bej gibi doğal renkli dokumalar elde edilmektedir. İki kanat parça olarak dokunan Eham dokuması, sonrasında desen ve motif özellikleri dikkate alınarak özel bir dikiş ile birleştirilerek tek parça haline getirilir.



Görsel.1 Eham Dokuma Tezgahı

[https://erzurumolgunlasmaenstitusu.meb.k12.tr/icerikler/el-sanatleri-eham-dokuma-atolyesi\\_13627008.html](https://erzurumolgunlasmaenstitusu.meb.k12.tr/icerikler/el-sanatleri-eham-dokuma-atolyesi_13627008.html)

#### 2.2. Motif Özellikleri

Eham düz renk ve desensiz olarak dokunan bir dokumadır. Birçok farklı nakış türü ile bu yüzeyler üzerine motifler eklenir. Bu şekilde her sıradaki nakış bölümü tamamlandıça ayakça ile gücü açılır ve bir sıra içine nakış ipliği yerleştirilir, nakış iplikleri tarak yardımıyla dokuma arasında sıkıştırılır ve nakış tamamlanana kadar aynı işlem devam eder (Elibol, Sari, 2021, s.35).



Ehram dokumasında kullanılan motifler genellikle kullanıldığı coğrafyasının doğal öğelerinden esinlenilerek stilize edilmiş bitkisel figürlerdir. Bunların dışında, geometrik motifler de oldukça sık kullanılmıştır. Kullanılan motifler başlıca, saat kordonu, elma şeleği, paşa merdiveni ve pirinç demi olarak belirtilebilir. Bu motiflerden saat kordonu ve paşa merdiveni gibi olan motifler genelde dokumanın kenarlarında kullanılır. Elma şeleği ve pirinç demi gibi motifler ise kompozisyon içinde serpmeye şeklinde raportlanarak kullanılır (Elibol, Sari, 2021, s.35).



Görsel. Erzurum Eham Dokumasına Ait Motif Özelliği

<https://tekstilsayfasi.blogspot.com/2021/08/bayburt-ehrami-nedir-ehram-kumas-ne.html>

### 3. Erzurum Eham Dokumasının Motifleri ve Sanal Ortamda Arşivlenmesi

Uzun yıllardır kullanılan Eham dokumasının, gelecek nesillere orijinalliği korunarak aktarılması büyük önem arz etmektedir. Geçmişten kadın sokak giysisi olarak kullanılan eham dokumaları, günümüzde artık nadiren giysi olarak kullanılmaktadır. Bu nedenle, Erzurum Eham dokumasının geleneksel özelliklerinin korunması giderek zorlaşmaktadır.

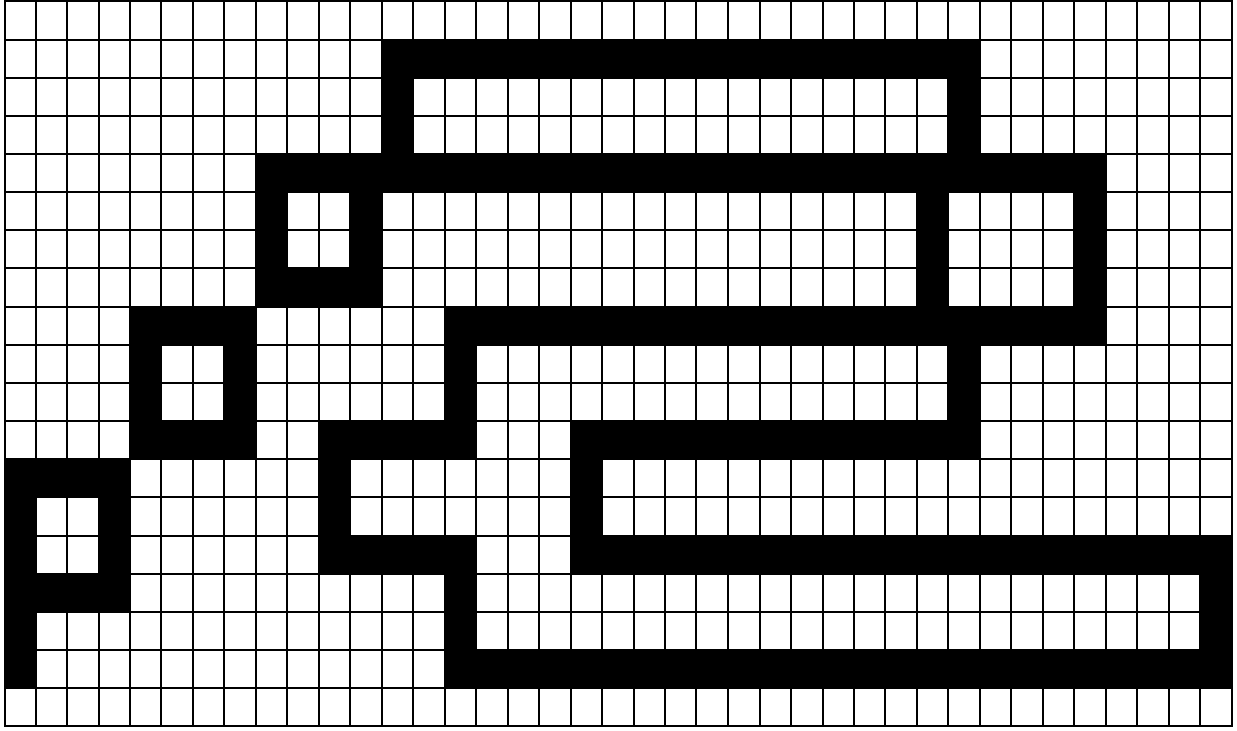
Bu kapsamda, çalışmada, eski, geçmiş yıllara ait dokumalar seçilerek motif özellikleri incelenmiştir. İncelenen motiflerin, ilgili program üzerinde çözümlenmesi yapılmış ve 1 desen tekrarına sahip raportları oluşturulmuştur. Siyah kareler dokuma sırasında ana iplik renginden farklı olarak ilerletilen desenin renklerini temsil ederken, beyaz renkli kareler ise ana dokuma rengini temsil etmektedir.

Çalışmada, motifleri incelenmek üzere 3 adet Eham dokuması seçilmiş ve motif arşivlemeleri yapılmıştır. Dokumadan incelenmek üzere elde edilen motifler, Saat Kordonu, Pirinç Demi ve Paşa Merdivenidir.

#### 3.1. Saat Kordonu Motifi



Görsel.3 Saat Kordonu Motifli Kırmızı Eham



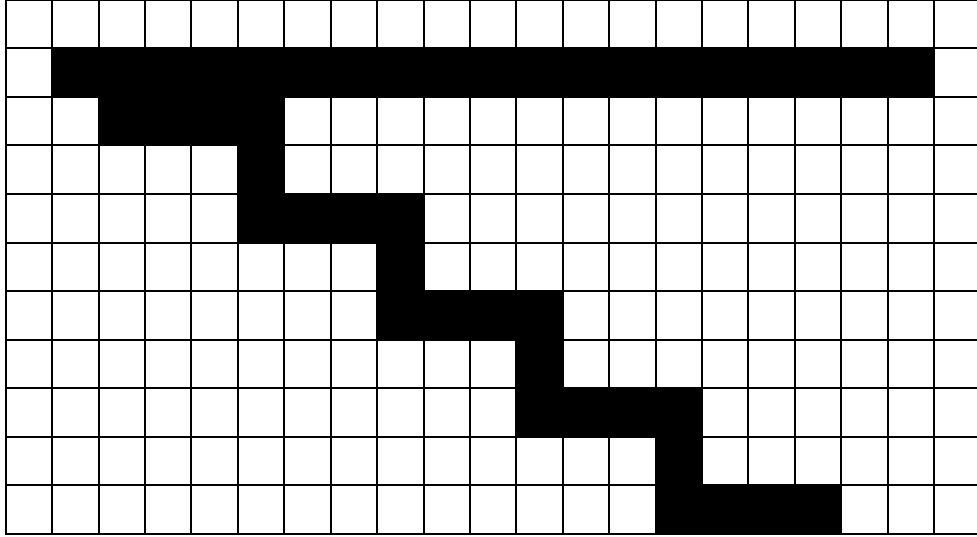
Şekil.1 Saat Kordonu Motifi Raport

### 3.2. Paşa Merdiveni Motifi



Görsel.4 Paşa Merdiveni Motifli Eham Dokuma



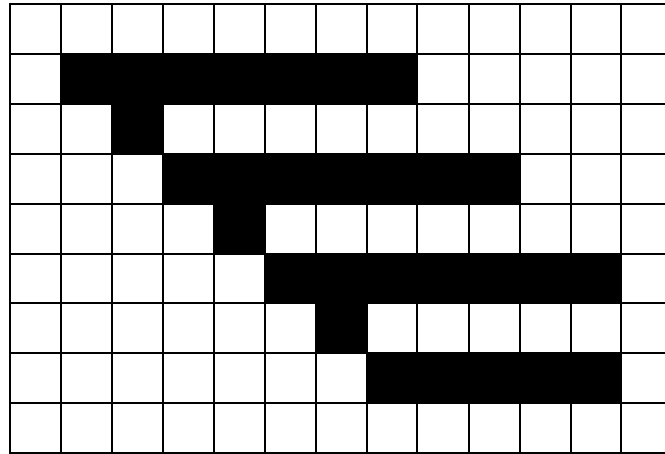


Şekil.2 Paşa Merdiveni Motif Raportu

### 3.3. Pirinç Demi Motifi



Görsel.5 Pirinç Demi Motifli Ehram Dokuma



Şekil.3 Pirinç Demi Motif Raportu

## **Sonuç**

Erzurum kùltürüne ait Efram dokuması gemiŖte en ok kullanılan kadın sokak giysisidir. Günümüzde ise nadir de olsa halk arasında kullanımı mevcut olan bu dokumanın, gelecek nesillere öznelliđinin korunarak aktarılması büyük önem arz etmektedir. Bu nedenle gelenekse Erzurum Efram dokumalarında sıklıkla görölen 3 motif incelenmek üzere seilmiŖtir. Bu sayede en ok kullanılan Efram desenlerinin raportlama alıŖmaları yapılmıŖ olup, dijital ortamda saklanması sađlanmıŖtır.

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# SIİRT PERVARİ NARI ATIK KABUĞU KULLANILARAK NİKEL GİDERİMİNİN KİNETİK ANALİZİ

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## Özet

Son dönemlerde biyomalzemeler adsorpsiyon prosesinde oldukça yoğun kullanılmakta ve özellikle ağır metal ile boya gideriminde önemli rol oynamaktadırlar. Bu çalışma da atık Siirt/Pervari nar kabuğu (APNK) adsorplayıcı olarak 308 K ve 318 K sıcaklıklarda kullanılarak deneyler gerçekleştirilmiştir. Bu çalışmanın mekanizmasını belirlemek amacıyla kinetik modellerden 4 tanesi çalışılmıştır. Bunlar arasında en yaygın kullanılan Pseudo-First Order, Pseudo-Second Order kinetik model, Elovich ve parçacık içi difüzyon modeli (Weber- Morris) sayılabilir. Regresyon analizi için en küçük kareler yöntemi kullanıldı. Modelleme sonucunda elde edilen verilere göre,  $R^2$  değeri en yüksek olan 0,9945 ile Pseudo second-Order'a uyduğu anlaşılmaktadır.  $q_e$  değeri ve  $k_2$  sabitleri elde edildikten sonra  $q_e$  değerinin arttığı tespit edilmiştir. Bu sonuçlara dayanarak, adsorplayıcının biyoçar veya aktif kömür olarak kullanımının daha uygun olabileceği tespit edilmiştir.

**Anahtar Kelimeler:** Pervari nar atığı, adsorpsiyon, nikel, giderim

## KINETIC ANALYSIS OF NICKEL REMOVAL USING SIIRT PERVARI POMEGRANATE WASTE PEEL

### **Abstract**

Recently, biomaterials have been used extensively in the adsorption process and play an important role especially in heavy metal and dye removal. In this study, experiments were carried out using waste Siirt/Pervari pomegranate peel (WPPP) as an adsorbent at 308 K and 318 K temperatures. In order to determine the mechanism of this study, 4 of the kinetic models were studied. Among these, the most commonly used pseudo-first order kinetic model, pseudo-second order kinetic model, Elovich and intraparticle diffusion model (Weber-Morris) can be presumed. The least squares method was used for regression analysis. According to the data obtained as a result of the modeling, it is understood that the result complies with Pseudo Second-Order with the highest R<sup>2</sup> value of 0.9945. It was determined that the q<sub>e</sub> value increased once the q<sub>e</sub> value and k<sub>2</sub> constants were obtained. Based on these results, it was determined that the adsorbent could be more suitable for use as biochar or activated charcoal.

**Keywords:** Pervari pomegranate waste, adsorption, nickel, removal

## 1. Giriş

Antik çağlardan günümüze kadar ağır metaller yaygın olarak kullanılmakta ve bunların toksisitesi insan sağlığını olumsuz etkilemeye devam etmektedir (Minello, et al., 2009). Organik kirleticiler biyolojik olarak bozuna bilirken metal iyonları bozunma esnasında zararsız yan ürünlere ayrışmamaktadırlar (Gupta, et al., 2001). Sulu atık akışının ağır metaller tarafından kirletilmesi, boyamacılık, metal kaplamacılık, madencilik, tabakhaneler, araba radyatörleri imalatı ile beraber mantar öldürücü, spreyler ve gübreler gibi birçok endüstriyel faaliyetlerden kaynaklanmaktadır (Abdel-Galil, et al., 2020). Sucul yaşam alanları, ağır metal, tekstil ve boyama endüstriyel faaliyetlerinden kaynaklı kirlilik nedeniyle git gide daha da savunmasız hale gelmektedir (Waghmare, et al., 2024). Modern endüstrinin hızla gelişmesine bağlı olarak değerli metallere olan talep ve ilgide artmıştır.

Birçok ağır metalin (Cu, Pb, Hg, Ni, Co, Cd, Mn v.b.) varlığı, su kaynaklarında artan kirliliğe neden olmakla kalmayıp, aynı zamanda insanlara yönelik şiddetli nörotoksositeye ve çevresel sorunlara da sebebiyet vermektedir (Sun, et al., 2022). Bu endüstriyel atıklardan özellikle bakır, nikel kurşun ve demir gibi büyük miktarda baz metallerin yanı sıra yüksek asit içeriği içermektedirler. Bu durum ağır metallerin bu karmaşık çözeltilerin, etkili bir şekilde ekstraksiyonuna ve zenginleştirilmesine de müdahale etmektedir (Aghaei, et al., 2019). Ağır metallerin yaygın kullanımına bağlı olarak, fabrikaların çoğunda atık su olarak doğaya salınmaktadır (Das, 2010). Ağır metalleri her türlü atık sudan uzaklaştırmak için çok çeşitli yöntemler vardır bunlar; indirgeme (Dal, et al., 2021), sementasyon (Ghomi, et al., 2020), iyon değişimi (Altunkaynak, et al., 2021), solvent ekstraksiyonu (Amin, 2009), pıhtılaşma (Mendoza, et al., 2023), kimyasal çökeltme (Onursal, et al., 2020), olarak yazılabilir. Son yıllarda yapılan çalışmalarda çeşitli tarımsal atık maddeler ve biyokütlelerden türetilen sorbentlerin sulu çözeltilerden ağır metal iyonlarının giderimindeki potansiyel uygulamaları araştırılmaktadır. Bunlar arasında ceviz, fındık, badem, fıstık, pirinç kabuğu, atık yapraklar nar, elma armut, muz, kivi, portakal, mandalina, patlıcan ananas kabukları ile mantar, kenger, gibi pek çok ürün sayılabilir (Ramazanoğlu, et al., 2023), (Altunkaynak, et al., 2021). Yukarıda bahsi geçen teknikler arasında adsorpsiyon ucuz kolay uygulanabilir ve seyreltik değerli metallerin geri kazanımı için uygun olmasından ötürü daha rekabetçi kabul edilmektedir (Malekbala, et al., 2005). Ting-Chu Hsu ile Ramazanoğlu ve arkadaşlarına göre, tarımsal atıklardan elde edilen adsorbanlar, büyük yüzey alanları ve zengin fonksiyonel grupları nedeniyle büyük ilgi görmektedirler. Ayrıca diğerleriyle karşılaştırıldığında adsorpsiyon için tarımsal atıkların kullanıldığı yöntemler, belirli kirleticiler için seçicilik, maliyet etkinliği, küçük tehlikeli kimyasalların bulunmaması ve yüksek metal bağlama etkinliğini de kapsamak üzere çeşitli avantajlar sunmaktadır (Hsu, 2009), (Ramazanoğlu, et al., 2022).

### 1.1. Adsorpsiyon

Adsorpsiyon teknolojisi, düşük maliyetli ve yüksek verimliliği nedeniyle su ve atık su arıtımında yaygın olarak uygulanan bir yöntemdir. Adsorpsiyon kinetik modelleri, adsorbanın performansını değerlendirmek ve adsorpsiyon kütle transfer mekanizmalarını araştırmak için kullanılmaktadır. Fakat kinetik modellerin fiziksel anlamları ve çözüm yöntemleri tam olarak belirlenmiş değildir (Wang & Guo, 2020). Aslında adsorpsiyon, kirleticilerin sıvı fazdan katı faza doğru kütle transfer işlemi olarak ifade edilebilir. Su ve su arıtma işlemlerinde en yaygın olarak kullanılan adsorpsiyon yöntemi, basit tasarımlı, kolay uygulanabilir ve yüksek verimliliğe sahiptir (Wang & Chen, 2009). Adsorpsiyon olayının oluşmasında çeşitli yöntemler bulunmaktadır. Prosesin hangi mekanizma ile gerçekleştiğini tespit etmek için değişik kinetik modeller mevcuttur. Bunlar arasında en yaygın kullanımı olanlar; Pseudo-First, Pseudo-Second Order, Weber-Morris ve Elovich kinetik modelleridir.

### 1.1.1. Kinetik Modeller

Adsorpsiyon, genellikle yüzey adsorpsiyonu ve gözeneklere difüzyon kombinasyonunu içeren bir yolu izleyen, karmaşık bir olgu olarak kabul edilir.

**1.1.1. Yalancı-Birinci Dereceli Kinetik Model:** Lagergren tarafından, türetilmiştir (Lagergren, 1898). Adsorpsiyon kapasitesinin “dengeye olan uzaklık” ile orantılı olduğunu ve bunun son denge ile arasındaki farkla ifade edildiğini öne sürer. Bununla ilgili bağıntının lineer formu aşağıda verildiği şekildedir.

$$\log(q_e - q_t) = \log q_e - k_1 t \quad (1)$$

**1.1.2. Pseudo-Second Order Kinetik Modeli:** Pseudo- second order kinetik modeli hız sınırlayıcı adımın, adsorplayıcı ile adsorplanan arasındaki etkileşmelerin kimyasal adsorpsiyon olabileceği ihtimalini ortaya koymaktadır (Dal, 2021). Adsorpsiyon, sözde ikinci dereceden kinetik modelde, iki yüzey bölgesinde gerçekleşmektedir. (Bazı araştırmacı yazarlara göre bu model "Blanchard modeli" olarak ifade edilmektedir. Bağıntının lineer formu aşağıda verildiği şekildedir.

$$\left( \frac{t}{q_t} = \frac{1}{k_2 q_e^2} + \frac{1}{q_e} \right) \quad (2)$$

### 1.1.2. Elovich Kinetik Modeli:

Elovich denklemi son yıllarda sadece katılar üzerindeki gaz adsorpsiyonunun kinetiğini değil, aynı zamanda kirleticilerin sulu çözeltilerden adsorpsiyonunu da tanımlamak için yaygın olarak kullanılmaktadır (Benjelloun, et al., 2021).

Bu model bize, adsorpsiyon olayının katı yüzeyinde nasıl gerçekleştiği hakkında fikir vermektedir ( Dal, et al., 2021). Bu model aşağıdaki denkleme karşılık gelir.

$$q_t = \frac{1}{\beta} (\ln \alpha \beta) + \frac{1}{\beta} \ln t \quad (3)$$

### 1.1.3. Weber-Morris Kinetik Modeli:

Tanecik içi difüzyona yönelik olarak, bu kinetik yaklaşıma atıfta bulunan birçok çalışma Weber-Morris'in 1963 yılında yaptığı çalışmaya dayanmaktadır. Bu çalışma basit aromatik bileşiklerin aktif karbon üzerinde adsorpsiyonu ile ilgilidir. Gram başına adsorplanan miktarın konsantrasyonunun zamanın karekökünün doğrusal bir fonksiyonu olduğunu ifade etmektedir ve aşağıdaki bağıntı bu çalışmaya aittir ( Weber & Morris, 1963).

$$q_t = K_{ID} \sqrt{t} \quad (4)$$

Formüle zamanla kaymanın eklenmesi ile formül son şeklini almıştır.

$$q_t = K_{ID} \sqrt{t} + I \quad (5)$$

burada;  $q_t$ : t zamanında adsorbandaki adsorbat miktarını ( $\text{mgg}^{-1}$ ),  $K_{ID}$ : Sabit parçacık içi difüzyon hızını, t: temas süresini (dk); ve I: parçacık içi difüzyon kinetik modelinin kesişimini ifade etmektedir.

## 2. Materyal ve Metot

### 2.1. Nar Kabuğu

Bu çalışmada tarımsal atık olarak, Siirt ili Pervari ilçesinden temin edilen nar kabukları kullanıldı. Nar kabukları yıkandıktan sonra oda sıcaklığında 20 gün süre boyunca kurutuldu. Daha sonra kurutulan nar kabukları 15000 rpm hızda Three Beans marka öğütücüde un haline getirildi. Çapı 100  $\mu$  olan elekten geçirildi. Elde edilen ham nar kabuğu tozu kimyasal işlemlere tabi tutulmadan kullanıldı.

## 2.2 Metal İyon Çözeltilerinin Hazırlanması

Adsorpsiyon çalışmasında kullanılacak olan Ni<sup>2+</sup> iyon çözeltisi, stok çözelti olarak 1000 mg/L derişiminde Merck marka Ni(NO<sub>3</sub>) alınan nikel (II) nitrat'tan deiyonize su kullanılarak hazırlandı.

## 2.3. Seri Deneyle

### 2.3.1. Adsorbanın hazırlanması

Bu çalışmada Siirt ili Pervari ilçesinden temin edilen nar kabukları iyice yıkandıktan sonra etüvde 35 °C' de kurutuldu. Daha sonra Three Beans marka öğütücüde un haline getirilip elekten geçirildi. 308 K ve 318 K sıcaklığında 100 rpm karıştırma hızında dengeye getirilmiştir.

### 2.3.2. Ölçmeler ve Hesaplamalar

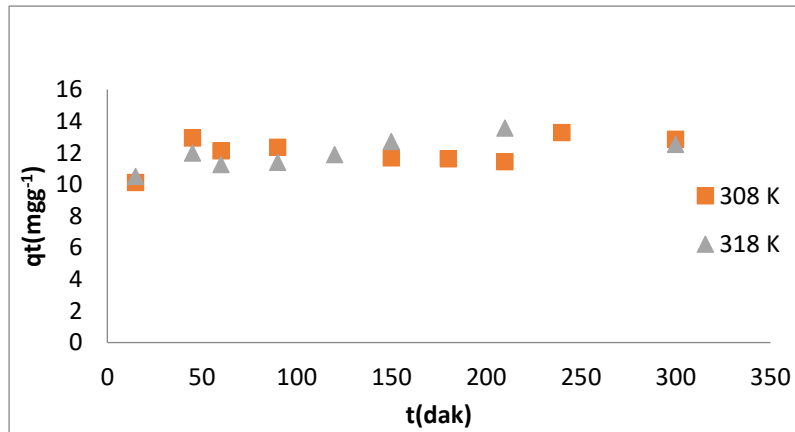
Bu işlemin akabinde (Perkin-Elmer Analyst AA2-400) markalı AAS (Atomik Adsorpsiyon Spektroskopisi) cihazında Ni<sup>2+</sup> konsantrasyonu, kalibrasyon eğrisi yöntemi belirlendi. Adsorbentın birim kütle başına adsorpladığı Ni<sup>2+</sup> iyonlarının miktarına bağlı olarak, t süresinde ki q<sub>t</sub>, aşağıda verilen denklem ile hesaplanmaktadır.

$$q_t = \frac{C_0 - C_t}{m} V \quad (6)$$

Burada q<sub>t</sub>(m<sub>g</sub>g<sup>-1</sup>), dengeye gelme sırasında adsorbanın kütle birimi başına uzaklaştırılan metal iyon miktarını, C<sub>0</sub> ve C<sub>t</sub> (m<sub>g</sub>L<sup>-1</sup>) ise sırası ile başlangıç ve denge konsantrasyonlarını ifade etmektedir (Altunkaynak, 2022).

### 2.3.2 Temas Süresinin Etkisi

Adsorpsiyon olayında Ni<sup>2+</sup> iyonunun adsorbent çözeltisindeki temas süresi oldukça önem arz etmektedir. Atık nar kabuğu ile Ni(II) nin giderimi üzerine temas süresinin etkisi şekil 1'de verilmiştir. Adsorpsiyon olayı, 50 m<sub>g</sub>L<sup>-1</sup> konsantrasyonlu Ni (II) başlangıç çözeltisi ve 0,2 g adsorplayıcı alınıp 308 ve 318 K sıcaklıklarında gerçekleştirildi. Şekil.1'de görüldüğü gibi 10-300 dakika zaman diliminde gerçekleşen deneyin verileri kullanılarak q<sub>e</sub>'nin t'ye karşı adsorpsiyon kinetiği grafiği elde edildi.



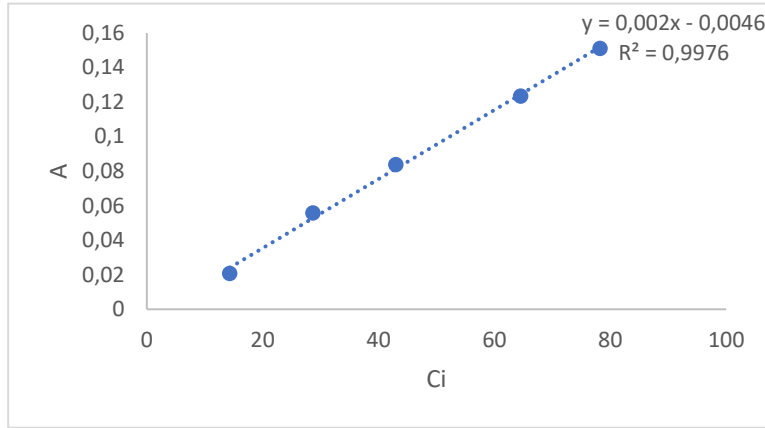
Şekil 1. ANK ile Ni (II)' nin giderimi üzerine temas süresinin etkisi (0.2 g alınan adsorban kütlesi, V = 25 mL çözelti hacmidir)

### 2.3.3. Kinetik Çalışmalar

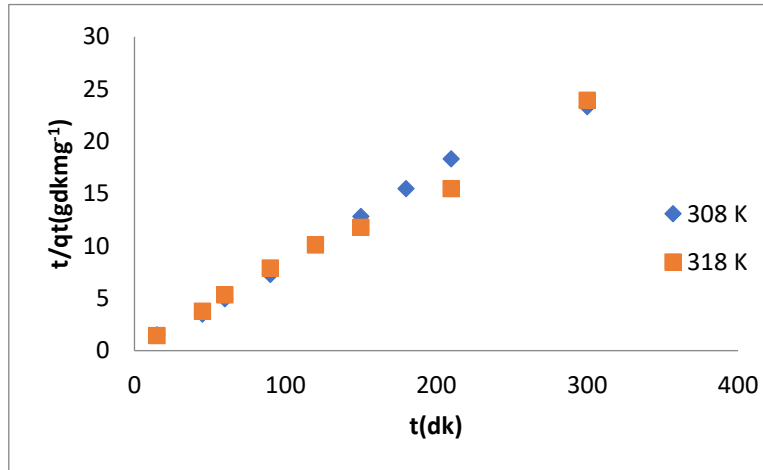
Atık sulardaki metallere uzaklaştırılmasında adsorpsiyon hızının bilinmesi son derece önem arz etmektedir. Çünkü adsorpsiyon prosesi zamana bağlı olarak işlemektedir. Atık nar kabuğunun nikel adsorpsiyonuna sürenin ve sıcaklığın etkisi ile ilgili oldukça fazla çalışma



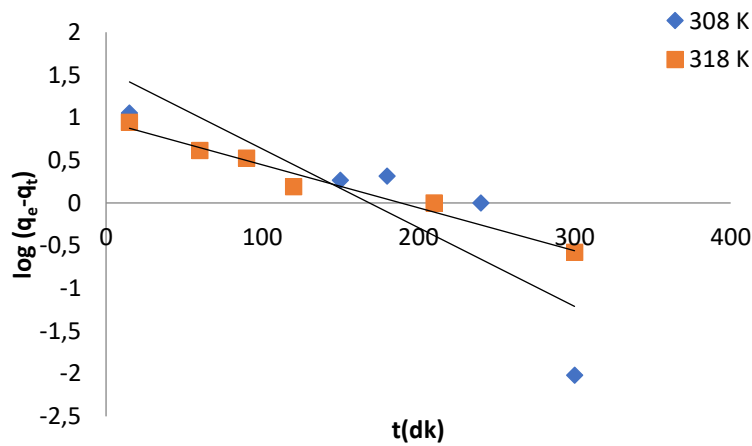
mevcuttur. Bunlardan en çok tercih edilen Pseudo-First Order, Pseudo-Second Order, Elovich ve Weber-Morris modelleri incelenmiş olup, elde edilen veriler aşağıdaki şekillerde ve tabloda verilmiştir.



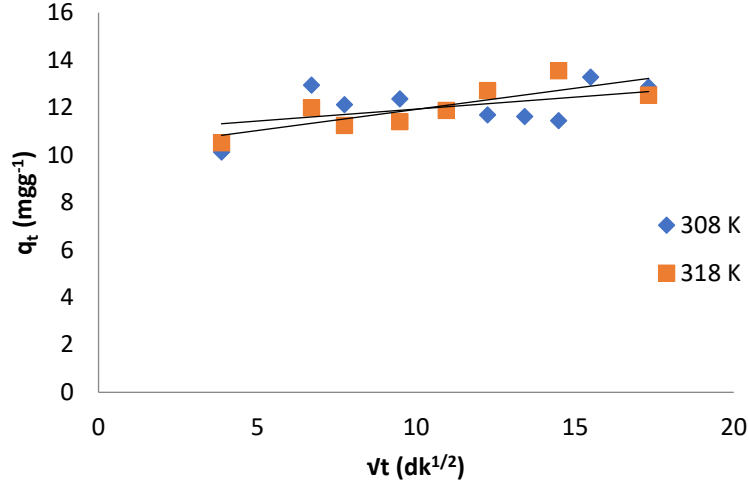
Şekil 2. Ni kalibrasyon grafiği.



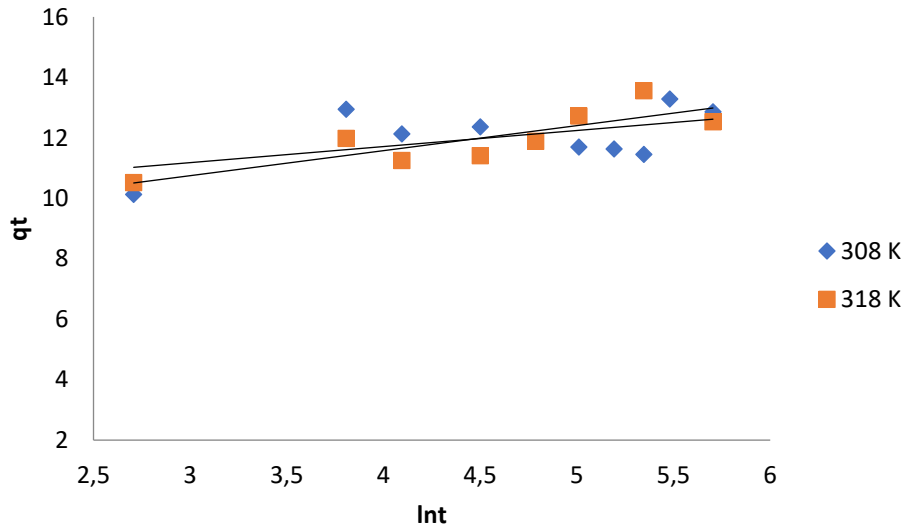
Şekil 3. Ni(II) nin 308 K ve 318 K sıcaklıklarında ANK Üzerindeki Çizgisel Pseudo –Second Order grafiği



Şekil 4. Ni(II) nin 308 K ve 318 K sıcaklıklarında ANK Üzerindeki Çizgisel Pseudo – First Order grafiği



Şekil 5. Ni(II) nin 308 K ve 318 K sıcaklıklarında ANK Üzerindeki Çizgisel Weber-Morris Grafiği



Şekil 6. Ni(II) nin 308 K ve 318 K sıcaklıklarında ANK Üzerindeki Çizgisel Elovich grafiği

**Tablo 1.** Ni (II)'nin ANK Üzerindeki Kinetik çalışma sabitlerini veren tablo.

Temperature (K)	Ho-Mc Kay			Lagergren		
	$K_2$ (dak <sup>-1</sup> )	$q_e$ (mgg <sup>-1</sup> )	$R^2$	$k_1$ (dak <sup>-1</sup> )	$q_e$ (mgg <sup>-1</sup> )	$R^2$
308	0,0206	12,406	0,9917	0,0092	35,99	0,7371
318	0,0134	13,1062	0,9945	0,005	8,9228	0,9703
	Elovich			Weber-Morris		
	$\alpha$ (mg/g min)	B (gmg <sup>-1</sup> )	$R^2$	$K_{wm}$ (mg.g-1.dak. <sup>1/2</sup> )	C (mgg <sup>-1</sup> )	$R^2$
308	36,244.10 <sup>6</sup>	1,8818	0,2851	0,1008	10,927	0,9736
318	18003	1,2083	0,8286	0,1782	10,14	0,958

Tablodaki değerler incelendiği zaman adsorpsiyon kinetiğinin en çok Yalancı-İkinci Dereceli (Pseudo- Second Order) hız modeline uyduğu tespit edilmiştir.

### 3. Sonuç ve Tartışma

Ağır metallerin endüstride, hatta günlük hayatımızda yaygın olarak kullanılıyor oluşu bizi ağır bir kriz ile yüzleştirmiştir: Kimyasal çevre kirliliği. Sorunla mücadelede kullanılan yöntemlerden biri de ucuz ve etkili olması nedeni ile adsorpsiyon yöntemidir. Bu çalışmada bir ağır metal olan nikelin adsorpsiyon kinetiğinde son yıllarda giderek popüleritesi artan yeşil kimya çalışmalarına paralel olarak, adsorplayıcı seçiminde biyomalzeme olan atık nar kabuğu kullanılmıştır. Bu yolla hem geri dönüşümle atık oluşumun engellenmesi, hem doğaya zararlı maddenin kullanılmaması, hem de malzemenin kısa zamanda doğada yok olması gibi yönleriyle yeşil kimya uygulaması yapılmıştır. Bu çalışmada adsorplayıcı olarak Siirt Pervari yöresinden toplanan atık nar kabuğu kullanılmıştır. Kinetik çalışmalar 308 ve 318 K olmak üzere iki sıcaklıkta gerçekleştirilmiştir. Deney sonrası elde edilen veriler modellenmiştir. Literatürde en yaygın kullanılan 4 kinetik model bu amaçla kullanılmıştır: Yalancı-Birinci dereceli kinetik model, yalancı-ikinci dereceli kinetik model, parçacık içi difüzyon modeli (Weber- Morris) ve Elovich kinetik modeli. Yapılan modelleme sonucunda deneysel verilerin sırasıyla 0,9917 ve 0,9945  $R^2$  değerleri ile yalancı-ikinci dereceli kinetik modele (pseudo-second order, PSO) son derece uyduğu belirlenmiştir.  $q_e$  değerleri sırası ile 12,407 ve 13,106  $mgg^{-1}$  olarak  $k_2$  sabitleri ise sırası ile 0,021 ve 0,011 ( $gmg^{-1}min^{-1}$ ) olarak belirlenmiştir. Kinetik deneyler sonucunda  $q_e$  miktarlarının arttığı gözlemlenmiştir. Bu sonuçlar adsorpsiyonun kemisorpsiyon karakteri taşıdığını, aynı zamanda endotermik olduğunu ortaya koymuştur. Her iki sıcaklık için de denge miktarının % 80'ine 25 dakikada varıldığı görülmüştür.  $q_e$  miktarlarının nispeten düşük çıkması nedeniyle adsorplayıcı olarak atık nar kabuğunun ham olarak değil de aktiflenmiş şekli veya biyoçar halinin kullanılması gerektiği öngörülmüştür.

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## **BAZI MEYVE ATIKLARININ ENERJİ POTANSİYELİNİN BELİRLENMESİ: EDİRNE İLİ ÖRNEĞİ**

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### **ÖZET**

Türkiye’de meyve üretim düzeyinin yüksek olduğu ve meyve üretimi konusunda tarihsel bir geçmişi olan Edirne ürün çeşitliliği açısından geniş bir ürün yelpazesine sahiptir. İlde tarımsal atık potansiyeli yüksek olduğu için meyve üretim kaynaklı atıkların miktarının belirlenmesi oldukça önem arz etmektedir. Bu çalışmada, Edirne İlinin meyve üretimden kaynaklanan kullanılabilir tarımsal atık miktarı ve bu atıkların enerji potansiyeli biyokütle açısından teorik olarak değerlendirilmiştir. Edirne İli için biyokütle ve enerji potansiyelinin belirlenmesinde, kullanılabilir atık potansiyeli bulunan üretim materyalleri seçilmiş olup hesaplamalarda İl Tarım Orman Müdürlüğü 2023 yılı bitkisel üretim istatistikleri ile farklı kurum ve araştırmacılar tarafından belirlenmiş olan katsayılar kullanılmıştır. Edirne’de 9 farklı meyve ağacı için budama atıklarının kuru biyokütle potansiyeli 2.155.195,063 ton/yıl ve toplam ısıl kapasitesi 43.103.901,26 GJ/yıl olarak hesaplanmıştır. İlin biyokütle üretim potansiyeli değerlendirilmiş ve mevcut durum ile geleceğe yönelik önerilerde bulunulmuştur.

**Anahtar Kelimeler:** Edirne, Meyve Atıkları, Biyokütle, Enerji

## **DETERMINING THE ENERGY POTENTIAL OF SOME FRUIT WASTE: A CASE STUDY OF EDİRNE PROVINCE**

### **Abstract**

Edirne, which has a high level of fruit production in Turkey and has a historical background in fruit production, has a wide product range in terms of product variety. Since the agricultural waste potential is high in the province, it is very important to determine the number of wastes originating from fruit production. In this study, the amount of usable fruit waste from plant production in Edirne Province and the energy potential of these wastes were evaluated theoretically in terms of biomass. In the determination of biomass and energy potential for Edirne province, production materials with usable waste potential were selected. In the calculations, the crop production statistics provincial directorate of agriculture and forestry, 2023 and the coefficients determined by different institutions and researchers were used. Dry biomass potential of pruning waste for fruit trees is calculated as 2.155.195,063 tons/ year and total calorific value capacity is 43.103.901,26 GJ/year. The biomass production potential of the province was evaluated and recommendations were made for the current situation and the future.

**Keywords:** Edirne, Fruits Wastes, Biomass, Energy

## **Giriş**

Biyokütle, yaşayan ya da yakın zamanda yaşamış canlılardan elde edilen fosilleşmemiş tüm biyolojik malzemenin genel adıdır. Biyokütle, bir enerji kaynağıdır ve endüstriyel anlamda biyokütle, bu biyolojik maddelerden yakıt elde edilmesi ya da diğer endüstriyel amaçlarla kullanılması ile ilgilidir. Yaygın olarak, biyoyakıt elde etmek amacı ile yetiştirilen bitkiler ile lif, ısı ve kimyasal elde etmek üzere kullanılan hayvansal ve bitkisel ürünleri ifade eder (Anonim 2021a).

Meyve bahçelerinde oluşan budama artıklarının değerlendirilmesi veya yok edilmesi önemli bir sorundur. Meyve ağaçları tarafından alınan makro elementlerin bir bölümü yaprak dökümü, çiçek-meyve dökümü ve budama ile bitkiden uzaklaşmakta ve toprağa dönmektedir. İlimizde özellikle zeytin ve antepfıstığı başta olmak üzere çeşitli meyve ağaçlarında budama artıkları büyük sorun olmaya başlamıştır. Ülkemizde meyve bahçelerinde oluşan budama artıkları genelde kışın yakacak olarak kullanılmakta veya boş alanlara terk edilmektedir. Sürdürülebilir tarım teknikleri ve çevre korunumu kapsamında tarımsal artıkların değerlendirilmesinin önemi artmaktadır. Budama artıkları, yakma işlemi ile birlikte toprağa gömme, kompostlaştırma ve yeniden işleme yöntemleri ile değerlendirilmelidir. Artıkların yakma işlemi dışındaki değerlendirilme yöntemlerinde, artıkların parçalanması ve uygun teknolojilerin kullanılması ile mümkündür (Anonim 2021a).

Bitkisel atıklar kullanılarak bölge, yöre ve işletme bazında biyogaz enerjisinin üretim potansiyeli konusunda yapılan çalışmalar incelendiğinde; Külcü (2016) tarımsal biyokütle potansiyelini incelediği bir çalışmada, Afyonkarahisar ilinde bir yılda açığa çıkan 2.838.954 ton bitkisel atıktan (%20 nem içeriğinde) 1.490.451 ton kompost üretilmesinin mümkün olduğunu belirtmiştir. Karabaş (2019), Sakarya da gıda olarak tüketilmek üzere yetiştiriciliği yoğun olarak yapılan ürünlerin teorik kuru biyokütle miktarı tarla bitkileri için 974 990.8 ton/yıl ve toplam ısıl kapasitesi 618 419 362 GJ/yıl, meyve ağaçları için budama artıklarının kuru biyokütle potansiyeli 28 304 823.6 ton/yıl ve toplam ısıl kapasitesi 566 096 472 GJ/yıl olarak hesaplanmıştır.

Bu çalışmada, Edirne ili 2023 yılına ait kullanılabilir bazı meyve veren ağaç sayılarına göre (elma çeşitleri, armut, kiraz, vişne, kayısı, ceviz, badem ve erik) sap atık değerlerinden elde edilebilecek atık miktarı (ton/yıl) ve atıklardan elde edilebilecek GJ/yıl cinsinden toplam ısıl kapasite miktarı belirlenmiştir.

## **Materyal Ve Yöntem**

### **Çalışma Alanı**

Edirne, Marmara Bölgesinin Trakya bölümünde 40 30 ve 42 00 kuzey enlemleri ile 26 00, 27 00 doğu boylamları arasında bulunmaktadır. Edirne genel karakteri itibarıyla geniş düzlüklerle, basık tepelerin yer almış bulunduğu bir havzada yer almaktadır. Bu Havza, Kuzey-Doğudan Istranca, batıdan da Rodop dağlarıyla çevrilmiş bulunmaktadır. Havzanın Kuzey-Batı köşesinde Istranca ve Rodop kitlesi birbirine yaklaşır, bu ikisinin arasında ise Meriç Vadisi yer alır. Konum itibarıyla Türkiye'nin tam batısında bulunan Edirne, 6 276 km<sup>2</sup> Yüzey şekilleri bakımından, İlin kuzeyinde Istranca dağları, orta bölümünde Ergene havzası, güneyinde Koru dağları ve platolar ile Meriç Ovası ve Deltası bulunmaktadır (Şekil 1). Edirne, Marmara Bölgesinde Kırklareli, Tekirdağ, Çanakkale illeri ve Yunanistan, Bulgaristan devletleri ile sınır komşusu bir ildir. Edirne'ye karayolu ile en yakın ulaşılabilen iller Kırklareli ve Tekirdağ'dır (62-141 km.). Komşu iller arasında en uzak mesafede olan il merkezi ise Çanakkale'dir (223 km). Edirne il hudutları dahilinde 763,5 km karayolu ağı vardır. Bunun 275 km.'si devlet yolu, 418 km.'si il yolu ve 70,5 km.'si otoyoldur. Devlet yolları ve il yollarının tamamı asfalt kaplamadır. Yüzölçümüyle ülke topraklarının binde 8'ini kaplamaktadır. İl merkezinin denizden yüksekliği 41 metredir. İlin alanı, doğudan Kırklareli'nin Pehlivan köyü, Merkez, Kofçaz; Tekirdağ'ın Malkara ve Hayrabolu ve Çanakkale'nin Gelibolu ilçeleri ile; batıda



Yunanistan; kuzeybatıda Bulgaristan; güneyinde ise Ege denizi ile çevrilidir. Edirne, demiryoluyla İstanbul'a ve Kapıkule üzerinden Avrupa'ya bağlanmış durumdadır. Edirne-İstanbul arası 299 km, Edirne-Kapıkule arası 20 km.dir (Anonim 2024a). Edirne ili ve ilçe haritasının krokisi Şekil 1'de verilmiştir (Önder, 2019).



Şekil 1. Edirne ili ve ilçeleri haritasının krokisi (Anonim 2024b)

### Tarım Alanlarının Yapısal Özellikleri

Edirne ilinin 627595 ha arazi varlığının; 380.262 ha (%61) tarım alanı, 81.279 ha çayır- mera alanı, 104.228 ha orman ve fundalık (% 9) ve 61.826 ha alanı ise diğer alanları kapsamaktadır. Edirne ili arazi varlığı ve kullanışlarına göre dağılımı Tablo 1'de gösterilmiştir (Önder 2019).

Tablo 1. Edirne İli Arazi Varlığı ve Dağılımı

DİĞER Alanlar (ha)	Oran (%)	Orman-Fundalık (ha)	Oran (%)	Çayır-Mera Alanı (ha)	Oran (%)	Tarım Alanı (da)	Oran (%)	Toplam
61.826	9	104.228	17	81.279	13	380.262	61	627.595

2023 Yılı TÜİK verilerine göre Edirne 'de bitkisel üretim; buğdayda, 1.351.806 dekar alanda 724.119 ton, ayçiçeğinde; 1.294.200 dekar alanda 257.651 ton, çeltikte 445.527 dekar alanda 367.352 ton, arpada; 65.720 dekar alanda 24.452 ton, şeker pancarında 13.990 dekar alanda 93.038 ton, mısırdaki 11.710 dekar alanda 11.271 ton, yulaf 'ta ise 9458 dekar alanda 4247ton ürün elde edilmiştir (Tablo 2).

**Tablo 2.** Edirne ili Bazı Bitkisel Üretim Göstergeleri Ürünler

Ürünler	Ekiliş Alanları (da)	Üretim (Ton)
Buğday	1.351.806	724.119
Ayçiçeği	1.294.200	257.651
Çeltik	445.527	367.352
Arpa	65.720	24.452
Şeker Pancarı	13.990	93.038
Mısır	11.710	11.271
Yulaf	9.458	4.247

Kaynak: Edirne Tarım ve Orman İl Müdürlüğü 2023 faaliyet raporu (Anonim 2023)

### Yöntem

Hesaplama yapılacak bitkisel ürün atık miktarı ve enerji potansiyeli hesaplamaları (Başçetinçelik ve ark. 2005; Karaca ve ark, 2016 ve Karabaş 2019; Baran ve Küçükler, 2021; Baran,2022) tarafından kullanılan yöntemlere göre aşağıdaki 1 ve 2 nolu eşitliklerle hesaplanmıştır.

#### Bitkisel Ürün Atık Miktarı ve Enerji Potansiyeli Hesaplanması

Teorik bitkisel üretim atıklarının mevcut miktarı, ürünlerin üretim miktarı ile atık ürün oranının çarpımı ile elde edilir. Ankara ilinde yetiştiriciliği yapılan meyve çeşitleri için atık ürün oranları ve kullanılabilirlik oranları Tablo 3'te yer almaktadır;

$$TBAM = \ddot{U}M \times AK \quad (1)$$

Burada;

TBAM= Teorik ürün atık miktarı (ton/yıl)

ÜM= Üretim miktarı (ton/yıl)

AK= Atık katsayısı

Bitkisel üretim atıklarının enerji potansiyeli ise teorik bitkisel üretim atık miktarı ile atık ısıl değerinin çarpımı ile elde edilir

$$AEP = TBAM \times AID \quad (2)$$

Burada;

AEP= Atık ürün enerji potansiyeli (MJ)

TBAM= Teorik bitkisel ürün atık miktarı (kg)

AID= Atık ısıl değeri (MJ/kg)

Bir hektarlık ortalama bir verime sahip araziden yılda ortalama 25-30 ton arasında kuru biyokütle sağlanabilmektedir (Karabaş 2019). Elverişli olan iklim koşulları açısından özellikle yarı tropik bölgelerde bu oran 40 tona kadar çıkabilmektedir. Kuru biyokütle'den elde edilen ısıl değerde 3800-4300 kcal/kg (1 kcal=1.10<sup>-7</sup> ton eşdeğer petrol) değerleri arasında olmaktadır (Yorgun ve ark, 1998; Kurt ve Koçer 2010; Karabaş 2019). Kullanılabilirlik oranı meyve ağaçları için 0.7 (%70) alınmıştır (CEC 2015; Sümer ve ark. 2016; Karabaş 2019).

### Araştırma Bulguları

Edirne İli'nin mevcut bitkisel üretim faaliyetlerine konu olan atık potansiyeli yüksek olan toplam 9 farklı meyve türü dikkate alınmıştır. Bu meyve ağaçları grubunda elma çeşitleri, armut, kiraz, vişne, kayısı, ceviz, şeftali, badem ve erik bulunmaktadır. İlde yetiştiriciliği yapılan ürünlerin atık potansiyelleri belirlenirken bu ürünlerin ekim alanları ve üretim

miktarları, Edirne İl Tarım ve Orman Müdürlüğü 2023 yılı faaliyet raporlarında yer alan verilerden alınmıştır. Bu verilerle Edirne ilinin biyokütle üretimine konu olabilecek atık potansiyeline sahip meyvelerin kullanılabilir atık miktarları hesaplanmıştır. Bahçe ziraatinde ağaç budama işlemlerinde biyokütle üretimine ait atıklar oluşturduğu için söz konusu atıkların belirlenmesinde seçilen meyve türlerine ait ağaçların sayıları göz önünde bulundurulmuştur. Meyve veren ağaç sayıları Edirne İl Tarım ve Orman Müdürlüğü 2023 yılı faaliyet raporundaki veriler esas alınarak belirlenirken budama atık katsayıları, kullanılabilirlik oranları ve birim ısıl değerleri CEC, (2015); Sümer ve ark. (2016); Karabaş (2019), Baran ve Emine (2021), Baran (2021)'den faydalanılmıştır. Edirne'de 2023 yılında 9 farklı meyve ağaçlarının budanması sonucu elde edilen atık miktarları bunlara ait ısıl değerleri, kullanılabilir atık miktarı ve toplam yıllık ısıl kapasite değerleri Tablo 3'te detaylandırılmıştır.

**Tablo 3. Edirne İlinde Meyve Ağaçları Atıkları ve Enerji Potansiyeli**

Ürün	Atık	Meyve Veren Ağaç Sayısı	Atık Katsayısı	Atık miktarı (ton/yıl)	Kullanılabilirlik oranı	Kullanılabilir atık (ton/yıl)	Birim Isıl değer (MJ/kg)	Toplam Isıl kapasite (GJ/yıl)
Elma Çeşitleri	Budama	222.077	7275242,52	519660,2	0,7	363762,126	20	7275242,52
Armut	Budama	123.246	4227337,8	301952,7	0,7	211366,89	20	4227337,8
Kiraz	Budama	57.483	4748095,8	339149,7	0,7	237404,79	20	4748095,8
Vişne	Budama	5.516	414692,88	29620,92	0,7	20734,644	20	414692,88
Şeftali	Budama	28.477	2882441,94	205888,7	0,7	144122,097	20	2882441,94
Ceviz	Budama	207.964	9986431,28	713316,5	0,7	499321,564	20	9986431,28
Kayısı	Budama	15.688	669877,6	47848,4	0,7	33493,88	20	669877,6
Badem	Budama	112.148	9122118,32	651579,9	0,7	456105,916	20	9122118,32
Erik	Budama	36.762	3777663,12	269833,1	0,7	188883,156	20	3777663,12
<b>TOPLAM</b>				<b>2.155.195,063</b>				<b>43.103.901,26</b>

Tablo 3'e baktığımızda meyve ağaçları içinde ise en fazla budama atığı 713316,5 ton/yıl ile ceviz'den elde edilebilmektedir. Cevizi sırasıyla; badem 651579,9 ton/yıl, elma çeşitleri 519660,2 ton/yıl, kiraz 339149,7 ton/yıl, armut 301952,7 ton/yıl, vişne 29620,92 ton/yıl, erik, 269833,1 ton/yıl, şeftali 205888,7 ton/yıl ve kayısı meyvesinde ise 47848,4 ton/yıl, olarak hesaplanmıştır. İlde meyve ağaçlarının budanmasına ait atıkların toplam teorik kullanılabilir miktarı 2.155.195,063 ton/yıl olup budama atıklarının teorik toplam ısıl değeri 43.103.901,26 GJ/yıl olarak hesaplanmıştır.

### Sonuç ve Öneriler

Tarım ve enerjinin büyük bir öneme sahip olduğunun daha iyi anlaşıldığı günümüzde öne çıkan üretim yöntemleri, yenilenebilir üretim üzerine kurulmuştur. Kaynakların hızla tükenmesi ve sürdürülebilir doğal yaşam için yenilebilir enerji son derece önemlidir. Edirne bulunduğu coğrafi bölge ve iklim şartlarının uygunluğu sebebiyle bitkisel ürün çeşitliliği fazla olan bir ildir. Bu çalışmada, Edirne ili 2023 yılına ait kullanılabilir bazı meyve veren ağaç sayılarına göre (elma çeşitleri, armut, şeftali, kiraz, vişne, kayısı, ceviz, erik ve badem) sap atık değerlerinden elde edilebilecek atık miktarı (ton/yıl) ve atıklardan elde edilebilecek GJ/yıl cinsinden toplam ısıl kapasite miktarı belirlenmiştir. Meyve ağaçlarının budama 2023 yılı içinde ve meyve ağaçlarının budanması kaynaklı olarak 2.155.195,063 ton atığın oluştuğu teorik olarak hesaplanmıştır. Bu atıkların oluşturduğu ısıl değerlerin toplamı 43.103.901,26 GJ/yıl dır. Tarımsal atıkların değerlendirilmesi enerji açığının giderilmesine fayda sağlarken,

ekonomik büyüme de katkı sağlayacaktır. Atıkların değerlendirilmesinin çevre koşullarına sağladığı yarar da göz önüne alınırsa, konunun çok kapsamlı olarak değer taşıdığı anlaşılacaktır.

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## YEMLİK BİR BAKLAGİL AĞAÇ TÜRÜ: *Sesbania grandiflora*

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### Özet

Özellikle gelişmekte olan ülkelerde kırsal kesimlerinde yem üretimine ilişkin yaygın bir uygulama genellikle bulunmamakta, hayvanlar, protein, mineral ve kullanılabilir enerji açısından kalitesi düşük olan tarım arazilerinde doğal olarak yetişen otlar, çalılar ve yabancı otlarla beslenmektedir. Yeşil yem, hayvancılığın mevcut yeşil yem talebini ve verimliliği artırarak yıllık nüfus artış hızını karşılayacak besin maddesi sağlaması nedeniyle kritik bir girdi olarak kabul edilmektedir. Leguminosae familyasından bir tür olan *Sesbania grandiflora*, 6-9 m yüksekliğe kadar dik ve hızlı büyüyen, seyrek ve yumuşak dallı, 25-30 cm çapında, tropikal Asya'ya özgü, sıcak ve nemli ortamlara iyi adapte olmuş küçük bir ağaçtır. Çiçeklenme ve meyve verme mevsimi çoğunlukla kıştır. Meyveleri 30 kadar tohum içeren uzun ve ince yeşil fasulyelerdir. Mevsimsel olarak su basan ortamlar için ideal olan bu baklagil ağacı tuza orta derecede toleranslıdır ve asitli topraklar gibi farklı koşullarda da büyüyebilir. Hayvan yemi, gıda, yeşil gübre, kağıt hamuru üretimi ve geleneksel ilaç olarak kullanılan bu bitki azot sabitleyici Rhizobia ile birleşmeye yönelik yüksek yeteneğe sahiptir. *Sesbania grandiflora*, yem amaçlı kullanılan çok yönlü bir baklagil ağacı olarak kolayca yetiştirilebilir, olumsuz alanlarda büyüyebilir ve verimini sürdürmek için karmaşık yönetim gerektirmez. Yeşil aksamı, protein, mineral ve vitamin açısından zengindir.

**Anahtar kelimeler:** *Sesbania grandiflora*, yem, baklagil ağaç

## A FORAGE LEGUME TREE SPECIES: *Sesbania grandiflora*

### **Abstract**

There is generally no widespread practice of feed production in rural areas, especially in developing countries, where animals are fed with grasses, shrubs and wild herbs that grow naturally on agricultural lands with low quality in terms of protein, minerals and usable energy. Forage is considered a critical input for animal husbandry and productivity; meat provides valuable nutrients to human populations. *Sesbania grandiflora*, a species from the Leguminosae family, is a small tree that grows upright and fast, up to 6-9 m high, with sparse and soft branches, 25-30 cm in diameter, native to tropical Asia, and well adapted to hot and humid environments. The flowering and fruiting season is mostly winter. The fruits are long, thin green beans containing up to 30 seeds. Ideal for seasonally flooded environments, this legume tree is moderately tolerant to salt and can grow in different conditions, such as acidic soils. Used as animal feed, food, green manure, pulp production and traditional medicine, this plant has a high ability to combine with nitrogen-fixing Rhizobia. *Sesbania grandiflora* can easily be grown as a versatile legume tree used for forage purposes, can grow in adverse areas and does not require complex management to maintain its yield. Its green parts are rich in protein, minerals and vitamins.

**Keywords:** *Sesbania grandiflora*, fodder, legume tree

## 1. Giriş

Hayvancılık, çiftçilerin geçim koşullarını iyileştirmek için tarımsal üretimin omurgası olarak kırsal ekonominin hayati bir bileşenidir. Hayvancılık sektörü, tarımsal faaliyetlerin birincil kaynağı ve insanlar için temel hayvansal protein kaynağıdır. Özellikle gelişmekte olan ülkelerde kırsal kesimlerinde yem üretimine ilişkin yaygın bir uygulama genellikle bulunmamakta, hayvanlar sıklıkla, protein, mineral ve enerji açısından kalitesi düşük olan, tarım arazilerinde doğal olarak yetişen çalılar ve yabani otlarla beslenmektedir. Bu nedenle mevsimlik yem kaynaklarına daha fazla güvenilmekte, bu da yıl boyunca sürekli yem tedarikinde dalgalanmalara neden olmaktadır. Öte yandan örneğin süt hayvanlarının yeşil yemlerle tek başına beslenmesi, konsantre yemlere göre çok daha ucuzdur. Bu nedenle, yeşil yem, hayvanların verimliliği artırarak insanların besin ihtiyacını karşıladığı için kritik bir girdi olarak değerlendirilmektedir. Yem bitkileri yetiştirme sistemlerinin faydası çoktur: Kaynakların daha verimli kullanılması, birim alan başına ve birim zaman başına verimliliğin artırılması, çiftçilere daha fazla ekonomik getiri sağlanması ve baklagillerle tahıl yemlerin birlikte dengeli olarak hayvanlara verilmesi nedeniyle yem açığının kapatılması için uygun seçenekler sunmaktadırlar (Shekara ve Chikkarugi, 2023).

Pantropikal bir cins olan *Sesbania* (Leguminosae familyası), dünyanın tropikal ve subtropikal bölgelerinde yaygın olarak bulunan yaklaşık 85 tür ve 34 alt tür içerir. Afrika ve Madagaskar'da yaklaşık 30 tür, Asya, Avustralya ve Pasifik adalarında yaklaşık 16 tür ve Neotropiklerde (güney ABD'den kuzey Arjantin'e, özellikle Kuzey ve Orta Amerika) dokuz türü bulunur. Yaklaşık beş türün dağılımı pantropiktir. Bu cins, sulak alanları tercih etmesi açısından ekolojik açıdan alışılmadık bir türdür ve baklagiller arasında morfolojik açıdan çok farklıdır (Farruggia ve ark., 2018). Baklagillerin çoğunun aksine, *Sesbania*'nın en az bir türü, hem toprak altındaki köklerde hem de toprak üstündeki gövdelerin yanal kısımlarında simbiyotik azot fiksasyonu için nodüller oluşturur. *Sesbania rostrata*'da, bu "gövde nodülleri", yan köklerin veya arayıcı köklerin tabanlarındaki bağlantılarla ilişkilidir ve rhizobia, yan ve arayıcı köklerin çıkıntısından kaynaklanan epidermisteki çatlaklar yoluyla konakçı bitki sürgününe girer (Goormachtig ve ark. 2004; Bomfeti ve ark., 2013). *Sesbania rostrata*'daki gövde nodülasyonu fakültatif ve kök nodülasyonunun daha tipik formundan farklıdır ve suya batmayan veya iyi havalandırılmış kökleri olan bitkilerde meydana gelir (Goormachtig ve ark., 2004).

*Sesbania*'nın özellikle Afrika ve Asya'daki geniş ekonomik önemi, bunların gölge bitkileri, rüzgar kesiciler, örtü bitkileri, insan gıdası, hayvan yemi, süs bitkileri, balık zehirleri (örneğin izoflavon kaynağı), lif kaynakları ve inşaat malzemeleri olarak kullanımını içerir. *Sesbania* çiçekleri ve tohumları ayrıca anti-tümör aktivitesini azaltan bileşikler de içerir (Laladhas ve ark., 2010). Çeşitli türlerin endüstriyel atık alanlarından ve diğer kirlenmiş topraklardan kurşun, çinko ve bakırın biyolojik olarak arıtılmasında çok etkili olduğu gösterilmiştir (Yang ve ark., 2003; Branzini ve ark., 2012).

*Sesbania* cinsi (Fabaceae familyası) otları, çalıları ve yumuşak odunsu bitkileri içerir, ancak dünyanın tropik bölgelerinde kısa ömürlü ağaçları da kapsar. *Sesbania* türleri genellikle tek yıllık veya iki yıllık olup, bazıları kısa süreli çok yıllık çalılar ve birkaç tür ise gerçek çok yıllıktır. Bu türlerin yüksek azot sabitleme kapasitesi, azot eksikliği olan topraklarda bile hızlı büyümelerine yardımcı olur ve *Sesbania* türlerinin tarımsal ormancılık ve odun üretim sistemlerinde yeşil gübre, karışık ekim bitkisi ve toprak örtüsü olarak kullanılmasına imkan sağlar (Mouhamad ve ark., 2014).

## 2. *Sesbania grandiflora*

Yaygın olarak "Agastya" olarak bilinen *Sesbania grandiflora* (Leguminosae familyası), 6-9 m yüksekliğe kadar büyüyen, çapı 25-30 cm civarında olan, yumuşak dallı küçük bir ağaçtır. Çiçekler beyaz ve etli, 7-10 cm uzunluğunda ve bezelyeye benzer, yaprak tabanında



salkımlar halinde bulunur. Yapraklar 5-30 cm uzunluğundadır ve 2.5 ila 3.5 cm uzunluğunda 16 ila 30 çift yaprakçığa sahiptir (Bagchi ve ark. 2021).



Şekil 1. *Sesbania grandiflora* a) bitki, b) tohum kabukları ve c) tohumlar (Ravulapalli ve ark., 2019).

*Sesbania grandiflora* küçük, dik, hızlı büyüyen ve seyrek dallı bir ağaçtır. Bu bitki tropikal Asya'ya özgüdür ve Malezya, Endonezya, Filipinler ve Hindistan'da yaygındır. Bu bitkinin Malay isimleri turi ve geti'dir. *Sesbania grandiflora*'nın tüm kısımları, halk hekimliğinde nezle, dizanteri, ateş, baş ağrısı, çiçek hastalığı, boğaz ağrısı ve stomatit gibi çeşitli hastalıkların tedavisinde geleneksel bir ilaç olarak deneysel olarak kullanılmaktadır (Hasan ve ark., 2012).

*Sesbania grandiflora* sıcak ve nemli ortamlara iyi adapte olmuştur. Düşük sıcaklıklara (yaklaşık 10 °C'nin altında) toleransı olmayan bir ova türüdür. Su birikmesini tolere etme konusunda olağanüstü bir yeteneğe sahiptir ve mevsimsel olarak su basan ortamlar için idealdir. Su bastığında, yüzen, arayıcı kökleri hareketlenir ve gövdeyi korur. Yağmurlu mevsimde hızla büyüyen, iki modlu bir yağış dağılımını tercih ediyor gibi görünmektedir, ancak 9 aya kadar uzun süreli kurak mevsimlere dayanma kapasitesine sahiptir. Rüzgara dayanıklı değildir. Yaygın olarak pirinç tarlalarında, yol kenarlarında, ev bahçelerinde ve karma tarım yapılan arazilerde yetiştiği görülür (Karmakar ve ark., 2016). Tuzlu toprağın, tuza orta derecede toleranslı bu baklagil ağacı ile ıslahı, tuz stresi sorunlarının aşılmasında yaygın olarak kullanılmaktadır (Giri ve ark. 2002). *Sesbania grandiflora* Irak'ın birçok yerinde de yetiştirilmektedir (Mouhamad ve ark., 2014).

*Sesbania grandiflora* aynı zamanda çok yıllık bir yeşil gübre bitkisi olarak da yetiştirilmektedir. Bitki, asitli topraklar gibi farklı koşullarda da büyüebilir. Yeşil aksam malç olarak kullanıldığında tuzlu toprakların verimliliğini ve önemli ölçüde iyileştirdiği ve humus içeriğini arttırdığı bildirilmektedir (Dhanapackiam ve Ilyas, 2010).

Bu bitkinin yaprakları dökülmeden önce sararır. Meyveleri 28-30 tohum içeren uzun ve ince yeşil fasulyelerdir. Çiçeklenme ve meyve verme mevsimi hemen hemen yılın her mevsiminde olmakla birlikte çoğunlukla kıştır. *Sesbania grandiflora*'nın Hindistan, Endonezya, Malezya, Filipin ve Myanmar'da tarımsal ekimi yapılmaktadır. Gıda, hayvan yemi, yem, kağıt ve kağıt hamuru açısından son derece hızlı büyüyen önemli bir tarımsal ormancılık türüdür ve bu bitki, azot sabitleyici Rhizobia ile birleşmeye yönelik yüksek yeteneğe sahip olduğundan, besin açısından yetersiz topraklarda bile gelişebilir. *Sesbania grandiflora*'nın yapraklarında bulunan fitokimyasal bileşenler alkaloidler, flavanoidler, glikozitler, tanenler, steroidler, proteinler, karbonhidratlar, saponinler, amino glikozitler, A, C & B kompleksi, Glikozit, Kumarinlerdir (Bagchi ve ark. 2021).

### 3. Yam bitkisi olarak *Sesbania grandiflora*

Yemlik ağaç baklagilleriyle zenginleştirilmiş hayvan besleme, özellikle kurak mevsimde düşük kaliteli diyetlerle beslenen geviş getiren hayvanların beslenmesini

iyileştirmek için iyi bir fırsat sunar. Yemlik ağaç baklagillerinin değeri, Avustralya'daki doğrudan otlatmadan, Tayland'daki keçilerin kes ve taşı tipi beslemeye kadar tropik coğrafyalarda defalarca kanıtlanmıştır (Shelton ve Dalzell, 2007; Phaikaew ve ark., 2012). Doğu Endonezya'da çiftçilerin yemlik ağaç baklagilleri yapraklarını yedirerek geviş getiren hayvanların proteinle beslenmesini artırdıkları iki önemli örnek vardır. Bunlardan ilki Lombok'un (Endonezya'nın Batı Nusa Tenggara bölgesinde bir ada) merkezinde *Sesbania grandiflora* ve Batı Sumbawa'daki (Endonezya'ya bağlı bir ada) *Leucaena leucocephala*'dır (Dahlanuddin ve ark., 2014).

*Sesbania grandiflora*, nemli tropik bölgelerde yem amaçlı kullanılan çok amaçlı bir baklagil ağacı olarak kolayca yerleşebilir, olumsuz alanlarda büyüyebilir ve verimini sürdürmek için karmaşık yönetim gerektirmez. Yeşil aksamı, protein, mineral ve vitamin açısından zengindir. Kuru ağırlık bazında yüzde 18-20 kuru madde, yüzde 20-22 ham protein, yüzde 18-20 ham lif, yüzde 9-10 kül, yüzde 1.5-2.0 kalsiyum içerir. 13.6 Kcal/kg KM metabolize edilebilir enerji, %33.0 NDF ve %28.4 ADF değerlerine sahiptir (Shekara ve Chikkarugi, 2023).

*Sesbania grandiflora* birçok bölgede yem olarak değerlendirilmektedir. Endonezya'nın güney-orta kesiminde, çeltik tarlalarının etrafındaki setlerde yetiştirilen bu bitki, yıllık sekiz aylık kurak mevsim boyunca sığır ve keçilerin besinlerinin %70'ini sağlar. Yapraklar %25-30 düzeyinde ham protein içerir. Yaprakları ve baklaları yem olarak değerlendirilir. Ağaç, tesis edildikten sonraki dört ay içinde yemlik yaprak üretir. Yapraklar ayrıca her 100 gramda 9600 IU A vitamini içerir. Yem üretimi için ağaç 90-120 cm boyunda (1.8 kg) kesilerek piriç samanıyla karıştırılarak hayvanlara yedirilir (Karmakar ve ark., 2016).

Toprak işleme uygulamaları ve karışık ekim, yem bitkilerinin nihai üretimi ve kalitesinde hayati bir rol oynar. Bu nedenle, 2013 ve 2014 yıllarında farklı toprak işleme uygulamaları altında tek başına ve farklı sıra oranlarıyla birlikte yetiştirilen tahıl ve *Sesbania grandiflora* bitkilerinin yem miktarı ve kalitesini karşılaştırmak amacıyla Zamir ve ark., (2022) tarafından saha çalışmaları yapılmıştır. Çalışmalarındaki toprak işleme uygulamaları minimum toprak işleme ve derin toprak işleme olmuştur. Ayrıca değişken sıra oranları denenmiştir: sadece sorgum, sadece darı, sadece *Sesbania grandiflora*, sorgum + *Sesbania grandiflora* (1:1), sorgum + sesbanya (1:2), sorgum + *sesbania* (2:1), darı + *sesbania* (1:1), darı + *sesbania* (1:2), darı + *sesbania* (2:1). Sonuçlar, yem veriminin toprak işleme uygulamalarından önemli ölçüde etkilendiğini göstermiştir. Ancak yem kalitesi önemsiz düzeyde etkilenmiştir. Derin toprak işleme, minimum toprak işlemeye kıyasla en yüksek taze yem verimi ve kuru madde verimi üretmiştir. Tahıllarla *Sesbania grandiflora* sıralarının birlikte ekimi, yem verimini ve kalitesini önemli ölçüde etkilemiştir. En yüksek taze ot ve kuru madde verimi yalnızca tahıl ekilen parsellerden elde edilmiş, en düşük verim ise darı + *Sesbania grandiflora* (1:2) uygulamasından alınmıştır. Tahıl + *Sesbania grandiflora*'nın farklı sıra oranlarında yetiştirilmesi yem kalitesini iyileştirmiştir (kül %'si ve ham protein %'si); ancak karışımdaki *Sesbania grandiflora* sıralarının artması ham lif içeriğini azaltmıştır.

Vijayakumar ve ark., (2021), Hindistan'da kes ve taşı besleme sistemi altında melez Jersey düve buzağlarında büyümeyi iyileştirmek için *Sesbania grandiflora*'nın baklagil yem kaynağı olarak diyetle takviyesini değerlendirmişlerdir. 12 adet melez Jersey düve buzağı (ortalama ağırlık 70.2±3.8 kg), her grupta altı hayvan olacak şekilde rastgele iki gruba (kontrol ve uygulama) ayrılmıştır. Uygulama ve kontrol gruplarında ortalama günlük kazanç sırasıyla 454±51 g gün<sup>-1</sup> ve 417±30 g gün<sup>-1</sup> olmuştur. Benzer şekilde uygulama ve kontrol gruplarında ortalama canlı ağırlık artışı sırasıyla 41±5 kg ve 38±3 kg olmuştur. *Sesbania grandiflora* yaprakları (2 kg gün<sup>-1</sup>) eklenen diyetle beslenen düve buzağlarının ortalama canlı ağırlık artışı ve ortalama günlük canlı ağırlık artışı istatistiksel olarak anlamlı bir fark göstermemiştir ancak kontrol diyetiyle beslenenleri sayısal olarak aşmıştır. Besin alımı ve *Sesbania grandiflora*'nın kalite özellikleri göz önüne alındığında, bu baklagil yemi, daha erken üreme büyüklüğüne

ulaşmak, ilk buzağılama yaşını ve maliyetleri azaltmak amacıyla büyüyen düve buzağılarını beslemek için küçük çiftliklerdeki kes ve taşı besleme sistemine entegre edilebilir bulunmuştur.

Olgun *Sesbania grandiflora* ağaçları otlama yüksekliğinin üstüne çıktığından, otlatılan otlaklarda veya biçme sistemlerine entegre kes ve taşı yem olarak kullanılır (Cook ve ark., 2005). *Sesbania grandiflora*, aynı zamanda steroller, saponinler ve tanenler gibi antibesinler de içerir (Vijayakumar ve ark., 2021). *Sesbania grandiflora* yaprakları, genç dalları ve baklaları sığır beslemek için çok lezzetlidir ve kurak mevsimde Doğu Endonezya'daki geniş getiren hayvanların toplam yem miktarının %70'e kadar olan kısmını oluşturur (Cook ve ark., 2005). Lombok adasında *Sesbania grandiflora*, keçilere sunulan en kolay bulunabilen baklagil yem kaynaklarından biridir (Dahlanuddin, 2001).

Azrul-Lokman ve ark., (2018), *Sesbania grandiflora*'nın doğal protein takviyesi ve kimyasal olmayan veteriner hastalık tedavisi aracı olarak kullanımına odaklanan bir ön çalışma yürütmüştür. Çalışmada keçilere 30 günlük uygulama süresinde *Sesbania grandiflora* bitkisinin yapraklarının diyetle ilave edilmesinin etkileri belirlenmiştir. Deney hayvanı olarak 10 adet keçi kullanılmış ve eşit olarak iki gruba ayrılmıştır. Grup 1 kontrol olarak grup 2 ise *Sesbania grandiflora*'nın kurutulmuş yapraklarıyla desteklenmiştir. Etkiler iki aşamalı gözlemlerle belirlenmiştir. Birinci aşamada, uygulama döneminde ölümcül durumun ortaya çıkma durumu araştırılmıştır. İkinci aşamada ise beslenme davranışı ve fiziksel özellikler gözlemlenmiştir. Deneme süresince her iki gruptaki keçiler arasında herhangi bir ölüm gözlenmemiş. Beslenme davranışı normal durumda seyretmiş, tutarlı canlı ağırlık artışı görülmüştür ve keçilerin fiziksel özelliklerinde herhangi bir anormallik tespit edilmemiştir. Sonuçlara dayanarak keçilerde *Sesbania grandiflora* yapraklarının takviyesinin güvenli olduğu sonucuna varılmıştır.

#### 4. Mikroorganizmalarla yaptığı simbiyoz

Biyolojik azot fiksasyonu tarım ve ormancılıkta verimliliği sürdürmenin anahtarıdır. Çeşitli biyolojik azot bağlayıcıları arasında Azospirillum, azot fiksasyonunda yer alan, yan kök oluşumunu teşvik eden ve bazı durumlarda köklerde nodüller oluşturan serbest yaşayan bir bakteridir. Verimli azot sabitleyici olan Azospirillum BPL7 suşu, Andhra Pradesh'te (Hindistan) izole edilmiştir. İzole edilen 19 suştan BPL7 suşu, *Sesbania grandiflora* bitkilerinde büyümeyi teşvik edici özellikler ve azot sabitleme aktivitesi göstermiştir (Vootla ve Pindi, 2014).

Hindistan topraklarının çeşitli agroekolojik bölgelerinden tuzak bitki yöntemi kullanılarak Singh ve Gera, (2018) tarafından *Sesbania grandiflora* kök nodüllerinden toplam 20 farklı Rhizobia izole edilmiştir. Bu rizobiyal izolatların yaklaşık %80'inin fosfat çözücü olduğu belirlenmiştir. Bu izolatların P-çözünürlük indeksi 1.96 ile 4.85 arasında değişmiştir. Rajasthan ve Haryana'da elde edilmiş izolatlarının mükemmel P-çözünürlüğe sahip olduğu ve daha yüksek *Sesbania grandiflora* verimi için biyogübre olarak kullanılabileceği belirlenmiştir.

#### 5. Diğer kullanım alanları

*Sesbania grandiflora*, toprağa azot katkısı nedeniyle sıklıkla bahçelerde ve mahsul tarlalarının çevresinde bulundurulur. Gölge etkisi düşüktür; ışığı fazla engellemez ve eşlik eden bitkilerin büyümesine olanak tanır. Düşen yaprakçıkları ve çiçekleri besin maddelerini toprağa geri dönüştürür. Fideler hızlı büyüme yeteneğinden dolayı tek yıllık yeşil gübre bitkilerine benzer şekilde yeşil gübreleme amacıyla kullanılmaktadır. Meyveleri, düşen yaprakçıkları ve çiçekleri mükemmel malç oluşturur ve toprağın verimliliğini artırır. Yoğun ekime, kısa süreliğine yetiştirmeye ve gıda üretimi amaçlı bitkileri ekmeden önce toprağı iyileştirmek için toprağın sürülmesine çok uygun bir bitkidir. *Sesbania grandiflora* erozyonla aşınmış toprakların rehabilite edilmesi için idealdir (Karmakar ve ark., 2016).



**Şekil 2.** *Sesbania grandiflora* 6-9 metre yüksekliğe kadar büyür ve Güney Hindistan'ın çeşitli yerlerinde yetiştirilir. Çiçekleri etlidir ve büyük gösterişli beyaz, pembe veya koyu kırmızı petalleri vardır (Venkateshwarlu ve ark., 2012).

*Sesbania grandiflora*, 3-4 yıllık çok kısa bir rotasyonla, diğer kağıt hamuru ağaçlarının çoğundan çok daha yüksek birim alan başına selüloz hammaddesi üretme kapasitesine sahiptir. 3-4 yaşındaki ağaçları bile kabuk soyulmadan hamur haline getirilebilmektedir ve ucuz baskı, yazı, dergi ve gazete kağıdı olarak kullanılmak üzere kimyasal hamurlaştırmaya uygundur. Lifleri kısıdır. Lifine iyi bir mukavemet sağlamak için uzun lifli bambu hamuruyla uygun oranlarda karıştırılabilir. 3 yıllık rotasyonla bir hektar alandan yılda yaklaşık 41 ton pulp hasat edilebilmektedir (Karmakar ve ark., 2016).

İçerdiği fitokimyasalların varlığı nedeniyle antihelmentik, antiülser, antibakteriyeldir ve antioksidan aktivite gösterir. Ayrıca yaprağın etanolik ekstraktı antihipertansif aktivite gösterir, metanolik ekstrakt analjezik aktivite gösterir ve sulu ekstraktı antiürotiyatik ve antioksidan aktiviteye sahiptir (Bagchi ve ark., 2021).

## 6. Sonuç

*Sesbania grandiflora*, yem amaçlı olarak kes-taşı sistemlerinde kullanılan çok yönlü bir baklagil ağacı olarak kolayca yetiştirilebilir, olumsuz alanlarda büyüyebilir ve verimini sürdürmek için karmaşık yönetim gerektirmez. Yeşil aksamı, protein, mineral ve vitamin açısından zengindir. Sıcak ve nemli iklimlerde kışın besleyici hayvan yemi üretmeye için uygun bir türdür.

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## ÂŞIK PAŞA'NIN GARİP-NÂME'SİNDE AHLAK EĞİTİMİ

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### Özet

13. yy. sonları ve 14. yy. başlarında yaşayan Âşık Paşa toplumu bilgilendirmek, yönlendirmek ve toplumda birlik ve beraberliği sağlamak amacıyla eserler kaleme almıştır. Onun bu amaçla yazdığı en önemli eserlerinden birisi kuşkusuz 730/1330 yılında kaleme aldığı Garib-nâme adlı eserdir. Bu eser, Türk edebiyatının önde gelen temel eserlerinden biridir. Dinî, tasavvufî, öğretici bir eser olan ve halkı eğitmek maksadı ile Türkçe olarak yazılan Garip-nâme, sade dili dolayısıyla asırlar boyunca çok geniş bir okuyucu kitlesine hitap etmiştir. Tasavvufî eserler arasında konusu ve tekniği bakımından benzerlerine pek rastlanmayan, orijinal karakterde - nüshalara göre beyit sayısı değişiklik gösterse de- yaklaşık 12 bin beyitlik bir mesnevidir. Âşık Paşa bir şair ve mutasavvıftır. Bu nedenle Garib-nâme, her ne kadar dini/tasavvufî bir eser olsa da dünyevi birçok konuyu da içinde barındıran müstesna bir konuma sahip eserdir. İşte bu çalışmamızda birçok konuyu içinde barındıran ve içerisinde bu konularla ilgili açıklamalara da yer verilen Garip-nâme'de ele alınan ahlak konuları ele alınacaktır. Ancak eserde ahlak eğitimine dair pek çok konunun yer alması ve bunların bir çalışmanın sınırını aşacağı nedeniyle en çok üzerinde durulan beş ahlaki değer ele alınıp değerlendirilmeye çalışılacaktır. Bu yapılırken eserde verilen beyitler çözümleme, yorumlama ve analiz metoduyla yeri geldiğinde diğer düşünürlerin fikirleriyle de karşılaştırılarak yapılmıştır.

**Anahtar Kelimeler:** Âşık Paşa, Garip-nâme, Ahlak Eğitimi, Selçuklu ve Osmanlı Dönemi



## MORAL EDUCATION IN ASHIK PASHA'S GARIP-NAME

### **Abstract**

Living in the late 13th and early 14th centuries, Âşık Pasha wrote works to inform, guide and ensure unity and solidarity in society. One of the most important works he wrote for this purpose is undoubtedly the Garib-nâme, written in 730/1330. This work is one of the leading fundamental works of Turkish literature. A religious, mystical and educational work, written in Turkish with the aim of educating the public, Garip-nâme has appealed to a very wide audience for centuries due to its simple language. It is a mesnevi of approximately 12 thousand couplets, with an original character, which has few equivalents among mystical works in terms of subject and technique - although the number of couplets varies according to the copies. Âşık Pasha is a poet and a mystic. For this reason, although Garib-nâme is a religious/mystical work, it has an exceptional position in that it also includes many worldly issues. In this study, we will discuss the moral issues addressed in Garip-nâme, which includes many issues and includes explanations about these issues. However, since there are many issues regarding moral education in the work and these would exceed the limits of a study, the five most emphasized moral values will be discussed and evaluated. While doing this, the couplets given in the work were analyzed, interpreted and compared with the ideas of other thinkers when necessary.

**Keywords:** Âşık Paşa, Garip-nâme, Moral Education, Seljuk and Ottoman Period



## Giriş

Türkiye tarihi açısından XIII. ve XIV. yüzyıl Anadolu’da siyasi ve sosyal açıdan önemli olayların yaşandığı bir dönemdir. Bu dönem geleceğe büyük izler bırakan Selçuklu Devleti’nin sonu ve gelecekte büyük medeniyet oluşturacak olan Osmanlı Devleti’nin ilk tohumlarının atıldığı bir dönemdir. Bu dönem aynı zamanda gerek Moğol istilası sebebiyle Anadolu topraklarında kargaşanın hâkim olmasına bağlı olarak toplumsal birlikteliğin bozulduğu gerekse bazı isyan ve savaşlar neticesinde Selçuklu Devleti’nin yıprandığı, yıkılma dönemine girdiği ve beyliklere ayrıldığı dönemdir.

Memlekette bu çalkantılı döneminin neticesinde toplumsal hayatta da ciddi olumsuzluklar ortaya çıkmış, birlik ve beraberlik kaybolmuş, her alanda çöküntülerin yaşanmasına sebep olmuştur. Bu olumsuzlukları ortadan kaldırmak için toplumun manevi önderleri başta olmak üzere, topluma katkı sağlayabilecek hemen herkes kaynağını dinden alan fikirlerle bozulan düzeni yeniden tesis etme çabasına girerek, toplumu bir arada tutmaya çalışmışlardır. Özellikle dini/tasavvufi hayat, toplumda canlılığını koruduğu ve geniş kitleleri etkisi altına alabildiği için daha çok bu yolun güçlendirilmesine önem verilmiştir. Bu bağlamda Mevlana, Yunus Emre, Ahi Evran gibi meşhur şahsiyetler XIII. ve XIV. yüzyılda Anadolu topraklarında yaşamış, fikirleriyle ve eserleriyle topluma yön vermiş ve gelecek nesillere de bırakılacak çok önemli eserler kaleme almışlardır (Âşık Paşa, 2000; Doruk, 2013).

### 1. Âşık Paşa’nın Hayatı ve Eserleri

Asıl adı Ali, mahlası Âşık olan Âşık Paşa, 1272 yılında Kırşehir civarındaki Arapkir’de doğmuştur. Babası Muhlis Paşa, Baba İlyas’ın oğludur (Âşık Paşa, 2000; Öztürk, 2020; Levend, 1953). Onun “Paşa” lakabı, babasının ilk oğlu olmasından dolayıdır (Kut, 1991). Âşık lakabının ise, kendisine Hızır (a.s.) tarafından verildiğini eserinde açıklar. Buna göre müellif tasavvuf yolundaki yegâne hocası Hızır (a.s.)’ın hem aşkı kendisine öğrettiğini, hem de ona “Âşık” lakabını verdiğini belirtmektedir.

Mutasavvıf bir şair olan Âşık Paşa’nın hayatına bakınca onun sadece Orhan Bey zamanında yaşamadığı görülür. O, Osmanlı Devletinin kuruluşunu da görmüştür. 1272 yılında doğduğuna göre, Âşık Paşa’nın çocukluğu III. Gıyaseddin Keyhusrev (1266-1284), gençlik yılları Sultan II. Mesud (1284-1296, 1302-1310) ve III. Alâeddin Keykubad (1298-1302) zamanlarında geçmiş ve Osman Bey devrini olgunluk yıllarında yaşamıştır. Ömrünün son yedi senesini ise Orhan Bey zamanında geçirmiştir. Bu durumda o, üç Selçuklu ve iki Osmanlı hükümdarı olmak üzere beş sultanın saltanat zamanlarında ömür sürmüştür. Bu ömür içinde tahsiline Kırşehir’de devam etmiştir. Süleyman-ı Türkmanî’den tasavvuf dersleri aldığı gibi kayın pederi Şeyh Osman’ın derslerinde yetişmiş, devrin siyasi şahsiyetleri yanında âlim ve şeyhleri ile temas kurmuştur. Âşık Paşa daha küçük yaşlarda tarikat çevrelerinde bulunmuş ve buralarda zahirî ve bâtinî ilimleri öğrenmiştir. İçinde yetiştiği bölge ve aldığı eğitim Âşık Paşa’nın hem dinî ilimlere vâkıf iyi bir âlim ve sûfi olmasını hem de edebiyata âşinalık kazanmasını sağlamıştır (Âşık Paşa, 2000).

Âşık Paşa’nın en önemli vasfı devrinin bir âlim ve mutasavvıfı olarak halkla olan ilişkisidir. O, Anadolu’nun buhranlı ve karışık zamanlarında Türk milletine yol gösterenlerdendir. Eserini de bu düşünceden hareket ederek yazmış, Türk dili ile eser vermeyi kendine başlıca vazife bilmiş ve halkı aydınlatma yolunu seçmiştir. Bunun için de kendini çok iyi yetiştirmiştir. Eserinde Türk kültürünün bütün devrelerine gider gelir. Bazı ifadelerinde Orhun Âbidelerine, Kutadgu Bilig’e, Dede Korkut’a, Mesnevî’ye ve Yunus’a giderken, bazı sözleri ile de Süleyman Çelebi’ye yönelir (Âşık Paşa, 2000).

Türkçe sevgisi önemli bir yer tutan, ilme büyük değer veren, âlimleri seven Âşık Paşa hayatını Allah aşkına, Hz. Peygamber ve Sahabe-i Kiram sevgisine adanmış, ehl-i sünnet akidesine sıkıca bağlı, dört büyük imama ayrı bir sevgi duyan, mutedil, Sünni bir mutasavvıftır. Çocukluk ve gençlik dönemi, bu fikirleri öğrenmekle geçen Âşık Paşa, 13 Safer 733/ 3 Kasım 1332 tarihinde vefat etmiştir. O, edebiyatımızda tasavvuf alanının ilk temsilcileri arasında yer alır. Devrinde

en büyük mesneviyi ortaya koymuştur. Eserini açık ve anlaşılır bir dil ile yazan Âşık Paşa, önder bir âlim, mütefekkir bir mürşit olarak halkı aydınlatmada bir hayli gayret sarfetmiştir. Bunun için Garib-nâme adlı büyük mesnevîsini yazmıştır. Babası ve dedesi gibi, İslâmi esaslara, dört büyük imama sıkı sıkıya bağlı olan Âşık Paşa bu eseri ile düşüncelerini, öğütlerini halka yaydığı gibi, daha sonraki asırlara da ulaştırmıştır (Yavuz, 1983; Köprülü, 1993). Müellifin Garib-name dışında eserlerinin de olduğu değişik kaynaklarda yer almaktadır. Tespit edebildiğimiz kadarıyla en meşhur eseri Garib-nâme'den başka Vâsıf-ı Hâl, Fakr-nâme, Kimya Risalesi, Şiirler, Risâle-i Âşık Paşa, Risâle fî Beyânî's Semâ gibi eserleri mevcuttur. Ancak burada sadece çalışmamızın konusunu oluşturan Garib-nâme ile ilgili bilgi verilecektir.

## 2. Garip-nâme'de Ahlak Eğitimi

Garip-nâme'de İslam'ın temel kaynakları Kur'an ve sünnet bağlamında tasavvufi düşünceden de büyük ölçüde istifade edilerek oluşturulmuş bireysel ve toplumsal ahlak eğitimine dair birçok ahlaki kavram yer almaktadır. Bu kavramlar insanın yapması ya da yapmaması gerekenleri, doğru-yanlış, günah-sevap, güzel-çirkin, övülmüş-yerilmiş fiilleri içermektedir. Aşağıda Âşık Paşa'nın Garib-nâme'sinde yer alan ahlak eğitimine dair en çok üzerinde durulan beş kavram ele alınacaktır.

### 2.1. Doğruluk

“Yalanın karşıtı” olarak bilinen doğruluk, İslamî kaynaklarda “sıdk” kelimesi ile ifade edilir. Sıdk kavramı, ayet ve hadislerde, diğer İslami kaynaklarda “hakikati konuşmak, gerçeğe uygun bilgi vermek, dürüst ve güvenilir olmak, vaadine sadakat göstermek” (Çağrı, 2009) gibi anlamlara gelmekte ve çokça kullanılmaktadır. Bu bağlamda İslam ahlakında doğruluk kavramına büyük önem verilmiş, insanların sözünde, özünde ve davranışlarında doğru olması istenmiştir (el-Mâide 5/1; et-Tevbe 9/119; el-Ahzab 46/35; Buhâri, “Edeb”, 69; Müslim, “Birr”, 103-105, Tirmizî, “Kıyâmet”, 60).

Âşık Paşa'da Garib-nâme adlı eserinde doğruluğun ne denli ahlaki bir kavram olduğunu vurgulamıştır. Hatta eserinin birinci bölümünün birinci kıssasında doğruluğa vurgu yapması bunun en güzel kanıtıdır. O, Hz. Ebubekir'in (r.a.) “sıddık” lakabına vurgu yaparak onun özünde, sözünde, işinde doğru olduğunu örnek olarak vermekte ve Allah ve Peygamber sevgisi için canından, cananından ve malından vazgeçtiğini dile getirmektedir. Bunu da Leyl suresi'nin 17 ve 18. ayetleriyle desteklemektedir.

Yagmalatdı mâl-u mülkü hânûmân / Vırdı ol 'ışka gönül-ü cismi can

Terk ile söyündürdü ol hırs odını / Dutdı sıdkı aldı Sıddîk adını

Âşık Paşa, Allah kime dürüst olmayı nasip etmişse, o insan kendisini her türlü beladan korumuş demek olduğunu belirterek, doğru insanın herkesten üstün olduğunu ve cennete gidebilmenin doğruluk olduğunu ifade etmektedir. Bununla birlikte doğruluktan ayrılanların ise mü'min değil, münafık olduğunu dile getirir.

Her kime virdiyse Hak dirliği / Ol Kişiden Savdı cümle şerliği”

Uçmağı bu sıdk-ıla aldı alan / Rahmeti ikrâr buldı bulan”

Her ki sıdkı yog-ısa mü'min degül / Bes münafıkdur degül anda kabul”( Âşık Paşa, 2000)

Garib-nâme'nin iki kıssasının sadece doğruluk kavramından bahsetmesi de müellifin doğruluğa verdiği önemi göstermesi açısından önemlidir. Eserde gerek yapılan ibadetlerde gerekse ahlaki değerler bakımından doğruluğun önemi sık sık vurgulanmış, doğru olmayan insanlar penceresiz eve benzetilerek kapkaranlık olduğu söylenmektedir.

Kul 'ibadet kılsa hoşdur Halık'a / İlle sıdk assı idiser sadıka

Bu gönüller eve benzer her biri / Baca sıdkun düşer andan Hak nurı

Bacasuz ev nitekim aydun degül / Aydını kendünize kılmaz kabul

### 2.2. Adalet

Adalet, hakka göre hüküm vermek, eşit olmak, davranış ve hükümde doğru olmak gibi anlamlara gelmektedir. Kur'an-ı Kerim ve hadislerde çokça geçen bu kavram, genellikle düzen,

denge, eşitlik, doğru yolu izleme, dürüstlük, tarafsızlık, adil olma gibi manalarda kullanılmıştır (Çağrı, 1988).

İslam ahlakının en önemli değerlerinden biri olan adalet kavramı ilk çağlardan beri Platon'dan Kant'a, Gazzâli'den Mevlana'ya ve günümüze kadar her düşünürün önem verdiği, üzerinde görüş bildirdiği önemli kavramlardan biridir. Âşık Paşa'da Garib-nâme adlı eserinde adalet kavramına çokça yer vererek bu kavramın önemine vurgu yapmış ve ayetlerle konuyu desteklemiştir. Yer yer de Hz. Ömer'in adaletine vurgu yaparak konuyu örneklendirmiştir (Âşık Paşa, 2000).

Âşık Paşa, adalet kavramı ile ilgili olarak, her insanın sahip olamayacağı, Allah'ın herkese vermediği üç özellikten bahseder. Bu özelliklerden birisi de ister mümin ister kâfir olsun hiçbir ayırım gözetmeksizin herkesin hakkını veren yani adaletli kimsedir. Allah'ın bu özellikteki insanın her zaman yanında olacağını, koruyacağını ve gözeteceğini ifade eder.

İşid imdi ol üçinçisin dahı / Şol-durur kim koymaya düşman ohı  
Münkir ü kâfirden ol kayurmaya / Aña karşı müdde'î dem urmaya

Kamu yirde bekleye Allah anı / İy hoşâ ne bahtlu anuñ canı

Âşık Paşa, adaletli olan insanı hiç kimsenin üzmeyeceğini, inanan ve inanmayan herkes tarafından seveceğini ve âdil insanın dünya ve ahirette mutlu olacağını, Allah'ın ahlakıyla ahlaklandığını ve derecesinin üstün olduğunu belirtmiştir.

Ger Müsülman ger cühud ger Nasrani / Kim bakup görür ise sever anı

Cümle halk andan yana iver ola / Kamuları ol dahı sever ola

Böyle olan kinsene devletlüdür / Mansıb u bahsayış ü hil'atlüdür

Görüldüğü gibi Âşık Paşa adaletli olmanın üstün bir erdem olduğunu vurgulayarak, adaletli insanın hem Allah hem de insanlar tarafından seveceğini ifade etmektedir.

### **2.3. Tevazu/Alçakgönüllülük ve Kibir**

Kibrin karşıtı olan tevazu, birine boyun eğmek, kendi itibar ve derecesini düşük görmek anlamlarına gelmektedir (İbn Manzur, Lisânü'l-'Arab). İnsanın layık olduğu durumdan daha düşük bir dereceye razı olmasını ve kişinin başkalarını aşağılayıcı ve küçültücü her türlü duygu ve davranıştan uzak olmasını da ifade eden tevazu, Türkçe'de alçakgönüllülük kavramıyla karşılanmaktadır (Çağrı, 2011). Kur'an-ı Kerim'de ve hadislerde tevazu (el-Mâide 5/54; el-İsrâ 17/24; Buhârî, "Rikâk", 38; Tirmizî, "Birr", 82; İbn Mâce, "Zühd", 16; Müslim, "Cennet", 6) öven ve bunun zıttı olan kibirlenme, böbürlenme, övünmeyi kınayan (Lokmân 31/18-19; el-İsrâ 17/37; İbn Mâce, "Eğ'ime", 30; İbn Mâce, "Fiten", 21) pek çok ifade mevcuttur. Ahlak âlimleri de tevazu ve kibir kavramlarını çokça ele almışlar bu konuda insanları uyarılmışlardır (el-Mâverdî, 1988; el-İsfahânî, 1984; Gazzâli, 2002).

Âşık Paşa, eserinde tevazu ve kibir kavramına pek çok yerde dikkat çekerek, konuyu "Muhakkak ki Allah kibirlenenleri sevmez" (en-Nahl, 16/23) ayeti etrafında açıklar ve ilk olarak Hz. Âdem ve şeytan örneğini vererek başlar. Hz. Âdem'in affedilmesinin sebebinin tevazu, İblis'in kovulmasının sebebinin ise kibir olduğunu belirtir. Daha sonra kibire kapılarak hüsrana uğrayan İblis, Ebrehe ve ordusu, Âd kavmi, Belâm b. Baûra gibi kişilerden bahsederek örnekler verir (Âşık Paşa, 2000).

Suçı Hak'dan dutsa layık olmaya / Eyle diyen hiç rahmet bulmaya

Nitekim İblis ile Adem durur / Bu söze tanuk bular mukhkem durur

Bunlar iksi suçlu oldu nagehan / Gerçi takdir Tanrı'nundur bi-güman

Birisi rahmet bulup geldi ileri / Birisi la'net olup kaldı geri

Âşık Paşa, tevazu ve kibir konusunu açıklarken dağ ve buğday örneğini de verir. Böylece konunun daha derinden idrak edilmesini sağlar. Allah'ın "ol" demesiyle her şeyin oluverdiğini ay, güneş, yıldızlar, deniz, su ne varsa hepsinin şükrettiğini, ancak dağların kibirlenip böbürlendiğini ve bu sebeple Allah'ın gazabına uğrayarak yaz ve kış sürekli karlar altında kaldıklarını, bazen duman ve tufan olduklarını ifade eder. Buğday örneği için de Hz. Âdem'in yeryüzüne indirilmesinden sonra, Rabbine yalvardığını ve Allah'ın da ona yeryüzüne buğday

taneleri saçmasını emrettiğini belirterek, buğdayın büyüyüp başak verdikten sonra “benim yerimi hiçbir nimet tutamaz” diyerek kibirlendiğini ve bu nedenle onun orak ile biçildiğini ifade eder. Yirümi dutmaya hîc ni‘met benüm / Dünyada server benem ‘izzet benüm  
Âşık Paşa, Mevlana’nın meşhur yedi öğüdünden biri olan “tevazu ve alçakgönüllükte toprak gibi ol” sözüne benzer şekilde, toprak gibi yüzünün yerde olması yani tevazu sahibi olması yönünde tavsiyelerde bulunur. Tevazu sahibi olanların Allah ve insanlar tarafından sevileceğini de dile getirir.

Her kim ol kendini miskin göre / Hak’dan ana durmadan rahmet ire

Her ki düşdi toprağa göturdiler / Eksiği ney ise bitürdiler

Kendüzin eksük gören oldı tamam / Ulular gönlinde ol dutdı makam

Âşık paşa, eserinde bu konuya oldukça önem vermiş, insanın Allah yolunda kendisini toprakla bir tutmasını, kibirden uzak durmasını, kulluğun bunu gerektirdiğini öğütlemiş, asil kimselerin değerini tevazu ile kazandığına yönelik açıklamalarda bulunmuştur. Bununla birlikte kibrin Allah’ın sevmediği hallerin başında olduğunu belirterek bu kötü ahlaktan kaçınılması gerektiğini söylemektedir. Bu bağlamda O, Allah’tan başka her şeyin aciz olduğunu, ölümlü olan insanların kibre kapılmasının onun felaketi olduğunu da ifade ederek bu konuda okuyucularını sık sık uyarmıştır.

#### **2.4 İffet/Hayâ**

Ahlak kitaplarında genişçe yer verilen iffet ve hayâ kavramı helal olmayan söz ve davranışlardan sakınmak, utanmak (Gazzâlî, 1970) anlamlarına gelmekte ve insanın başta gelen erdemlerinden biri olarak kabul edilmektedir. İslam ahlakı bakımından son derece önemli olan bu kavram, birçok filozofun da kabul ettiği adalet, hikmet, iffet, cesaret/şecaat gibi dört temel erdemden biridir (İbn Miskeveyh, 1983). Kur’an-ı Kerim ve hadis kaynaklarında bu iki kavram pek çok yerde vurgulanmaktadır (el-Bakara 2/273; en-Nûr 24/32-33; en-Nisâ 4/6; Buhârî, “Tefsîr”, 2/48; Müslim, “Zekât”, 2; İbn Mâce, “Zühd”, 5; İbn Mâce, “Rühûn”, 5). Ancak belirtmek gerekir ki iffet, hem erkek hem de kadın için geçerlidir. Hatta Nûr Suresi’nin 30-31. ayetlerinde ilk hitabın erkeklere olması dikkat çekicidir.

Âşık Paşa Garib-name’de diğer İslam düşünürleri gibi Kur’an ve sünneti referans alarak konuyu ele alır. Konuya Kur’an-ı Kerim’den Ahzab Suresi’nin 35. ayeti ile başlamış, iffetin korunmasının önemine vurgu yapmak için de anlatımını ayetlerle destekleyerek açıklamıştır. Utanma, ar ve hayâ duygusundan mahrum insanların adının âleme yayılmasının Allah tarafından sevilmediğini belirtmiştir.

Bay u yohsul görüben utanmaya / Utanup ol kendü adın sanmaya

Tanrı sevmez bu hulu avratları /Oldur âhir Tanrı’nın afetleri

Âşık Paşa eserinde iffet/hayâ sahibi olmanın güzelliğini vurgulayıcı ifadeler kullanmış, ayrıca hayâ sahibi olan insanlara değer verilmesi gerektiğini belirtmiştir. Müellif ayrıca iffeti “en geçerli akçe” olarak tanımlamış ve hayâyı kendine süs edinen kimseden Allah ve Peygamber’inin razı olacağını da dile getirmiştir.

Razı andan Hak resül hoşnud ola /Âkıbet anun mahmud ola

#### **2.5. Kanaatkârlık/Şükretmek**

Ahlak ve tasavvuf kaynaklarında sıkça kullanılan kanaatkârlık, kişinin azla yetinip payına düşene razı olması/şükretmesi, başkasının elindekine göz dikmemesi, aşırı kazanma hırsından kurtulması gibi anlamlara gelmektedir (Çağrı, 2001). Kur’an-ı Kerim’de doğrudan “kanaat” kelimesi geçmemekle birlikte, birçok ayette kanaatkârlığın önemi verilenlere şükür üzerinde durulmuş, dünyaya ve mala aşırı düşkünlük yerilmiştir. Hadislerde de gerek kanaat kökünden kelimelerle gerek başka ifadelerle kanaatkârlığın önemine vurgu yapıldığı görülmektedir (Buhârî, “Zekât”, 18; Müslim, “Zekât”, 120, 124,125; Müsned, II, 168, 173; Buhârî, “Rıfak”, 15).

Âşık Paşa, kanaati Maverdi'nin görüşüne<sup>1</sup> benzer şekilde üçe ayırır. Ancak Âşık Paşa, ibadetlerde kanaatkâr olunmaması gerektiğini, bunun Allah'a ulaşmada engel olduğunu, Allah'ın rızasını kazanmada kanaatin önemli bir yol olduğunu söyler.

Komaz anı kim ulaşa hazret'e / Ol kişi lâyük degüldür rahmete

Her ki tâ'at azına kâni' ola / Rahmetinden Tañrı'nuñ mahrûm kala

Âşık Paşa, kanaatkârlık konusunu büyük ölçüde şükür kavramıyla birlikte ele almış ve konuyu genellikle şükür ayetleriyle desteklemiştir. Örneğin, Hakk'a ulaşmanın ve cennete girmenin yolunun aza kanaat edip, her zaman şükretmek olduğunu ifade etmiş ve "Şükrederseniz nimetlerimi artırırım" (İbrahim 14/7) ayetiyle açıklamıştır. Ona göre insanın sahip olduğu can ve ten için Allah'a yüz bin kez şükretmesi gerektiğini söylemektedir.

Pes bize vacib durur şükr-ü sena / Günde yüz bin kez cana vü hem tene

Zira kim ten bir avuç toprak ıdı / Bilelikden ol dem ol irag ıdı

Müellif, eserinde Allah'ın yeryüzündeki tüm nimetleri insanlar için yarattığına, insanları yoktan var ettiğine, onları beslediğine hemen hemen her bir nimete dikkat çekerek şükredilmesi gerektiğini ifade etmiştir. Böylelikle insan kendisine bahşedilen bütün bu nimetlerin kadrini bilmiş olacağını dile getirmiştir. Öyle ki en büyük şükür sebebinin de insanın akıllı ve bilen bir varlık olmasına bağlamaktadır (Âşık Paşa, 2000).

### Sonuç

Türk, edebiyat ve medeniyet tarihinin önemli eserlerinden biri olan Garib-nâme, Âşık Paşa tarafından kaleme alınan 10 bölüm ve her bölümde 10 kıssadan müteşekkil bir eserdir. XIV. yüzyılda kaleme alınan Garib-nâme dünya, ahiret ve daha birçok konuda bilgi ve öğüt vermektedir. Eserin yazıldığı dönem göz önüne alınırsa onun değeri açıkça ortaya çıkacaktır. Zira XIII. ve XIV. yüzyıllar Anadolu Selçukluları ve Osmanlı Devleti'nin kesişim noktasına denk gelmekte ve birçok siyasi çekişmelerin meydana geldiği dönemdir. Garib-nâme, böyle bir dönemde toplumu eğitime ve birleştirme amacıyla yazılmıştır. Bunun yanında eserin nüshalarının yurt içi ve yurt dışında pek çok kütüphanede yer alması onun daha sonraki yüzyıllarda da çoğaltılarak okunduğunu, kabul gördüğünü ve değerini göstermektedir.

Âşık Paşa'nın Garib-nâme adlı eserindeki ahlak eğitimi ve öğretim yöntemlerini ele aldığımız bu çalışmada eserde pek çok ahlaki değerlere ait konuların ele alındığı görülmüştür. Ancak konunun sınırlandırılması açısından eserde ele alınan ahlaki değerlerden en çok üzerinde durulan beş ahlaki kavram değerlendirilmiştir. Çalışmada ele alınan ahlaki değerler doğruluk, adalet, tevazu / alçakgönüllülük, iffet / hayâ ve kanaatkârlık / şükretmektir. Garip-nâme'de İslam'ın temel kaynakları Kur'an ve sünnetten büyük ölçüde istifade edilerek oluşturulmuş bireysel ve toplumsal ahlak eğitimine dair birçok ahlaki kavram yer almaktadır. Bu kavramlar insanın yapması ya da yapmaması gerekenleri, doğru-yanlış, günah-sevap, güzel-çirkin, övülmüş-yerilmiş fiilleri içermektedir. Eserde yer alan ahlaki ilkelerden her biri ayet, hadis, özlü söz ve kıssalarla desteklenerek verilmiştir.

Garib-name'de soyut konuların somutlaştırılması, konunun daha iyi anlaşılması ve etkili ve kalıcı bir öğrenmeyi sağlamak amacıyla çokça kıssa verilmiştir. Ayrıca eserde temsili anlatım, anlatılanların ayet ve hadislerle desteklenmesi, peygamberlerin isimlerinin ve mucizelerinin verilmesi gibi eğitim yöntemleri tercih edilerek, ahlaki değerlerin verildiği görülmektedir.

İnsanların ve toplumların mutluluğu onların ahlaki yapılarına ve bunu gelecek nesillere aktarmalarındaki başarılarına dayanmaktadır. XIV. yüzyılda Âşık Paşa tarafından sade öz Türkçe ile ayet ve hadislerle desteklenerek ve kıssalarla zenginleştirilerek oluşturulan Garib-nâme, toplumun iyileştirilmesi ve birlik ve beraberliğin güçlü kılınmasında önemli rol üstlenmiştir. Garib-nâme'nin farklı yönleri ön plana çıkarılarak yapılan çalışmalar olmakla birlikte, eserde

<sup>1</sup> Kanaatin ilk ve en ileri derecesi, dünya nimetlerinden hayatın devamına yetecek kadarıyla yetinip başka bir şey istememek; ikincisi, kullanıp değerlendirebileceği kadarına sahip olup elinde fazladan kalabilecek şeylere ilgi duymamak; üçüncüsü de imkân ölçüsünde olanları istemek, güçlükle kazanılabilen şeylerin peşinde koşmamaktır. bk. el-Maverdi, *Edebü'd-dünyâ ve'd-din*, 224-225.

birey ve toplumun ahlakını güzelleřtirmek, insanları peygamber ahlakı ile ahlaklandırmak amacının ön planda olduđu ve ahlak eđitimi bađlamında yazılmıř nadide eserlerden olduđu görölmektedir.

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## ÂŞIK PAŞA’NIN GARİP-NÂME ADLI ESERİNDE KULLANILAN EĞİTİM METOTLARI

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### **Özet**

Türkiye tarihi açısından XIII. ve XIV. yüzyıl Anadolu’da siyasi ve sosyal açıdan önemli olayların yaşandığı bir dönemdir. Bu dönem geleceğe büyük izler bırakan Selçuklu Devleti’nin sonu ve gelecekte büyük medeniyet oluşturacak olan Osmanlı Devleti’nin ilk tohumlarının atıldığı bir dönemdir. Bu dönem aynı zamanda gerek Moğol istilası sebebiyle Anadolu topraklarında kargaşanın hâkim olmasına bağlı olarak toplumsal birlikteliğin bozulduğu gerekse bazı isyan ve savaşlar neticesinde Selçuklu Devleti’nin yıprandığı, yıkılma dönemine girdiği ve beyliklere ayrıldığı dönemdir. Memlekette bu çalkantılı döneminin neticesinde toplumsal hayatta da ciddi olumsuzluklar ortaya çıkmış, birlik ve beraberlik kaybolmuş, her alanda çöküntülerin yaşanmasına sebep olmuştur. Bu olumsuzlukları ortadan kaldırmak için toplumun manevi önderleri başta olmak üzere, topluma katkı sağlayabilecek hemen herkes kaynağını dinden alan fikirlerle bozulan düzeni yeniden tesis etme çabasına girerek, toplumu bir arada tutmaya çalışmışlardır. Özellikle dini/tasavvufi hayat, toplumda canlılığını koruduğu ve geniş kitleleri etkisi altına alabildiği için daha çok bu yolun güçlendirilmesine önem verilmiştir. Bu bağlamda Mevlana, Yunus Emre, Ahi Evran gibi meşhur şahsiyetler XIII. ve XIV. yüzyılda Anadolu topraklarında yaşamış, fikirleriyle ve eserleriyle topluma yön vermiş ve gelecek nesillere de bırakılacak çok önemli eserler kaleme almışlardır. Bu dönemde kaleme alınan eserlerden biri de Garip-nâme’dir. İşte bu çalışmamızda birçok konuyu içinde barındıran ve içerisinde bu konularla ilgili açıklamalara da yer verilen Garip-nâme’de ele alınan bazı eğitim metotları üzerinde durulacaktır.

**Anahtar Kelimeler:** Âşık Paşa, Garip-nâme, Eğitim Metotları, Selçuklu ve Osmanlı Dönemi



## EDUCATIONAL METHODS USED IN ASHIK PASA'S WORK NAMED GARIP-NÂME

### **Abstract**

In terms of Turkish history, the 13th and 14th centuries are a period when important political and social events took place in Anatolia. This period is the end of the Seljuk State, which left great marks on the future, and the first seeds of the Ottoman State, which would create a great civilization in the future, were sown. This period is also the period when social unity was disrupted due to the chaos prevailing in Anatolian lands due to the Mongol invasion, and when the Seljuk State was worn out, entered a period of collapse and divided into principalities as a result of some rebellions and wars. As a result of this turbulent period in the country, serious negativities emerged in social life, unity and solidarity were lost, and collapses were experienced in every field. In order to eliminate these negativities, especially the spiritual leaders of the society, almost everyone who could contribute to the society tried to re-establish the disrupted order with ideas that derived their source from religion and tried to keep the society together. Especially since religious/mystical life maintains its vitality in society and can influence large masses, more importance has been given to strengthening this path. In this context, famous figures such as Mevlana, Yunus Emre, Ahi Evran lived in Anatolia in the 13th and 14th centuries, shaped society with their ideas and works, and wrote very important works that will be left to future generations. One of the works written during this period is Garip-nâme. In this study, we will focus on some of the educational methods discussed in Garip-nâme, which includes many subjects and includes explanations about these subjects.

**Keywords:** Âşık Paşa, Garip-nâme, Educational Methods, Seljuk and Ottoman Period

## Giriş

Garip-nâme'nin konusu insandır. Nitekim eserin müellifi, bütün kâinatı insanda toplanmış olarak bulur ve bu nedenle insanın fizik ve ruh âlemine dikkatle bakarak bireye ve topluma yönelik orijinal yöntemlerle eğitici bilgiler sunar. İşte bu çalışmamızda birçok konuyu içinde barındıran ve içerisinde bu konularla ilgili açıklamalara da yer verilen Garip-nâme'de ele alınan ahlak konuları ele alınacaktır. Ancak eserde ahlak eğitimine dair pek çok konunun yer alması ve bunların bir çalışmanın sınırını aşacağı nedeniyle en çok üzerinde durulan beş ahlaki değer ele alınıp değerlendirilmeye çalışılacaktır. Bu yapılırken eserde verilen beyitler çözümleme, yorumlama ve analiz metoduyla yeri geldiğinde diğer düşünürlerin fikirleriyle de karşılaştırılarak yapılmıştır. Âşık Paşa'nın ahlak anlayışını çeşitli yönleriyle ele almayı amaçlayan bu çalışmada, eserde kullanılan bazı eğitim metotları üzerinde de durarak günümüz eğitim metotlarına yansımaları da görülmüş olacaktır. Tüm bu çalışmalar Prof. Dr. Kemal Yavuz tarafından yayına hazırlanan ve 2000 yılında Kültür ve Turizm Bakanlığı tarafından basılan "Garip-nâme" adlı eserden faydalanılarak gerçekleştirilmiştir.

### 1. Garip-nâme

Âşık Paşa'nın en önemli eseri olan Garip-nâme, 1330 yılında kaleme alınmış, Türk Dili ve Edebiyatı açısından oldukça önemli bir eserdir. Eser, bazı kaynaklarda; Divan-ı Âşık, Divan-ı Âşık Paşa, Maârifnâme ve Gencnâme gibi adlarla anılırsa da (Ergun, 1936; Muallim Naci; 1978), Âşık Paşa eserin adını bizzat kendisi Garip-nâme koymuştur.

Bu Garip-nâme anın geldi dile

Kim bu dil ehli dahı ma'ni bile

Âşık Paşa, Garip-nâme adlı eserini on bab/bölüm ve her bab on dasitan/kıssa olacak şekilde yazmıştır. Eserde döneminin birçok özelliği ile ilgili bilgiler de verilmektedir. Eserle ilgili çalışmalarda tahminî olarak on iki bin beyit olduğu zikredilirse de, Sadettin Nüzhet Ergun'un bildirdiğine göre 10.293 (Köprülü, 1979); Âmil Çelebioğlu'nun sayımına göre de 10.015 ve 10.312 beyittir (Çelebioğlu, 1976). Prof. Dr. Kemal Yavuz tarafından hazırlanan TDK tarafından basılan ve bizim çalışmamızda da kullandığımız mevcut baskısında 10.613 beyit bulunmaktadır.

Baştan sona kadar Fâilâtün Fâilâtün Fâilün vezni ile mesnevî tarzında yazılan eser, son derece sade bir dil ile kaleme alınmıştır. Müellif eseri, Arapça ve Farsça'nın zor ifadeleriyle değil, Türkçe'nin o sade, pürüzsüz ve anlaşılır üslubuyla yazmıştır. Âşık Paşa'nın bu eseri Türkçe telif etmesi, büyük Türk Mutasavvıfı Yunus Emre'nin tesirinde kaldığını göstermektedir. Eser, muhtevası itibarıyla Dinî-tasavvufî bir eser olması hasebiyle Türk Tasavvuf Tarihi açısından da önemli bir çalışma olarak ortaya çıkmaktadır (Doruk, 2013).

On bölümden meydana gelen eserin her bölümünün de on kıssaya yer vermesi ve bölümden bölüme genişleyerek, bir nizam içinde gittikçe açılması Garip-nâme'nin en dikkat çekici özelliğidir.<sup>2</sup> Bu açıdan bakılınca eserdeki konular da birbiri ardından açılıp genişlemektedir. Bunu bölümleri takip edip her bölümü on ile çarptığımız (10+20+30+40+50+60+70+80+90+100=) takdirde Garip-nâme'nin en azından 550 konuyu işlediğini veya bu kadar mesele üzerinde durup açıklamalara yer verdiğini belirtmek gerekir. Böylece açılan ve bu açılmada genişleyen, genişleyip büyürken de nizam ve intizamını koruyan, insanı daha ötelere götüren, Âşık Paşa'nın deyimini ile nelerin olduğunu gösteren bir kâinat aynası ile karşılaşır ve zerrelere güneşlere yol alır, hikmet ve sırlara kavuşmuş olur. İşte Garip-nâme'nin en önemli özelliği budur. Bu durum, şairinin ne derecede geniş bir düşünce ve ibretle baktığını, nasıl bir hayal gücüne sahip olduğunu, ne derecede görüş inceliklerine dikkat ettiğini, ilmî titizliğini ve eserinin orijinalliğini göstermesi açısından da önemlidir. Bu yönden

<sup>2</sup> Âşık Paşa, Garip-nâme'de eserini niçin on bölüme ayırdığını ve her bir bölümü niçin tekrar on kısımda topladığını da açıklamıştır. Bunun sebeplerinden biri eski âlimlerin hesap ilminin temelini on üzere kurmalarıdır. Bu anlayışa göre Allah Kur'an'da sevdiklerini on defa övmüş, yine dostlarını on kez methetmiştir. Düşmanlarını da on kez anarak zemetmiştir. Ona göre insanın kusurlu olmasının, tam olamamasının sebebi de dokuz aylık olması sebebiyledir. Müellif on sayısının tam olduğuna inanmıştır. Böylece eserini on sayısı bağlamında kendine has bir şekilde oluşturmuştur.

bakılınca eserde karşılaşılan bu şaşırtıcı durum kitabın niçin Garib-nâme adı ile anıldığının da sebebi olabilir. Ayrıca eser tasavvufî yönde Hakk'a kavuşmanın sırlarını vermesi bakımından da önemlidir. Dünya bir gurbet yeri kabul edilirse Garib-nâme adının niçin verildiği de ortaya çıkmış olacaktır (Âşık Paşa, 2000; Kut, 1991).

Garib-nâme, hem dünyevî hem de uhrevî birçok konudan bahseder ve günlük hayata çok geniş yer verir. Bazen varlığın asıl unsurları olan anâsır-ı erba'a ve onun insan yaşamı üzerindeki etkisinden, bazen ziraatın nasıl olduğu ve insanın da ekinin bitmesi misali gibi nasıl olgunlaşım biteceğinden, bazen yedi felek ve gökteki yıldızların ana karnındaki cenine ve insanın hayatının başlangıcından sonuna kadarki evrelerine ve karakterlerine etkisinden bahseder. Yine o, kızları evlendirmekten, öksüzlerin hallerinden, yıldız ve gezegenlerin durumundan, her zaman geçerliliğini koruyan hükümdarlığın akıl, asalet, yiğitlik, ilim ve cömertlik gibi sağlam temellerinden, tarikat ve adabından, şeyh-mürit ilişkisinden, kâinattaki her bir varlığın özelliğinden bahseder. Neticede bunlar gibi pek çok konuya temas eder. Öyle ki insan ahlakından, yaratıcının sonsuz kuvvet ve kudretinden, Hz. Peygamber ve sahabe-i kiramdan da bahseder. Kısacası eser dinin özüne uygun olan her şeye temas eder. Dolayısıyla Âşık Paşa, mesele ve hadiseleri açıklayan bir bakış açısına sahiptir. Kâinat ona göre bir aynadır. O, kâinattan insana gelir. Her bir varlığın özelliğini belirtir, kıyaslar ve benzer tarafları ile ilgi kurduğu gibi, zıtlıkları da gözler önüne serer. Ayrıca bir kısım öğütlerinde de ana baba, hoca ve esnaf velisi olan ahiden dua almayı da tavsiye eder. Bunlara hizmeti, sözlerini dinlemeyi, ilim öğrenmeyi, özellikle hoca eşliğinde kul olmayı; ahilikle ilgili olarak da ihlâs sahibi olmayı, halkın sıkıntısını yüklenip gidermeyi, malı mülkü insanların yoluna ve faydalarına harcamayı, gelen gidenle ilgilenip onları boş göndermemeyi, yolunu şaşırana yol göstermeyi sıkı sıkıya tembih eder. İş hayatını anlatır. Onda yetmiş iki millete bir gözle bakmak, hangi dine mensup olurlarsa olsunlar insanlar arasında ayırım yapmamak fikri de vardır.

Müellif eserini Türk milleti için yazdığını söyler. Türkçenin o devirde hor görüldüğünü, her dilin araştırılıp incelendiğini, öteki dillerde eserler verildiğini, Türk dili ile kimsenin ilgilenmediğini, bu durumu Türk milletinin de bilmediğini ve Garib-nâme adlı eserini bunun için yazdığını, böylece Türklüğün kendi dilinde eserler okuyup hikmetlere ulaşmasını ve mahrum kalmamasını ister. Bunu:

Gerçi kim söylendi bunda Türk dili / İlla ma'lum oldu ma'nî menzili

Türk diline kimsene bakmaz-ıdı / Türklere hergiz gönül akmaz-ıdı

Türk dahı bilmez-ıdı ol dilleri / İnce yolu ol ulu menzilleri

Bu Garib-nâme anın geldi dile / Kim bu dil ehli dahı ma'ni bile

Tâ ki mahrûm kalmaya Türklere dakı / Türk dilinde anlayalar ol Hak'ı

beyitlerinde dile getirir. Netice itibariyle Âşık Paşa eserini Türk milletinin hikmetlere ulaşması için Türkçe yazdığını ve mensubu bulunduğu millete bir armağan bıraktığını, böylece asırlar ötesinde hatırlanacağını düşünmektedir.

Garib-nâme'nin şekil özelliği konusunda da şunları söyleyebiliriz: Eserde bol miktarda ayet, hadis ve kelam-ı kibardan faydalanmıştır. Özellikle ayetlerden çokça yararlandığını, eserde yer alan yüz kıssanın tamamında Kur'an ayetlerinin kullanıldığı, yirmiden fazlasının ise doğrudan doğruya Kur'an ayetleri perspektifinde yazıldığı görülmektedir. Böylece eserin tamamında bir şekilde Kur'an ayetlerinin kullanıldığı görülmektedir.

## **2. Garib-nâme'de Kullanılan Eğitim Metotları**

Belli bir sonuca ulaşmak, bir problemi çözmek, her hangi bir işi görmek, bir teşebbüsü sonuçlandırmak için bilinçli bir şekilde izlenen yol, usul anlamlarına gelen yöntem, (Alaylıoğlu- Oğuzkan, 1976) eğitimde ulaşımak istenen hedefe varmak için oldukça önemlidir. Her bilim dalının kullandığı birtakım yöntemler vardır, ancak anlatım, soru-cevap, tartışma gibi hemen hemen bütün bilim dallarının ortaklaşa kullandığı yöntemler olsa da hepsi aynı yöntemi kullanmazlar. Ama bir kimse hangi bilim dalıyla uğraşırsa uğraşsın mutlaka o bilim dalının yöntemlerini iyi bilmek durumundadır. Bu itibarla ahlak eğitimi açısından incelediğimiz Garib-

nâme'de yer alan birtakım öğretim yöntemleri tespit edilmiş, bunlardan bazıları aşağıda verilmiştir.

### 2.1. Kıssa

Kendisinden ders alınması gereken kısa hikâye (TDK, “Kıssa”, <https://sozluk.gov.tr>.) anlamına gelen kıssa, eğitimde öğüt verme, bilgi verme, örneklendirme, somutlaştırma ve anlatılanların insanlar tarafından kolay kavranmasını sağlamaya yöneliktir. Kıssalar geçmişten günümüze eğitimde kullanılmıştır. Bunun en güzel örneklerini Kutsal Kitabımız Kur'an-ı Kerim'de görmekteyiz. Zira Kur'an'da birçok kıssaya yer verilmiş, insanların bu kıssalardan ders çıkarmaları istenmiştir. Böylece eğitimin de amacı olan “bireyde davranış değişikliği” oluşturulmak istenmiştir.

Âşık Paşa'nın Garib-nâme adlı eseri on bölümden meydana gelmekte ve her bölümde on kıssaya yer vermesi, dolayısıyla eserinde yüz kıssaya eserin en dikkat çekici özelliğidir. Bu kıssalardan ilk bölümde yer alan 10 kıssanın isimleri şöyledir: Peygamberin arkadaşlarının halleri kıssası, yirmi dört bin peygamber kıssası, organların ibadetleri kıssası, iki göz kıssası, insan eli kıssası, suların birliği kıssası, kazların kılavuza uyması kıssası, Kâbe yolunda Arap kıssası, Padişahın nasihatleri kıssası ve dört yoldaş kıssasıdır. Bu kıssalardan birinci bölümün dördüncü kıssası olan “iki göz kıssası” örnek olarak aşağıda verilmiştir.

1. İki göz ne yapılması gerektiğini ve sevgili ile nasıl birlik edeceğini söyler.

2. Bunlar birbirinden ayrılmaz şekilde yaratılmıştır; birlikte görürler, birlikte ağlarlar, birlikte uyurlar, birlikte uyanırlar.

3. İşte böyle tam bir birliğe bağlandıklarından dolayı Allah bunlara tecelliye kavuşmak gibi bir kutluluk verir.

4. Bunlar gibi sevgiliyle birlikte bulunan kederlenmez. Böyle kişi, dünyada saadetle yaşar, ahirette de rahmete kavuşur (Âşık Paşa, 2000).

Müellif, iki gözün birlikte hareket etmekle Allah'ın görmeye layık olduklarını, şaşıp sapmama elbisesi giydiklerini anlatırken böyle bir hikâye aktarmıştır. Burada şunu vurgulamak gerekir ki, 10 bölüm ve 100 kıssadan oluşan bu eserde yer alan kıssalar bazen tek bir konuyu ihtiva ederken bazen de aynı kıssa içerisinde farklı birkaç konuyu barındırabilmektedir. Hatta bazı kıssalar aynı anda iki, üç, hatta dört konuyu işlemektedir (Topcu, 2019).

### 2.2. Temsili Anlatım

Bir şeyi başka bir şeyin yerine ikame etme esasına dayalı olarak bir manayı kendine ait olmayan lafızlarla ifade etme anlamına gelen temsili anlatım, söze edebi bir hüviyet kazandırır. Temsil eden ile temsil edilen arasında uygun ve makul ilgiler kurularak oluşturulan temsili anlatım, sözü/yazıyı tesirli, cazip ve bedii kılma gibi amaçlarla tercih edilir. Ayrıca anlaşılması zor konu ve meselelerin anlaşılır kılınması adına daha çok soyutu somuta indirgemek amacıyla temsili anlatıma başvurulmaktadır (Cürcani, 2018).

14. asrın en hacimli eserlerinden biri olan Garib-nâme'de temsili anlatım yöntemine çokça başvurulduğu görülmektedir. Yüz dasitan/alt bölümden oluşan Garib-nâme'nin kırk dördünde temsili anlatıma başvurulmuştur. Nitekim birinci bölümde on, ikinci bölümde yedi, üçüncü bölümde üç, dördüncü bölümde sekiz, beşinci bölümde altı, altıncı bölümde iki, yedinci bölümde bir, sekizinci bölümde beş, dokuzuncu bölümde bir ve onuncu bölümde bir kez temsil getirilmiştir. Buradan hareketle eserin ilk beş bölümünde otuz dört temsil, son beş bölümünde ise on temsile başvurulduğu anlaşılmaktadır. Müellif, ilk beş bölümde temsili anlatıma daha çok ağırlık verirken, sonraki beş bölümde daha çok nasihatçi bir yaklaşım sergilemiştir. Bunun farklı sebepleri olmakla birlikte, yaklaşık 12.000 beyitten müteşekkil bir eserin kısa zamanda yazılması mümkün değildir. Âşık Paşa, eserin yazma süresini biraz daha kısa tutabilmek açısından sonraki bölümlerde temsili anlatımdan uzak kalmış olabilir. Çünkü temsili anlatımla yazmak zor ve uğraş gerektiren bir iştir. Bunun yanında eserin daha da hacimli olmaması düşüncesi ve kullanılacak temsil bulamama gibi sebeplerle son bölümlerde fazla temsili anlatım yapmadığı kanaatindeyiz (Kandemir, 2022).

Örneğin, birinci bölümün sekizinci temsili od (ateş)'tir. Kâbe'ye giderken soğuk yüzünden zahmet çeken ve ateş yakmaya çalışan bir kişinin meseli anlatılır.

Bu kezın taşı kavı dutdı bile / Bir yañadan çakmağı aldı ele  
Urdı taşa çıkdı od düşdi kava / Cümle hâcet ol sa'at oldı revâ  
Çünkim od yandı hak'a şükr eyledi / Od katında oturup fikr eyledi  
Fikr içinde ma'niyi böyle güder / Zıkr içinde sözi böyle şerhider

Görüldüğü gibi, ateş yakmaya çalışan kişi birçok yol denese de çakmak, taş ve kavı'yı bir araya getiremeyince ateşi yakamaz. Burada birlik ve beraberliği, tevhidi ateş temsili üzerinden anlatmıştır. Burada Âşık Paşa'nın eserinde birlik fikrine çok önem verdiğini de belirtmek gerekir. Çünkü kendisi sosyal açıdan dağınık bir toplumda yaşamıştır. Bu nedenle eserinin birinci bölümündeki on kıssanın tamamında birlik fikrini topluma anlatmaya çalışır. Eserin şekil ve muhteva yönünün geometriksel olarak birbiriyle ilintili olması da bu kıssanın birinci bölümde yazılmasının amillerindendir. Çünkü birinci bölüm 'bir' ile ilintili şeylerin anlatıldığı bölümdür (Doruk, 2013).

### 2.3. Ayet ve Hadislerle Destekleme

Âşık Paşa, Garib-nâme'sinde anlatmak istediği konuları işlerken sıkça ayet ve hadislerden yararlanmakta, onları metin ve muhteva ile iç içe kullanmaktadır. Ayet ve hadisler sadece dini konuların işlendiği ve anlatıldığı kısımlarda değil, diğer kısımlarda da göze çarpmaktadır. Ancak Âşık Paşa'nın eseri Kur'an ayetlerini ve hadisleri açıklamayı amaç edinmiş bir tefsir ve hadis kitabı değildir. Bu nedenle ondan ayet ve hadisleri açıklama amaçlı eserlerden beklenebilecek bir yorum faaliyeti beklentisi içinde olmamız mümkün değildir. Bununla birlikte eserde çokça ayet ve hadise temas edildiği ve işlenen konuların ayet ve hadislerle ustaca desteklendiği görülmektedir. Örneğin, Âşık Paşa üçüncü bölümün dokuzuncu kıssasında Allah'ın üç çeşit insan tipi yarattığını belirterek bunu Fâtır Suresi'nin 32. ayetini<sup>3</sup> delil getirerek ele almaktadır (Doruk, 2013).

Beyân ider kim Hak Ta'âlâ üç dürlü  
Halk Ketm-i 'Adem'den vücûda  
Getürdi bu ayetden ki Femiñhüm Zâlimün Li Nefsihi İktibâs İdüp  
Ma'lûm ve Mefhûm olur 35/32.  
Diñle imdi eydeyüm birkaç haber / Ger cânuñda var-ısa 'ışkdan eser  
Bu haberden bir nasihat alasin / Aña bakup kendü hâlün bilesin  
Kamuya vâcib-durur hâl añlamak / hâlini bilmekdür ahvâl añlamak  
Kendü hâlin bilmeyen hayvân-durur / Ger niçe kim sûreti insân-durur

### 2.4. Peygamberlerin isimlerinin ve mucizelerinin verilmesi

Garib-name'de Peygamberlerin isimleri ve mucizelerinin de verilerek konunun anlatıldığı görülmektedir. Kur'an-ı Kerim'de geçen yirmi beş peygamberin on dördünün ismi ve mucizeleri geçmektedir. Bu bağlamda en çok Hz. Muhammed'in ismi ve mucizeleri verilmektedir. Bunun yanında Hz. Âdem, Hz. İdris, Hz. İbrahim, Hz. İsmail, Hz. Davud, Hz. Eyüp, Hz. Hud, Hz. Nuh, Hz. Musa, Hz. Yunus, Hz. Yusuf, Hz. Süleyman ve Hz. İsa da ismi geçen diğer peygamberlerdir. Özellikle gerek örnek yaşantısı gerek mucizeleri olmak üzere Hz. Muhammed'in her bölümde ve toplamda 406 defa zikredildiği görülmektedir. Bu durum eserin insanları peygamber ahlakıyla ahlaklandırma amacı gözetilerek yazıldığını da göstermektedir.

Ol Muhammed hem kuluñdur hem resûl / Anı sen sevdün ü sen kıldıñ kabûl  
Kâla'llahû ta'âlâ Muhammedün resûlu'llâhi  
Mustafâ'dur Mustafâ'dur Mustafâ / Müctebâ'dur Müctebâ'dur Müctebâ  
Eyle kim sevdi Çalap ol Ahmed'i / Hem resûlüm hem habîbümsin didi  
Hem didi ger sen degül miseñ 'ayân / Yaradur degül idüm kevn ü mekân  
Levlâke lemâ halaktü'l-eflâk

<sup>3</sup> bk. "Sonra biz kullarımızdan seçtiklerimizi o kitaba mirasçı kaldık. Onlardan kimi kendine kötülük eder, kimi orta bir durumdadır, kimi de Allah'ın izniyle hayır işlerinde yarışır; işte büyük lütuf budur."

Cümle senüñ dôstlıguñçun eyledüm / Senüñ aduñla bile yazdum adum  
Lâilâhe illa'llâhu Muhammedün resûlu'llâhi  
Pes bilüñ kim gelmedi hem gelmeye / Mustafâ gibi kimesne dünyeye  
Pes Muhammed geldi baş oldu aña / Menzili cûyendelikdur görseñz  
Bâki niçe halk ki vardur dünyede / Tâbi'îdür bu vücûduñ iy dede  
Oldur Allah ögdügi ol âdemî / Aña bir ev eyledi bu 'âlemi  
Ve lekad kerremnâ benî âdeme 17/70  
Çün birikdürdi buları ol Çalap / Pes anuñ üzre bu kez kıldı hitâb  
Eytdi işle niçe buyrıldı ise / Dogru durgıl niçe emr oldu ise  
Festakım kemâ ümirte 11/112.

Görüldüğü üzere Âşık Paşa Hz. Muhammed'in bir özelliğinden bahsederken ayet ve hadislerle de desteklemektedir. Diğer peygamberlerin ismi ve mucizelerini de genel olarak aynı şekilde ayetlerle desteklemektedir.

### **Sonuç**

Türk, edebiyat ve medeniyet tarihinin önemli eserlerinden biri olan Garib-nâme, Âşık Paşa tarafından kaleme alınan 10 bölüm ve her bölümde 10 kıssadan müteşekkil bir eserdir. XIV. yüzyılda kaleme alınan Garib-nâme dünya, ahiret ve daha birçok konuda bilgi ve öğüt vermektedir. Eserin yazıldığı dönem göz önüne alınırsa onun değeri açıkça ortaya çıkacaktır. Zira XIII. ve XIV. yüzyıllar Anadolu Selçukluları ve Osmanlı Devleti'nin kesişim noktasına denk gelmekte ve birçok siyasi çekişmelerin meydana geldiği dönemdir. Garib-nâme, böyle bir dönemde toplumu eğitime ve birleştirme amacıyla yazılmıştır. Bunun yanında eserin nüshalarının yurt içi ve yurt dışında pek çok kütüphanede yer alması onun daha sonraki yüzyıllarda da çoğaltılarak okunduğunu, kabul gördüğünü ve değerini göstermektedir.

Âşık Paşa'nın Garib-nâme adlı eserindeki ahlak eğitimi ve öğretim yöntemlerini ele aldığımız bu çalışmada eserde pek çok ahlaki değerlere ait konuların ele alındığı görülmüştür. Ancak konunun sınırlandırılması açısından eserde ele alınan ahlaki değerlerden en çok üzerinde durulan beş ahlaki kavram değerlendirilmiştir. Çalışmada ele alınan ahlaki değerler doğruluk, adalet, tevazu / alçakgönüllülük, iffet / hayâ ve kanaatkârlık / şükretmektir. Garip-nâme'de İslam'ın temel kaynakları Kur'an ve sünnetten büyük ölçüde istifade edilerek oluşturulmuş bireysel ve toplumsal ahlak eğitimine dair birçok ahlaki kavram yer almaktadır. Bu kavramlar insanın yapması ya da yapmaması gerekenleri, doğru-yanlış, günah-sevap, güzel-çirkin, övülmüş-yerilmiş fiilleri içermektedir. Eserde yer alan ahlaki ilkelerden her biri ayet, hadis, özlü söz ve kıssalarla desteklenerek verilmiştir.

Garib-name'de soyut konuların somutlaştırılması, konunun daha iyi anlaşılması ve etkili ve kalıcı bir öğrenmeyi sağlamak amacıyla çokça kıssa verilmiştir. Ayrıca eserde temsili anlatım, anlatılanların ayet ve hadislerle desteklenmesi, peygamberlerin isimlerinin ve mucizelerinin verilmesi gibi eğitim yöntemleri tercih edilerek, ahlaki değerlerin verildiği görülmektedir.

İnsanların ve toplumların mutluluğu onların ahlaki yapılarına ve bunu gelecek nesillere aktarmalarındaki başarılarına dayanmaktadır. XIV. yüzyılda Âşık Paşa tarafından sade öz Türkçe ile ayet ve hadislerle desteklenerek ve kıssalarla zenginleştirilerek oluşturulan Garib-nâme, toplumun iyileştirilmesi ve birlik ve beraberliğin güçlü kılınmasında önemli rol üstlenmiştir. Garib-nâme'nin farklı yönleri ön plana çıkarılarak yapılan çalışmalar olmakla birlikte, eserde birey ve toplumun ahlakını güzelleştirmek, insanları peygamber ahlakı ile ahlaklandırmak amacının ön planda olduğu ve ahlak eğitimi bağlamında yazılmış nadide eserlerden olduğu görülmektedir.

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## 5-HİDROKSİTALİDOMİT MOLEKÜLÜNÜN FRONTIER ORBİTAL, MEP VE SİLİKO ANALİZİ

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### **Özet**

Talidomidin metabolitlerinden biri 5-hidroksitalidomiddir (5-hidroksitalidomid). Tipik kütlesi 274,23 g/mol ve kimyasal formülü  $C_{13}H_{10}N_2O_5$ 'dir. Talidomidin vücuttaki metabolizması sırasında üretilen bu maddenin bir dizi biyolojik sonucu vardır. Bu nedenle, bu çalışmada teorik ve deneysel olarak önemli olan 5-hidroksitalidomid molekülünün optimizasyon, frontier moleküler orbital (HOMO ve LUMO) ve moleküler elektrostatik potansiyel analizleri Gaussian 09W paket programı kullanılarak gerçekleştirilmiştir. Çalışmanın son bölümünde ise çalışılan molekülün potansiyel hedefi Swiss Target aracılığıyla belirlenmiş ve Auto dock Vina yardımıyla in silico hesaplamalar gerçekleştirilerek sonuçlar ilgili alanlarda genişletilmiştir.

**Anahtar Kelimeler:** Talidomid, Frontier Orbital, MEP, Moleküler Kenetlenme



## FRONTIER ORBITAL, MEP AND IN SILICO ANALYSIS OF 5-HYDROXYTHALIDOMIDE MOLECULE

### **Abstract**

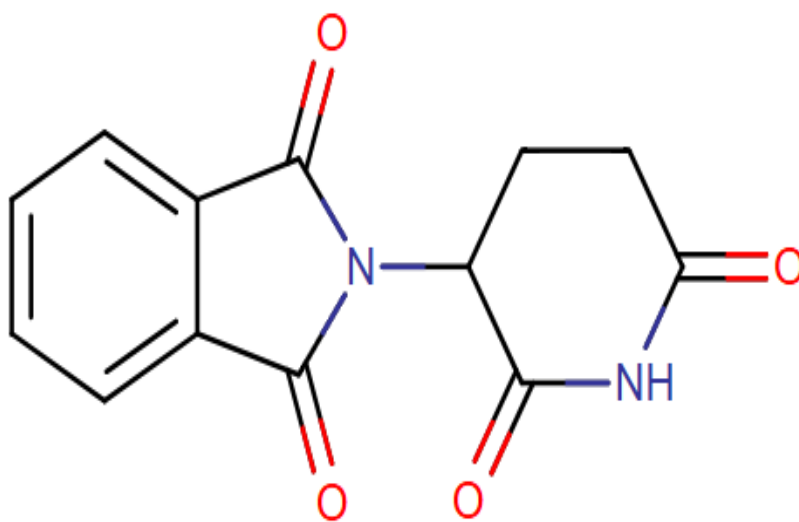
One of thalidomide's metabolites is 5-hydroxythalidomide (5-hydroxythalidomide). Its typical mass is 274.23 g/mol and its chemical formula is  $C_{13}H_{10}N_2O_5$ . This substance, which is produced during the body's metabolism of thalidomide, has a number of biological consequences. Therefore, in this study, optimization, frontier molecular orbital (HOMO and LUMO) and molecular electrostatic potential analyses of the theoretically and experimentally important 5-hydroxyphthalidomide molecule were performed using the Gaussian 09W package program. In the last part of the study, the potential target of the studied molecule was determined via Swiss Target and in silico calculations were performed with the help of Auto dock Vina and the results were extended in the relevant areas.

**Keywords:** Thalidomide, Frontier Orbital, MEP, Molecular Docking

## Introduction

One of thalidomide's main metabolites, 5-hydroxythalidomide, has important pharmacological characteristics that support its biological actions. Cytochrome P450 enzymes, especially CYP2C19, catalyze the formation of this metabolite. Modulating the immune response is one of 5-hydroxythalidomide's primary pharmacological activities. Numerous cytokines, including tumor necrosis factor-alpha (TNF- $\alpha$ ), which is essential for inflammatory processes, have been demonstrated to be influenced by it. Moreover, 5-Hydroxythalidomide is significant in the context of cancer therapy, especially in situations like multiple myeloma, since it maintains some of the anti-angiogenic qualities of its parent molecule. Furthermore, a key factor in the pharmacological profile of 5-Hydroxythalidomide is its interaction with cereblon (CRBN), a substrate recognition element of the CRL4 E3 ubiquitin ligase complex. Certain proteins are broken down as a result of this interaction, which may have therapeutic ramifications, particularly when combined with targeted protein degradation techniques. But it's crucial to remember that although 5-hydroxythalidomide helps thalidomide achieve its therapeutic goals, it also carries some of the drug's teratogenic hazards, thus using it in clinical settings needs to be done with caution. All things considered, 5-Hydroxythalidomide's pharmacological characteristics highlight both its intricacy and therapeutic promise (<https://go.drugbank.com/drugs/DB01041>; Yamamoto, Ito, Yamaguchi, & Handa, 2022). The overall chemical form (C<sub>13</sub>H<sub>10</sub>N<sub>2</sub>O<sub>5</sub>) of the structure is Fig. 1.

The Gaussian 09W package software (Frisch et al., 2009) was utilized in this investigation to carry out optimization, molecular electrostatic potential analysis, and frontier molecular orbital (HOMO and LUMO) evaluations of the 5-hydroxyphthalidomide molecule. In the last section of the study, Swiss Target (Daina, Michielin, & Zoete, 2019) was used to identify the possible target of the chemical under investigation. Auto Dock Vina (Trott & Olson, 2010) was used to facilitate in silico calculations, and the findings were expanded upon in pertinent areas.



**Figure 1.** The chemical structure of thalidomide molecule (<https://go.drugbank.com/drugs/DB01041>).

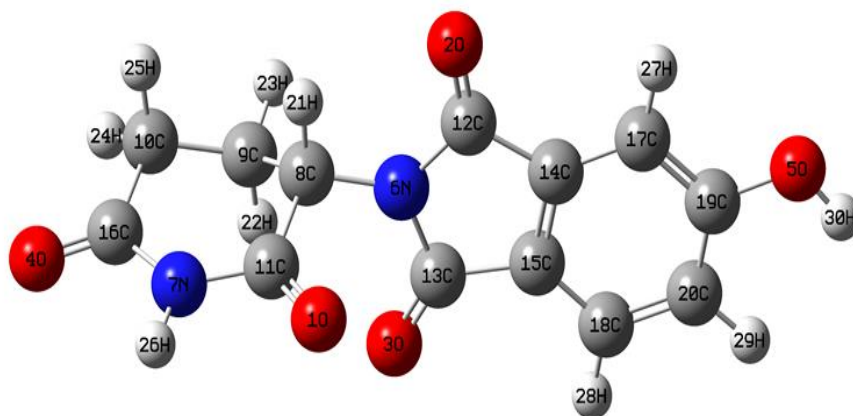
## Materials and Methods

The Gaussian 09W package (Frisch et al., 2009) and Gauss View 5.0 (Dennington, Keith, & Millam, 2009) interface programs were used to perform quantum chemical calculations (molecular optimization, frontier orbitals and MEP analysis) of the title molecule. The DFT/B3LYP theory/functional and 6-311++G(d,p) basis set were employed. In the next

step, the possible target for the molecule was found with Swiss Target (Daina et al., 2019). Then, Autodock Vina was used to perform docking simulations of the ligand molecule to the associated protein (Trott & Olson, 2010).

### DFT Analysis

This section includes the sum of electronic and zero point energies obtained as a result of molecular optimization, the symmetry state of the molecule, the dipole moment, the frontier orbitals known as HOMO and LUMO distributions and molecular electrostatic potential results. The 5-hydroxythalidomide molecule was optimized using DFT/B3LYP theory/functional and the 6-311++G(d,p) set and it was shown in Fig. 2.



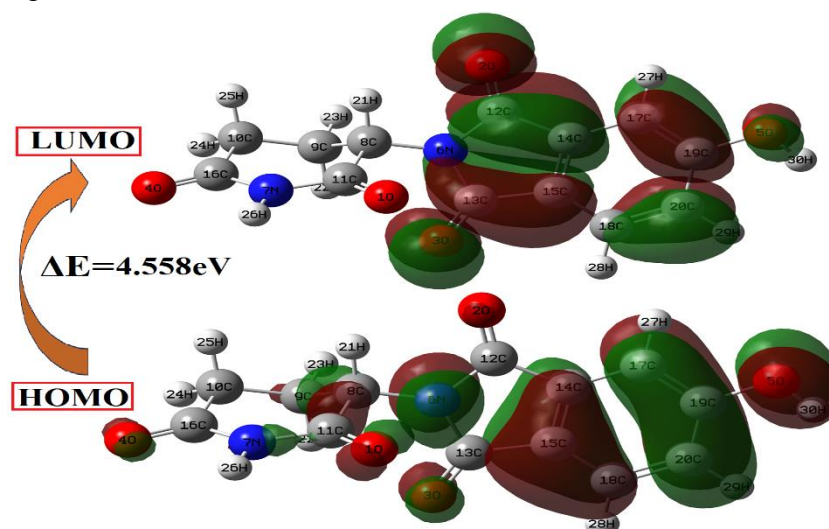
**Figure 2.** The optimized structure of 5-hydroxythalidomide molecule.

The sum of electronic and zero point energy of the molecule were found to be -987.37795738 a.u, dipole moment 5.6011 and dyne symmetry C1. In the next step, we investigated the stability of the molecules and the HOMO-LUMO distributions (Fig. 3), i.e. frontier orbitals (Parr & Pearson, 1983; Parr, Szentpály, & Liu, 1999) and the quantitative descriptors (Table 1) that we can obtain using them.

**Figure 3.** HOMO and LUMO distributions of 5-hydroxythalidomide molecule.

As can be seen from Fig.3, the HOMO distributions are concentrated on the right and middle sides of the molecule, while the LUMO distributions are focused on the right side of the molecule starting from the N6 atom. The bandwidth of the molecule was calculated as 4.558 eV,

ionization potential  
electron affinity  
2.665 eV,  
hardness  
chemical softness  
0.219 eV,



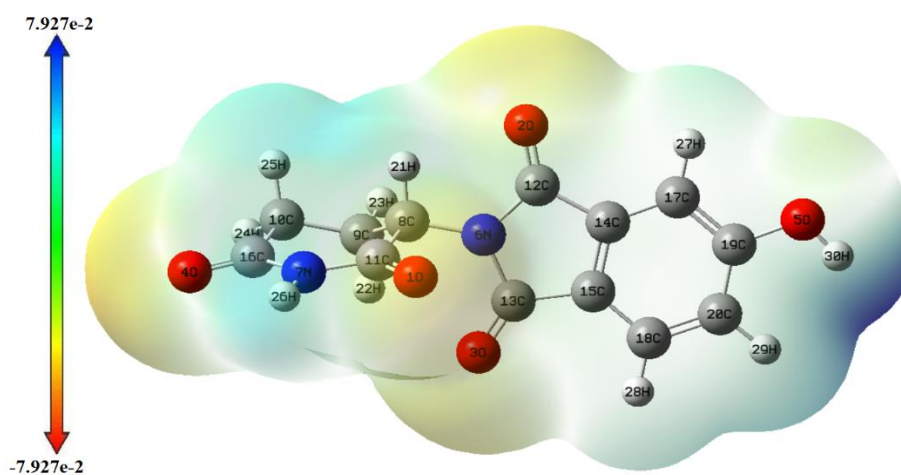
7.223 eV,  
affinity  
2.279 eV,  
softness

electronegativity 4.944 eV, chemical potential -4.944 eV, electrophilic index 5.362 eV and max charge transfer index 2.169 eV.

**Table 1.** Frontier orbital values and global descriptors of the title compound.

Parameters (eV)	molecule
	Vacuum
$E_{LUMO}$ (eV)	-2.665
$E_{HOMO}$ (eV)	-7.223
Energy bandgap $ E_{HOMO} - E_{LUMO} $	4.558
Ionization potential ( $I = -E_{HOMO}$ )	7.223
Electron affinity ( $A = -E_{LUMO}$ )	2.665
Chemical hardness ( $\eta = (I - A)/2$ )	2.279
Chemical softness ( $\zeta = 1/2\eta$ )	0.219
Electronegativity ( $\chi = (I + A)/2$ )	4.944
Chemical potential ( $\mu = -(I + A)/2$ )	-4.944
Electrophilicity index ( $\omega = \mu^2/2\eta$ )	5.362
Max. Charge transfer index ( $\Delta N_{max.}$ )	2.169

Later, the MEP surface of the molecule was then constructed using the same theory, functional and base set and is shown in Fig. 4. The MEP surface of the molecule is very important to see the electrophilic and nucleophilic points of the molecule (Singh, Khan, & Uddin, 2023; Socrates, 2004; Sohtun, Kannan, Dhandayutham, & Velusamy, 2018). In addition, the MEP scale is also given in the same figure.

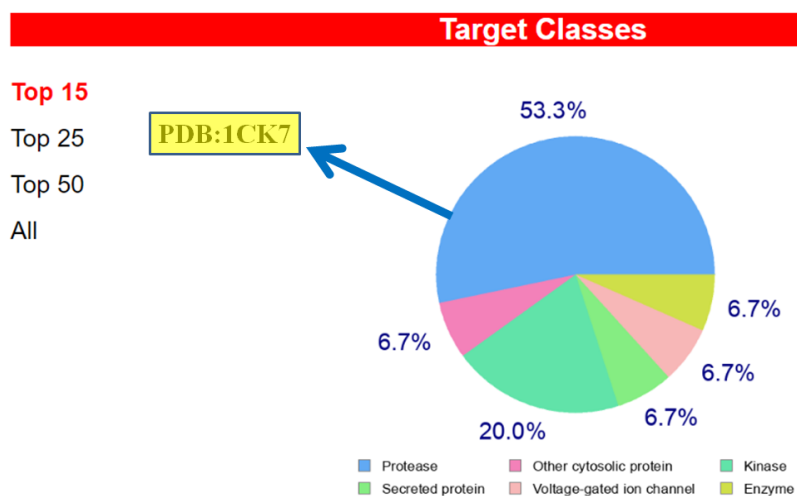


**Figure 4.** MEP distributions of 5-hydroxythalidomide molecule.

### Molecular Docking Analysis

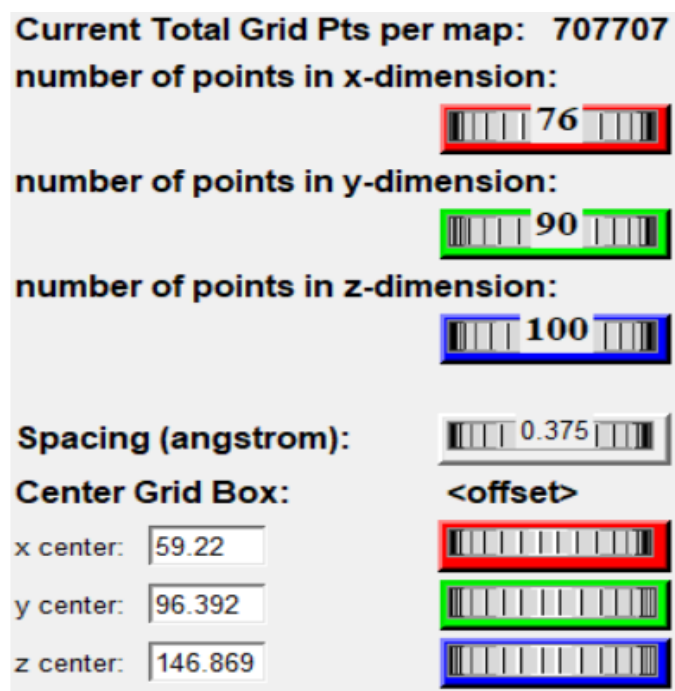
A computer method called molecular docking is used to forecast how a small molecule, such as a drug, would attach to a receptor, such as a protein. This approach aids researchers in comprehending molecular interactions, which is essential for creating novel drugs (Fan, Fu, & Zhang, 2019; Morris & Lim-Wilby, 2008; Trott & Olson, 2010). At this stage of the study, we

first identified a possible target for the molecule using the Swiss Target database (Daina et al., 2019) as shown in Fig. 5.

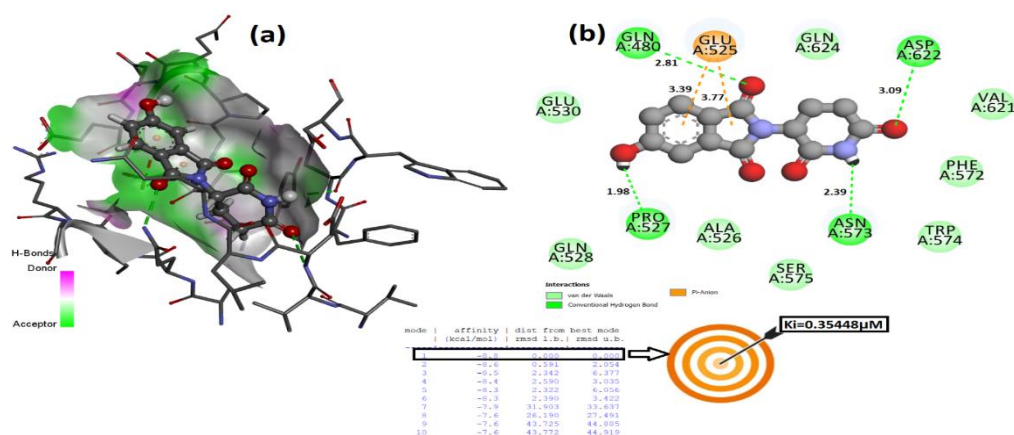


**Figure 5.** Possible target for 5-hydroxythalidomide molecule.

Autodock Vina was used to perform docking simulations of the ligand molecule (5-hydroxythalidomide) to the associated protein (PDB: 1CK7) (Trott & Olson, 2010). The parameters used for the calculation are given in Fig. 6. The results obtained are given in 3D and 2D formats in Fig. 7, as well as the top ten binding energies obtained considering the rotational angles of the molecule and the  $K_i$  inhibition coefficient value ( $\exp(\Delta G/RT)$  equation "(G: binding energy, R: gas constant=  $1.987203610^{-3}$  kcal/mol, and T: room temperature= 298.15K)" calculated for the highest binding energy.



**Figure 6.** The grid parameters for ligand+protein interaction.



**Figure 7.** (a) 3D and (b) 2D molecular docking results of the ligand+PDB:1CK7.

## Conclusion and Recommendations

The following points can be used to highlight the outcomes in the Conclusion and Recommendations section:

- The optimization energy, dipole moment and symmetry state of the molecule were determined.
- Frontier orbital (HOMO and LUMO distributions) analysis of the molecule was researched and the results were interpreted.
- The molecule's electrophilic (on oxygen atoms such as O1, O2, O3, O4, O5, N6, and N7) and nucleophilic (on hydrogen atoms) sites were determined using MEP analysis.
- A possible target, i.e. receptor, for the 5-hydroxythalidomide molecule was identified through the Swiss Target database.
- Autodock Vina was used to conduct a molecular docking study between the ligand and the 1CK7 protein. The 5-hydroxythalidomide compound can be regarded as a good potential inhibitor for a related target based on the scores that were obtained.

## Thanks and Information Note

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# TÜRKİYE CUMHURİYETİ'NİN İLK YILLARINDA BİLİMSEL GELİŞMELER VE YENİLİKLER

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## Özet

Cumhuriyetin erken döneminde Türkiye'nin bilimsel gelişim süreci, ülkenin modernleşme hedeflerinin bir parçası olarak büyük bir önem taşımıştır. Bu dönemde, ekonomik kalkınma ve sanayileşme süreçlerinde bilim ve teknolojinin önemi vurgulanmış, bilime sadece bir gelişim aracı olarak değil, aynı zamanda toplumsal ve kültürel reformların temel dayanağı olarak da bakılmıştır. Türkiye'nin bilim politikaları, 1923-1950 yılları arasında şekillenen stratejik yaklaşımlar sayesinde, daha sonraki yıllarda da ülkenin bilim ve teknoloji alanında kaydettiği ilerlemelerin temelini oluşturmuştur. Cumhuriyet döneminde Türkiye, bilim ve eğitim alanlarında önemli adımlar atmış, yabancı uzman ve öğretim elemanları getirilerek üniversite reformları gerçekleştirilmiştir. 1933 Üniversite Reformu sonrasında Hacettepe Üniversitesi Tıp Fakültesi ve Orta Doğu Teknik Üniversitesi gibi kurumlar, Amerika Birleşik Devletleri'nden gelen uzmanlarla iş birliği yapmıştır. Bilimsel kurumlaşma da bu süreçte önemli bir yer tutmuş, Kızılay, Refik Saydam Enstitüsü, Kandilli Gözlemevi gibi kurumlar yeniden yapılandırılmıştır. Ayrıca, TÜBİTAK ve Devlet Meteoroloji İşleri Genel Müdürlüğü gibi yeni kurumlar kurulmuş, Makina Kimya Endüstrisi Kurumu ve Türkiye Atom Enerjisi Kurumu gibi kuruluşlar faaliyete geçmiştir. Bu dönemde matematik, fizik ve astronomi alanında önemli çalışmalar yapılmış, Türkiye'nin ilk kuşak bilim insanları, Cumhuriyet'in bilimsel temellerini atmıştır. Osmanlı döneminde yetişen bu bilim insanları, Cumhuriyet'in sunduğu yeni imkanlarla uluslararası literatüre önemli katkılarda bulunmuşlardır. Bu çalışmada, 1923-1950 yılları arasında Türkiye'deki bilimsel gelişmelerin toplumsal ve ekonomik kalkınmadaki rolü incelenmekte ve bu dönemin bilim politikalarının günümüz perspektifinden değerlendirilmesi yapılmaktadır. Sonuç olarak, erken Cumhuriyet döneminde bilim ve teknolojiye verilen önem, Türkiye'nin modernleşme sürecindeki en kritik unsurlardan biri olmuştur.

**Anahtar Kelimeler:** Cumhuriyet Dönemi Bilim, Bilimsel Gelişim, Üniversite Reformları, Türkiye Modernleşmesi, Bilim Politikaları.



## SCIENTIFIC ADVANCES AND INNOVATIONS IN THE EARLY YEARS OF THE REPUBLIC OF TURKEY

### **Abstract**

In the early Republican period, Turkey's scientific development process was of great importance as part of the country's modernization goals. In this period, the importance of science and technology in the processes of economic development and industrialization was emphasized, and science was viewed not only as a development tool but also as a fundamental basis for social and cultural reforms. Thanks to the strategic approaches shaped between 1923 and 1950, Turkey's science policies laid the foundation for the country's progress in science and technology in the following years. During the Republican era, Turkey took important steps in the fields of science and education, and university reforms were carried out by bringing in foreign experts and lecturers. After the 1933 University Reform, institutions such as Hacettepe University Faculty of Medicine and Middle East Technical University collaborated with experts from the United States. Scientific institutionalization also played an important role in this process, and institutions such as the Red Crescent, Refik Saydam Institute and Kandilli Observatory were restructured. In addition, new institutions such as TÜBİTAK and the General Directorate of State Meteorological Affairs were established, and organizations such as the Mechanical and Chemical Industry Corporation and the Turkish Atomic Energy Authority became operational. During this period, important studies were carried out in the fields of mathematics, physics and astronomy, and Turkey's first generation of scientists laid the scientific foundations of the Republic. These scientists, who grew up in the Ottoman period, made important contributions to the international literature with the new opportunities offered by the Republic. This study examines the role of scientific developments in Turkey's social and economic development between 1923 and 1950 and evaluates the science policies of this period from a contemporary perspective. In conclusion, the importance given to science and technology in the early Republican period was one of the most critical elements in Turkey's modernization process.

**Keywords:** Science in the Republican Era, Scientific Development, University Reforms, Turkish Modernization, Science Policies.

## **Introduction**

The early Republican era holds significant importance as the foundation period for Turkey's science and technology policies. With the establishment of the Republic of Turkey in 1923, the country embarked on a series of reforms aimed at becoming a modern state. Among these reforms, the emphasis placed on science and technology, particularly under the leadership of Mustafa Kemal Atatürk, played a strategic role in the nation's economic and cultural development.

Following the foundation of the Republic, the state's relationship with science was shaped by two key dimensions: firstly, the development of industrialization policies based on science and technology for economic growth; and secondly, the implementation of social reforms aimed at integrating Turkish society into contemporary life guided by reason and science. These two dimensions formed the core of the Republic's science and technology policies and directed Turkey's modernization process. (Dolen, 2012)

During this period, the effective integration of science and technology into Turkey's economic and cultural development became one of the defining characteristics of the young and dynamic Republic. Mustafa Kemal Atatürk's famous statement, "the truest guide in life is science," reflects the significance attributed to science at that time, embodying the Republic's effort to create a society centered around rationality and scientific thinking. Thus, the scientific and technological initiatives undertaken during the Early Republican era have formed the cornerstone of Turkey's contemporary science policies. (Zürcher, 2004).

## **Scientific and Educational Reforms**

Following the proclamation of the Republic, Turkey undertook comprehensive reforms in the fields of science and education. These reforms aimed to place scientific thought at the core of societal life, in line with the country's modernization objectives. Mustafa Kemal Atatürk's declaration that "the truest guide in life is science" stands as one of the strongest expressions of the importance attached to science and education during this period. (Kışlalı, 1993)

The 1933 University Reform was one of the most significant milestones in this process. The closure of Darülfünun and the establishment of Istanbul University laid the foundation for the introduction of a modern university system in Turkey. With this reform, scientists from Germany and other European countries played a crucial role in strengthening Turkey's scientific infrastructure. Istanbul University, along with the Higher Institute of Agriculture established in Ankara, became the leading centers of scientific research and education during this period. (İnönü, 2005)

During this period, the Law on the Unification of Education (Tevhid-i Tedrisat Kanunu) was enacted to ensure national unity and cohesion in education. This law led to the closure of religious schools (medreses) and centralized all educational institutions under a single authority, thereby creating a structure based on contemporary scientific principles. Additionally, institutions such as Millet Mektepleri (National Schools) and Halkevleri (People's Houses) were established to elevate the educational level of the public and to disseminate the values of the Republic to broader segments of society. These institutions played a crucial role in increasing literacy rates, particularly in rural areas, and in promoting modern scientific thinking. (Somel, 2016).

## **Scientific and Educational Reforms**

Following the proclamation of the Republic, Turkey undertook significant reforms in the fields of science and education. Guided by Atatürk's emphasis on science and technology, these reforms were implemented to strengthen the country's scientific infrastructure and to create a scientific environment capable of competing on an international level. These efforts played a

critical role in Turkey's modernization process and laid the groundwork for the nation's scientific development. (Kışlalı, 1993).

**The 1933 University Reform:** The university reform of 1933 brought about profound changes to Turkey's scientific and academic structure. The closure of Darülfünun and the establishment of Istanbul University marked one of the first steps towards the modernization of the education system. As part of this reform, scholars from various European countries, particularly Germany, were invited to Turkey, enriching the academic environment and contributing significantly to the education system. Istanbul University and the Higher Institute of Agriculture in Ankara emerged as the foremost scientific and educational centers of this period. The reform not only introduced structural changes but also brought about a fundamental transformation in the understanding of scientific research and education. (Zürcher, 2004).

**Innovations in Education:** The Republican era was a period of profound reforms in the education system. The Law on the Unification of Education (Tevhid-i Tedrisat Kanunu) centralized the education system under a single authority, leading to the closure of medreses inherited from the Ottoman period and the transition to modern educational institutions. Additionally, initiatives such as Millet Mektepleri (National Schools) and Halkevleri (People's Houses) aimed to spread education and scientific awareness across all segments of society. These institutions played a critical role, particularly in rural areas, by increasing literacy rates and promoting modern scientific thought. These comprehensive changes in the education system enabled the dissemination of scientific consciousness to all parts of society. (Somel, 2016).

**Scientific Institutionalization:** The Republican era marked a significant turning point in the restructuring of scientific institutions and the establishment of new ones. Key scientific and health institutions such as the Turkish Red Crescent (Kızılay), the Refik Saydam Institute, and the Kandilli Observatory were reorganized during this period, becoming integral parts of modern Turkey's scientific infrastructure. Additionally, new institutions like the Scientific and Technological Research Council of Turkey (TÜBİTAK) and the General Directorate of Meteorology were established, along with the creation of the Turkish Atomic Energy Authority and the Machinery and Chemical Industry Corporation (Makina Kimya Endüstrisi Kurumu). These institutions played a crucial role in supporting Turkey's scientific research and promoting scientific progress. (İnönü, 2005).

**Scientists and Their Contributions:** Scientists of the Atatürk era played a significant role in laying the scientific and technological foundations of the Republic. Cahit Arf made notable contributions to international literature in the field of mathematics, particularly for his work on algebraic equations and quadratic forms. Ali Fuat Berkman, known for his research in soil mechanics, contributed to Turkey's engineering advancements, particularly in railways and bridges. Paris Pişmiş and Abdullah Kızılırmak made significant contributions in astronomy, while Hüsnü Seçkin and Nüşet T. Gökdoğan also advanced the fields of astronomy and mathematics during this period. Remziye Hisar, who made important contributions in chemistry, is remembered as Turkey's first female chemist. Other prominent scientists, including Hakkı Akyol, Mustafa Aytaç, Cankut Örmeci, and Orkan Altan, made valuable contributions to scientific research during the Republic era. The efforts of these scientists helped Turkey take important steps in the fields of science and education, making a substantial impact on the Republic's modernization process. (Berker, 1975; Arf, 1988; Sağlam, 2007)

These comprehensive reforms, along with the contributions of pioneering scientists, facilitated Turkey's development in the fields of science and education, significantly contributing to the

Republic's modernization process. The Early Republican era highlights the critical role that the emphasis on science and technology played in the country's path toward modernization.

### **Science and Technology Policies**

Following the proclamation of the Republic, science and technology were placed at the core of Turkey's development strategy. Under the leadership of Mustafa Kemal Atatürk, the belief that the advancement of science and technology was essential for the country's modernization was widely embraced, leading to the implementation of various policies and reforms. These policies played a critical role in Turkey's economic, social, and cultural development.

During the Republican period, science and technology were viewed not only as tools for advancing industry and agriculture but also as key instruments for raising the general knowledge level of society and creating an educated workforce. In this context, the state made substantial investments and launched various projects aimed at maximizing the contribution of science and technology to national development. The promotion of scientific and technological advancements, particularly in the agriculture and industrial sectors, played a pivotal role in the country's economic progress. (Somel, 2016; Dölen, 2010)

The process that began with the 1933 University Reform laid the foundation for policies that supported scientific research and academic activities in Turkey. The invitation of foreign experts, the establishment of research centers, and the formation of academic staff facilitated the acceleration of scientific progress. Institutions like the Higher Institute of Agriculture and Istanbul University, founded during this period, became central hubs for scientific research and technological innovation.

Various research institutions and institutes established by the state to promote scientific and technological development played a crucial role in implementing these policies. The Refik Saydam Hygiene Institute, established in the 1930s, pioneered the use of scientific methods in combating infectious diseases, while the Kandilli Observatory helped elevate Turkey's standing in international astronomy. Additionally, organizations such as the Machinery and Chemical Industry Corporation (Makina Kimya Endüstrisi Kurumu) and the Turkish Atomic Energy Authority (Türkiye Atom Enerjisi Kurumu) contributed to Turkey's advancements in technology and industry. (İnönü, 2005; Berker, 1975)

Another critical aspect of science and technology policies was the dissemination of scientific thinking within Turkey's educational system and the creation of a society grounded in scientific research. In this context, not only educational institutions but also public education initiatives and research centers played a key role in ensuring that scientific knowledge reached wider segments of society. Educational centers such as Halkevleri (People's Houses) and Millet Mektepleri (National Schools) increased public access to scientific knowledge and contributed to the spread of scientific consciousness. (Erdemir, 2019)

In conclusion, the science and technology policies followed during the early years of the Republic laid the foundation for Turkey's modernization and paved the way for long-term scientific development. These policies not only helped Turkey gain recognition in the international arena in the fields of science and technology, but also made significant contributions to the country's economic and social progress. The steps taken during the Early Republican period formed the basis for Turkey's future scientific and technological achievements and guided the nation's path toward development. (Kışlalı, 1993; Zürcher, 2004).

### **Scientists and Their Contributions**

Since the establishment of the Republic, numerous scientists have made significant contributions to Turkey's scientific and technological development, in line with the goal of strengthening the country's scientific infrastructure. These scientists played key roles not only through their research but also in enhancing the educational and academic framework of the

country. The scientists who emerged during the early years of the Republic conducted internationally recognized and acclaimed research, further establishing Turkey's presence in the global scientific community.

### **Cahit Arf (1910-1997)**

Cahit Arf, one of Turkey's most renowned mathematicians, gained international recognition for his contributions to algebra and number theory. After completing his doctoral studies under Hasse in Germany, Arf made significant contributions to the field of mathematics in 1938 through his work on algebraic equations and quadratic forms, which became widely recognized in the international mathematical community. The mathematical concept known as Arf invariants is named after him. Arf's work directly contributed to the scientific development efforts of the Republican era and served as a source of inspiration for many young scientists (Arf, 1988; Kışlalı, 1993).

### **Behram Kurşunoğlu (1922-2003)**

Behram Kurşunoğlu was a renowned Turkish theoretical physicist known for his groundbreaking work in high-energy physics and the Unified Field Theory. Educated at the University of Cambridge, Kurşunoğlu made significant contributions to the field of theoretical physics, particularly in his attempts to unify the fundamental forces of nature. He continued his academic career at Cornell University, where he furthered his research in theoretical physics. His work not only advanced the understanding of physics internationally but also played a crucial role in enhancing the scientific reputation of Turkish scholars on the global stage. Kurşunoğlu's contributions to science during the Republic era underscored the importance of scientific advancement in Turkey's modernization efforts, serving as a source of inspiration for future generations of scientists. (Kurşunoğlu, 1992; Arık, 2010).

### **Ratip Berker (1909-1997)**

Ratip Berker was a prominent figure in mathematics and mechanics, known for his pioneering research in hydrodynamics. After completing his education abroad, Berker returned to Turkey and joined the faculty at Istanbul University, where he made significant academic contributions to the fields of hydrodynamics and fluid mechanics. His work not only advanced these disciplines but also played a crucial role in the development of mechanics as a field of study in Turkey. Through his in-depth exploration of the relationships between mathematics and physics, Berker contributed to Turkey's progress in these scientific domains, helping to shape the country's academic landscape. (Berker, 1975; İhsanoğlu, 2014).

### **Paris Pişmiş (1911-1999)**

Paris Pişmiş, internationally renowned for her contributions to astronomy, was one of the pioneers who laid the foundation for modern astronomical studies in Turkey. Her research on galactic dynamics and stellar systems brought her recognition in the global scientific community. After receiving her education abroad, Pişmiş played a crucial role in advancing the field of astronomy in Turkey. Her work significantly contributed to the international acknowledgment of Turkey's efforts in the field of astronomy, making her a key figure in the country's scientific progress. (Pişmiş, 1980; Gürsoy, 2007).

### **Remziye Hisar (1902-1992)**

Remziye Hisar, Turkey's first female chemist, made significant contributions to the field of chemistry during the early Republican period. A graduate of Sorbonne University in France, Hisar was known for her research in biochemistry in Turkey. She played a pioneering role in promoting the involvement of women in scientific research and became a role model for future

generations of female scientists. Her work not only advanced the field of chemistry in Turkey but also paved the way for the participation of women in scientific endeavors. (Hisar, 1958; Yalçın, 2005)

### **Other Leading Scientists**

During this period, scientists such as Cevdet Bilsay, Ali Fuat Berkman, Nazım Terzioğlu, Hulusi Behçet, and Feza Gürsey made significant contributions in the fields of mathematics, medicine, and physics. Hulusi Behçet, in particular, gained recognition in the medical world for his discovery of “Behçet’s Disease.” Feza Gürsey established himself in the international scientific community through his work in high-energy physics and particle physics. The contributions of these scientists played a crucial role in strengthening the scientific infrastructure of the Republic and establishing Turkey’s place on the global scientific stage.

These scientists not only spearheaded Turkey’s scientific development but also played a key role in the country's modernization process. Their work laid the foundation for Turkey’s scientific and technological advancements, contributing significantly to the nation’s international recognition in the scientific arena. (Gürsey, 1970; Behçet, 1946).

### **Foreign Scientists and Their Contributions**

In the early Republican period, foreign scientists played a crucial role in contributing to Turkey’s scientific development. Particularly following the 1933 University Reform, many scientists from Germany and other European countries were invited to Turkey, where they made significant contributions to the modernization of the country's academic and scientific infrastructure. These foreign scientists not only helped form academic faculties but also led the establishment of a scientific research culture.

With the rise of the Nazi regime in Germany in 1933, many Jewish scientists were forced to leave their home countries. Turkey, taking advantage of this situation, opened its doors to these scientists to accelerate scientific progress. Approximately 40 foreign scientists began working at Istanbul University and other academic institutions, pioneering scientific research in Turkey. (İnönü, 2005; Widmann, 1973).

#### **Prof. Dr. Erich Frank**

One of the most prominent foreign scientists who came to Turkey, Prof. Dr. Erich Frank made significant contributions to the country's scientific development through his work in the field of medicine. Serving at Istanbul University’s Faculty of Medicine, Frank played a key role in advancing modern medical education in Turkey. His work, particularly in internal medicine and clinical research, greatly contributed to the modernization of medical education in the country. (Widmann, 1973).

#### **Prof. Dr. Curt Kosswig**

German zoologist Curt Kosswig was a key figure in the development of zoology and biology in Turkey. He founded the Department of Zoology at Istanbul University’s Faculty of Science and conducted pioneering research on the diversity of Turkey’s fauna. Kosswig's work also contributed significantly to modernizing biology education in Turkey, mentoring a generation of Turkish scientists. His extensive studies on freshwater fish and other species played an essential role in the advancement of biological sciences in Turkey. (Schmidt, 1995).

#### **Prof. Dr. Philipp Schwartz**

Philipp Schwartz made significant contributions to the field of pathology in Turkey by establishing the Department of Pathology at Istanbul University. His arrival in Turkey played a crucial role in restructuring medical education based on scientific research. Schwartz was

instrumental in introducing research-based medical education, laying the foundation for modern medical training in Turkish medical schools. His work helped establish a culture of scientific inquiry in pathology and influenced the future of medical research in Turkey. (Widmann, 1973) Prof. Dr. Philipp Schwartz played a pivotal role in the development of modern pathology in Turkey during the early Republican era. Forced to flee Nazi Germany due to the regime's anti-Semitic policies, Schwartz arrived in Turkey in 1933, where he was appointed to establish the pathology department at Istanbul University. His efforts not only modernized medical education in Turkey but also laid the groundwork for research-oriented medical training.

In addition to his academic contributions in Turkey, Schwartz founded the Notgemeinschaft Deutscher Wissenschaftler im Ausland (Emergency Association of German Scientists Abroad) in Switzerland. This organization was instrumental in supporting numerous displaced German scientists by securing academic positions for them abroad, including in Turkey. The association facilitated the migration of many prominent German academics to Turkey, significantly contributing to the modernization of Turkish universities and scientific infrastructure. Through his leadership and initiatives, Schwartz not only enhanced pathology studies but also played a crucial role in building Turkey's scientific capacity by integrating highly skilled foreign academics into the national system (Dölen, 2012).

### **Prof. Dr. Fritz Neumark**

Prof. Dr. Fritz Neumark was another prominent scholar who made significant contributions to Turkey in the field of economics. Teaching at Istanbul University's Faculty of Economics, Neumark played a key role in shaping Turkey's economic thought. His work laid the foundation for modern economic science in the country and contributed to the education of many Turkish economists. Neumark's influence extended beyond the classroom, as his theoretical and practical contributions helped modernize Turkey's economic policies and academic structure. (Neumark, 1954; Toprak, 1995).

### **Prof. Dr. Carl Ebert**

Carl Ebert was one of the founding figures of modern theater education in Turkey, making significant contributions to the development of the performing arts in the country. He played an active role in establishing the Istanbul City Theater and the Ankara State Conservatory, where he helped professionalize the art of theater and elevate it to an internationally recognized level. Ebert's efforts were instrumental in shaping Turkey's theatrical landscape and in promoting the performing arts as a serious academic discipline. (Kara, 2002).

### **Prof. Dr. Alfred Kantorowicz**

Prof. Dr. Alfred Kantorowicz was a renowned German dentist who fled Nazi persecution and was invited to Turkey by Atatürk. His contributions were pivotal in transforming dental education and practice in Turkey. One of his significant reforms was extending the dental program from three to four years and incorporating new branches such as prosthodontics and preventive dentistry into the curriculum (Gülmez, 2007). Kantorowicz also integrated fields like aesthetic surgery and orthodontics into the dental curriculum, laying the groundwork for modern dentistry in Turkey.

The knowledge and expertise brought by foreign scientists to Turkey not only contributed to the advancement of scientific research but also led to the implementation of new methods and modern techniques in education. These scientists played a critical role in forming academic faculties, establishing a research culture, and advancing modern scientific education in Turkey. Their legacy had a profound impact on the successful implementation of the Republic's scientific development policies.

In conclusion, the foreign scientists who arrived in Turkey during the early years of the Republic played a pivotal role in the country's scientific and academic development. Their collaboration significantly contributed to the widespread adoption of scientific research, the modernization of the educational system, and the realization of Turkey's scientific advancement goals.

### **Conclusion and Evaluation**

The scientific and technological advancements initiated during the early Republican period left a lasting impact on Turkey's modernization process. Mustafa Kemal Atatürk's emphasis on science not only contributed to the country's economic development but also fostered social and cultural transformation. The reforms and scientific policies of this era laid the foundation for Turkey's scientific infrastructure, opening the door to long-term advancements in science and technology.

Major educational reforms, such as the 1933 University Reform and the Law of Unification of Education (Tevhid-i Tedrisat), aimed to modernize Turkey's education system and create a society based on scientific thinking. These reforms played a crucial role in the modernization of Turkish society and the spread of scientific thought. The university reform, in particular, significantly contributed to the development of scientific research and academic activities in Turkey, bolstered by the expertise of foreign scientists who helped strengthen the nation's scientific capacities.

Scientific institutions and research centers established during this period, such as the Refik Saydam Hygiene Institute and Kandilli Observatory, played an essential role in spreading modern scientific research across the country. The creation of organizations like TÜBİTAK and other scientific institutions further helped elevate Turkey's scientific endeavors to an international level.

The importance placed on science and technology during the early Republican period not only addressed the needs of the time but also laid the foundation for the scientific structure of contemporary Turkey. The reforms of this period shaped Turkey's scientific and technological infrastructure, and the country began to establish a presence in the global scientific community. In conclusion, the steps taken during the early years of the Republic ensured the long-term sustainability of Turkey's scientific and technological development. Atatürk's view of science as the foundation of social, cultural, and economic progress had a direct impact on the country's modernization, fostering the spread of scientific thought within Turkish society. The early reforms in science and education not only addressed the needs of that era but also laid the groundwork for today's scientific infrastructure. The scientific institutions, academic traditions, and international achievements that Turkey possesses today are a direct result of the steps taken during the Republic's formative years.

This scientific legacy has enabled Turkey to become a competitive player in the global science and technology arena, reinforcing the success of the Republic's modernization project. As Turkey continues to embrace scientific thought, the influence of the science and technology policies from this period remains evident to this day.



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## CUMHURİYETİN ERKEN DÖNEMİNDE MATEMATİK VE FİZİK: ÖNEMLİ BİLİM ADAMLARI VE KATKILARI

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### Özet

Cumhuriyetin ilk yıllarında Türkiye’de bilim ve teknoloji alanındaki ilerlemeler, eğitim ve üniversite reformlarıyla paralel olarak gelişmiştir. 1933 yılında İstanbul Üniversitesi’nin kurulması ve yabancı bilim insanlarının Türkiye’ye davet edilmesi, bilimsel araştırmaların ve eğitim faaliyetlerinin modernleşmesine büyük katkı sağlamıştır. Bu dönemde matematik ve fizik gibi temel bilimler, üniversitelerin fen fakültelerinde yoğun bir şekilde çalışılmış ve bu alanlarda önemli bilim insanları yetişmiştir. Matematik ve fizik alanlarında önemli katkılarda bulunan bu bilim insanları, bilimin gelişimine yön vermiştir. Bu bildiri, Cumhuriyetin erken döneminde öne çıkan matematik ve fizik alanlarında öne çıkan bilim insanlarını incelemektedir. Cumhuriyet döneminde matematik alanında doktorasını tamamlayan ilk kişi Kerim Erim’dir. Çağdaş matematiğin yaygınlaşmasında, matematik terimlerini Türkçeleştirme çalışmalarında aktif görev almıştır. Cahit Arf’ın modern matematiğin temellerini atan çalışmaları dikkat çekmektedir. Arf’ın özellikle cebirsel yapıların ve sayı teorisinin geliştirilmesine yönelik katkıları, uluslararası alanda da tanınmıştır. Feza Gürsey Cumhuriyet döneminin en önde gelen fizikçilerinden biridir. Feza Gürsey, özellikle kuantum mekaniği ve genel görelilik teorisi üzerine yaptığı çalışmalarla tanınmıştır. Behram Kurşunoğlu, teorik fizik alanında uluslararası çapta tanınan bir Türk bilim insanıdır. Özellikle Einstein’ın genel görelilik teorisi ve birleşik alan teorisi üzerine yaptığı çalışmalarla tanınır. Kurşunoğlu, kuantum mekaniği ve yüksek enerji fiziği konularında da önemli araştırmalar yapmıştır. Bu bilim insanlarının katkıları, Türkiye’nin bilimsel altyapısının güçlendirilmesine ve uluslararası bilim camiasında tanınmasına önemli rol oynamıştır. Cumhuriyet dönemi bilim insanlarının çalışmaları, Türkiye’nin bilimsel ilerlemesinin temel taşlarını oluşturmuş ve uluslararası düzeyde tanınan bilim insanları yetiştirilmesine katkıda bulunmuştur.

**Anahtar Kelimeler:** Cumhuriyet Dönemi, Matematik, Fizik, Bilim İnsanları

## **MATHEMATICS AND PHYSICS IN EARLY REPUBLICAN TURKEY: PROMINENT SCIENTISTS AND THEIR CONTRIBUTIONS**

### **Abstract**

In the early years of the Republic, advances in science and technology in Turkey developed in parallel with educational and university reforms. In 1933, the establishment of Istanbul University and the invitation of foreign scientists to Turkey contributed greatly to the modernization of scientific research and educational activities. During this period, basic sciences such as mathematics and physics were intensively studied in the science faculties of universities and important scientists were trained in these fields. These scientists, who made important contributions in the fields of mathematics and physics, shaped the development of science. This paper examines the prominent scientists in the fields of mathematics and physics in the early Republican period. Kerim Erim was the first person to complete his doctorate in mathematics in the Republican era. He took an active role in the dissemination of modern mathematics and the Turkishization of mathematical terms. Cahit Arf's work, which laid the foundations of modern mathematics, draws attention. Arf's contributions to the development of algebraic structures and number theory were recognized internationally. Feza Gürsey was one of the most prominent physicists of the Republican era. Feza Gürsey was especially known for his work on quantum mechanics and the general theory of relativity. Behram Kurşunoğlu is an internationally recognized Turkish scientist in the field of theoretical physics. He is especially known for his work on Einstein's general theory of relativity and unified field theory. Kurşunoğlu also conducted important research in quantum mechanics and high energy physics. The contributions of these scientists played an important role in strengthening Turkey's scientific infrastructure and gaining recognition in the international scientific community. The work of the scientists of the Republican era formed the cornerstones of Turkey's scientific progress and contributed to the development of internationally recognized scientists.

**Keywords:** Republic Era, Mathematics, Physics, Key Scientists

## **Introduction**

### **Overview of Scientific Studies in the First Years of the Republic**

With the proclamation of the Republic, Turkey experienced radical changes in many social, cultural and scientific fields; the legacy of the Ottoman Empire was taken over and a modern nation-state was created (Acun, 1999; Aslan & Alkış, 2015). In this process of change, the fields of science and education also underwent a major transformation. In the early years of the Republic, scientific studies in Turkey were encouraged and accelerated by state policies, and important research was carried out especially in basic sciences such as mathematics, physics, chemistry, biology and medicine. During this period, the development of scientific studies and science culture in Turkey progressed in parallel with educational and university reforms. The development of scientific studies in the early years of the Republic was a continuation of the modernization movements that began in the late Ottoman Empire. In the last periods of the Ottoman Empire, modern educational institutions were established under the influence of western science and technology, and scientific studies began to be carried out in these institutions. However, with the proclamation of the Republic, this process gained momentum, and it was aimed to spread science and scientific methods to all areas of society. With the reforms carried out under the leadership of Atatürk, scientific thought and research became one of the fundamental elements of the modernization policies of the state. Educational reforms played a major role in the development of scientific studies in the early years of the Republic. With the 1924 Law on Unified Education, the education system was unified, and a modern education structure was established. This law encouraged the spread of scientific thought and the increase in scientific research in Turkey. During this period, one of the most important steps that enabled the development of scientific studies in Turkey was the transformation of Darülfünun into Istanbul University (Korkut, 2003). With the 1933 University Reform, Istanbul University was transformed into a modern scientific center and many scientists continued their studies there. This reform is recognized as an important step towards improving the quality of scientific research and scientific education in Turkey. In the early years of the Republic, scientific studies were carried out intensively not only in educational institutions but also in various state institutions and research centers. Scientific research, especially in the fields of health, agriculture and industry, contributed greatly to Turkey's economic and social development (Albayrak and Öztürk 2021). The Agricultural Institutes established during this period carried out important studies to develop modern agricultural techniques in Turkey, which enabled Turkey to increase its agricultural production and adopt modern agricultural techniques. Similarly, the work carried out by the Ministry of Health led to significant progress in the field of public health in Turkey and important steps were taken in the fight against infectious diseases. Universities played a major role in the development of scientific studies in the early years of the Republic. With the 1933 University Reform, many higher education institutions and research centers were established in Ankara as well as Istanbul University, and these institutions became the centers of scientific research in Turkey (Erdem, 2012). Especially the Faculties of Science and Engineering became the centers where scientific studies were concentrated in Turkey during this period. The research conducted in these faculties enabled Turkey to make significant progress in the field of science and technology. During this period, many scientists who contributed to the development of scientific studies in Turkey were trained. Studies in the field of science and technology in Turkey were generally carried out by students and academics sent abroad. These scientists brought Western scientific methods and knowledge to Turkey and contributed to the development of scientific studies in Turkey. In particular, studies in basic sciences such as mathematics and physics contributed to Turkey's recognition and prestige in the world scientific community. In this period, scientists such as Cahit Arf in mathematics and Feza Gürsey in physics pioneered the development of scientific studies in Turkey. International relations and cooperation played an important role in the development of

scientific studies in the early years of the Republic. In this period, Turkey entered the process of integration with western science and technology and signed many international scientific collaborations (Uğural, 2016). Especially scientists from Germany made significant contributions to the development of scientific studies in Turkey. Many scientists who escaped from Nazi Germany took refuge in Turkey and continued their scientific studies here. These scientists made significant contributions to the establishment of a modern understanding of science in Turkey and to the improvement of the quality of scientific research (Namal, 2012; Keser, 2020). These scientists, especially at Istanbul University, pioneered the conduct of many scientific studies in Turkey. Another important factor that contributed to the development of scientific studies in Turkey during this period was the development of scientific publishing and scientific associations. In the early years of the Republic, many scientific associations were established in Turkey and these associations contributed to the dissemination of scientific research and scientific knowledge. Founded in 1929, the Millet Mektepleri (National Schools) and the Turkish Historical Society (Turkish Historical Society), which was established in 1932, have made important efforts to support scientific studies and disseminate scientific knowledge (Uğural, 2016). During this period, articles published in many scientific journals and scientific books contributed to the development and dissemination of scientific thought in Turkey.

Scientific studies conducted in the first years of the Republic did not only remain at the academic level, but also made significant contributions to Turkey's social and economic development (Çakmak, 2008). The studies conducted in this period contributed to the development of modern agricultural techniques, improved health services and increased industrial production in Turkey. In particular, studies in fields such as agriculture, medicine and engineering played an important role in achieving Turkey's development goals. Scientific research conducted during this period enabled the establishment of modern science and the spread of scientific thought in Turkey. The development of scientific studies was also supported by state policies (Kodal, 2023). The science policies realized under the leadership of Atatürk encouraged the development of scientific research and scientific education in Turkey. During this period, the importance given to scientific studies contributed to the spread of scientific thought and the increase in scientific research in Turkey. In particular, the support provided by the state in areas such as supporting scientists, financing scientific research and encouraging scientific publishing enabled the development of scientific studies in Turkey. The studies also contributed to Turkey's recognition and respectability in the international scientific world (Kayadibi, 2006). The studies carried out in this period increased Turkey's scientific reputation and allowed it to be recognized in the world scientific community. Scientific studies conducted in Turkey were presented at international scientific congresses and symposiums and attracted worldwide attention. In particular, studies in fields such as mathematics and physics contributed to Turkey's recognition and prestige in the international scientific community.

In conclusion, scientific studies in Turkey in the early years of the Republic underwent a major transformation as part of the modernization process. The studies conducted in this period contributed to the development of scientific research in Turkey, the establishment of a modern understanding of science and the spread of scientific thought. In addition to the science policies of scientists, universities and the state, interactions with the international scientific world also played a major role in the development of scientific research in Turkey. When evaluated from the perspective of science and the history of science, these studies have an important place in Turkey's scientific development process and are considered as one of the important steps that paved the way for the development of science in Turkey. This process continues to shed light on the development of science in Turkey and the scientific research of future generations.

## **Prominent Scientists in Mathematics in Turkey in the First Years of the Republic**

### **a. Ord. Prof. Dr. Kerim Erim**

Born on January 31, 1894, Kerim Erim started his education in Aleppo. In 1919, he completed his doctorate at the University of Erlangen, becoming the first Turk to receive a doctorate in mathematics. His doctoral thesis was on “Über die Trägheitsformen eines Modulsystems” (Inertial Forms of Modular Systems) and he defined the concept of inertial form. He played an important role in the establishment of the Faculty of Science at Istanbul University and contributed to laying the foundations of modern mathematics in Turkey. Erim taught theoretical calculus, analytical geometry, cosmography, trigonometry, philosophy of science and mechanics. He is also known for his work on mathematical analysis, differential equations, algebra, geometry, elasticity-plasticity (Duru, 2019). He also edited many scientific publications for the development of mathematics in Turkey. One of Kerim Erim's most important contributions was the establishment of the modern mathematics curriculum in the Department of Mathematics at Istanbul University. Kerim Erim met Einstein in Berlin in 1930 and shared his experience in his article “An Hour with Einstein” (Erim, 2004; Bahadır, 2004). He was a founding member of the Turkish Mathematical Society in 1948 and the Turkish Physical Society in 1950. In 1952, he organized the Eighth International Congress of Theoretical and Applied Mechanics in Istanbul. The congress was considered an important event that increased Turkey's international recognition in the scientific field. His efforts to modernize mathematics education led to the training of many scientists in this field in Turkey. On December 28, 1952, Kerim Erim passed away in Istanbul and was buried in Edirnekapı Cemetery. In 1977, 25 years after his death, he was awarded the TÜBİTAK Service Award (Bahadır, 2006).

### **b. Ord. Prof. Dr. Ratip Berker**

Born on June 5, 1909 in Istanbul, Ratip Berker started his education in Istanbul. After graduating from Kadıköy Saint-Joseph High School in 1926, he studied mathematics and engineering at the Universities of Nancy and Lille in France. In 1932, after graduating as an engineer from the Nancy Institute of Electromechanics and Applied Mechanics, he returned to Turkey and continued his academic career at Istanbul University and Istanbul Technical University. In 1936, Berker went to France to complete his doctorate at the University of Lille, where he attracted attention with his doctoral thesis titled “Sur quelques cas d'integration des equations du mouvement d'un fluide visqueux incompressible” in which he analyzed some solutions of the equations of motion of a viscous and incompressible fluid (Kahya & Topdemir, 2002; Topdemir & Unat, 2013). Berker's academic career was not limited to Turkey; he lectured at prestigious institutions such as Indiana University (USA), Lille University (France), Paris-IV University (France) and Boğaziçi University. He has conducted in-depth studies especially in the fields of fluid mechanics and mathematical physics. His work made significant contributions in the fields of Newtonian fluid theory, differential equations and mathematical analysis (Topdemir & Unat, 2013). Ratip Berker's contributions to the world of science were not limited to academic publications and lectures. He also took an active role in the management of scientific societies and journals. He was awarded the TÜBİTAK Science Award in 1968 and the TÜBİTAK Service Award in 1991. He was also awarded honorary doctorates by Hacettepe University in 1975 and Istanbul Technical University in 1980. In 1983, he was awarded the “Officier de la Légion d'honneur”, one of the most prestigious orders of France. In 1991, he was awarded the “Information Age Award” by the Turkish Ministry of Culture. Ord. Prof. Dr. Ratip Berker, besides having a respected place in the world of science, is also remembered for the students he trained and his contributions to the scientific community. In 1997, Prof. Berker passed away in Istanbul and his name was given to the library at ITU Gümüşsuyu campus, thus his scientific legacy continues to be kept alive for generations.

### **c. Ord. Prof. Dr. Cahit Arf**

Born on October 11, 1910 in Thessaloniki, Cahit Arf started his education in Istanbul. He completed his higher education at Ecole Normale Superieure in France in 1932 and his PhD at Göttingen University in 1938. Cahit Arf, one of the most important names in the field of mathematics in the Republican era, is known worldwide for his work in various fields such as algebra, number theory, elasticity theory, analysis, geometry and engineering mathematics. Hasse-Arf Theorem, Arf Invariant, Arf Rings and Arf Closure, which are named after Arf, are considered as important concepts in the world of mathematics (Sertöz, 2013). Cahit Arf, who taught mathematics at Istanbul University and later at Robert College, raised the quality of mathematics education in Turkey and trained many students. In his studies, he saw mathematics not as memorization but as discovery. "Mathematics is a work of patience; it is necessary to understand it not by memorizing, but by discovering." He instilled this approach in his students. His contributions to science were not limited to algebra and number theory but also extended to engineering mathematics and geometry (Terzioğlu & Yılmaz, 2005). His work on synthetic geometry problems and quadratic forms made his name permanent in the world of mathematics. Cahit Arf also played an important role in the establishment of the Scientific and Technical Research Council of Turkey (TÜBİTAK) and contributed to the shaping of science policy in Turkey (Tonta & Çelik, 2013). Arf received the TÜBİTAK Science Award in 1974, honorary doctorate degrees from Istanbul Technical University and Karadeniz Technical University in 1980 and from METU in 1981. He died on December 26, 1997 as a result of a heart attack.

### **d. Prof. Dr. Nazım Terzioğlu**

Born in 1912 in Kayseri, Nazım Terzioğlu started his education in Kayseri. After completing his higher education at Göttingen and Munich Universities, he completed his doctoral thesis entitled "Über Finslersche Raeume" (On Finsler Spaces) in 1936 at Ludwig-Maximilians University of Munich under the supervision of Prof. Dr. Constantin Caratheodory (Yıldırım, 1993). Terzioğlu worked in some scientific organizations such as the Geophysics Institute of Istanbul University, the Hydrobiology Institute in Baltalimanı, Istanbul, and the Cosmic Shua Institute (Yıldırım, 2012). He contributed greatly to the development of modern mathematics education in Turkey. Terzioğlu is especially known for his research in mathematical analysis and functional analysis (Kahya & Topdemir, 2002). In addition, he organized various congresses, colloquia, summer courses, conferences and seminars for mathematics education and research in Turkey and invited foreign scientists, thus contributing to the education of young generations. In 1976, on the opening day of the symposium organized in honor of Prof. Dr. Rolf Nevanlinna of Finland, who was Terzioğlu's teacher, at the Silivri facilities, Nazım Terzioğlu died of a heart attack on the morning of September 20, 1976, but the symposium was completed with some changes in the program.

## **Prominent Physics Scientists in Turkey in the First Years of the Republic**

### **a. Prof. Dr. Feza Gürsey**

Feza Gürsey was born in Istanbul on April 7, 1921 and started his education in Paris. Gürsey graduated first in Physics and Mathematics from the Faculty of Science at Istanbul University, and in 1945 he received a scholarship from the Ministry of National Education and received his PhD from Imperial College in England. During his doctoral studies, he published two important papers titled "A one-dimensional statistical system" and "On two-component wave equations", which attracted attention in the field of theoretical physics (Serdaroğlu, 2007).

In the 1950s, he traveled to the United States and worked on theoretical physics at Brookhaven National Accelerator Laboratory, Princeton Institute for Advanced Studies and Columbia University (Kahya & Topdemir, 2002). During this period, his paper "showing the relevance of charge independence and baryon conservation to the Pauli Transformation" attracted great

attention from the leading physicists of the period. Wolfgang Pauli praised this paper in a letter to the Russian physicist Landau and stated that he and Heisenberg were considering using this symmetry in their model. Gürsey's work led to important steps in understanding the behavior of subatomic particles (Topdemir & Unat, 2013).

Returning to Turkey in 1961, Feza Gürsey started working as a professor at the Department of Theoretical Physics at the Middle East Technical University (METU), where he made efforts to accelerate the development of theoretical physics, inviting famous physicists to Turkey and organizing many international conferences. In 1968, he was awarded the TÜBİTAK Science Prize.

Between 1965 and 1974, he was a visiting professor at Yale University, where he conducted research on topics such as nonlinear chiral models and conformal symmetry (Tozar, 1994). In 1977, together with Sheldon Glashow, he received the Oppenheimer Prize for his contributions to elementary particle physics (Alpar, 1992). Returning to Turkey after his retirement in 1991, Gürsey continued his work at Boğaziçi University and inspired young scientists. He died on April 13, 1992 due to prostate cancer. Gürsey's name was given to the Feza Gürsey Science Center in Ankara, honoring his contributions to science and education.

#### **b. Prof. Dr. Behram Kurşunoğlu**

Behram Kurşunoğlu was born in Trabzon on March 14, 1922 and started his education in Trabzon. After attending Ankara University, he went to England for his higher education, where he pursued in-depth studies in physics at Edinburgh and Cambridge universities. While working on his PhD in Cambridge, he had the opportunity to work with the famous scientist Paul Dirac and in this process, he conducted important research on Einstein's general theory of relativity (Perlmutter & Meshkov, 2004). Kurşunoğlu continued his career in the United States and worked at Cornell University. His most recognized period in the world of science began with the Institute of Theoretical Physics, which he founded at the University of Florida in 1968. This institute hosted many Nobel Prize-winning scientists at that time and hosted their work. The scientific meetings organized under Kurşunoğlu's leadership, known as Orbis Scientiae, were among the important events that brought together theoretical physicists around the world. Kurşunoğlu's scientific work focused especially on unified field theory and quantum mechanics. His efforts to improve Einstein's theories attracted great interest in the scientific world (Kurşunoğlu, 1952). He also conducted important research in the fields of nuclear energy and high energy physics. In the mid-1970s, he established another research center called Global Foundation at the University of Miami and continued his scientific studies and international collaborations (Topdemir & Unat, 2013). Kurşunoğlu, who also made great contributions to scientific developments in Turkey, was one of the founding members of the Turkish Atomic Energy Authority (TAEK) and took part in various projects to strengthen the country's scientific infrastructure (Perlmutter, 2005).

Kurşunoğlu advocated the need for a mobilization for Turkey's development in the field of science and technology and continued to work in line with this vision. Died on October 25, 2003 in Florida due to a sudden heart attack, Behram Kurşunoğlu is an unforgettable scientist who left behind great contributions to the world of science. His works such as “Modern Quantum Theory” and “Remembering a Great Physicist” on Paul Dirac are among the most important parts of his scientific legacy.

#### **c. Prof. Dr. Hüseyin Cavid Erginsoy**

Hüseyin Cavid Erginsoy was born in Ankara on May 20, 1924, started his education in Istanbul and continued his studies in Italy after his family moved there. His years in Italy developed his interest in art and his aesthetic sense. When he returned to Turkey, he enrolled in Galatasaray High School, where he met Feza Gürsey, another famous physicist of the future. This



acquaintance turned into an important friendship and collaboration in both of their careers (Gürsey, 1968). After graduating from Galatasaray High School, he started his education at Istanbul Technical University's Department of Electrical Engineering, but his scientific ambitions led him to a different path. In 1943, Erginsoy received a scholarship from the University of London and after a long and difficult journey due to the war, he arrived in England (Dirican, 1998). Here, he studied Electrical Engineering at Kings College, but his interest in physics led him to this field.

He started to work in the field of solid state physics and developed the formula known as “Erginsoy Impurity Scattering Formula” which has an important place in solid state physics. This work is an important discovery that explains how foreign atoms in semiconductor crystals affect electrons by quantum mechanics methods (Topdemir & Unat, 2013). This formula has become one of the classic works in the field of solid state physics. After completing his PhD, Erginsoy returned to Turkey and started working in the field of energy and took part in the construction of the Sarıyer Dam. His interest in reactor physics brought him to the Atomic Energy Study Department of Etibank. His work here made a great impact at the international level and brought him to an important position in the International Atomic Energy Organization (Gürsey, 1969).

However, Erginsoy felt that he had strayed away from pure science and at the age of 38, he resumed his scientific studies at Brookhaven National Research Laboratories in the USA. Here he gained worldwide fame with his work on “channeling”. In 1967, he returned to Turkey and started teaching at METU. However, he died shortly afterwards at the age of 43 due to a heart attack. He left behind a legacy of scientific work and an inspiring legacy for his students.

#### **d. Prof. Dr. Erdal İnönü**

Erdal İnönü was born in Ankara on June 6, 1926 and started his education in Ankara. In 1947, after graduating from Ankara University, Faculty of Science, Department of Physics-Mathematics, he went to the United States and earned his master's and doctorate degrees in physics at the California Institute of Technology (Caltech) (Topdemir & Unat, 2013). After completing his doctoral studies, he worked as a researcher at Princeton University for a while. In 1952, İnönü returned to Turkey and started his academic career as an assistant at Ankara University, Faculty of Science. In the 1960s, he joined METU and pioneered the establishment of the Department of Theoretical Physics. During his academic career at METU, he served as Dean and Rector of the Faculty of Science and Letters and won the TÜBİTAK Science Award in 1974 (Aslan, 2014). One of Erdal İnönü's greatest contributions to the world of science was his theoretical work entitled “İnönü-Wigner Group Reduction”, which he developed at Princeton University in 1951 with Hungarian-American physicist Eugene Wigner (Topdemir & Unat, 2013). This work has been accepted as a general method in group theory and has taken its place among the basic methods of mathematical physics. This method has had important applications especially in fields such as quantum mechanics and nuclear physics. In 1982, he became the first director of the Feza Gürsey Institute established by TÜBİTAK in Istanbul, where he made significant contributions to the development of scientific research (Topdemir & Unat, 2013). In 2004, he was awarded the Wigner Medal, one of the most prestigious awards in physics after the Nobel Prize, and became the second Turkish scientist to receive it after Feza Gürsey. As both a scientist and an academic leader, he pioneered the development of basic sciences and the spread of science culture in Turkey. İnönü's contributions to science were not limited to his own research in his own field, but he also made significant contributions to the development of scientific and academic institutions in Turkey and to raising the standards of scientific research (Bahadır, 2018). Erdal İnönü, who passed away on October 31, 2007, continues to be remembered for the legacy and works he left to the world of science.

#### **e. Prof. Dr. Asım Orhan Barut**

Asım Orhan Barut was born in Malatya on June 6, 1926 and started his education in Malatya. He started his university education at Istanbul Technical University and continued his studies in electrical engineering at Zurich Technical University in Switzerland. However, his deep interest in physics led him to direct his career to this field and he specialized in this field by shifting his education to physics (Kahya & Topdemir, 2002). In 1953, Barut went to the United States of America, where he continued his studies in physics and mathematics. In particular, he conducted in-depth research on group theory, quantum mechanics and electrodynamics. He worked as a faculty member at the University of Colorado for many years in the USA, where he became known for his work on dynamic group theory (Topdemir & Unat, 2013). Asım Orhan Barut is best known in the scientific world for his work titled “Non-Compact Groups”. He published this work with R. Rockza in 1977 and it attracted great international attention. The book has been translated into many languages and is considered as one of the classic works in physics literature (Oralalp, 1995). In addition, his book “Electrodynamics, Classical Fields and Particles” published in 1964 is another important work that is still important today. This book provides an in-depth overview of classical field theory and particle physics and is used as a reference in physics education. Asım Barut's contributions to science were not limited to academic studies. His 1988 article “Erwin Schrödinger's 100th Anniversary and the Present State of Quantum Mechanics” is noteworthy as one of the first popular articles on wave mechanics in Turkey. In this article, the birth and development of Schrödinger's theory of wave mechanics and its impact on the world of science are discussed. Barut draws attention to Schrödinger's efforts to unify relativity theory and wave mechanics while trying to understand this theory more deeply and emphasizes the philosophical debates in this field (Bahadır, 2019). He makes important observations about the stance of great physicists such as Schrödinger, Einstein and de Broglie against the probabilistic understanding of quantum mechanics. Asım Orhan Barut is an internationally respected scientist who has left a deep mark on the Turkish scientific world with the students he trained, the books he published and his scientific studies. His original contributions in the basic fields of physics and his in-depth analysis of scientific developments have made him one of the leading figures in the history of Turkish science.

#### **4. An Evaluation in terms of Science and History of Science - Conclusion**

The works of prominent mathematical and physical scientists in Turkey in the early years of the Republic are of great importance in terms of science and the history of science. These scientists played important roles not only in scientific fields but also in the establishment and development of modern science in Turkey. They pioneered the development of scientific research, the modernization of educational institutions and the international recognition of scientists. The work of these scientists has enabled the quality of scientific research in Turkey to increase and to be recognized worldwide. The contributions of scientific studies and scientists in Turkey have also made significant contributions to the development of scientific thought and scientific culture. The establishment of scientific thought, the adoption of scientific methods and the importance given to scientific research have enabled the development of scientific culture and increased scientific awareness in Turkey. The legacy of these scientists still sheds light on the development of science in Turkey and the scientific research of future generations.

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## DUBAİ TURİZMİ

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### **Özet**

Bu araştırmada Dubai turizmi incelenmiştir. Dubai, Birleşik Arap Emirliklerinin yedi emirliğinden biridir. Özellikle alışveriş merkezleri, gökdelenleri, plajları, uluslararası spor etkinlikleri ile dikkat çeken Dubai, teknolojinin en üst düzeyde kullanıldığı marka şehirlerdendir. Dubai’de turizm, en dinamik sektörlerden biridir. Lüks bir turizm destinasyonu olarak bilinen Dubai’de turizm sektöründe teknoloji, yenileşme ve sürdürülebilirlik eksenli bir bakış açısı hâkimdir. İkincil verilerden ve saha incelemesinden yararlanılan araştırmada öncelikle Orta Doğu ve Birleşik Arap Emirlikleri turizmine genel çerçevede bakılmış, ardından Dubai turizmi tarihsel gelişimi, çekicilikleri ve vizyonu açısından değerlendirilmiştir. Araştırmada son olarak Dubai turizmine ilişkin bir değerlendirme yapılmıştır.

**Anahtar Kelimeler:** Dubai, Birleşik Arap Emirlikleri, Turizm, Orta Doğu

## DUBAI TOURISM

### **Abstract**

In this research, Dubai tourism is analyzed. Dubai is one of the seven emirates of the United Arab Emirates. Dubai, which attracts attention especially with its shopping malls, skyscrapers, beaches, international sports events, is one of the brand cities where technology is used at the highest level. Tourism is one of the most dynamic sectors in Dubai. Known as a luxury tourism destination, Dubai has a perspective based on technology, innovation and sustainability in the tourism sector. In the research, which utilized secondary data and field research, firstly the Middle East and United Arab Emirates tourism was examined in a general framework, and then Dubai tourism was evaluated in terms of its historical development, attractiveness and vision. Finally, an evaluation of Dubai tourism was made in the research.

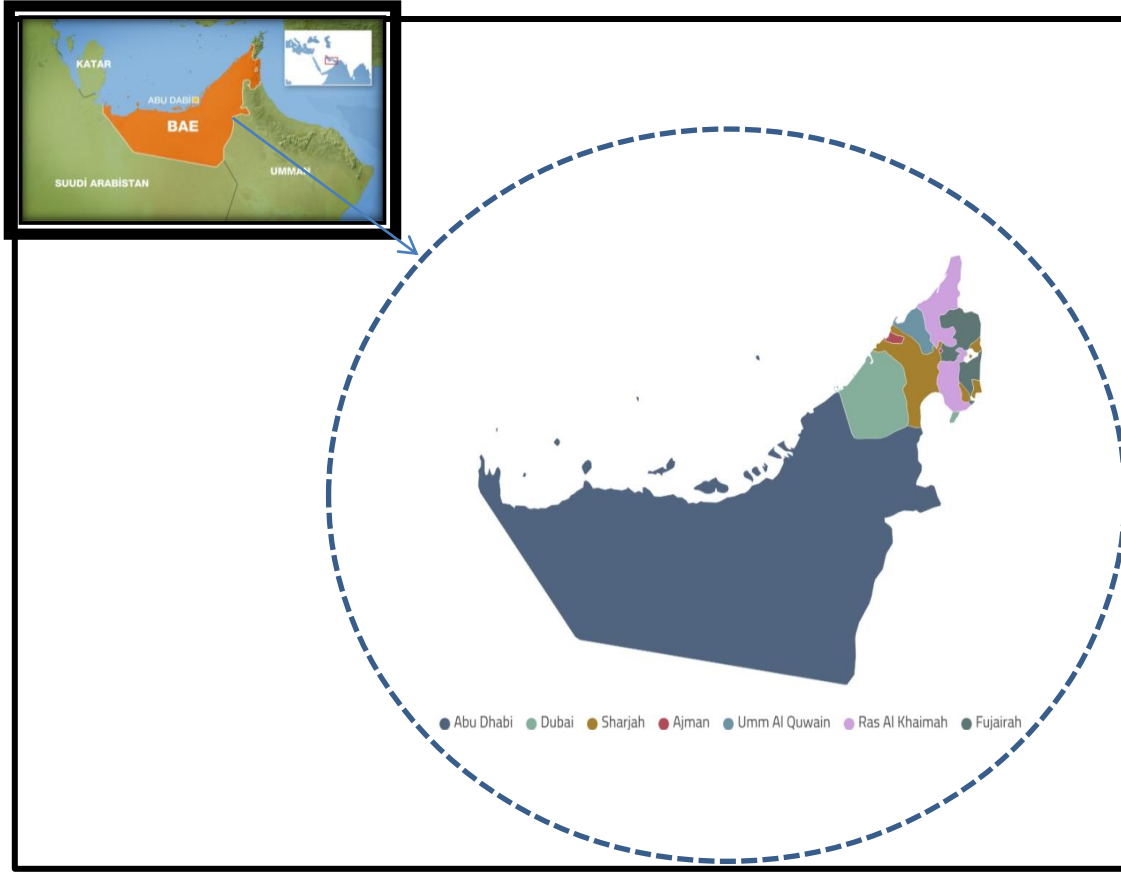
**Keywords:** Dubai, United Arab Emirates, Tourism, Middle East

## Giriş

Bağımsızlık öncesinde Aşiretler Devleti (Trucial States) olarak bilinen Birleşik Arap Emirlikleri (BAE), 2 Aralık 1971’de İngiltere’den bağımsızlığını kazanmıştır (Bandırma Ticaret Borsası, 2021: 2). Dubai; Abu Dhabi, Sharjah, Ajman, Umm Al Quwain, Ras Al Khaimah ve Fujairah dâhil olmak üzere BAE’nin yedi emirliğinden biridir (Stephenson ve Knight, 2010: 278). Şekil 1’de yedi emirliğin konumu görülmektedir. Dubai, adalar hariç BAE’nin yaklaşık %5’ini oluşturan 4.114 km<sup>2</sup> alanıyla ikinci büyük emirliktir. Eski bölgeleri 1.500 m<sup>2</sup>’lik bir alanı kapsayan Dubai, tarihi ve kültürel mirası nedeniyle “Körfezin İncisi” ve “Dünyanın Mücevheri” olarak bilinir. Emirlik, Arap Yarımadası’nın doğu kıyısında, Arap Körfezi’nin güneybatı köşesinde yer alır. Güneyde Abu Dhabi ve kuzeydoğuda Sharjah, güneydoğuda Umman Sultanlığı ile sınırını paylaşır. Dubai, deniz seviyesinden yaklaşık 16 m yüksekliktedir. Şehir, kuzeyde Deira ve güneyde Bur Dubai şeklinde ikiye bölen tarihi koy ile karakterize edilir. 2016 yılında emirliğin 14 ilçeye bölünmesini içeren yeni bir adresleme sistemi başlatılmıştır. Dubai’nin batı tarafında birkaç kumlu plaj, koyun doğu ucunda bir mangrov, iç ve batı bölgelerinde çok sayıda çöl, Hatta bölgesinde ise vadiler bulunmaktadır (United Arab Emirates Ministry of Foreign Affairs, 2024a; The United Arab Emirates’ Government Portal, 2024).

Dubai ile ilgili ilk kayıtlı kaynak, Venedikli inci tüccarı Gaspero Balbi’nin bölgeyi ziyaret edip Dubai’nin inci endüstrisi hakkında bahsettiği 1587 yılına dayanır (Unesco, 2024). Dubai; yüksek kuleleri, lüks otelleri, devasa alışveriş merkezleri ile önemli bir çekim merkezidir. Ancak Dubai’yi çekim merkezi haline getiren sadece yüksek kuleleri, lüks otelleri, devasa alışveriş merkezleri değil, iş imkânları, yüksek yaşam standardı, kaliteli ve çeşitli eğitim olanaklarına sahip olmasıdır (Özoral, 2018: 118). Dubai, 3.787.381 nüfuslu bir şehirdir ve bu nüfusun %80’inini yabancılar oluşturur. Kültürlerin buluşma noktası olan Dubai’de birçok yer, turistlerin farklı ihtiyaçlarına cevap verir. Deira ve Bur Dubai, altın, baharat ve parfüm çarşılarının bulunduğu eski şehir olarak bilinir. Dünyanın en yüksek binası Burj Khalifa ve dünyanın en büyük alışveriş merkezi Dubai Mall dâhil olmak üzere yükselen gökdelenlere sahip olan Down Town Dubai, Palm Jumeirah, dünyaca ünlü Atlantis the Palm dâhil olmak üzere birçok birinci sınıf otele sahip yapay bir adadır. Ayrıca, Jumeirah Plajı, Dubai Marina, Blue Waters Adası, en iyi otel markalarına, plajlara ve restoranlara ev sahipliği yapan diğer popüler turistik noktalardır (Detrovés Experiences, t.y.: 2; Dubai Statistics Center, 2024).

Dubai’de turizm sektörü, çarpıcı büyüme gösteren en önemli sektörlerden biridir. Çeşitli faktörler tarafından (Avrupa, Asya ve Afrika arasında yer alan stratejik coğrafi konum, mükemmel altyapı, proaktif ekonomi politikaları, temiz plajlar, yıl boyunca güneşli olma gibi yönlendirilen sektör, ekonomi üzerinde güçlü bir çarpan etkisine sahiptir (Benchabane, t.y.: 2). Bu araştırmanın amacı; Dubai turizmini incelemektir. Bu amaç doğrultusunda araştırmada Dubai turizmi; tarihsel gelişim, çekicilikler ve vizyon açısından ele alınmıştır. Araştırmada ikincil verilerin yanında saha incelemesinden de yararlanılmıştır. Dubai turizminin tarihsel gelişim, çekicilikler ve vizyon yönleriyle değerlendirildiği araştırma, literatüre sunacağı katkı açısından önemlidir.



**Şekil 1.** BAE'yi Oluşturan Yedi Emirliğin Konumu

**Kaynak:** Al Jazeera Türk, 2013; United Arab Emirates Ministry of Economy, 2024.

### Orta Doğu Ve Bae Turizmine Genel Bir Bakış

Dünya Turizm Örgütüne göre (DTÖ) Orta Doğu; BAE, Bahreyn, Filistin, Irak, Katar, Kuveyt, Libya, Lübnan, Mısır, Suriye, Suudi Arabistan, Umman, Ürdün ve Yemen'den oluşmaktadır (World Tourism Organization, 2024; Henderson, 2006: 88).

DTÖ'ye göre 2023 yılında uluslararası turist sayısı 1 milyar 300 bin iken turizm geliri, 1 trilyon 507 milyar ABD dolarıdır. Gerek turist sayısında gerekse turizm gelirinde bölgelerin aldığı pay sırasıyla Avrupa, Asya ve Pasifik, Amerika, Orta Doğu ve Afrika şeklindedir. Dolayısıyla Orta Doğu bu beş bölge içerisinde dördüncü sırada yer almaktadır. DTÖ'ye göre 2023 yılında Orta Doğu'ya 86 milyon 969 bin turist gelmiştir. Bunun 28 milyon 146 bini BAE'ye, 27 milyon 424 bini Suudi Arabistan'a, 5 milyon 346 bini Ürdün'e, 1 milyon 666'sı Lübnan'a, 4 milyon 54 bini Katar'a, 2 milyon 18 bini Suriye'ye aittir. Bahreyn, Filistin, Irak, Kuveyt, Libya, Mısır, Umman ve Yemen'e gelen turist sayısına ilişkin ise bu yıla ait herhangi bir veri bulunmamaktadır. Bölgedeki turist sayısı 2023 yılında 2022 yılına göre %28,3, 2019 yılına göre %22 oranında artmıştır. Bölge, 2023 yılında 128 milyar 513 milyon ABD doları turizm geliri elde etmiştir. Bu yıl içerisinde BAE ise 51 milyar 920 milyon, Suudi Arabistan 35 milyar 989 milyon; Mısır, 14 milyar 77 milyon; Katar, 8 milyar 848 milyon; Ürdün, 7 milyar 399 milyon; Lübnan, 5 milyar 409 milyon; Kuveyt, 1 milyar 736 milyon ABD doları turizm geliri elde ederken Bahreyn, Filistin, Irak, Libya, Suriye, Umman ve Yemen'in turizm gelirlerine ilişkin ise herhangi bir veri bulunmamaktadır. Dolayısıyla BAE, Orta Doğu destinasyonunda uluslararası turist sayısı ve gelirinde ilk sırada yer almaktadır. Covid-19'un başladığı 2019 yılında gelen turist sayısında dünyada 19. iken 2023 yılında 12. olmuştur. Diğer taraftan 2019 yılında turizm gelirinde dünyada 13. iken 2023 yılında 6. olmuştur. Turizm harcamalarında ise 2019 yılında 24. iken 2023 yılında 14. olmuştur. Orta Doğu, 2024 yılının ilk çeyreğinde uluslararası varışların pandemi öncesi seviyeleri %36, 2023 yılının ilk çeyreğini ise %4 aşmasıyla en güçlü



göreceli büyümeği gerçekleştirmiştir. Bu, Orta Doğunun pandemi öncesi sayıları toparlayan ilk dünya bölgesi olduğu (+%22) 2023 yılındaki olağanüstü performansın ardından yaşanmıştır. Bölgedeki çeşitli destinasyonlar olağanüstü sonuçlar elde etmiştir. Katar (+%177) ve Suudi Arabistan (+%98) bu destinasyonlar arasındadır (World Tourism Organization, 2024).

BAE, birçok açıdan ideal bir turizm destinasyonudur. Bunlar; ekonomik ve siyasi istikrar, Doğu ve Batı'yı birbirine bağlayan stratejik bir konum, büyük uluslararası havayollarına mükemmel bağlantı, güçlü ve turizmi destekleyen altyapı, çeşitli kategorilere ve bütçelere uygun geniş konaklama seçenekleri, her yaş grubuna hitap eden etkinlikler, eşsiz biyolojik çeşitlilik, çöllerin, vahaların, dağların, vadilerin ve ovaların, mangrovların, plajların ve çeşitli bitki örtüsünün, yaban hayatının ve deniz yaşamının güzelliği, farklı dinsel ve kültürel geçmişlere sahip 200'den fazla milletten insanın uyum ve barış içinde yaşadığı dinsel ve kültürel hoşgörüdür. BAE; konferanslar, bölgesel ve uluslararası sergiler ve at yarışlarının yanında Dubai Dünya Kupası, Abu Dhabi Formula 1 Grand Prix, Dubai Çöl Klasik Golf Turnuvası, FIFA Kulüpler Dünya Kupası, Dubai ve Abu Dhabi'de düzenlenen film festivalleri, Küresel Girişimcilik Zirvesi gibi büyük küresel etkinlikler açısından da dünya standartlarında bir mekân haline gelmiştir. 2016 yılında, seyahat ve turizm sektörünün BAE'nin GSYİH'sine doğrudan katkısı 68,5 milyar AED (18,7 milyar ABD doları) idi ve bu toplam GSYİH'nin %5,2'sine denk gelmekteydi. 2017'den 2027'ye kadar yıllık %5,1 artarak 116,1 milyar AED'ye (31,6 milyar ABD doları) çıkması tahmin edilmektedir ve bu da 2027 yılında toplam GSYİH'nin %5,4'üne denk gelmektedir. Seyahat ve turizm sektörünün BAE'nin GSYİH'sine toplam katkısı 159,1 milyar AED (43,3 milyar ABD doları) idi ve bu da GSYİH'nin %12,1'ine denk gelmektedir. Yıllık %4,9 artarak 264,5 milyar AED'ye (72 milyar ABD doları) çıkması tahmin edilmektedir ve bu da 2027 yılında GSYİH'nin %12,4'üne denk gelmektedir (United Arab Emirates Ministry of Foreign Affairs, 2024b).

## **Dubai'de Turizm**

### **Dubai'de Turizmin Tarihsel Gelişimi**

Bir dizi faktör, Dubai'nin turizmde dönüşümünü mümkün hale getirmiştir. Özellikle ticaret mirası aracılığıyla yabancı ziyaretçilerle uzun süreli etkileşim ve iktidardaki Al Maktoum ailesinin stratejik coğrafi konum, kış güneşi, geniş plajlar ve çöl manzaraları gibi emirliğin doğal turizm varlıklarının potansiyelini tanıma vizyonu bu dönüşümde etkili olmuştur. Konaklama, havacılık ve rekreasyon tesislerini kapsayan birinci sınıf bir altyapının oluşturulması için kamu ve özel sektör yatırımları işbirliği içinde yürütülmüştür. Bu nedenle turizm, BAE'nin en dinamik sektörlerinden biri olarak ortaya çıkmıştır ve yedi emirliğin her birinde kendini göstermektedir; ancak Dubai'de şehrin ekonomisinde önemli bir bileşen haline gelmiştir. 1950'li yıllarda hiç oteli olmayan Dubai, 1990'lı yılların sonlarına doğru dünyanın en lüks otel projelerine yatırım yaparak uluslararası üst düzey turist pazarına girmeyi başarmıştır. 2000 yılına kadar Dubai'ye her yıl 3 milyondan fazla turist gelmiştir. 1996 ile 2000 yılları arasında dış danışmanların ortaya çıkışına, turizm yanlısı politikalara, cazibe merkezlerinin, tesislerin ve etkinliklerin yapılmasına tanık olmuştur. 2000 ile 2010 yılları arasında daha önce yapılan cazibe merkezleri, tesisler ve etkinliklere odaklanmada keskinleşme ve artış, daha fazla turizm yanlısı politikalar tasarlama, yapılar oluşturma, kontroller sağlama gibi yeni faaliyetler ve stratejiler geliştirilmiştir. İnsanları emirliğe çekmek için Dubai Alışveriş Festivali, Dubai Yaz Sürprizleri, Dubai Uluslararası Film Festivali, Dubai Uluslararası Caz Festivali, Arap Seyahat Pazarı, Dubai Hava Gösterisi, Dubai Dünya Kupası, Dubai Çöl Klasik PGA Golf Turnuvası, Dubai Açık ATP Tenis Turnuvası gibi çeşitli etkinlikler düzenlenmiştir. 2010 ile 2020 yılları arasında emirliğin gelişimi, Dubai'nin turizm vizyonunu takip edecek şekilde planlanmıştır. Bu bağlamda başta Latin Amerika, Çin ve Afrika olmak üzere bir dizi kaynak pazarda farkındalık yaratılmaya çalışılmıştır (Kotsi ve Michael, 2015).

Dubai’de toplam uluslararası ziyaretçi sayısı Covid-19’un başladığı 2019’da 16,73 milyon iken 2022’de 14,36 milyona gerilemiş, 2023’te 17,15 milyona ulaşmıştır. Ziyaretçiler, 2023’te Dubai’de daha uzun süre kalmayı tercih etmiştir ve ortalama geceleme sayısı 2019’da 3,4 iken 3,8’e yükselmiştir. Dubai’de 2019’un sonunda 741 tesiste 126.120 oda bulunurken bu sayı 2022’nin sonunda 804 tesiste 146.496 odaya ulaşmıştır. 2023’te Dubai’de 821 tesiste 150.291 oda bulunmaktadır. Diğer taraftan ziyaretçi memnuniyeti, 2022 yılında %78,2 iken 2023 yılında %82,0’a yükselmiştir. Oxford Economics’in araştırması, Dubai’nin 2024’te 20 milyondan fazla uluslararası ziyaretçi ağırlayacağını öngörmektedir. Dubai, 2024’ün ilk yarısında 9,31 milyon uluslararası ziyaretçi ağırlamıştır (Dubai Department of Economy and Tourism, 2023; Dubai Department of Economy and Tourism, 2024a).

Dubai; altın rengi plajları, yıl boyu süren güneşi ve Batı ve Doğu’dan gelen çok uluslu şirketlerden gelen uluslararası yatırım dalgasıyla iş ve eğlence için dünya haritasının merkezinde yer aldığı söylenebilir. Dubai’nin şu anda bulunduğu yerde, küçük balıkçı teknesi ile çölden başka bir şey olmadığına inanmak zordur. Ancak bugün, tam bir zıtlık söz konusudur. Dubai, 1960’lı yıllarda çöllerinde petrol bulunmasıyla daha önce küçük, durgun balıkçı köyünden dünyanın en lüks ve gösterişli turistik yerlerinden biri haline gelmiştir ve dünyanın dört bir yanından misafirleri çekmektedir. Bazı insanlar, ortasında petrol çıkaran bir ülkenin biraz “şanslı” doğasını ve böyle bir şanstın gelen zenginliğin gücünü düşünebilirken Dubai’nin ziyaretçi çekiciliğindeki sürekli büyümenin tesadüf olmaktan çok, düşünce ve kesin planlamadan oluşan uzun vadeli bir stratejik plan olduğunu söylemek doğru olacaktır (Nadkarni ve Hayes, 2016: 213).

## **Dubai’nin Başlıca Turizm Çekicilikleri**

### **Tarihi Al Fahidi Mahallesi**

Tarihi Al Fahidi (eski adıyla Bastakiya) Mahallesi, başka yerlerde bulunan fütüristik mimariyle keskin bir tezat oluşturarak şehrin geçmişine renkli bir bakış sunar. Gölgeci cadde ve sokaklardan oluşan labirentte dolaşırken kum, taş, mercan ve alçıdan yapılmış zarif avlulu geleneksel rüzgâr kuleli evler görülebilir. Bastakiya olarak da bilinen bu evler, 20. yüzyılda buraya yerleşen İranlı tüccarlar tarafından inşa edilmiştir. Binalar; girişik bezeme pencereler, dekoratif alçı paneller ve paravanlarla orijinal hallerine uygun olarak restore edilmiştir. Bölge; sanat galerilerine, müzelere ve kafelere ev sahipliği yapmaktadır (Dunston ve Monaghan, t.y.). Şekil 2’de Tarihi Al Fahidi Mahallesi görülmektedir.



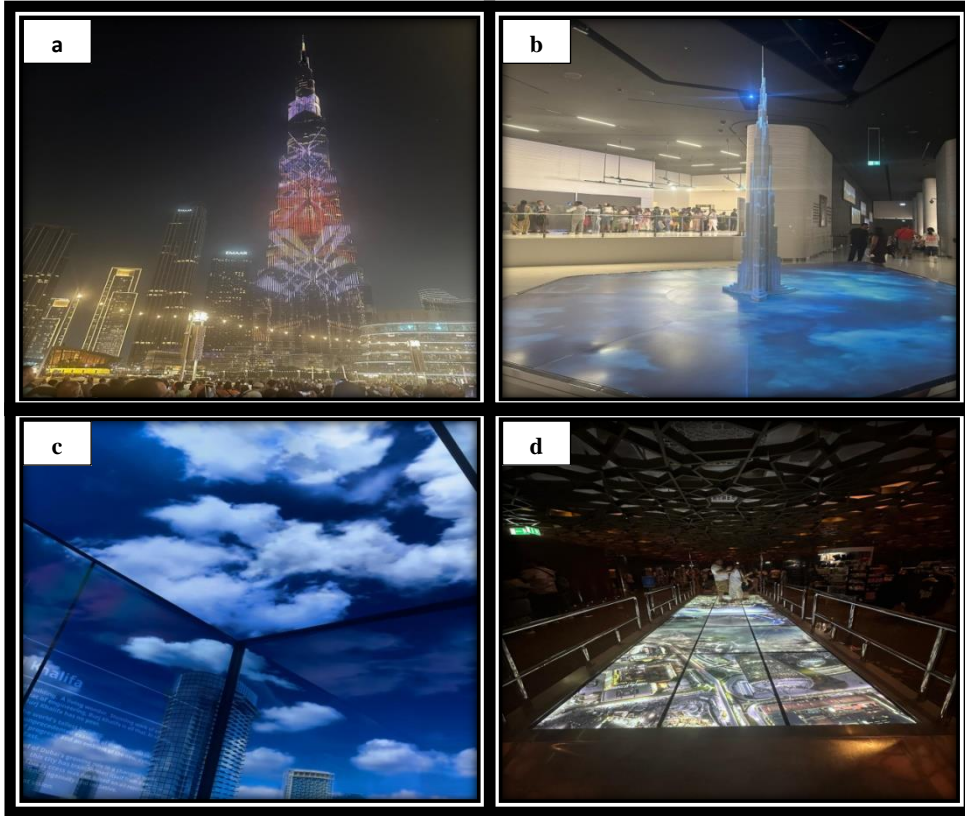
Şekil 2. Tarihi Al Fahidi Mahallesi

Kaynak: Visit Dubai, 2024a.

### **Burj Khalifa**

2010 yılında açılan Burj Khalifa, 828 m ile dünyadaki en yüksek binadır. İğne inceliğindeki dış hatları Dubai’nin üzerinde yükselmekte ve neredeyse 100 km uzaklıktan görülebilmektedir. Milyarlarca dolarlık Downtown Dubai’nin gelişiminin merkez parçası olarak planlanmıştır; ancak Dubai hükümdarı Şeyh Muhammed’in isteği üzerine mimarlar onu dünyanın en yüksek

binası ve Dubai'nin yükselen tutkularının gerçek bir sembolü haline getirmişlerdir (Dunston ve Monaghan, t.y.: 12). Sahada yapılan araştırma sonucunda yapının dışında ışık gösterisinin yapıldığı, yapının maketinin ardından bilgilendirme panolarına yer verildiği, asansöründe bilgilendirmelerin ve teknolojinin iyi kullanılarak ziyaretçilere görsel şov yapıldığı, kata ulaşan ziyaretçilerin fotoğraf çekmek için yarıştığı gözlenmiştir. Diğer taraftan yapının iç kısımdan dış kısmının izlenebilmesine imkân tanıyan yürüyüş yolu ile satış noktasına turistlerin yoğun ilgi gösterdiği görülmüştür. Şekil 3'te Burj Khalifa'nın dış kısmı (a), maketi (b) asansörü (c) ve yürüyüş yolu (d) görülmektedir.



Şekil 3. Burj Khalifa'nın Dış Kısmı (a), Maketi (b), Asansörü (c) ve Yürüyüş Yolu (d)  
Kaynak: Dağdeviren, 2024a.

### Jumeirah Bölgesi Yapıları

Liman bölgesinden güneybatıya doğru kıyı boyunca uzanan Jumeirah, şehrin en göz alıcı ve en çok rağbet gören banliyölerinden biridir. Sessiz, yemyeşil sokaklar begonvillerle kaplı lüks villalarla doludur. Güney ucundaki alçak katlı banliyöler, şehrin en ünlü üç simgesiyle noktalanmıştır: ikonik “yedi yıldızlı” Burj Al Arab Jumeirah Oteli, devasa dalga şeklindeki Jumeirah Beach Oteli ve Madinat Jumeirah Çarşısını içine alan Madinat Jumeirah Kompleksi. Bölgenin plajları, barları ve restoranları şehrin en iyileri arasındadır. Wild Wadi Su Parkı, heyecan ve eğlence tutkunlarını kendine çeker. Bölgenin önemli yapılarından biri de Jumeirah Camisi'dir. Modern İslam mimarisinin önemli örneklerinden birini temsil eden cami, 1998 yılında inşa edilmiştir. Ön cephesi özellikle Ramazan aylarında ışık gösterileriyle nefes kesicidir. Pürüzsüz beyaz taştan inşa edilen cami, özenle dekore edilmiş ikiz minaresi ve görkemli kubbesiyle şehrin simgesidir (Dunston ve Monaghan, t.y.: 20, 76; Jumeirah Mosque, 2018). Şekil 4'te Yedi Yıldızlı Burj Al Arab Jumeirah Oteli ve Madinat Jumeirah Kompleksi, Şekil 5'te Jumeirah Beach Oteli, Şekil 6'da ise Jumeirah Camisi görülmektedir.



**Şekil 4.** Yedi Yıldızlı Burj Al Arab Jumeirah Oteli ve Madinat Jumeirah Kompleksi

**Kaynak:** Dağdeviren, 2024b.



**Şekil 5.** Jumeirah Beach Oteli

**Kaynak:** Jumeirah Beach Hotel, 2024.



**Şekil 6.** Jumeirah Camisi

**Kaynak:** Jumeirah Mosque, 2018.

### **Dubai Koyu**

Dubai'nin kalbinde bulunan Arap Körfezi'nin doğal bir deniz suyu koyudur. 14 kilometre uzunluğunda ve 100-500 metre genişliğindedir. Güneydoğu'ya doğru uzanır ve Ras Al-Khor Yaban Hayatı Koruma Alanı'nda son bulur. Koy, şehri Bur Dubai ve Deira olmak üzere iki bölüme ayırır ve tarih boyunca bölgenin ekonomik gelişiminde önemli bir rol oynamıştır. Dubai Koyu'nun bilinen en eski tanımı, bir İngiliz Kraliyet Donanması subayının 1822 tarihli raporunda bulunur. Koyun, Dubai'nin bir ticaret limanı olarak kurulmasının ve erken gelişiminin gerçek varoluş nedeni olması muhtemeldir. Başlangıç noktası belki de 1833 olarak

alınabilir. Bu tarihte Şeyh Maktum bin Buti El Falasi liderliğindeki Bani Yas kabilesinin yaklaşık 800 üyesi, koyun ağzındaki Bur Dubai bölgesine yerleşmiştir. İnci dalışı, balıkçılık ve ticarete odaklı gelişen bir liman olma potansiyeline sahip güvenli, doğal bir liman olan koy, ilk yerleşimciler için bariz bir tercihti. O zamanlar bir diğer ana endüstri olan balıkçılık da ılık ve sığ suları çeşitli ve zengin bir deniz yaşamını destekleyen koy boyunca gelişmiştir. Yaklaşık bir yüzyıl boyunca, sınırlı derinliği nedeniyle büyük gemilerin girişine izin vermesede koy, şehrin tek limanı ve Dubai'nin ticari konumunu oluşturmada en önemli unsur olarak kalmıştır. 20. yüzyılın ikinci yarısında, koyun ticari merkez olarak önemi, daha büyük gemilerin geçişine izin vermek ve malların yüklenmesini ve boşaltılmasını kolaylaştırmak için bir dizi iyileştirmeyi zorunlu kılmıştır. Modern Dubai'nin kıyı şeridi boyunca onlarca kilometre boyunca etkileyici büyümesine rağmen koy şehrin kalbi olmaya devam etmiştir (Unesco, 2024). Akşamları ışık ve müzik gösterilerine, yüzen yatlara, yelkenlere, gemilere tanıklık edilebilen ve aynı zamanda ticaret zamanlarındaki eski Dubai'ye göz atılabilen popüler bir ziyaret yeridir (Detrovex Experiences, t.y.: 4). Şekil 7'de Dubai Koyu görülmektedir.



Şekil 7. Dubai Koyu

Kaynak: Visit Dubai, 2023.

### Dubai Müzesi

Müze, geçmiş ve günümüz geleneklerine dair bir fikir verir ve Dubai'nin birkaç yüzyılda çoğu şehrin başardığını nasıl beş on yıla sığdırdığına dair canlı bir resim sunar. Tarihi Al Fahidi bölgesinde bulunan müze, şehrin en eski binalarından biri olan Al Fahidi Kalesi'nin içinde ve altında yer almaktadır. Şehrin küçük bir çöl yerleşiminden ticaret, finans ve turizm açısından Arap dünyasının merkezi haline gelme sürecini konu almaktadır (Dunston ve Monaghan, t.y.: 14). Dubai Müzesi'nin içinde renkli diyoramalar ve aydınlatıcı tarihi sergiler bulunmaktadır. Galerilerde tarihi Arap evleri, camiler, çarşılar ve hurma çiftlikleri yeniden canlandırılırken aynı zamanda çöl ve deniz yaşamından sahneler tasvir edilmektedir. Bu cazibe merkezinde ayrıca bölgedeki inci dalgıçlığının zengin tarihi keşfedilmekte ve o dönemde kullanılan gerçek ağırlıklar ve teraziler sergilenmektedir. Burada MÖ 3000 yılına kadar uzanan tarihi eşyalar sergilenmektedir. Eski ve modern Dubai arasındaki büyük farkın vurgulandığı müze, Dubai Koyu'nun güney ucundadır (Visit Dubai, 2024b). Şekil 8'de Dubai Müzesi'nde bulunan ahşap Arap yelkenlisi görülmektedir.





**Şekil 8.** Dubai Müzesi'nde Bulunan Ahşap Arap Yelkenlisi  
**Kaynak:** Visit Dubai, 2024.

### **Dubai Mucize Bahçesi**

Dünyanın en büyük doğal çiçek bahçesidir. Her mevsim, hava kış başlangıcında soğumaya başladığında kapılarını yeniden açar. 150 milyondan fazla açmış çiçeğin olduğu 72.000 metrekarelik bahçe, bölgenin en güzel, hoş kokulu yerlerinden biridir (Dubai Miracle Garden, 2024). 2013 yılında Sevgililer Günü'nde açılmıştır ve her yıl milyonlarca ziyaretçiyi ağırlamaktadır. Koruma alanı, bölgenin ilk kapalı kelebek bahçesi olan ve yıl boyunca açık olan Dubai Kelebek Bahçesi'ne de ev sahipliği yapmaktadır (CNN, 2017). Şekil 9'da Dubai Mucize Bahçesi görülmektedir.



**Şekil 9.** Dubai Mucize Bahçesi  
**Kaynak:** CNN, 2017.

### **Dubai Çerçevesi**

Dubai'deki Zabeel Park'ta bulunmaktadır. Eski ve Yeni Dubai'nin etkileyici manzaralarını 'çerçeveleyen' ikonik bir yapıdır ve emirliğin zengin geçmişi ile görkemli bugünü birbine bağlayan mecazi bir köprü görevi görür. Dünyanın en büyük çerçeve yapısıdır. Yapının yüksekliği 150 metre, genişliği ise 95 metredir. İnşaatında 9 bin 900 metreküpten fazla betonarme, 2 bin ton çelik ve 2 bin 900 metrekare lamine cam kullanılmıştır. 15.000 metrekareyi aşkın altın renkli paslanmaz çelik kaplamalı Dubai Çerçevesi, Expo 2020 Dubai logosundan esinlenerek tasarlanmış bir halka tasarıma sahiptir. Dubai Çerçevesi'nin dikdörtgen tasarımı, birçok mimar ve sanatçının ideal yapısal dengelyi oluşturduğuna inandığı 1.618'lik 'altın orandan' esinlenerek oluşturulmuştur. Gökyüzü güvertesine çıkan asansör, ziyaretçileri 75 saniyede 48. kata taşımaktadır. Yapı, esas olarak bir gözlemevi olarak hizmet vermekte olup kuzeyde eski Dubai'nin ve güneyde yeni kısımların manzaraları izlenebilmektedir. Bu manzaraların görülmesine imkân tanıyan gökyüzü güvertesinden önce Emirati mirasının

sergilendiđi bir dizi galeri ile Őhrin geleceđinin nasıl olacađının hayal edilmesini sađlayacak Future Dubai galerisi ziyaret edilebilir. Őhrin muhteŐem manzarasını sunan Dubai erevesi, Dubai'nin ilk kuruluşundan gelecekteki gelişimine kadar olan hikâyesini gelecek nesiller için deđer taşıyacak Őekilde anıtlılaştırmaktadır. Dolayısıyla Dubai erevesi, bir gözlemevi olduđu kadar aynı zamanda bir müze ve anıttır (Detroves Experiences, t.y.: 4; Dubai Frame, 2024a, Wikipedia, 2024a). Őekil 10'da Dubai erevesi görölmektedir.



**Őekil 10.** Dubai erevesi  
**Kaynak:** Dubai Frame, 2024b.

### **Geleceđin Müzesi**

Dubai'nin mimari harikası olan Geleceđin Müzesi, 2071 yılına açılan bir kapıdır. Geleceđin umut dolu bir simölasyonu olan müze, insanlara güç verirken deđişime de ilham olmaktadır. Geleceđin Müzesi'ndeki etkinlikler, mümkün olanın ötesinde deneyimleri hayata geçirmekle eş anlamlıdır. Müzenin misyonu, tüm ziyaretçiler için sanatı, teknolojiyi ve ilhamı bir araya getirmektir (Museum of the Future, 2023). Őekil 11'de Geleceđin Müzesi görölmektedir.



**Őekil 11.** Geleceđin Müzesi  
**Kaynak:** Museum of the Future, 2024.

### **Dubai Marina ve Palm Jumeirah**

Dubai Marina, sahil boyunca gökdelenlerin birkaç kilometre boyunca kesintisiz uzandıđı, açık hava restoranlarının, kafelerin ve alışveriş yerlerinin bulunduđu bir bölgedir. Kıyıdan uzakta, Atlantis tatil köyünün talandırdıđı dünyanın en büyük yapay adası olan Palm Jumeirah yer almaktadır (Dunston ve Monaghan, t.y.: 82).

Palm Jumeirah, Dubai'deki yapay açık deniz adalarının, özel konutların ve otellerin bulunduđu yerdir. Havadan bakıldığında takımadalar bir dairenin içinde stilize edilmiş bir palmye ağacına benzemektedir. Palm Jumeirah, 21. yüzyılın başlarında inşa edilmiştir (Lewis, 2024). BAE'deki

ilk turizm projelerinden biridir ve Őu anda Atlantis The Palm, One & Only The Palm ve ok daha fazlası dâhil olmak üzere Dubai'nin en lüks tatil yerlerinden bazılarına ev sahiplięi yapmaktadır. Ayrıca yemek seenekleriyle öne ıkan Nobu ve 101 Dining Lounge & Marina gibi restoranlar burada hizmet vermektedir (Detroves Experiences, t.y.: 4). Kıyısından bir köprü üzerinden geilerek ulaşılan bir gövde üzerinden her iki yana dağılan ve her iki yanda 8 adet olmak üzere toplam on altı adet kolu bulunan bir palmye ağacı görünümündedir. Etrafı hilal şeklinde bir dalgakıran ile çevrilidir. 5'e 5 km olup 800 adet futbol sahasından daha geniş olan ada, anakaraya hava rayın getięi 300 m uzunluęunda bir köprü ile hilal ise gövdeye bir deniz altı tüneli ile bağlanır (Wikipedia, 2024b). Őekil 12'de Dubai Marina, Őekil 13'te ise Uluslararası Uzay İstasyonundan çekilen Palm Jumeirah görölmektedir.



**Őekil 12.** Dubai Marina  
**Kaynak:** Daędeviren, 2024b.



**Őekil 13.** Palm Jumeirah  
**Kaynak:** Chiao, 2005.

### **Dubai Mall**

Dubai AlıŐveriŐ Festivaline ev sahiplięi yapan alıŐveriŐ merkezidir. Toplam alanı, yaklaşık 1 milyon 115 bin metrekaredir (200 futbol sahasına eŐdeęerdir). AlıŐveriŐ, eęlence ve dinlence iin dñyanın en büyük yeri olarak bilinir ve dñyanın en yüksek binası olan Burj Khalifa'nın yanında bulunur. İerisinde 1200'den fazla maęaza, yüzlerce yiyecek ve iecek satıŐ noktası hizmet vermektedir. Zemin katında 140'tan fazla türü temsil eden 33.000'den fazla su canlısına ev sahiplięi yapan Dubai Akvaryumu & Sualtı Hayvanat Bahesi bulunmaktadır. Burada gerekleŐtirilen eŐitli etkinlikler, deniz yaŐamının daha yakından tanınmasına imkân tanımaktadır. Kafeste Őnorkelli yüzme ve köpekbalıęı dalıŐı turistlere sunulan etkinliklerdendir (Detroves Experiences, t.y.: 5; Dubai Aquarium & Underwater Zoo, 2024; Tbo Academy,



2022). Şekil 14’te Dubai Mall içerisinde bulunan Dubai Akvaryumu & Sualtı Hayvanat Bahçesi’ne ait görsel yer almaktadır.



Şekil 14. Dubai Akvaryumu & Sualtı Hayvanat Bahçesi  
Kaynak: Dağdeviren, 2024a.

### Dubai Fıskiyesi

Dünyanın en yüksek performans gösteren fıskiyesidir. 274 metreden daha uzun olan fıskiye, 30 dönümlük Burj Gölü’nde bulunmaktadır. 6.600’den fazla WET Superlight ve 25 renkli projektör, 1.000’den fazla farklı su ifadesinin görsel spektrumunu oluştururken 50 renkli projektör toplam 1,5 milyon lümenlik bir çıkışla tam bir renk spektrumu sağlar. 83.000 litreden fazla su kullanılmaktadır. Fıskiyenin bulunduğu alanda klasik Arap müziğinin yanı sıra çeşitli çağdaş Arap ve yabancı müzikler de çalınmaktadır. (Burj Khalifa, 2024). Şekil 15’te Dubai Fıskiyesi görülmektedir.



Şekil 15. Dubai Fıskiyesi  
Kaynak: Dubai.It, 2024.

### Çöl Safarisi

Dubai, çoğunlukla kumlu çöllerden oluşmaktadır. Kumlu çölde safari Dubai’de mutlaka yapılması gereken etkinliklerdendir. Ziyaretçiler; sabah, akşam ve gece safarisi arasından seçim yapabilmektedir. Sonunda, seçilen safariye bağlı olarak kahvaltı veya akşam yemeği servisi edilmektedir (Detroves Experiences, t.y.: 5). Yapılan incelemede çöl safari sahasında deve çiftliklerinin, endemik bitkilerin ve doğada dolaşan ceylanların olduğu görülmüştür. Şekil 16’da çöl safarisine ait görsel yer almaktadır.



**Şekil 16.** Çöl Safarisi  
**Kaynak:** Dağdeviren, 2024b.

Kültürel miras alanları içerisinde Miras Evi, Majlis Ghorfat Umm Al Sheif; müzeler içerisinde Etihad Müzesi, Al Shindagha Müzesi, Şair El Ukayli Müzesi, Kadın Müzesi, Kahve Müzesi, diğer dikkat çeken mekânlar arasında yer almaktadır (Government of Dubai, 2024). Yapay adalardan oluşan “Dünya Adaları” ise tam anlamıyla hayata geçmiş durumda değildir. Diğer taraftan adaların oluşturulması için denizden kum çıkarma çalışmalarının mercan resiflerine zarar verdiği bilinmektedir.

### **Dubai’nin Turizm Vizyonu**

Dubai’de turizmin sürekli gelişimi, sürdürülebilirliği ve uzun vadeli vizyonu için Ocak 1997’de “Dubai’yi dünyanın önde gelen turizm destinasyonu olarak konumlandırma” misyonuyla uzmanlaşmış bir ekonomik kuruluş olan Turizm ve Ticaret Pazarlama Departmanı (DTCM- Department of Tourism and Commerce Marketing) kurulmuştur (Benchabane, t.y.: 9). Departman; Dubai’deki turizmin planlanması, denetlenmesi, geliştirilmesi ve pazarlanması konusunda başlıca yetkilidir. Emirliğin ticaret sektörünün tanıtımı ve pazarlanmasıyla ilgilenir. Oteller, tur operatörleri ve seyahat acenteleri dâhil olmak üzere tüm turizm hizmetlerinin lisanslanması ve sınıflandırılmasından sorumludur. Departman, Dubai’nin turizm vizyonunu gerçekleştirerek ekonomisini güçlendirmeye kendini adanmıştır. Bu doğrultuda tanıtım gezileri, etkinlikler, sergiler ve sürükleyici teknolojiler aracılığıyla çalışmalarına devam etmektedir (Dubai Pulse, 2024).

Dubai Sürdürülebilir Turizmi, Dubai Ekonomi ve Turizm Bakanlığı tarafından turizm sektörünün sürdürülebilirlik hedeflerine ulaşmasına yardımcı olmak için geliştirilen, Birleşmiş Milletler (BM) Sürdürülebilir Kalkınma Hedefleri 2030 ile uyumlu, D33 Gündemi ve BAE’nin Net Sıfır 2050 stratejisini destekleyen bir girişimdir. Dubai’nin sürdürülebilirliği turizm sektörüne entegre etme konusundaki kararlılığı, aşağıdaki hedefleri yerine getirme taahhüdüyle ilişkilidir (Dubai Department of Economy and Tourism, 2024b: 4):

- Kaliteli eğitim
- Temiz su ve sanitasyon
- İnsana yakışır iş ve ekonomik büyüme
- Endüstri, yenileşme ve altyapı
- Sürdürülebilir şehirler ve topluluklar
- Sorumlu tüketim ve üretim
- İklim eylemi
- Su altı yaşamı
- Amaçlar için ortaklıklar

Sürdürülebilirlik Endüstrisi Raporu’nda Dubai Ekonomi ve Turizm Bakanlığı Çevresel Sürdürülebilirlik ve Sosyal Sorumluluk Komitesi Başkanı Yousuf Lootah’ın ortaya koyduğu şu hususlar, Dubai’nin turizm vizyonuna ilişkin önemli saptamaları içermektedir:

- Sürdürülebilirlik çağrısı her zamankinden daha yüksek sesle yankılanırken ve BAE'nin Sürdürülebilirlik Yılı 2024'e uzatılırken Dubai Ekonomi ve Turizm Bakanlığı ve kilit paydaşlar, BAE Başkan Yardımcısı ve Başbakanı ve Dubai Hükümdarı Majesteleri Şeyh Muhammed bin Raşid El Maktum'un vizyonu ile uyumlu olarak Dubai'yi ziyaret etmek, yaşamak ve çalışmak için en iyi şehir yapma çabalarını desteklemeye kararlıdır. Bu strateji, ayrıca Dubai Ekonomik Gündemi D33'ün iddialı hedefleriyle de uyumludur. Bu hedef, Dubai'nin önümüzdeki on yılda iş ve eğlence için en iyi üç küresel şehir arasındaki konumunu daha da sağlamlaştırmak içindir.
- Hükümet girişimleri, sürdürülebilir bir ekosistem ve son teknoloji altyapı, Dubai'nin sürdürülebilir kalkınmada küresel bir lider olarak ortaya çıkmasına katkıda bulunurken kamu-özel sektör ortaklıkları ve paydaşlarla işbirlikleri, işletmelerin sürdürülebilir uygulamaları teşvik etmek için yenilikçi girişimleri ve teknolojiyi benimsemesiyle Dubai'nin sürdürülebilirlik gündemi için temel itici güçler olmuştur.
- Dubai Ekonomi ve Turizm Bakanlığı'nın devam eden Dubai Sürdürülebilir Turizm girişimi, turizm ve ağırlama sektörleri için sürdürülebilirlik programları uygulamaya devam etmektedir ve Dubai Veliaht Prensi ve Yürütme Kurulu Başkanı Şeyh Hamdan bin Muhammed bin Raşid El Maktum tarafından Şubat 2022'de başlatılan şehir çapında bir sürdürülebilirlik girişimi olan "Dubai Can" ile desteklenmektedir.
- BAE'nin 2023'ün sonlarında Expo City Dubai'de BM İklim Değişikliği Konferansı olan COP28'e ev sahipliği yapmasının ardından Dubai'yi dünyanın en sürdürülebilir destinasyonlarından biri haline getirme çabaları söz konusudur. Bu vizyonun merkezinde Dubai'nin tarihi cazibe merkezlerini ve kültürel mirasını korurken sürdürülebilir ağırlama, eko-turizm ve akıllı şehir teknolojisi gibi alanlarda inovasyonu teşvik etmek yer almaktadır.
- Çeşitliliğin kutlandığı ve her bireyin değer gördüğü dünyanın en kapsayıcı ve erişilebilir destinasyonlarından biri olarak tanınmak, büyük gurur kaynağıdır. Sürdürülebilir insan sermayesi gelişimine odaklanarak toplulukları güçlendirmek, turizmin faydalarının toplum genelinde eşit bir şekilde paylaşılmasını sağlamak, önemlidir.
- Yeşil altyapı projelerinden temiz enerji stratejilerinin tanıtımına kadar uzanan girişimler ile temiz ulaşım ve doğal alanların korunması gibi alanlarda ilerleme söz konusudur. Ayrıca, Dubai'yi sürdürülebilir kentsel kalkınmada küresel bir lider haline getirmede kamu-özel sektör ortaklıklarının yaşanması, gelecek nesil sürdürülebilirlik liderlerinin eğitilmesi ve yeşil uygulamaların turizmle ilgili tüm operasyonlara daha fazla yerleştirilmesi önemli uygulamalardır.
- Sürdürülebilir kalkınma ve karbon azaltma hedefleri doğrultusunda cesur adımlar atılmaktadır. Kararlılık ve eylem yoluyla Dubai, net sıfır karbonlu bir şehir olma vizyonunu gerçekleştirme gayretindedir.

Yapılan saha incelemesinde sürdürülebilirlik konusunda otel odalarında enerji tasarrufuna yönelik uygulamaların olduğu, plastik su şişesi yerine cam şişelerin kullanıldığı görülmüştür.

### **Sonuç ve Öneriler**

1950'li yıllarda hiç oteli olmayan, 1990'lı yılların sonlarına doğru dünyanın en lüks otellerin yapılmaya başlandığı Dubai'nin Burj Khalifa, Dubai Çerçevesi, Dubai Mall, Dubai Mucize Bahçesi gibi birçok turizm çekiciliği bulunmaktadır. Ürün çeşitlendirme, pazarlamadaki gücüyle enlerin şehri Dubai, turistlerin fazlasıyla ilgi gösterdiği bir destinasyondur. Dubai'ye gelen turistlerin (örneğin, Batılı ve Arap) beklenti ve davranışları arasında karşıtlıklar söz konusudur. Önemli olan bu karşıtlıkların takdir edilmesi ve ikisi arasında yönetilmesi gereken çatışma potansiyelinin söz konusu olduğunun unutulmamasıdır (Henderson, 2006: 97). Diğer taraftan "Dünya Adaları"nda bulunan yapay adaların sular altında kalması, denizden kum çıkarma çalışmalarının mercan resiflerine zarar vermesi, Dubai turizmine ilişkin sorunlardandır. Yapay adaların sular altında kalmaması için projeler hayata geçirilmeli, mercan

resiflerine ilişkin koruyucu tedbirler alınmalıdır. Bunun yanında Dubai Ekonomi ve Turizm Bakanlığı tarafından yayımlanan Sürdürülebilirlik Endüstrisi Raporu'nda belirtildiği gibi küçük bir deęişim, büyük bir etkiyi ifade eder. Otel odalarında plastik su şişesi yerine cam şişelerin kullanılması, elektrik tasarrufuna yönelik uygulamalar, sürdürülebilirlik adına atılan önemli adımlardandır. Dubai, planlama çalışmaları ve stratejik politikaların etkisiyle gelecekte de turizmiyle adından fazlasıyla söz edilen bir destinasyon olmaya devam edecektir.

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## SEYFE GÖLÜ'NDE KUŞ GÖZLEMÇİLİĞİ TURİZMİ

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### **Özet**

Seyfe Gölü, İç Anadolu Bölgesinde bulunan Türkiye'nin önemli sulak alanlarından biridir. Doğal güzellikleri ve kuş popülasyonu nedeniyle "Kuş Cenneti" olarak tanımlanan Seyfe Gölü, "Önemli Kuş Alanları (ÖKA)" listesinde bulunan birçok kuş türüne ev sahipliği yapmaktadır. Bu araştırmada Seyfe Gölü'nü coğrafik yapı ve sorunlar açısından irdeleyerek kuş gözlemciliği turizmi açısından potansiyelini ortaya koymak amaçlanmıştır. İkincil verilerden yararlanılan ve "Kuş Gözlemciliği Turizmi" ile "Seyfe Gölü ve Kuş Gözlemciliği Turizmi" ana başlıklarından oluşan araştırmada öncelikle kuş gözlemciliği turizmi kavramı açıklanmış, kuş gözlemciliği turizminin etkileri üzerinde durulmuştur. Ardından Seyfe Gölü'nün coğrafik yapısı, Seyfe Gölü'nü tehdit eden sorunlar, Seyfe Gölü'nün kuş gözlemciliği turizmi açısından potansiyeli konularında bilgi verilmiştir. Araştırmada son olarak Seyfe Gölü'ne ilişkin değerlendirme yapılarak öneriler geliştirilmiştir.

**Anahtar Kelimeler:** Seyfe Gölü, Sulak Alan, Kuş Cenneti, Kuş Gözlemciliği



## **BIRD WATCHING TOURISM IN SEYFE LAKE**

### **Abstract**

Seyfe Lake is one of the important wetlands of Türkiye located in the Central Anatolia Region. Seyfe Lake, defined as a “Bird Paradise” due to its natural beauties and bird population, hosts many bird species on the “Important Bird Areas (IBA)” list. In this research, it is aimed to reveal the potential of Lake Seyfe in terms of bird watching tourism by examining its geographical structure and problems. In the research, which was made use of secondary data and consisted of the main titles of “Bird Watching Tourism” and “Seyfe Lake and Bird Watching Tourism”, the concept of bird watching tourism was first explained and the effects of bird watching tourism were emphasized. Then, information was provided on the geographical structure of Seyfe Lake, the problems threatening Seyfe Lake, and the potential of Seyfe Lake in terms of bird watching tourism. Finally, an evaluation was made regarding Seyfe Lake and suggestions were developed.

**Keywords:** Seyfe Lake, Wetland, Bird Paradise, Bird Watching

## **Giriş**

Biyolojik çeşitliliğin ve ekolojik dengenin korunması ve sürdürülebilirliğinin sağlanması açısından büyük öneme sahip olan sulak alanlar, tropikal ormanlarla birlikte yeryüzünün en fazla biyolojik üretim yapan ekosistemleridir (Çiftçi, Günek ve Nazik, 2021: 43; Kıymaz, 2010: 175). 4 Nisan 2014 tarihli ve 28962 sayılı Resmî Gazetede yayımlanan Sulak Alanların Korunması Yönetmeliğine göre sulak alanlar; tabii veya suni, devamlı veya geçici, suları durgun veya akıntılı, tatlı, acı veya tuzlu, denizlerin gelgit hareketlerinin çekilme devresinde altı metreyi geçmeyen derinlikleri kapsayan, başta su kuşları olmak üzere canlıların yaşama ortamı olarak önem taşıyan bütün sular, bataklık, sazlık ve turbiyeler ile bu alanların kıyı kenar çizgisinden itibaren kara tarafına doğru ekolojik açıdan sulak alan kalan yerlerdir (Resmî Gazete, 2014).

Sulak alanların karbon depolayarak iklim değişikliğini kontrol altına almada önemli bir etkisi vardır. Bununla birlikte sulak alanlar; rüzgâr, dalga ve akıntı etkilerini azaltmada rol oynarlar. Bunun yanı sıra sulak alanlar, yer altı sularının beslenme ve boşalmasını dengeleme, azotu ve fosforu arıtma, kimyasalları süzme, doğal arıtımı sağlama konularında etkilidirler. Bünyesinde barındırdıkları biyolojik çeşitliliğin ve iklime olan olumlu etkilerinin yanı sıra erozyon ve sediment kontrolü sağlayarak toprağın korunmasını sağlarlar. Küresel iklim değişikliğinin gelecek 100 yılda tam anlamıyla hissedileceği düşünüldüğünde dünyanın çeşitli yerlerinde yaşanacak aşırı hava olaylarının kontrolünde sulak alanlarının işlevi daha da önem kazanacaktır. Sulak alanları sağlıklı biçimde muhafaza etmek, yok olmalarını engellemek ve kayıpları telafi etmek, bu konuda atılacak önemli adımlar arasındadır (Doğal Hayatı Koruma Vakfı, 2008: 7).

Türkiye’de 14’ü Ramsar Alanı, 59’u Ulusal Öneme Haiz Sulak Alan ve 49’u Mahalli Öneme Haiz Sulak Alan olmak üzere 122 sulak alan bulunmaktadır (Tarım ve Orman Bakanlığı, 2024a). Seyfe Gölü, Ramsar statüsüne sahip İç Anadolu Bölgesinde bulunan dört sulak alandan biridir. Arkeolojik kalıntılar, yöredeki ilk yerleşimlerin Tunç Çağında olduğunu göstermektedir. Göl ve çevresinde bu döneme ait pek çok eski yerleşim yeri ve höyük bulunmaktadır. Yapılan araştırma sonuçları, tarih boyunca göl kıyısına yerleşen halkın tarımla uğraştığını göstermektedir (Kırşehir Valiliği, 2014: 8, 15; Reis ve Yılmaz, 2007).

Seyfe Gölü; çevresinde bulunan höyükler, çevresindeki bitki örtüsünün doğallığı, turkuaz rengi manzarası ile kalabalık kuş gruplarının oluşturduğu olağanüstü görüntü, tanıtım ve turizme imkân sağlayacak altyapının geliştirilmesiyle çok sayıda insanı alana çekebilecek bir potansiyele sahiptir (Kırşehir Valiliği, 2014: 10). Göl, doğal güzellikleri ve kuş popülasyonu nedeniyle “Kuş Cenneti” olarak tanımlanır (Ahiler Kalkınma Ajansı, 2016: 1).

Kuş gözlemciliği turizminin önemi, sistemli bir şekilde artmıştır. Bu artışın modern insanın doğal köklerinden izole olmasıyla ilişkili olduğuna inanılmaktadır. Boş zamanlarda doğaya yaklaşma girişimleri, son derece kentleşmiş, teknolojik bir ortamda günlük yaşamın bir telafi biçimidir (Kordowska ve Kulczyk, 2014: 15). Bu araştırmanın amacı, Seyfe Gölü’nü coğrafik yapı ve sorunlar açısından irdeleyerek kuş gözlemciliği turizmi açısından potansiyelini ortaya koymaktır. Bu kapsamda araştırmada öncelikle kuş gözlemciliği kavramı ve etkileri üzerinde durulmuş, ardından Seyfe Gölü’nün coğrafik yapısı, Seyfe Gölü’nü tehdit eden sorunlar, Seyfe Gölü’nün kuş gözlemciliği turizmi açısından potansiyeli konularında bilgi verilmiştir. İkincil verilerden yararlanılan araştırma, literatüre sunacağı katkı açısından önemlidir.

## **Kuş Gözlemciliği Turizmi**

### **Kuş Gözlemciliği Turizmi Kavramı**

Literatür incelendiğinde kuş gözlemciliği turizmiyle ilgili farklı tanımlar yapıldığı görülmektedir. Güney Afrika Cumhuriyeti Ticaret ve Sanayi Bakanlığına göre kuş gözlemciliği turizmi, kuş gözlemcilerinin kuşları doğal ortamlarında görmek amacıyla alışlagelmiş ortamlarının dışına (yurt içi veya yurt dışı) yaptıkları seyahatlerdir. Kuş gözlemciliği turizmi,

doğal ortamın bileşenlerine, yani kuşlara ve yaşam alanlarına odaklanır. Bu nedenle doğa temelli turizmin bir alt kategorisidir (Department of Trade and Industry, 2010).

Albayrak'a göre (2013) kuş gözlemciliği, doğayı kuşların gözünden görme ve tanımayı sağlayan gözleme dayalı bir spor türüdür. Parklar, sulak alanlar, ormanlar, bozkırlar, dağlar ve göller gibi doğal ortamlarda yapılabilir. Çok uzun yıllardır, çeşitli kişiler tarafından hobi olarak gerçekleştirilmiştir. Kuş gözlemciliği turizmi ise kuşların doğal ortamlarındaki hareketlerini, göçlerini, barınma ve üremelerini izlemeye dayalı faaliyettir.

Cui'ye göre (2020) kuş gözlemciliği turizmi, kuşları gözlemlemeyi, onlara değer vermeyi, onların özelliklerini ve davranışlarını kaydetmeyi amaçlayan bir turizm faaliyetidir. Diğer bir tanımla turistlerin kuşları gözlemlediği ve vahşi kuşların ekosistemini değiştirmeden yaşam alanlarını keşfettiği bir turizm türüdür.

Gelişmekte Olan Ülkelerden İthalatı Geliştirme Merkezine göre kuş gözlemciliği turizmi, asıl amacın kuşları doğal ortamlarında gözlemlemek olduğu seyahatleri ifade eder. Eğitim ve eğlence amaçlı olarak kuşları bulma, gözleme ve tanımlama faaliyetlerini içerir. Doğa turizmi ve macera turizmiyle çok yakından ilişkilidir. Bu nedenle kuş gözlemciliği turizmi sunan birçok tur operatörü aynı zamanda doğa ve macera temelli geziler de sunar. Kuş gözlemciliği turizmi; sıradan kuş gözlemciliği, coşkulu kuş gözlemciliği ve sınırlı kuş gözlemciliği olmak üzere üç uzmanlık alanına ayrılır (Centre for the Promotion of Imports from Developing Countries, 2021). Tablo 1'de bu uzmanlık alanları, örnek tur operatörleriyle birlikte verilmiştir.

**Tablo 1.** Örnek Tur Operatörleriyle Kuş Gözlemciliği Uzmanlık Alanları

Uzmanlık Alanı	Örnek
Sıradan Kuş Gözlemciliği	Robin Pope Safaris, Zambiya, Malavi ve Zimbabve'de yürüyüş, kamp ve su altı safarileri sunan ve grup turlarına ve aile safari turlarına genellikle kuş gözlemciliğini de dâhil eden bir tur operatörüdür.
Coşkulu Kuş Gözlemciliği	Venture Uganda, kapsamlı kuş gözlemciliği safarileri sunan bir tur operatörüdür. Bunun yanı sıra kültürel, doğa ve macera aktivitelerini içeren diğer kuş gözlemciliği tur paketleri de sunmaktadırlar.
Sınırlı Kuş Gözlemciliği	Myanmar Birding Tours, yalnızca kuş gözlemcilerine özel turlar sunmaktadır. Görmek istenilen kuşlara bağlı olarak çeşitli kuş gözlem turları sunarlar.

**Kaynak:** Centre for the Promotion of Imports from Developing Countries, 2021.

### **Kuş Gözlemciliği Turizminin Etkileri**

Kuş gözlemciliği turizmi, çeşitli nedenlerden dolayı yaban hayatı turizminin önemli bir parçasını oluşturur. Birincisi geniş bir mekânsal kapsama sahiptir. Her peyzaj bölgesinde ve farklı ekosistemlerde gözlemler yapılabilir. Bahçe kuşlarının yanı sıra daha egzotik tarla ve orman türleri de ilgi çekicidir. İkincisi kuş gözlemciliği, çevre dostu bir tutum geliştirir ve genellikle doğanın korunmasına yönelik ciddi bir katılımı sonuçlanır. Bu nedenle kuş gözlemciliği turizminin sadece yüksek düzeyde korunan alanlarda yapılmayacağı, aynı zamanda yapılması gereken bir turizm türü olduğuna sıklıkla vurgu yapılır (Kordowska ve Kulczyk 2014: 15).

Kuş gözlemciliği turizminin olumlu ve olumsuz etkileri bulunmaktadır. Tablo 2'de Şekercioğlu (2002) tarafından derlenen bu etkilere yer verilmiştir. Tablo 2'de görüldüğü gibi kuş gözlemciliği turizminin olumlu etkileri; kuş çeşitliliği ve yerel gelir arasında bağlantı kurulması, yaban hayatının korunması için mali bir teşvik sağlanması, klasik turizme göre etkisi daha az olmasına karşın daha fazla gelir bırakması, benzersiz kuş türleri nedeniyle yerel kontrolü artırması, geleneksel güzergâhlar dışındaki alanların ziyaret edilmesi, istenen türler sayesinde korunmayan alanların korunması, yerel doğa tarihi bilgisinin değerlendirilmesi, yerel rehberlerin eğitilmesi ve istihdam edilmesi, kuşların korunması için fon oluşturulması ve ornitolojik bilgiye katkıda bulunmasıdır. Diğer taraftan kuş gözlemciliği turizminin olumsuz

etkileri ise ses çıkararak ve gereğinden fazla yaklaşarak kuşların rahatsız edilmesi, yuva yırtıcılığının ve yuva terkinin artması, nadir ve/veya tehdit altındaki kuşların rahatsız edilmesinin artması, ziyaretçi kaynaklı kirlilik ve habitat tahribatının yaşanması, yerel topluluklardan nakit sızıntılarının olması, dışlanan yerel halkın kızgınlık göstermesi ve turizmle ilişkili kültürel bozulmanın yaşanmasıdır.

**Tablo 2. Kuş Gözlemciliği Turizminin Etkileri**

<b>Kuş Gözlemciliği Turizminin Olumlu Etkileri</b>	<b>Kuş Gözlemciliği Turizminin Olumsuz Etkileri</b>
Kuş çeşitliliği ve yerel gelir arasında bağlantı kurulması	Ses çıkararak ve gereğinden fazla yaklaşarak kuşların rahatsız edilmesi
Yaban hayatının korunması için mali bir teşvik sağlanması	Yuva yırtıcılığının ve yuva terkinin artması
Klasik turizme göre etkisi daha az olmasına karşın daha fazla gelir bırakması	Nadir ve/veya tehdit altındaki kuşların rahatsız edilmesinin artması
Benzersiz kuş türleri nedeniyle yerel kontrolü artırması	Ziyaretçi kaynaklı kirlilik ve habitat tahribatının yaşanması
Geleneksel güzergâhlar dışındaki alanların ziyaret edilmesi	Yerel topluluklardan nakit sızıntılarının olması
İstenen türler sayesinde korunmayan alanların korunması	Dışlanan yerel halkın kızgınlık göstermesi
Yerel doğa tarihi bilgisinin değerlendirilmesi	Turizmle ilişkili kültürel bozulmanın yaşanması
Yerel rehberlerin eğitilmesi ve istihdam edilmesi	
Kuşların korunması için fon oluşturulması	
Ornitolojik bilgiye katkıda bulunması	

**Kaynak:** Şekercioglu, 2002: 284.

## **Seyfe Gölü ve Kuş Gözlemciliği Turizmi**

### **Seyfe Gölü'nün Coğrafik Yapısı**

Seyfe Gölü, İç Anadolu Bölgesinin Orta Kızılırmak Bölümü'nde, 39°16'0" Kuzey, 34°25'59" Doğu koordinatlarında, Kırşehir il merkezinin kuzeydoğusunda tektonik kökenli çukurlukta bulunmaktadır. Gölün rakımı, 1120-1200 m'dir. Adını batısındaki Seyfe Köyü'nden alan göl; sulak alan ve yer yer sazlık, bataklık alanlardan oluşmaktadır. Doğusunda, kıyıya yakın sazlıklardan oluşmuş pek çok adacık vardır (Bird Life International, 2024a; Doğal Hayatı Koruma Vakfı, 2008: 47; Kırşehir Valiliği, 2014: 8; Kırşehir Valiliği, 2024, Reis ve Yılmaz, 2007; Tarım ve Orman Bakanlığı, 2024a; Tarım ve Orman Bakanlığı, 2024b).

Seyfe Gölü'nün 23.585 hektarlık kısmı 1989 yılında Birinci Derece Doğal Sit Alanı, 10.978 hektarlık kısmı 1990 yılında Tabiatı Koruma Alanı olarak ilan edilirken 10.700 hektarlık kısmı ise 1994 yılında Ramsar Sözleşmesi listesine dâhil edilmiştir (Doğal Hayatı Koruma Vakfı, 2008: 109; Tarım ve Orman Bakanlığı, 2024a; Tarım ve Orman Bakanlığı, 2024b). 15 Eylül 2024 tarihli ve 32663 sayılı Resmi gazete ile Seyfe Gölü Tabiatı Koruma Alanı sınırı revize edilmiş ve büyüklüğü 5.501,22 hektara düşürülmüştür. Göl havzasının güneyi, güneybatısı ve kuzeybatısı nispeten yüksek dağlarla çevrili iken diğer tarafları tepeciklerle çevrilidir (Tarım ve Orman Bakanlığı, 2024a; Tarım ve Orman Bakanlığı, 2024b). Topografik olarak düşük meyilde olması nedeniyle yağışlara ve mevsimlere bağlı olarak göl alanı büyük değişiklikler göstermektedir. Yaz mevsiminde yörenin yağış almayışı, derelerin kuruması, pınarların sularının tamamına yakınının sulamada kullanılması ve aşırı buharlaşma nedeniyle gölün su seviyesinde önemli miktarda düşüş yaşanmaktadır (Kırşehir Valiliği, 2014: 9; Reis ve Yılmaz, 2007; Tarım ve Orman Bakanlığı, 2024b).

Seyfe Gölü'nün beslenmesi, gölün batı ve kuzeybatısındaki pınarlar, dip kaynakları, drenaj alanındaki yüzeysel akış ve göl alanına düşen yağışlarla olmaktadır. Göl suları tuzlu olduğu için tarım amaçlı kullanılamamaktadır. Diğer yandan, sulak alanı besleyen yer altı suları evsel ve tarımsal amaçlı kullanılmaktadır (Doğal Hayatı Koruma Vakfı, 2008: 49-50).

### **Seyfe Gölü'nü Tehdit Eden Sorunlar**

“Türkiye'nin Önemli Kuş Alanları: 2004 Güncellemesi” kitabında Seyfe Gölü'nü tehdit eden sorunlar, su rejimine müdahale ve tarımsal yoğunlaşma olmak üzere iki başlık altında toplanmıştır. Ancak kitapta alan üzerindeki ana tehdidin su rejimine yapılan müdahaleler olduğu belirtilmektedir. Devlet Su İşlerinin 1998'de uyguladığı drenaj projesinin gölü geniş bir

kanalla kuzeydeki bozkır alandan ayırarak alanın doğal su bütçesinde kayıplara neden olduğunun vurgulandığı kitapta Orta Anadolu'daki pek çok sulak alan gibi son yıllarda gölün kurduğu, gölün kuzeyindeki tuzcul bozkır alanın tarıma açılmak istendiği belirtilmektedir (Kılıç ve Eken, 2004: 126).

Kıymaz'a göre (2010) Seyfe Gölü evsel, tarımsal, hayvancılık ve avcılık faaliyetlerinden kaynaklanan çeşitli çevresel etkenlerin baskısı altındadır. Gölün kuzeyinde oldukça büyük bir alana sahip Malya Devlet Üretim Çiftliğinin atık suları ile tarımdan dönen suların gölün kuzeyinde yer alan drenaj kanalı ile göle taşınması, pınarların göle ulaştığı yerde oluşan deltanın tarım alanı kazanmak amacıyla kurutulmuş tarıma açılması, içme ve sulama amacıyla pınarların kullanılmasının gölün su rejimini ve kalitesini olumsuz şekilde etkilemesi, göl ve kıyı çevresindeki üreticiler tarafından tarımsal faaliyetlerin bilinçsizce yapılması, kimyasal mücadele ve ilaçların tarım arazilerinde kontrolsüz bir şekilde kullanılması, aşırı ve yanlış sulama yapılması, tarımsal sulamada kaçak kuyuların kullanımının yer altı su seviyesindeki azalmalara neden olması, su kaynaklarının çekilmesi sonucu tuzun rüzgârın etkisiyle çevredeki tarım alanlarına serpilmesi, sulama amaçlı yer altı su kaynaklarından aşırı ve kontrolsüz su alınması, Seyfe Gölü'nü tehdit eden sorunlardandır. Bunun yanında gölün iklim değişikliğinden kaynaklı suları çekilmiş durumdadır ve su havzasına 4 km mesafede dört maden şirketi arama çalışmaları yürütmektedir (Ekicioğlu, 2024).

Gölün su kaynakları yönetimine ilişkin sorunları da bulunmaktadır. Bu sorunları ise Kıymaz (2010); çeşitli kurumların yetkileri çerçevesinde bölgede yapılmış çalışmaların tek elden toplanılmasını öngören bir veri tabanının henüz oluşturulamaması, yerel düzeyde su kaynaklarına ilişkin yeterli verinin olmaması, mevcut verilerin ise henüz güncelleştirilememesi, teknik, sosyoekonomik, idari, ekolojik ve bilimsel yönlerden gölün bütüncül olarak değerlendirilememesi şeklinde ifade etmektedir.

### **Seyfe Gölü'nün Kuş Gözlemciliği Turizmi Açısından Potansiyeli**

Seyfe Gölü, besin maddelerince zengin olmasının yanı sıra tuzlu olması, tuzludan tatlıya doğru değişen nitelikteki bataklıkları, geniş step alanları ve güvenli adalar gibi farklı ekolojik karakterdeki yaşama ortamları ile değişik türden binlerce kuşa ideal beslenme, barınma ve üreme ortamı oluşturmaktadır. Kuş varlığı, özellikle kış ve göç dönemlerinde belli sayılara ulaşmaktadır (Doğal Hayatı Koruma Vakfı, 2008: 48).

Gölün tuzluluk oranı hayli yüksek olduğundan kış aylarında kolay donmamaktadır. Bu durum kuşlar için kış aylarında beslenme kolaylığı sağlamaktadır. Seyfe Gölü'ne ilişkin ilk ornitolojik kayıtlar, 1968 yılında başlamıştır. 1969-1970 kış aylarında gölde yapılan sayımda 152.380 tane kuş tespit edilmiştir (Çobanoğlu, 2000: 22; Ertan, Kılıç ve Kasperek, 1989: 74, aktaran Yiğitbaşıoğlu, 1995: 153). Seyfe Gölü'nde 29 Eylül 1986 tarihinde yapılan sayımda ise 320.000 i aşan sayıda kuş saptanmıştır (Evirgen ve Gürpınar; 1987: 41, aktaran Yiğitbaşıoğlu, 1995: 153-154). Seyfe Gölü'nde, anılan tarihte yapılan sayımda 32.000 tane flamingo tespit edilmiştir. Flamingolar, genellikle konaklama amacıyla Seyfe Gölü'ne uğrarlar ve bunların çoğu kışı burada geçirirler. Fakat 1971 yılında birkaç çiftin kuluçkaya da yattığı belirlenmiştir (Ertan, Kılıç ve Kasperek, 1989: 74, aktaran Yiğitbaşıoğlu, 1995: 154). İlerleyen yıllarda büyük bir olasılıkla İran-Irak savaşının etkileri sonucu kuş sayısında dünya literatürünü sarsacak artışlar olmuştur. 1986-1988 yılı sonbaharında yapılan sayımlarda göl çevresindeki kuş sayısının 400 bine ulaştığı tespit edilmiştir (Eyüpoğlu, 2022: 144). Yapılan gözlemler sonucunda göl ve çevresinde 1992 yılında 186 kuş türü, aynı yıl içerisinde Hacettepe Üniversitesi Çevre Uygulama ve Araştırma Merkezi tarafından yapılan çalışmada 180 kuş türü tespit edilmiştir. 1999 yılında yapılan gözlemlerde ise 205 kuş türü tespit edilmiştir (Kırşehir Valiliği, 2014: 14; Doğal Hayatı Koruma Vakfı, 2008: 48). Çobanoğlu (2000) tarafından yapılan araştırma sonucunda göl ve çevresinde 50 familyadan 215 tür ve 4 alt tür olduğu tespit etmiştir. Ayrıca araştırmacı, 215 türün 124'ünün yaz aylarında bölgede olduğunu

gözlemlemiştir. Kırşehir Valiliği verilerine göre (2024) adacıklar ve göl çevresinde ötücü kuşlar da dâhil olmak üzere toplam 187 kuş türünde 480 bin kuş bir arada varlığını sürdürmektedir. Sakarca kazı, suna, angıt, çamurcun ve sakarmeke, Seyfe Gölü'nde kalabalık gruplar oluşturan kuş türleridir. Göl; sazlıkları, çayırlikları, göl içerisindeki adacıkları ve yakın çevresindeki çayırlik alanları ile su kuşları için Türkiye'deki önemli kuluçka alanlarından biridir. Gölün doğusundaki adalarda, flamingo, ak pelikan, kaşıkçı, küçük ak balıkçıl, çeltikçi, macar ördeği, uzun bacak, kılıçgaga, mahmuzlu kız kışı, akdeniz martısı, karabaş martı, gülen sumru, küçük sumru kuluçkaya yatan önemli kuş türleridir. Tuz Gölü'nden sonra flamingonun Türkiye'deki en önemli üreme alanıdır. Ayrıca sonbaharda yüz binlerce ördek alanda konaklamaktadır. Son yıllarda Seyfe Gölünü besleyen doğal su kaynaklarının içme ve sulama suyu olarak kullanılması sebebiyle göldeki su seviyesi düşmüştür. Bu nedenle göl alanındaki kuş sayısı beklenenden daha az sayıda görülmektedir. Su kuşlarına ek olarak göl çevresi sonbaharda leyleklerin önemli toplanma alanlarından biridir. Göl çevresindeki stepler ise nesli dünya çapında tehlikede olan kuş türlerinden biri olan toyun beslenme ve üreme alanıdır (Kırşehir Valiliği, 2014: 14; Doğal Hayatı Koruma Vakfı, 2008: 48-49). Tablo 3'te Seyfe Gölü'nde ÖKA kriterlerini karşılayan popülasyonlara ilişkin veriler yer almaktadır.

2005 ve 2008 yıllarında tamamen kuruyan göl; 2009 kışının nemli olması, yaz mevsiminin diğer yıllara göre daha serin geçmesiyle tekrar su tutmuştur. Buna bağlı olarak da birçok kuş türü 2009 yılında alana geri dönmüştür (Çiftçi vd., 2021: 45). Seyfe Gölü Ekoloji Derneği Başkanlığı yapan ve Covid-19 nedeniyle yaşamını yitiren Ömer Çetiner'in 2020 yılında göldeki kuraklıkla ilgili şu tespitleri çarpıcıdır: Göl, son 10 yılda belirli aylarda kurumaktadır ve göldeki kuraklık süresi daha önceleri yılda iki veya üç ay olurken bu süre 2019 yılında 5 aya, 2020 yılında ise 6 aya çıkmıştır (Yıldız, 2020). Seyfe Gölü kuşlar için hâlâ önemli bir alandır ve varlığını sürdürdüğü sürece kuşlar tarafından tercih edilecektir. Birçok kuş türünün 2009 yılında alana geri dönmesi buna güzel bir örnektir (Çiftçi vd., 2021: 45).

**Tablo 3.** Alanda ÖKA Kriterlerini Karşılıyan Popülasyonlara İlişkin Veriler

Tür	Kırmızı Liste	Dönem	Yıl(lar)	Sayı	ÖKA Kriterleri
Sakarca (Anser albifrons)	Asgari Endişe	Kış	-	3.250-7.200 birey	B1i
Angut (Tadorna ferruginea)	Asgari Endişe	Kış	-	421-978 birey	A4i, B1i
Büyük flamingo (Phoenicopterus roseus)	Asgari Endişe	Üreme	1992	1.200 üreme çifti	B1i, B2
Büyük flamingo (Phoenicopterus roseus)	Asgari Endişe	Üreme dışı	1986-1996	5.490-16.000 birey	A4i, B1i
Toy (Otis tarda)	Tehlikede	Üreme	-	30 birey	A1
Kaşıkçı (Platalea leucorodia)	Asgari Endişe	Üreme	1989-1996	50 üreme çifti	B1i, B2
Ak pelikan (Pelecanus onocrotalus)	Asgari Endişe	Üreme	1989-1996	100 üreme çifti	B1i, B2
Kılıçgaga (Recurvirostra avosetta)	Asgari Endişe	Üreme	1989-1996	500 üreme çifti	A4i, B1i
Mahmuzlu kızkuşu (Vanellus spinosus)	Asgari Endişe	Üreme	1989-1996	10 üreme çifti	B2
Akdeniz martısı (Larus melanocephalus)	Asgari Endişe	Üreme	1989-1996	500 üreme çifti	B3
Küçük sumru (Sternula albifrons)	Asgari Endişe	Üreme	1989-1996	500 üreme çifti	A4i, B1i, B2
Gülen sumru (Gelochelidon nilotica)	Asgari Endişe	Üreme	1989-1996	500 üreme çifti	A4i, B1i, B2
Küçük kerkenez (Falco naumanni)	Asgari Endişe	Üreme dışı	1996	59 birey	A1
A4iii Tür grubu - Su kuşları	Yok	Kış	1989	21.861 birey	A4iii

**Kaynak:** Kılıç ve Eken, 2004: 126; Bird Life International, 2024b.

Kuş gözlemciliği turizmi, kuşlara ve doğaya merak duyan herkesin yapabileceği, fazla malzeme gerektirmeyen bir etkinliktir. Sulak alanlar, kuş gözlemcileri için kuşları izlemenin en kolay olduğu alanlardır. Seyfe Gölü, bu sulak alanların başında gelmektedir. Seyfe Gölü'nde kuş gözlemciliği yapılabilmesi için temel malzeme dürbündür. Ziyaretçiler, gözlem yaparlarken Seyfe Höyüğü'nü de görebilmektedir. Bunun yanında 2013 yılında Orman ve Su İşleri Bakanlığı tarafından Badıllı Köyü sınırları içinde ve göle yakın bir yerde kuş gözlem kulesi yapılmıştır (Kırşehir Valiliği, 2014: 16).

### Sonuç

Kırşehir il merkezinin kuzeydoğusunda, Birinci Derece Doğal Sit Alanı ile Tabiatı Koruma Alanı içerisinde bulunan ve Ramsar Sözleşmesi listesine dâhil edilmiş durumdaki Seyfe Gölü, Türkiye'nin önemli sulak alanlarından. Ancak Kıymaz'ın da (2010: 183) ifade ettiği gibi göl ve havzası; evsel, tarımsal, hayvancılık ve avcılık faaliyetlerinden kaynaklanan etkenlerin baskısı altındadır. İçme ve sulama suyu temin etmek için su rejimine yapılan müdahaleler, gölü olumsuz yönde etkilemiştir. Küresel iklim değişikliğinin etkisi gölde görülürken su havzasına 4 km mesafede maden çalışmaları yürütülmektedir.

Göl, doğal güzelliği ile dikkat çekicidir. Ayrıca kırmızı listede tehlike altında bulunan toya, kırmızı listede asgari endişe içerisinde bulunan sakarca, angut, büyük flamingo, Akdeniz martısı, küçük kerkenez gibi ÖKA kriterlerini karşılayan birçok popülasyona ev sahipliği yapmaktadır. Doğal güzelliği ve kuş popülasyonu ile kuş gözlemciliği turizmi için önemli bir

potansiyele sahip Seyfe Gölü ile ilgili tüm paydaşların üzerine düşen görevler bulunmaktadır. Ancak en önemli görev, karar alıcılara düşmektedir. Su rejimine yapılan müdahaleler önlenmeli, devam eden maden çalışmaları durdurulmalıdır. Gölün sürdürülebilirliği noktasında katkı sunacak diğer önemli bir kesim üniversiteler ve çevre örgütleridir. Gölün sürdürülebilirliğine katkı sunacak araştırma, değerlendirme, proje ve diğer bilimsel çalışmalar hayata geçirilmelidir. Diğer önemli bir kesim ise yerel halktır. Yerel halk; evsel su tüketiminde, tarımsal, hayvancılık ve diğer faaliyetlerinde su kullanımına dikkat etmelidir. Türkiye'nin iklim değişikliği etkilerini fazlasıyla hissettiği şu dönemlerde sulak alanların karbon depolayarak iklim değişikliğini kontrol altına almada önemli bir role sahip olduğu gerçeği unutulmamalıdır. Kuş yoksa kuş gözlemciliği turizmi de yok!



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## HEMŞİRELERİN ÇALIŞMA ORTAMLARI: HEMŞİRELER, HASTALAR VE SAĞLIK KURUMLARINA ETKİSİ

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### Özet

Hemşirelerin çalışma ortamı, hemşirelik uygulamasını teşvik eden veya kısıtlayan örgütsel özellikler olarak tanımlanmaktadır. Sağlıklı bir çalışma ortamı tatmin edici, zihinsel ve fiziksel olarak güvenlidir ve hemşireleri tam potansiyelleriyle çalışmaya ve kaliteli bakım sağlamaya teşvik eder. Olumlu bir çalışma ortamı hemşirelerin klinik uygulamalarının tüm yönlerini kullanmalarına ve hastalara güvenli, kaliteli bakım sunmalarına olanak tanıyan faktörleri temsil eder. Bu faktörler: hemşirelerin yönetime katılması ve temsil gücü, kaliteli bakım için gerekli hemşirelik kaynakları, yönetici hemşirelerin tutumu ve liderlik özellikleri, insan gücü ve diğer kaynakların yeterliliği, hekim-hemşire-meslektaş iletişimi olarak tanımlanmıştır. Ayrıca, hemşirelerin çalışma ortamı, Donabedian'ın Yapı-Süreç-Sonuç bakım kalitesi modelinde önemli bir yapısal bileşen olarak kabul edilir. Hemşirelerin çalışma ortamını etkileyen önemli faktörler iş yükü ve personel seviyeleri, karar alma serbestliği, iş talepleri ve karmaşıklığı, iyi liderlik ve birim tabanlı kararlara katılma yeteneğidir. Hemşirelerin çalışma ortamları hemşireleri hastaları ve sağlık kurumlarını doğrudan etkilemektedir. Çalışma ortamının hemşireler üzerine etkisi ilgili yapılan deneysel araştırmalar, hemşirelerin çalışma ortamı özellikleri ile işe katılımı, iş tatmini, tükenmişlik ve işten ayrılma niyetleri arasında ilişki olduğunu ortaya koydu. Çalışma ortamı iyi olmayan ya da yetersiz olan hemşirelerin işe katılımı, iş tatmini düşmekte, tükenmişlik ve işten ayrılma niyetleri artmaktadır. Son zamanlarda yapılan bir çalışma hemşirelerin çalışma ortamlarının hemşirelerin bakım davranışlarını da etkilediğini ortaya koymuştur. Güvenli ve sağlıklı bir çalışma ortamının, hemşirelerin iyi bir ruhsal ve fiziksel durumda olmasını sağlayarak hastanın iyileşme sürecini hızlandırmakta, tıbbi hataların sayısını azaltmakta, hasta bakım kalitesi ve hasta memnuniyetini arttırmaktadır. Hemşireler için olumlu çalışma ortamlarını oluşturan kurumlarda hemşire ve hasta memnuniyeti arttığı için bu durumdan sağlık kuruluşları da olumlu etkilenmektedir. Bu derleme çalışmasında, hemşirelerin çalışma ortamları ayrıntılı olarak ele alındı ve hemşirelerin çalışma ortamlarının hemşireler, hastalar ve sağlık kuruluşları üzerindeki etkisi son literatür ile birlikte ayrıntılı olarak incelenmiştir.

**Anahtar kelimeler:** hemşireler, çalışma ortamı, hastalar, sağlık kuruluşları

## **NURSES' WORK ENVIRONMENTS: IMPACT ON NURSES, PATIENTS AND HEALTH CARE INSTITUTIONS**

### **Abstract**

Nurses' work environment is defined as organizational features that encourage or constrain nursing practice. A healthy work environment is satisfying, mentally and physically safe, and encourages nurses to work to their full potential and provide quality care. A positive work environment represents factors that allow nurses to use all aspects of their clinical practice and provide safe, quality care to patients. These factors are defined as: nurses' participation in management and agency, nursing resources required for quality care, attitude and leadership characteristics of nurse managers, adequacy of manpower and other resources, physician-nurse-colleague communication. In addition, nurses' work environment is considered an important structural component in Donabedian's Structure-Process-Outcome care quality model. Important factors affecting nurses' work environment are workload and staffing levels, decision-making freedom, job demands and complexity, good leadership, and the ability to participate in unit-based decisions. Nurses' work environments directly affect nurses, patients, and healthcare institutions. Experimental studies on the effects of the work environment on nurses have revealed a relationship between nurses' work environment characteristics and their engagement, job satisfaction, burnout, and intentions to leave. Nurses whose work environment is poor or inadequate have lower engagement, job satisfaction, and increased burnout and intentions to leave. A recent study has shown that nurses' work environments also affect nurses' caring behaviors. A safe and healthy work environment ensures that nurses are in good mental and physical condition, accelerates the patient's recovery process, reduces the number of medical errors, and increases the quality of patient care and patient satisfaction. Since nurse and patient satisfaction increases in institutions that create positive work environments for nurses, healthcare institutions are also positively affected by this situation. In this review study, nurses' work environments were discussed in detail and the impact of nurses' work environments on nurses, patients and healthcare institutions was examined in detail with the latest literature.

**Keywords:** nurses, work environment, patients, healthcare institutions

## **Giriş**

Dünya Sağlık Örgütü (DSÖ), 17 Eylül 2020 tarihini Dünya Hasta Güvenliği Günü olarak ilan etmiş ve sağlık çalışanları için güvenli bir ortamın, hasta güvenliği açısından hayati öneme sahip olduğunu bildirmiştir (DSÖ, 2024). Hemşirelerin çalışma ortamı hemşireleri hastaları ve sağlık kurumlarını doğrudan etkilemektedir (Wei ve ark. 2018). Ne yazık ki, mevcut araştırma zenginliğine ve ardından gelen girişimlere rağmen, hastane çalışma ortamı sınırlı kaynaklar ve artan iş talepleriyle hemşirelerin çalışma ortamları sorunlu olmaya devam etmektedir. Dahası, hemşirelerin çalışma ortamı şu anda küresel hemşirelik işgücü eksikliğinden ve son pandemiden de olumsuz etkilenmektedir. Dünya Sağlık Örgütü'ne göre, dünya çapında yaklaşık 6 milyon sağlık çalışanı açığı bulunmaktadır ve 6 hemşireden 1'i önümüzdeki 10 yıl içinde emekli olmaya hak kazanacaktır (Dünya Sağlık Örgütü (DSÖ) 2023). Sınırlı bir bütçe, daha az kaynak ve personel ile çalışırken mükemmel hemşirelik bakımı sağlama konusunda her zamankinden daha fazla baskı vardır (Alsubhi ve ark., 2020; Weston 2022). Tükenmişlik belirtilerine ve ayrılma niyetine yol açan nedenleri daha iyi anlamak ve stratejik hemşirelik iş gücü planlamasının yapılması temel müdahaleleri belirlemek hemşireleri elde tutmayı teşvik etmek açısından önemlidir.

İlgili literatür tarandığında günümüze kadar hemşirelerin çalışma ortamları ile ilgili uluslararası (Van Bogaert ve ark., 2017; Wan ve ark., 2018; Ambani ve ark., 2020; Liu ve ark., 2021) ve ulusal (Kocaman ve ark., 2018; Arslan Yürümezoğlu ve Sarioğlu 2022; Yılmaz ve Seren İntepeler 2023; Yılmaz ve Kocak 2024) birçok çalışma yapılmasına rağmen halen hemşirelerin çalışma ortamları ile ilgili çok fazla sorun olduğu ve bu sorunların günümüzde de devam ettiği görülmektedir. Konunun önemi olması nedeni ile bu derleme çalışmasında hemşirelerin çalışma ortamlarının hemşireler, hastalar ve sağlık kurumları üzerine etkisi güncel literatür ışığında ele alınmıştır. Bu derleme çalışmasının hemşirelerin çalışma ortamlarını düzenlemede hemşire ve hastane yöneticilerine yol göstermesi beklenmektedir.

## **Hemşirelerin Çalışma Ortamı**

Çalışma ortamı, profesyonel hemşirelik uygulamalarını kolaylaştıran, zorlaştıran veya engelleyen bir çalışma ortamının örgütsel özellikleri olarak tanımlanmaktadır (Lake ve ark., 2019). Sağlıklı bir çalışma ortamı tatmin edici, zihinsel ve fiziksel olarak güvenlidir ve hemşireleri tam potansiyelleriyle çalışmaya ve kaliteli bakım sağlamaya teşvik eder (Lake, 2002). Hemşirelerin çalışma ortamını etkileyen önemli faktörler iş yükü ve personel seviyeleri, karar alma özgürlüğü, iş talepleri ve karmaşıklığı, iyi liderlik ve birim tabanlı kararlara katılma yeteneğidir (Wei ve ark., 2018).

Olumlu bir çalışma ortamı hemşirelerin klinik uygulamalarının tüm yönlerini kullanmalarına ve hastalara güvenli, kaliteli bakım sunmalarına olanak tanıyan faktörleri temsil eder (Lake, 2002). Bu faktörler: hemşirelerin yönetime katılması ve temsil gücü, kaliteli bakım için gerekli hemşirelik kaynakları, yönetici hemşirelerin tutumu ve liderlik özellikleri, insan gücü ve diğer kaynakların yeterliliği, hekim-hemşire-meslektaş iletişimi olarak tanımlanmıştır (Lake, 2002; Türkmen ve ark., 2011). Türkiye’de ise “Hemşireler İçin Sağlıklı Çalışma Ortamı Standartlarının Geliştirilmesi” projesi kapsamında ülkemize özgü hemşireler için sağlıklı çalışma ortamı standartları geliştirilmiştir. Hemşireler için sağlıklı çalışma ortamı standartları; “Hemşire İş Yükü, Geliştirme ve Kariyer Planlama, Sosyal Haklar, İş Sağlığı ve Güvenliği, Uygun Fiziki Koşullar ve Yeterli Araç-Gereç, Ekip İş Birliği, İletişim, Takdir ve Tanınma ve Etkili Yönetim ve Liderlik” olmak üzere altı ana standart belirlenmiştir (Kocaman ve ark., 2018).

## **Hemşirelerin Çalışma Ortamlarının Hemşireler Üzerine Etkisi**

Onlarca yıllık deneysel araştırmalar çalışma ortamının hemşireler üzerindeki etkisini incelemiş ve çalışma ortamı özellikleri ile iş katılımı (Van Bogaert ve ark., 2017; Wan ve ark., 2018), iş

tatmini (Van Bogaert ve ark., 2017; Wei ve ark., 2018; Ambani ve ar., 2020), tükenmişlik (Van Bogaert ve ark., 2017; Wan ve ark., 2018) ve işten ayrılma niyetleri arasında ilişki bulmuştur (Van Bogaert ve ark., 2017; Wan ve ark., 2018; Wei ve ark., 2018; Ambani ve ar., 2020 ). Ayrıca, hemşirelerin çalışma ortamı, Donabedian'ın Yapı-Süreç-Sonuç bakım kalitesi modelinde önemli bir yapısal bileşen olarak kabul edilmektedir (Donabedian, 1998).

Araştırmalar, bakım sağlayamamanın hemşirelerin refahını iş memnuniyetini azaltarak, tükenmişlik semptomlarını artırarak ve sonuç olarak işten ayrılma niyetlerini artırarak etkilediğini göstermiştir (Wan ve ark., 2018; Lake ve ark., 2020).

Çalışma ortamları ile iş tatmini, tükenmişlik, ihmal edilen bakım ve mesleği bırakma niyeti arasındaki ilişkiye dair son araştırmalar bu ilişkinin daha iyi anlaşılmasını sağlamıştır (Van Bogaert ve ark., 2017; Lee ve Scott, 2018).

Hem destekleyici olmayan bir çalışma ortamı hem de kaçırılan hemşirelik bakımı tükenmişlik sendromu belirtilerinin öngörücüleri olarak kabul edilmektedir (Dall'Ora ve ark., 2020). Artan işten ayrılma oranı, personel içindeki moral ve ekip çalışmasını etkiler, sonuç olarak iş yükünü ve ayrılma niyetini artırır (Jun ve ark., 2021).

### **Hemşirelerin Çalışma Ortamlarının Hastalar Ve Sağlık Kuruluşları Üzerine Etkisi**

Hemşirelerin çalışma ortamı hemşireleri, hastaları ve sağlık kurumlarını doğrudan etkilemektedir (Wei ve ark. 2018). Ne yazık ki, mevcut araştırma zenginliğine ve ardından gelen girişimlere rağmen, hastane çalışma ortamı sınırlı kaynaklar ve artan iş talepleriyle hemşirelerin çalışma ortamları sorunlu olmaya devam etmektedir. Hemşirelik alanında, hemşirelerin çalışma ortamlarının sağlık hizmeti kalitesi için bir katalizör olarak önemine dikkat çeken dünya çapında çeşitli raporlar ve girişimler olmuştur (Lake ve ark., 2020).

Mıknatis Hastaneler özellikle de hemşirelere uygun çalışma ortamları oluştururlar. Mıknatis hastanelerde hemşirelik yönetimi ve liderliği, hemşirelerin özerklik derecesi, terfi fırsatları, bakım modellerinin uygulanması ve eğitim yoluyla mesleki gelişim olarak özetlenen sağlanan gibi sağlık hizmetlerinin kalitesine katkıda bulunan sağlıklı çalışma ortamını hemşirelere sunmaktadır (Stimpfel, Sloane, McHugh ve Aiken, 2016). Uluslararası hastane yönetimleri sağlık hizmetlerinin kalitesini iyileştirmek için hemşirelere olumlu çalışma ortamı sağlaması konusunda sürekli baskı altındadır ve bunun için çabalamaktadır (Boamah, Spence Laschinger, Wong ve Clarke, 2018). Ayrıca, daha fazla oranda hemşireden oluşan bir yatak başı bakım işgücü, daha iyi sonuçlar ve hastanın kalış süresi ile ilişkilidir (Aiken ve ark., 2017; Moissoglou ve ark., 2019).

Çalışma ortamını oluşturan özel nitelikler ve çok boyutlu rolü, bu niteliklerin incelenmesini ve sağlanan hizmetlerin kalitesi üzerindeki potansiyel etkilerinin araştırılmasını zorunlu hale getirmektedir. Çalışma ortamı, kaçırılan hemşirelik bakımının en önemli belirleyicilerinden biridir (Chaboyer ve ark., 2020; Lake ve ark., 2020). Yetersiz personel ve kaynaklar, bunların kötü kullanımı, yüksek iş yükü ve yetersiz iletişim, ihmal edilen hemşirelik bakımını etkileyen faktörlerdir (Liu ve ark., 2018; Cho ve ark., 2020). Kaçırılan hemşirelik bakımı, hemşirenin belirli bir görevin yapılması gerektiğini bilmesine rağmen bakımı zamanında veya hiç sağlayamaması durumunda oluşan bir ihmal hatası olarak tanımlanmaktadır (Kalisch ve Williams, 2009). Dünya genelindeki hastane ortamlarında yüksek oranda kaçırılan hemşirelik bakımı vakaları olmakla birlikte ülkeler arasında ve içinde farklılıklar bulunmaktadır (Griffiths ve ark., 2018). Kaçırılan hemşirelik bakımının hastalar üzerindeki etkisi uzun uzadıya incelenmiştir (Chaboyer ve ark., 2020; Kalánková ve ark., 2020) ve bakım sağlama süreçlerinin bir göstergesi olarak görülmektedir (Lake ve ark., 2020; Cho ve ark., 2020).

Ağır iş yükü, insan ve maddi kaynakların yetersizliği, iletişim ve ekip çalışmasının eksikliği (Yılmaz ve Yılmaz Kocak., 2024) hatta profesyonellerin örgütsel politikalara ve karar alma süreçlerine düşük düzeyde katılımı, olumsuz olayların riskini artırır (Lake, 2002) ve hasta güvenliği ile ilgili olumsuz sonuçlara neden olur (Malinowska-Lipień ve ark., 2021).

Orta Doğu ülkelerinde, işyerinde zorbalığın, hastaların güvenliği üzerinde büyük bir etkiye sahip olan kötü bir hemşirelik çalışma ortamını gösterdiği gözlemlenmiştir; Bu nedenle, hemşirelik çalışma ortamını iyileştirmek için atılan adımlar, hastaların güvenliğinin iyileştirilmesine yol açabilir. Benzer şekilde, başka bir Orta Doğu ülkesinde, ankete katılan hemşirelerin yalnızca %35,2'si algılanan hastaların güvenliğine ilişkin olumlu düzeyler bildirdi; bu, personel ve kaynak yeterliliği, profesyonel iletişim tarzı ve hemşirelerin hastane kalite iyileştirme faaliyetlerine katılımının hasta güvenliğiyle pozitif korelasyona sahip olması gibi çalışma ortamının olumlu yönlerini yansıtmaktadır (Aiken ve ark., 2021). Hemşirelerde daha yüksek bakım kalitesi ve hasta güvenliği algısı oluşturduğunu (Aiken ve ark., 2017; Swiger ve ark., 2017), ilaç hatalarını azalttığını (Swiger ve ark., 2017), hastaların bakım kalitesi algısını yükselttiğini (Aiken ve ark., 2021) ve hasta mortalitesini düşürdüğünü (Aiken ve ark., 2017) göstermektedir. Yüksek tükenmişlik oranları, üretkenliğin azalmasına ve devamsızlık ve işten ayrılma niyetlerinin artmasına neden olduğu için sağlık bakım sisteminin masraflarını da artırmıştır.

### **Sonuç**

Güvenli ve sağlıklı bir çalışma ortamının, hemşirelerin iyi bir ruhsal ve fiziksel durumda olmasını sağlayarak hastanın iyileşme sürecini hızlandırmakta, tıbbi hataların sayısını azalmakta, hasta bakım kalitesi ve hasta memnuniyetini arttırmaktadır. Hemşireler için olumlu çalışma ortamlarını oluşturan kurumlarda hemşire ve hasta memnuniyeti arttığı için bu durumdan sağlık kuruluşları da olumlu etkilenmektedir. Bu nedenle hastane ve hemşire yöneticilerinin hemşireler olumlu bir çalışma ortamı sunmaları son derece önemlidir. Bu derleme çalışması hemşirelerin çalışma ortamlarını düzenlenmesinde, sağlık bakım kalitesinin artırılmasında hemşire ve hastane yöneticilerine, politika yapıcılara yol gösterici olabilir.

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## SAĞLIK ÇALIŞANLARINDA İKİNCİ KURBAN OLGUSU

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### Özet

Tıbbi hatalar hasta güvenliğini tehdit eden en önemli nedenlerdendir. Bir sağlık bakım profesyonelinin mesleki hayatı boyunca istemeden de olsa tıbbi hataları ve hasta güvenliği olaylarını yaşamaması kaçınılmazdır. Hoş karşılanmayan bu durum hastaları ve sağlık bakım profesyonellerini olumsuz etkilemektedir. Herhangi bir hasta güvenliği olayında olumsuz etkilenen ilk kurban (mağdur) hasta, ikinci kurban (mağdur) ise tıbbi hatayı yapan sağlık bakım profesyonelleri (hekim, hemşire, ebe ve sağlık görevlisi) olarak tanımlanmaktadır. Ülkemizde tıbbi hataların sistemden kaynaklı olabileceği göz ardı edilmekte ve tıbbi hata nedeni olarak genellikle sağlık bakım personelleri (özellikle de hemşire ebeler) gösterilmektedir. Bu durum da sağlık bakım personellerinin hatalar nedeniyle suçlanmasına, ceza almasına ve ikinci kurban olarak nitelendirilmesine neden olmaktadır. İkinci kurban olan sağlık bakım personeli bu duruma düşmemek için hatayı gizlemekte ve bildirmemektedir. Hataların bildirilmemesi, bu hatanın tekrar oluşmaması için yapılacak düzenlemeleri engeller ve daha büyük bir hata olarak tekrar karşımıza çıkmasına neden olabilir. Bu nedenle hatayı yapan sağlık bakım profesyoneli suçlu, mağdur, kurban olarak görülmemelidir. Yapılan literatür incelemesi sonucunda sadece ikinci kurban olgusu ölçeğinin geçerlilik ve güvenilirliğinin yapıldığı bir uluslararası makale ve ulusal bir derleme makalesine ulaşılmıştır. Bu nedenle bu çalışmada, Türkiye’de oldukça yeni olan ikinci kurban olgusu ayrıntılı olarak ele alınarak sağlık bakım profesyonellerinin ve yöneticilerinin farkındalıklarının artırılması amaçlanmıştır. Bu çalışma tıbbi hataların önlenmesi çalışmalarında hastane ve hemşire yöneticilerine rehberlik edebilir. İkinci kurban olarak görülen sağlık bakım personelinin ve hastaların olumsuz etkilenebileceği göz önünde bulundurulduğunda hastane ve hemşire yöneticilerinin bu alanda düzenleyici çalışmaları yapması önerilmektedir.

**Anahtar Kelimeler:** ikinci kurban olgusu, tıbbi hatalar, sağlık bakım çalışanı

## SECOND VICTIM CASE IN HEALTHCARE WORKERS

### **Abstract**

Medical errors are one of the most important threats to patient safety. It is inevitable for a health care worker to unintentionally experience medical errors and patient safety incidents throughout their professional life. This unwelcome situation negatively affects patients and health care workers themselves. In any patient safety incident, the first victim who is negatively affected is the patient and the second victim is the health care workers (physicians, nurses, midwives and paramedics) who have committed the medical error. In Türkiye, the fact that medical errors may be associated with the system is ignored and health care professionals (nurse-midwives in particular) are often cited as the cause of medical errors. This situation causes them to be blamed and penalized for errors, while they are also characterized as second victims. In order to avoid this situation, health care workers, who are considered to be the second victims, hide the error and ignore reporting. Failure to report errors challenges the arrangements to be made to prevent the re-occurrence of the error and may lead to greater errors due to re-occurrence. Therefore, the health care workers who have committed an error should not be considered a criminal, victim or sufferer. As a result of the literature review, only one international article and one national review article on the validity and reliability of the Second Victim Phenomenon Scale were found. Accordingly, this study aimed to raise the awareness of health care workers and administrators by discussing the second victim case, which is quite newly approached in Türkiye, in detail. This study may guide hospital and nurse managers in their efforts to prevent medical errors. Considering that health care personnel and patients who are considered as second victims may be negatively affected, it is recommended that hospital and nurse managers should carry out regulatory studies in this field.

**Keywords:** second victim case, medical errors, health care worker

## **Giriş**

Tıbbi hatalar hasta güvenliğini tehdit eden en önemli nedenlerdendir. Bir sağlık bakım profesyonelinin mesleki hayatı boyunca istemeden de olsa tıbbi hataları ve hasta güvenliği olaylarını yaşaması kaçınılmazdır [1]. İkinci kurban terimi ilk olarak 2000 yılında Wu tarafından tanımlandı [2]. Herhangi bir hasta güvenliği olayında, ilk kurban hasta iken, ikinci kurban, olayın nedeni olabilecek ve bu durumdan olumsuz etkilenen sağlık çalışanlarıdır (doktor, asistan, hemşire, ebe ve sağlık teknisyeni) [3, 4].

Hasta güvenliği veya tıbbi hata olaylarının örnekleri arasında hastaların karıştırılması, ilaç ve doz seçimi hatası, yanlış teşhis, yanlış tıbbi tedavi ve bir prosedür sırasında kazara zarar verme yer alır [5]. Bu tür vakalar bu hataları yapanlarda kalıcı duygusal izler bırakabilir. Sıklıkla, ikinci kurbanlar bu beklenmedik hasta sonuçlarından kişisel olarak kendilerini sorumlu hisseder ve klinik bilgileri ve becerileri hakkında şüphe duyarlar. Aynı şekilde, kazaya yakın olaylara karışan sağlık çalışanları da benzer duygular yaşayabilmektedir [6, 7]. Yapılan bir çalışmada tüm sağlık çalışanlarının yarısına yakını mesleki kariyerleri boyunca ikinci kurban olgusunu deneyimlediğini bildirilmiştir [8].

İkinci kurbanlar duygusal sorunların yanında hem mesleki hem de kişisel düzeyde sıkıntı yaşarlar [9,10]. Bu durumda, tıbbi hatalar veya olumsuz olaylar sağlık çalışanlarını ciddi şekilde etkileyebilir ve kalıcı izlere neden olabilir [11]. İkinci kurbanlar, anksiyete, depresyon, suçluluk ve uyku bozuklukları gibi travma sonrası stres bozuklukları gibi yaygın olan semptomlarla karşı karşıya kalırlar [12]. Bu semptomlar bireylerin duygusal ve fiziksel sağlıklarını etkileyerek, mesleki yetenekleri konusunda güvensiz hissetmelerine ve özgüven kaybı ve iş tatmininde azalma gibi önemli duygusal sıkıntılar yaşamalarına neden olmaktadır [13].

Tıbbi alanda, hataların temel nedenini belirlemek, gelecekte hataların meydana gelmesini önlemek için önemlidir [14]. Hasta güvenliği önlemleri genellikle olumsuz bir olaya yanıt olarak protokoller ve diğer müdahaleler yoluyla geliştirilir [15]. İkinci kurbanlar, yalnızca sağlık sistemindeki zayıflıkları ele almakla kalmayıp aynı zamanda sağlık kurumlarının iyileşmesine yardımcı olarak yapıcı değişimin geliştirilmesine katkıda bulunabilir [16]. Deneyimleriyle başa çıkmak için yardıma ihtiyaç duyan ikincil kurbanlar, mümkün olan en uygun şekilde, yapıcı değişime neden olmak için yaşadıkları olumsuz olayın sorumluluğunu kabul etmeye teşvik edilmelidir [17]. Ancak, yetersiz destek birimlerine sahip cezalandırıcı klinik ortamlarda, sağlık profesyonelleri tıbbi hataları bildirmekten endişe duymaktadır ve bu da gelecekteki hataların önlenmesini olumsuz etkilemektedir [18,19]. Çalışmalar, birçok sağlık profesyonelinin tıbbi bir hatadan sonra destek almakta zorluk çektiğini ortaya koymuştur. Olumsuz bir olayla ilişkili stresle başa çıkmak için yardım veya rehberlik almak üzere birime ulaşamamışlardır [8, 20].

## **İkinci Kurban Olgusunun Sağlık Personelleri, Hastalar ve Aileleri, Sağlık Kuruluşları Üzerindeki Etkisi**

Albert Wu, ikinci kurban olgusu durumunda tehlikeye atılan ve sıklıkla gözden kaçan sağlık profesyonellerinin duygusal olarak yaralanabileceğini belirtmiştir [2]. Yapılan çalışmalarda sağlık çalışanlarının tıbbi hata ve hasta güvenliği olayları sonucunda ikinci kurban olarak görülmektedirler. Duygusal olarak (kendinden şüphe duyma, suçluluk, endişe, öfke, utanç, hayal kırıklığı, kendinden nefret etme ve depresyon) [1,7,21,22], bilişsel (şefkat memnuniyetsizliği, tükenmişlik, ikincil travmatik stres ve rahatsız edici anılar) [23,24] ve fiziksel (uyku bozuklukları, mide bulantısı, kan basıncında artış ve kalp hızı veya solunum hızı) [25, 26] olarak bir takım sorunlar ile karşı karşıya kalmaktadırlar.

Ayrıca, gözetimsiz bırakılırsa, ikinci kurbanlar daha da kötüleşebilir ve mesleki yeterliliğin azalmasına doğru ilerleyebilir. Bu durum çalışanların işten ayrılmasına ve devamsızlığın artmasına ve yetersiz hasta bakımına [27,28,29], travma sonrası stres bozukluğu, tükenmişlik, kendine zarar verme veya intihar etmeye [30,31] neden olabilmektedir.

Sayırsız semptom ve komplikasyon, ikinci kurban sendromu olarak bilinir. Mevcut çalışanların işi bırakması yüksek bir devir hızına, yeni çalışanların seçim ve işe alım nedeniyle maliyetlerin artmasına neden olur. Ayrıca, işe başlayan yeni çalışanlar tarafından sağlanan üretkenlik ve klinik hizmetler, ayrılan deneyimli kişininkilerle aynı olmayabilir [32]. Daha da kötüsü, bireysel bir endişeden yola çıkarak ikinci kurban durumu, itibar, adli tıp, insan kaynakları veya parasal konularla sağlık kuruluşlarına yani üçüncü kurbanlara domino etkisi yaratabilir [33,34,35].

Örgütsel desteğin sürekliliği, meslektaş, yönetici ve kurumsal destek üçlüsünü kapsar. Herhangi bir hasta güvenliği olayından sonra, meslektaşlar ikinci kurbanlara en yakın oldukları için genellikle ilk müdahale ekibi olarak hareket eder. Meslektaş veya akran desteği, en elverişli, aranan ve başarılı destek türü olarak kabul edilir [3,19]. Meslektaş desteğinin yanı sıra, iyi bir süpervizör desteği ile birlikte elverişli çalışma ortamlarının oluşturulması ve kurumun desteği önemlidir [3,36, 37].

### **Sonuç Ve Öneriler**

Ülkemizde tıbbi hataların sistemden kaynaklı olabileceği göz ardı edilmekte ve tıbbi hata nedeni olarak genellikle sağlık bakım personelleri (özellikle de hemşire ebeler) gösterilmektedir. Bu durum da sağlık bakım personellerinin hatalar nedeniyle suçlanmasına, ceza almasına ve ikinci kurban olarak nitelendirilmesine neden olmaktadır. İkinci kurban olgusunu yaşayan sağlık personeli duygusal, bilişsel ve fiziksel olarak sıkıntılar yaşayabilmektedir. Sağlık çalışanlarını ikinci kurban olgusundan korumak için hatalar karşısında sağlık çalışanlarını suçlamamak, cezalandırıcı kültürden uzak olmak gerekmektedir. Bununla birlikte hataların oluşmasını önlemek için sistem kaynaklı hatalara odaklanmak ve gerekli düzenlemeleri yapmak gerekmektedir. Bu çalışma tıbbi hataların önlenmesi çalışmalarında hastane ve hemşire yöneticilerine rehberlik edebilir. İkinci kurban olarak görülen sağlık bakım personelinin ve hastaların olumsuz etkilenebileceği göz önünde bulundurulduğunda hastane ve hemşire yöneticilerinin bu alanda düzenleyici çalışmalarını yapması önerilmektedir.

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## GÜNCEL KILAVUZLAR EŞLİĞİNDE HİPERTANSİYON YÖNETİMİ ve HEMŞİRELİK

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### Özet

Yılda 10,4 milyon ölüme neden olan hipertansiyon, yaygın, önlenbilir ve tedavi edilebilir bir kardiyovasküler hastalıktır. Dünyada 1 milyar üzerinde hipertansiyon tanılı hasta mevcut olup, yetişkinlerde yaygınlığı %30-45 arasındadır. 2000-2010 yılları arasında yüksek gelirli ülkelerde farkındalık, tedavi ve kontrol oranlarında artış görülürken, düşük ve orta gelirli ülkelerde artış daha az gözlenmiş, tedavi oranlarında azalma tespit edilmiştir. Kan basıncı düşürülmesi erken morbidite ve mortaliteyi önemli ölçüde azaltabilmektedir. Yaşam tarzı değişiklikleri ve ilaç tedavi stratejileri ile kan basıncında azalmanın başarılabilirdiği kanıtlanmıştır. Buna rağmen, kan basıncı kontrol oranları dünya genelinde düşüktür ve Avrupa genelinde tatmin edici olmaktan uzaktır. Hipertansiyon yönetimini iyileştirmek için, son yıllarda birçok ülke 2015 yılında yayınlanan SPRINT çalışmasının sonuçlarını fazlasıyla dikkate alarak klinik uygulama kılavuzları ve kanıta dayalı kılavuzlar oluşturmuşlar ve güncellemişlerdir. 2017'de Amerikan Kardiyoloji ve Amerikan Kalp Derneği, 2018'de Avrupa Kardiyoloji Derneği ve Avrupa Hipertansiyon Derneği, 2019'da Sağlık ve Bakım Mükemmelliği Enstitüsü (NICE), kılavuzlarının son güncel hallerini yayınlamışlardır. Yeni gelişmeler hipertansiyonu yeniden tanımlamayı, çoklu ilaçların tek bir hap kombinasyon şeklinde tedaviye başlamayı, daha fazla ofis dışı kan basıncı ölçümü ve daha düşük kan basıncı hedefleri önermektedir. Kılavuzlar ve önerileri, sağlık profesyonellerinin günlük uygulamalarında karar vermeyi kolaylaştırmalıdır. Bununla birlikte, bir hasta ile ilgili nihai kararlar, ilgili hastaya ve bakım vericisine danışarak sorumlu sağlık profesyonel(ler)i tarafından verilmelidir. Bu sebeple kılavuzlar eşliğinde en doğru kararı verme tüm sağlık profesyonellerini ilgilendiren bir konu olarak karşımıza çıkar.

**Anahtar Kelimeler:** Hemşirelik, hipertansiyon, hipertansiyon kılavuzları, hipertansiyon yönetimi

## **HYPERTENSION MANAGEMENT AND NURSING WITH CURRENT GUIDELINES**

### **Abstract**

Hypertension, which causes 10.4 million deaths per year, is a common, preventable and treatable cardiovascular disease. There are over 1 billion patients diagnosed with hypertension worldwide, and its prevalence in adults is between 30-45%. While awareness, treatment and control rates increased in high-income countries between 2000 and 2010, the increase was less in low- and middle-income countries, and treatment rates decreased. Lowering blood pressure can significantly reduce early morbidity and mortality. It has been proven that blood pressure reduction can be achieved with lifestyle changes and drug treatment strategies. Despite this, blood pressure control rates are low worldwide and far from satisfactory in Europe. In order to improve hypertension management, many countries have recently developed and updated clinical practice guidelines and evidence-based guidelines, taking into account the results of the SPRINT study published in 2015. In 2017, the American Heart Association and Cardiology Association, in 2018, the European Society of Cardiology and the European Society of Hypertension, and in 2019, the Institute for Health and Care Excellence (NICE) published the latest updated versions of their guidelines. New developments suggest redefining hypertension, initiating treatment with a single pill combination of multiple drugs, more out-of-office blood pressure measurements, and lower blood pressure targets. Guidelines and their recommendations should facilitate decision-making in the daily practice of healthcare professionals. However, final decisions regarding a patient should be made by the responsible healthcare professional(s) in consultation with the relevant patient and caregiver. For this reason, making the most accurate decision in accordance with the guidelines is a matter of interest to all healthcare professionals.

**Keywords:** Nursing, hypertension, hypertension guidelines, hypertension management

## 1. Giriş

Yüksek kan basıncı (KB) olarak tanımlayabileceğimiz hipertansiyon (HT), tüm dünyada yaygın olarak görülen kardiyovasküler sistem hastalıklarındandır. HT önlenebilir ve tedavi edilebilir bir hastalık olmakla birlikte, inme, böbrek hastalığı, erken ölüm ve yeti yitimine neden olarak sağlık ve ekonomi alanında önemli bir yük oluşturmaktadır. Yılda 10,4 milyon ölüme neden olan HT, küresel ölümün önde gelen nedeni olmaya devam etmektedir (Unger ve ark., 2020). Küresel rakamları incelediğimizde, 2010 yılında yaklaşık 1,39 milyar insanın HT'si bulunmaktadır ve büyük çoğunluğu (1,04 milyar) düşük ve orta gelirli ülkelerdedir (Mills ve ark., 2016). Yetişkinlerde genel HT prevalansı % 30-45, küresel çapta standartlaştırılmış yaygınlığı erkeklerde ve kadınlarda sırasıyla % 24 ve % 20'dir (Williams ve ark., 2018). 2000-2010 yılları arasında yüksek gelirli ülkelerde farkındalık, tedavi ve kontrol oranlarında artış görülürken, düşük ve orta gelirli ülkelerde artış daha az gözlenmiş, tedavi oranlarında azalma tespit edilmiştir (Mills ve ark., 2016). KB düşürülmesi erken morbidite ve mortaliteyi önemli ölçüde azaltabilmektedir. Yaşam tarzı değişiklikleri ve ilaç tedavi stratejileri ile KB'de azalmanın başarılabilirdiği kanıtlanmıştır. Buna rağmen, KB kontrol oranları dünya genelinde düşüktür ve Avrupa genelinde tatmin edici olmaktan uzaktır. Sonuç olarak, HT, kardiyovasküler hastalık (KVH) ve tüm nedenlere bağlı ölümlerin dünya çapında ve kıtamızda önlenebilir başlıca nedeni olmaya devam etmektedir (Williams ve ark., 2018).

Çeşitli girişimlere rağmen, KB'nin yükselmesi ve kardiyovasküler morbidite ve mortalite üzerindeki olumsuz etkisi, gelire bakılmaksızın, küresel olarak artmaktadır. Bu nedenle, küresel düzeyde tuz alımının azaltılması, taze meyve ve sebzelerin bulunabilirliğinin iyileştirilmesi artırılmaya çalışılmaktadır. HT yönetimini iyileştirmek için, son yıllarda birçok ülke 2015 yılında yayınlanan SPRINT çalışmasının sonuçlarını fazlasıyla dikkate alarak klinik uygulama kılavuzları ve kanıta dayalı kılavuzlar oluşturmuşlar ve güncellemişlerdir. 2017'de Amerikan Kardiyoloji ve Amerikan Kalp Derneği (ACC / AHA), 2018'de Avrupa Kardiyoloji Derneği ve Avrupa Hipertansiyon Derneği (ESC / ESH), 2019'da Sağlık ve Bakım Mükemmelliği Enstitüsü (NICE), kılavuzlarının son güncel hallerini yayınlamışlardır ((McCormack ve ark., 2019). Yeni gelişmeler HT'yi yeniden tanımlamayı (Whelton ve ark., 2018), tek bir hap kombinasyon tedavisi ile tedaviye başlamayı (Williams ve ark., 2018), daha fazla ofis dışı KB ölçümü (Whelton ve ark., 2018; Umemura ve ark., 2019) ve daha düşük KB hedefleri önermektedir (Whelton ve ark., 2018; Williams ve ark., 2018; NICE, 2019). Kılavuzlar ve önerileri, sağlık profesyonellerinin günlük uygulamalarında karar vermeyi kolaylaştırmalıdır. Bununla birlikte, bir hasta ile ilgili nihai kararlar, ilgili hastaya ve bakım vericisine danışarak sorumlu sağlık profesyonel(ler)i tarafından verilmelidir. Bu sebeple kılavuzlar eşliğinde en doğru kararı verme tüm sağlık profesyonellerini ilgilendiren bir konu olarak karşımıza çıkar.

## 2. Ht'de Tanım ve Sınıflandırma

Erişkinlerde (>18 yaş) klinikte ölçülen ve tekrarlanan ölçümler ile sistolik kan basıncının (SKB)  $\geq 140$  mmHg ve/veya diyastolik kan basıncının (DKB)  $\geq 90$  mmHg olması HT olarak tanımlanır (Williams ve ark., 2018; Aydoğdu ve ark., 2019; NICE, 2019). Yüksek SKB ( $\geq 140$  mm Hg) ve düşük DKB (<90 mm Hg) olarak tanımlanan izole sistolik HT gençlerde ve yaşlılarda yaygındır. Çocuklar, ergenler ve genç yetişkinler de dâhil olmak üzere genç bireylerde, izole sistolik HT, esansiyel HT'nin en yaygın şeklidir (Williams ve ark., 2018; Unger ve ark., 2020). Avrupa Kardiyoloji Derneği (ESC) ve Avrupa Hipertansiyon Derneği (ESH) ile Amerikan Kalp Derneği (AHA) kılavuzlarını incelediğimizde HT sınıflandırmalarında ufak farklılıklar mevcuttur (Tablo 1).

**Tablo 1.** HT'nin Sınıflandırması Kanıt Düzeyleri (Whelton ve ark., 2018; Williams ve ark., 2018)

Kılavuz	Öneri	Sınıf	Seviye
ESC/ESH	HT ofisine göre KB'nin optimal, normal, yüksek normal veya sınıf 1-3 HT olarak sınıflandırılması önerilir.	1	c
AHA	KB'yi normal, yüksek veya evre 1 veya 2 HT olarak sınıflandırılması önerilir.	1	b

Ülkemizde ise yayınlanan 2019 Türk Hipertansiyon Uzlaş Raporu, güncel gelişmeler ve kılavuzlar neticesinde KB sınıflandırmasını yapmıştır (Aydoğdu ve ark. 2019) (Tablo 2).

**Tablo 2.** Klinik KB Düzeylerine Göre KB Sınıflandırması -Türk HT Uzlaş Raporu 2019

Kategori	Sistolik (mmHg)		Diastolik (mmHg)
Normal	<120	ve	<80
Artmış	120–139	ve / veya	80–89
Hipertansiyon	≥140	ve / veya	≥90
Evre 1	140–159	ve / veya	90-99
Evre 2	≥160	ve / veya	≥100

### 3. Kan Basıncı Ölçümü ve Hipertansiyon Teşhisi

- Ofis veya klinik KB ölçümü HT tanısı ve takibinin temelini oluşturur (Williams ve ark., 2018; Aydoğdu ve ark., 2019; Unger ve ark., 2020).
- HT tanısını doğrulamak için genellikle 1–4 haftalık aralıklarla KB seviyesine bağlı olarak 2-3 ofis ziyareti gereklidir. KB ≥180 / 110 mm Hg ise ve kardiyovasküler hastalık (KVH) kanıtı varsa, tanı tek bir ziyarette konulabilir (Aydoğdu ve ark., 2019; Unger ve ark., 2020). NICE 2019 raporuna göre bu değer ≥180/120 mmHg olarak kabul edilir (NICE, 2019).
- Mümkünse, HT tanısı ofis dışı KB ölçümü ile doğrulanmalıdır. Ofis dışı KB ölçümü ile gerçekte hipertansif olmayan %10-30 beyaz önlük HT'si ve HT varlığı ofis-klinikte teşhis edilemeyen %10-15 maskeli HT'ye daha doğru teşhis konulabilir (Unger ve ark., 2020). Türk HT Uzlaş Raporuna ve ESC/ESH kılavuzuna göre evde KB ölçümü ile ≥135/85 mmHg ve üzeri HT teşhisi için sınır kabul edilmektedir (Williams ve ark., 2018; Aydoğdu ve ark., 2019).
- Oskültator veya osilometrik yarı otomatik veya otomatik sfigmomanetreler doktor ofisinde KB ölçümü için tercih edilen yöntemdir. Üst koldan kol çevresi için uygun bir manşet boyutu kullanılarak ölçüm yapılmalıdır. Ölçüm öncesi hastanın oturur durumda en az beş dakika dinlenmesine izin verilmeli, avuç açık, kolu kalp seviyesinde ve bir seferde en az iki ölçüm yapılarak (en az iki dakika ara ile) ortalaması kaydedilmelidir (Williams ve ark., 2018; Aydoğdu ve ark., 2019; NICE, 2019).
- İlk değerlendirmede KB her iki koldan, tercihen aynı anda ölçülmelidir (Williams ve ark., 2018; Aydoğdu ve ark., 2019; Unger ve ark., 2020). Tekrarlanan ölçümlerde kollar arasında >10 mmHg'lik tutarlı bir fark varsa, daha yüksek KB'li kol ölçüm için kullanılır. Fark >20 mmHg ise daha fazla araştırma gereklidir (Unger ve ark., 2020). Türk HT Uzlaş Raporuna, ESH/ESC ve NICE kılavuzlarına göre araştırma için farkın >15 mmHg olması yeterlidir (Williams ve ark., 2018; Aydoğdu ve ark., 2019; NICE, 2019).
- Ayakta KB ölçümü: Postüral hipotansiyonu gösteren semptomlar olduğunda tekrarlı tedavilerde, yaşlılarda ve diyabetli kişilerde ilk ziyarette 1 dakika sonra ve 3 dakika sonra ayakta ölçüm yapılmalıdır. Ortostatik hipotansiyon 3 dakika içinde SKB'de ≥20 mmHg, DKB'de ≥ 10 mmHg'lık bir azalma olarak tanımlanır ve artan mortalite ve kardiyovasküler risk ile ilişkilidir (Williams ve ark., 2018).

### 4. Hipertansiyonun Tanı-Teşhis ve Ölçüm Sürecinde Hemşirelik Uygulamaları

HT'nin ilk tanılanmasında kılavuzlara göre doktor ölçümü esas alınmaktadır. Ofis-klinik KB ölçümleri doktor tarafından yapılabilenkte ise de her yerde bu durum sabit değildir. Aynı zamanda kliniklerde yatan hastalarda KB ölçümü çoğunlukla hemşireler tarafından gerçekleştirilmektedir. HT'de hemşirelik çalışmalarının kanıta dayalı olarak değerlendirilmesi

ilk olarak 2005 yılında gerçekleştirilmiş, 2009 yılında da revize edilmiştir. HT’de hemşirelik yönetimine dair yapılması gerekenler diğer uluslararası HT kılavuzlarında ele alınmış, fakat hemşirelik alanındaki yapılan çalışmaların hangi kanıt düzeyinde kaldığı ile ilgili başka kılavuz yayınlanmamıştır. HT’de Hemşirelik Yönetimi Kılavuzu, HT’nin tanı-teşhis ve ölçüm sürecinde hemşirelik uygulamalarını kanıt düzeyleri ile bize sunmuştur (Grinspun ve Coote, 2009) (Tablo 3).

**Tablo 3. Hipertansiyonun Tanı-Teşhis ve Ölçüm Sürecinde Hemşirelik Uygulamaları Kanıt Düzeyleri**

Öneri	Kanıt Düzeyi
<b>Uygulama Önerileri</b>	
<b>Tanı ve Teşhis</b>	
Hemşireler, HT’nin erken saptanmasını kolaylaştırmak için yetişkinlerin kan basıncını değerlendirmede her fırsatı kullanacaktır.	IV
Hemşireler, hastaların/bireylerin kan basıncını değerlendirirken doğru tekniği, uygun manşet boyutunu ve uygun şekilde bakımı yapılmış / kalibre edilmiş ekipmanı kullanacaktır.	IV
Hemşireler, HT’nin tanısında yer alan süreç hakkında bilgi sahibi olacaklardır.	IV
Hemşireler, potansiyel tanı ve HT’nin izlenmesine yardımcı olmak için hastaları kendi kendine / evde tansiyon izleme teknikleri ve uygun ekipman konusunda eğiteceklerdir.	IV
Hemşireler, hastaları/bireyleri hedef tansiyonları ve bu hedefe ulaşma ve sürdürmenin önemi hakkında eğiteceklerdir.	IV

NICE 2004 raporunda KB ölçümleri yapan sağlık profesyonellerinin, yeterli başlangıç eğitimi ve performanslarının periyodik olarak gözden geçirilmesi gerektiğini savunur ve son kılavuzda da bu konuda değişiklik yapılmamıştır (NICE, 2019). Yukarıda verilen bilgilere göre HT’nin teşhis ve ölçüm sürecinde hemşirelik uygulamalarının kanıt düzeyi düşük bulunmuştur. Teşhis ve ölçüm sürecinde doktorların daha aktif olmaları, yeterli sayıda ve geniş örneklem kitlesinde hemşirelik araştırmalarının yapılmayışı da bu alanda kanıtların düşük olmasının nedeni olarak düşünülmektedir.

## 5. Hipertansiyonun Tedavisi

HT tedavisi farmakolojik ve nonfarmakolojik olarak uygulanmakta olup, amaç morbidite ve mortalitenin azaltılmasıdır. Buna göre tolere edilebilmesi halinde SKB’nin 140 mm Hg’nın, DKB’nin ise 90 mmHg’nın altında tutulması hedeflenmelidir (Kanıt düzeyi A) (Özpancar, 2016; Nerenberg ve ark., 2018; Williams ve ark., 2018). Birkaç yüz bin hastayı içeren randomize kontrollü çalışmaların meta-analizleri, SKB’de 10 mmHg’lık azalma veya DKB’de 5 mmHg’lık azalmanın, hipertansif aralıktaki başlangıç kan basıncına, kardiyovasküler (KV) risk seviyesine, komorbiditelere (örn. Diyabet ve kronik böbrek hastalığı), yaş, cinsiyet ve etnik kökene bakılmaksızın tüm büyük KV olaylarda % 20, tüm nedenlere bağlı mortalitede % 10-15, inmede % 35, koroner olaylarda % 20 ve kalp yetmezliğinde % 40’lık bir azalmayı kanıtlamıştır (Williams ve ark., 2018). Yaşam tarzı değişiklikleri uzun dönemde ve düzenli uygulanabildiği takdirde KB yükselme eğiliminde olan bireyleri hipertansif olmaktan koruyabildiği gibi, hipertansif bireylerde de ilaç ihtiyacını azaltabilmekte ve hedef organ hasarını önlemede faydalı olabilmektedir (Özpancar, 2016). HT tedavisinde nonfarmakolojik ve farmakolojik tedavinin yanısıra tedavide risk temelli yaklaşım, hastalara göre ilaç seçimi, ilaç uyumu da ele alınan temel konulardandır (Aydoğdu ve ark., 2019).

### 5.1. Yaşam Tarzı Değişiklikleri

HT tedavisinde nonfarmakolojik tedavi olarak benimsenen yaşam tarzı değişiklikleri; ideal vücut ağırlığının sağlanması, tuz kısıtlaması, sağlıklı beslenme, sigaranın bırakılması, alkol kısıtlaması, hareketli yaşam ve stres yönetimini kapsamaktadır (Williams ve ark., 2018; Aydoğdu ve ark., 2019).

### 5.1.1. Vücut Ağırlığının Kontrolü

Dünya Sağlık Örgütü'ne (WHO) göre, 2005 yılında 15 yaş üstü yaklaşık 1,6 milyar yetişkin fazla kilolu olarak bildirilirken, 2015 yılı için bu rakamın yaklaşık 2,3 milyar olduğu tahmin edilmektedir (Jiang ve ark., 2016). Sağlık Bakanlığı verilerine göre ise ülkemizde erişkin nüfusun % 64,9'unun normal vücut ağırlığının üzerinde olduğu (%34,6 fazla kilolu, %30,3 obez) bildirilmektedir (Aydoğdu ve ark., 2019). Framingham Kalp Çalışması verilerine göre, % 5'lik bir kilo alımının 4 yıllık bir dönemde HT riskini % 30, ideal kilonun %20 üstünde HT gözlenme olasılığını da 8 kat arttırdığı belirlenmiştir. Bununla birlikte, kilo kaybı hem sistolik hem de diyastolik kan basınçlarını azaltır. Beden kütle indeksi (BKİ) ile KB arasında ilişki tuz alınımından bağımsızdır. 5 kg almakla sistolik basınç erkeklerde 4,4, kadınlarda 4,2 mmHg artar. KB ile kilo arasındaki pozitif korelasyon çocuk ve adölesanlarda da mevcuttur. Kilo kaybı ile erişkinlerin 1/3'ünde KB regülasyonu için ilaç gerekmez. Ayrıca antihipertansiflerin etkisi artar. İlaç gereksinimi azaldığı gibi antihipertansif ilaç dozu %30 oranında azalır (Turkjem, 2020).

Kilo kaybının sağlanması, diyet tavsiyesi, düzenli egzersiz ve motivasyon danışmanlığını içeren multidisipliner bir yaklaşım ile desteklenmelidir (Williams ve ark., 2018). Fazla kilolu olan hipertansif hastaların uygun kiloya inmesi önerilmeli (Umemura, 2019) veya en azından kilo vermesi (ağırlığının en az %5–10'u kadar kilo kaybı) teşvik edilmelidir (Aydoğdu ve ark., 2019).

### 5.1.2. Diyet Sodyum Kısıtlaması

Günlük >5 g sodyum alımının (yaklaşık bir çay kaşığı tuz), HT prevalansını artırdığı belirlenmiştir. Küresel olarak, normal sodyum alımı günde 3,5-5,5 g arasındadır (günde 9 - 12 g tuza karşılık gelir). ESC/ESH ile Kanada Hipertansiyon Kılavuzuna göre sodyum alımının yaklaşık 2,0-2,4 g (günde yaklaşık 5,0-6,0 g tuza eşdeğer) ile sınırlanması önerilir (Nerenberg ve ark., 2018; Williams ve ark., 2018). Amerikan Kardiyoloji Kolejinde göre ise bu değer günlük 1,5 g'dır (Whelton ve ark., 2018). Türkiye'de genel popülasyonda yapılan SALTURK çalışmaları günlük tuz tüketiminin oldukça yüksek olduğunu (yaklaşık 15 g/gün) ve bunun HT ile ilişkisini göstermiştir (Aydoğdu ve ark., 2019). Diyetle etkili oranda tuz azaltımı kolay değildir ve genellikle zayıftır. Tüketilen gıdaların hangilerinde ne kadar sodyum içerdiğinin bilinmesi gereklidir ve genellikle işlenmiş gıdalar yüksek sodyum içerirler (Williams ve ark., 2018). Günlük sodyum alımının 1 g azaltılması ile hipertansiflerde 5-6 mmHg, normotansiflerde 2-3 mmHg azalma olacağı bildirilmektedir (Whelton ve ark., 2018).

### 5.1.3. Hipertansiyonu Düşürücü Diyet (Dietary Approaches to Stop Hypertension-DASH Diyeti)

Karbonhidrat ve yağ alımının fazla olması, zamanla arterlerde ateroskleroza neden olmakta ve HT'ye zemin hazırlamaktadır. Yüksek kalorili diyet alımının bir başka zararlı etkisi, çevresel dokularda norepinefrin salınımının artışı, sempatik sinir sistemi aktivasyonu ve plazma norepinefrin artışıdır. Yüksek yağ ve karbonhidrat alımının periferik al ve p-adrenerjik reseptörleri akut olarak uyarması ve böylece sempatik aktivitenin ve KB'nin yükselmesine yol açtığı ileri sürülmüştür (Jiang ve ark., 2016). Tüm bu etkiler göz önüne alındığında doymuş ve trans yağ içeriği azaltılmış gıdalar, meyveler, sebzeler, tam tahıllar ve az yağlı süt ürünleri bakımından zengin diyet HT hastalarının tercih etmesi gereken beslenme şekli olmalıdır. Proteinler çoğunlukla sebzelerden karşılanmalı ve diyetle haftada en az iki kez balık yer almalıdır. İşlenmiş ve hazır gıdalar tercih edilmemelidir (Whelton ve ark., 2018; Aydoğdu ve ark., 2019). Diyetle alınan yeterli miktarda potasyum, kalsiyum, magnezyum ve omega-3 yağ asitleri prostaglandin I<sub>2</sub>'yi artırır, angiotensin ve norepinefrine vasküler cevabı azaltır. Günde 3 g'ın üzerinde omega-3 yağ asidi kan basıncını 5,5/3,5 mmHg azaltır. Günlük 90 mmol potasyum alımı KB'yi 8,2/4,4 mmHg azaltır. Ancak potasyum, kalsiyum ve magnezyum

genelde gıdalarda bol miktarda vardır ve diyete eklenmesi çoğu kez gereksizdir (Turkjem, 2020).

#### 5.1.4. Sigaranın Bırakılması

Sigara içmek, KVH ve kanser için önemli bir risk faktörüdür. Çoğu Avrupa ülkesinde, özellikle erkeklerde sigara içme oranı düşmekle birlikte, birçok bölgede ve yaş grubunda hala yaygındır ve genel olarak Avrupa'da yaygınlık % 20-35 arasındadır (Williams ve ark., 2018). Ülkemizde 4207 Sayılı Tütün Ürünlerinin Zararlarının Önlenmesi ve Kontrolü Hakkında Kanun ile başlatılan sigara yasağı ile sigara içme sıklığı azalmasına rağmen istendik seviyede değildir. Sağlık Bakanlığı 2016 verilerine göre  $\geq 15$  yaş yetişkinlerin % 26,5'i halen sigara içmektedir ve sigara içme sıklığı erkeklerde (%40,1) kadınlardan (%13,3) daha yüksektir (Aydoğdu ve ark., 2019). Hem normotansif hem de hipertansif sigara kullanıcılarının sigara kullanmayanlara oranla KB değerleri daha yüksek tespit edilmektedir. Hipertansif hastaların sigara kullanmaması, kullanıyor ise mutlaka bırakması tavsiye ve teşvik edilmelidir. Yalnızca tavsiye ile bırakma oranı 12 ayda %1-3 iken farmakoterapi ile desteklendiğinde bu oran %70-100'e ulaşmaktadır (Williams ve ark., 2018; Aydoğdu ve ark., 2019).

#### 5.1.5. Alkol Tüketiminin Azaltılması

Alkol, sempatik aktiviteyi ve renin-anjiyotensin-aldosteron sistemini aktive ederek KB'nin yükselmesine yol açar (Turkjem, 2020). Alkol kısıtlamakla KB 4 mmHg kadar azalır (Whelton ve ark., 2018). Hipertansif hastaların alkol kullanması önerilmez. Eğer kullanıyorlarsa hipertansif erkeklere haftada 14 birim, kadınlara da 8 birim tüketim izni verilebilir (1 birim 125 mL şarap veya 250 mL biraya eşittir) (Williams ve ark., 2018; Aydoğdu ve ark., 2019).

#### 5.1.6. Düzenli Fiziksel Aktivite

Fiziksel aktivite KB'de, akut bir artışa neden olurken, uzun dönemde HT'nin önlenmesi ve tedavisinde, KV risklerin ve ölüm oranlarının azaltılmasında etkili olmaktadır. Hastaların yaşına ve fiziksel durumuna göre, haftada 5-7 günde en az 30 dakikalık orta yoğunlukta dinamik aerobik egzersize (yürüyüş, koşu, bisiklete binme veya yüzme) katılmaları önerilmelidir. Direnç egzersizlerinin haftada 2-3 gün yapılması da tavsiye edilebilir (Williams ve ark., 2018; Aydoğdu ve ark., 2019).

#### 5.1.7. Stres Yönetimi

Psikososyal faktörlerin primer HT gelişiminde rolü önemlidir. Davranış tedavisi (transdental meditasyon, yoga, biofeedback ve psikoterapi) ile gevşeme tekniklerinin KB'yi düşürdüğü bilinmektedir. Hipertansif hastalara bu konuda önerilerde bulunulmalıdır (Aydoğdu ve ark., 2019).

#### 5.1.8. Yaşam Tarzı Değişiklikleri ve Önerilerinin Kanıt Düzeyleri

Yaşam tarzı değişiklikleri ve önerilerle ilgili kanıt düzeyleri Tablo 4'te belirtildiği gibidir.

**Tablo 4.** Yaşam Tarzı Değişiklikleri ve Önerilerinin Kanıt Düzeyleri (Nerenberg ve ark., 2018; Williams ve ark., 2018)

Yaşam Tarzı Değişikliği	Kanada HT Kılavuzu-2018'e göre bulguların kanıt düzeyleri	ESC/ESH 2018 Kılavuzuna göre önerilerin kanıt düzeyleri
Sodyum alımının azaltılması (<5g/gün)	A	I-A
Alkol alımının azaltılması	B	I-A
HT düşürücü diyet	B	I-A
Vücut ağırlığının kontrolü	B	I-A
Düzenli fiziksel aktivite	D	I-A
Sigaranın bırakılması	C	I-B

Yaşam tarzı değişikliklerine başlama zamanı ile ilgili de kılavuzlar kanıt düzeylerine göre öneride bulunmuşlardır (Tablo 5).

**Tablo 5.** Yaşam tarzı değişikliği ne zaman önerilir?

	ESC/ESH 2018 Kılavuzu	AHA/ACC 2017 Kılavuzu
Yaşam tarzı değişikliği	• Derece 2-3 HT'de farmakolojik tedaviye eş zamanlı başlanmalıdır (I-A)	• KB $\geq$ 130/80 mmHg ile <160/100 mmHg arasında ise yaşam tarzı değişikliği önerilir (II-A)
	• Derece 1 HT'de normal KB'ye ulaşmak için önerilir (II-B)	• (Beyaz önlük HT değilse farmakolojik tedaviye ek olarak başlanmalıdır (II-A))
	• Yaşlı hastalarda farmakolojik tedaviyle birlikte önerilir (I-A)	• SKB 120-129 mmHg, DKB <80 mmHg ofis ölçümünden sonra; maskeli HT ise yaşam tarzı değişikliği farmakolojik tedaviyle birlikte önerilir (II-A)
	• Yüksek-normal (130-139/85-89 mmHg) KB'de yaşam tarzı değişikliği önerilir (I-A)	• Yüksek- normal KB'de yaşam tarzı değişikliği önerilir (II-A)

### 5.1.9. Farmakolojik Tedavi

- Makrovasküler hedef organ hasarı veya diğer KV risk faktörleri olmayan hastalarda ortalama DKB ölçümleri 100 mm Hg (Düzyey A) veya ortalama SKB ölçümleri 160 mm Hg (Düzyey A) ise antihipertansif tedavi reçete edilmelidir.
- Makrovasküler hedef organ hasarı veya diğer bağımsız KV risk faktörleri varlığında antihipertansif tedavi, ortalama DKB ölçümleri 90 mmHg (Düzyey A), ortalama SKB ölçümleri 140 mmHg (140-160 mmHg için Düzyey B;> 160 mm Hg için Düzyey A) için kuvvetle düşünölmelidir (Nerenberg ve ark., 2018).
- 100'den fazla ölkeden elde edilen veriler, HT'si olan yetişkinlerin ortalama % 50'sinden azının KB düşürücü ilaç aldığını göstermektedir. Oysa KB'de 20/10 mmHg'lık bir fark kardiyovasküler riskte % 50'lik bir azalmayla ilişkilidir (Unger ve ark., 2020). Çoğu hasta, optimal KB kontrolü elde etmek için yaşam tarzı değişikliklerine ek olarak ilaç tedavisine ihtiyaç duyacaktır. HT tedavisi için beş ana ilaç sınıfı önerilmiştir: ACE inhibitörleri, ARB'ler, beta blokerler, kalsiyum kanal blokörleri ve diüretiklerdir. Bu ilaçlar KB'yi düşürme kanıtı, plasebo kontrollü çalışmalardan KV olaylarını azalttıklarına dair kanıtlar ve genel KV morbidite ve mortalitesi üzerinde geniş eşdeğerlik kanıtı sundukları için önerilmektedirler (Kanıt düzeyi I-A) (Williams ve ark., 2018).

## 6. Antihipertansif İlaç Kullanan Hastaların Takibi

Antihipertansif ilaçların etkisi 3-4 haftada ortaya çıkacağı için bu süreçte tedavi başlanan veya tedavisinde değişiklik yapılan bireylerin kontrol edilmesi gerekir. Kontrol sonucunda hedef KB'ye ulaşamazsa ilk ilacın dozu artırılabilir veya beş ilaç grubundan bir ilaç daha eklenebilir. Hedef KB'ye ulaşana kadar ilave ilaç ile kontroller sağlanır. Üçlü kombinasyon ile de hedef KB'ye ulaşamazsa farklı grup ilaçlardan destek tedavi verilebilir, ek klinik konsültasyon ile uzman değerlendirmesi gerekebilir ((Uzman Görüşü - E Sınıfı) (James ve ark., 2014). Tedaviye yanıtın değerlendirilmesinde evde KB izlemi önerilir ve bu konuda hasta ve/veya ailesinin eğitimi önemlidir (NICE, 2019). Tedaviye başlangıç ve izlemede hastaların yaşı, komorbiditeleri, etnik kökenleri, özel durumları, KV riskleri ve mevcut KV hastalıkları yanı sıra (Nerenberg ve ark., 2018; Whelton ve ark., 2018; Williams ve ark., 2018), hastaların tercihleri de göz önüne alınmalıdır (NICE, 2019).

## 7. Antihipertansif Tedaviye Uyum ve Bağlılık

Bağlılık, bir kişinin ilaç kullanma, diyet yapma veya yaşam tarzı değişikliklerini yürütme gibi davranışlarında, sağlık profesyonelinin önerilerine ne kadar uyum sağladığı ve gerçekleştirebildiği ile açıklanabilir. Antihipertansif tedaviye uyulmaması, hipertansif



hastaların % 10-80'ini etkiler ve suboptimal KB kontrolünün temel faktörlerinden biridir. Antihipertansif tedaviye uyumsuzluğun etiyojisi; sağlık sistemi, farmakolojik tedavi, hastalıklar, hastalar ve sosyoekonomik durumla ilişkili olabilir (Unger ve ark., 2020). Tedavinin erken kesilmesi ve reçete edilen ilaçların günlük yetersiz kullanımı, zayıf bağlılığın en yaygın şeklidir. Tedavi başlangıcında 6 ay sonra, üçte birinden fazlası ve 1 yıldan sonra, hastaların yaklaşık yarısı tedavilerini kesebilmektedirler (Naderi ve ark., 2012). Kötü ilaç uyumu, reçete edilen ilaç sayısı arttıkça artmaktadır (Williams ve ark., 2018).

Tedaviye uyumu artırmak için 2020 Uluslararası Hipertansiyon Derneği Global Hipertansiyon Uygulama Kılavuzunun önerileri şu şekilde sıralanabilir:

- İlaç uyumunu artırmak için aşağıdaki stratejiler göz önünde bulundurulmalıdır;
  - polifarmasinin azaltılması - tek hap kombinasyonlarının kullanımı
  - her gün birden fazla zamanda (sadece sabah değil, öğle veya akşam gibi) günde bir defa ilaç alımı, karışık dozlamadan kaçınılması
  - bağlılık davranışını günlük alışkanlıklarla ilişkilendirme
  - hastalara uyum geri bildirim sağlama
  - evde KB izleme
  - ilaçların hatırlatıcı ambalajını kullanma
  - öz-yönetim için kişilerin sorumluluk almasına dayalı danışmanlık
  - cep telefonları veya kısa mesaj servisleri gibi elektronik bağlılık (uyum) yardımları
  - bağlılık izlemeyi iyileştirmek için multidisipliner (örneğin, eczacılar) sağlık ekibi yaklaşımı benimsenmelidir (Unger ve ark., 2020).

Ayrıca ilave olarak;

- Yaşam tarzı önerilerinin ilaç tedavisi kadar önemli olduğu anlatılmalıdır.
  - Hastalığın kronik olduğu, ilaçların sürekli alınması ve düzenli kontrollere gelmesi gerektiği anlatılmalıdır.
  - Gerekli olmadıkça ilaç değişikliği yapılmamalıdır.
  - Hastaya yeterince zaman ayrılmalı, hastanın kendini anlatmasına izin verilmeli ve hastayla iyi bir iletişim kurulmalıdır (Aydoğdu ve ark., 2019).
- Antihipertansif tedaviye uyumsuzluğu teşhis etmek için objektif dolaylı (yani eczane kayıtlarının gözden geçirilmesi, hap sayımı, elektronik izleme cihazları) ve doğrudan (yani tanıklı ilaç alımı, ilaçların idrar veya kandaki biyokimyasal tespiti) tespit önerilir.
  - Anket çalışmaları ile de hastaların tedaviye uyum düzeyleri rahatlıkla belirlenebilir (Williams ve ark., 2018).

### **7.1. Antihipertansif Tedavi ve Hemşirelik Uygulamaları**

Hemşirelerin HT'li hastaların tedaviye uyumunda çok önemli rolleri vardır. Hemşireler HT'yi kontrol etmek ve kardiyovasküler risk faktörlerini azaltmak için tanılama, eğitim, danışmanlık, işbirliği ve izlem gibi rollerin uygulanması ve geliştirilmesinden sorumludur. Bunları yaparken ise kanıta dayalı uygulamaları bilmeli ve hayata geçirebilmelidir. Tayvan'da hemşireler üzerinde yapılan bir araştırmada hemşirelerin HT ile ilgili kanıta dayalı uygulamalardan yeterince haberdar olmadığı (Chen ve ark., 2011), İspanya'da yapılan başka bir araştırmada HT taraması için hemşirelerin yeterince hazır olmadığı ve profesyonel bir eğitimden geçmesi gerektiği vurgulanmıştır (Serrat-Costa ve ark., 2016). Diğer yandan bağımsız hemşirelik uygulamaları ile HT yönetiminde oldukça başarılı olunacağı, hemşire önderliğindeki kliniklerde, doğru KB ölçümlerini sağlamak ve hastayı eğitmek, uzun süreli tedaviye uyumu teşvik etmek için hemşirelerin daha fazla zaman ayırabileceğini belirtmişlerdir. Ayrıca verilen hemşirelik bakımının maliyet etkin olduğu da kabul edilmiştir (Brown, 2017). Yarı deneysel olarak yapılan eğitim programlarının hipertansiyonu olan hastaların bilgiyi artırma, öz yönetimi geliştirme ve zararlı yaşam tarzı alışkanlıklarını kontrol etmede etkili olduğunu göstermiştir (Beigi ve ark., 2014).

Hipertansiyon Hemşirelik Yönetimi Kılavuzu 2009 yılı raporuna göre Tedavi Planının Değerlendirilmesi ve Geliştirilmesi, Eğitim Önerileri, Organizasyon ve Politika Önerileri aşağıdaki tabloda yer almaktadır (Grinspun ve Coote, 2009) (Tablo 6).

**Tablo 6.** Hemşirelik Uygulamalarında Tedavi Planının Değerlendirilmesi ve Geliştirilmesi, Eğitim Önerileri, Organizasyon ve Politika Önerileri

Öneri		Kanıt Düzeyi
<b>Uygulama Önerileri</b>		
<b>Tedavi Planının Değerlendirilmesi ve Geliştirilmesi</b>		
Yaşam Tarzı Müdahaleleri	Hemşireler, HT yönetimini etkileyebilecek, değişim için potansiyel alanları tanıyabilecek ve ikincil komplikasyonları önleyebilecek hasta hedeflerine ulaşmaya yardımcı olmak için işbirliğine dayalı bir yönetim planı oluşturabilecek yaşam tarzı faktörlerini belirlemek için hastalarla birlikte çalışacaktır.	IV
Diyet	Hemşireler, diyetisyenler ve sağlık ekibinin diğer üyeleri ile işbirliği içinde, HT yönetiminin bir parçası olarak hastaları diyet risk faktörleri hakkında değerlendirecek ve eğiteceklerdir.	IV
	Hemşireler, diyetisyenler ve sağlık ekibinin diğer üyeleri ile işbirliği içinde, HT'si olan hastalara DASH Diyet tüketmeleri konusunda danışmanlık yapacaklardır.	Ib
	Hemşireler, HT'si olan müşterilere diyetle verilen sodyum alımlarını, diyetisyenler ve sağlık ekibinin diğer üyeleri ile işbirliği içinde önerilen 65-100 mmol / gün miktarıyla sınırlamaları konusunda danışmanlık yapacaklardır.	Ia
Sağlıklı Kilo	Hemşireler hastaların kilosunu, Beden Kitle İndeksini (BKİ) ve bel çevresini değerlendirecektir.	IV
	Hemşireler, BKİ değeri $\geq 25$ olan ve bel çevresi 102 cm (erkek) ve 88 cm (kadın) olan hastaların kilo azaltma stratejilerini dikkate alacaklardır.	IV
Egzersiz	Hemşireler, hastaların mevcut fiziksel aktivite seviyelerini değerlendireceklerdir.	IV
	Hemşireler, sağlık ekibiyle işbirliği içinde, haftada 4 ila 7 kez 30-60 dakika boyunca gerçekleştirilecek orta yoğunlukta dinamik egzersiz yapmaları için hastalara danışmanlık yapacaklardır.	Ia
Alkol	Hemşireler, hastaların doğrulanmış bir araç kullanarak miktar ve sıklık dâhil olmak üzere alkol kullanımını değerlendireceklerdir.	Ib
	Hemşireler rutin olarak müşterilerle alkol tüketimini tartışacak ve alkol kullanımını azami ölçüde uygun şekilde sınırlandırmayı önerecektir.	III
Sigara kullanımı	Hemşireler sigara içme ile kardiyovasküler hastalık riski arasındaki ilişki hakkında bilgi sahibi olacaklardır.	IV
	Hemşireler, hastaların sigarayı bırakmasını kolaylaştırmak için onların tütün kullanım durumunu belirleyecek ve Kısa Tütün Müdahalelerini uygulayacaktır.	Ia
Stres	Hemşireler, HT tanısı alan hastaların stresli olaylara nasıl tepki verdiklerini anlamalarına ve stresle etkili bir şekilde nasıl başa çıkacaklarını ve yöneteceklerini öğrenmelerine yardımcı olacaktır.	IV
İlaçlar	Hemşireler, reçeteli, reçetesiz, bitkisel ve yasadışı ilaç kullanımını içeren hastaların ilaç geçmişi sorgulayacaktır.	IV
	Hemşireler, HT tanısı konan hastalar için reçete edilebilecek ilaç sınıfları hakkında bilgi sahibi olacaklardır.	IV
	Hemşireler, doktorlar ve eczacılarla işbirliği içinde HT'nin farmakolojik yönetimi hakkında eğitim verecektir.	IV
Uyumun Değerlendirilmesi	Hemşireler, hastalarla terapötik ilişkiler kurmaya çalışacaktır.	IV
	Hemşireler, HT yönetimine ilişkin hastaların beklentilerini ve inançlarını araştıracaklardır.	III
	Hemşireler, her uygun ziyarette hastaların tedavi planına bağlılığını değerlendireceklerdir.	III
Uyumun Geliştirilmesi	Hemşireler, HT'si olan hastaların tedavi planlarıyla ilgili geçerli seçimler yapmaları için gerekli bilgileri edineceklerdir.	III
	Hemşireler, hastaların doz rejimlerini basitleştirmek için reçetelerle birlikte çalışacaktır.	Ia
	Hemşireler, uyumu kolaylaştırmak için rutini ve hatırlatıcıları teşvik edecektir.	Ia
	Hemşireler, randevu konusunda sıkıntı yaşayan hastaların, bakımlarını sürdürmek için takip telefon görüşmeleri yapmasını sağlayacaktır.	IV
İzleme ve Takip	Hemşireler, antihipertansif tedavi gören hastaların sağlık ekibi ile işbirliği içinde uygun takip edilmesini sağlayacaklardır.	IV
Dokümantasyon	Hemşireler, HT yönetimi ile ilgili kapsamlı bilgileri belgeleyecek, hasta ve sağlık ekibi ile paylaşacaktır.	IV

<b>Eđitim Önerileri</b>	
HT'si olan yetişkinlerle çalışan hemşireler, temel hemşirelik eğitimi müfredatı, sürekli mesleki gelişim fırsatları ve yeni iş yerlerine yönlendirme yoluyla edinilen uygun bilgi ve becerilere sahip olmalıdır. Bilgi ve beceriler asgari olarak aşağıdakileri içermelidir: <ul style="list-style-type: none"> <li>■ HT'nin patofizyolojisi;</li> <li>■ Tetkik fırsatlarını en üst düzeye çıkarmak;</li> <li>■ Teşhisi kolaylaştırmak;</li> <li>■ HT'si olan hastaların değerlendirilmesi ve izlenmesi;</li> <li>■ Uygun hasta / aile eğitimi sağlanması;</li> <li>■ Yaşam tarzı değişikliklerini desteklemek;</li> <li>■ Bireyin güçlendirilmesini teşvik etmek; ve</li> <li>■ Hasta ve sağlık ekibinin diğer üyeleriyle dokümantasyon paylaşımı ve iletişim.</li> </ul>	IV
<b>Organizasyon ve Politika Önerileri</b>	
Sağlık kuruluşları, HT bakımını artırmak ve hemşirelerin HT yönetimindeki rolünü geliştirmek için disiplinlerarası ekip içinde işbirlikçi bir uygulama modeli geliştirecektir.	IV
Sağlık kuruluşları, bağıllık yönetiminde eğitime izin veren bakım sağlama sistemleri ve ayrıca bağıllığı ve buna katkıda bulunan faktörleri doğru bir şekilde değerlendirecek bir araç oluşturacaklardır.	IV
Sağlık kuruluşları, aşağıdakileri izlemelerine olanak tanıyan temel göstergeler ve sonuç ölçümleri geliştireceklerdir: <ul style="list-style-type: none"> <li>■ kılavuz ilkelerin uygulanması,</li> <li>■ bu kılavuz ilkelerin kaliteli hasta bakımını optimize etme, verimlilik veya elde edilen maliyet etkinliği üzerindeki etkisi.</li> </ul>	IV
En iyi hemşirelik uygulama kılavuzları, ancak uygun planlama, kaynaklar, organizasyonel ve idari destek ve uygun kolaylaştırmanın olduğu durumlarda başarıyla uygulanabilir.	IV

Hemşireler, sağlık hizmetinin her alanında yer alırken hasta ile iletişimde en fazla rol alan sağlık profesyoneli olmaktadır. Tüm sağlık problemlerinde olduğu gibi, oldukça sık rastlanan HT'nin yönetiminde de hemşirelere büyük pay düşmektedir. Hemşireler uygulamalarını tüm dünyaca benimsenmiş kanıt temelli olarak yapmalıdırlar. HT'de de kanıta dayalı uygulamalar ve kılavuzlar yayınlanmakta ve güncellenmektedir.

Kanıta dayalı hemşirelik uygulamalarının desteklenmesi, kılavuzlar eşliğinde kurumun veya uygulama ortamının şartları ile bireylerin ihtiyaçları ve istekleri göz önüne alınarak gerçekleştirilebilir. Kılavuzlar, bireyselleştirilmiş müşteri hizmetleri için karar vermede yardımcı olacak ve mümkün olan en iyi bakımı sağlamak için uygun yapıların ve desteklerin mevcut olmasını sağlayacak bir araç olarak kullanılmalıdır. Uygulama değişikliklerine öncülük eden ve bunları kolaylaştıran hemşireler, diğer sağlık uzmanları ve yöneticiler ile birlikte politikalar, prosedürler, protokoller, eğitim programları, değerlendirme ve dokümantasyon araçlarının geliştirilmesi için kılavuzlardan faydalanmalıdırlar. Aynı zamanda kanıtlara katkıda bulunmak için araştırma ve gözlemsel çalışmalarına da devam etmelidirler.

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## VARFARİN KULLANIMINDA ÖZ-YÖNETİM

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### Özet

Varfarin; mekanik kalp kapak protezi ameliyatı sonrası, atrial fibrilasyon (AF), kardiyak aritmi, derin ven trombozu (DVT), pulmoner emboli, akut koroner olaylar sonrası tromboembolik olayların profilaksisi, romatizmal kalp kapak hastalıkları ve iskemik serebrovasküler hastalıklarda korunma ve tedavi amacıyla yaygın olarak kullanılır. Varfarin kullanımı tüm yaş gruplarındaki hastalarda %4, 65 yaş ve üzeri hasta grubunda ise %12,8'dir. Varfarinin terapötik aralığının dar olması ve gıda, ilaç, genetik faktör, yaş gibi nedenlerden dolayı etkisinin bireyler arası farklılık göstermesi, tedavi altındaki hastaların monitörizasyonunu gerektirmektedir. Güvenilir ilaç dozu, protrombin zamanının uluslararası standartlaştırılmış değeri olan INR (Uluslararası Normalleştirilmiş Oran -International Normalized Ration) ile yapılmaktadır. Yararlarına rağmen düzenli laboratuvar takibi gerektirmesi, dar terapötik penceresi, öngörülemez ve değişken olabilen farmakolojik yanıtı, antitrombotik etkisinin geç başlaması, pek çok ilaç ve besinlerle etkileşimi, genetik geçişli varfarin direnci gibi sınırlılıkları söz konusudur. Bu sınırlılıklarla birlikte diyet ve aktivite kısıtlamaları, kanama olasılığı endişesi, çoklu ilaç kullanımı tedavinin yönetimini zorlaştıran unsurlardır. Hasta bireyi merkeze alan yöntemlerle bireyin kendi kendine INR izlemi yapabilmesi, tedavi ve komplikasyonları izleyebilmesi, beslenme yönetimi, ilaç yönetimi sağlayabilmesi bireyin öz-yönetimini destekleyen girişimlerdir. Kronik hastalıkların kontrolü ve tedavisinde öz-yönetim kavramı başarının ön koşuludur ve hastanın kendisi ile ilgili karar verme ve bakım sorumluluğunu üstlenmesini ifade eder. Hastanın merkezde olduğu öz-yönetim kavramında hasta tedavisiyle ilgili kendi seçimlerini yapabilme yeteneğindedir. Varfarin tedavisinde öz-yönetim denilince hastanın evde kendi INR testini yapabilmesi, gerektiğinde doz ayarı yapabilmesi veya bunun için ilgili birime ulaşabilmesi, ilaç ve besin etkileşimlerini kontrol edebilmesini ifade etmektedir. Varfarin kullanan hastaların da öz-yönetim becerilerinin en üst düzeyde geliştirilmesi ve bunu yaşam biçimi olarak benimsemeleri önemlidir.

**Anahtar Kelimeler:** Hemşirelik, öz yönetim, varfarin.

## SELF-MANAGEMENT OF WARFARIN USE

### **Abstract**

Warfarin is widely used for the prevention and treatment of atrial fibrillation (AF), cardiac arrhythmia, deep vein thrombosis (DVT), pulmonary embolism, prophylaxis of thromboembolic events after acute coronary events, rheumatic heart valve diseases and ischemic cerebrovascular diseases after mechanical heart valve prosthesis surgery. Warfarin use is 4% in patients of all age groups and 12.8% in patients aged 65 and over. The narrow therapeutic range of warfarin and the fact that its effects vary among individuals due to factors such as food, medication, genetic factors and age necessitate monitoring of patients under treatment. A safe drug dose is determined by the internationally standardized value of prothrombin time, the INR (International Normalized Ratio). Despite its benefits, it has limitations such as the need for regular laboratory monitoring, narrow therapeutic window, unpredictable and variable pharmacological response, late onset of antithrombotic effect, interaction with many drugs and nutrients and genetic warfarin resistance. Along with these limitations, dietary and activity restrictions, concerns about the possibility of bleeding and multiple drug use are factors that make treatment management difficult. The ability of the individual to monitor INR on their own, monitor treatment and complications, and provide nutritional management and medication management with methods that focus on the patient are initiatives that support the individual's self-management. The concept of self-management in the control and treatment of chronic diseases is a prerequisite for success and refers to the patient assuming responsibility for decision-making and care regarding themselves. In the self-management concept where the patient is at the center, the patient is capable of making their own choices regarding their treatment. When it comes to self-management in warfarin treatment, it refers to the patient being able to perform their own INR test at home, adjusting the dose when necessary or reaching the relevant unit for this, and being able to control drug and food interactions. It is important for patients using warfarin to develop their self-management skills to the highest level and adopt this as a lifestyle.

**Keywords:** Nursing, self-management, warfarin.

## 1.Giriş

Arteriyel ve venöz tromboembolik hastalıklar günümüzde mortalite ve morbiditenin önemli bir nedenidir (Alay ve ark., 2011). Tromboembolik olayların önlenmesi veya tedavisi için oral yolla kullanılan varfarin, karaciğerde K vitaminine bağlı olarak üretilen pıhtılaşma faktörlerinden II, VII, IX, X ve doğal antikoagülan proteinler olan protein C ve protein S'nin sentezini önleyerek koagülasyonun gecikmesine neden olan önemli bir ilaç grubudur (Opie ve Gersh, 2009; Ageno ve ark., 2012). Altmış yılı aşkın bir süredir varfarin dünyada ve ülkemizde en yaygın kullanılan oral antikoagülan (OAK)'dır (Alay ve ark., 2011; Goldstein, 2013). Ulusal Travma Bilgi Bankası (National Trauma Databank) verilerine göre varfarin kullanımı tüm yaş gruplarındaki hastalarda 2002'de %2,3 iken 2006'da %4, 65 yaş ve üzeri hasta grubunda ise 2002'de %7,3 iken 2006 yılında %12,8 olduğu belirlenmiştir (Dossett ve ark., 2011).

Varfarin; mekanik kalp kapak protezi ameliyatı sonrası, atrial fibrilasyon (AF), kardiyak aritmi, derin ven trombozu (DVT), pulmoner emboli, akut koroner olaylar sonrası tromboembolik olayların profilaksisi, romatizmal kalp kapak hastalıkları ve iskemik serebrovasküler hastalıklarda korunma ve tedavi amacıyla yaygın olarak kullanılır (Anticoagulation Europe, 2011; Yıldırım, 2013; Yıldırım ve Temel, 2014). Tedavide özellikle AF'li hastalarda uzun dönem (Akyol, 2010) ve mekanik kalp kapağı takılan hastalarda tromboembolik komplikasyonların önlenmesi için ömür boyu antikoagülan kullanımı zorunludur (Salman ve ark., 2015). Hayati önemine ve yaygın kullanımına rağmen varfarinin terapötik aralığının dar olması ve gıda, ilaç, genetik faktör, yaş gibi nedenlerden dolayı etkisinin bireyler arası farklılık göstermesi, tedavi altındaki hastaların monitörizasyonunu gerektirmektedir.

Varfarin monitörizasyonu için hastalardan kan alınarak izlem yapılmaktadır. Güvenilir ilaç dozu, protrombin zamanı (PT) ile belirlenmektedir. Ancak bu testin uygulamasında ülkeler arasında farklı tromboplastin kaynağı kullanılması PT'yi değerlendirmede hastaların takibi açısından farklılık doğuracağından Dünya Sağlık Örgütü (DSÖ) tarafından 1983 yılında INR (Uluslararası Normalleştirilmiş Oran -International Normalized Ration) kavramı kabul edilmiştir (Voukalis ve ark., 2016). INR değerinin hesaplanmasında:  $INR = \frac{\text{Hastanın PT değeri}}{\text{Kontrol PT değeri}}$  ISI formülü kullanılmaktadır. PT; hastanın protrombin zamanı, ISI ise, Uluslararası Duyarlılık İndeksidir. INR değerinin birimi yoktur ve normal bir insanda INR değeri 1'dir. Hedef INR değeri sabit olmayıp hastalığın etiyolojisine göre farklılık gösterir (Türk Kardiyoloji Derneği – TKD, 2008; Mercan ve Enç, 2011).

INR değeri hastalığa özgü hedef sınırın altında ise tromboemboli riskini, hedef sınırın üstünde ise kanamaya eğilimi ifade eder. Bu nedenle antikoagülan tedavinin yönetiminde hem pıhtı oluşumunu hem de kanama riskini önleyecek güvenilir ilaç dozunun ayarlanması gereklidir. Tromboemboli ve gelişebilecek inme riskinin önlenmesinde varfarinin üstünlüğüne karşın, düzenli laboratuvar takibi gerektirmesi, dar terapötik penceresi, öngörülemeyen ve değişken olabilen farmakolojik yanıtı, antitrombotik etkisinin geç başlaması, pek çok ilaç ve besinlerle etkileşimi, genetik geçişli varfarin direnci gibi sınırlılıkları söz konusudur. Bu sınırlılıklarla birlikte diyet ve aktivite kısıtlamaları, kanama olasılığı endişesi (Çırak ve ark., 2013), çoklu ilaç kullanımı tedavinin yönetimini zorlaştıran unsurlardır (Bajorek ve ark., 2007). Son zamanlarda tromboemboli yönetimi için alternatif ajanlar kullanılabilir hale gelmesine rağmen risksiz olmamaları ve yüksek tedavi maliyetleri nedeni ile varfarin hala birincil tedavi seçeneği olarak devam etmektedir (Nasser ve ark., 2012).

Varfarin tedavisi alan bireylerin tedavi yönetiminde türlü zorluklarla karşı karşıya olduğu bilinmektedir. Hasta bireyi merkeze alan yöntemlerle bireyin kendi kendine INR izlemi yapabilmesi, tedavi ve komplikasyonları izleyebilmesi, beslenme yönetimi, ilaç yönetimi sağlayabilmesi bireyin öz-yönetimini destekleyen girişimlerdir. Kronik hastalıkların kontrolü ve tedavisinde öz-yönetim kavramı başarının ön koşuludur ve hastanın kendisi ile ilgili karar verme ve bakım sorumluluğunu üstlenmesini ifade eder (Ory ve ark., 2013). Varfarin kullanan hastaların da öz-yönetim becerilerinin en üst düzeyde geliştirilmesi ve bunu yaşam biçimi



olarak benimsemeleri önemlidir. Kendi kendine izlem yapılmaması, besin-ilaç etkileşimi kontrolü konusunda yetersiz kalınması zayıf terapötik kontrole neden olmaktadır. Sonuçta ise, bu durum tedavi yılı başına en az %15 herhangi bir komplikasyon gözlenmesinden, yine tedavi yılı başına en az %7-8 majör kanamadan sorumludur (Ansell ve ark., 2005). Varfarin kullanan bireylerin öz-yönetim becerilerinin geliştirilmesinde hemşirelere büyük sorumluluk düşmektedir. Bireylerin öncelikle hastalık ve yönetimi konusunda bilinçlendirilmesi, daha sonra öz-yönetim becerileri konusunda eğitilmeleri gerekmektedir. Bireyler kendi kendilerine tedavi yönetimini üstlendikleri takdirde sorumluluk duyguları artacak, hayat konforları daha iyi hale gelecektir.

## **2. Genel Bilgiler**

### **2.1. Varfarin**

Varfarinin keşfi oldukça ilginç olaylar sonucu olmuştur. Kanada ve Kuzey Amerika'da 1920'li yıllarda tatlı yonca ile beslenen hayvanlarda genel belirtisi kanama olan bir hastalık başlamış ve hastalığın ölümlü sonuçlandığı görülmüştür. Sonraki yıllarda yine aynı hastalığın devam etmesi ve bir çiftçinin yerel tarımsal deney istasyonuna başvurması ile araştırmalar başlamıştır. Bu merkezde bulunan araştırmacı kimyager Karl Paul Link ve öğrencisi Wilhelm Schoeffel tarafından yapılan çalışmalar sonucunda 1940 yılında yoncanın yapısındaki dikumarol (dicoumarol) maddesini keşfetmişlerdir. Link, bu maddenin sentezini yapmayı başarmış ve sonraki iki yılda "Wisconsin, Tarımsal Deney İstasyonu"daki (Wisconsin Agricultural Experimental Station) laboratuvarında Winconsin Mezun Araştırmaları Vakfı (Winconsin Alumni Research Foundation)'nın desteği ile temel kimyasal yapılarına uygun 100'den fazla hydroxycoumarin sentezlemiştir. Sentezlenen maddelerden özellikle iki tanesinin antikoagülan potansiyelini fark etmiş, fare ve köpeklerde etkili olduğunu saptamıştır. 1941 yılında da insanlarda denenmiş ve kullanılmaya başlanmıştır. Link ve arkadaşlarının çalışmaları sonucu elde edilen ve adına varfarin denilen ilaç, uzun yıllar koroner trombüsün önlenmesi amacıyla kullanılmıştır (Ansell ve ark., 2008; Cook-Campbell ve Sefton, 2010; Queensland Health, 2024).

### **2.2. Varfarinin Etki Mekanizması**

Varfarin, 4-hidroksikoumarin yapısında olan ve oral yoldan alınan bir antikoagülandır. Varfarin, karaciğerde K vitaminine bağlı olarak sentezlenen faktör II, VII, IX, X ile, antikoagülan protein C ve S'nin sentezini ve aktivasyonunu bozarak, antikoagülan etki göstermektedir (Çolak ve ark., 2016). Varfarin, oral yolla alındıktan sonra gastrointestinal sistemden (GİS) hızlı ve yüksek oranda absorbe olur. Plazma konsantrasyonu 1-9 saatte maksimal düzeye ulaşırken, yarılanma ömrü ortalama 36-72 saattir. Etkisini hipoprotrombinemi yaparak gösteren varfarinin emilim oranı yüksek olmasına rağmen plazma proteinlerinden albümine daha çok bağlandığı için biyotransformasyonu yavaş olup etkisi 2-7 gün arasında başlar. Protein C ve S üzerine olan etkisi nedeniyle prokoagülan etki gösterebilen ve ilk 24 saatte hiperkoagülopatiye neden olmasından dolayı tedaviye düşük molekül ağırlıklı heparinle başlanır ve 4-5 gün birlikte devam ettirilir (Ageno ve ark., 2012). Varfarin tedavisi kesildikten sonra antikoagülan etki 4-5 gün daha devam eder (Opie ve Gersh, 2009). Varfarin böbrek ve karaciğer tarafından metabolize edilip, metabolitleri idrar ve gaita ile vücuttan atılır (Altunbaş ve ark. 2013; Queensland Health, 2024).

### **2.3. Varfarin Tedavi Endikasyonları ve Kullanımı**

Varfarin, akut veya tekrarlayan venöz tromboemboli profilaksi ve tedavisinde, pulmoner emboli tedavisinde, ortopedik cerrahi ve kanser hastalarında venöz tromboembolizmin önlenmesinde, akut miyokard enfarktüsü (MI), kalp kapak protezi, atriyal fibrilasyon (AF) veya flutter hastalarında, inme riskinde ve antifosfolipid sendromunda sistemik embolizasyonun

önlenmesinde kullanılmaktadır (Wigle ve ark., 2013). Varfarin tedavisi venöz tromboembolide ve pulmoner embolide 3 ay veya embolinin tekrarlama durumuna göre daha uzun süreli, cerrahi operasyon sonrası 2-5 hafta arasında, AF hastalarında hastalığın seyrine göre (Wigle ve ark., 2013), metastatik kanserli hastalarda, risk faktörlerinin yok edilemediği durumlarda ve kalp kapak protezlerinde ise genellikle ömür boyu devam edilmesi önerilmektedir (Wigle ve ark., 2013; Salman ve ark., 2015).

Varfarin tedavisinde büyük özofageal varisler, ciddi trombositopeni varlığı, son altı ayda kanama öyküsü, dekompanse karaciğer hastalığı, hamilelik ve doğum sonrası 48 saat, hipersensivite durumu, alkolizm, demans veya ağır bilişsel bozukluk, kontrol altına alınmamış hipertansiyon (HT) ve ağır kanama riski olan hastalarda cerrahi operasyon sonrası ilk 72 saat kontrendikedir (Queensland Health, 2024).

Oral yolla, günde tek doz ve tercihen akşamları alınması önerilen varfarin, her gün aynı saatte içilmelidir. Unutulduğu takdirde ertesi gün çift doz almak yerine günlük dozun alınması önemlidir. Varfarin ilaç ve besin etkileşimi olan bir ilaç olmasından dolayı, yemeklerle en az bir saat ara ile, ilaçlarla iki saat ara ile alınmalıdır (Holcomb, 2006). Günlük doz 5mg/gün olarak başlanmalı ve INR düzeyine göre doz ayarlaması yapılmalıdır. Hastalık etiyojisine göre belirlenen varfarin dozu, INR değerine göre alınmalıdır. AF'li hastalarda belirlenen INR değeri 2,0-3,0 arasında olması gerekirken, (Li ve ark., 2020), mekanik kalp kapağı ameliyatı geçiren hastalarda Amerikan Kardiyoloji Birliği (American College Of Cardiology- ACA) ve Amerikan Kalp Derneği (American Heart Association- AHA) INR değerinin 2,5-3,5 arasında olması gerektiğini bildirmiştir (Salman ve ark., 2015). MI geçiren bireylerde de INR aralığının 2,5-3,5 arasında olması gerektiği bildirilmiştir. Venöz tromboemboli durumunda ise INR aralığı 2,0-3,0 arasında olmalıdır (Bozkurt, 2016).

#### **2.4. Varfarinin Besinlerle Etkileşimi**

Ortalama günlük K vitamini ihtiyacı 100 mcg kadardır. Yüksek dozda K vitamini içeren besinlerin alınması varfarinin etkinliğini azaltacaktır (Yıldırım, 2013). Kereviz, karahindiba, anason, meyan kökü, papatya, atkestanesi, bohça otu, çarkıfelek çiçeği, çemen, dağ kestanesi, frenk inciri, ısırgan otu, kaşıkotu, kırmızıbiber, yonca, melekotu, parmakotu, sinameki, su rezenesi, yabani turp, yabani havuç, zargan, keten tohumu, zerdeçal, deniz yosunu, greyfurt, karanfil, yer elması, zencefil, ayakotu, demirhindi, filkulağı, gilaburu, ginseng, koyungözü, meyankökü, sarımsak, söğüt, soğan, ananas gibi bitkiler ilacın etkisini artırarak kanamaya sebep olabilmektedirler (Aşiret ve Özdemir, 2012; TKD, 2012; Pulmoner Tromboembolizm Tanı ve Tedavi Uzlaş Raporu, 2015). Brüksel lahanası, nohut, karalahana, kişniş, karaciğer, maydanoz, marul, ıspanak, pazı, siyah / yeşil çay, leblebi, civanperçemi, kaşıkotu, ökseotu, şalgam, su teresi, fesleğen, brokoli, roka, semizotu, zeytin, soya fasulyesi ve yağları, balık yağı gibi besinler yüksek K vitamini içeriği sebebiyle ilacın etkisini azaltmaktadır (Türk Hematoloji Derneği-THD, 2010; Olson, 2023). Varfarin alan hastalarda diyet düzenlenmesi yapılırken K vitamini içeren gıdaların diyetten tamamen çıkarılması yerine, istikrarlı beslenme alışkanlığının sürdürülmesi, beslenme düzeninde günlük K vitamini miktarının sabit tutulması, dolayısıyla K vitamini alımındaki geniş değişikliklerden kaçınılması daha önemlidir (Violi ve ark., 2016).

#### **2.5. Varfarinin İlaçlarla Etkileşimi**

Varfarin ilaçlarla en çok etkileşime giren ilaçlardandır. Trombosit fonksiyonları üzerine etkili olan her ilaç dolaylı olarak varfarinin etkisini azalayabilir veya artırabilir.

**Varfarin etkinliğini arttıran ilaçlar:** Kumarinin diğer türevleri; makrolidler, penisilin G, sefalosporinler, amoksisilin, tetrasiklin, kloramfenikol, florokinolonlar, metronidazol, izoniazid gibi antibiyotikler; kapesitabin, flukanazol, itrakonazol, ketokonazol ve mikonazol antifungalleri; serotonin geri alım inhibitörü antidepressan ilaçlar (fluksetin, sertralin), trisiklik

antidepresanlar, fenitoin, valproat; simetidin, ranitidin, omeprazol; klofibrat, simvastatin; kortizon, prednizon; asetaminofen, aminosalisilik asit, diklofenak, piroksikam vb nonsteroid antienflamatuvar ilaçlar, alkol, aspirin, klopidogrel, heparin, direk trombin inhibitörleri, E vitamini; levotiroksin; amiodarone, diltiazem, verapamil, propranolol, propafenon, kinin, allopurinol, tamoksifen, disülfiram ve daha birçok ilaç varfarin etkinliğinin artmasına neden olmaktadır (Wigle ve ark., 2013; Olson, 2023).

**Varfarin etkinliğini azaltan ilaçlar:** Antitiroid ilaçlar, rifampin, griseofulvin, haloperidol, atorvastatin, pravastatin, kolestiramin, azatiopurin, metimazol, fenobarbital, sekobarbital, karbamazepin, fenitoin, C vitamini (yüksek doz), K vitamini, östrojenler, antihistaminikler, spironalaktone ve kortikosteroidler ise ilacın etkinliğini azaltan ilaçlardır (Olson, 2023).

## 2.6. Hastaların Varfarin Tedavisi Sırasında Yaşadıkları Sorunlar

Yapılan araştırmalar hastaların tedavi yönetimi, ilaç ve besin etkileşimleri konularında bilgilerinin yetersiz olduğunu (Briggs ve ark., 2005), tedaviye uyum ve maliyet sorunu yaşadıkları (Bajorek ve ark., 2007), laboratuvarlar arası farklı sonuçlar elde edildiği, yaş artışı ile birlikte komplikasyonların artışı, tedaviyi yönetmede zorluklar ve polifarmasi sorunu yaşadıkları (Briggs ve ark., 2005) belirlenmiştir. Yapılan hemşirelik çalışmalarında da benzer sonuçlar elde edilmiş (Cook-Campbell ve Sefton, 2010; Wilson ve ark., 2015), mekanik kapak ameliyatı olan hastalarda taburculuk sonrası eğitimin etkili olduğu, hastaların yaş, eğitim düzeyi, gelir durumu ve tedavi süresi ile tedavi uyumu arasında anlamlı bir ilişkinin olduğu (Wilson ve ark., 2015) belirlenmiştir.

## 3. Varfarin Kullanan Bireylerin Öz-Yönetimi

Öz-yönetim, bireyin kendisi ve sağlığı ile ilgili kendi bakımını yönetebilme yeteneği, tüm kararlara katılımı ve tercihlerini sunabilme, sağlık ekibinin diğer üyeleri ile işbirliği içinde olarak kendisinin anahtar rol oynaması olarak tarif edilebilir (Ory ve ark., 2013). Hastanın merkezde olduğu öz-yönetim kavramında hasta tedavisiyle ilgili kendi seçimlerini yapabilme yeteneğindedir. Varfarin tedavisinde öz-yönetim denilince hastanın evde kendi INR testini yapabilmesi, gerektiğinde doz ayarı yapabilmesi veya bunun için ilgili birime ulaşabilmesi, ilaç ve besin etkileşimlerini kontrol edebilmesini ifade etmektedir (Grunau ve ark., 2011; Jenner ve ark., 2015).

### 3.1. Varfarin Kullanan Hastaların Öz-Yönetiminde Hemşirenin Rolü

Varfarin kullanım sıklığı, süresi, ilacın etkinliğinin kandaki değerinin izlem gerekliliği ve yan etki potansiyeli açısından kronik hastalıkların tedavisinde özel bir yere ve öneme sahiptir. Kanama, hematom, trombositopeni gibi hayati önem taşıyan yan etkileri olan antikoagülan ilaç kullanan bireylerin özellikle sağlık personeli tarafından değerlendirilmesi gerekmektedir (Aşiret ve Özdemir, 2012). Hemşireler öncelikle varfarin kullanan hastaların gereksinimlerinin ne olduğunu saptamalı ve buna yönelik olarak eğitim ve bilgilendirme yapmalıdır. Yaşamsal bulguların takibi, laboratuvar izlemi, INR düzeyleri ve kullanılması gereken ilaç dozu, beslenme şekli, ilaç etkileşimleri, fizik aktivite, seyahat, komplikasyonların önlenmesi konularında yol gösterici olmalıdır (Franchini ve ark., 2016). Hemşire öncelikle varfarin kullanan hasta ve hasta yakınlarına ilaç kullanımı ve izlemi ile ilgili yaşam standardı oluşturacak önemli bilgiler vermelidir.

- ✓ Hemşire öncelikle bireyi değerlendirmeli, ilacın dozunu, doğru kullanımını etkileyen, etkisini değiştirebilen ya da yan etkilerin gelişmesine neden olabilen biyofizyolojik, psikolojik, sosyokültürel, çevresel ve politikoekonomik faktörleri irdelemelidir. Bu faktörlerden bazıları yaş, cinsiyet, eşlik eden kronik hastalıklar, malignite, travma, beslenme, alkol-sigara alışkanlığı, alerjileri, ilave kullanılan ilaçlar, hafıza, algılama,

karar verme yeteneđi, eđitim dzeyi, iř kořulları, farklı iklimlere sık seyahat etme durumu, gelir dzeyi, sosyal gvencesi olarak sıralanabilir.

- ✓ Tedavi bařlangıcında kanama riski yksek olduđundan kanama bulgu ve belirtilerinin erken tanınması, laboratuvar bulgularının izlemi nemlidir (aPTT, INR, PT). Hasta hastanede yatıyorsa yařam bulguları takip edilir, hasta travmadan korunur, mmkn olduđunca entbasyondan (nazogastrik tp, riner kateter) ve invaziv iřlemlerden (intramskler enjeksiyon vb.) kaınılır (Ařiret ve zdemir, 2012).
- ✓ Antikoaglan ilacın dođru dozda kullanılmasının amacı ve nemi konusunda bilgi verilir. Varfarin-ila ve varfarin-gıda etkileřimleri hakkında bilgi verilir. Varfarin; oral yolla, gnde tek doz halinde ve mmknse her gn aynı saatte alınmalıdır. A veya tok alınabilir fakat besinlerle etkileřimi olduđu iin yemekle birlikte alınmamalıdır. Daha ok đleden sonra saat 16:00 civarında alınması nerilmektedir.
- ✓ Alınması gereken doz unutulur ve aynı gn gece saat 24:00'e kadar hatırlanırsa, gnlk dozun aynen alınması gerektiđi ve normal kullanım řekliyle devam edilmesi nerilir. Eđer gnlk doz alınmamıř ise bir sonraki gn asla iki gnlk ila alınmamalı, normal kullanım řekline devam edilmelidir.
- ✓ Yanlıř doz ila alındıđında ve/veya iki gn ve daha fazla ila alımı unutulduđunda mutlaka kayıt edilmesi gerektiđi ve hekim/hemřireye bildirimini nerilir.
- ✓ Hastaya tıbbi kontrolleri ve laboratuvar incelemelerini (aPTT, INR) dzenli takip etmesinin nemi vurgulanır. Mmknse INR testi iin aynı laboratuvar kullanılmalıdır.
- ✓ Varfarin kullanımını sırasında ilave ila kullanımını gereksiniminde mutlaka hekim/hemřireye danıřması gerektiđi, kontrolsz ila kullanımından kaınması belirtilir.
- ✓ Diř tedavisi ve/veya herhangi bir cerrahi giriřim ncesi mutlaka hekime bildirmesi ve uygun olan ila dozu ayarlamasının yeniden yapılmasının gerekliliđi anlatılır.
- ✓ Elde edilen veriler deđerlendirilerek; bireyin gnlk yařam aktivitelerine iliřkin var olan/olası sorunları ve aktivitelerini etkileyen diđer tm faktrler gz nne alınarak hasta bireyin yardım gereksiniminin tr /derecesi belirlenmeli ve hasta birey iin en dođru, en uygun giriřimler planlanarak uygulanmalıdır.
- ✓ Olası kanamaların nlenmesi iin ađız bakımında yumuřak diř fırası, tırař iin tırař makinesi kullanımı nerilir. Sert burun temizliđinden ve konstipe olmaktan kaınması nerilir.
- ✓ Evde- iř yerinde- bahe iřlerinde travmalardan korunması gerektiđi, delici-kesici aletleri kullanmaktan kaınması gerektiđi hastaya ğretilir.
- ✓ Ayak yaralanmalarından korunmak iin yalın ayak gezilmemesi gerektiđi, ayakkabı veya terlik kullanımına dikkat etmeleri vurgulanmalıdır.
- ✓ Ara ii-dıřı trafik kazaları, kesici-delici alet yaralanmaları, darp, yksekten dřme, řiddetli bař arpması gibi i ve dıř kanamaya neden olabilecek durumlarda derhal hastaneye bařvurması řiddetle vurgulanır. Oluřan kk kesiklerde kanayan blgeye en az 5-10 dakika basın uygulaması yapılmalı, kesik blge kol veya bacakta ise kalp seviyesine elevasyonu sađlanmalı, blge bykse ve kanama durmuyorsa acil sađlık merkezine bařvurulmalıdır. (Ařiret ve zdemir, 2012)
- ✓ Aktivite ve istirahat arasındaki dengenin sađlanması ve aktivite sınırlamalarının amacı aıklanır, uygun egzersiz/aktivite planı belirlenir.
- ✓ Hastalara eđitim verilirken yařlı bireylerde ve kadınlarda daha fazla zen gsterilmelidir. Yařlı bireylerde unutma ve anlamada kognitif sorunlar ve yařa bađlı kanama riskinin artıřı sebebiyle, kadınlarda ađır menstrual kanama olasılıđı sebebiyle dikkatli olunmalıdır.
- ✓ Ekstra kan testleri gerekebileceđinden bařka herhangi bir hastalıđın (ishal, kusma, enfeksiyon veya ateř) belirtileri varsa bir doktora bildirmeleri gerektiđi sylenmelidir.

- ✓ Hastaların OAK kullandığına dair bir notu taşıması, hastanın kendini ifade edemediği herhangi bir kaza veya yaralanmada müdahale edeni yönlendireceği için böyle bir belgeyi taşımasının gerekliliği hasta ve yakınlarına anlatılmalıdır. Zira hastaların çoğu bu konuya dikkat etmemektedir. (Mercan ve Enç, 2011; Köksal ve Avşar, 2015).
- ✓ Hastalar kendi ilaç dozlarını ve INR değerini kaydetmeye teşvik edilmeli, kendi kendine tedavi rejimini yönetmeleri öğretilmelidir. Hastalar her aldıkları tableten sonra tarih atarak kayıt tuttukları takdirde doz unutulmasının önüne geçilecektir.
- ✓ Hasta ve yakınlarına acil durumlar ya da sormak istediği konular için ulaşabileceği hekim ya da hemşirenin ismi ve telefon numaraları mutlaka verilmelidir. Polikliniklerde takip edilen hastalar için de eğitim programları düzenlenerek bireylerin eğitim gereksinimleri saptanmalıdır. (Aşiret ve Özdemir, 2012; Mercan ve Enç, 2011; Köksal ve Avşar, 2015; Queensland Health, 2024).

### 3.2. Varfarin Kullanımında Fizik Muayene ve Yaşam Bulgularının Takibi

Kanam ve inme sebebi olabileceğinden özellikle kan basıncı izlemi bu hastalarda önemlidir. Kan basıncı izlemi ile birlikte nabız takibinin yapılması da önemlidir. İzlemler haftalık veya herhangi bir anormal durum olduğunda yapılmalı ve bu ölçümler hasta ve hasta yakınlarına öğretilmelidir (Salinas ve Madison, 2016).

### 3.3. Varfarin Kullanımında İlaç Yönetimi

İlaç kullanımında sıklıkla karşılaşılan problemler, ilacın unutulması, aynı saatte alamama, polifarmasi gibi sorunlardır. Bunları önlemek için haftalık veya günlük ilaç kutuları kullanımı, alarm kurularak saatin hatırlatılması, yaşlı hastalarda polifarmasi ve diğer komplikasyonların önlenmesi için gruplandırma yapılarak bir başkası tarafından ilacın verilmesi gibi yöntemlere başvurulabilir (Haque, 2009). Hemşireler tarafından ise varfarin alan hastaların düzenli elektrokardiyografi (EKG) izlemi ve INR izlemi konusunda yönlendirme yapmaları gerekir. Ayrıca ilacın etkileri ve yan etkileri, kullanım şekli ve izlemi konusunda da yeterli bilgilendirme yapmalıdırlar. Varfarin kullanım programı ve dozu, ilacını almayı unutursa ne yapması gerektiği, ilacı kullanım sırasında oluşabilecek acil durumlar ve bu durumun doktora ya da hemşireye bildirilmesi gerektiği, varfarin kullanırken günlük yaşamda nelere dikkat etmesi gerektiği konuları da hastaya açıklanmalıdır (Ory ve ark., 2013).

### 3.4. Varfarin Kullanımında Beslenme Yönetimi

K vitamini içeren besinlerin varfarin mekanizmasını etkilediği ve etkisini azalttığı bilinmektedir. Bu besinlerin hastaya ve besin hazırlayıcılarına öğretilmesi gerekmektedir. Diyet düzenlemesinde K vitamini içeren gıdaların diyetten tamamen çıkarılması yerine, beslenme düzeninde günlük K vitamini miktarının sabit tutulması, dolayısıyla K vitamini alımındaki geniş değişikliklerden kaçınılması daha önemlidir (Violi ve ark., 2016).

### 3.5. Varfarin Kullanımında INR İzlemi

Varfarinin terapötik aralığının dar olması, komplikasyonların önlenmesi ve tedavi etkinliğinin sağlanması açısından hastaların tedavi başladıktan sonra kan testleriyle düzenli takibini gerektirmektedir. Varfarin tedavisini izlemede en yaygın kullanılan laboratuvar testi PT'dir. Bu testin uygulamasında çeşitli ülkelerde farklı tromboplastin kaynağı kullanılması PT'yi değerlendirmede hastaların takibi açısından farklılık doğuracağından DSÖ tarafından 1983 yılında INR kavramı kabul edilmiştir (Voukalis ve ark., 2016). INR değerinin birimi yoktur ve normal bir insanda INR değeri 1 olarak kabul edilmektedir. Bireyin hastalığına özgü belirlenen INR düzeyinin subterapötik düzeyde olması tromboembolik olayların artışına (Oake ve ark., 2008), subterapötik düzeyde olması ise ciddi gastrointestinal kanama, intraserebral ve diğer majör kanama olaylarının artışına sebep olmaktadır (Vigué, 2008). Hedef INR değeri derin ven

trombozu, pulmoner emboli, kardiyomiyopati, AF, antifosfolipid sendromu, akut MI ve serebrovasküler olay geçiren bireylerde 2-3 arasında; mekanik prostetik kalp kapağı varlığında ise 2,5-3,5 arasında tutulmalıdır (Ansell ve ark., 2008; TKD, 2012). Varfarin tedavisinde doz-cevap ilişkisi bireyler arasında büyük değişiklikler gösterir. Yaşlı hastalar varfarin tedavisine daha hassas olduklarından daha büyük dikkat gereklidir. İstenilen INR düzeyinde bile tüm hastalarda ayda bir kez bakılması önerilir (Wigle ve ark., 2013).

Antikoagülan tedavinin etkinliğini değerlendirmede yalnızca INR değerine bakılması yeterli olmayıp zaman içerisinde etkin düzeyde ne kadar kalındığının da değerlendirilmesi gerekmektedir. TTR oranı (etkin INR düzeyi sayısı/toplam kontrol sayısı X 100) hesaplanarak bu değerlendirme yapılabilir, %75'in üzeri en iyi, %60-%75 arası orta dereceli antikoagülan kontrolü ifade etmektedir (Proietti ve Lip, 2016). Ancak yapılan çalışmalar göstermiştir ki OAK alan hastaların çoğunluğunda TTR oranı hedeflenen değerin altındadır (Li ve ark., 2020; Proietti ve Lip, 2016).

INR izleminde güçlükler yaşanması, maliyet ve zaman sorunları nedeniyle son yıllarda hastaların evde kendi kendine INR izlemi yapabilmesi gündeme gelmiştir. Elle taşınabilir cihazlar ve stripleri aracılığıyla bireyler kendi kendilerine INR izlemi yapabilmektedir. Yapılan bir çalışmada evde kendi kendine INR izlemi ile terapötik aralıkta kalma oranı %72 iken, olağan bakım alan hastalarda %50 olarak belirlenmiştir ve oldukça farklıdır (Grunau, 2011). Ayrıca kendi kendine INR izlemi yapan hastaların konfor düzeyinin daha yüksek olduğu ve hastaların bu durumdan memnun oldukları saptanmıştır (Jenner ve ark., 2015).

Sonuç olarak varfarin kullanan hastaların öz-yönetiminde birçok faktör rol almakta ve bireysel değişkenler oldukça yüksek seviyededir. Bu değişkenlerin kontrol altına alınabilmesi için öncelikle bireylerin tanınması, bu değişkenlerin belirlenmesi ve uygun eğitim programına dâhil edilmeleri temel noktadır. Bu sebeple varfarin hastalarında öz-yönetimi geliştirmek için eğitim müdahalelerinin bireyselleştirilmesi oldukça önemlidir (Praxedes ve ark., 2020).

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## COMPARISON OF CHEMICAL AND PHYSICAL PROPERTIES OF NATURALLY OCCURRING GRAPHITE IN KUTAHYA ALTINTAŞ-OYSU DISTRICT AND 99% PURITY INDUSTRIAL GRAPHITE

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### Abstract

Graphite naturally occurs in crystalline, flake, or amorphous forms. Its purity can vary between 70% and 90%. Natural graphite possesses varying electrical and thermal conductivity, chemical resistance, and mechanical properties depending on its purity. It is used in applications such as pencil cores, foundries, lubricants, battery rods, and refractory materials. High-purity graphite, on the other hand, is composed of carbon atoms with very high purity and is produced in laboratory settings. It can achieve purity levels of 99% or higher. This type of graphite has high thermal and electrical conductivity, chemical resistance, and a low coefficient of friction. Due to its excellent electrical conductivity, it is used in electronic devices, nuclear reactors, and high-temperature applications. The carbon content of high-purity graphite minerals ranges between 90% and 98%, indicating that the graphite is of high purity and suitable for industrial use. Graphites with carbon content between 85% and 95% are typically classified as Industrial Quality Graphite, while those with carbon content between 70% and 85% are considered Low Quality Graphite. Graphite mining in Turkey began in 1941, and since then, economically valuable graphite deposits have been discovered in over 20 regions. These deposits are found in various areas, including Kastamonu, Yozgat, Kütahya, Muğla, Adıyaman, İzmir, Istanbul, Aydın, and Artvin. The Kütahya-Oysu deposit is the only actively mined graphite deposit in Turkey, located within the Upper Paleozoic Emirgazi Formation, which consists of amphibolite gneiss, schist, quartzite, and marble, reflecting high-temperature and high-pressure conditions. Amorphous graphite mineralization is spread throughout the metamorphic layers. Due to significant tectonic deformation, ore zones are discontinuous, with ore thickness varying between 5 and 10 meters. This deposit contains a total of 7.2 million tons of graphite and has a potential of up to 125 million tons of graphite ore. In industrial-grade graphite samples with 99% carbon content, trace elements are present in the following abundance order: Ca, Si, Mg, Al, Fe, W, K, Sr, Au, S, Ti, Cu, Ar, and Mn. In the Kütahya Altıntaş Oysu sample, known to have a carbon content between 75% and 85%, trace elements identified include Ca, Fe, Si, Al, Mg, S, K, Cl, Mn, Na, Sr, Ti, As, Au, Pb, Pt, Zn, Cu, V, Ge, Br, Ni, Co, and Ar. The presence of trace elements in graphite can impact its quality and usability, so it is essential to carefully analyze these trace elements for specific applications. The primary component of graphite is carbon. Additionally, the presence of minerals such as quartz, pyrite, biotite, and apatite can vary depending on the formation process and geological environment of the graphite. XRD data for pure graphite and the Kütahya sample show similar peaks. Such similar XRD data indicate that the materials have comparable crystal structures or phases.

**Keywords:** Natural Graphite, 99% Pure Graphite, Element Content, Mineral Component.

## Introduction

In response to the increasing importance of natural resources throughout history, many countries, communities and the European Union (EU) have conducted and are continuing numerous studies on critical raw materials. The most important of these studies are the “Critical Raw Materials for the EU” prepared by the European Union and the “Risk Lists” prepared by the British Geological Survey (BGS). In the Critical Raw Materials for the EU report, 41 raw materials were examined and 14 critical raw materials were determined, and graphite is one of these 14 critical raw materials. The British Geological Survey also examined 52 elements/element groups in 2011, created a risk criterion and published the “Risk List 2011” list. In addition to this study, a separate study was conducted for industrial minerals in 2012 and the “BGS Industrial Minerals Risk List 2012” list was prepared. Graphite is one of the important raw materials in these studies.

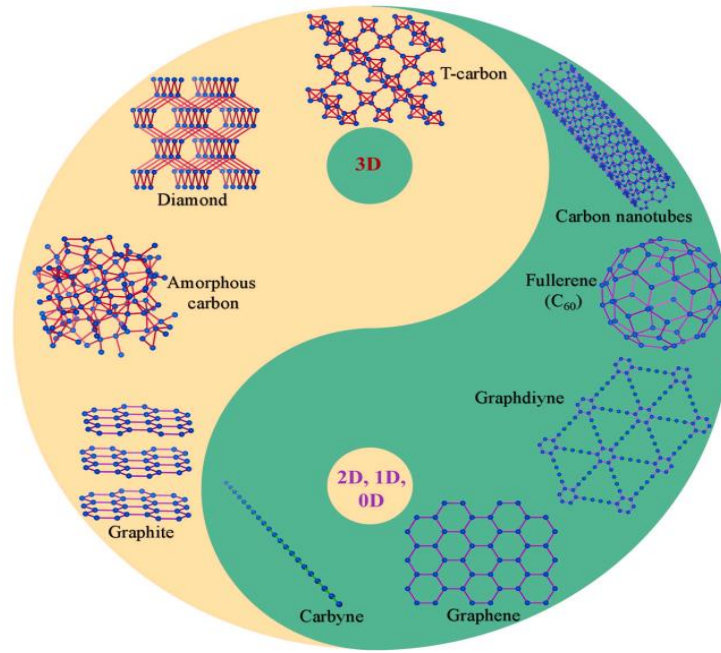
The reasons why graphite is considered such a strategic raw material are; Excellent thermal conductivity, Excellent electrical conductivity (It can be up to 20 times more conductive than copper), Its very important properties such as heat resistance (Uysal, 2012a; Uysal, 2012b; Uysal, 2012c; EU Report, 2014). Graphite, a carbon mineral (carbon minerals; coal, graphite and diamond), has very different properties from coal and diamond. The density of coal is 1.3-1.9 g/cm<sup>3</sup>, graphite is 2.1-2.3 g/cm<sup>3</sup> and diamond is 3.5 g/cm<sup>3</sup> (Figure 1).



**Figure 1.** Natural and synthetic graphite image.

Graphite is a carbon mineral with a very soft, oily texture and the ability to bend into thin sheets. Its hardness is 1-2 (on the Mohs scale), and its density is 2-2.26. Its color is black and gray, its line color is ash. It exists in nature in crystal, flake and amorphous forms, the best form is crystalline graphite and has the highest grade (Table 1) Graphite burns at 600-670°C in an oxygen environment, does not burn up to 3,500°C in normal air environments, its melting point is 3,927°C, and when it reaches its melting temperature, it turns directly into a gas, not a liquid. It is stable at normal temperatures and resistant to chemical decomposition. It is resistant to acids, bases and salts, and is insensitive to chemical reactions (Table 2).

Graphite, a grayish-black opaque (sometimes with an earthy-matte luster) mineral with a metallic luster, is one of four forms of pure crystalline carbon (the others are carbon nanotubes, diamonds, and fullerenes). The structure of diamond is formed by each carbon atom being bonded to four other carbon atoms by strong covalent bonds in a regular isometric structure - the hardest known mineral. In graphite, the carbon atoms are bonded to only three other carbon atoms, forming strong, two-dimensional layers that are extremely stable, but here each layer is weakly bonded to adjacent layers by van der Waals bonds (Figure 2).



**Figure 2.** Other Forms of Crystalline Carbon (Yi et al. 2022)

In 2020, global graphite consumption consisted of 38% natural and 62% synthetic graphite. Synthetic graphite was used in electrodes (32%), recarburizing (10%), shaped graphite (4%), lubricants (4%), and other applications (12%). Natural graphite was utilized in refractories (16%), batteries (8%), foundries (5%), and other uses (9%) (Natural-Resources Canada 2022). Graphite is divided into two classes as Natural Graphite and Synthetic Graphite.

### 1. Natural Graphite

- a. Amorphous graphite (also known as microcrystalline or cryptocrystalline graphite).
- b. Flake graphite and Crystalline graphite; It is found in the form of lump or vein graphite.

**Table 1.** Areas of Use of Graffiti According to Its Features (MTA, 2023)

Purpose of Use	Areas of Use
Refractory (or durable)	Refractory Bricks Casting Dyes Crucibles Horizontal Muffle Furnaces (Retort) Stove Dyes Electrodes
Conductivity	Motor and Generator Brushes Battery Powders Brake Linings Electrodes Printing (Electro - Typing) Heat Exchangers
Carbon Donor	Carbon Booster Smelting Processes Nuclear Moderators (Neutron Moderators)
Lubrication	Lubricants Motor and Generator Brushes Gunpowder Polish Tires Pencils Bearings Seed and Fertilizer Coating Brake Liners Piston Rings Engine Liners
Chemical Inertness	Gaskets Adhesives Paints Refractories Battery Carbons Casting Paints Rust Cleaners (Boilers) Stove Paints

**Amorphous Graphite;** It is formed as a result of the metamorphism of coal beds under high pressure and temperature and contains microcrystalline grains in metamorphic rocks, has an earthy appearance, and is mainly produced in Mexico, China and South Korea.

**Flake and Crystal Graphite;** They are types of crystal graphite named according to their locations and grades. Flake graphite; It is formed by the metamorphism of organic substances that have accumulated in layers in metamorphic rocks and then changed under high temperature and pressure, and together with this graphite; gangue minerals such as schist, gneiss etc. may be found. The best form is crystalline graphite and has the highest grade. Vein type graphite is usually formed as a result of the accumulation of organic materials in the cavities and cracks of metamorphic rocks, and other minerals such as feldspar, quartz, mica, pyroxene, zircon, apatite, etc. can be found with this type of graphite (Uysal, 2012a; Kwiecińska and Petersen, 2004).

**Table 2.** Graphite Types According to Usage Areas (Syrahresources, 2023)

Areas of Use	Flake Graphite	Amorphous Graphite	Crystalline Graphite	Synthetic Graphite
Lithium-Ion Batteries (LIB)	x		x	x
Refractory and Casting Industry	x	x		x
Lubricant and Coating	x	x	x	x
Friction Products	x	x	x	x
Powder Metallurgy	x		x	x
Pencil	x	x		
Nuclear Reactors	x		x	x
Hydrogen Fuel Cells	x			x
Vanadium Redox FlowBatteries			x	x
Electric Arc Furnaces				x
Graphite Electrodes in Aluminum Production				x

Due to its properties, graphite has a wide range of uses. The purest graphite is mostly used in electric batteries, dry batteries, steel industry and electro-metallurgy industry, electrodes in electrical devices, pencil manufacturing and reactors as atomic graphite.

Graphites with lower carbon content and less purity can be used in refractory coatings and in the production of refractory pastes in furnaces, in foundry (iron and steel), in painting, in graphite greases and in many other areas (Graphite One Resource, 2015; Urcun, 2008, ÖİK Report).

### Conclusion and Recommendations

In Turkey, production has been made from formations where graphite has been defined at different times, but production could not be continued in these production areas due to the fact that the ores showed a disseminated structure and the graphitization value was not at the desired level (Uysal, 2012a; Urcun, 2008, ÖİK Report). As a result of the enrichment studies carried out in MTA in the ore with relatively good graphitization properties around Bandırma-Çığmış village, a product containing 70% C was obtained.

The fact that the ore had a lot of quartz and clay, the failure to implement the correct plan in a timely manner, etc., caused the ore to remain idle (Uysal, 2012a). The formations in the Kütahya region are among the best formations in our country in terms of graphitization. Although the results of the pilot scale enrichment studies of the ore carried out in MTA were not positive, it was determined that the graphitization value and grade of this deposit were remarkable (Figure 3).

In the 1980s, graphite mining was intensively carried out in the Kütahya-Altıntaş-Oysu regions. In those years, graphite was produced as an underground operation in both regions, and a large part of the 60-70% C content obtained after the chinking process was offered to the iron and steel industry and the casting industry (Tufan and Batar, 2015).

With the demand for graphite concentrate with a C ratio of 80-85% in the European market towards the end of the 1980s, investments in the enrichment of graphite ore became inevitable. The producer company in the Kütahya region started investing in a flotation facility with a capacity of 100 tons/day in 1990, and trial production began in late 1991.





**Figure 3.** Türkiye graphite deposits map (İlhan et al. 2020).

### Geochemistry of Graphite Formation

Carbon is the fourth most abundant element in the solar system. It ranks 12th to 17th among the elements, with an estimated concentration of 180 to 270 ppm in the Earth's crust. Determining the presence of carbon in the Earth's crust is difficult because the carbon that is present cycles through rocks, sediments, the atmosphere, the biosphere, and ocean deposits. The behavior of carbon in the geochemical cycle is affected by the formation of carbon. Most of the carbon in the Earth's crust (about 80-90 percent) is found in carbonate rocks. Most of the other carbon on Earth is found in living and fossil organic matter, in the atmosphere as carbon dioxide, or dissolved in the ocean. All forms of carbon are involved in the carbon cycle. Graphite accounts for only a small portion of the carbon in the Earth's crust, probably less than 0.5 percent. Much of this graphite probably originated from high-temperature thermal alteration of organic matter from biogenic sources deposited in sedimentary rocks and underground reservoirs. Graphite is stable and inert in the crust, unchanged under surface weathering conditions. Burial and thermal metamorphism tend to recrystallize graphite. Therefore, graphite remains largely isolated from the general carbon cycle.

The graphite mineralization in the Kütahya Oysu deposit, which is the only operated deposit in our country, is located in the Upper Paleozoic Emirgazi formation, which consists of amphibolite gneiss, schist, quartzite and marble representing high temperature and high pressure conditions. Amorphous graphite mineralization is seen spread throughout metamorphic layers. Due to strong tectonic deformation, ore zones are generally discontinuous and ore thickness varies between 5-10 meters. The deposit contains 7.2 million tons of graphite (JORC) and potentially 125 million tons of graphite ore. Regarding the mineralization in the region; it is mentioned that graphite mineralization exists at deeper depths (more than 225 m) and has a mine life of 15 years. The only known active graphite business in our country, owned by a private company, is located in Kütahya. The mine located in Oysu Village of Kütahya has an operating permit within an area of 1,500 hectares. Amorphous graphite is produced thanks to the flotation facility with a monthly production capacity of 4,500 tons. In addition to graphite, antimony and kaolin raw materials are also located within the same area.

In industrial-grade graphite samples with 99% carbon content, main and trace elements are present in the following abundance order: Ca, Si, Mg, Al, Fe, W, K, Sr, Au, S, Ti, Cu, Ar, and Mn (Figure 4). In the Kütahya Altıntaş Oysu sample, known to have a carbon content between 75% and 85%, trace elements identified include Ca, Fe, Si, Al, Mg, S, K, Cl, Mn, Na, Sr, Ti, As, Au, Pb, Pt, Zn, Cu, V, Ge, Br, Ni, Co, and Ar (Figure 5).

The presence of trace elements in graphite can impact its quality and usability, so it is essential to carefully analyze these trace elements for specific applications.

The primary component of graphite is carbon. Additionally, the presence of minerals such as quartz, pyrite, biotite, and apatite can vary depending on the formation process and geological environment of the graphite. XRD data for pure graphite (Figure 6) and the Kütahya sample (Figure 7) show similar peaks. Such similar XRD data indicate that the materials have comparable crystal structures or phases.

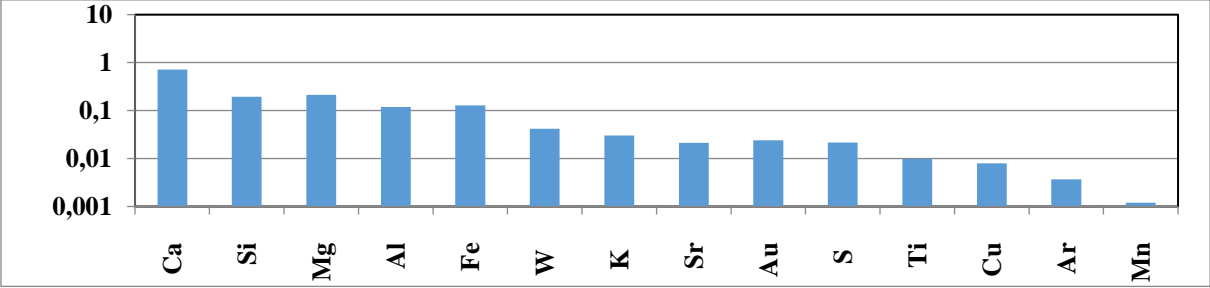


Figure 4. Main and trace elements content of industrial-grade graphite of samples by 99% carbon content

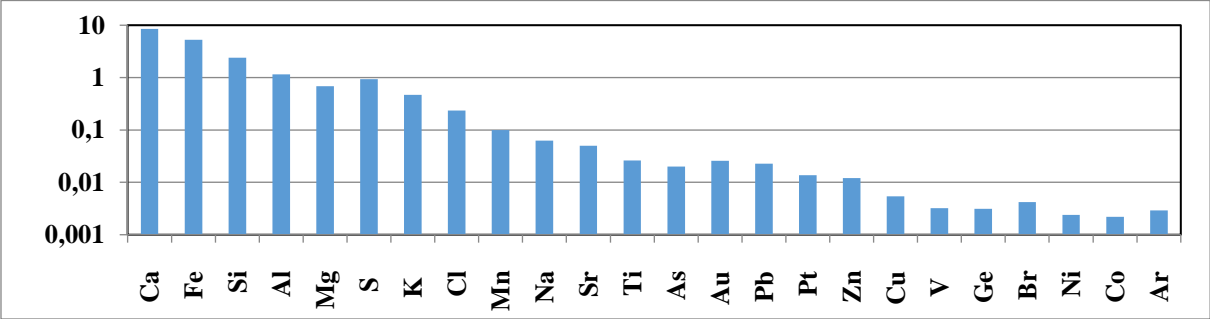


Figure 5. Main and trace elements content of graphite of samples in Kütahya Altıntaş Oysu.

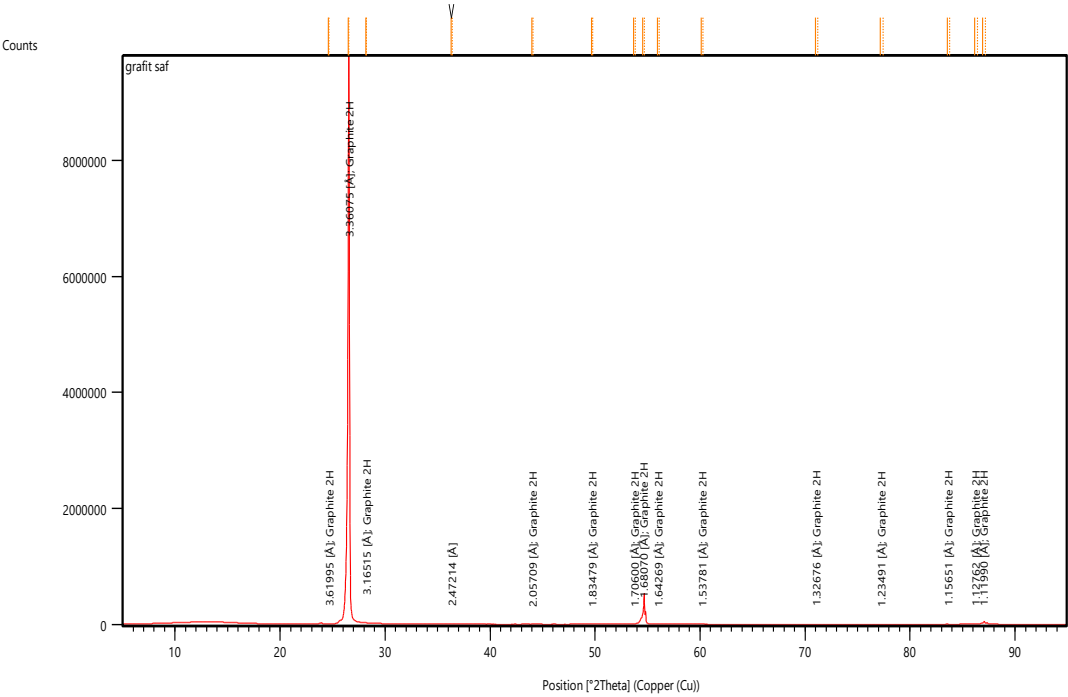


Figure 6. XRD data for pure graphite.



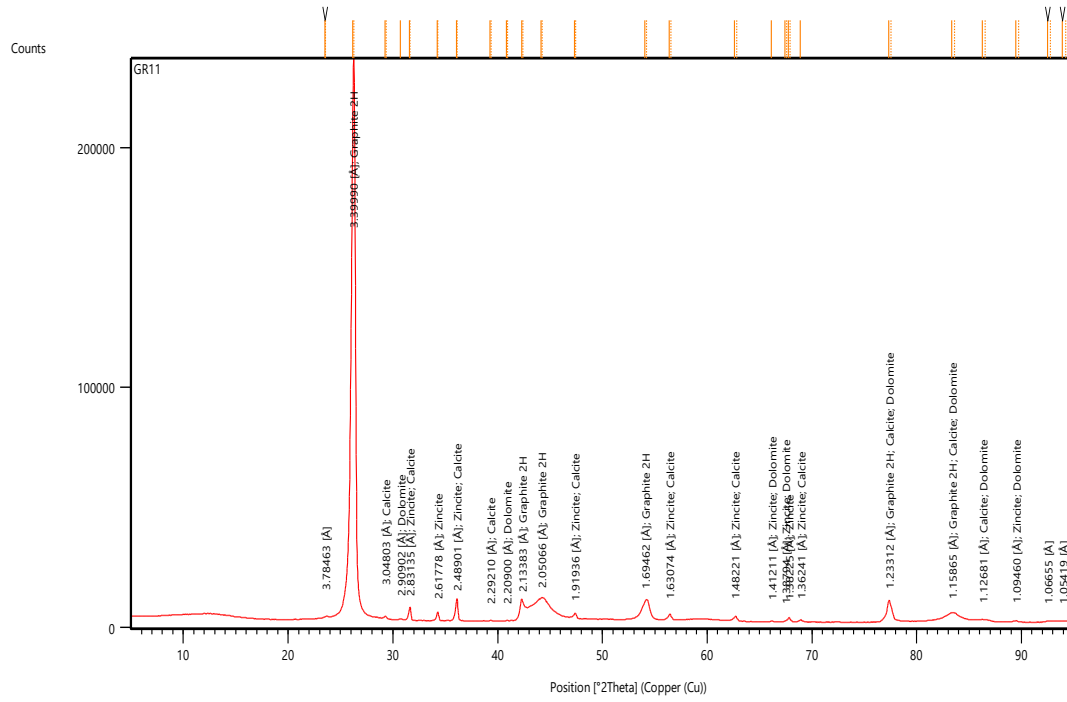


Figure 7. XRD data for the Kütahya graphite sample

**Thanks and Information Note**

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## ORGANIC GEOCHEMICAL CHARACTERISTICS OF BITUMINOUS SHALES IN THE HIRKA FORMATION

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### **Abstract**

This study investigates the bituminous shales of the Hırka Formation, dating to the Middle Miocene, within the Beypazarı Basin. The Hırka Formation, which spans the Middle to Upper Miocene, consists of conglomerates, agglomerates, sandstones, siltstones, shales, coal, bituminous shales, limestones, and tuffs, and is exposed in the western part of Beypazarı and the northern part of Yeni Çayırhan. These shales, part of the Neogene lignite formation sequence in Western Anatolia, were influenced by both fluvial and lacustrine facies, forming predominantly under lacustrine conditions. In this study, bituminous shale samples collected from various locations within the Hırka Formation were analyzed for their organic matter content, types, maturity, and depositional environment. The analyses were conducted using Total Organic Carbon (TOC) measurements and Rock-Eval pyrolysis to reflect the general characteristics of the basin. The TOC content of the samples ranged from 2.08% to 48.48%, with an average of 10.013%. The presence of more than 0.5% organic carbon in the rocks indicates their potential as source rocks. The organic geochemical analyses revealed that most samples fall within the Type 1 kerogen range on the HI (Hydrogen Index) vs. OI (Oxygen Index) plot, while a few samples were in the Type 2 kerogen range. Typically, petroleum source rocks contain amorphous-sapropelic organic matter and are composed of Type 1 and Type 2 kerogens. Tmax values indicate that most samples are within the petroleum generation window, with some levels showing immature or early maturity stages. The combined evaluation of organic matter content, thermal maturity, and kerogen types demonstrates that the bituminous shales possess significant potential for petroleum generation.

**Keywords:** Hırka Formasyonu, bitümlü şeyl, Toplam Organik Karbon (TOC), organik jeokimya, Rock-Eval piroliz analizi

## **Introduction**

Total Organic Carbon analysis is applied to determine the amount of organic carbon in the rock. The amount of organic matter in the rock is expressed as a weight percent. The TOC value of a rock sample is measured by burning the organic matter under air or oxygen atmosphere. This temperature is 1500°C for Leco, 1100°C for Charmograph and 600°C for Rock-Eval. Rocks with good source rock properties have high TOC values. However, not every rock with high TOC can be expected to be a source rock.

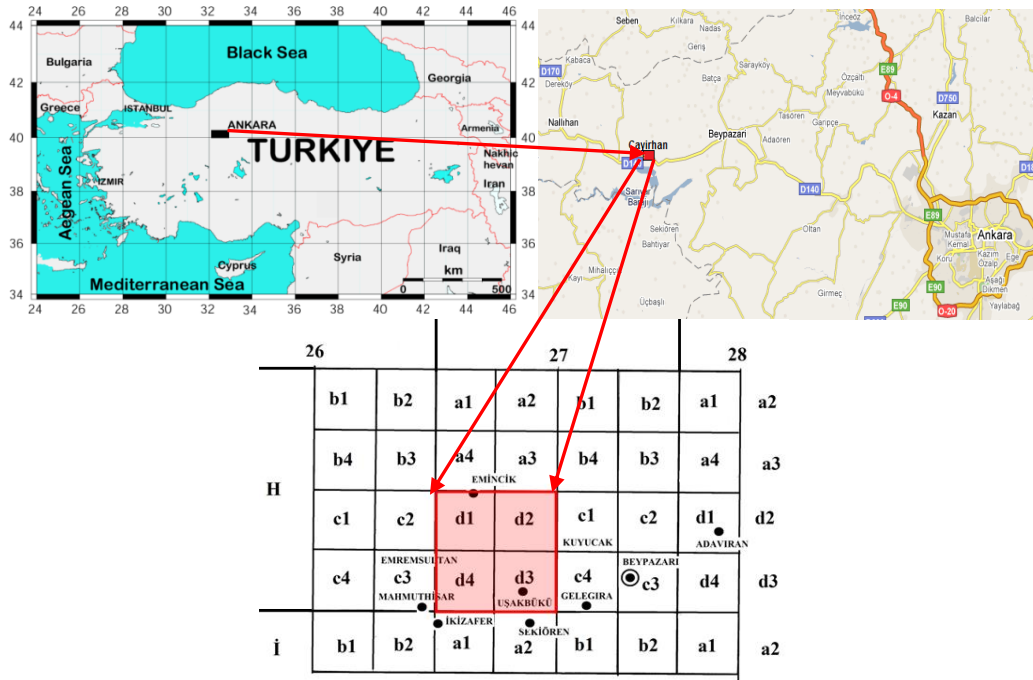
In this section, bituminous shale samples taken from different points of Hırka Formation in Beypazarı basin were evaluated in terms of organic matter amount, organic matter type, maturity and depositional environment. For this reason, the analyzed bituminous shale samples were selected to represent the entire basin and Total Organic Carbon (TOC) and Rock-Eval pyrolysis analyses of these samples were performed.

The type and maturity of organic matter in rocks control the composition and amount of hydrocarbons to be formed (Philippi 1965, Vanderbroucke et al. 1976, Durand and Espitalie 1976, Tissot and Welte 1978, Peters 1986).

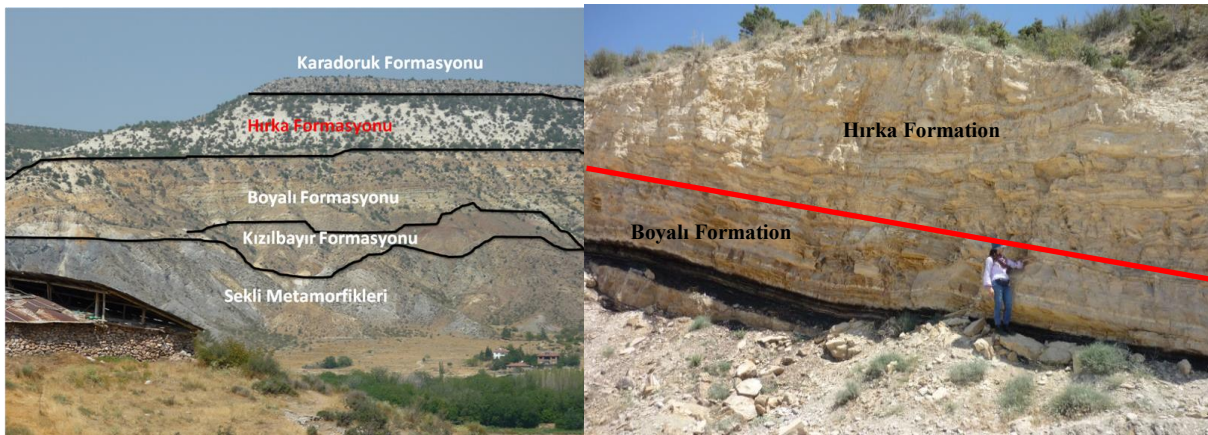
Organic geochemical analyses give the best results especially in drilling samples. Because drilling samples are protected from all kinds of surface effects. Therefore, organic geochemical analyses were carried out from drillings made in the field and systematic fresh surface samples during field investigations. The amount of organic matter in the host rocks can be determined by determining the total amount of organic carbon (TOC) in the rock. The total amount of organic carbon represents the sum of the carbon amount of kerogen in the rock and the carbon amount of hydrocarbons derived from this kerogen but not released out of the rock (Durand et al. 1972). The amount and type of organic matter in a rock can determine the potential of the host rock. If we compare and evaluate the organic carbon percentages obtained from the analyses with the host rock classifications used, it is seen that they vary between very good and excellent host rock properties. Using the data obtained from pyrolysis analysis such as Tmax, HI, TOC, S1, S2 peaks according to the pyrolysis analysis results, the organic matter type, petroleum source rock potential and maturity were determined. While most of the samples in the HI versus OI graph fall into the Type 1 kerogen range, all of the remaining very few samples except one are in the Type 2 kerogen range.

## **Study area**

Located west of Beypazarı and north of Yeni Çayırhan. It covers an area of 30 km<sup>2</sup> within the Bolu H27-d1-d2-d3-d4 sheets, west of Beypazarı and just northeast of Çayırhan. The Neogene basin within the approximately 1500 km<sup>2</sup> area between Beypazarı and Sarıyar Dam presents a sedimentary sequence thicker than 1000 m between Middle-Upper Miocene (Figure 1-2).



**Figure 1.** Location of the study area and the Neogene Basin including the study area.



**Figure 2.** a) Field relationships of Sekili metamorphics, Kızılbaşır, Boyalı, Hırka and Karadoruk Formations, b) Boyalı and Hırka Formation contact.

This sedimentary sequence unconformably overlies the basement rocks consisting of metamorphic, ophiolite, carbonate and clastic rocks of Paleozoic to Eocene age. The Miocene sequence consists of Boyalı, Hırka, Karadoruk and Sarıağıl Formations from bottom to top.

## Materials and Methods

**Organic Matter Analysis:** In order to determine the amount and type of organic matter in the examined samples, pyrolysis analyses were performed on samples at the Research Center Laboratories of the Turkish Petroleum Corporation (TPAO). Some of these analyses were performed using a Rock-Eval II type device. The analysis method is based on heating 100 mg of ground rock sample in a helium atmosphere for 3 minutes. The Rock-Eval II device contains a pyrolysis measurement unit, an oxidation measurement unit, and also an automatic sample carrier that places S1, S2, S3 into the pyrolysis measurement unit and then into the oxidation measurement unit. Both pyrolysis data and TOC values can be obtained using the Rock-Eval II device. The Rock-Eval II device contains a TOC module where the TOC value is calculated automatically.

**Kerogen Elemental Analyses;** (C, H, S, N, O) Kerogen elemental analyses of samples from the study area were carried out using the mass spectrum (EI) VG-ZAPSPEC spectrometer at TÜBİTAK-ATAL. This method involves boiling approximately 0.5 g of kerogen extracted from the rock with a solution passed through argon gas at 60 °C for 7 hours, then waiting at -20 °C for 2 hours, and filtering and drying the precipitated material, and calculating the C, H, S, N, O element amounts as a percentage in the remaining material.

### **Organic Matter Analysis**

Organic geochemical analyses give the best results especially in drilling samples. Because drilling samples are protected from all kinds of surface effects. For this reason, organic geochemical analyses were carried out from drillings made in the field and systematic fresh surface samples during field investigations. The amount of organic matter in the host rocks can be determined by determining the total amount of organic carbon (TOC) in the rock. The total amount of organic carbon represents the sum of the carbon amount of kerogen in the rock and the carbon amount of hydrocarbons derived from this kerogen but not released out of the rock (Durand et al. 1972). The amount and type of organic matter in a rock can determine the potential of the host rock. It is known that rocks containing only more than 0.50% organic carbon in terms of weight percentage can be host rock (Ronov1958, Gehman1962, Welte1965, Meiver1967, Dow1978, Momper1978, Tissot and Welte 1978, Ala et al.1980, Basu et al.1980). Rocks with lower organic carbon content than this value lose their feature of being host rock. Because even if some oil is formed in such rocks, this oil cannot be thrown out of the rock, and even if it is thrown, it cannot provide significant accumulation where it goes. Generally, if the amount of organic carbon is less than 0.5%, it is defined as poor, between 0.5-1.0% it is medium, and if it is more than 1.0% it is defined as good-rich host rock (Thomas 1979, Kraus and Parker1979). The organic carbon percentages in bituminous shale samples of the Miocene Hırka Formation vary between 2.08-48.48. The average organic carbon value of the formation is 10.013%. If we compare and evaluate the organic carbon percentages obtained from the analyses with the host rock classifications used, it is seen that they vary between very good and excellent host rock properties. Using the data obtained from pyrolysis analysis such as Tmax, HI, TOC, S1, S2 peaks according to the pyrolysis analysis results, the organic matter type, petroleum source rock potential and maturity were determined. While most of the samples in the HI versus OI graph fall into the Type 1 kerogen range, all of the remaining very few samples except one are in the Type 2 kerogen range. In addition, the Tmax values obtained in the measured pyrolysis analysis data help us to comment on the thermal evolution of the host rock. In the HI versus Tmax graph, it was determined that most of the samples fall into the Type 1 kerogen range and are between diagenesis and the petroleum window. Considering the Tmax limit values that vary according to kerogen types in the study conducted by Espitaliè et al. (1985) , it was determined that most of the samples were in the petroleum window, and when the samples were evaluated stratigraphically level by level, it was determined that some levels were in the Immature-Early Mature stage.

### **Kerogen**

Kerogen is a type of solid, insoluble organic matter found in sedimentary rocks. It consists of various organic materials, including remnants of dead plants, algae, and microorganisms, which have been transformed by geological processes involving compression and heat. The total estimated carbon content in kerogen across the Earth is around  $10^{16}$  tons, making it the largest reservoir of organic compounds, significantly surpassing the organic content of all living organisms by a factor of 10,000.

The composition of kerogen in a specific rock formation is influenced by the original type of organic matter present. It can be categorized based on its origins into three main types:

lacustrine (derived from algae), marine (from plankton), and terrestrial (from pollen and spores). The characteristics of kerogen are also affected by the degree of heat and pressure it has experienced, as well as the duration of these geological processes.

As a result, sedimentary rocks contain a complex mixture of organic compounds, which serve as precursors to hydrocarbons such as oil and gas. Essentially, kerogen represents fossilized organic material that has been buried and subjected to high temperatures and pressures over millions of years, leading to various chemical transformations. It is insoluble in common organic solvents and does not have a defined chemical formula. When heated, kerogen can convert partially into liquid and gaseous hydrocarbons, ultimately leading to the formation of petroleum and natural gas.

### **Conclusion and Recommendations**

A comparison of the organic matter of the petroleum source rock and the elemental components of kerogen in bituminous shales shows that the amorphous sapropelic organic matter of bituminous shales generally belongs to both Type 1 and Type 2 kerogens according to the classifications made previously. Type 3 is not a kerogen associated with bituminous shales. The concentration of Type 3 organic matter is derived from terrestrial plants and is generally classified as carbonaceous shale or humic coal associated with coal. The organic matter is derived from planktonic organisms (microscopic Algae, Copopods, Ostrocota) and microorganisms (such as bacteria and algae) living in recent sediments. According to the Van-Krevelen Diagram of the samples belonging to the Hirka Formation, it was determined that the kerogen types generally fall between Type 1 and Type 2 kerogens in the atomic H/C versus O/C plot (Tissot and Welte 1978). In the optical examinations of kerogens made on bituminous shales, it was determined that although almost all samples consist of algal residues, sometimes they can be formed by a mixture of amorphous organic residues. The main algal types are Botryococci and Tasmanaceae (Tissot and Welte 1984). The remaining part is amorphous, probably due to microbial alteration that occurs during the sedimentation process. Kerogen types are generally grouped into three classes (Tissot and Welte 1984, Jacobson 1991, Korkmaz 1990).

a) Type I: These types of kerogens have a very high atomic H/C ratio and a low atomic O/C ratio. They are mainly composed of algal lipids or organic matter with increased lipid ratios due to microbial activities. When pyrolyzed at 550°C or 600°C, a large portion of the kerogen turns into oil. These types of kerogens have a very high oil and gas generation potential. Type I kerogens are formed in lakes and marine environments where sediment input is high.

b) Type II: These types of kerogens have lower atomic H/C ratios and oil generation potentials than Type I, but they are still economically important. Type II kerogens are generally observed in marine sediments where autochthonous organic matter consisting of a mixture of phytoplankton, zooplankton and microorganisms (bacteria) is found.

c) Type III: They have a relatively low atomic H/C ratio and a high atomic O/C ratio. They usually have significant gas generation potential when buried deeply, but their oil generation potential is weak. Type III kerogens are generally composed of terrestrial high plants.

According to the Van-Kravel diagram, it was determined that the H/C versus O/C values of the samples fell in the area between vitrinites and alginites as maceral groups, between exinites, dinoflagellates, algae, pollens and spores, concentrated in the area between bituminous coals and bituminous shales according to the lithology of the source rock, and fell in the area between marine zooplankton and lacustrine complexes according to the depositional environment of the source rock.

**Thanks and Information Note**

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# KONYA İLİNDE OLUŞAN KENTSEL ISI ADASI'NIN KARŞILAŞTIRILMASI VE VIPER SD4 EĞİTİM UÇAĞININ PERFORMANSINA ETKİSİ

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## Özet

Çalışmada kullanılacak istasyonların seçiminde 2013 yılı itibariyle nüfusu 500.000 ve üzeri olan ve üniversitemiz pilotaj departmanına ait eğitim uçuşlarının yapıldığı Konya ili ve şehir ısı adası bakımından topografik özellikleri benzer olan Karapınar kırsal istasyonu konu alınmıştır. Şehirsel istasyon ile coğrafi açıdan en az farklılık gösteren ve aynı meteorolojik kütlelerin etkisinde kalan kırsal istasyonun uzun vadeli sıcaklık verileri (1964-2018 yılları arası) yazarlardan Kamile Yasdıman'ın 2021 yılında biten doktora tezinde çalışılmıştır. Meteoroloji Genel Müdürlüğü'nden alınan 2018 – 2024 yılı verilerine öncelikle Mann-Kendall testi uygulanmıştır. İstasyonlara ait trendlerin başlama yılını belirleyebilmek amacıyla ise Sen'in Trend Eğim Metodu tercih edilmiştir. Kent istasyonu ile kırsal istasyon arasında yapılan analizlere göre, kent merkezi her daim aylık maksimum sıcaklık bakımından 0.7°C; aylık minimum sıcaklık bakımından 0.3°C ve aylık ortalama sıcaklıklar bakımından da 0.4°C daha sıcak olduğu tespit edilmiştir. Ultralight Viper SD4 tipi tek motorlu içten yanmalı piston motorlara sahip uçaklar için artan sıcaklık değişikliği ile beraber motor performansının ve kaldırma kuvvetinin düştüğü, kalkış koşu mesafesinin uzadığı ve kaldırma kuvveti ve motor performansı düşmesi nedeniyle ihtiyaç duyulan güç nedeniyle yakıt tüketiminin arttığı tespit edilmiştir. Düzenli sıcaklık artışının eğitimlerde kullanılan Viper SD4 uçak yapısında kullanılmış olan karbon fiber yapıyı zamanla aşındırdığı ve yorulmaya sebep olduğu gözlemlenmiştir. Uçak yapısında meydana gelen deformasyonun piston motor sisteminde düzensiz hareketlere ve dolayısıyla motordan gövde kanat yapısına akseden bir titreşime sebep olduğu görülmektedir. Meydana gelen dinamik yükler malzeme yorulmasına ve ileri aşamada çatlama sebebine sebep olduğundan uçuş güvenliğini tehdit eden önemli bir unsurdur. Sıcaklığa bağlı uçak üzerindeki performans ve yapısal değişimler grafik haline getirilmiş ve sonuçlar kıyaslanmıştır.

**Anahtar Kelimeler:** Şehir Isı Adası, Motor Performansı, Yakıt Tüketimi

## COMPARISON OF URBAN HEAT ISLAND FORMED IN KONYA PROVINCE AND ITS EFFECT ON THE PERFORMANCE OF VIPER SD4 TRAINING AIRCRAFT

### Abstract

In this study, the Karapınar rural station, which has similar topographical characteristics in terms of the urban heat island to Konya province, where training flights are conducted by the pilotage department of our university, and whose population was 500,000 or more as of 2013, was chosen to investigate the impact of the urban heat island on the structural and performance characteristics of the Viper SD4 aircraft used in training flights. Long-term temperature data (1964-2018) of the rural station, which shows the least geographical difference from the urban station and is affected by the same meteorological masses, was studied in the Ph.D. thesis of one of the authors, completed in 2021. The Mann-Kendall test was initially applied to the 2018-2024 data obtained from the Turkish State Meteorological Service. To determine the starting year of trends for the stations, Sen's Trend Slope Method was preferred. According to the analyses between the urban and rural stations, it was found that the city center was consistently warmer by 0.7°C in terms of monthly maximum temperature, 0.3°C in terms of monthly minimum temperature, and 0.4°C in terms of monthly average temperatures. For ultralight aircraft like the single-engine, internal combustion piston-engined Viper SD4, it was determined that with the increasing temperature, engine performance, and lift decreased, the takeoff roll distance extended, and fuel consumption increased due to the power required because of the reduction in lift and engine performance. It was observed that the regular temperature increase caused the carbon fiber structure used in the Viper SD4 aircraft, which is used in training, to erode over time and lead to fatigue. Deformation occurring in the aircraft's structure caused irregular movements in the piston engine system and, consequently, a vibration transferred from the engine to the fuselage-wing structure. The dynamic loads resulting from this lead to material fatigue and, in advanced stages, cracking, which poses a significant threat to flight safety. The performance and structural changes on the aircraft due to temperature were visualized, and the results were compared.

**Keywords:** Urban Heat Island, Engine Performance, Fuel Consumption

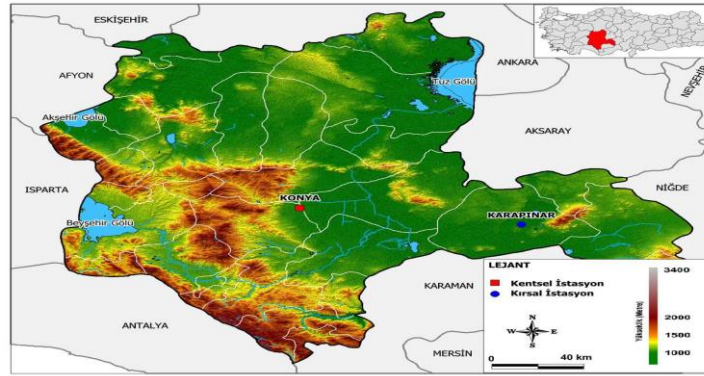
## **Introduction**

Cities' climates have experienced increasing temperatures due to increased urbanization over the past decades (Chen, H., & Zhang, Y., 2017). The present recent review of the impact of environmental measures on urban heat islands (UHI). While there are several review articles on UHI, there has been no significant work dealing with the effect of VIPER SD4 training airplane performance and vibration influence on UHI. Thus, this article encapsulates new researches about Konya city's urban heat island character and its impact of our training planes' performances.

The Viper SD4 aircraft, utilized as a training aircraft, is equipped with a 100 HP internal combustion piston engine operating on the Otto cycle (TOMARK, 2020). Environmental factors, particularly fluctuations in air temperature, significantly impact the thrust and operational performance of these engines, and consequently, their fuel consumption. Factors affecting aviation fuel efficiency, and the engine performance are thermal and propulsive efficiencies, and overall drag on aircraft (Ren & Leslie, 2019). This research interests on the thermal environmental factors, by observing the heat island over the region of flight between 1964-2024. Understanding the impact of temperature increase on aircraft performance and fuel consumption is of critical importance for pilots and aerospace engineers to determine the flight duration to be performed, enabling a safer and more economical flight.

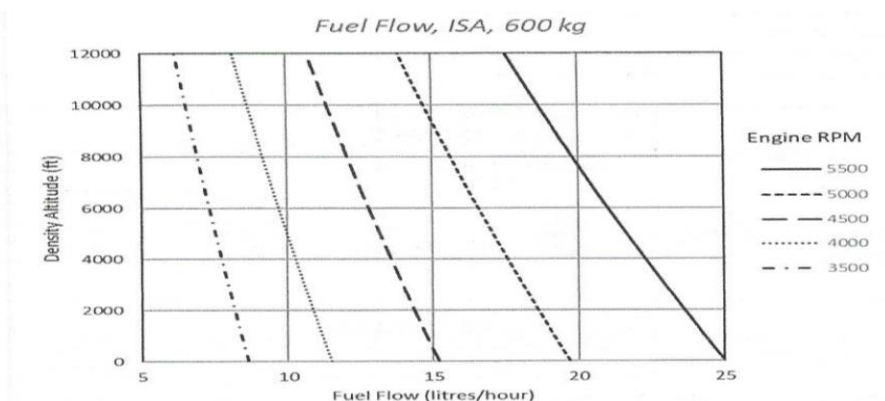
## **Materials and Methods**

This study, conducted as a spatial analysis, focuses on Konya city center with a population of 500,000 and Karapınar, a rural station, in Turkey in 2013. The primary reason for selecting 2013 is the report specifically published by the IPCC, which predicts that climate changes will continue unabated, temperatures will rise, and the frequency of other extreme weather events will increase. The study is based on the monthly average maximum, average minimum, and average temperatures throughout the year. Temperature-related changes were examined on a monthly and seasonal basis, and values from the city center and the nearest rural area were compared to determine the existence or absence of the Urban Heat Island effect. During the study, data sets were first requested from the archives of the Turkish State Meteorological Service, and the data for the city and rural stations were grouped and averaged. The homogeneity of these data was then tested, and graphs were created using specialized software to observe trends. The statistical significance of the generated graphs was checked, and the Q Median values obtained from the Sen's Slope Method used for temperature comparison were recorded at the end of each analysis. These values were calculated according to the total dataset year, and a specific temperature value was calculated for each monthly temperature average, enabling a comparison between the urban and rural stations. Konya is located in the Central Anatolia Region of Turkey. It is surrounded by Niğde and Aksaray to the east, Isparta to the west, Salt Lake to a part of the northeast, Afyonkarahisar and Eskişehir to the northwest, Ankara to the north, Karaman and Mersin to the south-southeast, and Antalya to the southwest. The province is mathematically located between 31° 14' and 34° 25' east longitudes and 36° 41' and 39° 16' north latitudes (Figure 1)



**Figure 1:** Location map of Konya and Karapınar

Konya is one of the most prosperous provinces in Turkey in terms of population growth. According to the reports of the Turkish Statistical Institute (TUIK), the city center population, which was around 920,000 as of 2013, has just exceeded 1 million in 2018. The total number of neighborhoods in the central districts of Konya is currently 222 (TUIK, General Directorate of Provincial Administration, 2020). In line with the study, Karapınar was selected as the comparison station for Konya. 6-year temperature data covering the years 2019 and 2024 obtained from the General Directorate of Meteorology were used. Konya's data were taken from the station with the meteorological code 17244 and at an altitude of 1020 meters. Meteorological data for Karapınar, the comparison station, were taken from the meteorological station with the meteorological code 17902 and at an altitude of 999 meters. The 6-year data set for Konya and Karapınar includes monthly maximum temperature, monthly minimum temperature and monthly average temperature, and all of these were subjected to annual and seasonal trend analyses, and Mann-Kendall analyses were used to check whether there was a significant positive or negative trend; The values formulated according to the SenQ value and long-term temperature averages were compared as the city center and the comparison station. Tables were originally created for the results of the obtained values. The Urban Heat Island (UHI) is detected, to ensure the effects of UHI on Viper SD4's engine performance the analytic calculations are done. According to the aircraft manual the fuel flow chart is given in figure 2 at ISA conditions. To compare the ideal results with the experimental and analytical results the specific fuel consumption of the Viper SD4, a piston-engine aircraft, has been formulated. According to the ideal gas law, temperature directly influences both pressure and density. An analysis of the Viper SD4's database was conducted to evaluate the variation in fuel consumption in response to changes in temperature.



**Figure 2.** Fuel Flow Chart of Viper SD4 (TOMARK, 2020)

Specific fuel consumption of piston engine:

$$C_p = \frac{dW_F}{Pdt}$$

The ideal gas law:

$$P = d(R_d)T$$

Assuming the propeller efficiency is  $\eta$  and the aircraft is performing a steady (constant speed) level flight, the required engine power in this condition is as follows:

$$P = \frac{DV}{\eta}$$

Assuming level flight,  $L=W$ , the differential equation for flight time:

$$dt = -\frac{\eta LDW}{C_p DVW}$$

Given that lift and drag forces can be expressed through certain equations:

$$L = C_L \frac{\rho}{2} V^2 S \quad D = C_D \frac{\rho}{2} V^2 S$$

Considering the aircraft's initial weight as  $W_0$ , the flight time until consuming an amount of fuel  $W_F$ :

$$W_F = \frac{W_0 \left( \frac{\sqrt{2}}{2} \frac{C_p}{\eta \sqrt{\rho S}} \frac{C_D}{C_L^2} t + \frac{1}{\sqrt{W_0}} \right)^2 - 1}{\left( \frac{\sqrt{2}}{2} \frac{C_p}{\eta \sqrt{\rho S}} \frac{C_D}{C_L^2} t + \frac{1}{\sqrt{W_0}} \right)^2}$$

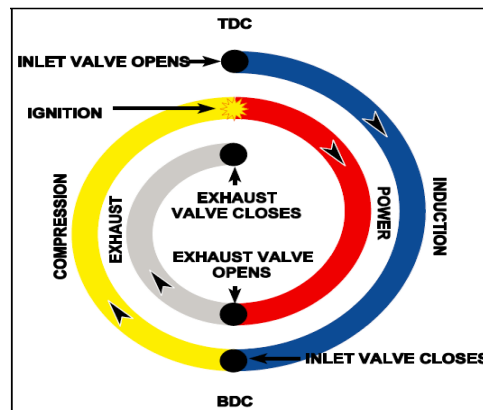


Figure 3. The Otto Cycle of Piston Engine



Figure 4. The Viper SD4 Training Aircraft

## Findings and Discussion

When we examine the findings obtained from the Mann-Kendall test applied to the averages of six years of temperature data, no significant trend was found at the 95% significance level in Konya's seasonal evaluation of monthly maximum temperature averages for winter, monthly minimum temperatures for winter, or monthly average temperatures for spring and summer. In contrast, no significant trend was detected in the seasonal evaluation of Karapınar's monthly maximum temperature averages for spring, monthly minimum temperature averages for winter, or monthly average temperatures for winter and spring. In other words, since the Z-value of the stations remained within the confidence interval based on the critical value of  $\pm 1.96$ , the null hypothesis ( $H_0$ ) was accepted, indicating the absence of a trend.

However, this result does not mean that there are no increases or decreases in temperature at these stations, even though they are not statistically significant. To clearly present the temperature differences, temperature values obtained from the formulas in Sen's Trend Analysis outputs were specifically created in the subsequent tables. At this point, graphs spanning 54 years from one of the authors of the study Dr. Kamile YASDIMAN's doctoral thesis were also used in the study. As is well known, urban heat island studies should cover at least 40 years or more. As a result, from Figure 5 to Figure 16 the monthly maximum, average, and the minimum temperature for Konya and Karapınar region is shown.



**Figure 5:** 54-Years Mann-Kendall Correlation ( $U_t-U_t'$ ) Graphs in Monthly Maximum Temperature (Konya)



**Figure 6:** 2019 - 2024 Mann-Kendall Correlation ( $U_t-U_t'$ ) Graphs in Monthly Maximum Temperature (Konya)





Figure 7: 54-Years Mann-Kendall Correlation ( $U_t-U_{t'}$ ) Graphs in Monthly Maximum Temperature (Karapınar)

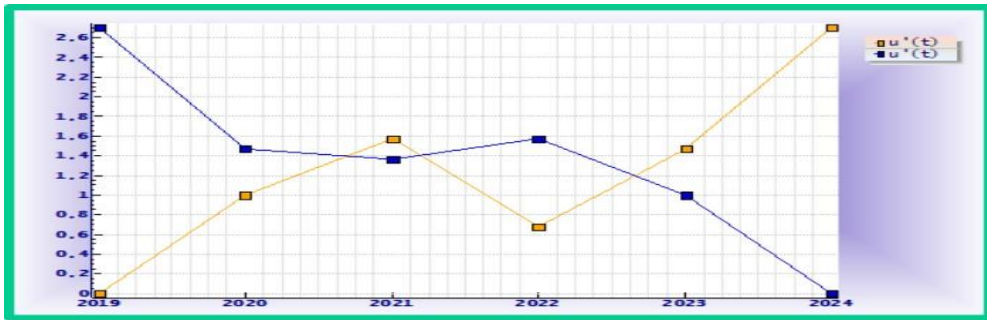


Figure 8: 2019 - 2024 Mann-Kendall Correlation ( $U_t-U_{t'}$ ) Graphs in Monthly Maximum Temperature (Karapınar)



Figure 9: 54-Years Mann-Kendall Correlation ( $U_t-U_{t'}$ ) Graphs in Monthly Minimum Temperature (Konya)

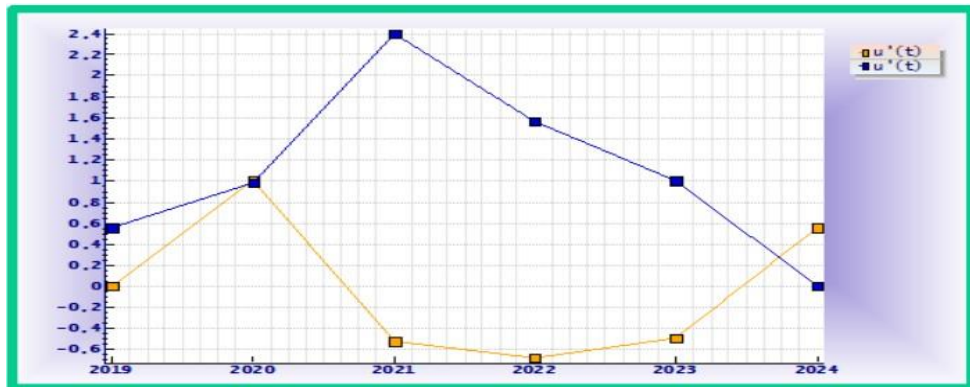


Figure 10: 2019 - 2024 Mann-Kendall Correlation ( $U_t-U_{t'}$ ) Graphs in Monthly Minimum Temperature (Konya)



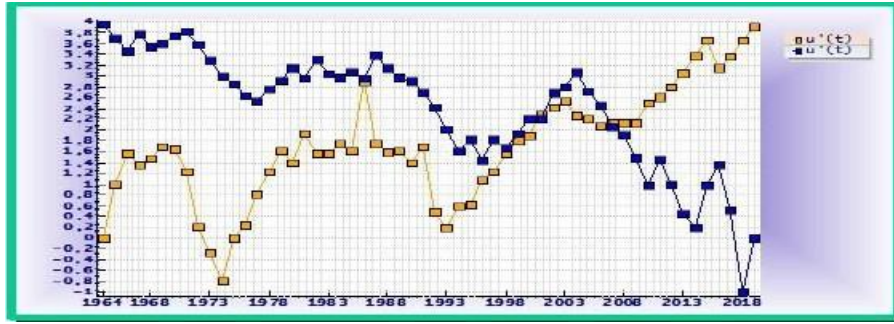


Figure 11: 54-Years Mann-Kendall Correlation ( $U_t-U_{t'}$ ) Graphs in Monthly Minimum Temperature (Karapınar)

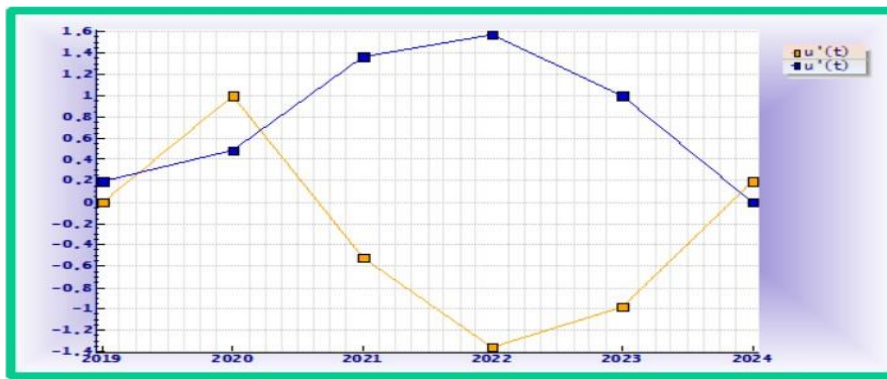


Figure 12: 2019 - 2024 Mann-Kendall Correlation ( $U_t-U_{t'}$ ) Graphs in Monthly Minimum Temperature (Karapınar)



Figure 13: 54-Years Mann-Kendall Correlation ( $U_t-U_{t'}$ ) Graphs in Monthly Average Temperature (Konya)

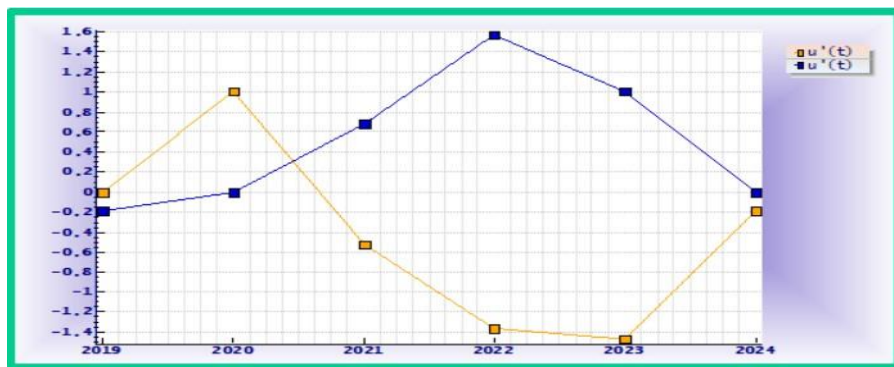
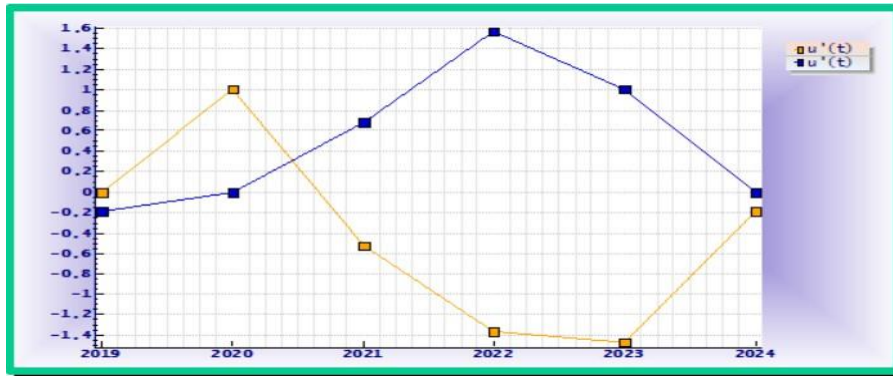


Figure 14: 2019- 2024 Mann-Kendall Correlation ( $U_t-U_{t'}$ ) Graphs in Monthly Average Temperature (Konya)



**Figure 15:** 54-Years Mann-Kendall Correlation ( $U_t-U_{t'}$ ) Graphs in Monthly Average Temperature (Karapınar)



**Figure 16:** 2019 - 2024 Mann-Kendall Correlation ( $U_t-U_{t'}$ ) Graphs in Monthly Average Temperature (Karapınar)

**Table 1:** Differences between Annual Averages of Monthly Maximum, Minimum and Average Temperatures ( $^{\circ}\text{C}$ )

Method Stations	Sen's Slope Method		
	Konya	Karapınar	Difference
Annual Maximum Temperature	1,8	1,1	<b>0,7</b>
Annual Minimum Temperature	0,3	-0,07	<b>0,3</b>
Annual Average Temperature	0,3	-0,035	<b>0,4</b>

According to the temperature values observed in the tables calculated using the SenQ method, the assumption that the annual and seasonal temperature data are homogeneous, or in other words, that the hypothesis that they come from the same population is accepted, shows that significant trends were observed in the time series. In other words, when we accept those within the fixed confidence interval of  $\pm 1.96$  as significant (statistically significant based on the applied test), the differences in increases and decreases appear as shown in the table.

In the Mann-Kendall Correlation ( $U_t-U_{t'}$ ) graphs, which display long-term trends for Konya and the comparison station Karapınar, significant trend increases were observed in all of Konya's monthly maximum, monthly minimum, and monthly average temperature averages in the yearly evaluations. However, in the yearly evaluation graphs for Karapınar, the comparison station, a significant trend was only observed in monthly maximum temperatures, while no significant trend was detected in monthly minimum and monthly average temperatures. According to the results of the temperature differences in the annual evaluations based on the

SenQ value (Table 1), Konya is observed to be warmer than the comparison station Karapınar by 0.7°C in monthly maximum temperature averages, 0.4°C in monthly minimum temperature averages, and 0.3°C in monthly average temperature averages.

**Table 2:** General Properties of VIPER SD4

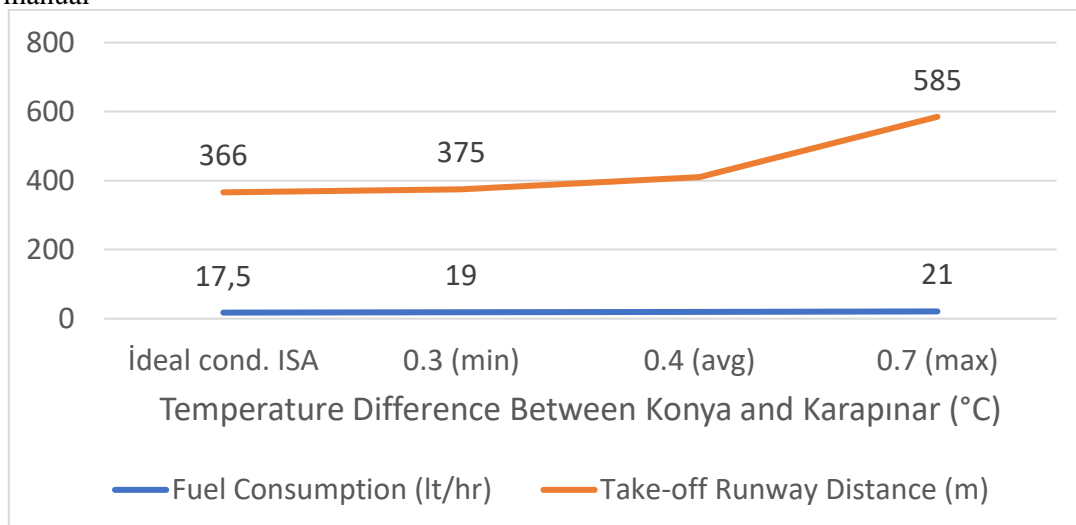
Weights (VIPER SD4)	Unit (kg)
Empty weight of the Viper SD4	391.8
Maximum take-off mass MTOM	600
Fuel tank capacity	72 (2*50 liters)

**Table 3:** Take-off run distance comparison according to the manual for concrete and grass runway surface

RUNWAY SURFACE	Take-off run distance		Take-off distance over 50 ft (15 m) obstacle	
	m	ft	m	Ft
Tarmac/Concrete	199	653	366	1201
Grass	227	745	417	1369

Table 2 and Table 3 are taken from the Viper SD4 aircraft manual. For the ISA conditions it is shown that in concrete runway surface the Take-off run distance will be 366 m over 50 ft. For grass runway surface it will increase to 417 m. According to the heat island resulted the maximum, average and the minimum temperature between Konya and Karapınar region the take-off run distance and fuel consumption per liter is calculated. Table 4 shows that for minimum temperature range the TORA increased to 375 m, and the fuel consumption is also increased to 19 liters per hour. As the temperature range increases, both TORA and fuel consumption is also increases. For the maximum temperature range between Konya and Karapınar region the TORA and fuel consumption reaches its highest amount. TORA will reach almost 600 m, and the fuel consumption reaches 21 liters per hour.

**Table 4:** Comparison of the experimental TORA and Fuel Consumption results according to the Viper SD4 manual



## Conclusion and Recommendations

For summer months between 2020 and 2024, considering performance and consumption effects under increased temperatures, it was noted that at 75% power settings and engine speeds of 4500-5000 RPM, the average hourly fuel consumption was 19 liters in 2020. However, due to the increase in temperature in 2024, the hourly fuel consumption under the same flight conditions reached 21 liters. According to the performance section of the Viper SD4 aircraft manual, the fuel consumption under ISA conditions (density 1013.25 hPa, +15°C) is calculated to be 17.5 liters for the respective flight regime. This calculation, conducted by the manufacturer under standard atmospheric conditions with a baseline temperature of +15°C, shows that the fuel consumption values observed in Konya during the summer months between 2020 and 2024 were higher than the figures stated in the aircraft manual. This discrepancy is attributed to the increased average temperature observed during this period compared to the standard conditions used in the manual.

Due to the increase in temperature compared to ISA conditions, the aircraft requires a Takeoff Run Available (TORA) distance of 350 meters. However, in Konya, when comparing the years 2020 and 2024, it was observed that this distance increased to 500-600 meters. The primary reason for this increase in takeoff roll distance is the reduction in engine performance due to temperature rise, resulting in insufficient engine power output needed for takeoff and the inability to generate the necessary thrust for achieving the minimum takeoff speed. The decline in engine performance due to increased temperature prevents the aircraft from reaching the required minimum acceleration speed, necessitating the use of additional power to maintain the lift coefficient and prevent the aircraft from falling below the stall speed. Consequently, during these years, it was observed that the engine performance loss led to an increase in fuel consumption by 2 liters per hour under normal conditions, an increase in takeoff roll distance by 300 meters, and a noticeable decline in lift and overall flight performance.

As a conclusion, the fuel consumption of the Viper SD4 aircraft, powered by a piston engine, is directly related to the operational efficiency of the engine. As temperature increases, engine efficiency decreases, leading to higher fuel consumption. The relationship between fuel consumption and temperature is influenced by several key factors:

**Rich Mixture Usage:** In hot weather conditions, a richer fuel-air mixture is often used to enhance engine power, which directly contributes to increased fuel consumption.

**Longer Takeoff Distance:** In hot conditions, aircraft require higher takeoff speeds and longer takeoff distances. Consequently, engines need to operate at higher power settings for longer durations, resulting in greater fuel consumption.

**Cruise Performance:** An increase in temperature affects fuel consumption during cruise as well. Lower air density forces aircraft to expend more power to maintain the same speed and altitude, significantly increasing fuel consumption, especially on long flights.

As temperature increases, air density decreases. Lower density reduces the amount of air that each cylinder can draw in, adversely affecting the efficiency of the engine. The reduction in air density leads to a decrease in the amount of oxygen participating in the combustion process, which in turn limits the engine's power output.

**Reduced Power Output:** In hot weather, the engine's power output decreases. Consequently, pilots must increase throttle to maintain the necessary thrust, compensating for the diminished air density required for combustion. This action results in a higher rate of fuel consumption per unit time.

**Decreased Thrust Efficiency:** Air density also influences propeller efficiency. Less dense air causes the propellers of piston-engine aircraft to operate less efficiently, which negatively impacts the aircraft's speed and climbing ability.

**Precautionary Measures Against Temperature Increase**

**Flight Planning:** Flights can be scheduled during early morning or late afternoon to avoid the peak midday temperatures. During these hours, the air temperature is lower, and engines operate more efficiently.

**Higher Altitude:** Flying at higher altitudes provides lower temperatures and denser air, which helps the engine operate more efficiently and reduces fuel consumption.

**Aircraft Maintenance:** Regular engine maintenance ensures the proper functioning of fuel systems. Cleaning air filters and adjusting engine settings can help the engine run more efficiently, thereby reducing fuel consumption.

**Thanks and Information Note**

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# HAVALİMANI OPERASYONLARININ EMNİYETLİ BİR ŞEKİLDE YÜRÜTÜLEBİLMESİ İÇİN NİTELİKLİ PERSONEL İSTİHDAMI, EĞİTİM GEREKLİLİKLERİ VE EĞİTİMLERİN PERSONEL ÜZERİNDEKİ ETKİLERİ

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## ÖZET

Havacılık Dünya çapında ekonomik, teknolojik ve sosyal gelişmeyi en fazla etkileyen faaliyet alanlarından biridir. Havacılıkta meydana gelen teknolojik gelişmeler ile beraber Havayolu ulaşımı en güvenli ulaşım biçimi ayrıca, ekonomik büyümeye duyarlı, geniş kapsamlı düzenlemelerin geçerli olduğu, yüksek teknolojiye sahip araç ve donanım ile nitelikli insan gücünün kullanıldığı bir alan olarak tanımlanmaktadır. Havacılık faaliyetleri ve bu faaliyetlerin yürütüldüğü ortamlar ise yüksek risk taşıyan ortamlar olarak tanımlanmaktadır. Bu çerçevede değerlendirildiğinde; havalimanları havayolu ulaştırma sistemlerinin temel ögesidir. Bu çalışma ile Dünya’da havacılık faaliyetlerinin katlanarak artış göstermesi, yeni teknolojik gelişmeler ile beraber havacılık faaliyetlerinde emniyet ilkelerinin benimsenmesinin daha önemli hale gelmesi ve tüm bu bilgiler doğrultusunda Havalimanlarının işletilmesinde operasyonların emniyetli bir biçimde yürütülebilmesi ve denetlenmesi açısından nitelikli personel istihdam edilmesi, havacılıkta insan faktörünün pozitif etkisinin teşvik edilmesi amacıyla personelin eğitimlerinin aktif bir şekilde sürdürülmesinin önemi vurgulanmaktadır.

**Anahtar Kelimeler :** Havalimanı İşletmeciliği, Havacılık, Emniyet Yönetim Sistemi, Eğitim, İnsan Faktörü

## **THE RECRUITMENT OF QUALIFIED PERSONNEL, TRAINING REQUIREMENTS AND THE EFFECTS OF TRAINING ON PERSONNEL FOR THE SAFE CONDUCT OF AIRPORT OPERATIONS**

### **Abstract**

Aviation is one of the fields of activity that has the greatest impact on economic, technological and social development worldwide. With the technological developments in aviation, airline transportation is defined as the safest mode of transportation, as well as a field that is sensitive to economic growth, where comprehensive regulations are valid, high-tech vehicles and equipment and qualified manpower are used. Aviation activities and the environments where these activities are carried out are defined as high-risk environments. When evaluated within this framework; airports are the basic element of airline transportation systems. With this study, it is emphasized that the aviation activities in the world have increased exponentially, the adoption of safety principles in aviation activities has become more important with new technological developments, and in line with all this information, the importance of employing qualified personnel in the operation of airports in order to carry out and supervise the operations in a safe manner, and the importance of actively continuing the training of personnel in order to encourage the positive effect of the human factor in aviation.

**Keywords :** Airport Management, Aviation, Safety Management System, Training, Human Factor



## Giriş

Havacılık dünya çapında ekonomik, teknolojik ve sosyal gelişmeyi en fazla etkileyen faaliyet alanlarından biridir. Havacılıkta meydana gelen teknolojik gelişmeler ile beraber havayolu ulaşımı en güvenli ulaşım biçimi olarak tanımlanmakta ve Dünya’da hava trafiği katlanarak artış göstermektedir.

Ülkemizde ilk havacılık çalışmaları 1912 yılında, bugünkü Atatürk Havalimanının hemen yakınındaki Sefaköy’de küçük bir meydana başlamış ve 1925 yılında kurulan ve daha sonraki yıllarda Türk Hava Kurumu adını alan Türk Tayyare Cemiyeti ile Türk Sivil Havacılığının kurumsal temelleri atılmıştır. İlk Sivil Hava Taşımacılığı ise 1933 yılında 5 uçaklık küçük bir filo ile “Türk Hava Postaları” adı ile başlatılmıştır.

Türk Sivil Havacılık sektörünün altyapısını oluşturan tesis ve donanımıyla, 1933 yılından bu yana değişik isim ve statülerle hizmetlerini yürütmekte olan DHMİ, 233 sayılı Kanun Hükmünde Kararname ile Ana Statüsü çerçevesinde 1984 yılından itibaren faaliyetlerini Kamu İktisadi Teşebbüsü olarak sürdürmektedir. Türkiye Havalimanlarının işletilmesi ile Türkiye Hava sahasındaki hava trafiğinin düzenlenmesi ve kontrolü görevi, Devlet Hava Meydanları İşletmesi (DHMİ) Genel Müdürlüğüne yerine getirilmektedir.

Kuruluşun Ana Statüsü ile belirlenen amaç ve faaliyet konuları ise; Sivil havacılık faaliyetlerinin gereği olan hava taşımacılığı, havalimanlarının işletilmesi, meydan yer hizmetlerinin yapılması, hava trafik kontrol hizmetlerinin ifası, seyrüsefer sistem ve kolaylıklarının kurulması ve işletilmesi, bu faaliyetler ile ilgili diğer tesis ve sistemlerin kurulması, işletilmesi ve modern havacılık düzeyine çıkarılmasını sağlamaktır.

Ayrıca, Ülkemizde bulunan havalimanlarında ve yakın çevresinde meydana gelebilecek uçak kaza kırım ve yangınları ile havalimanlarında bulunan bina tesis yangınları ve acil durumlara müdahale amacıyla Uluslararası Sivil Havacılık Teşkilatı (ICAO) tarafından belirlenen standart ve önerilen uygulamalar çerçevesinde DHMİ tarafından ARFF (Aircraft Rescue and Fire Fighting) birimleri kurulmuş ve ARFF memurları istihdamı sağlanmıştır. Bununla birlikte, özel statüde bulunan havalimanlarında da kurtarma ve yangınla mücadele birimleri bulunmaktadır. ARFF birimleri 24 saat esasına göre hizmet vermekte ve ARFF Memurları vardiyalı sistemde çalışmaktadırlar. DHMİ tarafından ARFF personel seçimlerinde belirli kriterler belirlenmiştir ve ulusal mevzuatlarda bu hususlara yer verilmiştir. Türkiye’de itfaiyecilik mesleği yerel yönetimler bünyesinde İtfaiye Teşkilatı, Devlet Hava Meydanları İşletmesi (DHMİ) Genel Müdürlüğü bünyesinde ARFF memurları tarafından yürütülmektedir. Kısaltması ARFF olan unvanın tam olarak açılımı “Aircraft Rescue and Fire Fighting” olup, anlamı “Hava Kurtarma ve Yangınla Mücadele” dir. Bu görevi ifa eden kişilere ise “ARFF Memuru” denilmektedir. ARFF memurluğu, dışarıdan her ne kadar itfaiyecilikle benzer bir meslek alanı olarak gözükse de farklı konular açısından keskin sınırlarla birbirinden ayrılmaktadır. ARFF memurluğu ICAO standartlarına göre şekil almakta ve belirli periyotlar ile uçuş güvenliği açısından denetlenmektedir.

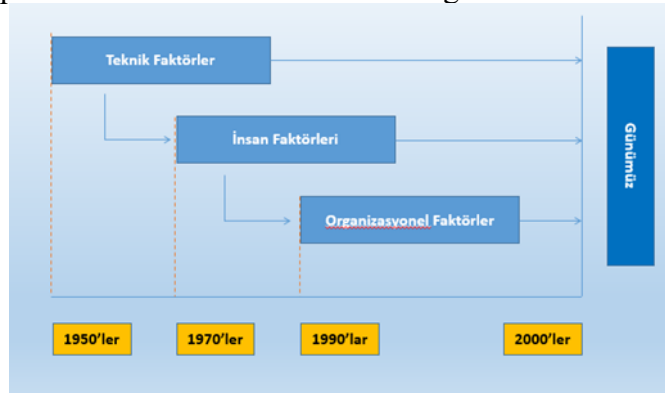
Havalimanlarında kurtarma ve yangınla mücadele hizmetlerinin herhangi bir acil durumda temel amacı hayat kurtarma operasyonunu gerçekleştirecek şekilde organize edilmesini, donatılmasını, personel istihdam edilmesini ve bu personelin eğitilmesini kapsamaktadır. İnsan hayatını kurtarma görevi cesaret, bilgi, tecrübe, grup çalışması, fiziki kabiliyet isteyen bir iştir. Bu nedenle, ARFF hizmetlerinde görevlendirilecek personelin iyi eğitilmiş olması, herhangi bir olay anında değişen koşulları anlayabilmesi oldukça önemlidir.

2920 sayılı Türk Sivil Havacılık Kanununda havalimanı; “karada ve su üzerinde hava araçlarının kalkması ve inmesi için özel olarak hazırlanmış, hava araçlarının bakım ve diğer ihtiyaçlarının karşılanmasına, yolcu ve yük alınmasına ve verilmesine elverişli tesisleri bulunan yerler” olarak tanımlanmıştır. Uluslararası Sivil Havacılık Teşkilatı (ICAO) tarafından yayınlanan Ek-14 ( Annex-14) kapsamında ise havalimanı benzer şekilde “tamamen veya kısmen hava araçlarının gelişi, kalkışı ve yüzey operasyonu için kullanılması öngörülen, karada

veya suda belirlenmiş tüm binalar, tesisatlar ve teçhizatlar dahil olmak üzere alanlardır” şeklinde tanımlanmıştır. Bu çerçevede değerlendirildiğinde havalimanları havayolu ulaştırma sistemlerinin temel ögesidir.

Havacılık emniyetin ön planda tutulduğu, karmaşık ve dinamik bir yapıya sahiptir. Havalimanlarının iki temel bölümü olan hava ve kara tarafı operasyonlarında en önemli unsur tüm faaliyetlerin Uluslararası düzenlemeler ve gereklilikler çerçevesinde, emniyet ve güvenlik ilkeleri benimsenerek, birbiri ile ilişkili, bütüncül bir yaklaşım içerisinde ve ortak çalışmalarla planlı olarak yürütülmesinin sağlanmasıdır. Sistem içerisinde her bir işletme, üretim hedeflerine ulaşabilmek için aynı operasyonel alanı paylaştığı diğer işletmeler ile etkileşim halindedir ve insan operasyonel süreçlerin her bir aşamasında belirleyici bir rol oynamaktadır. Bu nedenle bu yapı içerisinde insan hatası çok kötü sonuçlara yol açabilmektedir.

Havacılıkta emniyet ise “Bir hava aracının operasyonunu doğrudan etkileyen ya da ilgilendiren havacılık aktivitelerindeki risklerin azaltılması ya da kabul edilebilir seviyeye çekilmesidir.” şeklinde tanımlanmaktadır. Havacılıkta emniyet konusundan bahsedildiğinde; bu alanda yapılacak önemli faaliyetlerden biri de operasyonların emniyetli bir şekilde yapılmasını sağlayacak nitelikte personelin istihdam edilmesinin sağlanmasıdır.



### Emniyet Kavramının Gelişmesi

1970'lere kadar havacılığın ilk yılları, İkinci Dünya Savaşı'ndan önceki ve hemen sonraki yıllar, teknolojinin tam olarak gelişmemesi nedeniyle emniyet sorunlarının genellikle teknik etkenlere bağlandığı "teknik çağ" olarak karakterize edilmiştir.

1970'lerin ilk yıllarında jet motorlarının, radarın (hem havada hem de yerde), otomatik pilotların, uçuş yönlendiricilerin, gelişmiş navigasyon ve iletişim becerilerinin ve hem havada hem de yerde benzer performans artırıcı teknolojilerin kullanılmaya başlanması ile önemli teknolojik gelişmeler görülmüştür.

1970'lerin ortası ile 1990'ların ortası arası “insan çağının” başlangıcını müjdelemiş ve emniyetle ilgili çabaların odağı insanların performansına ve insani etkenlere yönelmiştir.

Bir operasyonel bağlamın insanların performansını nasıl etkileyebileceği ve olayları veya sonuçları nasıl biçimlendirebileceğinin tanınması ancak 1990'larda gerçekleşmiştir.

Dünya'da havacılık faaliyetlerinin katlanarak artış göstermesi, yeni teknolojik gelişmeler ile beraber havacılık faaliyetlerinde emniyet ilkelerinin benimsenmesi daha önemli hale gelmekle birlikte havacılık endüstrisinde insan faktörü rolünün de önemsenmesi gerekliliğini ortaya koymaktadır.

İnsan faktörleri (Human Factors) “Havacılık dizaynı, belgeleme, eğitim, uçuş/yer operasyonları ve bakım uygulamalarında; insan performansının doğru olarak göz önünde bulundurulmasıyla, insan ve diğer sistem elemanları arasında emniyetli bir uyumu sağlayan prensipler” olarak tanımlanmaktadır. Havacılıkta insan faktörleri birçok durumda etkileri örtüşen ve birbirini etkileyen faktörler olarak değerlendirilmekle birlikte bir faktörün diğerini etkileyebilecek derecede yakından ilişkili olduğu da gözlemlenmektedir.

## **Araştırma ve Bulgular**

1980'lerin sonu ve 1990'ların başında meydana gelen birçok uçuş kazası ve uçuş olayı bağlamında Kanada Taşımacılığı (Transport Canada), bakım hatalarına yol açabilen, kişilerin etkili ve güvenli hareketlerini kısıtlayan 12 insan faktörü tanımlamıştır. Bu faktörlerden birisi de bilgi ve tecrübe eksikliğidir.

**Tenerife faciası**, 27 Mart 1977 tarihinde, İspanya'nın Tenerife Adasında bulunan Los Rodeos Havalimanı'nda iki Boeing 747 uçağının yerde çarpışmasıyla oluşmuş bir kazadır. Kaza, pek çok ihmalin ve "İsviçre Peynir Modeli"ne göre pek çok peynir deliğinin bir araya gelmesi ile oluşmuştur. Dünya havacılık tarihinin bu en ölümlü kazası yerde gerçekleşmiş ve 583 kişi ölmüştür. Kaza sonrasında havacılıkta ve hava trafik kontrol yönetiminde çok köklü değişiklikler yapılmıştır. İspanya Sivil Havacılık Kaza İnceleme Komisyonu (CIAIAC) tarafından 70 kadar personelin, Amerikalı ve Hollandalı yetkililerin ve havayolu şirketi temsilcilerinin katıldığı soruşturmada kazanın asıl nedeni "yanlış iletişim ve yanlış varsayımlar" olarak belirlenmiştir. Bu kaza soruşturma yetkililerinin insan faktörlerini de hesaba kattığı ilk kaza olma özelliğini taşımaktadır.

**Linate Havaalanı faciası**; 8 Ekim 2001 Pazartesi sabahı İtalya'da Milano'daki Linate Havaalanı'nda meydana gelmiştir. Danimarka'nın Kopenhag kentine giden ve 110 kişi taşıyan McDonnell Douglas MD-87 tipi Scandinavian Airlines System Flight 686, kalkış sırasında Fransa'nın Paris kentine giden ve dört kişi taşıyan bir iş jeti Cessna Citation ile çarpışmıştır. Her iki uçaktaki 114 kişinin tamamı ve yerdeki dört kişi hayatını kaybetmiştir. İtalyan havacılık tarihinin en ölümcül kazası olmaya devam etmektedir. 16 Nisan 2004 tarihinde Milano'da bir mahkeme dört kişiyi faciadan dolayı suçlu bulunmuş, Havaalanı müdürü ve hava trafik kontrolörü sekiz yıl hapis cezasına çarptırılmış, Havaalanının eski müdürü ve hava trafik kontrol ajansının eski müdürü ise altı buçuk yıl ceza almıştır.

Genel olarak bakıldığında havacılık kazalarının nedenlerinin teknoloji, çevresel etki ve insan faktörü olarak ortaya çıktığı tüm araştırmalarda görülebilmektedir. Havacılık istatistiklerine göre kaza nedenleri arasında %80'e yakın bir oranla insan hatası birinci sırada yer almaktadır.

## **Sonuç**

Havacılık sektörü için insan kaynağı önemli bir yere sahiptir. Uçak kazaları insan hataları ve ihlallerinden kaynaklanabildiği gibi, yetenekli ve dikkatli personel tarafından fark edilip önlenmektedir. Bu nedenle havacılık sektöründe yer alan personelin operasyonları emniyetli bir şekilde yürütebilmesi için çok iyi eğitilmiş personelden oluşması gerekmektedir. İnsan hatasından kaynaklanan olayların ve kazaların önlenmesine yönelik tek bir yaklaşım bulunmamakla birlikte eğitim, emniyet, verimlilik gibi konuların birlikte ele alınması gerekmektedir. Havacılıkta insan faktörü çerçevesinde yapılan tüm incelemeler hatalar ve başarısızlıklar gibi olumsuz süreçler olarak değerlendirilmektedir. Her bir tehlikeli, emniyetsiz durumların ve olumsuz süreçlerin kontrol altına alınması ile hatalar minimize edilebileceği gibi insan faktörünün pozitif etkisinin uygulanması gereken bir unsur olduğu değerlendirilmektedir. İnsan kaynağının etkin ve verimli bir şekilde yönetilmesinde uluslararası kurallar ve bu kurallara bağlılık, hizmetlerin çeşitliliği, hızlı teknolojik gelişmeler ve bu yaygın konuların başka eğitim kurumlarında yeterince yer almaması nedeniyle hizmet içi personel eğitimi kritik bir öneme sahip olup işletme faaliyetlerinin sürdürülebilirliğini olumlu yönde etkilemektedir. Havacılık sektöründe emniyetsiz durumların minimize edilmesi için bilgi ve tecrübe eksikliğinin giderilmesi ve pozitif insan faktörünü sağlayabilmek için eğitimlerin aktif bir şekilde sürdürülmesi gerekmektedir. Bu eğitimlerin gerçekleştirilmesi havaalanı faaliyetleri için hem yasal hem operasyonel açıdan gerekli bir durumu ortaya koymaktadır.

ARFF hizmetlerinde görevli personel acil durumlarda görevleri esnasında çok hızlı kararlar almak ve bu kararları uygulamak durumundadırlar. Ulusal ve uluslararası sivil havacılık

kuralları da havacılık personelinin belli bilgi, eğitim ve beceri koşullarını sağlamasını zorunlu kılmaktadır.

Bu kapsamda, insan faktörü, operasyonel etkinlik ve standartlar birlikte değerlendirildiğinde; ARFF operasyonlarının başarıya ulaşabilmesi için ARFF personelinin yeterli yetkinliğe sahip olması, emniyetli, kontrollü ve gerçekçi bir ortamda eğitim almalarının sağlanması gerekmektedir.

Bunun için özellikle ARFF eğitimlerinde;

- Mümkün olduğu kadar gerçekçi olmasını sağlamak ve ARFF personelinin ısı ve dumanla kaplı bir ortama alışmasına yardımcı olması amacıyla ateşli yangın tatbikatı gerçekleştirilmesi,
- Simülasyon sistemleri vasıtasıyla ARFF operasyonlarının farklı yönlerini yansıtan gerçekçi ortamlar sağlanması,
- Yanlış iletişimi önlemek üzere donanıma karşı personel veya personele karşı personel ilkesi benimsenerek ARFF eğitim programlarının bilgilerin doğru bir şekilde ve zamanında aktarılmasını sağlayacak bileşenler içermesi,
- Acil durumlara müdahale sırasında insan performansını arttırması için çeşitli hava aracı tiplerinin farklı modelleri de dahil olmak üzere detaylı içeriklere yer verilmesi önemlidir.

Bu amaçla, DHMİ Genel Müdürlüğü tarafından Havalimanlarında görevli Havalimanı personeli için Havacılık Akademisi Kurulmuş ve Havaalanı Emniyeti ve İşletimine ilişkin eğitimler düzenlenmekte ayrıca, ARFF ve diğer itfaiyecilerin eğitimini sağlamak üzere Erzincan Eğitim Tesisleri kurulmuştur.

Havacılık Akademisinde «Havaalanı İşletimi ve Emniyetine» yönelik eğitimler uzman eğitimci kadrosu ile Havalimanlarında yüz yüze ve saha incelemesi ile gerçekleştirilmektedir.

- Havaalanı Emniyeti ve İşletimi Temel Eğitimi
- Emniyet Yönetim Sistemleri
- Acil Durum Planı
- Havacılık Bilgi Yayınlarında Yayımlanması gereken Havalimanı Bilgileri
- Pist Emniyeti ve Pist İhlallerini Önleme Eğitimi
- PAT Sahası Kontrolleri
- Maniaların Kontrolü
- Görsel yardımcıları
- Yabani Hayvanlarla ve Kuşla Mücadele
- Pist Yüzey Şartları
- Kötü Hava Şartlarındaki Operasyonlar
- PAT Sahalarının Fiziki özellikleri
- PAT Sahalarında Araç Kullanma
- Apron Yönetimi ve Apron Emniyeti

#### **Erzincan Eğitim Tesisleri; (Yangınla Mücadele Eğitim Simülasyonu)**

Yaklaşık olarak 400 m<sup>2</sup> kapalı alan ayrıca, 120\*100 mt. uygulama alanına sahip olup, tesis içerisinde kontrol kulesi, Uçak - Araç Simülasyonları ve Karla Mücadele Araç Simülasyonları, su tankı ve yakıt tankları yer almaktadır. Tesis barındırdığı senaryolar itibariyle çok yönlü eğitim olanaklarına sahiptir. Söz konusu simülasyonda yurt içinden ve yurt dışından gelen eğitim talepleri de ICAO standartları esas alınarak karşılanabilmektedir. ARFF personelinin uygulamalı eğitimlerinin gerçek olaylara benzetilmiş koşullarda yürütülmesini sağlamak amacıyla; Boeing 737-800 tipindeki bir uçak bire bir ölçülerle simüle eden çelik sistemden imal edilmiş ana uçak gövdesi yapısından oluşmaktadır.

**Anahtar Kelimeler:** Eğitim, Uçak Kazaları, Emniyet Kavramı, İnsan Faktörleri, ARFF Memuru, Havalimanı İşletmeciliği

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## KEKİK BİTKİSİNİN FARKLI TUZLULUK SEVİYELERİNE TOLERANS DÜZEYİNİN BELİRLENMESİ

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### Özet

Bu çalışmada, abiyotik stres koşullarından tuzluluğun kekik bitkisi üzerine karşı tolerans düzeyinin belirlenmesi hedeflenmiştir. Çalışma kapsamında kekik tohumları in vitro koşullarda 0 (KA) g, 1 (KB) g, 2 (KC) g ve 4 (KD) g konsantrasyonunda tuz (NaCl) içeren MS ortamına ekilmiştir. Araştırmada tohum çimlenme yüzdesi (%), gövde yaş ağırlığı (g), gövde kuru ağırlığı (g), kök yaş ağırlığı (g), kök kuru ağırlığı (g), gövde uzunluğu (mm) ve kök uzunluğu (mm) üzerine etkileri incelenmiştir. Çalışma sonucunda artan tuz seviyelerinin çimlenme yüzdesi (%), bitki gövde yaş ağırlığı (g), gövde kuru ağırlığı (g), kök yaş ağırlığı (g), kök kuru ağırlığı (g), gövde uzunluğu (mm) ve kök uzunluğu (mm) üzerine etkilerinin istatistiksel olarak önemli olduğu belirlenmiştir. Çimlenme yüzdesi en yüksek %36.00 ile KA ortamında gerçekleşirken, en düşük %14.00 ile KD ortamında görülmüştür. Bitkilerin gövde yaş ağırlığı incelendiğinde, 0.1878 g ile KA ortamından en yüksek değerler elde edilmiştir. En düşük değer ise 0.0083 g ile KD ortamından elde edilmiştir. Gövde kuru ağırlığının en yüksek olduğu bitkiler 0.0262 g ile KA ortamında görülürken, en düşük olan bitkiler 0.0018 ile KD ortamında saptanmıştır. Bitkilerin kök yaş ve kuru ağırlıkları en yüksek olan bitkiler sırasıyla 0.5510 g ve 0.0403 g ile KA ortamından elde edilmiştir. Gövde ve kök uzunlukları en yüksek olan bitkilerin 44.31 mm ve 25.61 mm ile KA ortamında olduğu gözlenmiştir. Sonuç olarak tuz seviyesi arttıkça kekik tohumlarının çimlenme yeteneğinin azaldığı ve bitki gelişiminin olumsuz etkilendiği bulunmuştur.

**Anahtar kelimeler:** Tuzluluk, İn vitro, Kekik

## DETERMINATION OF TOLERANCE LEVEL OF THYME PLANT TO DIFFERENT SALINITY LEVELS

### Abstract

In this study, it was aimed to determine the tolerance level of salinity, one of the abiotic stress conditions, on thyme plants. Within the scope of the study, thyme seeds were sown in MS medium containing salt (NaCl) at concentrations of 0 (KA) g, 1 (KB) g, 2 (KC) g and 4 (KD) g under in vitro conditions. The effects of salt levels on seed germination percentage (%), stem wet weight (g), stem dry weight (g), root wet weight (g), root dry weight (g), stem length (mm) and root length (mm) were investigated. As a result of the study, it was determined that the effects of increasing salt levels on germination percentage (%), stem wet weight (g), stem dry weight (g), root wet weight (g), root dry weight (g), stem length (mm) and root length (mm) were statistically significant. Germination percentage was highest in KA medium with 36.00% and lowest in KD medium with 14.00%. When the stem wet weight of the plants was analyzed, the highest value was obtained from KA medium with 0.1878 g. The lowest value was obtained from KD medium with 0.0083 g. The highest stem dry weight was obtained from KA medium with 0.0262 g, while the lowest was obtained from KD medium with 0.0018 g. The highest root wet and dry weights were obtained from KA medium with 0.5510 g and 0.0403 g, respectively. The highest stem and root lengths were observed in KA medium with 44.31 mm and 25.61 mm, respectively. As a result, it was found that as the salt level increased, the germination ability of thyme seeds decreased and plant growth was negatively affected.

**Keywords:** Salinity, In vitro, Thyme

## GİRİŞ

Kekik (*Thymus vulgaris* L.), Lamiaceae familyasına ait tıbbi ve aromatik bir bitkidir (Stahl-Biskup ve Saez, 2002; Bassole ve Rodolfo-Juliani 2012). Cins yaklaşık 250 türden oluşmaktadır (Cronquist, 1988; Nickavar ve ark., 2005; Mozafaryan, 2008). Bu cins, yüzyıllardır geleneksel tıpta dünya çapında kullanılan bitkileri içerir ve bunların çoğu biyoaktif bileşiklerin doğal kaynakları olarak ekonomik açıdan önemlidir (Stahl-Biskup ve Saez, 2002). *Thymus vulgaris* L., Akdeniz ve Güney Avrupa'ya özgü, ekonomik açıdan önemli bir bitkidir ve dünya çapında dağılıma sahiptir (Hosseinzadeh ve ark., 2015). Bu bitkinin adı, tıbbi ve iyileştirici etkilerinin sembolü olabilen cesaret ve güç anlamına gelen Yunanca "Thymos" kelimesinden gelmektedir (Mousavi ve ark., 2014). Kekik, aromatik, dezenfektan, anti-parazit, karminatif ve anti-kramp bitkisidir. Kekik, kan, sinir sistemleri ve tüm vücut sağlığı üzerinde etkilidir. Bu bitki güçlü bir antioksidandır ve ayrıca anti-parazit, terletici ilaç olarak da kullanılmaktadır. Bunların yanı sıra, balgam söktürücü, öksürük kesici, bronşit önleyici, spazm çözücü, kurt düşürücü, karminatif ve idrar söktürücü özellikleri nedeniyle yaygın olarak kullanılmaktadır (Miraj ve Kiani, 2016; Oliviero ve ark., 2016; Nabissi ve ark., 2018). Timüs türleri ikincil metabolitlerin zengin kaynaklarıdır. Başlıca örnekler, belirgin radikal süpürücü ve antimikrobiyal özelliklere sahip fenolik monoterpeneoidler karvakrol ve timoldür (Amiri, 2012; Ghasemi Pirbalouti ve ark., 2014; Roby ve ark., 2013; Turumtay ve ark., 2014; Tabari ve ark., 2017; Vitali ve ark., 2016). Ayrıca apigenin ve luteolin türevleri gibi flavonoidler ve sinamik, karnosik ve rosmarinik asitler gibi fenolik asitler kekik ekstraktlarının antioksidan kapasitesine önemli katkı sağlamaktadır (Marzouk ve ark., 2018; Roby ve ark., 2013; Caprioli ve ark., 2018). Bu bileşikler ayrıca kanser ve kronik inflamasyon gibi hastalıkların gelişimini geciktirmede önemli roller oynar. Bu nedenle, bu bileşenler kekik ve buldukları diğer bitki türlerinin yararlı sağlık etkilerinden sorumludur (Paur ve ark., 2010). Bilindiği üzere, uçucu yağ ve fenolik bileşenlerin biyosentezi kuraklık stresi, ağır metaller (Martín-Lara, 2018) ve ışık yoğunluğu (Ascrizzi ve ark., 2018) gibi çeşitli çevresel faktörlerden etkilenmektedir (Emami Bistgani ve ark., 2017b; Morshedloo ve ark., 2017). Kekik, tıp, kozmetik ve gıda endüstrilerinde kullanılır ve dünya çapındaki gereksinimleri karşılamak için büyük ölçekli ekimi ve üretimi gereklidir. Bu nedenle, araştırmacılar tarafından üretimine ve işlenmesine daha fazla dikkat edilmelidir (Jamzad, 2010; Morales, 2002; Yarnell, 2007).

Tuzluluk, suda ve toprakta çözünebilir tuzların ve mineral elementlerin bulunmasıdır ve bu da kök bölgesinde tuz birikmesine neden olur, böylece bitki toprak çözeltisinden yeterli suyu emmekte zorluk çeker. Toprak tuzluluğu, dünya çapında ürün verimini sınırlayan en önemli faktörlerden biridir, bu sorun özellikle kurak ve yarı kurak alanlarda tarım sektörünün en temel sorunlarından biri olarak kabul edilir. (Rezaee ve ark., 2018). Tuzluluk stresinin erken aşamalarında, toprakta ve bitkilerde yüksek tuz birikiminin neden olduğu ozmotik basınç nedeniyle, kök sistemlerinin su alma oranı azalır ve bunun sonucunda yapraklardan su kaybı hızlanır. Bu nedenle tuzluluk stresi hiperosmotik stres olarak da kabul edilir (Munns, 2005; Hakimi ve ark., 2022). Bitkiler tuzluluk stresine yanıt olarak singlet oksijen, süperoksit, hidroksil radikalleri ve hidrojen peroksit gibi ROS üretimini artırır (Apel ve Hirt, 2004; Mahajan ve Tuteja, 2005; Ahmad, 2010). Tuzluluk stresine bağlı ROS oluşumu lipidler, proteinler ve DNA gibi çeşitli bitki hücresi bileşenlerinde oksidatif hasara yol açabilir ve bitki hücrelerinin hayatı fonksiyonlarını bozabilir (Gupta ve Huang, 2014).

Aseptik koşullar altında bitki dokularının, organlarının ve bunların bileşenlerinin kültüre alınması olayına bitki doku kültürü denir (Thorpe, 2007). Bu çalışmada, kekik bitkisinin bitkisinin in vitro koşullarda farklı konsantrasyonlarda hazırlanmış 0 (LA) g, 1 (LB) g, 2 (LC) g ve 4 (LD) g NaCl'nin, tuzluluk koşullarına karşı etkisi belirlenmiştir. Bu kapsamda bu çalışmada, in vitro koşullarda kekik bitkisinin tuz toleransının belirlenmesi amaçlanmıştır.



## Materyal ve Metod

Çalışma, Sivas Bilim ve Teknoloji Üniversitesi, Tarım Bilimleri ve Teknoloji Fakültesi bitki doku kültürü laboratuvarında yapılmıştır. Çalışmada kekik tohumları kullanılmıştır. Kekik tohumları steril kabin içerisinde 20 dakika %20'lik sodyum hipoklorit çözeltisinde bekletilerek steril hale getirilmiştir. Kullanılan besin ortamları adlandırması ve ortam içerikleri Çizelge 1'de verilmiştir. Steril kabin içerisinde besin ortamları petrilere dökülüp soğuyup katılaşmaya bırakılmıştır. Katılaştıran ortamlara ekimi yapılmış ve  $25 \pm 2^\circ\text{C}$  sıcaklık 3.000 lüx' ışık altında 16 saat aydınlık 8 saat karanlık periyotta büyütme odasına alınmıştır.

**Çizelge 1.** Kullanılan besin ortamlarının içeriği

Adlandırma	Ortam İçeriği
KA	4.4 g/l MS + 0 g NaCl + 30 g/L sakkaroz + 7 g/L agar
KB	4.4 g/l MS + 1 g NaCl + 30 g/L sakkaroz + 7 g/L agar
KC	4.4 g/l MS + 2 g NaCl + 30 g/L sakkaroz + 7 g/L agar
KD	4.4 g/l MS + 4 g NaCl + 30 g/L sakkaroz + 7 g/L agar

Çalışmada kapsamında; çimlenme yüzdesi (%) (Kaya ve ark. 2006), gövde yaş ağırlığı (g), gövde kuru ağırlığı (g), kök yaş ağırlığı (g), kök kuru ağırlığı (g), gövde uzunluğu (mm) ve kök uzunluğu (mm) belirlenmiştir (Keleş, 2019). Çalışmada incelenen parametrelerden elde edilen verilere SAS temeli üzerine kurulu JMP 8.1 istatistik paket programında tesadüf parselleri deneme desenine göre analiz edilmiş ve ortalamalar LSD testi ile karşılaştırılmıştır.

## Bulgular ve Tartışma

Çalışma kapsamında kekik tohumlarının farklı tuzluluk seviyelerine tolerans düzeylerinin belirlenmesi amacıyla tohumların çimlenme yüzdesi (%), bitkilerin gövde yaş ağırlıkları (g), gövde kuru ağırlıkları (g), kök yaş ağırlıkları (g) ve kök kuru ağırlıkları (g) incelenmiştir. Çalışma sonucunda elde edilen veriler Çizelge 2'de verilmiştir. Bu kapsamda tohumların çimlenme yüzdesi istatistiksel olarak önemli bulunmuş ve en yüksek çimlenme yüzdesinin kontrol grubu olan KA (%36.00) ortamında olduğu belirlenmiştir. Çimlenme yüzdesi tuzluluk seviyesindeki artışa bağlı olarak kademeli olarak azalmıştır. En düşük çimlenmenin KD (%14.00) ortamında olduğu tespit edilmiştir.

Tuz seviyesindeki artışla birlikte bitkilerin gövde yaş ağırlıklarında azalmalar olmuştur. Gövde yaş ağırlığı en yüksek olan bitkiler 0.1878 g ile KA ortamından elde edilmiş ve bunu 0.0645 g ile KB ortamı takip etmiştir. Gövde yaş ağırlığı en düşük olan bitkiler 0.0083 g ile KD ortamından elde edilmiştir.

Bitkilerin gövde kuru ağırlıkları arasındaki farklılıklar istatistiksel olarak önemli bulunmuştur. Bu kapsamda tuz seviyelerinin artmasıyla birlikte, gövde yaş ağırlığına benzer şekilde gövde kuru ağırlıklarında da azalmalar olmuştur. Gövde kuru ağırlığı en yüksek KA (0.262 g) ortamından elde edilirken, en düşük KD (0.018 g) ortamından elde edilmiştir.

Çalışmada gelişen bitkilerin kök yaş ve kuru ağırlıkları incelendiğinde, tuz seviyesinin artışına bağlı olarak kök yaş ve kuru ağırlıklarında azalmalar meydana gelmiştir. Kök yaş ve kuru ağırlığı en yüksek olan bitkiler KA (sırasıyla 0.5510 g, 0.0403 g) ortamından elde edilmiştir. Bunu KB ortamı (sırasıyla 0.0403g, 0.0048 g) takip etmiştir. KC ortamında gelişen bitkilerin kök yaş ve kuru ağırlığında önemli oranda düşüş olduğu dikkat çekmektedir. KC ortamındaki bitkilerin kök yaş ağırlığı sert bir düşüşle 0.0082 g'a, kök kuru ağırlığı ise 0.0008 g'a düşmüştür.

Woodward ve Bennett (2005), Eucalyptus camaldulensis üzerinde yapılan bir çalışmada, büyüme ve gelişme ortamına NaCl ve absisik asit ilave etmiş ve bitkinin 100 mM

konsantrasyona kadar tuzluluğa adapte olduğunu tespit etmişlerdir. Rezaei Nasab ve ark. (2016), tuzluluğun lavanta bitkisi üzerine etkilerini belirledikleri çalışmada, tuz konsantrasyonundaki artışlar kök-sürgün kuru ağırlığı, kök-sürgün uzunluğu, dal sayısı, yaprak yüzeyi gibi morfolojik özelliklerin önemli ölçüde azalttığını dikkat çekmiştir. Agar ve ark. (2022), in vitro yetiştirilen *T. cilicicus*'un büyüme, gelişme ve sürgün oluşumu gibi fizyolojik etkileri, üç farklı tuz konsantrasyonu içeren bir besin ortamı kullanılarak değerlendirilmiştir. Elde edilen sonuçlarda bitkinin 50 mM'a kadar toleranslı olduğu ve hatta kontrol grubuna kıyasla daha iyi bir gelişme, rejenerasyon ve sürgün oluşturma potansiyeli kazandığını bildirmiştir.

**Çizelge 2.** Farklı tuz konsantrasyonlarının kekik çimlenmesi ve bitki gelişimi üzerine etkileri

Dozlar	Çimlenme yüzdesi (%)	Gövde yaş ağırlığı (g)	Gövde kuru ağırlığı (g)	Kök yaş ağırlığı (g)	Kök kuru ağırlığı (g)
KA	36.00a	0.1878a	0.0262a	0.5510a	0.0403a
KB	34.00a	0.0645b	0.0071b	0.0430b	0.0048b
KC	30.00b	0.0174c	0.0032bc	0.0082b	0.0008c
KD	14.00c	0.0083c	0.0018c	0.0075b	0.0007c
LSD	2.5871***	0.0285***	0.0042***	2.0796***	0.0069***

\*\*\*P ≤ 0.001

Bitkilerin gövde ve kök uzunlukları (mm) arasındaki farklılıklar istatistiksel olarak önemli bulunmuştur. Gövde uzunluğu en yüksek olan bitkiler KA (44.310 mm) ortamından elde edilmiş ve bunu KB (24.3875 mm) ortamındaki bitkiler takip etmiştir. KC (9.0320 mm) ve KD (5.7400 mm) ortamlarında gelişen bitkilerin gövde uzunluklarının önemli oranlarda düştüğü dikkat çekmiştir.

Kök uzunlukları bakımından bitkiler kıyaslandığında, en yüksek değerler KA (25.6050 mm) ortamından elde edilmiş ve bunu KB (19.6250 mm) ortamı takip etmiştir. Kök uzunluğu bakımından KC (5.2820 mm) ve KD (4.2000 mm) ortamlarında keskin düşüşler olduğu belirlenmiştir.

Tuzluluk, uygun konsantrasyonları aşan iyon girişi ve potasyumun sodyum tarafından yer değiştirmesinde yaygın olarak görüldüğü gibi besin dengesizliklerinin bir sonucu olarak bitkiler üzerinde iyon toksisitesi gibi diğer stresleri de beraberinde getirmektedir. Tuzluluk zararı temel olarak hücreler arası boşluklarda yüksek tuz birikiminin neden olduğu değişen su ilişkisinden kaynaklanmaktadır (Zhang ve ark., 2006). Artan tuzluluk seviyeleri, hücre bölünmesini ve bitki büyüme metabolizmasını azaltarak fide çıkışında gecikmeye neden olmaktadır (Maas ve Nieman, 1978). Khoshokhan ve ark. (2012), *T. Daenensis* ve *T. kotschyanus* tohumlarının tuz konsantrasyonunun olmadığı durumlarda en iyi çimlenmenin olduğunu saptamıştır. Çimlenme oranı, çimlenme yüzdesi, kök uzunluğu, sürgün uzunluğu ve kök uzunluğunun sürgün uzunluğuna oranının (r/s) sodyum klorürün konsantrasyonlarına bağlı olarak değişiklik göstermiştir. Tuz stresi düşük NaCl konsantrasyonunda (-3 bar) çimlenme oranı ve çimlenme yüzdesi üzerinde kayda değer bir etkiye sahip olmadığı, ancak -6 bar ozmotik potansiyel değerinde veya daha yüksek tuz stresi seviyelerinde hem oran hem de yüzde çimlenme kontrole kıyasla önemli ölçüde azaldığını bildirmiştir. Abdo ve ark., (2020) yaptıkları çalışmada yüksek seviyelerde tuzluluğun (2000 ve 3000 ppm) lavanta bitkilerinde büyüme parametrelerini bitki boyu, dal sayısı/bitki, kök uzunluğu, bitki başına kök sayısı, köklerin taze ve kuru ağırlıkları/bitki) azalttığını bildirmiştir.

**Çizelge 3.** Farklı tuz konsantrasyonlarının kekik bitkisinin gövde ve kök uzunlukları (mm) üzerine etkileri

Dozlar	Gövde uzunluğu (mm)	Kök uzunluğu (mm)
KA	44.3100a	25.6050a
KB	24.3875b	19.6250b
KC	9.0320c	5.2820c
KD	5.7400c	4.2000c
LSD	10.6678***	5.2930***

\*\*\*P ≤ 0.001

Çizelge 4'te tuz stresi altında kekik bitkilerinin gelişim parametreleri arasındaki korelasyon analizi sunulmuştur. Bu kapsamda incelenen parametrelerin tamamının arasındaki korelasyonlar pozitif niteliktedir. çimlenme yüzdesi ile gövde yaş ağırlığı (0.6211), kök yaş ağırlığı (0.5177), kök kuru ağırlığı (0.5350) ve gövde uzunluğu arasında pozitif güçlü korelasyon bulunmaktadır. Gövde yaş ağırlığı ile kök yaş ağırlığı (0.9495), kök kuru ağırlığı (0.9290), gövde uzunluğu (0.9048) arasında güçlü pozitif korelasyon bulunmaktadır.

**Çizelge 4.** Farklı tuz konsantrasyonlarının kekik bitkisinde incelenen özellikler arasındaki korelasyon analizi

	Çimlenme yüzdesi (%)	Gövde yaş ağırlığı (g)	Gövde kuru ağırlığı (g)	Kök yaş ağırlığı (g)	Kök kuru ağırlığı (g)	Gövde uzunluğu (mm)	Kök uzunluğu (mm)
Çimlenme yüzdesi (%)	1.0000	0.6211	0.6101	0.5177	0.5350	0.6242	0.6615
Gövde yaş ağırlığı (g)		1.0000	0.9683	0.9495	0.9290	0.9048	0.8172
Gövde kuru ağırlığı (g)			1.0000	0.9813	0.9720	0.8640	0.7151
Kök yaş ağırlığı (g)				1.0000	0.9884	0.8521	0.6846
Kök kuru ağırlığı (g)					1.0000	0.8233	0.6893
Çimlenme yüzdesi (%)						1.0000	0.8792
Kök Uzunluğu (mm)							1.0000

## Sonuç ve Öneriler

In vitro koşullar altında farklı dozlarda hazırlanmış NaCl'in kekik bitkisinin gelişimi üzerine etkileri belirlendiği çalışmada çimlenme yüzdesi, gövde yaş - kuru ağırlığı, kök yaş - kuru ağırlığı ve gövde - kök uzunlukları kontrol grubunda daha yüksek çıkmıştır. Konsantrasyonların artmasıyla bitki gelişimlerinin azaldığı saptanmıştır. Toprak tuzluluğu dünya çapında tarımsal sürdürülebilirlik için ciddi bir sorun haline gelmektedir. In vitro koşullarda bu tip çalışmaların farklı türlerde yapılarak yaygınlaştırılması abiyotik stres faktörlerinden tuzluluk toleransının belirlenmesi açısından büyük önem arz etmektedir.

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# IN VITRO KOŞULLARDA FARKLI TUZ KONSANTRASYONLARININ LAVANTA GELİŞİMİ ÜZERİNE ETKİLERİNİN BELİRLENMESİ

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## Özet

Bu çalışmada artan tuzluluğun lavanta bitkisinin gelişimi üzerine etkilerinin belirlenmesi amaçlanmıştır. Bu kapsamda lavanta tohumları, 0 (LA) g, 1 (LB) g ve 2 (LC) g konsantrasyonunda tuz içeren MS ortamına in vitro koşullarda ekilmiştir. Çalışmada, çimlenme yüzdesi (%), gövde yaş ağırlığı (g), gövde kuru ağırlığı (g), kök yaş ağırlığı (g), kök kuru ağırlığı (g), gövde uzunluğu (mm) ve kök uzunluğu (mm) parametreleri incelenmiştir. Çalışma sonuçları değerlendirildiğinde, tuz miktarının artmasıyla tohum çimlenme yüzdesinin ve bitki gelişiminin olumsuz etkilendiği belirlenmiştir. Tohum çimlenme yüzdesi en yüksek %68.00 LA (kontrol) grubunda bulunurken, en düşük %26.00 ile LC ortamında bulunmuştur. Bitkilerin gövde yaş ağırlığı en yüksek olan ortam LA (0.0407 g), en düşük olan ortam ise LC (0.0110 g) olarak belirlenmiştir. Bitkilerin gövde kuru ağırlıkları incelendiğinde ise en yüksek değerin LA (0.0047 g) ortamında bulunan bitkilerde olduğu saptanmıştır. Kök yaş ve kuru ağırlıklarında en yüksek değerlerin LA (sırasıyla 0.1013 g, 0.0056 g) ortamında olduğu dikkat çekmiştir. Bitkilerin gövde ve kök uzunlukları kıyaslandığında ise en yüksek değerler LA (sırasıyla 21.98 mm, 27.90 mm) ortamından elde edilmiştir. Denemede incelenen parametreler arasındaki korelasyon oranları incelenmiş ve gövde yaş ağırlığı ile kök yaş ağırlığı, kök kuru ağırlığı ve gövde uzunluğu arasında pozitif güçlü korelasyon olduğu belirlenmiştir. Çalışma sonuçlarına göre tuz konsantrasyonundaki artışların bitkilerin gelişim gücünü yavaşlattığı tespit edilmiştir.

**Anahtar kelimeler:** Tuzluluk, İn vitro, Lavanta

## **DETERMINATION OF THE EFFECTS OF DIFFERENT SALT CONCENTRATIONS ON LAVENDER GROWTH UNDER IN VITRO CONDITIONS**

### **Abstract**

In this study was to determine the effects of increasing salinity on lavender plant growth. In this context, lavender seeds were sown in MS medium containing salt at concentrations of 0 (LA) g, 1 (LB) g and 2 (LC) g under in vitro conditions. Germination percentage (%), stem wet weight (g), stem dry weight (g), root wet weight (g), root dry weight (g), stem length (mm) and root length (mm) parameters were analyzed. When the results of the study were evaluated, it was determined that seed germination percentage and plant growth were negatively affected with increasing salt content. The highest seed germination percentage was found in the LA (control) group with 68.00%, while the lowest was found in the LC medium with 26.00%. The highest stem wet weight was found in LA (0.0407 g) and the lowest in LC (0.0110 g). When the stem dry weights of the plants were analyzed, the highest value was found in LA (0.0047 g) medium. The highest values in root wet and dry weights were found in LA (0.1013 g, 0.0056 g, respectively). When the stem and root lengths of the plants were compared, the highest values were obtained from LA (21.98 mm, 27.90 mm, respectively). The correlation rates between the parameters examined in the experiment were examined and it was determined that there was a strong positive correlation between stem wet weight and root wet weight, root dry weight and stem length. According to the results of the study, it was determined that increases in salt concentration slowed down the growth of plants.

**Keywords:** Salinity, in vitro, Lavender



## Giriş

Günümüzde tıbbi bitkiler birçok ülkede geleneksel tıbbın önemli bir parçasıdır, ayrıca yeni terapötik yaklaşımlarda özel bir yere ve yüksek değere sahiptirler. Tıbbi ve aromatik bitkilerden olan *Lavandula* cinsi Akdeniz'i ve Güney Avrupa'yı çevreleyen topraklardan kuzey ve doğu Afrika ve Orta Doğu ülkelerinden, güneybatı Asya ve güneydoğu Hindistan'a kadar uzanan topraklara özgüdür (Koulivand ve ark., 2013). *Lavandula* cinsinin aromatik bitkileri Akdeniz bölgesinde çok yaygındır (Lis-Balchin, 2002). İtalya'da yetiştirme alanı kıyı bölgelerinden Apeninler'e kadar yaygındır ve iyi bir aromatik profile sahip olmak için optimum rakım deniz seviyesinden yaklaşık 800 m'dir (Baltoni, 2000). Lavanta kurak ve yarı kurak alanlarda yetişmektedir. Cins, yıllık, çok yıllık, otsu ve çalı bitkileri de dahil olmak üzere 39 türe ve yaklaşık 400 kültür çeşidine sahip Lamiaceae ailesine aittir (Koulivand ve ark., 2013; Demasi ve ark., 2018; Salehi ve ark., 2018). Başlıca türler lavanta (*Lavandula angustifolia* Mill.), başak lavanta (*Lavandula latifolia* L.) ve *L. angustifolia* x *L. latifolia*'nın melezlenmesiyle elde edilen steril bir melez olan lavandin'dir (*Lavandula* x *intermedia* Emeric ex Loisel.) (Pistelli ve ark., 2017). Lavanta ve lavandin, 12 ile 15 yıl sürebilen bir döngüye sahip çok yıllık türlerdir. Her iki ürün de eğimli, kireçli, iyi drene edilmiş ve taşlı topraklarda, tam güneş ışığı alan yerlerde yetişmektedir. *Lavandula* cinsinin bitkileri Avrupa'da en çok yetiştirilen aromatik türler arasındadır (Chrysargyris ve ark., 2017). *Lavandula* otları süs bitkisi olarak kullanılmasının yanı sıra, çiçeklerindeki linalil asetat, kafur, linalool, lavandulil asetat ve lavandulol gibi ikincil metabolitlerin zenginliği nedeniyle uçucu yağlar (EO'lar) ve reçineler üretmek için yetiştirilir (Hassiotis ve ark., 2010). Reçineler ve uçucu yağların kullanım alanları; parfümler, kozmetikler, ilaçlar, farmasötikler ve böcek ilaçlarıdır (Wells ve ark., 2018; Caccialupi ve ark., 2022). Lavanta türleri aromatik amaçlarla ve ayrıca tıbbi ve kozmetik olarak kullanılır. Lavanta kokusu yastıklarda, banyo bakımında, ev ve evcil hayvan ürünlerinde oldukça popülerdir ve birçok içeceğe, tatlıya, jöleye, reçele, marmelata, bala ve çeşniye eşsiz bir tat verir. Geleneksel tıpta ve dini törenlerde, ayrıca bal ve süs amaçlı olarak oldukça popülerdir. Ayrıca, son çalışmalar uçucu yağların önemli bir antifungal aktiviteye sahip olduğunu göstermiştir (Pohrib ve Nistor, 2012). Lavanta uzun bir tıbbi kullanım geçmişine sahiptir ve antikonvülsan, antidepresan, anksiyolitik, yatıştırıcı ve sakinleştirici özelliklere sahip olduğu ileri sürülmektedir (Cavanagh ve Wilkinson, 2002; Gorji, 2003; Vakili ve Gorji, 2006). Lavanta ayrıca Ebn-e-sina ve Razi gibi bazı orta çağ hekimleri tarafından epilepsi ve migren ataklarının tedavisi için reçete edilmiştir. Ayrıca, lavanta ağrı ve titreme tedavisinde faydalı olarak kabul edilir (Koulivand ve ark., 2013).

Tohum, bitkilerin farklı alanlara dağılması ve yerleşmesinde, olumsuz ve uzun süreli koşullarda bitki neslinin korunması ve hayatta kalmasında hayati bir rol oynayan kalıtsal bitki rezervlerinin çoğaltılması ve korunmasının ana faktörüdür (Bewley ve ark., 2013). Tohum çimlenmesi, embriyonun endosperm, perisperm, testa ve perikarp dahil olmak üzere çevreleyen örtülerin ucundan çıktığı fizyolojik bir süreçtir. Çimlenme, tohum tarafından suyun emilmesiyle başlar ve kök ve gövde de dahil olmak üzere embriyonik eksenin çevre yapılarından çıkmasıyla sona erer (Bewley ve ark., 2013). Bitkiler genellikle büyümelerini ve üretkenliklerini sınırlayan ve dünya çapında tarımsal üretimde önemli kayıplara neden olan farklı çevresel streslere maruz kalırlar. Bitkiyi ve ikincil metabolitlerin üretimini etkileyen en önemli faktörlerden biri tuz stresidir (Khorasaninejad ve ark., 2016). Dünyadaki ekili alanların yaklaşık %20'si ve sulanan arazilerin yaklaşık yarısı tuzluluktan etkilenmektedir ve miktarı giderek artmaktadır (Flowers, 2004). Jamil ve ark., (2011) dünya çapında ekilebilir arazilerin yaklaşık %50'sinin 2050 yılına kadar tuzluluktan etkileneceğini bildirmiştir. Toprak veya suyun tuzluluğu, dünyadaki bitki yetiştirme alanlarında ve özellikle kurak ve yarı kurak bölgelerde üretimi artırmanın önündeki en büyük streslerden biridir ve bitki üretimini ciddi şekilde sınırlayabilmektedir (Khorasaninejad ve ark., 2016). Tuzluluk, bitkilerin yeterince su alamadığı toprak ve su ortamında aşırı çözünebilir tuz ve minerallerin bulunmasıdır. Tuzluluk, besin maddelerinin

emiliminin engellenmesi, fotosistem 1 ve 2'nin (PSI ve PSII) bozulması gibi bitkilerin metabolizmasını ve fizyolojik faaliyetlerini bozmaktadır. Aynı zamanda bitki büyümesini, gelişimini ve verimini azaltmaktadır (Munns ve Tester, 2008). Genellikle, en yüksek tuzluluk hassasiyeti çimlenme ve fide büyümesinin başlangıcı sırasında görülmektedir (Kermode, 1990). Tuzluluğun çimlenme hızı ve çimlenme yüzdesi ile birçok bitkide kök ve sürgün büyümesi üzerindeki etkilerinin incelenmesi, çimlenme aşamasındaki tuzluluk stresinin birçok türde stres toleransının değerlendirilmesinde güvenilir bir test olduğunu göstermiştir. Tuzluluk çimlenme yüzdesini ve hızını azaltır ve kök ve sürgün uzunluğunu düşürür (Ghoulam ve Fares, 2001; Hakimi ve ark., 2022).

Bitki dokularının, organlarının ve bunların bileşenlerinin aseptik koşullar altında kültüre alınması olayına bitki doku kültürü denir (Thorpe, 2007). Üretimi zor olan türlerin çoğaltılması hastalıklardan ve virüsten ari materyallerin elde edilmesi, yok olma tehlikesi ile karşı karşıya kalınan türlerin korunması bitki doku kültürünün temel amaçlarındandır. Bu çalışmada, lavanta bitkisinin in vitro koşullarda farklı konsantrasyonlarda hazırlanmış 0 (LA) g, 1 (LB) g ve 2 (LC) g NaCl'nin, tuzluluk koşullarına karşı etkisi belirlenmiştir.

### Materyal VE Metod

Çalışma, Sivas Bilim ve Teknoloji Üniversitesi, Tarım Bilimleri ve Teknoloji Fakültesi bitki doku kültürü laboratuvarında yapılmıştır. Çalışmada, Lavanta çiçeği tohumları kullanılmıştır. Lavanta tohumları steril kabin içerisinde 20 dakika %20'lik sodyum hipoklorit çözeltisinde bekletilerek steril hale getirilmiştir. Kullanılan besin ortamları adlandırması ve ortam içerikleri Çizelge 1'de verilmiştir. Ortamlar hazırlandıktan sonra pH'ı, 5.8'e ayarlanmıştır. Besin ortamları 121 °C sıcaklıkta, 1.2 atm basınçta 15 dakika boyunca otoklavda steril edilmiştir. Besin ortamları steril kabin içerisinde petrilere dökülmüş ve soğuyup katılaşıncaya kadar bekletilmiştir. Katılaştıran ortamlara steril tohumların ekimi sağlanmış ve 25 ± 2°C sıcaklık ve 3.000 lüks ışık altında 16 saat aydınlık 8 saat karanlık periyotta büyütme odasına bırakılmıştır.

**Çizelge 1.** Kullanılan besin ortamlarının içeriği

Adlandırma	Ortam İçeriği
LA	4.4 g/l MS + 0 g NaCl + 30 g/L sakkaroz + 7 g/L agar
LB	4.4 g/l MS + 1 g NaCl + 30 g/L sakkaroz + 7 g/L agar
LC	4.4 g/l MS + 2 g NaCl + 30 g/L sakkaroz + 7 g/L agar

Çalışmada kapsamında; çimlenme yüzdesi (%) (Kaya ve ark. 2006), gövde yaş ağırlığı (g), gövde kuru ağırlığı (g), kök yaş ağırlığı (g), kök kuru ağırlığı (g), gövde uzunluğu (mm) ve kök uzunluğu (mm) belirlenmiştir (Keleş, 2019). Çalışmada incelenen parametrelerden elde edilen verilere SAS temeli üzerine kurulu JMP 8.1 istatistik paket programında tesadüf parselleri deneme desenine göre analiz edilmiş ve ortalamalar LSD testi ile karşılaştırılmıştır.

### Bulgular ve Tartışma

Lavanta tohumlarının çimlenme yüzdesi (%) üzerine tuzluluğun etkisinin istatistiksel olarak önemli olduğu belirlenmiştir (Çizelge 2). Kontrol grubu olan LA ortamındaki tohumların çimlenme oranının (%68.00) en yüksek olduğu belirlenmiştir. En düşük çimlenme oranı ise %26.00 ile LC ortamından elde edilmiştir.

Bitkilerin gövde yaş ağırlıkları incelendiğinde, tuz konsantrasyonu arttıkça gövde yaş ağırlığının azaldığı görülmüştür. En yüksek gövde yaş ağırlığı olan bitkiler, 0.0407 g ile LA ortamından en düşük gövde yaş ağırlığı olan bitkiler ise LB (0.0113 g) ve LC (0.0110 g) ortamlarından elde edilmiştir. Bu iki ortam istatistiksel olarak aynı grupta yer almıştır. Gelişen bitkilerin gövde kuru ağırlıkları incelendiğinde, en yüksek değerler 0.0047 g ile LA ortamından, en düşük değerler ise 0.0021 ile LC ortamından elde edilmiştir. Tuzluluk konsantrasyonlarının, bitkilerin kök yaş ve kuru ağırlıklarına etkileri incelendiğinde; en yüksek değerlerin LA

(sırasıyla 0.1013 g ile 0.0056 g) ortamında, en düşük değerlerin ise LC (sırasıyla 0.0013 g ile 0.0002 g) ortamında olduğu belirlenmiştir.

Khorasaninejad ve ark. (2016), tarafından yapılan çalışmada, tuzluluk stresinin lavantada tüm büyüme parametreleri ve uçucu yağ yüzdesinde ( $P < 0,05$ ) önemli bir etkiye neden olduğunu bildirmişlerdir. Toprak tuzluluk oranının artmasıyla; gövde uzunluğunda, sürgün yaş ağırlığında, kök yaş ağırlığında ve kök kuru ağırlığında azalmaya neden olduğunu tespit etmişlerdir. Rezaei Nasab ve ark., (2016) lavanta bitkisi üzerine tuzluluğun etkilerini inceledikleri çalışmada, tuz konsantrasyonundaki artışlarla kök-sürgün kuru ağırlığı, kök-sürgün uzunluğu, dal sayısı, yaprak yüzeyi gibi morfolojik özelliklerin önemli ölçüde azalttığını bildirmişlerdir. Szekely-Varga ve ark., (2020) iki *Lavandula angustifolia* çeşidinin kuraklığa ve tuzluluğa verdiği tepkileri analiz ettikleri çalışmada NaCl uygulamalarının, bitki köklerinde önemli bir su kaybına neden olmadığını bildirmişlerdir. Tuz stresinin, köklerden daha çok bitkilerin toprak üstü kısımlarının büyümesini etkilediğini belirlemişlerdir. Gövde ve yaprakların yaş ağırlıklarının, artan NaCl konsantrasyonlarına paralel olarak azaldığı ve 300 mM NaCl varlığında önemli oranlarda düşüşler olduğu tespit edilmiştir. Yüzde su içeriği bakımından tuz stresi köklerin aksine, gövde ve yapraklarda kademeli bir azalmaya neden olduğu bildirilmiştir. Çalışma sonuçları literatürü destekler niteliktedir.

**Çizelge 2.** Farklı tuz konsantrasyonlarının lavanta çimlenmesi ve bitki gelişimi üzerine etkileri

Dozlar	Çimlenme yüzdesi (%)	Gövde yaş ağırlığı (g)	Gövde kuru ağırlığı (g)	Kök yaş ağırlığı (g)	Kök kuru ağırlığı (g)
LA	68.00a	0.0407a	0.0047a	0.1013a	0.0056a
LB	30.00b	0.0113b	0.0040b	0.0360b	0.0013b
LC	26.00c	0.0110b	0.0021c	0.0013c	0.0002c
LSD	2.6667***	0.0030***	0.0042***	0.0005***	0.0007***

\*\*\* $P \leq 0.001$

Farklı tuz konsantrasyonlarının lavanta bitkisinin gelişimi üzerine etkilerinin istatistiksel olarak önemli olduğu belirlenmiştir (Çizelge 3). Bu kapsamda LA ortamındaki bitkilerin gövde uzunluğu 21.98 mm olarak belirlenirken, tuzluluk konsantrasyonunun arttığı LC ortamında gövde uzunluğu 5.08 mm olarak bulunmuştur. Tuz konsantrasyonunun bitkinin gövde uzunluğu üzerine olumsuz etkisi olduğu dikkat çekmektedir. Szekely-Varga ve ark., (2020) yaptıkları çalışmada, lavantada bitki gövdelerinin uzamasının, kontrol bitkilerinde stres altındaki bitkilere kıyasla önemli ölçüde daha büyük olduğunu bildirmişlerdir. Çalışmada 'Codreanca' çeşidi için gövde uzunluğu bakımından üç tuz uygulaması (100, 200 ve 300 mM NaCl) arasında küçük farklılıkların olduğu bildirilmiştir. 'Sevtopolis' çeşidinin gövde uzunluğunda azalmaların daha belirgin olduğunu tespit etmişlerdir.

Tuz konsantrasyonlarının, bitkilerin kök uzunlukları üzerine etkileri incelendiğinde, LA ortamındaki bitkilerin kök uzunlukları ortalaması 27.90 mm olduğu belirlenirken, LC ortamındaki bitkilerin kök uzunluklarının 7.50 mm olduğu belirlenmiştir. Tuz stresinin, gövde uzunluğunda olduğu gibi bitkilerin kök uzunlukları üzerine de olumsuz etkileri olmuştur. Szekely-Varga ve ark. (2020), yaptıkları çalışmada, iki farklı lavanta çeşidine uygulanan NaCl'nin konsantrasyona bağlı bir şekilde kök büyümesinin inhibisyonuna neden olduğunu bildirmişlerdir. Paraskevopoulou ve ark., (2020) yaptıkları çalışmada, lavantada tuzluluk stresinin başlangıçta bitkilerin toprak üstü büyüme parametresinde ifade edildiğini doğrulamışlardır. Daha spesifik olarak, bitki boyunun 200 mM NaCl'de 21. günden itibaren önemli ölçüde azaldığını bildirmişlerdir. Abdo ve ark., (2020) yüksek seviyelerde toprak tuzluluğunun (2000 ve 3000 ppm) lavanta bitkilerinde büyüme parametrelerini (bitki boyu, dal sayısı/bitki, kök uzunluğu, bitki başına kök sayısı, köklerin taze ve kuru ağırlıkları/bitki) azalttığını ortaya koymuştur.

**Çizelge 3.** Farklı tuz konsantrasyonlarının lavanta bitkisinin gövde ve kök uzunlukları (mm) üzerine etkileri

Dozlar	Gövde uzunluğu (mm)	Kök uzunluğu (mm)
LA	21.98a	27.90a
LB	11.10b	25.24a
LC	5.08c	7.50b
LSD	3.51***	3.27***

\*\*\*P ≤ 0.001

Bitkilerde büyüme inhibisyonu, kuraklık ve tuzluluk gibi çevresel stres faktörlerine maruz kalan bitkilerin tipik ve hızlı bir tepkisidir. Her ikisi de bitkilerde ozmotik strese neden olur ve ilk sonuç olarak hücre turgorunu ve genişlemesini azaltır (Munns ve Tester, 2008). Bununla birlikte, stres altındaki büyüme inhibisyonu nihayetinde bitki kaynaklarının, normalde birincil metabolizma ve büyüme (yani, biyokütle birikimi) için savunma mekanizmalarının aktivasyonuna doğru yeniden tahsis edilmesiyle ilişkilidir (Munns ve Tester, 2008; Hendawy ve Khalid, 2005; Hand ve ark., 2017). Çalışmada tuz stresi altındaki lavanta bitkilerinde, tohum çimlenmesi, gövde yaş ve kuru ağırlığı, kök yaş ve kuru ağırlığı, gövde ve kök uzunlukları da dahil olmak üzere çeşitli büyüme parametreleri belirlendi ve bu parametreler büyüme inhibisyonunun değerlendirilmesinde en güvenilir yoldur. Elde edilen veriler, tuz uygulamalarının, çalışmada kullanılan lavanta çeşidinde büyümeyi önemli ölçüde azalttığını açıkça göstermiştir. Benzer şekilde Paraskevopoulou ve ark., (2020) tarafından yapılan çalışmada da farklı tuz konsantrasyonları lavanta çeşitlerine uygulanmış ve yapraklarda kloroz, bitki gövdesine nekrozlar görülmesine rağmen bitki kayıplarının olmadığı bildirilmiştir. Szekely-Varga ve ark., (2020) çalışmalarında kullandıkları her iki *L. angustifolia* çeşidinin de tuz stresi karşısında nispeten dirençli olduğunu, en azından *Phaseolus* (Al Hassan ve ar., 2016; Morosan ve ark., 2017) gibi geleneksel mahsullerin çoğu çeşidine göre çok daha toleranslı olduğunu bildirmişlerdir. Bu çalışmada kullanılan lavanta çeşidinde de büyümenin inhibe olduğu, buna rağmen bitkilerin canlılığının devam ettiği göze çarpmaktadır. Önceki çalışmalar incelendiğinde, *L. angustifolia* ve cinslerinin diğer türlerinde tuz stresi koşullarında (Marulanda ve ark., 2007; Cordovilla ve ark., 2014; Chrysargyris ve ark., 2016; García-Caparrós ve ark., 2019; Chrysargyris ve ark., 2018) büyümenin azaldığı dikkat çekmektedir.

Tuz stresi altında bitkilerin gelişim parametreleri arasındaki korelasyon analizi Çizelge 4'te verilmiştir. İncelenen parametrelerin tamamının arasındaki korelasyonlar pozitif niteliktedir. Bu kapsamda çimlenme yüzdesi ile gövde yaş ağırlığı (0.9938), kök yaş ağırlığı (0.9941), kök kuru ağırlığı (0.9845) ve gövde uzunluğu arasında pozitif güçlü korelasyon bulunmaktadır. Gövde yaş ağırlığı ile kök yaş ağırlığı (0.9958), kök kuru ağırlığı (0.9703), gövde uzunluğu (0.9266) arasında güçlü pozitif korelasyon bulunmaktadır.

**Çizelge 4.** Farklı tuz konsantrasyonlarının incelenen özellikler arasındaki korelasyon analizi

	Çimlenme yüzdesi (%)	Gövde yaş ağırlığı (g)	Gövde kuru ağırlığı (g)	Kök yaş ağırlığı (g)	Kök kuru ağırlığı (g)	Gövde uzunluğu (mm)	Kök uzunluğu (mm)
Çimlenme yüzdesi (%)	1,0000	0,9938	0,7628	0,9941	0,9845	0,9493	0,6593
Gövde yaş ağırlığı (g)		1,0000	0,7031	0,9958	0,9703	0,9266	0,5914
Gövde kuru ağırlığı (g)			1,0000	0,7157	0,8085	0,9092	0,9856
Kök yaş ağırlığı (g)				1,0000	0,9838	0,9239	0,6094
Kök kuru ağırlığı (g)					1,0000	0,9532	0,7222
Gövde uzunluğu (mm)						1,0000	0,8371
Kök uzunluğu (mm)							1,0000

## **Sonuç ve Öneriler**

Mevcut çalışma, lavanta bitkisinin tuz stresine verdiği tepkiler hakkında yeni deneysel veriler sunmaktadır. Bitki büyümesi engellenmiş olsa da tüm bitkiler uygulanan sert stres koşullarını atlatmıştır. Sunulan bu çalışma, tuzluluğa daha dirençli ve dolayısıyla iklim değişikliği senaryosuna daha iyi adapte olmuş lavanta genotiplerinin hızlı taranmasının mümkün olduğunu ortaya çıkarmıştır. Bu çalışmanın sonuçlarında elde edilen veriler dikkate alınarak, gelecekteki çalışmalara, farklı tuzluluk konsantrasyonlarının ve farklı çeşitlerin denenerek, tuza toleranslı çeşitlerinin belirlenmesi önerilmektedir.

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# YOLOV8 DERİN ÖĞRENME MODELİ KULLANILARAK HASSAS HASAT SİSTEMLERİ İÇİN KİVİNİN FİDE ÜZERİNDE TESPİTİ

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## Özet

Robotik sistemler, teknolojinin ilerlemesiyle birlikte insanın yerini almaya başlamıştır. Sanayi, tarım, tıp, havacılık gibi birçok alanda kullanımlarını görmekteyiz. Tarım sektöründe kullanılmaya başlayan robotik sistemlerin alt yapısı derin öğrenme ve yapay zekadan oluşmaktadır. Bu sistemler özellikle hassas tarım uygulamalarında önemli bir rol oynamaya başlamışlardır. Çalışmada kivi hasadında maliyeti en yüksek oranda olan işçilik maliyetini azaltacak robotik sistemlerde kullanılmak üzere kivi dal üzerinde bulunması hedeflenmiştir. Kivi fide üzerinde doğru bir şekilde tanınması ve geliştirilecek seçici robotik hasat sisteminin kullanılması, artan tarımsal işgücü maliyetinin yol açtığı sorunlarını hafifletecektir. Çalışmada tespit sistemi için YOLOv8 derin öğrenme modelinin 5 alt modeli kullanılmıştır. Alt modellerin performanslarının karşılaştırılması ve en başarılı modelin belirlenmesi amaçlanmıştır. Modellerin performansları, Precision-Recall eğrisi, F1 güven eğrisi, Precision-Güven eğrisi ve Recall-Güven eğrisi gibi metriklerle değerlendirilmiştir. Elde edilen sonuçlara göre, en yüksek Precision-Recall eğrisi değerine sahip olan model Large modeldir (0.871 mAP@0.5). Large modelin nesne tespiti konusunda en yüksek doğruluğa ve doğru pozitif tespitlerde en tutarlı performansa sahip olduğunu göstermektedir. Yapılan karşılaştırmalar Large modelin nesne tespiti konusunda en başarılı model olduğunu, XLarge modelin ise en düşük performansı sergilediği tespit edilmiştir.

**Anahtar Kelimeler:** Derin öğrenme, YOLOv8, tanımlama, robotik sistemler

## RECOGNITION OF KIWIFRUIT ON SEEDLING FOR PRECISION HARVESTING SYSTEMS WITH YOLOV8 DEEP LEARNING MODEL

### Abstract

With the advancement of technology, robotic systems have begun to replace humans. They are used in many fields, such as industry, agriculture, medicine and aviation. The infrastructure of robotic systems used in the agricultural sector consists of deep learning and artificial intelligence. These systems play a particularly important role in precision farming applications. This study is about recognising the kiwi on the branch to use it in robotic systems that reduce labour costs, which are the highest cost in kiwi harvesting. The accurate detection of kiwifruit on the sapling and the use of the selective robotic system to be developed will alleviate the problems caused by increasing labour costs in agriculture. In the study, 5 sub-models of the YOLOv8 deep learning model were used for the recognition system. The aim is to compare the performance of the sub-models and determine the most successful model. The performance of the models was evaluated using metrics such as the precision-recall curve, the F1-confidence curve, the precision-confidence curve and the recall-confidence curve. According to the results obtained, the model with the highest value of the precision-recall curve is the Large model (0.871 mAP@0.5). The Large model has the highest accuracy in object recognition and the most consistent performance in true positive recognitions. The comparisons show that the Large model is the most successful model in object detection, while the XLarge model has the lowest performance.

**Keywords:** Deep learning, YOLOv8, identification, robotic systems

## 1.Giriş

Robotik hasat sistemleri, derin öğrenme, yapay zeka ve tarımın kesişim noktasında önemli bir dönüşüm geçirmektedir. Bu teknolojiler, mahsul yönetimi uygulamalarında verimliliği artırmak, işçilik maliyetlerini azaltmak ve tarımsal süreçleri otomatikleştirmek için kullanılmaktadır (Kujawa ve ark., 2021; Zheng ve ark., 2019). Geliştirilen sistemler, robotların mahsulleri otonom olarak tespit edebilmesi, sınıflandırabilmesi ve hasat edebilmesi için gelişmiş algoritmalar kullanarak tarımda iş gücü eksikliğini gidermede kritik rol oynamaktadır. Yapay zeka (AI) ve bilgisayarla görme alanlarındaki gelişmeler, robotların tarımsal görevlerde daha fazla uyarlanabilirlik ve doğrulukla çalışmasına olanak tanımaktadır. Evrişimli Sinir Ağları (CNN'ler), meyve algılama ve sınıflandırma gibi görevlerde büyük başarı göstermiştir (Halstead ve ark., 2021). İlk robotik sistemler, genellikle basit mekanik çözümler sunarken, derin öğrenme teknolojileri, özellikle CNN'lerin tarımsal uygulamalarda kullanımının yaygınlaşması ile yeni bir döneme girmiştir. YOLO (You Only Look Once) ve Faster-RCNN gibi modeller, tarımsal robotların doğruluk ve hız açısından performansını artırmış, otomatik hasat sistemlerinin daha verimli çalışmasına olanak tanımıştır. Robotik hasat sistemlerinin derin öğrenme ile güçlendirilmesi, büyük ve çeşitli veri kümelerinin kullanılmasını gerektirir. Tarımsal uygulamalarda kullanılan sinir ağlarının eğitimi, genellikle büyük ölçekli veri kümelerine dayanarak gerçekleştirilir (Anonim 1). Bu kapsamda geliştirilen yeni mimariler, YOLO gibi algoritmalarla hızlı ve doğru veri işleme yetenekleri sunar. PATHoBot gibi projeler, derin öğrenme ve robotik izleme sistemlerini entegre ederek mahsul sağlığı izleme ve hasat tahmini konularında önemli ilerlemeler kaydetmiştir (Zheng ve ark., 2019). Farklı tarımsal ortamlarda robotların otonom çalışması, doğru nesne tespiti ve veri işleme kapasiteleri ile yakından ilişkilidir. Derin öğrenme, tarımsal sistemlerde RGB ve derinlik verilerini birleştirerek meyve tespitinde hassasiyet sağlamıştır (Brown ve ark., 2020). Özellikle RGB-D kameraların kullanımı, görsel verilerle derinlik verilerini bir araya getirerek robotik sistemlerin meyve lokalizasyonunu büyük ölçüde iyileştirmiştir. Derin öğrenme teknolojilerinin robotik hasat sistemlerine entegrasyonu, tarımsal süreçlerde iş gücüne olan ihtiyacı önemli ölçüde azaltarak maliyet tasarrufu sağlamaktadır. Bir tarım robotu, insan işçilerle karşılaştırıldığında tarımsal operasyonları çok daha hızlı ve verimli bir şekilde gerçekleştirebilir. Bu sistemler aynı zamanda çok yönlüdür; ot temizleme, gübreleme ve meyve toplama gibi birden fazla görevi yerine getirebilirler. Robotik sistemlerin sunduğu diğer önemli avantajlar arasında sürdürülebilirlik ve hassasiyet yer almaktadır. Robotlar, insanlardan daha hassas çalışabilmekte, bu da tarımsal süreçlerde israfın azalmasını ve verimliliğin artmasını sağlamaktadır. Ayrıca, gelişmiş kameralar ve sensörlerle donatılmış bu robotlar, zararlıları ve yabancı otları doğru bir şekilde tespit ederek gereksiz pestisit kullanımını azaltabilir (Anonim 2). Robotik hasat sistemleri büyük potansiyel sunsa da, bu teknolojilerin geniş çaplı benimsenmesi önünde önemli engeller bulunmaktadır. Özellikle, gerçek zamanlı veri işleme ve karar verme süreçleri, yüksek performanslı grafik işlem birimlerine (GPU) olan bağımlılığı artırmaktadır. Bu durum, özellikle tarımsal kaynakların sınırlı olduğu ortamlarda robotik sistemlerin ölçeklenebilirliğini sınırlayabilir (Cheng ve ark., 2023). Robotik sistemlerin meyve tespitindeki doğruluğu, çevresel değişiklikler gibi faktörlere bağlı olarak dalgalanabilir. YOLOv7 gibi modeller yüksek doğruluk ve hız sunsa da, meyve lokalizasyonunda zorluklar yaşanmakta ve bu hatalar robotların performansını olumsuz etkileyebilmektedir (Abeyrathna ve ark., 2023). Ters kinematik hesaplamalar, eklem açıları ve son efektörlerin doğruluğunu etkileyen karmaşık süreçlerdir (Yoshida ve ark., 2022).

Robotik kivi hasadı, tarımda otomasyon ve verimliliği artırmayı amaçlayan bir alan olup, geleneksel yöntemlerle zor ve zaman alıcı olan hasat süreçlerini optimize etmektedir. Bu kapsamda, robot teknolojileri ve yapay zeka uygulamaları kivi hasadında önemli bir rol oynamaktadır. Öncelikle, robotik sistemlerin tarımda uygulanabilirliği üzerine yapılan araştırmalar, bu teknolojilerin geliştirilmesi ve yaygınlaşmasını desteklemektedir. Kiviye

yönelik küresel talep artmaya devam ederken, geleneksel elle hasat yöntemleri, özellikle işgücü mevcudiyetinin hızla azaldığı Japonya gibi yaşlanan tarım topluluklarında sürdürülebilirlik sorunlarıyla karşı karşıyadır. İşgücü eksikliğinin getirdiği bu baskılar, özellikle Japonya gibi bölgelerde kivi hasadı için işgücüne duyulan ihtiyacı artırmıştır (Xiao ve ark., 2023; Williams ve ark., 2019). Robotik ve derin öğrenme teknolojilerinin entegrasyonu, bu sorunların çözülmesine olanak tanıyan yenilikçi bir yöntem olarak öne çıkmaktadır. Bu teknolojiler, çiftçilerin hasat edilen meyvelerin kalitesini artırırken üretkenliği de korumalarına olanak tanımaktadır. Özellikle derin öğrenme tekniklerindeki son gelişmeler, robotik hasat sistemlerinin yeteneklerini önemli ölçüde artırmıştır. Evrişimli sinir ağları (CNN'ler) ve "You Only Look Once" (YOLO) gibi nesne algılama algoritmaları, tarımda robotik uygulamaları daha etkili hale getirmektedir (Williams ve ark., 2019; Anonim 3). Bu yenilikler, kiviin değişen çevre koşullarında bile gerçek zamanlı olarak algılanmasına ve sınıflandırılmasına olanak tanıyarak verimli hasat işlemlerini kolaylaştırmaktadır.

Kumar ve ark. (2022), meyve tespiti ve konumlandırma algoritmalarının geliştirilmesi üzerine yaptıkları inceleme ile tam otomatik robotik sistemlerin inşasında rehberlik edecek önemli bilgiler sunmuşlardır. Xu ve ark.(2022), modüler bir tarımsal robotik sistemin (MARS) tasarımı ve uygulanmasına yönelik araştırmalarıyla bu tür sistemlerin yüksek verimlilikle çalışabileceğini ortaya koymuşlardır. Bu araştırmalar, meyve hasadında hassasiyet ve verimliliği artıran robotların geliştirilmesine katkı sağlamaktadır. Robotik kivi hasadında kullanılan teknolojiler, meyve toplama sürecini daha verimli ve hassas hale getirmek için çeşitli yenilikler içermektedir. Li ve ark. (2022), meyve ve sebze toplama robotlarının uç birimlerinin yapısal gelişimi ve tanıma yöntemleri üzerine yaptıkları inceleme ile, bu tür robotların verimliliğini artırmaya yönelik önemli öneriler sunmuşlardır. Bu teknolojiler, gelecekte meyve hasadının daha düşük hasar oranı ile gerçekleştirilmesine olanak tanıyacaktır.

Makine öğrenimi ve yapay zeka teknolojileri de robotik kivi hasadında önemli bir rol oynamaktadır. Mohyuddin ve ark. (2024), akıllı tarım sistemlerinde makine öğrenimi yaklaşımlarının kullanılmasını inceleyerek, bu teknolojilerin meyve hasadında daha hassas ve verimli uygulamalar için nasıl entegre edilebileceğini açıklamıştır. Görsel algılama sistemleri ve yapay zeka teknikleri, kivi hasadında robotik sistemlerin etkinliğini artıran başlıca unsurlardan biridir. Jia ve ark. (2022), kivi yaprak hastalıklarının tespit etmek için geliştirdikleri iki aşamalı derin öğrenme algoritması ile tarımsal izleme süreçlerini daha verimli hale getirmiştir. Pan ve ark.(2024) ise kivi çiçeklerinin polinasyonunu tespit etmek için yeni bir algoritma geliştirmiş ve bu algoritma, kivi üretim sürecindeki izleme çalışmalarını daha etkili kılmıştır. Birrell ve ark.,(2019) iceberg marul için bir robotik hasat sisteminin saha testlerini gerçekleştirmişlerdir.

Robotik sistemler yalnızca hasat sürecinde değil, aynı zamanda hasat sonrası meyve kalitesinin korunmasında da önemli bir rol oynamaktadır. Passafiume ve ark. (2020), Aloe vera jel bazlı yenilebilir kaplamaların kivi kalitesi üzerindeki etkilerini inceleyerek, bu kaplamaların meyve kalitesini korumada etkili olduğunu göstermişlerdir. Anggono ve ark. (2022), meyve koruma ve paketleme teknolojilerinin meyvelerin raf ömrünü uzatmada önemli bir rol oynadığını vurgulamışlardır. Robotik tarım sistemlerinin sürdürülebilirlik ve çevresel etkiler üzerindeki rolü de önemli bir araştırma konusu olmuştur. Vurro ve ark. (2023), meyve ağaçlarının izlenmesi için geliştirdiği biosensör sisteminin su tasarrufu ve verimlilik sağladığını ortaya koymuş, bu tür teknolojilerin tarımsal üretkenliği artırarak çevresel sürdürülebilirliği nasıl destekleyebileceğine dikkat çekmişlerdir. Bu gibi çevresel etkileri minimize eden teknolojiler, robotik tarım sistemlerinin daha geniş çapta benimsenmesi için kritik öneme sahiptir.

Pergola tarzı meyve bahçeleri için tasarlanan çok kollu hasat robotları, karmaşık tarım arazilerinde otonom olarak gezinebilir ve kiviye en az hasarla etkili bir şekilde bulup toplayabilir (Williams ve ark., 2019). Ancak robotik kivi hasadı uygulaması da zorluklar içermektedir. Oklüzyon, değişken aydınlatma koşulları ve meyve tanımının zorlukları gibi

faktörler, dinamik tarım ortamlarında öne çıkan engellerdir. Derin öğrenme modellerinin eğitimi için büyük veri kümelerine duyulan ihtiyaç, özellikle olgunlaşmamış veya hasarlı meyvelerle ilgili verilerin sınırlı olduğu senaryolarda ek zorluklar yaratmaktadır (Tang ve ark., 2020; Xiao ve ark., 2023). Bu teknolojilerin geliştirilmesine devam ettikçe, robotik kivi hasadının geleceği umut verici görünmektedir. Bu gelişmeler, hem operasyonel verimliliği hem de meyve kalitesini artırmayı hedeflemektedir (Yoshida ve ark., 2022; Li ve ark., 2022). Bu sistemler, yalnızca hasadın hızını ve doğruluğunu artırmakla kalmaz, aynı zamanda robotların farklı aydınlatma koşullarında etkili meyve tanıma yeteneklerini geliştirir. Ayrıca, pergola tarzı meyve bahçelerinde otonom olarak gezinebilme yeteneğine sahip çok kollu hasat robotları, stereo eşleştirme teknikleriyle donatılmış gelişmiş görüş sistemleri sayesinde kiviye doğru bir şekilde tespit edebilmektedir (Williams ve ark., 2019). Hasat robotlarının etkinliği, sağlam görüş sistemlerine dayanır. RGB-D kameraları, hem renk hem de derinlik bilgisi sağlayarak meyve tespitine yardımcı olmaktadır. Ayrıca, YOLO ve Faster R-CNN gibi diğer nesne tespiti algoritmaları da tarım robotlarında kullanılmaktadır. Bu algoritmalar, hesaplama yükü ve algılama hızı arasında farklı ödünleşimlerle çalışmaktadır (Anonim 4). Robotik kivi hasadında hala bazı zorluklar mevcuttur. Özellikle oklüzyon, değişken aydınlatma koşulları ve çevresel değişiklikler gibi faktörler meyve tespitini zorlaştırmaktadır (Fu ve ark., 2024; Tang ve ark., 2020). Ayrıca, tarımsal veri kümelerinin sınırlı olması, derin öğrenme modellerinin eğitimi için bir başka zorluk teşkil etmektedir (Tang ve ark., 2020; Xiao ve ark., 2023). Gelecekteki araştırmalar, bu zorlukların üstesinden gelmek için daha küçük veri kümeleriyle çalışan derin öğrenme tekniklerine odaklanmalıdır. Kivi hasadındaki robotik yenilikler, tarım sektöründe verimliliği artırmayı ve iş gücü eksikliğine çözüm sunmayı hedeflemektedir. Çiftçiler, üreticiler ve teknoloji geliştiricileri arasında devam eden iş birlikleri, bu teknolojilerin benimsenmesini hızlandırabilir ve daha geniş bir tarımsal operasyon yelpazesine erişilebilirlik sağlayabilir (Anonim 5; Anonim 6). Robotik kivi hasadı, tarımda otomasyon ve verimlilik artırma çabalarının önemli bir parçası olarak öne çıkmaktadır. Yapay zeka ve robot teknolojilerindeki gelişmeler, bu alandaki uygulamaların etkinliğini artırmakta ve gelecekte tarımsal üretimde daha fazla otomasyon sağlamaktadır. Bu teknolojiler, kivi gibi meyvelerin hasadını daha verimli, sürdürülebilir ve ekonomik hale getirmektedir.

Bu çalışmanın amacı, YOLOv8 modelinin en karmaşık veya en gelişmiş versiyonunu bulmaktan ziyade, mevcut verileri en iyi şekilde analiz ederek hangi YOLOv8 modelinin en uygun olduğunu tespit etmektir. Elde edilen sonuçlar, farklı YOLOv8 modellerinin kivi tespiti üzerindeki performanslarını karşılaştırmamıza ve en iyi sonucu veren modeli belirlememize olanak sağlamaktadır. Çalışma sürecinde her modelin güçlü ve zayıf yönleri detaylı bir şekilde analiz edilmiştir. Ayrıca, belirli durumlarda hangi modelin daha uygun olduğu tespit edilmiştir. Çalışma da yalnızca tarım uygulamalarında değil, genel olarak nesne tespiti projelerinde model seçiminin ve veri analizinin önemine dikkat çekmek amacıyla gerçekleştirilmiştir. En iyi sonuçları elde edebilmek için, model performansını etkileyen tüm faktörler dikkatlice değerlendirilmiş ve optimize edilmiştir. YOLOv8 modellerinin farklı varyantlarını kullanarak nesne tespiti alanında kivi tespitinin önemini ve bu süreçte elde edilen bulguların tarım sektörüne katkı sağlayabileceğini ortaya koymaktadır. Çalışma YOLOv8 'in en iyi modeli bulmayı değil, aynı zamanda verileri en iyi şekilde analiz ederek en uygun çözümleri sunmayı hedeflemektedir. Bu yaklaşım, nesne tespiti ve makine öğrenimi projelerinde başarılı sonuçlar elde etmek için kritik bir rol oynamaktadır.

## **2. Materyal ve Yöntem**

### **2.1. Materyal**

Kivi meyvesi (*Actinidia deliciosa*), son yıllarda Türkiye'de giderek daha önemli bir tarım ürünü haline gelmiştir. Hasat dönemi, kivin olgunlaşma sürecine göre planlanmalı ve dikkatle yönetilmelidir. Meyvenin olgunlaşması, kalitesini ve pazar değerini doğrudan etkileyen önemli

bir aşamadır. Hasat zamanı, kivi'nin fiziksel ve biyokimyasal özelliklerine göre belirlenir. Mersin'de farklı yüksekliklerde yetiştirilen "Hayward" kivi çeşidi üzerinde yapılan bir araştırmada, rakımın meyve ağırlığı ve boyutu üzerinde etkili olduğu gözlemlenmiştir (Kara ve ark., 2024).

Hasat sırasında, meyvelerin zarar görmemesi için özenli bir yöntem kullanılmalıdır. Hasarsız akustik yöntemlerle meyve sertliği ölçülebilir ve meyveye zarar vermeden bu değerler belirlenebilir (Odabaş ve ark., 2021). Ayrıca, kivi meyvesinin hasat öncesinde besin değerlerinin analizi de önemlidir. Bu çalışmalar, meyvenin kalitesini artırmak amacıyla yapılmalı ve kivi bitkisinin ihtiyaç duyduğu makro ve mikro besin elementleri belirlenmelidir (Çil ve ark., 2023). Kivi meyvesi hassas bir yapıya sahip olduğu için elle hasat yapılması tercih edilir. Elle hasatta dikkat edilmesi gerekenler:

- Sapından Kesme: Kivi'nin sapından kopartılarak hasat edilmesi, meyvenin zarar görmesini önler.
- Zedelenmemesi: Meyvenin kabuğu ince olduğundan, zedelenmeden toplanması gerekir. Zedelenen kiviler daha çabuk bozulur ve kalite kaybına uğrar.

Son yıllarda robotik hasat sistemleri de kivi hasadında kullanılmaya başlanmıştır. Bu sistemler, kivi gibi hassas meyveleri toplamak için tasarlanmış olup, iş gücünü azaltmak ve hasat sürecini hızlandırmak için kullanılmaktadır.

Çalışma eğitim ve test seti olarak iki bölümden oluşmaktadır. Eğitim setinde çeşitli internet kaynaklarından alınmış 500 fotoğraf, test setinde 100 fotoğraf, çapraz test setinde doktora tezinde kullanılan videolar kullanılmıştır. Şekil 1'de model eğitiminde kullanılan datasetten 2 adet görüntü verilmiştir.

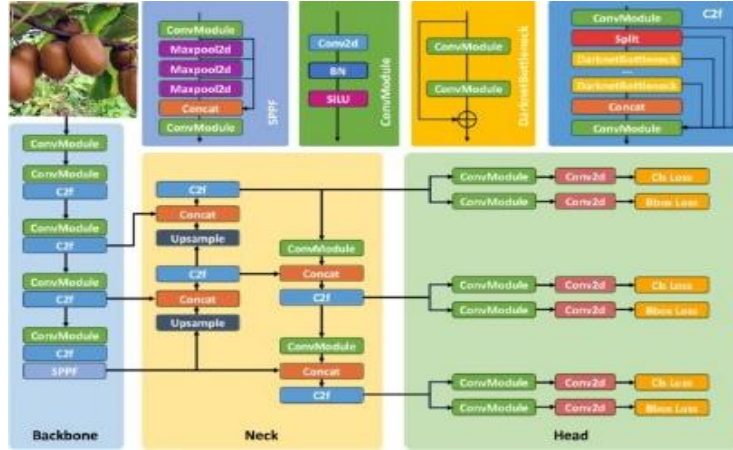


Şekil 1. Eğitimde kullanılan Dataset görüntüleri (Anonim 7,8)

## 2.2. Yöntem

YOLOv8 gerçek zamanlı olarak nesne tespiti yapmak için geliştirilmiştir. Geleneksel iki aşamalı yöntemler nesnelere tespit etmek için birden fazla işlem yaparken, YOLOv8, nesnelere tek bir işlemde ve yüksek hassasiyetle tespit eder (Widayani ve ark., 2024). YOLOv8, doğruluk, hız ve genelleme yeteneklerinde önemli gelişmeler sunar. Bu nedenle, tıbbi görüntüleme, çevresel izleme gibi pek çok alanda kullanılabilir (Shamda ve ark., 2024; Zubayer ve ark., 2024). Algoritmanın önemli yeniliklerinden biri, Multi-Head Self-Attention (MHSA) adlı bir mekanizmadır. Bu özellik, YOLOv8'in karmaşık senaryolarda, dikkat dağıtıcı unsurlar olsa bile, daha doğru sonuçlar vermesini sağlar (Ma ve ark., 2024). Bu sayede YOLOv8, daha önceki sürümlerine göre daha yüksek doğruluk oranlarına ulaşır (Safaldin ve ark., 2024). YOLOv8, tıbbi teşhis alanında da başarılı bir şekilde kullanılmıştır. Diyabetik retinopati ve koroner arter hastalığını tespit etmede oldukça etkilidir (Moura ve ark., 2024; Usame ve ark., 2023). Bu başarılar, algoritmanın hassas görüntü analizi gerektiren alanlarda ne kadar etkili olduğunu gösterir. Sağlık alanındaki başarısının yanı sıra YOLOv8, çevre ve ekoloji çalışmalarında da kendini kanıtlamıştır. Biyoçeşitliliği izlemek ve su altındaki plastik atıkları tespit etmek gibi görevlerde kullanılmıştır (Gayá-Vilar ve ark., 2024; Khriiss ve ark., 2024). Buna ek olarak, YOLOv8, yüksek doğruluk oranlarını korurken hızlı işlem yapma kapasitesine de sahiptir.

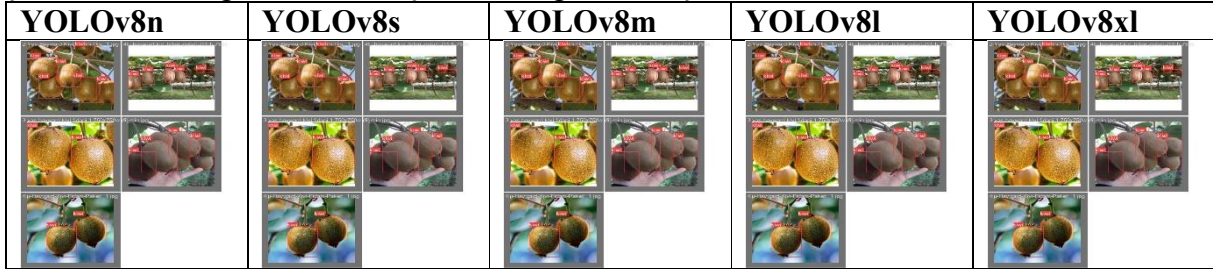
Yapılan mimari değişiklikler sayesinde, ortalama %90 doğruluk oranı ve saniyede 30 kare hızına ulaşmıştır (Safaldin ve ark., 2024). Bu performans, YOLOv8'i otonom sürüş ve güvenlik sistemleri gibi gerçek zamanlı nesne tespitinin hayati olduğu alanlar için ideal bir seçim yapar (Sukkar ve ark., 2024; Cheng ve ark., 2024). YOLOv8, nesne tespiti alanında büyük bir ilerleme sağlamaktadır. Hem doğruluk hem de hız açısından oldukça başarılıdır ve geniş bir uygulama yelpazesinde kullanılabilir. Bu nedenle, araştırmacılar ve uygulayıcılar için vazgeçilmez bir araç haline gelmiştir. Şekil 2'de YOLOv8'in blok diyagramı gösterilmiştir.



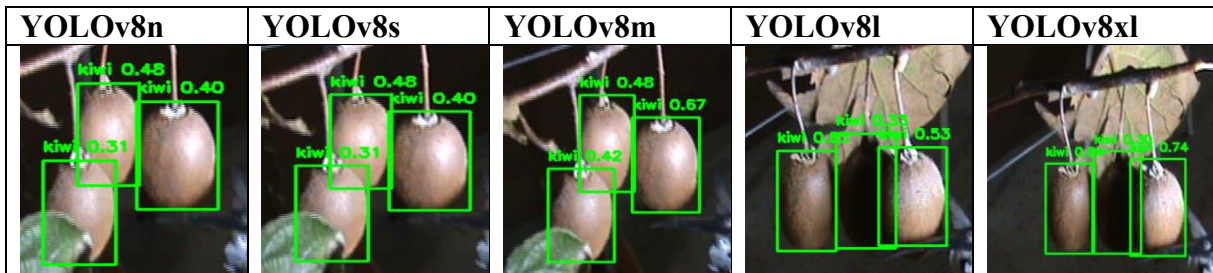
Şekil 2. YOLOv8 blok diyagramı (Sahafi ve ark., 2024)

### 3. Araştırma Sonuçları ve Bulgular

Şekil 3 ve 4'de eğitim test sonuç ekranları gösterilmiştir.



Şekil 3. Test sonuç ekranı (Anonim 9,10,11,12,13)



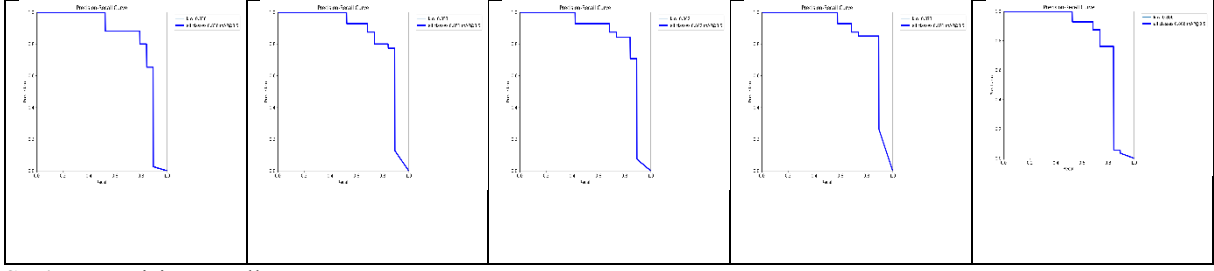
Şekil 4. Test sonuç ekranı (orijinal)

Modellerin genel karşılaştırılması ve en başarılı modelin belirlenmesi şu şekildedir;

#### 3.1. Precision-Recall Curve

Yolov8n	Yolov8s	Yolov8m	Yolov8l	Yolov8xl
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Şekil 5. Precision-recall curve

Precision-recall curve, bir modelin precision (kesinlik) ve recall (duyarlılık) değerleri arasındaki ilişkiyi grafiksel olarak gösterir. Precision, doğru pozitif tahminlerin toplam tahminlere oranıdır, recall ise doğru pozitif tahminlerin gerçek pozitiflere oranıdır. Bu eğri, modelin performansını özellikle dengesiz veri kümelerinde (pozitif sınıfların negatif sınıflara göre çok az olduğu durumlar) değerlendirmek için kullanılır.

Precision-recall curve, modelin belirli bir threshold (eşik) seviyesinde ne kadar doğru ve eksiksiz tahminler yaptığını gösterir. Bu, özellikle hataların maliyetinin yüksek olduğu durumlarda (örneğin, bir hastalığın tespiti veya kalite kontrol süreçleri) önemlidir.

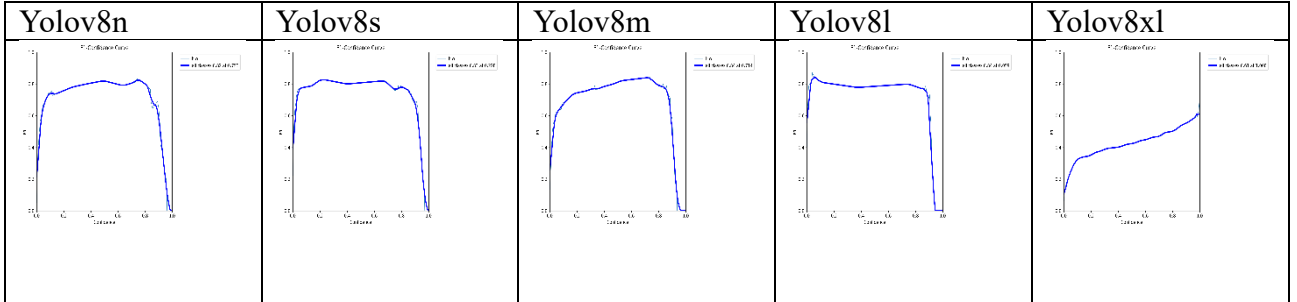
Kivi tespiti yapan model için precision-recall curve önemlidir. Çünkü yanlış pozitif ve yanlış negatif tespitlerin maliyeti yüksek olabilir. Yanlış pozitif bir tespit, kiviinin aslında mevcut olmadığı durumlarda yanlış alarm verirken, yanlış negatif bir tespit, mevcut bir kiviye kaçıır. Bu nedenle, modelin kiviye doğru bir şekilde tespit edebilmesi kritik öneme sahiptir.

Modellerin Karşılaştırılması

- Nano Model: 0.836 mAP@0.5
- Small Model: 0.851 mAP@0.5
- Medium Model: 0.842 mAP@0.5
- Large Model: 0.871 mAP@0.5
- XLarge Model: 0.806 mAP@0.5

Large model, en yüksek precision-recall curve değerine (0.871 mAP@0.5) sahiptir, bu da onun kiviye doğru ve eksiksiz bir şekilde tespit etmede en iyi performansı gösterdiğini işaret eder.

### 3.2.F1 Confidence Curve



Şekil 6. F1 confidence curve

F1 confidence curve, bir modelin belirli bir confidence (güven) seviyesinde F1 skorunu gösterir. F1 skoru, precision ve recall'un harmonik ortalamasıdır ve modelin genel doğruluğunu ve eksiksizliğini değerlendirir. Bu eğri, modelin çeşitli güven seviyelerinde ne kadar iyi performans gösterdiğini belirlemek için kullanılır.

F1 confidence curve, modelin güven seviyelerine göre ne kadar doğru ve eksiksiz tahminler yaptığını gösterir. Bu, özellikle modelin belirli bir güven seviyesinde çalıştırılması gerektiğinde (örneğin, yanlış alarm oranını azaltmak için) önemlidir.



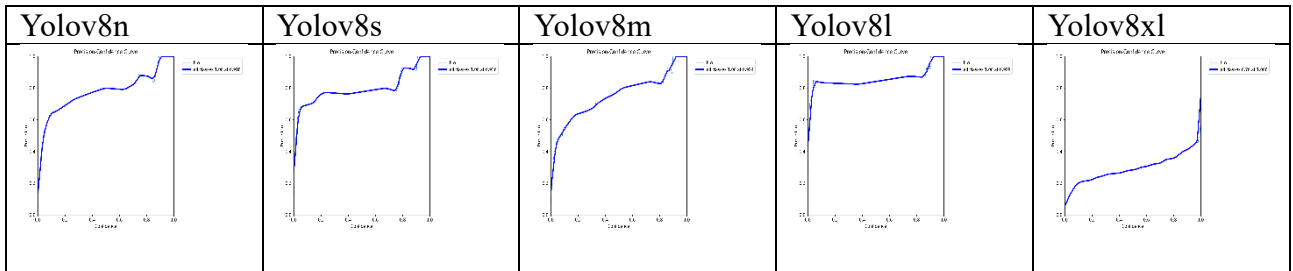
Kivi tespiti yapan model için F1 confidence curve, modelin kiviği tespit ederken ne kadar güvenilir olduğunu gösterir. Modelin güven seviyesine göre tespit doğruluğu ve eksiksizliği değişebilir, bu da kiviği tespiti sürecinde doğru kararlar alabilmek için kritik öneme sahiptir.

Modellerin Karşılaştırılması

- Nano Model: F1 score 0.82 at confidence 0.753
- Small Model: F1 score 0.83 at confidence 0.228
- Medium Model: F1 score 0.84 at confidence 0.714
- Large Model: F1 score 0.84 at confidence 0.059
- XLarge Model: F1 score 0.61 at confidence 1.000

Medium ve Large modeller, en yüksek F1 skorlarına sahiptir ve benzer performans göstermektedir. Ancak, Large model daha düşük bir confidence seviyesinde bu yüksek performansı sağladığı için daha tutarlı bir model olarak öne çıkar.

### 3.3.Precision-Confidence Curve



Şekil 7. Precision-Confidence Curve

Precision-confidence curve, modelin çeşitli confidence seviyelerinde precision değerini gösterir. Bu eğri, modelin farklı güven seviyelerinde ne kadar doğru pozitif tahminler yaptığını belirlemek için kullanılır. Precision-confidence curve, modelin güven seviyesi arttıkça doğruluğunu ne kadar koruyabildiğini gösterir. Bu, modelin belirli bir güven seviyesinde çalıştırılması gerektiğinde doğruluğunu değerlendirmek için önemlidir.

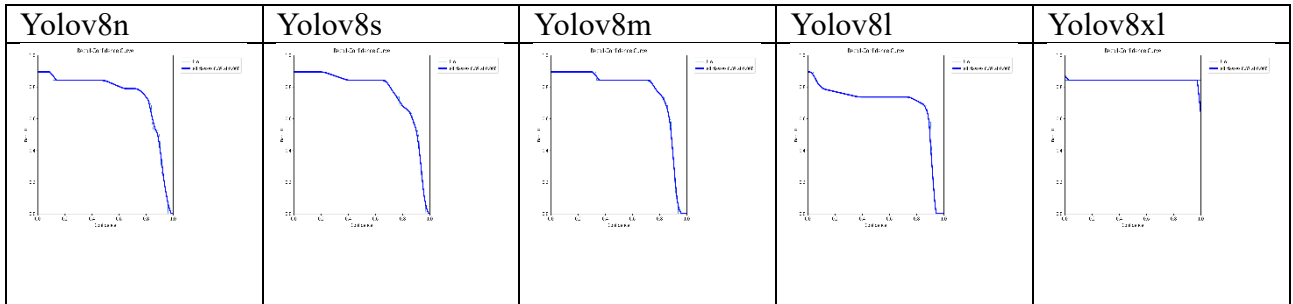
Kiviği tespiti yapan model için precision-confidence curve, modelin belirli bir güven seviyesinde kiviği ne kadar doğru tespit ettiğini gösterir. Yüksek güven seviyelerinde yüksek precision, yanlış pozitiflerin minimumda tutulmasını sağlar, bu da tespit sürecinin güvenilirliğini artırır.

Modellerin Karşılaştırılması

- Nano Model: Precision 1.00 at confidence 0.918
- Small Model: Precision 1.00 at confidence 0.936
- Medium Model: Precision 1.00 at confidence 0.924
- Large Model: Precision 1.00 at confidence 0.929
- XLarge Model: Precision 0.76 at confidence 1.000

Small model, en yüksek precision-confidence değerine sahiptir, bu da onun yüksek güven seviyelerinde kiviği neredeyse tamamen doğru tespit ettiğini gösterir.

### 3.4.Recall-Confidence Curve



Şekil 8. Recall-Confidence Curve

Recall-confidence curve, modelin çeşitli confidence seviyelerinde recall değerini gösterir. Bu eğri, modelin farklı güven seviyelerinde ne kadar doğru pozitif tespitler yapabildiğini belirlemek için kullanılır.

Recall-confidence curve, modelin güven seviyesi arttıkça eksiksizliğini ne kadar koruyabildiğini gösterir. Bu, modelin belirli bir güven seviyesinde çalıştırılması gerektiğinde eksiksizliğini değerlendirmek için önemlidir.

Kivi tespiti yapan model için recall-confidence curve, modelin belirli bir güven seviyesinde kiviye ne kadar eksiksiz tespit ettiğini gösterir. Yüksek recall, modelin kiviye kaçırmamasını sağlar, bu da tespit sürecinin doğruluğunu artırır.

Modellerin Karşılaştırılması

- Nano Model: Recall 0.89 at confidence 0.000
- Small Model: Recall 0.89 at confidence 0.000
- Medium Model: Recall 0.89 at confidence 0.000
- Large Model: Recall 0.89 at confidence 0.000
- XLarge Model: Recall 0.87 at confidence 0.000

Tüm modeller benzer recall-confidence değerlerine sahiptir, bu da onların tüm confidence seviyelerinde yüksek bir tespit oranına sahip olduğunu gösterir. Ancak, XLarge model biraz daha düşük bir değere sahip olduğundan daha az başarılı olarak değerlendirilebilir.

Genel olarak, Large model en başarılı model olarak öne çıkmaktadır. Precision-recall curve ve F1 confidence curve değerlerinde en yüksek performansı gösteren Large model, kiviye doğru ve eksiksiz tespit etmede en iyi performansı sergilemiştir. Small model ise precision-confidence curve açısından en iyi performansı göstermiştir, ancak genel değerlendirmede Large modelin gerisinde kalmaktadır. En başarısız model olarak ise XLarge model öne çıkmaktadır; precision-recall curve ve F1 confidence curve değerlerinde diğer modellere göre daha düşük performans göstermiştir.

Bu detaylı inceleme ve karşılaştırma sonucunda, Large modelin kiviye tespit etme konusunda en başarılı model olduğu, XLarge modelin ise en başarısız model olduğu sonucuna varılmaktadır.

- Precision-Recall Curve: Large model, 0.871 mAP@0.5 değeriyle en yüksek performansa sahiptir. Bu, modelin kiviye doğru ve eksiksiz bir şekilde tespit ettiğini gösterir.
- F1 Confidence Curve: Large model, 0.84 F1 skoru ile en yüksek performansı göstermektedir. Daha düşük bir confidence seviyesinde bu performansı sağladığı için tutarlıdır.
- Precision-Confidence Curve: Large model, 0.929 confidence seviyesinde 1.00 precision değeriyle, yüksek güven seviyelerinde kiviye doğru tespit etme yeteneğini korur.
- Recall-Confidence Curve: Large model, 0.89 recall değeriyle yüksek bir tespit oranına sahiptir, bu da kiviye eksiksiz bir şekilde tespit edebildiğini gösterir.

Detaylı inceleme sonucunda;

1. Precision-Recall Curve: Large modelin yüksek mAP@0.5 değeri, modelin genel doğruluğunu ve eksiksizliğini yansıtır. Bu metrik, kiviye doğru tespit etme ve yanlış alarmları minimumda tutma kapasitesini gösterir.
2. F1 Confidence Curve: Large modelin 0.84 F1 skoru, precision ve recall arasındaki dengeli performansını ifade eder. Bu, modelin hem doğru pozitifleri yakalamada hem de yanlış negatifleri minimumda tutmada başarılı olduğunu gösterir.
3. Precision-Confidence Curve: Large model, 0.929 confidence seviyesinde 1.00 precision değerine ulaşarak, yüksek güven seviyelerinde bile hatasız tespit yapabildiğini kanıtlar. Bu, kiviye tespit etme sürecinde güvenilirlik sağlar.
4. Recall-Confidence Curve: Large model, tüm confidence seviyelerinde yüksek recall değerleri sunar, bu da kiviye eksiksiz tespit etme yeteneğini ifade eder.

Large model, kiviği tespit etme konusunda en iyi performansı gösteren model olarak tespit edilmiştir. Hem doğruluk hem de eksiksizlik açısından en yüksek değerlere sahip olup, kiviği tespit etmede güvenilir ve tutarlı bir performans sergilemektedir. Bu nedenle, kiviği tespit etme görevinde kullanılacak en ideal model olduğu anlaşılmaktadır.

En Başarısız Model: XLarge Model

- Precision-Recall Curve: XLarge model, 0.806 mAP@0.5 değeriyle en düşük performansı gösterir. Bu, modelin kiviği doğru ve eksiksiz tespit etme yeteneğinin zayıf olduğunu işaret eder.
- F1 Confidence Curve: XLarge model, 0.61 F1 skoru ile diğer modellere göre belirgin şekilde düşük performans sergilmektedir.
- Precision-Confidence Curve: XLarge model, 1.000 confidence seviyesinde 0.76 precision değeriyle, yüksek güven seviyelerinde bile hatalı tespit yapabileceğini göstermektedir.
- Recall-Confidence Curve: XLarge model, 0.87 recall değeriyle diğer modellerin gerisinde kalır, bu da kiviği eksiksiz tespit edemediğini göstermektedir.

Detaylı inceleme sonucunda;

1. Precision-Recall Curve: XLarge modelin düşük mAP@0.5 değeri, modelin genel doğruluk ve eksiksizlik açısından zayıf performans sergilediğini göstermektedir. Model, kiviği doğru tespit etmede ve yanlış alarmları minimumda tutmada başarısızdır.
2. F1 Confidence Curve: XLarge modelin 0.61 F1 skoru, precision ve recall değerlerinin dengeli olmadığını ve modelin genel performansının düşük olduğunu ifade eder. Model, doğru pozitifleri yakalamada ve yanlış negatifleri minimumda tutmada yetersizdir.
3. Precision-Confidence Curve: XLarge model, 1.000 confidence seviyesinde 0.76 precision değeriyle, yüksek güven seviyelerinde bile hatalı tespit yapma potansiyeline sahiptir. Bu, modelin kiviği tespit etme sürecinde güvenilir olmadığını gösterir.
4. Recall-Confidence Curve: XLarge modelin düşük recall değerleri, modelin kiviği eksiksiz tespit edemediğini ve birçok kiviği kaçırabileceğini gösterir. Bu, modelin kiviği tespit etme sürecinde başarısız olduğunu işaret eder.

XLarge model, kiviği tespit etme konusunda en düşük performansı gösteren modeldir. Hem doğruluk hem de eksiksizlik açısından en düşük değerlere sahip olup, kiviği tespit etmede güvenilir ve tutarlı olmayan bir performans sergiler. Bu nedenle, kiviği tespit etme görevinde kullanılacak en ideal olmayan model olarak değerlendirilmiştir.

Large model, kiviği tespit etme konusunda en yüksek performansı gösterirken, XLarge model en düşük performansı sergilemektedir. Bu sonuçlar, her iki modelin kiviği doğru ve eksiksiz bir şekilde tespit etme yeteneklerini ortaya koyar. Large model, doğruluk ve eksiksizlik açısından en yüksek değerlere sahip olup, kiviği tespit etmede güvenilir ve tutarlı bir performans sergilerken, XLarge model bu kriterlerde yetersiz kalmaktadır.

## 5.Sonuçlar ve Öneriler

Çalışmada YOLOv8 modelleri (Nano, Small, Medium, Large ve XLarge) kiviği doğru bir şekilde tespit etme performansları açısından karşılaştırılmıştır. Değerlendirme kriterleri arasında Precision-Recall eğrisi, F1 Confidence eğrisi, Precision-Confidence eğrisi ve Recall-Confidence eğrisi kullanılmıştır. Yapılan analizler sonucunda aşağıdaki önemli bulgular elde edilmiştir. Precision-Recall Performansı Large modelinde, 0.871 mAP@0.5 değeriyle en yüksek performansı göstermiştir. Bu, kiviği doğru ve eksiksiz tespit etmede diğer modellere kıyasla daha üstün olduğunu göstermektedir. F1 Skoru için Large modelinde 0.84 F1 skoru ile en yüksek performansı sağladığı tespit edilmiştir. Bu bulgular, Large modelin genel doğruluk ve eksiksizlik açısından daha dengeli ve tutarlı olduğunu göstermektedir. Precision ve Confidence değerleri Large modelinde 0.929 confidence seviyesinde elde ettiği 1.00 precision değeri, kiviği tespit etme sürecinde yüksek güvenilirlik sunduğunu göstermektedir. Recall Performansı

deęeri tm modellerde benzerlik gstermiřtir. Analizler sonucunda Large modelin kiviye tespit etme konusunda en bařarılı model olduęunu gstermektedir. Hem doęruluk hem de eksiksizlik aısından en yksek deęerlere sahip olan Large model, kiviye doęru ve tutarlı bir řekilde tespit edebilme yeteneęiyle ne ıkmıřtır. Bu bulgular doęrultusunda, kiviye tespit etme amacıyla Large modelin tercih edilmesi gerektięi tespit edilmiřtir.

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# BİLECİK VE ESKİŞEHİR LOKASYONLARI BUĞDAY SAP ATIKLARININ ENERJİ POTANSİYEL DEĞERLERİNİN KARŞILAŞTIRMALI TEORİK ANALİZİ

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## Özet

Enerji, ülkelerdeki toplumların farklı alanlarda kullandıkları direkt gözlemlenemeyen fakat kendi konumundan hesaplanabilen fiziksel sistemlerin özellikleridir. Pek çok ülke gibi Türkiye’de yüksek miktarda enerji ihtiyacı duyan ve ithal eden ülkelerdendir. Biyogaz enerjisi, artan enerji taleplerinin karşılanması için sağlanması bakımından önemlidir. Biyogaz enerjisinin üretilebilmesi, verimli olarak kullanılabilmesi için organik atıklardan enerji üretilmesi çalışmaları yaygınlaşmıştır. Araştırmada, Eskişehir ve Bilecik lokasyonlarında bulunan buğday sap atıklarının biyogaz, biyokütle, enerji potansiyel parametreleri kıyaslanmıştır. Atıklardan elde edilen metan gazı enerji değeri çeşitli parametreler ile hesaplanmıştır. Eskişehir ve Bilecik lokasyonlarına ait kuru madde ve atık potansiyelleri sırasıyla; 8621-9797 ton ile 1524-1731 ton olarak saptanmıştır. Potansiyel elde edilebilir uçucu kuru madde ve metan potansiyelleri sırasıyla; 8523-2131 ton, 1506-377 CH<sub>4</sub> kg saptanmıştır. Enerji potansiyelleri 76710-13556 MJ’dür. Eskişehir lokasyonunda buğday sap atıklarından elde edilebilecek enerji potansiyeli Bilecik lokasyonundan daha fazla olduğu belirlenmiştir.

**Anahtar Kelimeler:** Atık potansiyelleri, Bilecik, Buğday, Enerji, Eskişehir



## COMPARATIVE THEORETICAL ANALYSIS OF ENERGY POTENTIAL VALUES OF WHEAT STALWASES IN BILECIK AND ESKISEHIR LOCATIONS

### **Abstract**

Energy is the properties of physical systems that societies in countries use in different areas and cannot be directly observed but can be calculated from their own location. Like many countries, Turkey is one of the countries that need and import high amounts of energy. Biogas energy is important in terms of meeting the increasing energy demands. In order to produce biogas energy and use it efficiently, researches on energy production from organic wastes have become widespread. In the research, biogas, biomass, energy potential parameters of wheat stalk waste in Eskisehir and Bilecik locations were compared. The energy value of methane gas obtained from wastes was calculated with various parameters. The dry matter and waste potentials of Eskisehir and Bilecik locations were determined as; 8621-9797 tons and 1524-1731 tons, respectively. The potential obtainable volatile dry matter and methane potentials were determined as; 8523-2131 tons, 1506-377 CH<sub>4</sub> kg, respectively. The energy potentials were 76710-13556 MJ. It was determined that the energy potential that can be obtained from wheat stalk wastes in Eskisehir location is higher than Bilecik.

**Keywords:** Waste potentials, Bilecik, Wheat, Energy, Eskişehir

## Giriş

Teknolojik gelişmeler ve yükselen nüfus ülkelerin enerji ihtiyacını artırmaktadır. Ülkelerin enerji ihtiyaçlarını karşılamaları ve kendine yeterliliklerinin sağlanması amacıyla yenilenebilir enerji kaynaklarını etkin olarak kullanmalıdırlar. Güneş, rüzgar v.b enerji sistemlerinin yanı sıra biyogaz sistemlerinden de enerji elde edilmesi özellikle çevrenin korunması ve sürdürülebilir ekolojik dengenin sağlanması bakımından önem arz etmektedir.

Biyogaz, sınıflandırılmış organik atıkların anaerobik koşullarda bakteriyel bozunması sağlanarak açığa çıkan metan gazından elde edilmektedir. Organik atıklardan tesislerde optimum verimlilik sağlanması açısından çeşitli sınıflandırmalar gerekmektedir. Bitki, yem, ürün hasat atıkları gibi tarımsal atıklar, pazar, belediye, ev v.b farklı alanlardan toplanan atıklar, sanayi yan ürün atıkları şeklinde sınıflandırmalar gerçekleştirilmektedir (Naneli, 2022).

Bilecik ve Eskişehir lokasyonlarında teorik olarak buğday sap atıklarının potansiyel enerji değerlerinin saptanması amacıyla gerçekleştirilen araştırma, biyogaz tesislerinin optimum verimlilikte çalışması ve sürdürülebilirliğinin sağlanması bakımından önemlidir. Bu bağlamda tesislerin sürdürülebilirliğinin sağlanması için organik atıklardan buğday sap atığının da substrat olarak yeterli miktarda bulunması gerekmektedir. Belirtilen illerde yapılan araştırma ile tesisler için gerekli olan buğday sap atığı potansiyeli ve enerji değeri saptanmıştır.

## Materyal ve Metot

### Enerji potansiyellerinin belirlendiği iller

Buğday sap artıkları hususunda gerçekleştirilen araştırma Bilecik ve Eskişehir lokasyonlarında gerçekleştirilmekte olup, buğday sap atıklarının teorik olarak potansiyel biyogaz hammaddesi, özgül metan oranı, enerji değerleri saptanmıştır.

### Bilecik ve Eskişehir illeri

Bilecik ili Güney Marmara bölgesinde yer almakta olup, Eskişehir ili İç Anadolu bölgesinin kuzeybatısındadır. Bilecik ve Eskişehir illeri sırasıyla; 2678 km<sup>2</sup> ve 4307 km<sup>2</sup> yüzölçümü ve yaklaşık 850 m ile 788 m yükseltilere sahiptir. Bilecik ilinde 565677 da tahıllar ve diğer bitkisel ürünler yetiştirilirken Eskişehir ilinde 3826517 da alanda bahsedilen sınıf üretim gerçekleştirilmektedir (Tablo 1). Eskişehir ilinde nadas alanlar Bilecik iline göre çok daha fazla olup yaklaşık 1.4 milyon da olarak saptanmıştır. Bilecik ilinde ise nadas alan yaklaşık 102 bin da olarak belirlenmiştir. Bilecik ve Eskişehir illerinin son on yıllık tahıl ekim alanları tablo 2’de verilmiştir. Buğday saplarının enerji potansiyelleri teorik olarak belirlenirken %15’lik değer dikkate alınmıştır (Öztürk & Başçetinçelik, 2006).

**Tablo 1.** Bilecik ve Eskişehir illerinde ekim alanları dağılımı (da)\*

Arazi türü (da)	Bilecik	Eskişehir
Meyveler, İçecek ve Baharat Bitkileri	151884	41284
Nadas	102180	1432918
Sebze	51250	112203
Süs Bitkileri	0	197.2
Tahıllar ve Diğer Bitkisel Ürünler	565677	3826517

\*: TÜİK, 2024

Bilecik ve Eskişehir illeri buğday sap atıklarının teorik enerji potansiyellerinin belirlenmesi sırasında Sharma ve ark. (1988) yöntemleri doğrultusunda belirlenmiş olup, atıkların metan gazı enerji değerleri Aybek ve ark. (2015) araştırmalarındaki yöntem doğrultusunda saptanmıştır.

**Tablo 2.** Bilecik ve Eskişehir illerinde yıllara göre buğday ekim alanları (da)\*

İller	Bilecik**		Eskişehir	
	Yıllar	Ekmeklik buğday	Ekmeklik buğday	Makarnalık buğday
2014		301496	1841054	10832
2015		316072	1816375	10985
2016		314062	1829426	12733
2017		311114	1931220	18767
2018		301413	1811375	10835
2019		298915	1841973	16147
2020		320813	1701645	11562
2021		308740	1610017	10790
2022		305200	1558939	8350
2023		311951	1754951	10254

\*: TÜİK, 2024, \*\*: Bilecik ilinde makarnalık buğday ekim alanı bulunmamaktadır.

Analizlerde kullanılan denklemler:

$$AP = \left( \frac{EA \times 37 \times 15}{100} \right) / 1000$$

$$KM = \left( \frac{AP \times 88}{100} \right)$$

$$UKM = \left( \frac{AP \times 87}{100} \right)$$

$$\text{ÖMO} = UKM \times 0.25$$

$$ME = \text{ÖMO} \times 36$$

### Denklemlerde,

**AP:** Buğday atık potansiyeli (ton/yıl)

**EA:** Buğday ekim alanı (da)

**KM:** Elde edilebilir kuru madde potansiyeli (ton/yıl)

**UKM:** Uçucu kuru madde potansiyeli (ton/yıl)

**ÖMO:** Özgül metan oranı (CH<sub>4</sub> kg)

**ME:** Metan gazı enerji değeri (MJ)

### Bulgular ve Tartışma

Bilecik ve Eskişehir illerinde yapılan araştırmada buğday sap atıkları potansiyel değerleri saptanmıştır (Tablo 3). İncelenen parametreler bakımından Eskişehir lokasyonu Bilecik lokasyonundan çok daha yüksek potansiyel değerlere sahiptir. Özellikle potansiyel metan enerji değeri Eskişehir lokasyonunda 76710 MJ iken Bilecik lokasyonunda 13556 MJ olarak saptanmıştır.

**Tablo 3.** Bilecik ve Eskişehir illerinde buğday sap atıkları enerji potansiyelleri

İller	Bilecik	Eskişehir
Parametreler	Buğday sap	Buğday sap
AP	1731 ton	9797 ton
KM	1524 ton	8621 ton
UKM	1506 ton	8523 ton
ÖMO	377 CH <sub>4</sub> kg	2131 CH <sub>4</sub> kg
ME	13556 MJ	76710 MJ

Farklı lokasyonlarda gerçekleştirilen diğer araştırmalarda araştırmacılar atık potansiyelleri, kuru madde, uçucu kuru madde, özgül metan oranı, enerji potansiyelleri sırasıyla; 6187.4 ton/yıl-2827.1 ton/yıl, 5444.9 ton/yıl-2459.5 ton/yıl, 5383.1 ton/yıl-2459.5 ton/yıl, 1345.8 CH<sub>4</sub> kg-614.9 CH<sub>4</sub> kg, 48447.4 MJ-22135.6 MJ olarak saptamışlardır (Taşova ve Naneli, 2019). Demir (2018)'in Kars lokasyonunda gerçekleştirdiği araştırmada 76.9 milyon m<sup>3</sup> biyogaz

potansiyelinin olduđunu, belirtilen miktarın sađlanacađı kadar atık maddelerin bulunduđunu bildirmiřtir. Bazı bitki atıklarının potansiyel enerji deđerlerinin incelendiđi farklı bir arařtırmada arařtırcılar yaklaşık 827.4 milyon m<sup>3</sup> biyogaz elde edilebileceđini bildirmiřlerdir (Alibař ve ark., 2015). Farklı lokasyonlar, farklı bitki grupları, bitki sayılarındaki farklılıklar gibi faktörler arařtırmalardaki verilerin birbiriyle yakın deđerler oluřturmamasının nedenidir.

### **Sonuç**

Bilecik ve Eskiřehir illerinde buđday sap atıklarının teorik olarak potansiyellerinin incelendiđi arařtırmada; atık potansiyeli, kuru madde, uçucu kuru madde, özgül metan oranı, metan gazı enerji deđeri parametrelerine ait bilgiler paylařılmıřtır. Bilecik lokasyonunda özgül metan oranı ve metan enerji deđerleri sırasıyla; 377 CH<sub>4</sub> kg, 13556 MJ olarak saptanırken, Eskiřehir lokasyonunda ise sırasıyla; 2131 CH<sub>4</sub> kg, 76710 MJ olarak belirlenmiřtir. Yapılan çalıřmadan elde edilen sonuçlar buđday sap atıkları enerji potansiyelinin Eskiřehir lokasyonunda Bilecik lokasyonuna göre daha yüksek deđerde olduđunu ortaya koymaktadır.

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# BUĞDAY SAP ATIKLARININ ENERJİ POTANSİYEL DEĞERLERİNİN KARŞILAŞTIRMALI TEORİK ANALİZİ: AFYON VE UŞAK ÖRNEĞİ

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## **Özet**

Teknolojinin sürekli değişmesi, gelişmesi ve nüfus artışı dünyada enerji ihtiyacının artmasına neden olmaktadır. Yenilenebilir enerji kaynaklarının kullanımı birçok avantajlarından dolayı artış göstermektedir. Organik atıkların enerjiye dönüştürülerek ekonomiye kazandırılması tüm dünyada yaygınlaşmaktadır. Organik atıklardan enerji elde edilmesi çalışmalarında biyogaz tesisleri ön plana çıkmaktadır. Ülkelerde biyogaz tesisi kurulması planlanan lokasyonların organik atık potansiyelinin belirlenmesi tesislerin sürdürülebilirliği bakımından önemlidir. Afyon ve Uşak illerinde buğday sap atıklarının biyokütle, potansiyel enerji, biyogaz özellikleri karşılaştırılmıştır. İncelenen özellikler literatürlerdeki formüller ile hesaplanmıştır. Afyon ile Uşak illerine ait atık potansiyelleri, kuru madde, uçucu kuru madde, metan ve enerji potansiyelleri sırasıyla; 9040-3877 ton, 7955-3411 ton, 7865-3373 ton, 1966-843 CH<sub>4</sub> kg, 70784-30353 MJ olarak belirlenmiştir. Afyon ili buğday sap atıkları enerji potansiyeli Uşak ilinden daha fazla olduğu belirlenmiştir.

**Anahtar Kelimeler:** Afyon, Buğday, Enerji, Metan potansiyelleri, Uşak

## COMPARATIVE THEORETICAL ANALYSIS OF ENERGY POTENTIAL VALUES OF WHEAT STAL WASTES: THE EXAMPLE OF AFYON AND USAK

### **Abstract**

The continuous change and development of technology and population growth cause the energy demand in the world to increase. The use of renewable energy sources is increasing due to its many advantages. The conversion of organic waste into energy and its use in the economy is becoming widespread all over the world. Biogas facilities come to the fore in researches on obtaining energy from organic waste. Determining the organic waste potential of locations where biogas facilities are planned to be established in countries is important for the sustainability of the facilities. The biomass, potential energy and biogas properties of wheat stalk waste in Afyon and Uşak provinces were compared. The examined properties were calculated with the formulas in the literature. The waste potentials, dry matter, volatile dry matter, methane and energy potentials of Afyon and Uşak provinces were determined as; 9040-3877 tons, 7955-3411 tons, 7865-3373 tons, 1966-843 CH<sub>4</sub> kg, 70784-30353 MJ, respectively. It has been determined that the energy potential of wheat stalk waste in Afyon province is higher than that of Uşak province.

**Keywords:** Afyon, Wheat, Energy, Methane potentials, Uşak

## Giriş

Dünyada enerji tüm toplumların pek çok alanlarda kullandıkları doğrudan gözlemlenemeyen ancak kendi konumundan hesaplanabilen fiziksel sistemlerin kapsamlı özelliklerindedir. Gelişen teknoloji ve artan nüfus ile birlikte ülkelerin çoğu ihtiyaçların karşılanması amacıyla enerji ithalatı yapan ülke konumundadır. Türkiye de pek çok ülke gibi çeşitli alanlarda kullanmak için enerji ithal eden ülke konumundadır. Araştırmacılar 2020’li yılların başlarında Türkiye’nin enerji ihtiyacının yaklaşık %75 oranında ithalat ile karşılanabileceğini bildirmişlerdir (Arslan ve Solak, 2019). Sanayi sektörünün gelişmesi, işsizliğin azalması, yerel üretimle ekonominin yükselmesi gibi faktörler zincir reaksiyon halinde gerçekleşmekte olup özellikle sanayi sektörünün gelişmesi bakımından enerji arzının istenilen miktarda ve yerel kaynaklar ile sağlanması gerekmektedir. Enerji ihtiyacının yerel kaynaklardan sağlanması ulusal bağımsızlık için elzemdir.

Enerji kaynakları, yenilenebilir ve yenilenemeyen (fosil) kaynaklar olarak iki temel kısımda incelenmektedir. Yenilenebilir enerji kaynakları: Rüzgar, güneş, jeotermal, biyokütle, hidroelektrik v.b. Yenilenemeyen enerji kaynakları: Kömür, petrol, doğalgaz v.b olarak belirlenmiştir (Naneli, 2022). Yenilenebilir enerji kaynaklarından üretimin sağlanması, kaynakların tükenmemesi ve çevre tahribatı oluşturmamalarından dolayı daha fazla önem arz etmektedirler. Özellikle biyogaz tesislerinde tarımsal atıklar, pazar v.b farklı alanlardan toplanan organik atıklar, endüstriyel yan ürün atıkları substrat olarak kullanılmaktadır. Belirtilen atıkların çevreye olumsuz etkileri önlenmekte olup enerji olarak ulusal ekonomiye kazandırılmaktadır. Yapılan araştırmada, belirtilen illerde buğday sap atıklarının potansiyel enerji değerinin teorik olarak belirlenmesi, tesislerin sürdürülebilirliği açısından buğday sap atığından yeterli substratın sağlanıp sağlanmaması hususunun belirlenmesi amaçlanmıştır.

## Materyal ve Metot

### Enerji potansiyellerinin belirlendiği iller

Araştırma Afyon ve Uşak illerinde gerçekleştirilmekte olup, buğday sap atıklarının teorik olarak potansiyel substrat, biyogaz, enerji değerleri belirlenmiştir.

### Afyon ve Uşak illeri

Afyon ve Uşak illeri Ege bölgesinde yer almaktadır. Yüzölçümleri sırasıyla; 1025 km<sup>2</sup> ve 5556 km<sup>2</sup> olarak belirlenmiştir. Afyon ili 1021 m, Uşak ili 906 m yükseltilere sahiptir. Afyon ilinde yüksek miktarda nadas alanı dikkat çekmekte olup yaklaşık 4 milyon da alanda tahıllar ve diğer bitkisel ürünler yetiştirilmektedir. Uşak ilinde ise nadas alanı daha az olup yaklaşık 2 milyon da ile tahıllar ve diğer bitkisel ürünler en fazla üretim alanına sahiptir (Tablo 1). Her iki ilin son yıllardaki tahıl ekim alanları tablo 2’de verilmiştir. Buğday saplarının biyokütle potansiyelleri belirlenirken %15’lik değer kullanılmıştır (Öztürk & Başçetinçelik, 2006).

**Tablo 1.** Afyon ve Uşak illerinde ekim alanları dağılımı (da)\*

Arazi türü (da)	Afyon	Uşak
Meyveler, İçecek ve Baharat Bitkileri	158759	121936
Nadas	1359962	49203
Sebze	89312	76385
Süs Bitkileri	0	0
Tahıllar ve Diğer Bitkisel Ürünler	3951159	2033645

\*: TÜİK, 2024



**Tablo 2.** Afyon ve Uşak illerinde yıllara göre buğday ekim alanları (da)\*

İller	Afyon		Uşak	
	Yıllar	Ekmeklik buğday	Makarnalık buğday	Ekmeklik buğday
2014	1190297	510846	98004	649990
2015	1155432	502675	99487	614163
2016	1166297	499434	97845	571978
2017	1184257	490097	98290	559832
2018	1127936	501920	98957	554837
2019	1152181	505588	103170	547671
2020	1074153	542820	118333	624444
2021	1120722	543778	118025	585875
2022	1090471	468764	123030	573730
2023	1125819	503027	123450	575021

\*: TÜİK, 2024

Buğday sap atıklarının teorik olarak potansiyellerinin belirtilen illerde belirlenmesi bazı araştırmacıların yöntemleri doğrultusunda gerçekleştirilmiştir (Sharma ve ark., 1988). Atıkların metan gazı enerji değeri araştırmacıların çalışmalarındaki yöntem doğrultusunda saptanmıştır (Aybek ve ark., 2015).

Analizlerde kullanılan denklemler:

$$AP = \left( \frac{EA \times 37 \times 15}{100} \right) / 1000$$

$$KM = \left( \frac{AP \times 88}{100} \right)$$

$$UKM = \left( \frac{AP \times 87}{100} \right)$$

$$\text{ÖMO} = UKM \times 0.25$$

$$ME = \text{ÖMO} \times 36$$

#### Denklemlerde,

**AP:** Buğday atık potansiyeli (ton/yıl)

**EA:** Buğday ekim alanı (da)

**KM:** Elde edilebilir kuru madde potansiyeli (ton/yıl)

**UKM:** Uçucu kuru madde potansiyeli (ton/yıl)

**ÖMO:** Özgül metan oranı (CH<sub>4</sub> kg)

**ME:** Metan gazı enerji değeri (MJ)

#### Bulgular ve Tartışma

Afyon ve Uşak illerinde gerçekleştirilen buğday üretimi sap atıklarının enerji potansiyel değerleri saptanmıştır (Tablo 3). Atık potansiyeli, kuru madde, uçucu kuru madde, özgül metan oranı, metan enerji değeri parametreleri bakımından Afyon ili Uşak ilinden daha fazla substrat potansiyeline sahiptir.

**Tablo 3.** Afyon ve Uşak illerinde buğday sap atıkları enerji potansiyelleri

İller	Afyon	Uşak
Parametreler	Buğday sap	Buğday sap
AP	9040 ton	3877 ton
KM	7955 ton	3411 ton
UKM	7865 ton	3373 ton
ÖMO	1966 CH <sub>4</sub> kg	843 CH <sub>4</sub> kg
ME	70784 MJ	30353 MJ

Araştırmacılar, Tokat ve Bolu illerinde buğday sap atık potansiyelleri, kuru madde, uçucu kuru madde, özgül metan oranı, enerji potansiyelleri sırasıyla; 6187.4 ton/yıl-2827.1 ton/yıl, 5444.9 ton/yıl-2459.5 ton/yıl, 5383.1 ton/yıl-2459.5 ton/yıl, 1345.8 CH<sub>4</sub> kg- 614.9 CH<sub>4</sub> kg, 48447.4 MJ-22135.6 MJ olarak bildirmişlerdir (Taşova ve Naneli, 2019). Kars ilinde yapılan benzer bir çalışmada araştırmacılar yılda yaklaşık 76.9 milyon m<sup>3</sup> biyogaz sağlanacak miktarda (yaklaşık 1.6 milyon ton/yıl) atık potansiyelinin olduğunu belirtmişlerdir (Demir, 2018). Diyarbakır ilinde çok sayıda bitkide yapılan çalışmada araştırmacılar incelenen bitki artıklarından elde edilen biyogaz potansiyelinin yılda yaklaşık 827.4 milyon m<sup>3</sup> olarak saptamışlardır (Alibaş ve ark., 2015). Araştırmacıların araştırmalarındaki verilerinin birbiriyle örtüşmeyip farklı olmasının nedeni farklı lokasyonlar, farklı bitki grupları, bitki sayılarındaki farklılıklardan kaynaklanmaktadır.

### Sonuç

Uşak ve Afyon illerindeki buğday sap atıklarında yapılan araştırmada; atık potansiyeli, kuru madde, uçucu kuru madde, özgül metan oranı, metan gazı enerji değeri parametreleri incelenmiştir. Metan enerji değerleri Afyon ilinde 70784 MJ, Uşak ilinde 30353 MJ olarak belirlenmiştir. Elde edilen sonuçlar doğrultusunda buğday sap atıkları enerji potansiyeli Afyon ilinin Uşak iline göre daha yüksek olduğu belirlenmiştir.

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## FARKLI YÜZEYLERDE ELEKTROPOLİMERİZE EDİLEN POLİANİLİNİN ELEKTROKİMYASAL OLARAK İNCELENMESİ

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### Özet

İnsanoğlu hayatını daha iyi bir noktaya getirmek için teknolojiyi kullanır. İletken polimerle hazırlanan özellikli malzemeler bu konuda teknolojik ilerlemeyi sağlayan ürünlerin başında gelir. Polianilin (PANİ), ayarlanabilir elektriksel özellikleri, dikkate değer mekanik mukavemeti ve kolay ve düşük maliyetli üretim süreci nedeniyle en eski ve en kapsamlı araştırılmış iletken polimerler. Bu malzemeler farklı yüzeylerde farklı elektriksel çekimde olacakları için kapasitansları etkilenir. Bu çalışmada platin (Pt), paslanmaz çelik ve karbon fiber yüzey gibi farklı yüzeylerin PANİ ile kaplandığında göstereceği spesifik ve çift tabaka kapasitans değerleri döngülü voltametri ve elektrokimyasal empedans verileri kullanılarak hesap edildi. Morfolojik görüntüleme taramalı elektron spektroskopisi (SEM) ve atomik kuvvet mikroskopisi (AFM) kullanılarak belirlendi. -0,2V/1,1V potansiyel aralığında yapılan kaplamalarda spesifik kapasitans değerleri,  $2,91 \cdot 10^{-2}$  F'dan,  $3,1 \cdot 10^{-5}$  F'a değişirken; çift tabaka kapasitans değeri  $9,45 \cdot 10^{-3}$  F'dan  $5,6 \cdot 10^{-5}$  F değerine kadar değiştiği hesap edildi. Faz açısı değeri ise  $65^\circ$ 'den  $95^\circ$ 'ye değişmekteydi. Bu veriler dikkate alındığında PANİ'nin farklı yüzeylerde elektrokimyasal olarak kaplandığında farklı kapasitans değerleri gösterdiği bu farklılığın ise paslanmaz çelik yüzeyde daha yüksek karbon fiber yüzeyde ise daha düşük olduğu görüldü. Yüzeyde oluşan kaplamanın farklılığı olduğu da gösterildi. Buna göre karbon fiber yüzeyde daha kabarık şekilli kaplama gerçekleşirken, Pt yüzeyde ise daha sıkı, düz, pürüzsüz bir kaplama gözlemlendi. Morfolojideki bu farklılık yüzeyle kaplama arasındaki değişikliğe ve dolayısıyla kapasitans değerindeki farklılığa da sebep olduğu düşünüldü.

**Anahtar Kelimeler:** Polianilin, Elektropolimerizasyon, Yüzey kaplama, Kapasitans.

## **ELECTROCHEMICAL INVESTIGATION OF POLYANILINE ELECTROPOLYMERIZED ON DIFFERENT SURFACES**

### **Abstract**

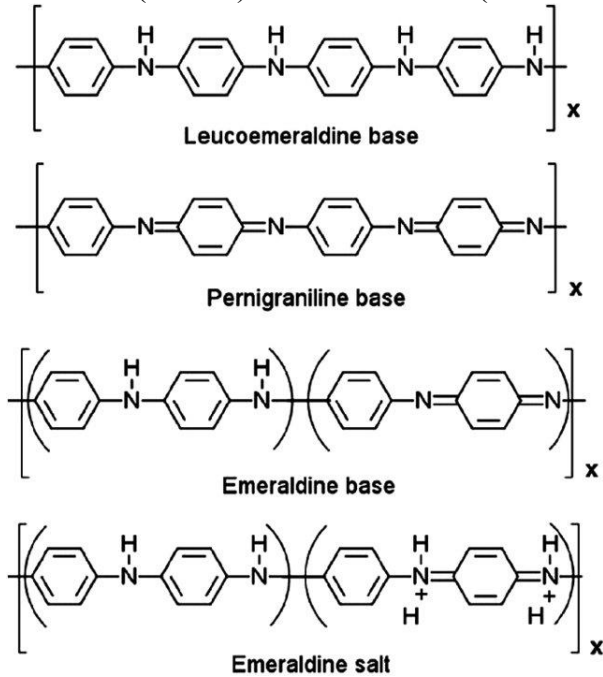
Mankind uses technology to improve their lives. Specialized materials prepared with conductive polymers are at the forefront of products that provide technological advancement in this regard. Polyaniline (PANI) is the oldest and most extensively researched conductive polymers due to its adjustable electrical properties, remarkable mechanical strength and easy and low-cost production process. Since these materials will have different electrical attractions on different surfaces, their capacitances are affected. In this study, the specific and double layer capacitance values of different surfaces such as platinum (Pt), stainless steel and carbon fiber surfaces when coated with PANI were calculated using cyclic voltammetry and electrochemical impedance data. Morphological imaging was determined using scanning electron spectroscopy (SEM) and atomic force microscopy (AFM). While the specific capacitance values in the coatings made in the potential range of -0.2V/1.1V changed from  $2.91 \times 10^{-2}$  F to  $3.1 \times 10^{-5}$  F; The double layer capacitance value was calculated to vary from  $9.45 \times 10^{-3}$  F to  $5.6 \times 10^{-5}$  F. The phase angle value varied from  $65^\circ$  to  $95^\circ$ . When these data were taken into consideration, it was seen that PANI showed different capacitance values when electrochemically coated on different surfaces, and this difference was higher on the stainless steel surface and lower on the carbon fiber surface. It was also shown that there was a difference in the coating formed on the surface. Accordingly, while a more puffy-shaped coating was formed on the carbon fiber surface, a tighter, flatter, smoother coating was observed on the Pt surface. It was thought that this difference in morphology caused the change between the surface and the coating and therefore the difference in the capacitance value.

**Keywords:** Polyaniline, Electro-polymerization, Surface coating, Capacitance.

## Giriş

Gelişen teknoloji elbette daha fazla enerjiye ve daha fazla elektriksel kapasitansa gereksinim duyar. İletken metallere alternatif olarak keşfedilen iletken polimerler biyosensör, enerji depolama sistemleri elektrokatalizör gibi birçok uygulamada başarıyla kullanılan malzemelerdir. Bunlar yapılarında rezonans yapı sayesinde iletkenlik kazanan organik bileşiklerdir. PoliAnilin (Pani) kimyasal kararlılığı, doplanabilirliği, redoks döngüsü, elektriksel iletkenlik, düşük fiyat ve kolay sentezlenebilirliği sayesinde elektrot malzemesi (Smirnov ve ark., 2019; Chen ve ark., 2019) olarak, metalleri korozyondan korumada (Bertuoli ve ark., 2019; Merz ve ark., 2019), ikincil pil yapımında (Rochliad ve ark., 2015) mikroelektroniklerde (Li ve ark., 2014) ve bir elektrokromik malzeme (Ranjbar ve ark., 2019) olarak diğer iletken polimerlere göre daha tercih edilebilir olmuştur. Pani, elektrokaplama (Hui ve ark., 2016), kimyasal sentez (Kaykha ve ark., 2019) ve arayüzey (Fang ve ark., 2018) polimerizasyonu gibi sentezleme yöntemleri ile elde edilirken, herhanagi bir yükseltgeyici kimyasala ihtiyaç duymadan yapılan hızlı, kolay ve pratik bir yöntem olan elektropolimerizasyon yöntemi (Li ve ark., 2017) kullanılarak kaplama işlemi daha çok tercih edilir. Elektropolimerizasyon Pt, Karbon, altın gibi çeşitli elektrotlar kullanılarak yapılabilir. (Palma-Cando ve ark., 2019). Elektrot yüzeyi iletken polimerle kaplandığında elektrokimyasal olarak kapasitans sergiler ve bu değer özellikle enerji depolama cihazları ve süper kapasitörler için büyük önem taşımaktadır.

Pani nin birbirinden farklı iletken yapıya sahip 3 farklı formu bulunur. Bunlar; Üç baz tipinde bulunur (oksidasyon durumu): pernigranilin (PB) – tamamen oksitlenmiş (mor/kırmızı/siyah), zümrüt (EB) – kısmen oksitlenmiş (mavi/mor) ve lökoemeraldin (LB) – tamamen indirgenmiş (sarı/renksiz). Bu PANI formlarının her biri farklı elektriksel ve termal özelliklere sahiptir [Yoon ve ark., 2011], ancak hepsinin düşük elektriksel iletkenlik değerleri vardır: 1 S/cm (pernigralin),  $1 \cdot 10^{-10}$  S/cm (zümrüt) ve  $1 \cdot 10^{-10}$  S/cm (lökoemeraldin).



Şekil 1. Anilinin oksidasyon halleri. (Zoshki ve ark., 2017)

Enerji özellikle gelişen teknolojilerde önemli ve değerlidir. Geri kazanımı ve depolaması üretimi kadar hayati önem taşır. Son zamanlarda iletken polimerlerle nanokarbonlu kompozitler enerji geri kazanımı/depolama alanında umut verici olduğu bildirilmiştir [Khomenko ve ark., 2005]. Bu malzemelere dayalı süper kapasitörler nispeten yüksek kapasiteye sahiptir: 485 F/g (PANI SWCNT'ler) (Gupta ve ark., 2006), 110 F/g (PEDOT/PSS-SWCNT)[32] ve 1266 F/g

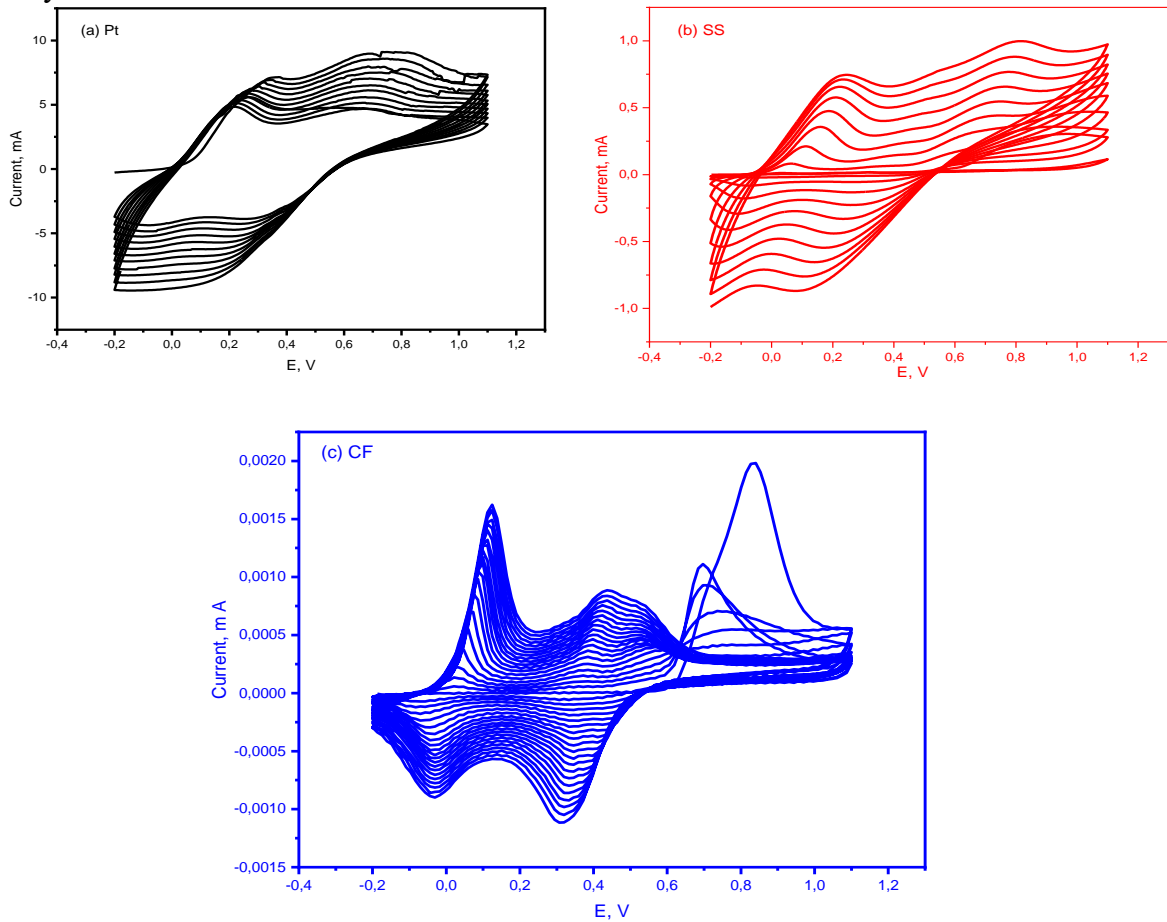
(gözenekli PANI/SWCNT'ler) ( Chem ve ark., 2011). Bu çalışmada anilin monomerinin Platin (Pt), paslanmaz çelik (SS) ve karbon fiber (CF) gibi farklı yüzeylerde Döngülü Voltametri (CV) tekniği kullanılarak elektropolimerizasyon sonucu kaplanması ile oluşan elektrodun elektrokimyasal empedans (EIS) ve kapasitans kıyaslanması yapıldı. Ayrıca oluşan polimerin yüzeyi morfolojik olarak Taramalı Elektron Mikroskobu (SEM) ve Atomik Kuvvet Mikroskobu (AFM) ile incelendi.

### Materyal Metot

Tamamlayıcı elektrot olarak Pt tel, reference elektrot olarak gümüş (Ag) tel ve çalışma elektrodu olarak ise incelemeye bağlı olarak Pt, SS ve CF olmak üzere üçlü elektrot sistemi kullanıldı. Aniline monomer olarak Sigma –Aldrich ten satın alındı. Deneylerde elektrolit olarak 0,1 M H<sub>2</sub>SO<sub>4</sub> çözücü olarak ise saf su kullanıldı. CV grafikleri ve empedans verileri Princeton Applied Research Potentiostat model 2263 Potentiostat/Galvanostat (Dolas ve ark., 2014; Dolas ve ark, 2016) cihazında PowerSuit uygulaması kullanılarak elde edildi. Monomer 10 mM olacak şekilde 5 mL CV hücrelerinde deneyler yapıldı. Potansiyel aralığı (E ) -0,2/1,2 V; tarama hızı (v) 50 mV s<sup>-1</sup>.

### Bulgular ve Tartışma

Pt, SS ve CF elektrot yüzeyinde elektropolimerleşen aniline ait CV grafiği Şekil 2 a, b, c de sırasıyla verilmektedir.



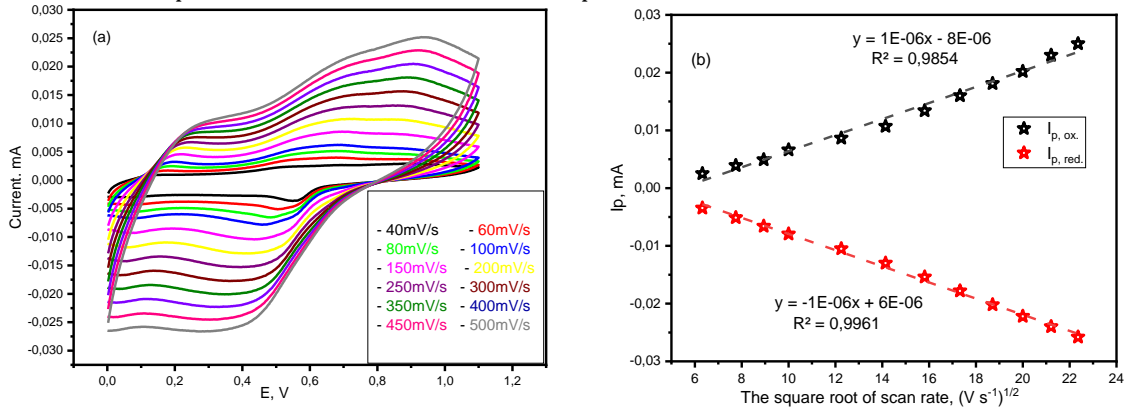
Şekil 2. a) Pt, b) SS ve c) CF elektrot yüzeyinde Anilin elektropolimerizasyonuna ait CV grafiği. (E: -0,2/1,2 V; v: 50 Mv s<sup>-1</sup>; elektrolit : 0,1 M H<sub>3</sub>PO<sub>4</sub>)

Şekilden Pt yüzeyinde anilin monomeri yaklaşık 0,1 V ve 0,5 V olmak üzere iki pik vererek yükseltgenmeye uğradığı anlaşılabilir. Elektrot yüzeyinde polimerin büyüdüğü döngü arttıkça

artan polimer pik akımlarından açıktır. Grafik CF yüzeyinde daha belirgin olduğu gözlemlendi, bu CF yüzeyi ile monomer arasındaki elektriksel etkileşimin daha iyi olduğu şeklinde yorumlanabildi.

SC elektrot yüzeyinde oluşan polimerin (Pani) monomersiz ortamda farklı tarama hızlarında alınan CV grafikleri Şekil 3a da verildi. Randles-Sevcik eşitliğine (Eşitlik 1) göre tarama hızıyla pik akım değerleri grafiğe alındığında eğimin R2 değeri 1 e yaklaşmasıyla elektropolimerizasyonun difüzyon veya adsorpsiyon kontrollü olup olmaması hakkında yorum yapılabilir. (Dolas ve ark., 2016; Dolas, 2022)

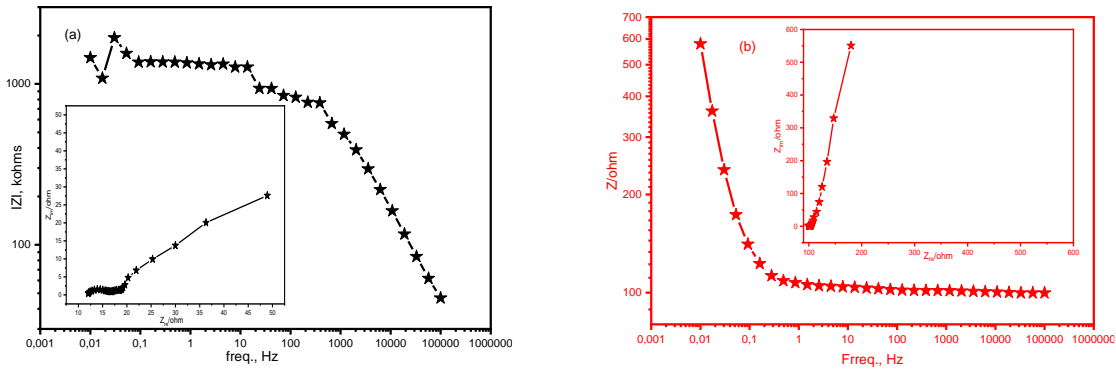
$$I_p = 2,69 * 10^5 n^{3/2} AD^{1/2} \nu^{1/2} C_p \quad (\text{Eşitlik 1})$$



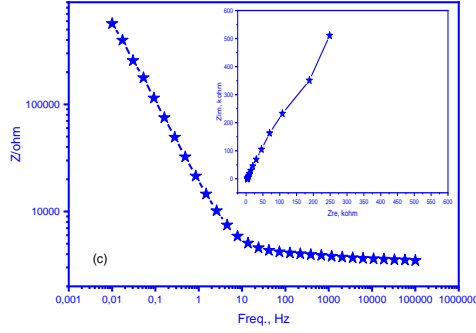
**Şekil 3.** a) Pani kaplı CF elektrot ile farklı tarama hızları uygulanarak alınan monomersiz ortam CV eğrileri, b) tarama hızı karekökü- $I_p$  grafiği (Randles-Sevcik eşitliği).

Tarama hızının kareköküne karşılık monomersiz ortam cv grafiklerinden alınan yükseltgenme ve indirgenme pik akım değerlerinin grafik eğrileri 0,98 ve 0,99 regresyon katsayısı ile yüksek lineerlik sağladığı görüldü. Bu da elektropolimerizasyon mekanizmasının difüzyon kontrollü olduğunu gösterdi.

Her bir Pani kaplı elektrodun elektrokimyasal empedans verileri ise yine monomersiz ortamda alındı ve elede edilem Magnitude ve Nyquist fgrafikleri Şekil 4 te verildi.







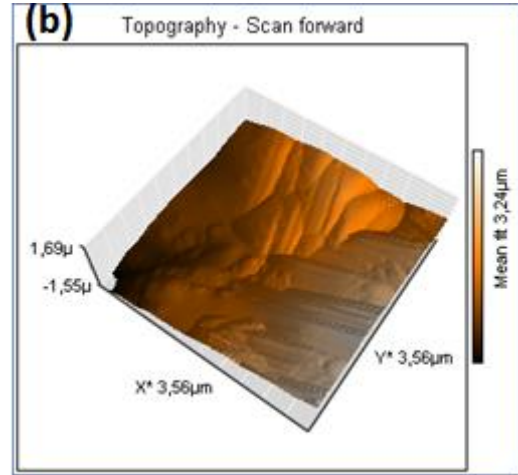
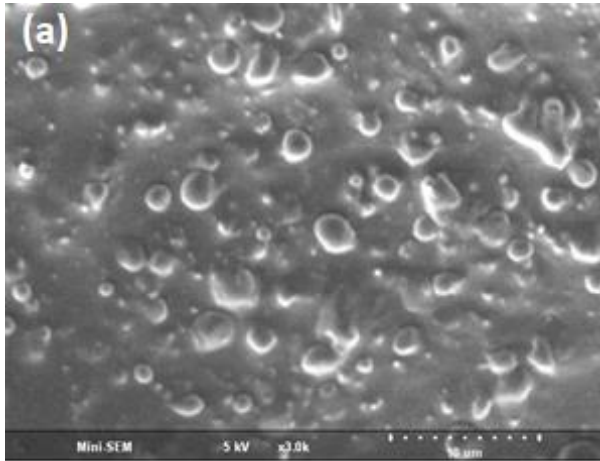
**Şekil 3.** a. SS, b. Pt ve c. CF elektrotlarına ait Magnitude grafiği (inset grafikleri ilgili elektrotun Nyquist grafikleridir). (0,1M H<sub>2</sub>SO<sub>4</sub> elektrolit ortamı, 0,1Hz-100 kHz)

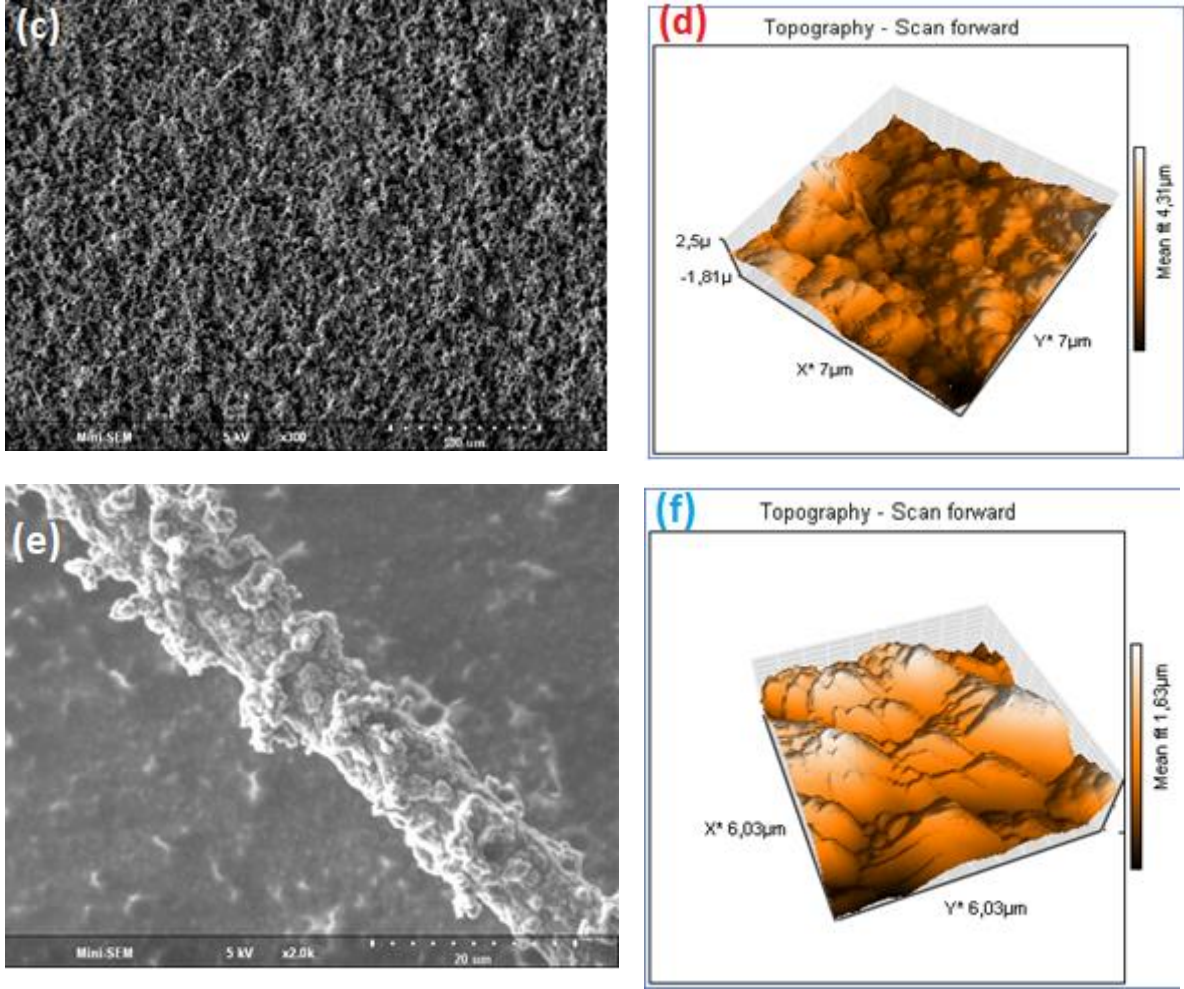
Frekansa göre değişen empedans verileri magnitude grafiğinde takip edildi ve bu grafikten çift tabaka kapasitans (Cdl) verilerine, Nyquist grafiklerinden (inset grafikler) ise Csp verilerine ulaşıldı. Bu veriler toplu halde Tablo 1 de yer almaktadır.

**Tablo 1.** Pani kaplı elektrotların Csp, Cdl ve faz açısı verileri.

Yüzey	Csp, F cm <sup>-2</sup>	Cdl, F cm <sup>-2</sup>	Faz açısı, derece
Paslanmaz çelik	2,91*10 <sup>-2</sup>	9,45*10 <sup>-3</sup>	65
Platin		7,855*10 <sup>-4</sup>	95
Karbon fiber	3,1*10 <sup>-5</sup>	5,6*10 <sup>-5</sup>	75

Elde edilen veriler incelendiğinde Pani kaplı SS elektrotunun 2,91\*10<sup>-2</sup> F cm<sup>-2</sup> lık Csp değeri ve 9,45\*10<sup>-3</sup> F cm<sup>-2</sup> lık Cdl değeri ile diğerlerine göre daha kapasitif özellik sergilediği gözlemlendi. Bu elektrot malzemesinin iletkenliği ve kaplama ile etkileşimi ile açıklanabilir. Diğer elektrotlar daha iletken özellik gösterdiler bu faz açısının yüksekliği ile orantılıdır. Kaplamanın elektrotla yan yana geldiğinde farklı kapasitif ve iletken özellikler göstermesi kaplamanın morfolojisi ile ilgisini inceleyebilmek için kaplamanın SEM VE AFM görüntüleri Şekil 4 de verildi.





Şekil 4. a) SS, c) Pt, e) CF elektrotlarının SEM görüntüleri ve b) SS, d) Pt, f) CF elektrotlarının AFM görüntüleri.

SEM görüntüleri kaplamanın SS yüzeyinde daha sıkı, pürüzsüz; Pt yüzeyinde daha gözenekli, homojen dağılmış bir pürüzlü; CF de ise yine çiçekli bir yapıya sahip olduğunu gösterdi. AFM görüntüleri de pürüzlülüğü ortaya koydu. Bu elektrotların kapasitif ya da iletkenlik göstermelerinin morfolojisine bağlı olduğunu göstermek için önemli bir sonuçtur.

### Sonuç

Sonuç olarak bu çalışmada Anilin monomeri SS, Pt ve CF gibi farklı iletkenlik gösteren yüzeylerde elektropolimerizasyon yöntemi kullanılarak polimerleştirildi. Bu işlem  $-0,2V$  ile  $1,2 V$  arasında  $50 \text{ mV s}^{-1}$  tarama hızı kullanılarak  $0,1M \text{ H}_2\text{SO}_4$  elektrolit ortamında gerçekleştirildi. Elektrotlar yüzeyinde anilin monomeri yaklaşık  $0,1 V$  ve  $0,5 V$  olmak üzere iki pik vererek yükseltgenmeye uğradı. Pikler CF yüzeyinde daha belirgin olduğu gözlemlendi, bu CF yüzeyi ile monomer arasındaki elektriksel etkileşimin daha iyi olması ile açıklanabilir. Randles-Sevcik grafik eğrileri  $0,98$  ve  $0,99$  regresyon katsayısı ile yüksek lineerlik sağladığı görüldü. Bu da elektropolimerizasyon mekanizmasının difüzyon kontrollü olduğunu gösterdi. Elde edilen empedans verilerinden Pani kaplı elektrotlardan SS elektrotunun  $2,91 \cdot 10^{-2} \text{ F cm}^{-2}$  lık Csp değeri ve  $9,45 \cdot 10^{-3} \text{ F cm}^{-2}$  lık Cdl değeri ile diğerlerine göre daha kapasitif özellik sergilediği belirlendi. Bu elektrot malzemesinin iletkenliği ve kaplama ile etkileşimi ile açıklanabilir. Diğer elektrotlar daha iletken özellik gösterdiler bu faz açısının yüksekliği ile orantılıdır. SEM ve AFM görüntüleri elektrotların kapasitif ya da iletkenlik göstermelerinin morfolojisine bağlı olduğunu göstermek için önemli bir sonuçtur.

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## ADSORBENT OLARAK AKTİF KARBONUN ÜRETİMİNİ VE KULLANIMINI ETKİLEYEN FAKTÖRLER

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### **Özet**

Günümüz teknolojisi ve artan ihtiyaçlar endüstride hareketliliği sağladı ancak, ağır metal iyon ve moleküllerin içme ve şebeke sularına ve doğaya karışması gibi birçok zararı da çevreye ve canlılığa verdi. Adsorpsiyon bu zararlı molekül ve iyonların ortamdaki alınması ve doğaya verdikleri zararı en aza indirmeyi sağlayan bir uygulamadır. Adsorpsiyon performansını belirleyen baş eleman aktif karbondur. Aktif karbon, çeşitli karbon içeren malzemelerden çeşitli yöntemlerle işlenerek elde edilen ve zararlı iyon veya molekülleri ortamdaki uzaklaştırmak için adsorbent, katalizör destek malzemesi veya elektrot malzemesi olarak çeşitli uygulamalarda kullanılan yüksek yüzey alanına sahip malzemelerdir. Yüksek yüzey alanını yapısında bulunan gözenekler sayesinde kazanır. Bu sebeple gözenek oluşumunu etkileyen her aşama önem arz etmektedir. Aktif karbon, kabuk, sap gibi doğal atıklardan kimyasal, fiziksel ve yeşil sentez gibi çeşitli yöntemler kullanılarak elde edilir. Kimyasal yöntemlerde çeşitli aktifleştirici ajanlar, fiziksel yöntemde ise yüksek sıcaklıklar kullanılır. Yeşil sentezde ise daha çok materyalin nanopartiküllerle fonksiyon kazandırılması sağlanır. Bu çalışmada, aktif karbonun yüzey alanı ve gözenek dağılımını inceleyen çalışmalar derlenmiştir. Elde edilen veriler, aktifleştirici ajanın türü ve miktarı, ham materyalle etkileşme süresi, karbonizasyon sıcaklığı ve süresi gibi faktörler elde edilen AC'nin yüzey alanını ve gözenek hacminin gözenek çapına göre dağılımını etkilediğini gösterdi. Öyle ki, bazı karakterli aktifleştiriciler ham materyali tahriş ederek işlerken, asit karakterli aktifleştiricilerin gözeneklerin açılmasına yardım ettiği ve yüzey alanını artırdığı belirlendi. Mikro gözenek oluşumunun daha çok KOH gibi bazlarla mezo ve makro gözeneklilik oluşumunun ise bor türevi maddelerle elde edildiği görüldü. AC özelliklerini etkileyen koşullar ve ne yönde etki ettiği bilinirse üretiminde amaca uygun yapılacağı bu sayede enerji, ham madde ve ekonomik anlamda fayda sağlanarak daha çok verim alınacağı önerilmektedir.

**Anahtar Kelimeler:** Aktif karbon, Üretim koşulları, Yüzey alanı, Gözenek dağılımı.

## FACTORS AFFECTING THE PRODUCTION AND USE OF ACTIVATED CARBON AS ADSORBENT

### Abstract

Today's technology and increasing needs have provided mobility in the industry, but have also caused many harms to the environment and life, such as heavy metal ions and molecules mixing into drinking and mains water and nature. Adsorption is an application that allows the removal of these harmful molecules and ions from the environment and minimizes the harm they cause to nature. Activated carbon plays a very effective role in adsorption performance. It gains its high surface area thanks to the pores in its structure. For this reason, every stage affecting pore formation is important. Activated carbon is obtained from natural wastes such as shell and stem using various methods such as chemical, physical and green synthesis. Activating agents are used in the chemical method, while high temperatures are used in the physical method. In green synthesis, the material is mostly provided with nanoparticles to gain function. In this study, studies examining the surface area and pore distribution of activated carbon were reviewed. The obtained data showed that factors such as the type and amount of the activating agent, the interaction time with the raw material, carbonization temperature and time affect the surface area of the obtained AC and the distribution of the pore volume according to the pore diameter. In fact, it was determined that while basic activators irritate the raw material, acidic activators help open the pores and increase the surface area. It was seen that microporosity formation was mostly obtained with bases such as KOH, and meso- and macroporosity formation was obtained with boron derivatives. It is suggested that if the conditions affecting the properties of AC and in what direction they affect are known, it will be produced in accordance with the purpose, thus providing more efficiency by providing energy, raw material and economic benefits.

**Keywords:** Activated carbon, Production conditions, Surface area, Pore distribution.

## Giriş

Adsorpsiyon, su veya hava ortamında kir, boya ağır metal gibi zararlı molekül ve iyonların çeşitli adsorbentler yüzeyinde tutunması prensibine dayalı bir uygulamadır. Aktif karbonlar (AC) birim ağırlıkta yüksek yüzey alanı barındırmaları sebebiyle adsorpsiyon uygulamalarında büyük önem taşır. AC bu özelliklerden dolayı su arıtma (Imran ve ark., 2006; Carrott ve ark., 2001), yiyecek (Zhang 2018), sağlık, tekstil (Gupta ve ark., 2021), elektrot yapımı (Adekunle ve ark., 2015; Wu ve ark., 2015) ve katalizör desteği (Lam ve ark., 2016.; Jüntgen, 1986) olarak başarıyla kullanıldı. Polimer (Gong ve ark., 2021), plastik (Fan ve ark., 2021) gibi ham maddeler adsorbent olarak karşımıza çıktı. Ancak bu maddelerin bulunuşları bakımından az ve pahalı olmaları bir dezavantajdır. Bu sebeple araştırmacılar bol bulunan, ucuz ve tamamen doğal birer ürün olan zirai atıklara (Rodriguez-Mirasol ve ark., 1993) yöneldi. Çünkü zirai atıklar yapılarında bulunan selülozik yapıdan dolayı işlenip kolayca AC haline getirilebilir. Bu sayede çevre kirliliğın azalacak ve ekonomik anlamda da fayda sağlayacak bir yönelim oldu. AC üretimi için fıstık kabuğundan (Lua ve ark., 2005), biber saplarına (Dolas, ve ark., 2022a, Dolas, 2023a), portakal kabuğundan (Carlos ve ark., 2021), mısır atıklarına (Wu ve ark., 2021) kadar çok çeşitli bir yelpazede atıklar kullanıldı.

Geleneksel aktif karbon üretimi, fiziksel, kimyasal olmak üzere başlıca iki yöntemle hazırlanır. Aktif karbon üretiminde fiziksel aktivasyon süreci karbon dioksit veya su buharı kullanılarak yüksek sıcaklıkta, kimyasal aktivasyon işleminde ise fosforik asit ( $H_3PO_4$ ) (Vernersson ve ark., 2002; Liou, 2010), çinko klorür ( $ZnCl_2$ ) (Lua ve ark., 2005), metal hidroksitler ( $NaOH$  ve  $KOH$  vb. ) gibi aktive edici kimyasal maddeler kullanılarak gerçekleştirilmektedir. (Dolas ve ark., 2011). Son zamanlarda bu yöntemlere entegre edilen mikrodalga destekli üretim yöntemleri de kullanılmaktadır. Bu sayede geleneksel yönteme kıyasla daha yüksek yüzey alanı ve gözenek boyutuna erişildiği rapor edilir.(Dolas H, 2023b) Bunlara ek olarak yine son zamanlarda kimyasal kullanımını daha az miktara çekmek adına yeşil sentez yöntemi kullanılmaktadır. Bu yöntemde tamamen sadece  $CuSO_4$  gibi zararlı olmayan bir nanopartikül kaynağı kullanılarak ve yaprak kök gibi organik malzemelerin ekstraktı kullanılarak nano boyutta etkin ve aktif karbonlar üretildi. (Dolas H, 2023c)

AC yüzey alanları incelenirken Brunauer-Emmett-Teller (BET) yüzey alanı daha çok kullanıldı. Burada bağıl basınca karşı yüzeyin kriyojenik koşullarda adsorbe etmiş olduğu  $N_2$  gazı hacminden yola çıkılarak isotermler oluşturulur ve buralardan uygun hesaplamalarla BET yüzey alanı mikro-mezo- veya makro- gözenek hacmi belirlenir.

AC elde etmek için kullanılan sistem yüksek sıcaklık kül fırınından oluşan bir sistemdir. (Şekil 1 )



Şekil 1. AC üretim şeması. (Dolas, 2022b)



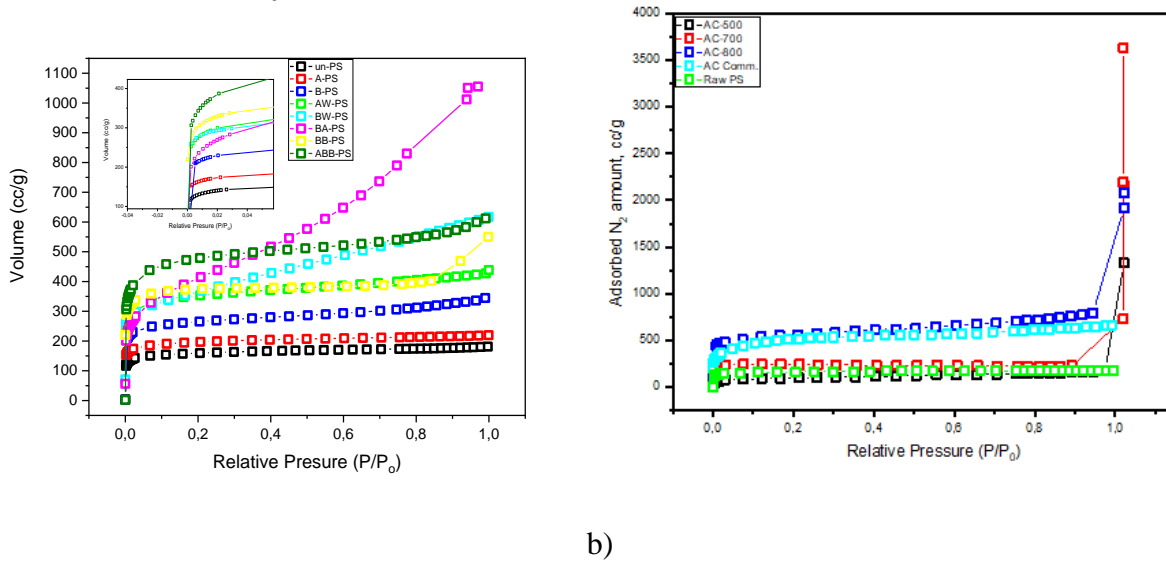
## Bulgular ve Tartışma

AC için yüksek yüzey alanı ve geniş gözenek boyutlarına ulaşmak için aktifleştirici maddenin türü, oranı, aktifleştirici ile etkileşim süresi, karbonizasyon sıcaklığı gibi süreci etkileyen birçok parametre vardır. Söz konusu parametrelerin incelendiği çalışmalara bakıldığında fıstık kabuğu örneğinde aktifleştirici olarak  $ZnCl_2$  kullanıldığında yüksek yüzey alanlarına ulaşıldığı görüldü. Bu yükseklik yapıdaki mikro gözenekliliğin artmasından dolayıdır. Bunun yanında  $NaCl$  kullanımı yapıdaki mikro gözenekliliğe daha fazla katkı sağladığı için daha yüksek yüzey alanlarına ulaşıldığı gözlenmiştir (Dolas ve ark., 2011) diğer taraftan, detaylı incelemek için asit baz, tuz ve bor içerikli materyallerle elde edilen AC ların yüzey alanı incelendi. Bu çalışmada yüzey alanına aktifleştirici maddenin etkisinin büyük olduğu görüldü. İncelemede kullanılan AC lar asit (%10 HCl) ile yıkama asitte bekletme, baz (%10 NaOH) ile yıkama bazda bekletme, asit ve baz karakterli bor türevi aktifleştiriciler (borik asit, boraks ve amonyum biborat) kullanıldı.(Dolas, 2022c ) Etiketleme ise tablo 1 de gösterildiği gibiydi.

**Tablo 1.** AC etiketleme.

Activation condition	Washing PW-raw material	Washing HCl	Washing NaOH	Waiting HCl	Waiting NaOH	Waiting Boric Acid	Waiting Borax	Waiting Amm. BB
Name	Un-PS	A-PS	B-PS	AW-PS	BW-PS	BA-PS	BB-PS	ABB-PS

Bu AC a ait izoterm Şekil 2 de verildi.



**Şekil 2.** a) Farklı aktifleştirici kullanılarak elde edilen AC ların izoterm grafikleri. (Dolas 2022c ), b) Farklı sıcaklıklarda elde edilen AC a ait izoterm.(Dolas, 2022b)

Şekil 2a daki izoterm AC nun adsorpsiyon kapasitesi ve yüzey alanı hakkında bilgi verir. Elbetteki ne kadar çok hacim gözlenirse o kadar yüksek yüzey alanı gösteriyor demektir. Ancak burada dikkat edilmesi gereken husus mikro gözenek miktarıdır. ABB-PS diğer tüm AC lardan daha yüksek mikro gözenek hacmi göstermiş olduğu için BET yüzey alanı da diğerlerinden yüksek elde edildi. Tablo 2 bu verileri kıyaslamalı olarak gösterdi.



**Tablo 2.** Farklı aktifleştirici için BET, Langmuir, mikro gözenek hacim ve yüzey alanı ve adsorpsiyon enerjisi verileri

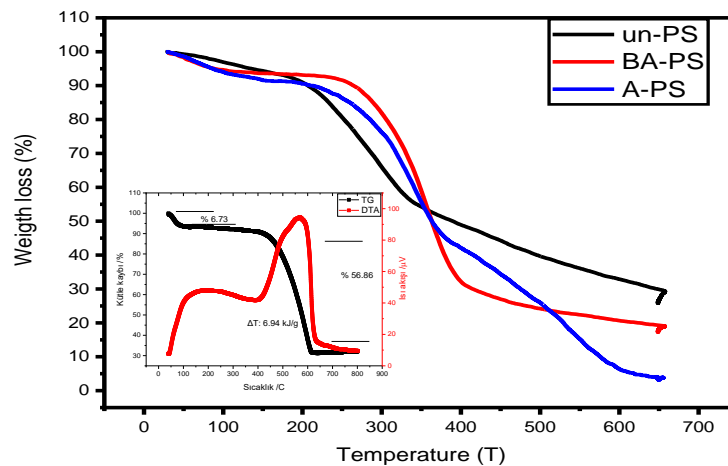
AC	Gözenek çapı, A <sup>0</sup>	Adsorpsiyon enerjisi, kJ/mol	DR Mikrogözenek hacmi, cc/g	DR Mikro gözenek yüzey alanı, m <sup>2</sup> /g	Yüzey alanı by BET, m <sup>2</sup> /g
Un-PS	14,357	9,055	0,426	1199,900	500,021
A-PS	6,212	20,928	0,293	825,048	620,036
AW-PS	7,099	18,313	0,520	1462,949	838,521
B-PS	19,290	6,736	1,269	3572,151	1117,291
BW-PS	10,965	11,856	0,639	1798,129	1302, 547
BA-PS	9,918	13,108	0,532	1495,734	1441
BB-PS	6,44	20,176	0,56	1571,18	1471
ABB-PS	18,932	6,867	2,085	5865,632	1518

Karbonizasyon sıcaklığı da yüzey alanına etki eden bir diğer önemli faktör olduğu rapor edildi. Bu çalışmada Fıstık kabukları AW-PS üzerinden yapılan sıcaklık incelemesinde ise sıcaklığın yükselmesi ile yüzey alanının arttığı anlaşıldı. Burada 500, 700 ve 800 oC olmak üzere 3 farklı sıcaklık çalışıldı. Elde edilen izotermlerden (Şekil 2b) alınan veriler tablo 3 de verildi.

**Tablo 3.** Farklı sıcaklık için BET, Langmuir, mikro gözenek hacim ve yüzey alanı ve adsorpsiyon enerjisi verileri. (Dolas, 2022b)

	BET, m <sup>2</sup> /g	Langmuir, m <sup>2</sup> /g	DR mikro gözenek hacmi, cc/g	DR mikro yüzey alanı, m <sup>2</sup> /g	Adsorp. Ener. kJ/mol
Un-PS	500,275	632,858	0,426	1199,900	9,055
Comm. AC	1648	2479,262	0,659	1849,312	14,976
AC-500	422,052	447,019	0,161	453,86	9,872
AC-700	1022,031	1051,394	0,454	1278,232	14,354
AC-800	2093,063	3939,573	1,053	2963,759	10,927

Tablo 3 de kullanılan aktifleştirici madde asittir. Sıcaklık yükseldikçe yapıdaki mikro gözenek oluşumuna pozitif katkı sağladığı rapor edildi (Dolas, 2022b). AC üretiminde sıcaklığın fazla kullanılması yapıdaki gözenekliliği fazla yıkabileceği ve yüzey alanını düşürebileceği olgusuyla TG-DTA ölçümleri alındı (Dolaş, 2022c). Burada organik bozunmanın hangi sıcaklık aralığında ve yüzde kaçlık bir kütlele bozunma vereceği hatta kullanılacak ısı hakkında bilgi edinilebildi (Şekil 3).



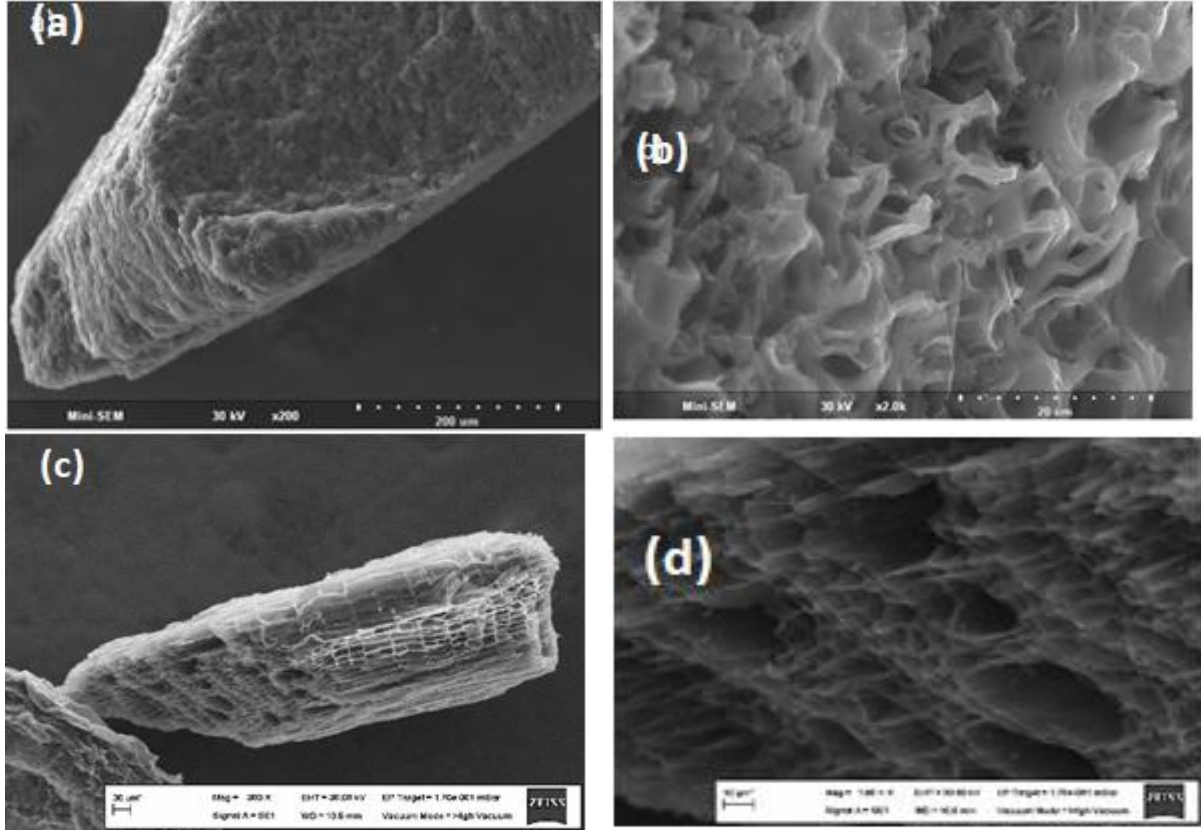
**Şekil 3.** TG grafikleri (T:30-650 oC; ısıtma hızı: 10 C dk-1, azot atmosferi). (Dolaş, 2022c)

TG-DTA grafiklerinden % 60 lık organik bozunmayı 200-3000oC aralığında görüldüğü ham maddenin asit ve borik asit kullanımıyla işlemede bu sıcaklık aralığının yüksek dereceye kaydığı ve organik bozunmanın ise % 85 ve 65 e yükseldiği rapor edildi.

**Table 4.** The mass losing and heat data of ACs. (Dolaş, 2022c)

Activating material	Mass losing /%	Heat /kJ/g
None	%60	1,92
HCl	%85	8,1
Borik asit	%65	1,7

Elde edilen AC ların morfolojik incelemesi ise SEM ile yapıldı ve elde edilen görüntüler(Şekil 5) ham madde ye bağlı gözenek şeklinde farklılık gösterebileceği kanısını doğurdu.



**Şekil 5.** a) ve b) ABB-PS ((Dolaş, 2022c)) ve c) ve d) Biber sapından ((Dolaş, 2023c) AC sem görüntüleri

Biber sapından ham materyal kullanılarak elde edilen AC yapısında daha nanorod yapılı gözenekler elde edileirken fıstık kabuğundan elde edilen AC lar daha farklı formda gözenekler elde edildiği rapor edildi.

## Sonuç

Sonuç olarak yüksek yüzey alan için AC üretiminde gözenek oluşumunu etkileyen her aşama önem arz etmektedir. Aktifleştirici ajanın türü ve miktarı, ham materyalle etkileşme süresi, karbonizasyon sıcaklığı ve süresi gibi faktörler elde edilen AC nun yüzey alanını ve gözenek hacminin gözenek çapına göre dağılımını etkilediğini gösterdi. Öyle ki, bazı karakterli aktifleştiriciler ham materyali tahriş ederek işlerken, asit karakterli aktifleştiricilerin gözeneklerin açılmasına yardım ettiği ve yüzey alanını artırdığı belirlendi. Mikro gözenek oluşumunun daha çok NaOH gibi bazlarla mezo ve makro gözeneklilik oluşumunun ise bor türevi maddelerle elde edildiği görüldü. AC özelliklerini etkileyen koşullar ve ne yönde etki ettiği bilinirse üretiminde amaca uygun yapılacağı bu sayede enerji, ham madde ve ekonomik anlamda fayda sağlanarak daha çok verim alınacağı önerilmektedir.

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## İKLİM DEĞİŞİKLİĞİ VE TARIMSAL KURAKLIĞIN SU KAYNAKLARI ÜZERİNE ETKİSİ

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### Özet

Yaşamın temel bileşeni olan su, iklimsel değişikliklerin gelecek yıllarda beklenen olumsuz etkilerinden dolayı, özellikle tarımsal amaçlı kullanımında büyük risk altındadır. Dünya genelinde nüfusun hızla artması, insanların gıdaya olan ihtiyacını da artırırken su kaynakları üzerindeki baskı daha fazla hissedilmektedir. Bölgesel iklim modelleri ile yapılan çalışmalar, gelecek yıllarda minimum ve maksimum sıcaklıklarda artış ve yağışlarda ise azalmaların yanısıra, çoğu iklim parametrelerinde değişkenliklerin olabileceğini öngörmektedir. Bu durum suyun tüm sektörlerde daha yoğun kullanılmasına ve yer altı su kaynaklarının daha hızlı tükenerek kirletilmesine neden olabilecektir. Bu anlamda su kaynakları potansiyelinin daha etkin bir şekilde kullanılması ve buna dayalı stratejilerin geliştirilmesi kaçınılmaz bir hal almaktadır. İklim değişikliği ve tarımsal kuraklığın hidrolojik çevrim üzerindeki olumsuz etkileri, su kaynaklarının potansiyeline ve tarımsal sulamaya yansımaktadır. Su kaynaklarının büyük çoğunluğunun tarımsal sulamada kullanıldığı ülkemizde, gelecekte ortalama sıcaklıklardaki artış ve tarımsal kuraklık etkileşimi, bitki su tüketimine de olumsuz etki edecek böylece suyun daha etkin kullanıldığı damla sulama gibi sulama yöntemleri önemini artıracaktır. Bu çalışmada gelecek yıllarda beklenen iklimsel değişikliklerin ve tarımsal kuraklığın, su kaynakları üzerine olası olumsuz etkileri değerlendirilmiş ve suyun daha etkin kullanılabilmesi için öneriler sunulmuştur.

**Anahtar Kelimeler:** İklim değişikliği, su kaynakları, sulama, tarımsal kuraklık

## THE EFFECTS OF CLIMATE CHANGE AND AGRICULTURAL DROUGHT ON WATER RESOURCES

### **Abstract**

Water, which is the main element of life, is at great risk especially in its use for agricultural purposes due to the expected adverse effects of climatic changes in the future. Due to the heavy increase of population in the world, people's requirements for food increases and the pressure on water resources is felt more. Studies with regional climate models predict that there may be changes in most climate parameters as well as increases in minimum and maximum temperatures and decreases in precipitation in the future years. This may cause water to be used more intensively in all sectors and cause underground water resources to be depleted and polluted more quickly. In this sense, it becomes inevitable to use water resources potential more effectively and develop strategies. Adverse effects of climate change and agricultural drought on the hydrological cycle are reflected in the potential of water resources and agricultural irrigation. In our country, where the majority of water resources are used for agricultural irrigation, the increase in average temperatures and agricultural drought interaction in the future will also adversely affect crop evapotranspiration so irrigation methods such as drip irrigation in which water is used more effectively will increase their importance. In this study, expected the possible adverse effects of climatic changes and agricultural drought in the future on water resources were evaluated and suggestions were presented to use water more effectively.

**Keywords:** Climate change, water resources, irrigation, agricultural drought

## Giriş

İklim değişikliği IPCC tarafından, iklim sisteminde karşılaştırılabilir uzun zaman periyodunda yavaş olarak meydana gelen değişiklikler şeklinde tanımlanmaktadır. Fakat Birleşmiş Milletler İklim Değişikliği Çerçeve Sözleşmesi'nde, antropojenik yani insan etkileri sonucu dolaylı veya doğrudan olan etkiler sonucu olarak da tanımlanmaktadır. Günümüzde etkisini fazlaca ve her geçen gün artarak hissettiğimiz iklim değişikliği, özellikle hızlı nüfus artışı, doğal kaynakların hızla tüketilmesi ve kirletilmesi gibi sebeplerle gelecekte en büyük sorun olması beklenmektedir ayrıca dünya nüfusunun artışına paralel olarak gıda ve su gereksinimi de artmaktadır. Diğer taraftan toprak ve kullanılabilir su kaynaklarının sınırlı olduğu bilinen bir gerçektir. Artan nüfusa bağlı olarak gıda güvenliğini sağlamak amacıyla tarımsal üretimin sürdürülebilir bir şekilde artırılması ve mevcut sınırlı su kaynaklarının en verimli şekilde kullanılması gerekmektedir.

Araştırmalar, yeryüzündeki binlerce noktada ölçülen yüzey ve atmosferik sıcaklık değerlerine ve uydu verilerine dayanarak 1880 yılından bu yana küresel ortalama sıcaklığın 0.9°C arttığını belirlemiştir. Atmosferdeki CO<sub>2</sub> oranı sanayi devrimi öncesi döneme kıyasla %47'lik bir artış göstererek 278 ppm'den 410 ppm'e ulaşmıştır (Çapar, 2019). En yüksek CO<sub>2</sub> emisyonuna neden olan yakıt türleri sırasıyla kömür, petrol ve doğal gazdır. IPCC'nin güncel raporlarına göre küresel ısınma seviyesi, mevcut hızda artmaya devam ettiği takdirde 2030-2052 yılları arasında küresel ortalama sıcaklık artışının 1.5°C'ye ulaşacaktır (IPCC, 2018). Dünya Bankası ise CO<sub>2</sub> emisyonlarının şu andaki artış hızıyla devam etmesi durumunda 2060 yılında ortalama sıcaklıklardaki artışın 4°C'yi bulacağı uyarısını yapmaktadır (Çapar, 2019).

NASA'nın GRACE uydu verilerine göre Antarktika (üst bölge) ve Grönland (alt) buz tabakalarının kütlesi 2002 yılından bu yana azalmakta olup, 2009 yılından sonra kütle kaybı hızlanmıştır. Buz kütlesi kaybının değişim oranı Antarktika'da 139 Gigaton/yıl, Grönland'da ise 267 Gigaton/yıl'dır. (NASA, 2024). Deniz seviyesindeki değişim ise 1993 yılından bu yana en son 2024 Temmuz ayında yapılan ölçüme göre 101.9 mm'dir (NASA, 2024). Deniz seviyesi yükselmesinin iki nedeni; buz kütlelerinin ve buzulların erimesi ile denize ilave su eklenmesi ve sıcaklığın artmasına bağlı olarak deniz suyunun genişmesidir.

## İklim Değişikliği ve Su Kaynakları

İklim değişikliği ve su çok yakından ilişkilidir. Bilim insanlarına göre iklim değişikliğinin en önemli etkileri su döngüsünün bozulması ve su kalitesinin değişmesidir. Dünyadaki su kaynaklarının su döngüsü ile birlikte sabit kaldığı söylenebilir ancak iklim değişikliği nedeniyle su kaynaklarının dünyada bulunduğu yer ve zaman değiştiği için birçok yerde miktar ve kalite açılarından su kaynaklarının yönetimi güçleşecektir.

İklim değişikliğinin etkileri havza bazında ele alındığında aşağıdaki etkiler beklenmektedir (Demuth, 2017).

**Taşkın;** ekstrem hava olayları nedeniyle kış aylarında nehir akışlarının, yüzey akışlarının ve taşkınların artması beklenmektedir.

**Kuraklık;** yüksek sıcaklık ve yağışın azalması nedeniyle kuraklık beklenmektedir.

**Hidroelektrik güç;** akıştaki değişiklikler temiz güç üretimini azaltacaktır.

**Tarım;** sulama suyu ihtiyacı artacaktır.

**Kar kütlesi;** %25 oranında azalma su teminini değiştirecektir.

**Su kullanımı;** tarımsal, kentsel ve çevresel su talebi artacaktır.

**Su kalitesi;** deniz seviyesi yükselmesi nedeniyle tuzlu su girişi deltaları ve kıyı akiferleri etkileyecektir.

Nüfusun su kaynakları üzerindeki baskısını ortaya koyabilmek için çeşitli indeksler kullanılmaktadır. Bu amaçla için yaygın olarak kullanılan Falkenmark Su Stresi İndeksi (Falkenmark, 1983) bir yılda kişi başına düşen su miktarıdır. Bu indekse göre Türkiye'nin 2023 yılı nüfusu 85.372.377 olup, kişi başına düşen yıllık su miktarı 1.311 m<sup>3</sup>/kişi/yıldır. Falkenmark

Su Stresi İndeksine göre Türkiye su stresi (su sıkıntısı) çeken bir ülke konumundadır. Dünya nüfusunun 1950’de 2.5 milyardan bugün 6.5 milyara gelmesiyle, sulanan alan iki ve çekilen su miktarı üç katına çıkmıştır. Mevcut üretim deseninde bir değişiklik olmazsa tarımda kullanılan su 2050’de %70-90 artacaktır. Tarımda kullanılan su miktarı bugün 7130 km<sup>3</sup> olup, 2050’de yaklaşık iki katına 12000-13500 km<sup>3</sup>’e çıkacağı öngörülmektedir (Çakmak ve Gökalp, 2011).

### **İklim Değişikliği ve Kuraklık**

Kuraklık genel olarak, yağışın normalin altına düşmesi olarak tanımlanır. Bununla beraber, bu eksikliğin zaman ve süresine göre kuraklıkla ilgili çeşitli tanımlar ortaya çıkmıştır. Kuraklığın başlangıç ve bitişinin belirsiz oluşu, kümülatif olarak artması, aynı anda birden fazla kaynağa etkisi ve ekonomik boyutunun yüksek olması onu diğer doğal afetlerden ayıran en önemli özelliklerdir. Herhangi bir bölgede kuraklık, frekans, şiddet, süre ve etki alanı gibi ifadelerle tanımlanır (Willeke ve ark. 1994).

Çok yavaş gelişerek belirli bir süreçte oluşan bu doğal olayın süresi uzadıkça sonuçları da çok tehlikeli boyutlara ulaşmaktadır. Esas olarak yağış yetersizliğine bağlı olarak su azlığıyla ortaya çıkan kuraklık, üretimde azalmaya, yetersiz beslenmeye, sonuçta kıtlık, açlık ve ölümlere neden olabildiğinden çok önemli sosyal ve ekonomik sorunların yaşanmasına neden olmaktadır ancak bütün tanımlarda, iklim dalgalanmalarına bağlı yağış yetersizliği bu olayın temel nedeni olarak gösterilmektedir. Bunun için “genellikle yağış yetersizliği nedeniyle, yeraltı ve yerüstü doğal su varlığının belli bir süreçte, bölgesel boyutta ve önemli ölçüde ortalama değerlerin altına düşmesiyle oluşan su açığı” şeklindeki kuraklık tanımı, bugün için en yaygın ve en geçerli olanıdır (Kömüşçü ve ark. 2002).

### **Kuraklık Çeşitleri**

Bugüne kadar kuraklık; meteorolojik, tarımsal, hidrolojik, coğrafi hatta sosyal ve ekonomik yönden farklı biçimlerde tanımlanmış ve farklı isimler altında değerlendirilmiştir. Genel olarak aşağıda özetlenen üç esas kuraklık türünden söz edilebilir.

**Tarımsal kuraklık;** bitkinin kök bölgesinde, büyüüp gelişmesi için yeterli nem bulunmaması durumu olarak ifade edilir. Belirli bir bitkinin büyüme periyodu boyunca, suya ihtiyaç duyduğu belirli bir kritik dönemde yeterli toprak nemi olmadığı zaman tarımsal kuraklık meydana gelir. Tarımsal kuraklık, meteorolojik kuraklıktan sonra ve hidrolojik kuraklıktan önce ortaya çıkan tipik bir durumdur. Tarımsal kuraklık, toprağın derinlikleri doymuş halde olsa bile ürün verimlerini ciddi oranda düşürebilir. Yüksek sıcaklıklar, düşük nispi nem ve kurutucu rüzgarlar yağış azlığının etkilerinin katlanmasına sebep olur.

**Hidrolojik kuraklık;** uzun süre devam eden yağış eksikliği neticesinde ortaya çıkan yeryüzü ve yeraltı sularındaki azalma ve eksiklikleri ifade eder. Nehir akım ölçümleri ve göl, rezervuar, yeraltı su seviyesi ölçümleri ile takip edilebilir. Yağmur eksikliği ile akarsu, dere ve rezervuarlardaki su eksikliği arasında bir zaman aralığı olduğundan dolayı hidrolojik ölçümler kuraklığın ilk göstergelerinden değildir.

**Meteorolojik kuraklık;** Belirli bir zaman periyoduna ait meteorolojik normallerden (genellikle bu en az 30 yıldır) meydana gelen sapma olarak tanımlanır. Bu tanımlamalar genellikle bölgeseldir ve tahminen bölgesel klimatolojinin tam olarak anlaşılması temeline oturur. Normal olarak meteorolojik ölçümler kuraklığı ifade etmede başta gelen göstergelerdir. Kuraklık periyotları genellikle, belirlenen eşik değerlerinin altında yağışa sahip olan günlerin sayısı olarak tanımlanmıştır.

Kuraklık yavaş gelişen tehlikeli bir meteorolojik olay olmasına rağmen, insanlara ve çevreye en fazla zarar veren doğal afetlerin başında gelmektedir. Çünkü kuraklığın bir yerde ne zaman



başladığı ve ne zaman biteceği tam olarak bilinmemektedir. İlk aşamada daha önce alınan bazı önlemlerle ortaya çıkan olumsuzluklar atlatılabilecek gibi görünse de, kuraklığın uzaması hâlinde bu önlemler yetersiz kalmaktadır.

Dünyada gittikçe artan tatlı su açığı nedeniyle, zaten oldukça sınırlı olan mevcut tatlı su varlığı ihtiyacı karşılamaktan çok uzak kalmakta, üretimde düşme, kıtlık ve açlık yaşanmaktadır. Buna bağlı olarak hem ulusal hem de uluslararası çok büyük sosyal ve ekonomik sorunlar doğmaktadır. Bunun sonucunda büyük can ve mal kayıplarının olduğu afet boyutunda olaylar yaşanmaktadır.

Bir yörede, bir bölgede veya bir ülkede görülen kuraklık sadece orada yaşayanlar için değil, gelişmiş ve gelişmekte olan bütün ülkeler, dolayısıyla dünyadaki bütün insanlar için önemli sorunlar doğuran bir tehlikedir. Çünkü bir yerde, iklim dalgalanmalarına bağlı olarak görülen kuraklık, mutlaka diğer ülkelerde de bir iklim anomalisinin yaşanmasına neden olmaktadır (Willeke ve ark. 1994).

Yağış eksikliğinden kaynaklanan kuraklıklar tarım alanları üzerinde önemli düzeyde verim kayıplarına ve ciddi ekonomik gelir düşüşlerine neden olabilir. Kuru havadan kaynaklanan nem azlığı bitki gelişmesi açısından zararlı canlıların gelişimi için elverişli bir ortam oluşturur ve zararlıların artmasına, bitki hastalıklarının çoğalmasına neden olur. Bu zararlı canlılar ve hastalıklar hem ürün miktarında önemli düzeyde kayıplara hem de ürün kalitesinde ciddi düşüşlere neden olur.

Tarımsal kuraklıkta toprakta bitkinin kök bölgesi içinde, bitkinin yararlanabileceği suyun miktarı esas alınmaktadır. Bitkilerin su ihtiyacını karşılayacak miktardaki suyun toprakta bulunmadığı süreler tarımsal açıdan kurak olarak belirtilmektedir. Yağış, bitki su tüketimi ve toprak özellikleri tarımsal kuraklık için ana faktörler olarak sayılabilir. Hidrolojik kuraklık ise, uzun süreli yağış azlığından dolayı yeryüzü ve yer altı su kaynaklarında meydana gelen azalmadır.

Sulama, doğal kaynaklardan sağlanan suyun, yılın yalnızca bir döneminde veya tümünde yeterli olmadığı yörelerde gerekli bir tarımsal uygulamadır. Bitki, suyu solar enerjiye ve büyüme durumuna bağlı olarak mevsim boyunca değişik miktarlarda tüketir. 2022 yılı itibarıyla Türkiye’de yıllık su tüketimi 57 milyar m<sup>3</sup> ve bu miktarın %77’si sulama, %23’ü içme-kullanma suyu ile endüstri amaçlı kullanılmaktadır ayrıca ülkemizde ekonomik olarak sulamaya açılan alan toplam 8.5 milyon hektar olup bunun %81.9’u sulanabilir alan ve bu alanın %54.9’u sulanmaktadır (DSİ, 2023).

İklim değişikliği nedeniyle sıcaklıkların ortalama 2.5-3.5°C artacağı; yağış miktarının ise %25-35 oranında azalacağı öngörülmektedir (ICCAP, 2007). Diğer taraftan, küresel ısınma ve iklim değişikliğinin, sulamada kullanılan suyu %40 artıracığı saptanmıştır. Su kaynaklarının (112 km<sup>3</sup>/yıl), sulanabilir alanların tümünün sulamaya açılması durumunda, yeterli olmayacağı anlaşılmıştır. Nüfus artışı, sanayideki gelişme, çevre kirliliği ve iklim değişikliği gibi faktörlerin su kaynakları üzerindeki olumsuz etkisi dikkate alındığında, dünyada gelecekte çok önemli su sıkıntılarının beklediği söylenebilir. Bu açıdan, suyun etkin kullanımı, yeni su kaynaklarının bulunması sorunun çözümü için büyük önem taşımaktadır. Suyun etkin kullanılması, sulama ile ilgili alışkanlıkların değiştirilmesine, yeni sulama yöntemlerinin kullanılmasına bağlıdır. Yeni su kaynakları ise geleneksel olmayan suları, yani taban suyunu, drenaj kanal sularını ve seyreltilmiş veya damıtılmış deniz suyunu kapsamaktadır (Kanber ve ark. 2005; Kanber ve ark. 2008).

Su kaynakları üzerindeki baskıların nasıl azaltılacağı, mevcut büyüme hızı, değişen su tüketim alışkanlıkları ve artan su talebi karşısında su kaynaklarının yıllar sonrasına tahrip edilmeden nasıl aktarılacağı ve iklim değişikliğinin su kaynakları üzerindeki olumsuz etkilerine nasıl uyum sağlanacağı yüzyılımızın en önemli insanlık sorunları arasındadır.

Ülkemiz açısından önemli olan ana sektörler; içme ve kullanma suyu, tarım ve sanayidir. Bu sektörlerin iklim değişikliğine karşı alabilecekleri başlıca önlemler kapsamında

gerçekleştirilmesi muhtemel uyum faaliyetleri; içme ve kullanma suyu için kayıp/kaçak oranlarının azaltılması, yağmur suyu hasadı, duş ve sifonlarda tasarruflu ekipmanların kullanılması ve evsel atıksuların yeniden kullanılması sayılabilir.

Tarım sektöründe; iklim değişikliğine uygun ürün deseni seçilmesi, yüzeysel sulamaların olabildiğince azaltılması ve damla sulama gibi verimli sulama tekniklerinin yaygınlaştırılması, kısıntılı sulama tekniğinin geliştirilmesi, organik tarım ve iyi tarım uygulaması olarak sıralanabilir. Bu anlamda basınçlı sulama yönteminin daha fazla desteklenmesi ve olası projelendirme hatalarının giderilmesi önem arz etmektedir. Tarımda sulama verimliliği ve çiftçinin bilinçlendirilmesi de önem taşımaktadır.

### **Sonuç**

Gelecek yıllarda yaşanması beklenen su sıkıntısı karşısında, tüm sektörlerdeki su talebinin karşılanabilmesi için ciddi önlemler alınması ve akılcı planlar yapılması gerekmektedir. İklim değişikliği ile uyumlu su yönetiminin geliştirilmesi konusunda yapılması gereken başlıca çalışmalar arasında; toprak ve su kaynakları ile ilgili kamu yönetiminin güçlendirilmesi, evsel, endüstriyel ve tarımsal su kullanımında verimli tekniklerin yaygınlaştırılması, suyun değerli ve sınırlı bir doğal kaynak olduğu bilincinin yerleştirilmesi için bir eğitim seferberliği başlatılması sayılabilir. Bunun yanında iklim modellerinin daha küçük ölçekte bölgesel olarak irdelenmesi ve adaptasyon stratejileri geliştirilmelidir. Ayrıca, su kaynakları konusunda AR-GE çalışmaları yapan üniversiteler ile kamu kuruluşları ve özel sektör arasında koordinasyon sağlanması ve sivil toplum kuruluşlarının güçlendirilerek iklim değişikliğinin gelecek yıllarda olası etkilerinin benimsenmesi gerekmektedir.

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## SU STRESINE TOLERANSLI NOHUT (*Cicer arietinum* L.) GENOTİPLERİNİN SAPTANMASI

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### **Özet**

Bu araştırma Siirt iklim koşullarında damla sulama yöntemiyle kısıntılı sulama uygulamalarının nohut bitkisinde verim ve verim parametreleri ile bitki su stres indeksi üzerine etkilerini belirlemek amacıyla bir tarla çalışması olarak yapılmıştır. Araştırmada sulama konuları; sulama suyu ihtiyacının tam olarak karşılandığı (%100) (I100 ) kontrol konusu ve tam sulamamadan %70 (I30), %30 (I70) oranında kısıntı yapılan üç sulama konusundan oluşturulmuştur. Yapılan istatistik analiz sonucunda verim ve verim parametreleri arasında istatistiksel olarak önemli düzeyde ilişkiler saptanmıştır. Sulama konularının verim ve verim bileşenleri üzerine etkisi %1 düzeyinde önemli bulunmuştur. Uygulanan su kısıntısına ve iklim şartlarına bağlı olarak, nohut bitkisinin bitki su tüketimi, bitki su stres indeksi, klorofil ve verim değerleri önemli ölçüde etkilenmiştir. Vejetasyon süresi boyunca en yüksek CWSI (Bitki Su Stres indeksi) değeri I35 sulama konusunda 0.70 ve en düşük CWSI değeri tam sulanan I100 sulama konusunda 0.18 olarak belirlenmiştir. Sezgin genotipinin verim, CC değeri genel ortalamasının üzerinde ve CWSI değeri düşüktür. Dolayısıyla Sezgin genotipinin su stresine toleranslı olduğu ve abiotik stres koşullarına dayanıklılık çalışmalarında değerlendirilebilir özelliklere sahip olduğu belirlenmiştir. Sonuç olarak CWSI ve CC değerlerinin su stresine toleranslı çeşit geliştirme çalışmalarında stres tarama parametresi (tolerans göstergesi) olarak kullanılabilirliği söylenebilir.

**Anahtar Kelimeler:** Nohut, Bitki su stress indeksi, Klorofil içeriği

## DETERMINATION OF WATER STRESS TOLERANT CHICKPEA (*Cicer arietinum* L.) GENOTYPES

### Abstract

This research was conducted as a field study to determine the effects of limited irrigation applications with drip irrigation method on yield and yield parameters and plant water stress index of chickpea in Siirt climate conditions. Irrigation issues in the research; It is composed of the control subject, in which the irrigation water need is fully met (100%) (I100), and three irrigation subjects, in which a reduction of 65% (I35) and 30% (I70) from full irrigation are made. As a result of the statistical analysis, statistically significant relationships were determined between yield and yield parameters. The effect of irrigation issues on yield and yield components was found to be significant at the 1% level. Depending on the applied water shortage and climatic conditions, plant water consumption, plant water stress index, chlorophyll and yield values of chickpea plants were significantly affected. During the vegetation period, the highest CWSI (Plant Water Stress Index) value was determined as 0.70 in I35 irrigation and the lowest CWSI value was 0.18 in fully irrigated I100 irrigation. The yield and CC values of Sezgin genotype are above the general average and the CWSI value is low. Therefore, it was determined that the Sezgin genotype was tolerant to water stress and had properties that could be evaluated in resistance studies to abiotic stress conditions. As a result, it can be said that CWSI and CC values can be used as stress screening parameters (tolerance indicators) in studies on developing varieties tolerant to water stress.

**Keyword:** Chickpea, Crop water stress index, Chlorophyll content

## 1. Giriş

Artan dünya nüfusuyla birlikte son yıllarda kısıtlı olan su kaynaklarına talep her geçen gün artmakta ve tarımda kullanılan su miktarı azalmaktadır (Aküzüm ve ark. 2003). Mevcut koşullarda kullanılabilir su ve toprak kaynaklarının kısıtlı olması, tarımda birim su ve birim alandan daha fazla ürün alma ihtiyacını ortaya çıkarmıştır (Çakmak ve ark., 2013). Ancak günümüzde agronomist ve bitki ıslahçıları bitkilerin yaşayabilmelerinden daha çok verimine odaklanmıştır. Sonuçta verimlilik esas alınmış, yüksek verim veren çeşitler öne çıkmıştır. Öte yandan son yıllarda küresel ısınmanın etkisiyle abiyotik stres faktörlerinin tarımsal üretimi olumsuz yönde etkilemesi, araştırmacıları iklim değişikliğinin zararlı etkilerine karşı yeni önlemler almaya zorlamıştır. Abiyotik stres etmenlerinin başında ise su stresi, yetersiz beslenme, tuzluluk, düşük ve yüksek sıcaklık gelmektedir (Kozłowski ve Pallardy, 1997). Bitki etkili kök derinliği boyunca (0-90 cm) toprakta bulunan mevcut su miktarının bitki gelişimini yavaşlatması veya olumsuz yönde etkilemesi su stresi olarak tanımlanabilir. Bitkilerde, su stresinin ilk belirtisi, stoma düzeyinde gerçekleşmekte ve stomalar transpirasyonla daha ileri bir su kaybını önlemek amacıyla kapanmaktadır (Flexas ve Medrano, 2002). Stomaların kapanması, kloroplast seviyesindeki CO<sub>2</sub> alınabilirliğini de azaltmakta ve net fotosentezin su stresinden olumsuz yönde etkilenmesi kaçınılmaz hale gelmektedir (Cornic, 2000). Bitkilerin içsel su durumunu; ne toprak su içeriğinin ne de atmosferik istemin, bitki su stres indeksi (CWSI) kadar doğru olarak belirleyemeyeceği bildirilmiştir (Reginato and Howe, 1985; Gençoğlan and Yazar, 1999). Bitkiler terledikçe yaprak sıcaklığı azalmakta ve hava sıcaklığının altına düşmektedir. Taç-hava sıcaklığı farkından ve psikrometrik ölçümlerden yararlanarak bitki su stres indeksi (CWSI) belirlenmektedir (Jackson, 1982; Gençoğlan and Yazar, 1999). Reginato (1983), günlük CWSI değerlerinin atmosferik isteme ve toprak su içeriğine bağlı olarak değiştiğini saptamıştır. Genel olarak sulamalardan önce toprak neminin azalması bitki taç sıcaklığı değerlerini artırıcı yönde etkide bulunmakta ve toprakta azalan nem ile birlikte bitki su stres indeksi (CWSI) değerleri de yüksek çıkmaktadır (Kırnak and Gençoğlan, 2001). Bitki su stres indeksi (CWSI) düşük, klorofil içeriği yüksek olan hat veya çeşitlerin daha yüksek verim, CWSI'yi yüksek klorofil içeriği düşük olanların ise daha düşük verim verdiği önceki çalışmalarda bildirilmiştir (Ucak et al. 2016). Bilge et al. (2008) Çukurova koşullarında ekmeklik ve makarnalık buğdaylarda yaprak taç sıcaklığı (bitki örtü sıcaklığı) değerleri ile verim arasında önemli korelasyon belirlemişler ve anılan parametrenin buğday ıslahında seleksiyon kriteri olarak kullanılabileceğini bildirmişlerdir. Kuraklık veya su stresini belirlemede kullanılacak parametrelerin kolay, hızlı, ucuz ve tekrarlanabilir olması son derece önem arz etmektedir. Çamoğlu et al. (2011) su stresinin anlık olarak belirlenmesinde, yaprak su içeriği ve klorofil değerlerinin kullanılabileceği bildirilmiştir. Öte yandan şeker mısır hatlarının su stresine dayanımını belirlemek amacıyla yapılan bir çalışmada toprak nemi ile klorofil içeriği arasında (r:0.58\*\*) istatistiki olarak (p<0.01) önemli pozitif yönde bir korelasyon bulunurken, CWSI ve verim arasında negatif yönlü yine önemli korelasyon saptanmıştır (Ucak et al., 2016).

Yapılan literatur çalışmalarında buğday bitkilerinde su stresine toleranslı genotiplerin tespit edilmesine yönelik çalışmalar yapılmasına karşın, nohut bitkisinin su stresine karşı tepkisini belirlemeye yönelik yeterli bilgiye ulaşılamamıştır. Ayrıca nohut bitkisinde su stresine karşı yapılacak agronomi çalışmalarında genotiplerin potansiyel durumlarını birbirinden ayırt etmek için etkili seleksiyon kriterlerinin tam olarak bilinmemesi, agronomi veya ıslah çalışmalarını kısıtlayan en önemli faktörlerden biri olduğu söylenebilir. Dolayısıyla bu çalışma 2024 yılında doğal tarla koşullarında, su stresli (WS:I<sub>70</sub>), aşırı su stresli (EWS:I<sub>35</sub>) ve su stressiz (SF:I<sub>100</sub>) koşullarda yetiştirilen, 3 adet nohut genotipinin (Caner, Sezgin, Onur) verim, bitki su stres indeksi ve klorofil içeriği değerlerinden faydalanarak su stresine karşı toleranslarını belirlemek amacıyla yapılmıştır. Ayrıca araştırmanın bir diğer amacında elde edilen bulguların, nohutta yapılacak su stresine toleranslılık çalışmalarına bir taban oluşturmasıdır. Bu çalışmanın doğal

tarla koşullarında yapılmasının sebebi; özellikle sera veya büyütme odaları gibi kontrollü alanlarda yapılan çalışmaların sonuçlarının pratiğe aktarılmasında bazı kaygıların bulunmasıdır. Araştırmanın yazlık ürün koşullarında yapılmasının sebebi ise doğal yağışların olası olumsuz etkilerini ötelemek amacıyla.

## 2. 2. Materyal ve Yöntem

Denemede bitki materyalini Onur, Sezgin ve Caner nohut çeşitleri oluşturmuştur. Deneme, açık tarla koşullarında 2024 yılında Siirt Üniversitesi Ziraat Fakültesi deneme sahasında yürütülmüştür. Deneme alanının denizden ortalama yüksekliği 894 m olup, 37° 58' N enlemi ve 41° 50' E boylamlarında yer almaktadır.

Siirt ilinde kara iklimi hüküm sürmekte olup, yazlar sıcak ve kurak, kışlar soğuk ve yağışlı geçmektedir. Yıllık yağış ortalaması 757 mm, sıcaklık ortalaması ise 16.1 °C 'dir. Ancak yağış yıl boyunca düzenli bir dağılım göstermemekte ve ayçiçeği bitkisinin yetiştirme sezonu boyunca ise hemen hiç yağış düşmemektedir. Siirt lokasyonu deneme arazisi toprağının elektriksel iletkenliği düşük olup tuzluluk sorunu bulunmamaktadır, kireç oranının bitki yetiştiriciliği açısından sorun oluşturmadığı, fosfor içeriği düşük, potasyum içeriğinin yüksek ve organik madde oranının orta derecede bulunduğu killi bünyeli toprak yapısında olup, tarla kapasitesi (TK) derinlik cinsinden 397 mm, solma noktası (SN) 277 mm, hacim ağırlığı 1.43 gr cm<sup>-3</sup> olarak hesaplanmıştır (Tuzuner, 1990).

## 2.2 Yöntem

Deneme Siirt Üniversitesi Ziraat Fakültesi deneme arazisinde yazlık nohut ekim olarak yağmurun olası olumsuz etkilerini ötelemek amacıyla 28 Şubat tarihinde kurulmuştur. Denemeler tesadüf bloklarında bölünmüş parsel deneme desenine göre üç tekerrürlü olacak şekilde kurulmuştur. Çalışmada 3 sulanma konusu belirlenmiştir.

Bunlar I100, I70, I35 olmaktadır.

Çalışmada 45 kg da<sup>-1</sup> 20-20-0 kompoze gübre kullanılmıştır. Vejetasyon süresi boyunca, 4 sulama yapılmıştır. Sulama aralığı elverişli nemin %50'ye düştüğü 0-90 cm derinliğindeki toprak nem düzeyi olarak seçilmiştir. Deneme parsellerinin sulanması, damla sulama yöntemi ile yapılmıştır ve sulama suyu sayaçlardan geçirilerek uygulanmıştır. Sulama suyunun kalitesi C2S1 olarak saptanmıştır. Denemede kullanılan sulama suyu nohut bitkisinin sulanması açısından bir sorun oluşturmamaktadır. Hasat, fizyolojik olumun tamamlandığı danedeki nem %10'a düştüğünde, her parsel kenarındaki ikişer sıra kenar tesiri olarak işlem dışı bırakılıp, orta iki sıradan el ile yapılmıştır. Deneme süresince, gerekli bakım işlemleri ve kültürel uygulamalar standart yöntemlere göre yapılmıştır. Elde edilen verilerin değerlendirilmesinde, JUMP istatistik bilgisayar paket programı kullanılarak, varyans analizi ve F-kontrolü yapılmıştır. Ortalamalar LSD-Testi yapılarak karşılaştırılmıştır (Der, ve Everitt, 2002).

### 2.2.1. Bitki su stresi indeksi (CWSI) ve klorofil içeriği

Bitki su stresi indeksi (CWSI) araştırmacıların önerdiği ampirik yöntemle belirlenmiştir (Erdem ve Delibaş, 2003). Anılan yöntemle göre CWSI şu eşitlikle tanımlanmıştır (Idso ve ark, 1982; Reginato, 1983 ).

$$CWSI= [(Tc-Ta)- LL] / UL- LL \quad (1)$$

Eşitlikte; Bitki Su Stresi İndeksi (CWSI), Tc, taç sıcaklığı (°C); Ta, hava sıcaklığı (°C); LL, bitkide su stresinin olmadığı alt sınır (bitkilerin potansiyel hızda transpirasyon yaptığı sınır değeri); UL, bitkilerin tamamen stres altında olduğu üst sınırı (bitkinin transpirasyon yapmadığı varsayılan sınır değeri) göstermektedir.

Söz konusu deneme konuları için her sulama konusunda meydana gelen bitki su tüketimi 90 cm toprak derinliği göz önüne alınarak su dengesi esasına göre hesaplanmıştır. Bu amaçla söz konusu periyodun başlangıcındaki toprak nemi miktarına o periyot içerisinde varsa uygulanan

sulama suyu miktarı ve etkili yağış değerleri eklenmiş, toplamdan periyot sonundaki toprak nemi değeri çıkarılmıştır (Browne, 1977; Jensen va rk., 1990). Sulama suyu kullanım etkinliği ve sulama suyu etkinliğinin belirlenmesinde ise verim değerleri uygulanan sulama suyu ve bitki su tüketimine bölünerek bulunmuştur.

### 3. Sonuç ve Tartışma

#### 3.1. Bazı verim parametreleri

Araştırmanın yapılan varyans analizi sonuçlarına göre verim, bitki su stress indeksi (CWSI), bitki boyu, çiçeklenme gün sayısı, fizyolojik olum ve çiçeklenme gün sayısı bakımından genotipler arasındaki farklılıklar istatistiki olarak ( $p < 0.01$ ) önemli bulunmuş ve LSD testine (gruplama) tabi tutulmuştur. Uygulanan sulama konularına ilişkin nohut çeşitlerinde belirlenen bazı verim parametrelerine ilişkin ortalama değerleri (LSD) Tablo 1’de verilmiştir.

**Tablo 1.** Uygulanan sulama konularına ilişkin nohut çeşitlerinde belirlenen bazı verim parametreleri

Uygulamalar	Verim (kg da <sup>-1</sup> )**	CWSI**	Klorofil içeriği (spad)**	Sulama (mm)	ETa (mm)	Çiçeklenme gün sayısı (Gün)**	Fizyolojik olum (Gün)**	Bitki boyu (cm)
Sulama konusu								
I <sub>100</sub>	259 a	0.21 c	40.00 a	226	354			
I <sub>70</sub>	232 b	0.41 b	32.00 b	149	293			
I <sub>35</sub>	223 b	0.61 a	32.00 b	82	164			
LSD (0.05)	12.00	0.016	0.39					
Çeşit								
Sezgin	252 a	0.35 c	36.00 a	226	354	111	174	62
Caner	239 b	0.41 b	33.00 b	226	354	110	176	57
Onur	222 c	0.47 a	36.00 a	226	354	106	176	54
LSD (0.05)	10.00	0.034	0.69					
Çeşit x Sulama konusu interaksyonu								
I <sub>100</sub> × Sezgin	280 a	0.18 ı	43.00 a	226	354			
I <sub>100</sub> × Caner	262 ab	0.21 h	42.00 b	226	354			
I <sub>100</sub> × Onur	247 bc	0.25 g	41.00b	226	354			
I <sub>70</sub> × Sezgin	236 cd	0.33 f	39.00 c	149	293			
I <sub>70</sub> × Caner	232 cde	0.44 e	34.00 d	149	293			
I <sub>70</sub> × Onur	230 cde	0.47 d		149	293			
I <sub>35</sub> × Sezgin	225 de	0.54 c	33.00 d	82	164			
I <sub>35</sub> × Caner	217 de	0.60 b	32.00 e	82	164			
I <sub>35</sub> × Onur	214 e	0.70 a	32.00 e	82	164			
LSD (0.05)	21.00	0.031	0.57					

(\*) Aynı harfle gösterilen ortalamalar arasındaki fark önemli değildir. LSD sınıflaması Prop \*\*: %1 düzey. \* $p \leq 0.05$  ; düzeyinde önemli\*\* $p \leq 0.01$  düzeyinde önemli. ns: önemli değil, Eta; bitki su tüketimi, IWUE; sulama suyu kullanım randımanı

**Çiçeklenme Gün Sayısı:** Çıkıştan itibaren her bir parseldeki bitkilerin % 50 çiçeklenme devresine ulaştığı zamandır. Parseldeki tüm bitkilerin durumu gözlemlenerek bitkilerin tamamına yakın kısmı bu devreye ulaştığı gün sayısı tespit edilmiştir. Nohut çeşitlerinde çiçeklenme gün sayısı bakımından sulama konuları arasında önemli farklılıklar tespit edilmiştir. Denemeye alınan nohut çeşitlerinin sulama konularına göre en erken çiçeklenme gün sayısı I35 sulama konusunda Onur 106 gün ve en geç çiçeklenme gün sayısı değeri I100 sulama konusunda Sezgin çeşidinde 111 gün olarak belirlenmiştir. Çiçeklenme diğer sulama konularında ise bu iki tarih arasında değişmiştir. İlk çiçek açan sulama konusu ile son çiçek açan arasında 5 gün fark olduğu belirlenmiştir. Bu farkın kısıntılı sulama uygulamaları ile ilgili olduğu düşünülmektedir.

**Bitki Boyu (cm):** Örnek olarak alınan gelişmiş 5 bitkinin boyu toprak seviyesinden merkezi dalın sonunda bulunan çiçek yüksekliğine kadar olan yükseklik cm olarak ölçülmüştür. Araştırmada sulama konularında bitki boyları 54 cm ile 62 cm arasında değiştiği en yüksek bitki boyunun I100 sulama konusunda 62 cm, en düşük bitki boyu ise I35 sulama konusunda



54 cm olarak elde edilmiştir. Diğer sulama konularındaki bitki boyu değerleri ise bu iki değer arasında değişmiştir. Kısıntılı sulama uygulamalarının, bitkilerde fenolojik olarak değişikliklere neden olduğu söylenebilir.

Tane verimi (kg da<sup>-1</sup>): Ekilen her tekerrürdeki dört sıradan orta iki sıra, kenardaki iki bitki hariç hasat edilmiştir. Harman edilen taneler temizlenip tartılmıştır. Tartım anında tanedeki nem oranı John Dickey nem ölçüm cihazı ile belirlenmiş ve % 10 neme göre hesaplanarak parsel verimi ve parsel veriminden faydalanarak dekara verim bulunmuştur.

Araştırmada, verim değerlerine ilişkin yapılan varyans analizinde sulama konuları %1 ve çeşitler istatistiki olarak %1 düzeyinde önemli çıkmıştır. En yüksek verim I100 sulama konusuxSezgin çeşit interaksiyonunda 280 kg/da, en düşük verim ise I35 sulama konusuxOnur çeşit interaksiyonunda 214 kg/da olarak elde edilmiştir.

Elde edilen bulgular Doğan ve ark. (2023) ve Mart ve ark. (2007)'nin bulgularıyla kısmen de olsa örtüşmektedir. Bu çalışmadan elde edilen bulgular ile anılan araştırmacıların bulguları arasında kısmen de olsa çok küçük farklılıklar bulunmaktadır. Bu farklılıkları iklim, toprak, denemede kullanılan çeşidin verim potansiyeline ve uygulanan sulama programına bağlı olduğu düşünülmektedir. Bitkinin büyüme periyotlarında ortaya çıkan uzun süreli yağışlar kapsüllerin küçülmesine, bitkide tane sayısının azalmasına, bunun sonucu olarak da dane veriminin düşmesine neden olmuştur (Uçak ve ark., 2018; Erman ve ark., 1997; Uçak ve Erman., 2019). Kısaca çiçeklenme ya da toplam vejetatif gelişme periyodunda yoğun olarak düşen yağış miktarı, elde edilen verimi olumsuz yönde etkilemiştir. Sulama konularına göre en yüksek ve en düşük verim veren çeşitlerin grafiksel gösterimi Şekil 2'de verilmiştir. En yüksek regresyon katsayısı beklenildiği gibi, tane verimiyle olmuş ve bu öğeyi bitki boyu, 1000 dane ağırlığı takip etmiştir.

Araştırmada, farklı sulama uygulamalarında bitki su stres indeksi (CWSI) değerlerinin 0.18-0.70 arasında değiştiği, en yüksek CWSI değerinin I35 sulama konusuxOnur çeşit interaksiyonunda 0.70 olduğu görülmüştür. En düşük CWSI değerinin ise I100 sulama konusuxSezgin çeşit interaksiyonunda 0.18 olduğu saptanmıştır. Klorofil içeriği değerlerinin ise çeşitlere göre 34 spad ile 36 spad arasında değiştiği belirlenmiştir. Klorofil içeriği değerlerinin sulama programına bağlı olarak değiştiği kısıntı uygulanan konularda düşük, tam sulanan konuda ise diğerlerine kıyasla daha yüksek olduğunu söylenebilir. CWSI ve klorofil içeriği değerlerinin iklime ve araştırmada kullanılan çeşide göre değişebileceği belirlenmiştir. Yapılan bu çalışmada Siirt koşullarında nohut bitkisinde kısıntılı sulama uygulamalarının tane verimi, bitki boyu, çiçeklenme gün sayısı (gün), yaprak klorofil içeriği (spad), bitki su stres indeksi, bitki su tüketimini etkilediği belirlenmiştir.

Darvishzadeh et al. (2010), genotiplerin su stresine toleranslarını belirlemedeki en önemli seleksiyon indeksinin genotiplerin hem su stresi koşullarında, hem de optimum koşullarda benzer performansları göstermesi olduğunu vurgulamışlardır.

Çalışmada CWSI değerleri erken vejetatif dönemde düşük, ancak aşırı su stresi uygulanan konularda çiçeklenme döneminde sulamalardan önce maksimum düzeye çıkmaktadır. Sulamalardan sonra ise düşme yönünde bir eğilim göstermektedir. Bu farklılıkları sulama yöntemi ve sulama programının yanı sıra, çalışmada bitki materyalini oluşturan çeşidin yaprağının dar veya geniş, tüylü yada tüysüz oluşuna, araştırmacının yapıldığı yöre iklim, toprak ve yetiştiricilik tekniklerinde görülen farklılıklara bağlayabiliriz. Ayrıca bu farklılıkları fotosentez metabolizması ile ilişkilendirmek gerekirse; bitkinin istenilen düzeyde fotosentez yapması ve klorofillerin bulunduğu fotosistem reaksiyonlarının optimum çalışması için hücrede optimum düzeyde suyun bulunması gerekmektedir. Aşırı su stresi uygulanan konuların toprak profili boyunca (0-90 cm) yeterli su bulunmadığından, iletim dokuları aracılığıyla yapraklara taşınan su miktarı da az olmaktadır. Bunun da yaprak sıcaklığında artışa sebep olduğu düşünülmektedir. Sonuç olarak bitkinin tam sulanması (I<sub>100</sub>) durumunda bitki su stres indeksindeki azalış, bitki yaprağı su içeriğinin fazlalığından kaynaklanmış olabilir. Nitekim

Kırnak and Gençođlan (2001) sulamalardan önce toprak neminin azalmasının bitki ta sıcaklıđı deđerlerini artırıcı yönde etkide bulunduđunu bildirmiştir. Diđer taraftan CWSI deđerinin bitkinin türüne, çeşidine, dar veya geniş yapraklı oluşuna, çevre ve iklim koşullarına bađlı olarak deđiştii önceki alıřmalarda belirtilmiştir (Alderfasi and Nielsen 2001; Testi, et al., 2008). Sonu olarak arařtırmadan elde edilen bulgular diđer arařtırıcının bulgularıyla örtüşmektedir.

#### **4. Sonular**

Bu alıřma; su-stressiz ve su-stresli koşullarda yetiřtirilen üç adet susam genotipinin, su stresine toleransının saptanması amacıyla yarı kurak iklim koşullarında bir tarla alıřması olarak yürütölmüştür. alıřmada su stresine toleranslı genotiplerin tespit edilmesinde su-stressiz ve su-stresli koşullardaki verim, CWSI ve klorofil içeriđi gibi kimi fizyolojik parametrelerden yararlanılmıřtır.

Sezgin genotipinin verim, CC deđeri genel ortalamanın üzerinde ve CWSI deđeri düřüktür. Dolayısıyla Sezgin genotipinin su stresine toleranslı olduđu ve abiotik stres koşullarına dayanıklılık alıřmalarında deđerlendirilebilir özelliklere sahip olduđu belirlenmiştir. Sonu olarak CWSI ve CC deđerlerinin su stresine toleranslı çeřit geliřtirme alıřmalarında stres tarama parametresi (tolerans göstergesi) olarak kullanılabilieceđi söylenebilir. Küresel iklimde görölen olası deđiřikliklerin bir sonucu olarak görölen su-stresi gibi abiyotik faktörler son yıllarda ticari bitkilerde verim azalmasına neden olmuřtur. Bu yüzden su-stresine toleranslı genotiplerin belirlenmesi veya ıřlah yoluyla geliřtirilmesi uzun vadede daha kalıcı bir önlemdir. ıřlah alıřmalarında başarılı olabilmenin yolu ise su stresine toleranslı genotip ya da hatların seiminden geçmektedir. Genotiplerin su stresine dayanımını belirlemede, alıřmada kullanılan birok stres tarama parametresinin kullanılabilir olduđu tespit edilmiştir. Bundan sonra yapılacak benzer alıřmalarda da (tarla koşullarında) bu arařtırma sonucunda elde edilen bulguların kullanılabilirliđi test edilebilir. Öte yandan anılan yörede benzer alıřmaların yapılmasının faydalı olabileceđi söylenebilir.

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## CLEARFIELD AYÇİÇEĞİ (Sunflower) BİTKİSİNDE KISINTILI SULAMA UYGULAMALARININ SU-VERİM İLİŞKİLERİ ÜZERİNE ETKİSİ

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### Özet

Bu araştırma Siirt Üniversitesi, Ziraat Fakültesi deneme arazisinde 2022 yılı ikinci ürün ayçiçeği bitkisinin yetiştirme sezonu boyunca yürütülmüştür. Damla sulama yöntemi ile uygulanan kısıntılı sulama altında ikinci ürün ayçiçeği bitkisinin su-verim ilişkilerini incelemek amacıyla uygulanmıştır. Araştırma üç tekerrürlü olarak tesadüf blokları bölünmüş parseller deneme deseninde yürütülmüştür. Denemede 1 çeşit clearfield ayçiçeği(Ç1=P64LP130) ile 2 çeşit tescilli ayçiçeği çeşidi (Ç2=P64LL134 ve Ç3=P63MM54) kullanılmıştır. Araştırmada farklı sulama düzeyleri, yedi günde bir 90 cm'lik toprak profilinde tüketilen suyun %100'ünün (I<sub>100</sub>, kontrol konusu) uygulandığı tam sulama ve tam sulamanın %70'inin (I<sub>70</sub>) ve %35'inin (I<sub>35</sub>) uygulandığı kısıntılı sulama konularından oluşturulmuştur. Clearfield olmayan ayçiçeği çeşitleri özellikle erken vejetatif dönemde yabancı ot ile rekabete girmekte zorlanmakta bu da verimde %40-50'lere varan önemli oranlarda düşüslere sebep olmaktadır.

**Anahtar Kelimeler:** Clearfield ayçiçeği, sulama, yabancı ot

## EFFECT OF RESTRICTED IRRIGATION APPLICATIONS ON WATER-YIELD RELATIONSHIPS IN CLEARFIELD SUNFLOWER PLANT

### Abstract

This research was carried out in the trial land of Siirt University, Faculty of Agriculture, during the growing season of the second crop sunflower plant in 2022. It was applied to examine the water-yield relations of the second crop sunflower plant under restricted irrigation applied with the drip irrigation method. The research was conducted in a randomized block split-plot trial design with three replications. In the experiment, 1 type of clearfield sunflower (Ç1 = P64LP130) and 2 registered sunflower varieties (Ç2 = P64LL134 and Ç3 = P63MM54) were used. In the study, different irrigation levels were used: full irrigation, where 100% of the water consumed in a 90 cm soil profile (I100, control subject) was applied every seven days, and limited irrigation, where 70% (I70) and 35% (I35) of full irrigation were applied. It was created from the topics. Non-Clearfield sunflower varieties have difficulty in competing with weeds, especially in the early vegetative period, which causes significant decreases in yield, up to 40-50%.

**Keywords:** Clearfield sunflower, irrigation

\*Bu bildiri Ruken Konuk'un yüksek lisans tezinin bir kısmından alıntı içermektedir.

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## Giriş

Ülkemizde insan beslenmesinde çoğunlukla ayçiçeği yağının tercih edilmesi ve artan yağ açığımız nedeniyle en önemli yağ bitkilerinden birisi ayçiçeğidir. Hemen her şeyin mekanize olması, düşük işgücü kullanımı, geniş alanlarda ekim potansiyeline sahip olmasına rağmen, ayçiçeği ekim alanlarında istenen artış sağlanamamıştır. Bunun en önemli nedenlerinden birisi; ülkemizin hemen her bölgesinde ayçiçeği kuru ziraat şeklinde (yağışa bağlı olarak sulanmadan) üretildiğinden, gelişme dönemindeki kuraklıkların tane verimini olumsuz yönde etkilemesiyle üretiminin yıllar bazında değişiklik göstermesidir. Tarımsal anlamda iklim değişikliğinin en ciddi sonucu olan su stresi veya kuraklık konusunda alınabilecek önlemlerden biride ülkemizde önemli bir ekim alanına sahip olan ayçiçeğinin, su stresi koşullarında yetiştirilebilecek yeni clearfield ayçiçeği çeşitlerinin su stresine olası tepkilerinin belirlenmesi ve su stresinin yabancı ot popülasyonu üzerine etkilerinin saptanması sürdürülebilir tarımın devamlılığı açısından büyük önem arz etmektedir (Anonim, 2022).

Türkiye sahip olduğu toprak ve su kaynakları ile çok değişik iklim koşulları yönünden dünyada tarımsal potansiyeli yüksek olan sayılı ülkeler arasında bulunmaktadır. Ülkemizde işlenen arazi 28,5 milyon hektardır. Yapılan etütlere göre, mevcut su potansiyeli ile teknik ve ekonomik olarak sulanabilecek arazi miktarı 8,5 milyon hektar olarak hesaplanmıştır. Sulanan alan ise 6,7 milyon ha'dır (Anonim, 2021). Moutonnet ve Heng (2002), yaptıkları çalışmada Akdeniz ülkeleri için suyun kısıntılı bir kaynak olduğunu, kişi başına gerekli toplam su miktarının ise yaklaşık 1700 m<sup>3</sup>/kişi/yıl olduğunu bildirmişlerdir. Ancak, çoğu Batı Asya ülkelerinde bu rakam 500 m<sup>3</sup>/kişi/yıl'dan daha azdır. Bu durum gelecekte artan nüfus için çok olumsuz bir durumdur. Tarım %70 kullanım oranı ile suyu en fazla tüketen sektördür. Ülkemizin nüfusu yaklaşık olarak 82 milyona ulaşmış bulunmaktadır. Hâlbuki tarım arazilerini daha fazla artırma olanağı bulunmamaktadır. Bu durumda artan nüfusumuzun beslenmesi, sanayimize hammadde sağlaması ve dış ödemeler dengesinde katkıda bulunması için tarımsal üretimin artırılması gerekmektedir. Bu husus ülke çapında iyi bir üretim planlaması ve günün modern tekniklerinin uygulanmasıyla sağlanabilir. Günümüzde bitkilerin sulanmasında yüzey sulama yöntemleri yetersiz kalmakta ve uygulanan sulama suyunun yalnızca 1/3'ü bitkiler tarafından terleme (transpirasyon) yoluyla kullanılmaktadır. Bu nedenle, sulama yöntemlerinin geliştirilmesine şiddetle ihtiyaç duyulmaktadır. Bu bağlamda, Türkiye'nin de dâhil olduğu Akdeniz ülkelerinde yapılan çalışmaların sonucuna göre; damla sulamanın, ortalama %42 su tasarrufu sağladığı, fertigasyonun geleneksel gübrelemeye göre verimi %42 arttırdığı, sulama suyu kullanma etkinliği ise %79 oranında daha yüksek olduğu belirtilmiştir. Özellikle yağmurlama ve damla sulama sistemlerine uygun sulama programları hazırlayıp, bu programları sulama otomasyonu ile birlikte uygulayarak su kullanım etkinliği daha da artırılabilir. Plastik sanayinin hızla gelişimi, sulama sistemi ve donanımındaki gelişmeler, basınçlı sulama sisteminin kullanımının artmasında itici bir güç oluşturmuştur. Bunun sonucu olarak son yıllarda birçok bitkinin sulanmasında yağmurlama ve damla sulama uygulamaları başlamıştır. Ülkemizde de bu konudaki araştırma çalışmaları yakın geçmişten (son 20-25 yıl) beri yapılmaktadır. Ayrıca, yüzey sulamadan damla sulama sistemlerine geçişte %30-60 arasında değişen oranda bir su tasarrufu sağlanabilmektedir (Anonim, 2003). Bitkilerin sulanması amacıyla, sulama programlarının oluşturulmasında son zamanlarda sulama otomasyonu kullanılmaya başlanmıştır. Sulama otomasyonu sulama programı ile birlikte kullanıldığında, daha hassas olmakta, su ve gübre kullanım etkinliğini arttırmakta, işçilik ve enerji giderlerini azaltmakta, verimi ve kaliteyi arttırmakta, insan hatasını en aza indirmekte, sık ve düşük hacimli sulama yapma imkânı sağlamaktadır.

## Materials and Methods

Bu araştırma, 2021-2022 yılında Siirt Üniversitesi Ziraat Fakültesi araştırma ve deneme alanında doğal tarla koşullarında, tesadüf bloklarında bölünmüş parseller deneme deseninde 3 tekerrürlü olarak yürütülmüştür. Araştırmada, bitki materyali olarak clearfield özelliklerine sahip ayçiçeği genotipleri kullanılmıştır.

Bölge yaz mevsiminde çoğunlukla Basra alçak basınç merkezine yerleşmiş olan kuru ve sıcak tropikal hava kütlelerinin etkisi altında kalmaktadır. Gündüz en yüksek hava sıcaklığı 40 °C'nin üzerine çıkabilmektedir. Basra alçak basınç merkezinin Anadolu'ya doğru genişlemesi ile oluşan ve "samyeli" olarak adlandırılan kuru ve sıcak rüzgârlar hem buharlaşmayı artırmakta ve hem de toz fırtınalarına neden olmaktadır. Ayrıca bölge Arabistan ve Suriye çöllerinden gelen tozlu havanın etkisi altında da kalmaktadır. Kış mevsiminde bölge, Orta Akdeniz'den gelen cephelerin etkisi altına girmektedir. Yağışlara neden olan bu cephe faaliyetleri Nisan ayına kadar devam etmektedir (Atalay ve Mortan, 2003). Benzer koşulların hakim olduğu inceleme alanında 1970-2013 yılları arasındaki dönemde yapılan ölçüm sonuçlarına göre yıllık ortalama hava sıcaklığı değeri 16,1 °C olarak tespit edilmiştir. Kış aylarında ülkemiz ve çevresini etkileyen planeter faktörlerin etkisiyle sahada en düşük düzeye inen ortalama sıcaklık değerleri Mart ayından itibaren hızlı bir yükselme eğilimine girerek Mayıs ve Haziran aylarında 25 °C'nin üzerine çıkmaktadır. İnceleme alanında yaz döneminde (Haziran, Temmuz, Ağustos) ortalama sıcaklıkların 26 °C'nin, kış döneminde ise (Aralık, Ocak, Şubat) 2,7 °C'nin altına düşmediği görülmektedir. En düşük (2,7 °C) ve en yüksek (30,5 °C) aylık ortalama hava sıcaklığı değerleri sırasıyla Ocak ve Temmuz aylarında gerçekleşmekte olup, bu değerler arasında 27,8 °C düzeyinde bir sıcaklık farkı bulunmaktadır (Ayberk, 2013).

## Findings and Discussion

### Verim ve Verim Bileşenleri

Araştırmadan elde edilen üç ayçiçeği genotipine ait varyans analiz sonuçları ve ortalama değerlere ait tablolar aşağıda ayrı başlıklar halinde verilmiştir.

#### 1.1.1. Verim (kg/da)

Farklı sulama konuları ve ayçiçeği genotiplerinden elde edilen verim değerlerine ait varyans analiz sonuçları Tablo 4.1'de verilmiştir. Yapılan varyans analizi sonuçlarına göre sulama konusu ve genotipler arasındaki farklar istatistiksel olarak %1 ( $p \leq 0.01$ ) önem seviyesinde önemli bulunmuştur. Konulara ilişkin oluşan LSD testi gruplamaları ise Tablo 4.2, 4.3 ve 4.4'de verilmiştir.

**Tablo 4.1.** Verim değerlerine ait varyans analiz tablosu

Varyasyon Kaynağı	Serbestlik Derecesi	Kareler Toplamı	Kareler Ortalaması	F değeri	P Değeri
Tekerrür	2	497,45	248,725	12,5894	0,1880
Sulama konusu	2	171494	85747	4340,153	<.0001**
Sulama konusuxTek&Random	4	79,0267	19,7567	0,1875	
Genotip	2	1792,08	896,039	8,5035	0,0050**
GenotipxSulama konusu	4	103,274	25,8185	0,2450	0,9072
Hata	12	1264,48	105,4		
Genel toplam	26	175230,30			

\*\* : % 1 seviyesinde önemli \* : % 5 seviyesinde önemli

**Tablo 4.2.** Sulama konularının verim değerlerine ait ortalama değerler tablosu (LSD)

Sulama Konuları	Verim
I <sub>100</sub>	307,22 A
I <sub>70</sub>	257,56 B
I <sub>35</sub>	118,89 C
ORTALAMA	227,89
CV (%)	4,50
LSD (0,01)	5,817

\* Aynı sütunda aynı harf ile gösterilen ortalamalar arasındaki fark P<0.01 değerleri içerisinde istatistiksel olarak önemlidir

**Tablo 4.3.** Genotiplerin verim değerlerine ait ortalama değerler tablosu ve LSD grupları

Genotip	Verim
P64LP130	237,06 A
P63MM54	229,34 A
P64LL134	217,26 B
ORTALAMA	227,89
CV (%)	4,50
LSD (0,01)	10,54

\* Aynı sütunda aynı harf ile gösterilen ortalamalar arasındaki fark P<0.01 düzeyinde istatistiksel olarak önemlidir

**Tablo 4.4.** Genotipxsulama konusunun verim değerlerine ait ortalamalar tablosu

Genotip*Sulama Konusu İnteraksiyonu	Verim
P63MM54,35	117,67
P63MM54,70	260,00
P63MM54,100	310,33
P64LL134,35	111,13
P64LL134,70	247,33
P64LL134,100	293,33
P64LP130,35	127,85
P64LP130,70	265,33
P64LP130,100	318,00
ORTALAMA	227,89
CV (%)	4,50
LSD	ÖD

\* Aynı sütunda aynı harf ile gösterilen ortalamalar arasındaki fark P<0.05 düzeyinde istatistiksel olarak önemlidir

Tablo 4.1’de verim değerlerine ilişkin varyans analiz tablosunda sulama konusu ve genotip varyasyon kaynakları % 1 seviyesinde önemli iken sulama konuları x genotip interaksiyonu ise istatistiksel olarak önemsiz bulunmuştur.

Tablo 4.2 incelendiğinde sulama konularının verim değerlerinin 118,89-307,22 kg/da arasında değiştiği görülmüştür. Araştırma sonuçlarına göre verim değerleri bakımından sulama konularının arasındaki farklılıklar % 1 seviyesinde önemli bulunmuştur. Verim değerlerine baktığımızda I<sub>100</sub> sulama konusu 307,22 kg/da ile a grubunda yer alırken I<sub>35</sub> sulama konusu 118,89 kg/da ile c grubunda yer almıştır. I<sub>70</sub> sulama konusu ise bu 2 sulama konusu arasında yer almış olup, b grubunda 2. grupta bulunmaktadır.

Tablo 4.3 incelendiğinde genotipler arasındaki verim değerleri 217,26-237,06kg/da arasında değiştiği gözlemlenmiştir. Araştırma sonuçlarına göre verim bakımından genotipler arasındaki farklılıklar % 1 seviyesinde önemli bulunmuştur. Araştırma sonuçlarına göre verim değerlerine baktığımızda 237,06 kg/da değeri ile P64LP130 ve 229,34 kg/da değeri ile de



P63MM54 en yüksek deęerleri ile a grubunda yer alırken; en düşük deęer 217,26 kg/da ise P64LL134 çeşidinde b grubunda yer almıştır.

Tablo 4.4 incelendiğinde genotipxsulama konusu arasındaki verim deęerlerinin 111,13-318 kg/da arasında deęiştii belirlenmiştir. Verim bakımından genotipxsulama konusu arasındaki farklılıklar istatistiksel olarak önemli bulunmamıştır. En yüksek verim deęeri; P64LP130\*100 interaksiyonunda 318 kg/da bulunurken; en düşük verim deęeri ise P64LL134\*35 interaksiyonunda 111,13 kg/da olarak tespit edilmiştir.

### **Conclusion and Recommendations**

Yapılan bu çalışmanın sonuçlarına göre Siirt'te ayçiçeğinde kısıntılı sulama yapılması önerilmemekte veya kısıntı yapma zorunluluęu olduęu takdirde bunun erken vejetatif gelişme döneminde (çiçeklenme öncesinde) maksimum %30 oranında yapılması önerilmektedir. Bir başka deyişle su kaynağı yetersiz olan böylesi yörelerde maksimum %30 düzeyinde su kısıntısı yapılması söylenebilir. Öte yandan clearfield olmayan ayçiçeęi çeşitleri ise özellikle erken vejetatif dönemde yabancı ot ile rekabete girmekte zorlanmakta buda verimde %40-50'lere varan önemli oranlarda düşüşlere sebep olmaktadır. Kısaca yabancı otlardan arı bir ayçiçeęi tarlası elde edilmek isteniyorsa clearfield ayçiçeęi çeşitlerinin yetiştiricilięinin yapılması önerilmektedir.

### **Teşekkür**

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# GAP PROJESİNİN TÜRKİYE EKONOMİSİNE KATKISI VE ŞANLIURFA İLİ TARIM İŞLETMELERİN SOSYO-EKONOMİK YAPISINDA MEYDANA GETİRDİĞİ DEĞİŞİMLER

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## **Özet**

Güneydoğu Anadolu Projesi (GAP), dünya çapında ölçeği, kapsamı ve hedefleriyle dikkat çeken bir girişimdir. Yaklaşık 75.358 km<sup>2</sup>'lik bir alana yayılan GAP, Fırat ve Dicle havzalarında gerçekleştirilen 13 alt proje paketi kapsamında hayata geçirilmektedir. Bu kapsamda, 22 baraj ve 19 hidroelektrik santralinin inşası planlanmakta, ayrıca sulama tesisleri gibi doğal kaynakların etkin kullanımını sağlayacak tesisler de öngörülmektedir. GAP Master Planı, öncelikle sanayileşme, eğitim seviyesinin yükseltilmesi, büyük ölçekli yatırımlar ve yerleşim sorunlarının çözümü üzerinde durmaktadır. Bu çalışmada, Türkiye'de ve uluslararası alanda önemli bir role sahip olan Güneydoğu Anadolu Projesi'nin (GAP) Şanlıurfa ilinin sosyo-ekonomik yapısında meydana getirdiği değişiklikler incelenmiştir. GAP öncesinde, Şanlıurfa ilindeki sektörel dağılıma bakıldığında, hizmet sektörünün % 54,7 ile birinci, tarım sektörünün % 41,8 ile ikinci ve sanayi sektörünün % 3,4 ile üçüncü sırada yer aldığı görülmektedir. Ancak, GAP'ın başlamasıyla (1990 yılı) tarım sektörü (% 53,1) birinci sıradan ikinci sıraya, hizmet sektörü (% 35,3) ise ikinci sıradan birinci sıraya yükselmiştir. Bununla birlikte, sanayi sektörünün ağırlığının arttığı ve % 11,4'e ulaştığı, ancak sıralamada değişiklik olmadığı belirlenmiştir. Sonuç olarak, bu projenin Şanlıurfa ilinin sosyo-ekonomik yapısında önemli değişikliklere neden olduğu ve etkilerinin devam edeceği belirlenmiştir. Ancak, hedeflenen düzeyde olmasa da, ciddi gelişmelerin meydana geldiği tespit edilmiştir. GAP'ın bölgedeki ekonomik yapının çeşitlenmesine ve büyümesine katkı sağladığı açıktır, ancak ilerleyen süreçlerde daha fazla analiz ve değerlendirme gerekmektedir.

**Anahtar Kelimeler:** GAP, Şanlıurfa, tarımsal yapı

## CONTRIBUTION OF GAP PROJECT TO TURKISH ECONOMY AND CHANGES IN SOCIO-ECONOMIC STRUCTURE OF AGRICULTURAL ENTERPRISES IN SANLIURFA PROVINCE

### **Abstract**

The Southeastern Anatolia Project (SAP) is an initiative that draws attention with its scale, scope and goals worldwide. Spread over an area of approximately 75,358 km<sup>2</sup>, GAP is being implemented within the scope of 13 sub-project packages carried out in the Euphrates and Tigris basins. Within this scope, the construction of 22 dams and 19 hydroelectric power plants is planned, and facilities that will ensure the efficient use of natural resources such as irrigation facilities are also foreseen. The GAP Master Plan primarily focuses on industrialization, increasing the level of education, large-scale investments and solving settlement problems. This study examines the changes brought about by the Southeastern Anatolia Project (GAP), which has an important role in Turkey and the international arena, in the socio-economic structure of Şanlıurfa province. When the sectoral distribution in Şanlıurfa province is examined before the GAP, it is seen that the service sector ranked first with 54.7%, the agricultural sector ranked second with 41.8% and the industrial sector ranked third with 3.4%. However, with the start of GAP (in 1990), the agricultural sector (53.1%) rose from first to second place, while the service sector (35.3%) rose from second to first place. However, it was determined that the weight of the industrial sector increased and reached 11.4%, but there was no change in the ranking. As a result, it was determined that this project caused significant changes in the socio-economic structure of Şanlıurfa province and that its effects would continue. However, it was determined that serious developments occurred, although not at the targeted level. It is clear that GAP contributed to the diversification and growth of the economic structure in the region, but more analysis and evaluation are required in the future.

**Keywords:** SAP, Şanlıurfa, agricultural structure

## 1.Giriş

Güneydoğu Toroslar'ın genel olarak güney etekleri ile Suriye sınırı arasında kalan saha, Türkiye'nin Güneydoğu Anadolu Bölgesi'ni oluşturur. Bu bölge, 1941 yılında Ankara'da düzenlenen I. Coğrafya Kongresi sonuçlarına göre; Toros Dağları'nın dış sırası önünde uzanan saha, kıvrımlar ve volkan kütleleriyle az arızalanmış büyük düzlükler sahasıdır. Batıda Hatay çukurunun doğu kenarı ile sınırlanan bölge; volkanik Karacadağ kütlelerinin doğusunda kalan kesime "Dicle Bölümü", batısında kalan kısma da "Orta Fırat Bölümü" adı verilerek iki alt bölüme ayrılmıştır. (Benek, 2006)

Bu bölgelerde, batıda Akdeniz Bölgesi, kuzey ve kuzeydoğuda Doğu Anadolu Bölgesi, güneyde ise Suriye yer almaktadır. Ancak, Güneydoğu Anadolu Projesi'nin (GAP) kapsamı, Güneydoğu Anadolu Bölgesi sınırlarıyla tam olarak örtüşmemektedir. (Benek, 2006)

GAP Bölgesi, ana hatlarıyla Güneydoğu Anadolu Bölgesi'ni kapsayan ve yaklaşık 75.000 km<sup>2</sup>'lik bir yüz ölçümüne sahip olan 9 ilde (Adıyaman, Batman, Diyarbakır, Gaziantep, Kilis, Mardin, Siirt, Şanlıurfa ve Şırnak) uygulanmaktadır (Demir, 2003). Bu doğrultuda, Orta Fırat Bölümü'nde yer alan Şanlıurfa ilinin batısında Gaziantep, kuzeybatısında Adıyaman, kuzeydoğusunda Diyarbakır, doğusunda Mardin illeri ve güneyinde ise Türkiye-Suriye Devlet Sınırı bulunmaktadır. (Şekil 1)

Şanlıurfa ili, Türkiye'nin %3'ünü oluşturan 18.584 km<sup>2</sup>'lik bir yüzölçümüne sahiptir. Bu toprakların %61,7'si platolar, %22'si dağlar ve %16,3'ü ovalarla kaplıdır (2003, İl Gelişim Planı). Topraklarının %64'ü tarıma elverişli olan Şanlıurfa ili, bu potansiyeliyle hem GAP Bölgesi hem de Türkiye için önemli bir konuma sahiptir.

Bunun temelinde:

1- 1989 yılında hazırlanan GAP Master Planı'na göre bölgede esas gelişme eksenini, Şanlıurfa'nın merkez olduğu Gaziantep-Şanlıurfa-Diyarbakır illerini kapsayan bir aks olarak belirlenmiştir. 2005 yılı verilerine göre, hedeflenen düzeyde olmasa da GAP Bölgesi'ndeki ana gelişme ekseninin bu çerçevede bir gelişme eğilimi gösterdiği görülmektedir.

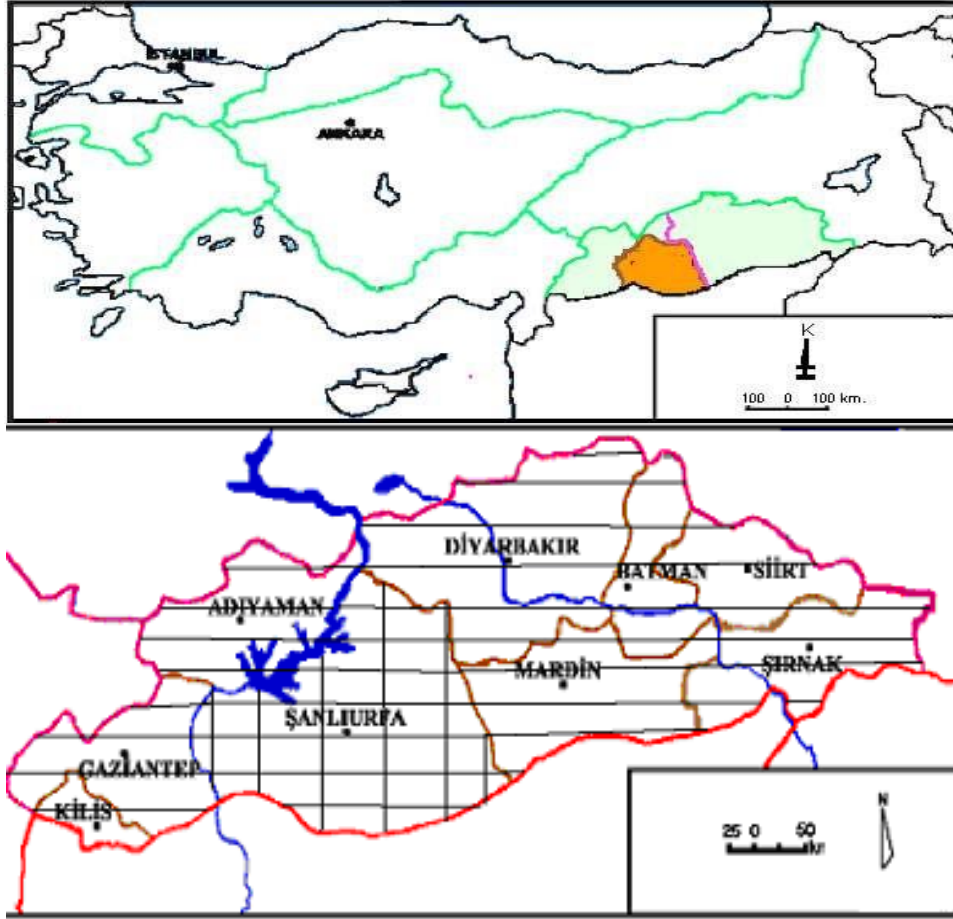
2- Yine GAP Master Planı'na göre, GAP'ın ilk iki ve temel hedefi bölgenin toprak ve su kaynaklarının optimum bir şekilde değerlendirilmesidir. Bu bağlamda, Şanlıurfa ili GAP'ın tam anlamıyla faaliyete geçmesi halinde üretilecek enerjinin %50'sini ve sulanacak tarımsal alanın ise %25'ine sahip olması öngörülmektedir.

3- Şanlıurfa ilinde GAP çerçevesinde gerçekleştirilen önemli projelerden biri inşaat çalışmaları devam eden GAP Uluslararası Hava Limanıdır. Bölgenin dünya ile yaklaşması bakımından önemli bir yatırım olan GAP Uluslararası Hava Limanı, Şanlıurfa şehrine 34 km. yakınlıkta bulunmaktadır.

4- Şanlıurfa ilinin kuzeybatı ve batı sınırını doğal bir sınır olan Fırat Nehri ve üzerinde inşa edilen Atatürk, Birecik ve Kargamış barajları ve göletleri oluşturmaktadır. Bu durum, tarımda sulama, balıkçılık ve turizm gibi birçok alanda Şanlıurfa'ya avantajlar sağlamaktadır.

5- GAP Master Planı'nda Şanlıurfa ilinin GAP'ın 'Tarım ve tarıma dayalı sanayinin ihracat üssü' olacağı öngörülmüştür. İlin, yüzölçümünün %64'ü tarıma (1205000 ha), tarım alanlarının %69,6'sı (836.000 ha) ise sulamaya elverişlidir. Bu potansiyel harekete geçirildiğinde, ilin tarımsal ürünlerde ve tarıma dayalı sanayileşmede büyük bir ekonomik kalkınma potansiyeline sahip olması beklenmektedir.

6- GAP süreci ile birlikte Şanlıurfa şehri, 34 km. mesafede (otoban) GAP Uluslararası Hava Limanı'na, 52 km. mesafede (duble yol) Akçakale Sınır Ticaret Merkezi'ne, 144 km mesafede (otoban) bölgenin en gelişmiş merkezi konumunda olan Gaziantep şehrine, 184 km.'lik mesafede Diyarbakır şehrine, 109 km.'lik mesafede Adıyaman şehrine ve 40 km.'lik mesafede Atatürk Barajı Göleti'ne yakın konumdadır.



Şekil 1: Şanlıurfa İlinin Türkiye’de ve GAP Bölgesi’ndeki Yeri ve Konumu

GAP öncesinde Şanlıurfa, Türkiye'nin gelişmişlik ortalamasına göre gelir düzeyi düşük bir yapıya sahip bir bölgeden oluşmaktadır. Gelenekçi toplumsal yapısıyla çağdaş yaşam koşullarının gerisinde seyretmekte ve ekonomik olarak dışa kapalı, geleneksel tarıma dayalı bir yapıya sahiptir. Bu durum, iç dinamizmden yoksun olmasıyla birlikte, üretilen ürünlerin işlenmek üzere il dışına pazarlanmasına ve sosyal, siyasal ve kültürel yapıda gelişmemiş bir görünüme neden olmaktadır. Eğitim ve sağlık hizmetlerinde de ülke standartlarının altında bir seviyede bulunmaktadır (Anonim, 2022).

Ancak, 1989 yılında hazırlanan GAP Master Planı'nda Şanlıurfa ilinin bölgenin tarım ve tarıma dayalı ihracat üssü olacağı öngörüldü. Ne var ki, 2005 yılı itibarıyla hedeflenen düzeyde performans gösterilememiştir.

Buna rağmen, GAP süreciyle birlikte Şanlıurfa ilinin sosyo-ekonomik yapısında değişim ve gelişmeler gözlemlenmektedir. Bu makale, GAP süreciyle birlikte Şanlıurfa ilinin sektörel yapısında (tarım, sanayi ve hizmet) ve genel sosyo-ekonomik yapısında meydana gelen değişim ve gelişmeleri verilere ve sahada yapılan gözlemlere dayalı olarak ele almaktadır.

## 2. Materyal ve Yöntem

### 3.1. Materyal

Bu araştırmanın temel verileri, Şanlıurfa ili Haliliye ilçesindeki Güneydoğu Anadolu Projesi (GAP) ile ilgili sosyo-ekonomik değişimleri incelemek amacıyla yapılan anketlerden elde edilmiştir. Araştırmacılar tarafından hazırlanan anket formları, ilçedeki üreticilerle birebir görüşülerek doldurulmuştur. Bu anketler, araştırma alanında doğrudan etkilenen kişilerin görüşlerini ve deneyimlerini yansıtmak amacıyla tasarlanmıştır.

Ayrıca, araştırma kapsamında daha geniş bir bakış açısı sağlamak için çeşitli araştırmalar, incelemeler ve derlemelerden de yararlanılmıştır. Bu kaynaklar, literatür taraması ve mevcut bilimsel çalışmaları içerebilir. Bu şekilde, araştırmacılar benzer çalışmaların sonuçlarına ve uzman görüşlerine dayanarak kendi araştırmalarının bağlamını daha iyi anlayabilirler.

Araştırma alanıyla ilgili veriler derlenirken, Şanlıurfa'daki çeşitli kamu kuruluşlarının veri kaynaklarından da faydalanılmıştır. Bu kuruluşlar arasında Şanlıurfa Tarım İl Müdürlüğü gibi resmi kurumlar bulunmaktadır. Bu kuruluşların sağladığı veriler, araştırma alanıyla ilgili resmi ve güvenilir bilgilere erişimi sağlamaktadır.

Son olarak, internet üzerindeki çeşitli web sitelerinde yayınlanan verilerden de yararlanılmıştır. Bu kaynaklar, güncel ve geniş kapsamlı bilgilere erişimi sağlayarak araştırmacılara farklı perspektifler sunabilir. Bu şekilde, araştırma alanıyla ilgili geniş bir veri seti elde edilerek daha kapsamlı bir analiz yapılabilir.

### 3.2 Yöntem

Araştırmada, örtü altı üretim yapan toplam üretici sayısının 3423 olduğu tespit edilmiştir. Ancak, tüm üreticileri kapsamak yerine örnekleme yöntemi kullanılarak bir kısmının seçilmesi uygun görülmüştür. Bu amaçla, örnekleme yöntemiyle belirlenecek örnek hacmi için oransal örnek hacmi formülü kullanılmıştır (Newbold, 1995). %95 güven aralığı ve %10 hata payı esas alınarak yapılan hesaplama sonucunda örnek hacmi 67 olarak belirlenmiştir.

Bu yöntem, araştırmanın güvenilirliğini sağlamak için örneklem büyüklüğünün belirlenmesinde yaygın olarak kullanılan bir yöntemdir. %95 güven aralığı, elde edilen sonuçların istatistiksel olarak güvenilir olduğunu belirlerken, %10 hata payı ise kabul edilebilir hata miktarını göstermektedir. Bu şekilde belirlenen örnek hacmi, araştırmanın genellemeler yapılabilir ve sonuçları daha güvenilir hale getirilebilir.

$$n = \frac{Np(1-p)}{(N-1)\sigma_p^2 + p(1-p)}$$

Formülde;

n = Örnek hacmi

N = Toplam üreticisi sayısı

p = Örneğe girecek üreticilerin oranı

Q<sup>2</sup>p = Oranın varyansıdır.

Ankette üreticilere yöneltilen soruların çeşitliliği, araştırmanın geniş kapsamlı bir şekilde yapıldığını göstermektedir. Bu sorular, üreticilerin yaş, eğitim düzeyi, arazi varlığı, pamuk ekim alanı, toplam pamuk verimi, pazarlama tekniği ve ürün satış fiyatı gibi önemli konulardaki bilgilerini değerlendirmeye yöneliktir. Ayrıca, bina varlığı, hayvan varlığı, kuruluşlara üyelik durumu, alet-ekipman varlığı gibi faktörlerin incelenmesi de araştırmanın kapsamını genişletmektedir.

Bu verilerin tanımlayıcı istatistik analizleri yapılarak elde edilen sonuçlar, araştırmanın amacına ve hipotezlerine dayalı olarak yorumlanabilir. Örneğin, üreticilerin eğitim düzeyi ile pamuk verimi arasındaki ilişki incelenebilir veya pazarlama tekniklerinin ürün satış fiyatları üzerindeki etkisi değerlendirilebilir.

Bu çeşitlilik, araştırmanın daha kapsamlı ve derinlemesine bir analiz yapılmasını sağlar. Elde edilen verilerin tablolarda gösterilmesi, sonuçların görsel olarak sunulmasını sağlayarak daha anlaşılır bir şekilde değerlendirilmesine olanak tanır. Bu şekilde, araştırmanın sonuçlarına dayalı olarak çeşitli öneriler ve politika tavsiyeleri geliştirilebilir.

### 3.Araştırma Bulguları

Bu bölümde, Şanlıurfa ili Haliliye ilçesinde gerçekleştirilen saha çalışması sonuçlarına dayalı olarak elde edilen veriler değerlendirilmiştir. Araştırma kapsamında, Haliliye ilçesindeki Güneydoğu Anadolu Projesi (GAP) tarafından sağlanan sosyo-ekonomik değişimler hakkında bilgi edinmek amacıyla üreticilerle yüz yüze anket çalışması gerçekleştirilmiştir. Bu anket çalışması sayesinde, üreticilerden sosyo-ekonomik değişimlerle ilgili veriler toplanmış ve bu veriler üzerinden sosyo-ekonomik değişimlerin tespiti ve analizi yapılmıştır.

Anket çalışması, üreticilerin yaşadığı sosyo-ekonomik değişimleri doğrudan ifade etmelerine ve araştırmacılara bu değişimleri daha iyi anlamaları için veri sağlamalarına olanak tanımıştır. Bu verilerin analizi, GAP projesinin bölgedeki etkilerini daha iyi anlamamıza ve değerlendirmemize yardımcı olmuştur.

Saha çalışması sonuçlarına dayalı olarak elde edilen verilerin değerlendirilmesi, bölgedeki sosyo-ekonomik değişimlerin niteliğini, yönünü ve etkilerini anlamamıza yardımcı olur. Bu değerlendirme, GAP projesinin bölgedeki etkilerini belirlemek ve gelecekteki politika kararlarını yönlendirmek için önemli bir araçtır.

#### **GAP Projesi İle Şanlıurfa İli Haliliye İlçesindeki İşletmelerin Sosyo-Ekonomik Değişimleri**

İncelenen işletmelerde bulunan üreticilerin %53,70'inin ilkokul mezunu, %38,80'inin ortaokul mezunu %7,5'inin lise mezunu olduğu belirlenmiştir.

**Tablo 1.** Üreticilerin Eğitim Düzeyi

Eğitim	Çiftçi sayısı	%
İlkokul	36	53.70
Ortaokul	26	38.80
Lise	5	7.50
Toplam	67	100.00

Verilere dayanarak, Şanlıurfa ili Haliliye ilçesindeki çiftçilerin eğitim düzeylerine ilişkin gözlemlerimize göre, çoğunlukla ilkokul mezunu oldukları ve daha düşük eğitim seviyelerine sahip oldukları görülmektedir. Bu durum, bölgedeki tarım topluluğunun genel eğitim seviyesinin düşük olduğunu ve bu durumun tarımsal üretim ve modern tarım uygulamaları konusunda bazı zorluklar yaratabileceğini düşündürmektedir.

Düşük eğitim seviyeleri, tarım tekniklerinin modernizasyonu, yeni teknolojilerin benimsenmesi ve pazarlama stratejilerinin geliştirilmesi gibi konularda çiftçilere erişimi kısıtlayabilir. Bununla birlikte, bu durum aynı zamanda tarım sektöründe eğitim ve danışmanlık hizmetlerine olan ihtiyacı da vurgulamaktadır. Eğitim programları ve teknik destek sağlayan kuruluşlar, çiftçilere modern tarım uygulamalarını öğretmek ve verimliliği artırmak için önemli bir rol oynayabilir.

Ancak, ilkokul ve ortaokul seviyelerinde eğitim almış olan çiftçilerin oranı oldukça yüksektir. Bu durum, eğitim düzeylerinin yavaş yavaş arttığını ve bölgedeki genç neslin daha yüksek eğitim seviyelerine sahip olabileceğini işaret edebilir. Gelecekte, daha yüksek eğitim seviyelerine sahip çiftçilerin sayısının artmasıyla birlikte tarımsal üretimde ve yönetiminde daha fazla yenilik ve gelişme beklenmektedir.

İncelenen işletmelerde yer alan üreticilerin minimum yaşı 30, maksimum yaşı 68, ortalama yaşı 51.79 olarak belirlenmiştir. Sonuçlara bakıldığında, üretim yapan çiftçilerin 30-45 ve 46-60 yaş grubu arasında yoğunlaştığı görülmektedir (Tablo 2). Bu yoğunlaşmanın bölgedeki temel sebebi orta yaş grubunun farklı istihdam alanlarının bulunmamasından kaynaklanmaktadır

**Tablo 2.** Üreticilerin Yaş Ortalaması

	Ortalama	Minimum	Maksimum
Yaş	51.79	30.00	68.00



İncelenen işletmelerde ortalama arazi mevcudu GAP öncesi 114.64 da iken GAP sonrası 119.10 dekara yükselmiştir (Tablo 3.) İncelenen işletmelerde arazi mevcudu ve parsellerin sayılarında gözlemlenen artış, tarım alanlarının genişlediğini göstermekte ve tarımsal üretim kapasitesindeki potansiyel artışı işaret etmektedir.

Özellikle pamuk ekim alanlarında ve tarımsal ekipman varlığında yaşanan artışlar, modern tarım tekniklerinin benimsenmesi ve verimliliğin artırılması açısından olumlu bir gelişme olarak değerlendirilebilir.

Ancak, işletmelerin büyükbaş ve küçükbaş hayvan varlığında azalışlar meydana geldiği belirlenmiştir. Bu durum, bölgenin bitkisel üretim odaklı bir yapıya doğru evrildiğini ve hayvancılığın önemini azaldığını göstermektedir.

**Tablo 3.** Üreticilerin GAP öncesi ve sonrası bazı sermaye unsurları

	GAP öncesi			GAP sonrası		
	Ortalama	Minimum	Maksimum	Ortalama	Minimum	Maksimum
<b>Arazi mevcudu</b>	114.64	30.00	350.00	119.10	30.00	350.00
<b>Parsel sayısı</b>	1.54	1.00	3.00	1.60	1.00	3.00
<b>Pamuk ekim alanı</b>	29.18	0.00	280.00	103.96	30.00	280.00
<b>Bina varlığı</b>	2.04	1.00	6.00	1.87	1.00	6.00
<b>Alet-Ekipman varlığı</b>	3.33	2.00	11.00	5.28	3.00	11.00
<b>Küçükbaş hayvan sayısı</b>	36.09	0.00	30.00	5.82	0.00	30.00
<b>Büyükbaş hayvan sayısı</b>	3.93	0.00	10.00	0.85	0.00	10.00

Bu veriler, GAP projesinin bölgedeki sosyo-ekonomik yapıyı nasıl etkilediğini ve tarımsal üretim üzerindeki değişimleri nasıl şekillendirdiğini daha iyi anlamamıza yardımcı olmaktadır. Bununla birlikte, tarım ve hayvancılık sektörlerindeki bu değişimlerin bölgenin ekonomik ve sosyal yapısına uzun vadeli etkilerini anlamak için daha fazla araştırma ve analiz gerekebilir. Tablo 4'e göre incelenen işletmelerde yer alan üreticilerin GAP sonrasında gelirlerinin ortalama 2.40 kat artış gösterdiğini ifade ettikleri belirlenmiştir.

**Tablo 4.** Üreticilerin GAP sonrası gelir artış durumu

GAP Sonrası Gelir Artışı	Ortalama	Minimum	Maksimum
	2.40	1.00	3.50

#### 4.Sonuç

Güneydoğu Anadolu Projesi (GAP), Türkiye'nin kalkınmasına büyük katkılar sağlamak amacıyla hayata geçirilmiş bir projedir. Şanlıurfa'nın tarıma dayalı ekonomisi, GAP projesinin tamamlanmasıyla birlikte büyük değişimler yaşamıştır.

Sektörel yapıya baktığımızda, Şanlıurfa'nın ekonomisinin büyük bir kısmının tarıma dayanmaktadır. Özellikle pamuk üretimi, il ekonomisinin belkemiğini oluşturmaktadır. GAP projesinin sulama imkanları Şanlıurfa'nın tarımsal üretimde öncü bir konuma gelmesini sağlamıştır.

Aynı zamanda, tarıma dayalı sanayi, özellikle tekstil sektörü, hızla gelişmektedir. Pamuğun büyük bir kısmının Şanlıurfa'da üretilmesi, tekstil sanayisinin bölgede hızla büyümesine olanak tanımaktadır.

Şanlıurfa'nın coğrafi konumu, üretilen ürünlerin Ortadoğu ve Avrupa Birliği gibi pazarlara kolay erişimini sağlamaktadır. Bu durum, bölge için yeni bir ihracat potansiyeli yaratmaktadır. Devletin bölge çiftçilerini yeni ürünlerle Ortadoğu ve Avrupa Birliği pazarlarına yönlendirmesi ve ihracat imkanlarını artırması önemlidir.

GAP projesinin tamamlanmasıyla birlikte, tarım, sanayi ve hizmet sektörlerinde gelişmeler yaşanması beklenmektedir.

Ancak, sosyal yapının tam anlamıyla gelişebilmesi için altyapı projelerinin tamamlanması gerekmektedir. Bu projeler, bölgedeki ekonomik büyümeyi destekleyecek ve Şanlıurfa'nın kalkınmasına önemli katkılar sağlayacaktır.

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## MEYVE ÜRETİMİNİN KARLILIK ANALİZİ: BATMAN İLİ ÖRNEĞİ

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### Özet

Bu araştırmada, Batman ilinde üretilen meyvelerin (antepfıstığı, armut, badem, ceviz, dut, elma, incir, kayısı, nar, üzüm) karlılık durumu Tarım ve Orman Bakanlığı Batman İl Müdürlüğü'nün 2023 dönemi verileri ile analiz edilmesi amaçlanmıştır. Batman ilinde üretilen tarla bitkileri ürünlerinin üretim masrafları, brüt üretim değerleri, brüt karları, net karları ve nispi karları incelenmiştir. Araştırmadan elde edilen sonuçlarına göre; Antep fıstığı üretiminin ortalama üretim masrafı 4186.42 TL/da, armut üretiminin ortalama üretim masrafı 6128.34 TL/da, badem üretiminin ortalama üretim masrafı 4472.11TL/da, ceviz üretiminin ortalama üretim masrafı 6122.35 TL/da, dut üretiminin ortalama üretim masrafı 6642.56 TL/da, elma üretiminin ortalama üretim masrafı 6173.74 TL/da, incir üretiminin ortalama üretim masrafı 5875.56 TL/da, kayısı üretiminin ortalama üretim masrafı 6540.43 TL/da, nar üretiminin ortalama üretim masrafı 6145.82 TL/da ve üzüm üretiminin ortalama üretim masrafı 4780.58 TL/da olarak hesaplanmıştır. Nispi kar açısından ele alındığında ise en yüksek değer antepfıstığı (6.45) üretimindedir.

**Anahtar Kelimeler:** meyve üretimi, brüt kar, net kar, nispi kar, karlılık

## **PROFITABILITY ANALYSIS OF FRUIT PRODUCTION: BATMAN PROVINCE EXAMPLE**

### **Abstract**

This research aimed to analyze the profitability of fruits (pistachio, pear, almond, walnut, mulberry, apple, fig, apricot, pomegranate, grape) produced in Batman province with the data of the Batman Provincial Directorate of the Ministry of Agriculture and Forestry for the period 2023. Production costs, gross production values, gross profits, net profits and relative profits of field crops produced in Batman province were examined. According to the results obtained from the research; The average production cost of pistachio production is calculated as 4186.42 TL/da, the average production cost of pear production is 6128.34 TL/da, the average production cost of almond production is 4472.11 TL/da, the average production cost of walnut production is 6122.35 TL/da, the average production cost of mulberry production is 6642.56 TL/da, the average production cost of apple production is 6173.74 TL/da, the average production cost of fig production is 5875.56 TL/da, the average production cost of apricot production is 6540.43 TL/da, the average production cost of pomegranate production is 6145.82 TL/da and the average production cost of grape production is 4780.58 TL/da. When considered in terms of relative profit, the highest value is in pistachio (6.45) production.

**Keywords:** fruits farm, gross profit, net profit, relative profit, profitability

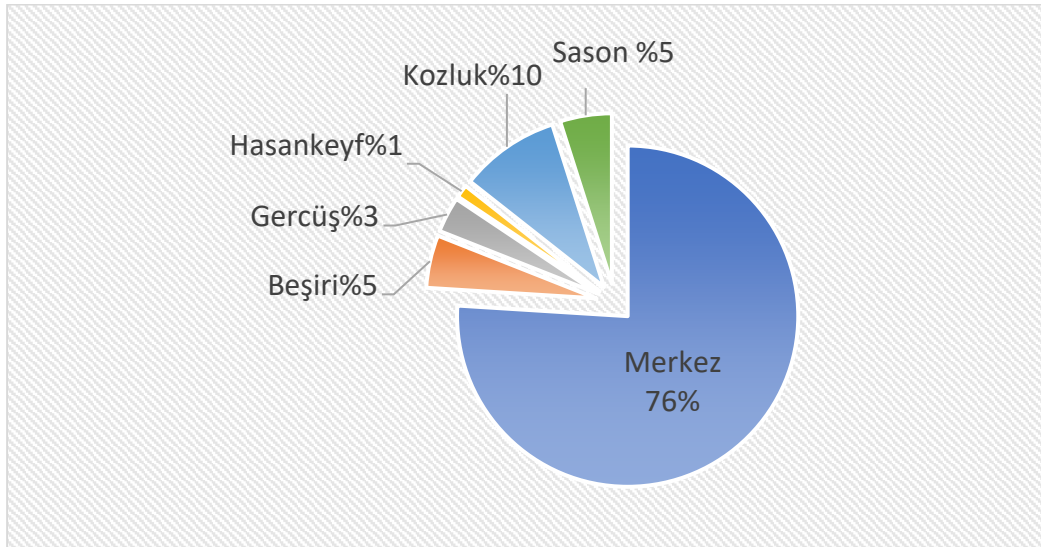
## 1. Giriş

Türkiye toprakları sahip olduğu ekolojik özellikleri, gen kaynakları ve çeşit zenginliği ile dünya meyveciliğine yön verebilecek bir potansiyeli bulunmaktadır. Ülkemizin özellikle ekonomik değeri yüksek olan antepfıstığı, zeytin, incir, fındık, badem ve cevizde dünya üretiminde ilk sıraya oturmaması için bir sebep bulunmamaktadır. Bu saydığımız meyvelere daha başka birçok meyveyi ekleyebileceğimiz gerçeği bir yanda dururken; asıl vurgulamak istediğimiz konu anavatanı Anadolu olan tüm meyvelerin üretiminde dünyada çok iddialı ülkeler arasında yer almamız gerektiğidir (Ak ve Pakyürek, 2022).

Batman, Türkiye Cumhuriyeti'nin Güneydoğu Anadolu Bölgesi'nde yer alan bir ildir. 1990 yılına kadar Siirt iline bağlı olan Batman, 16 Mayıs 1990 tarih ve 3647 sayılı kanunla Beşiri, Kozluk ve Sason ilçeleri Siirt'ten, Hasankeyf ve Gercüş ilçeleri ise Mardin'den alınıp Merkez'e bağlanarak Türkiye'nin 72. ili olmuştur. Batman ilinin, kuzey ve kuzeydoğusu yüksek, sarp ve dağlık olup güneyi ise dağlık ve engebelidir. Dicle nehri batıdan doğuya akarak il topraklarının içinden geçer. Batman çayı, Batman-Diyarbakır il sınırını çizerek Dicle nehri ile birleşir. Batman'da karasal iklim hüküm sürmektedir. Bölgede yazları sıcak ve kurak, kışlar soğuk ve yağışlı geçer. Batman ili 41 derece 10 dakika ve 41 derece 40 dakika doğu boylamları ile 38 derece 40 dakika ve 37 derece 50 dakika kuzey enlemleri arasında yer alır. Batman nüfusu (647.205) Türkiye nüfusu'nun ( 85.372.377 ) %0.75'ini oluşturmaktadır.

2023 yılı nüfus artış hızı %19,8, nüfus sayısına göre Türkiye il sıralaması 33, km<sup>2</sup>'ye düşen kişi sayısı 139 kişi, hane halkı büyüklüğü 4.6 kişi olarak belirlenmiştir.

Batman ili ilçe nüfuslarının dağılımı incelendiğinde %76'lık pay ile, en yüksek nüfusun merkez ilçede olduğu görülmektedir.. Merkez ilçeyi %10'luk pay ile Kozluk ilçesi, %5'erlik paylar ile Sason ve Beşiri ilçeleri izlemektedir (Şekil 1).



Şekil 1: Batman İlçelere Göre 2023 Yılı Nüfus Sayıları ve Oranları

Kaynak: Batman il nüfus ve vatandaşlık müdürlüğü

Batman il arazilerinin niteliklerine göre dağılımları incelendiğinde, en yüksek pay %43,34 ile tarıma elverişsiz arazilere aittir. Tarım arazilerinin oranı %33,36 olurken, orman arazileri %14,68 o, mera arazileri %8,63'lük pay almaktadır (Tablo 1).

**Tablo 1. Batman İline Ait Arazilerin Niteliklerine Göre Dağılımı**

Arazinin Cinsi (ha)	Toplam	Yüzde (%)
Tarım Arazisi	156.980	33.36
Mer'a Arazisi	40.592	8.63
Orman Arazisi	69.084	14.68
Tarıma Elverişsiz Arazi	203.944	43.34
GENEL TOPLAM	470.600	100.00

Kaynak: Batman İl Tarım ve Orman Müdürlüğü

Tablo 2 de Türkiye ve Batman ile toplam tarım alanlarının yıllar itibariyle azalış gösterdiği görülmektedir 2021 yılı itibariyle Batman ili tarım alanları Türkiye'deki toplam tarım alanlarının % 0.39'unu oluşturduğu belirlenmiştir.

**Tablo 2. Türkiye ve Batman ili toplam tarım alanı (2013-2021)**

Yıllar	Toplam Tarım Alanları (ha)	
	Türkiye	Batman
2013	23.805.512	117.758
2014	23.940.714	115.151
2015	23.933.614	112.047
2016	23.711.159	101.588
2017	23.346.598	91.111
2018	23.179.986	93.776
2019	23.099.503	91.925
2020	23.145.134	94.315
2021	23.445.680	93.161

Kaynak: Batman İl Tarım ve Orman Müdürlüğü

Bugüne kadar birçok çalışmada bazı meyvelerin üretim maliyetleri hesaplanmıştır. Özellikle antepfıstığı (Sandal ve Yurttaş, 2019; Külekçi ve Aksoy 2011), elma (Akça ve ark., 1999; Kanat ve ark., 2017), badem (Tursun ve ark., 2022), üzüm (Tutar ve Karlı 2024), gibi ürünlerin üretim maliyetlerini hesaplayan çalışmalar yapılmıştır. Bu çalışmada Batman ilinde meyve üretimine yönelik ekonomik analizin yapılması ve maliyeti etkileyen faktörlerin tespiti amaçlanmaktadır.

## 2. Materyal ve Yöntem

Çalışmanın materyalini ikincil nitelikli veriler oluşturmaktadır. Çalışmada Batman Tarım ve Orman İl Müdürlüğü Brifing Raporları, konu ile ilgili daha önce yapılmış tez, makale, kongre bildirimleri, Türkiye İstatistik Kurumu (TÜİK) tarafından yayınlanmış kaynaklar ve istatistiksel kayıtlardan yararlanılmıştır.

Çalışmada meyve üretim faaliyetinin karlılık durumunu ortaya koyabilmek için brüt kar, net kar ve nispi kar analizi yapılmıştır. Brüt karın hesaplanmasında, brüt üretim değerinden değişken masraflar çıkartılmıştır. Net karın hesaplanmasında brüt üretim değerinden üretim masrafları (değişken masraflar + sabit masraflar) çıkartılmıştır. Nispi kar ise brüt üretim değerinin üretim masraflarına bölünmesiyle hesaplanmıştır.

Çalışmada değişken masraflar: materyal masraflarını oluşturan tohum, gübre, zirai mücadele ilacı, su masrafları ve işgücü masrafları ile döner sermaye faiz karşılığında oluşmaktadır. Çalışmada sabit masraflar ise arazi kirası ve yönetim payından oluşmaktadır. Genel yönetim giderleri toplam değişken masrafların %3'ü olarak hesaplanmıştır.

## 3. Araştırma Bulguları

Tablo 3'de Batman ilinde yetiştirilen meyvelerin, Türkiye ve Batman ilinde, 2019-2023 yılları arası üretim alanlarında ve üretim miktarlarında meydana gelen değişim verilmiştir.

2023 yılı Batman ili meyve ürünlerinin ekilen alan miktarları incelendiğinde, en yüksek ekilen alan büyüklüğünün antepfıstığı ürününe ait olduğu belirlenmiştir. Antep fıstığının yıllar itibariyle ekilen alan miktarında meydana gelen değişim incelendiğinde ekilen alan miktarının

2019 yılından 2023 yılına gelindiğinde artış gösterdiği, 75122 dekardan 129405 dekara çıktığı belirlenmiştir. 2023 yılı itibariyle ekilen alan miktarı bakımından ikinci sırada yer alan ürün 31148 da ile üzüm olurken, onu sırasıyla ceviz, badem, nar, kayısı, elma, incir, armut ve dut izlemektedir (Tablo 3).

Tablo 3'e göre 2019 yılından 2023 yılına gelindiğinde yani son 5 yıl içerisinde Batman ilinde, armut, badem, ceviz, dut, elma, incir, kayısı, nar ve üzüm meyvelerinin ekim alanlarında azalış meydana geldiği görülmektedir. Badem, elma, incir, kayısı, üzüm Batman ilinde 2019 yılından 2023 yılına gelindiğinde üretim miktarı bakımından azalış gösteren ürünler olarak belirlenmiştir. Armut, ceviz, dut ve nar üretim alanlarının azalmasına karşın, üretim miktarı olarak artış gösteren ürünlerdir.

Türkiye geneline bakıldığında 2019 yılından 2023 yılına gelindiğinde 5 yıllık süreç içerisinde kayısı ve üzüm dışındaki tüm ürünlerin üretim miktarlarında artış meydana gelmiştir. Armut, dut ve üzüm üretim alanları ise azalırken; badem, ceviz, elma, incir, kayısı ve nar üretim alanları artış göstermiştir. Armut ve dut üretim alanları azalışına karşın üretim miktarlarında artış gösteren ürünler olurken, kayısı üretim alanları artış göstermesine rağmen üretim miktarında azalış gösteren ürün olarak belirlenmiştir.



**Tablo 3. Batman İli ve Türkiye’de Antep fıstığı, Armut, Badem, Cevizin Ekim Alanı (da) ve Üretim Miktarları (ton)**

Ürünler	Yıl	Batman				Türkiye				Pay(%)
		Ekilen Alan	İndeks (2023=100)	Üretim Miktarı	İndeks (2023=100)	Ekilen Alan	İndeks (2023=100)	Üretim Miktarı	İndeks (2023=100)	
Antep Fıstığı	2019	75122	100,00	1037	100,00	3662103	100,00	85000	100,00	1,22
	2020	93055	123,87	1203	116,01	3818466	104,27	296376	348,68	0,41
	2021	105939	141,02	963	92,86	3894509	106,35	119355	140,42	0,81
	2022	115069	153,18	2296	221,41	4087086	111,60	239289	281,52	0,96
	2023	129405	172,26	3440	331,73	4205622	114,84	176000	207,06	1,95
Armut	2019	402	100,00	199	100,00	262985	100,00	530723	100,00	0,04
	2020	242	60,20	254	127,64	260707	99,13	545569	102,80	0,05
	2021	236	58,71	233	117,09	251546	95,65	530349	99,93	0,04
	2022	209	51,99	287	144,22	237063	90,14	551086	103,84	0,05
	2023	208	51,74	289	145,23	227259	86,42	534513	100,71	0,05
Badem	2019	2260	100,00	444	100,00	470881	100,00	150000	100,00	0,30
	2020	1830	80,97	217	48,87	523695	111,22	159187	106,12	0,14
	2021	1902	84,16	195	43,92	577324	122,61	178000	118,67	0,11
	2022	1952	86,37	234	52,70	632663	134,36	190000	126,67	0,12
	2023	1732	76,64	203	45,72	686966	145,89	170000	113,33	0,12
Ceviz	2019	3330	100,00	238	100,00	1245527	100,00	225000	100,00	0,11
	2020	2746	82,46	456	191,60	1417899	113,84	286706	127,42	0,16
	2021	2726	81,86	452	189,92	1535204	123,26	325000	144,44	0,14
	2022	2768	83,12	440	184,87	1664949	133,67	335000	148,89	0,13
	2023	2612	78,44	479	201,26	1740796	139,76	360000	160,00	0,13
Dut	2019	60	100,00	30	100,00	19916	100,00	69317	100,00	0,04
	2020	60	100,00	38	126,67	20515	103,01	70620	101,88	0,05
	2021	60	100,00	30	100,00	19999	100,42	69475	100,23	0,04
	2022	50	83,33	35	116,67	16334	82,01	72892	105,16	0,05
	2023	5	8,33	36	120,00	17665	88,70	71383	102,98	0,05
Elma	2019	1210	100,00	363	100,00	481218	100,00	1041772	100,00	0,03
	2020	509	42,07	200	55,10	493281	102,51	1170203	112,33	0,02
	2021	414	34,21	175	48,21	489021	101,62	1277011	122,58	0,01
	2022	384	31,74	215	59,23	498185	103,53	1349382	129,53	0,02
	2023	331	27,36	224	61,71	512807	106,56	1306031	125,37	0,02
İncir	2019	670	100,00	237	100,00	521164	100,00	310000	100,00	0,08
	2020	440	65,67	176	74,26	536935	103,03	320000	103,23	0,06
	2021	415	61,94	167	70,46	546975	104,95	320000	103,23	0,05
	2022	385	57,46	189	79,75	572472	109,84	350000	112,90	0,05
	2023	361	53,88	209	88,19	574587	110,25	356000	114,84	0,06
Kayısı	2019	1018	100,00	337	100,00	1311780	100,00	846606	100,00	0,04
	2020	917	90,08	357	105,93	1327478	101,20	833398	98,44	0,04
	2021	817	80,26	342	101,48	1348794	102,82	800000	94,49	0,04
	2022	817	80,26	321	95,25	1418513	108,14	803000	94,85	0,04
	2023	785	77,11	306	90,80	1449405	110,49	750000	88,59	0,04
Nar	2019	935	100,00	432	100,00	285253	100,00	559171	100,00	0,08
	2020	766	81,93	529	122,45	284632	99,78	600021	107,31	0,09
	2021	714	76,36	479	110,88	292013	102,37	647676	115,83	0,07
	2022	683	73,05	476	110,19	290697	101,91	681460	121,87	0,07
	2023	609	65,13	484	112,04	293507	102,89	638821	114,24	0,08
Üzüm	2019	40358	100,00	13852	100,00	1862446	100,00	1394000	100,00	0,99
	2020	39993	99,10	19377	139,89	1821889	97,82	1614332	115,81	1,20
	2021	39498	97,87	14460	104,39	1735069	93,16	1434010	102,87	1,01
	2022	38218	94,70	14985	108,18	1685258	90,49	1543359	110,71	0,97
	2023	31148	77,18	10339	74,64	1632727	87,67	1376067	98,71	0,75

Kaynak: TÜİK, 2023

Batman ilinde yetiştiriciliği yapılan meyvelerin üretim masraflarına ilişkin bulgular Çizelge 4’de verilmiştir. Batman ilinde yetiştiriciliği yapılan meyvelerden en yüksek üretim masrafına sahip olan ürünün 4186.42TL/da ile Antep fıstığı olduğu belirlenmiştir. Bu ürünü üretim masrafları açısından sırasıyla, armut 6128.34 TL/da, badem 4472.11TL/da, ceviz 6122.35 TL/da, dut 6642.56 TL/da, elma 6173.74 TL/da, incir 5875.56 TL/da, kayısı 6540.43 TL/da ve nar 6145.82 TL/da izlemektedir. En düşük üretim maliyetine sahip ürün ise 4780.58 TL/da ile üzüm olmuştur. Antepfıstığı üretim masraflarının %44.06’sını toplam sabit masraflar oluştururken, %55.94’ünü değişken masrafların oluşturduğu belirlenmiştir. Değişken masrafların içinde en yüksek payı alan kalemin iş gücü masraflarından olan budamanın olduğu ortaya çıkmıştır. Badem üretim masraflarının %41.29’unu toplam sabit masraflar oluştururken, %58.71’ünü değişken masrafların oluşturduğu belirlenmiştir. Değişken masrafların içinde en yüksek payı alan kalemin iş gücü masraflarından olan hasadın olduğu ortaya çıkmıştır. Ceviz üretim masraflarının %39.32’sini toplam sabit masraflar oluştururken, %60.68’ini değişken masrafların oluşturduğu belirlenmiştir. Değişken masrafların içinde en yüksek payı alan kalemin iş gücü masraflarından olan hasadın olduğu ortaya çıkmıştır. İncir üretim masraflarının %44.29’unu toplam sabit masraflar oluştururken, %55,71’ini değişken masrafların oluşturduğu belirlenmiştir. Değişken masrafların içinde en yüksek payı alan kalemin iş gücü masraflarından olan budamanın olduğu ortaya çıkmıştır. Batman ili meyve yetiştiriciliğinin karlılık analizine bakıldığında ise nispi karı en yüksek olan meyvenin 6.55’lik oran ile Antep fıstığı olarak hesaplanmıştır. Antep fıstığını nisbi karlılık açısından izleyen ürünler ceviz (3.29), badem (2.95), incir (2.81), elma (1.75), armut (1.66), kayısı (1.61), üzüm (1.53), dut (1.51) olurken nispi karı en düşük ürün nar (1.22) olarak belirlenmiştir (Tablo 4).

**Tablo 4. Batman İli Meyve Üretimi Maliyet ve Karlılık Analizi**

Masraf Unsurları	Tutarlar									
	Antep Fıstığı	Armut	Badem	Ceviz	Dut	Elma	İncir	Kayısı	Nar	Üzüm
<b>Materyal Masrafları (TL/da)</b>										
Gübre	495.00	353.50	495.00	510.00	495.00	353.50	353.50	353.50	510.00	515.00
Elektrik (Sulama)	-	780.00	-	780.00	-	780.00	780.00	780.00	780.00	-
Zirai Mücadele İlacı	138.00	168.00	138.00	168.00	54.00	168.00	54.00	114.00	114.00	168.00
<b>Alt Toplamı</b>	<b>633.00</b>	<b>1301.50</b>	<b>633.00</b>	<b>1458.00</b>	<b>549.00</b>	<b>1301.50</b>	<b>1187.50</b>	<b>1247.50</b>	<b>1404.00</b>	<b>683.00</b>
<b>İşgücü Masrafları (TL/da)</b>										
Toprak İşleme	385.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00	330.00
Budama	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00	420.00
Sulama	-	250.00	-	250.00	-	250.00	-	250.00	250.00	-
Zirai Mücadele	312.50	375.00	312.50	375.00	125.00	375.00	125.00	250.00	250.00	375.00
Hasat	385.00	385.00	685.00	560.00	2700.00	385.00	385.00	385.00	385.00	770.00
<b>Alt Toplamı</b>	<b>1502.50</b>	<b>1760.00</b>	<b>1747.50</b>	<b>1935.00</b>	<b>3575.00</b>	<b>1760.00</b>	<b>1510.00</b>	<b>1635.00</b>	<b>1635.00</b>	<b>1895.00</b>
<b>Diğer Masraflar (TL/da)</b>										
Çuval/Kasa	25.00	196.00	50.00	75.00	350.00	280.00	385.00	350.00	315.00	140.00
Nakliye	70.00	35.00	70.00	70.00	105.00	35.00	35.00	35.00	35.00	70.00
<b>Alt Toplamı</b>	<b>95.00</b>	<b>231.00</b>	<b>120.00</b>	<b>145.00</b>	<b>455.00</b>	<b>315.00</b>	<b>420.00</b>	<b>385.00</b>	<b>350.00</b>	<b>210.00</b>
Döner Sermaye Faizi	111.53	164.63	125.03	176.90	228.95	168.83	155.88	163.38	169.45	139.40
<b>Toplam Değişken Masraflar (TL/da)</b>	<b>2342.03</b>	<b>3457.13</b>	<b>2625.53</b>	<b>3714.90</b>	<b>4807.95</b>	<b>3545.33</b>	<b>3273.38</b>	<b>3430.88</b>	<b>3558.45</b>	<b>2927.40</b>
Yönetim Karşılığı	70.26	103.71	78.77	111.45	144.24	106.36	98.20	102.93	106.75	87.82
Arazi Sermayesi Faizi	1500.00	1750.00	1500.00	1750.00	1500.00	1750.00	1750.00	1750.00	1750.00	1500.00
Sabit Tesis Amortismanı	127.50	545.00	153.03	280.00	105.76	514.70	502.65	1005.30	471.36	126.36
Sabit Tesis Faizi	146.63	272.50	114.78	266.00	84.61	257.35	251.33	251.33	259.25	139.00
<b>Toplam Sabit Masraflar (TL/da)</b>	<b>1844.39</b>	<b>2671.21</b>	<b>1846.58</b>	<b>2407.45</b>	<b>1834.61</b>	<b>2628.41</b>	<b>2602.18</b>	<b>3109.55</b>	<b>2587.37</b>	<b>1853.18</b>
<b>Üretim Masrafları (TL/da)</b>	<b>4186.42</b>	<b>6128.34</b>	<b>4472.11</b>	<b>6122.35</b>	<b>6642.56</b>	<b>6173.74</b>	<b>5875.56</b>	<b>6540.43</b>	<b>6145.82</b>	<b>4780.58</b>
Verim (kg/da)	100.00	600.00	240.00	310.00	500.00	900.00	550.00	750.00	750.00	332.00
Ürün Maliyeti (TL/kg)	41.86	10.21	18.63	19.75	13.29	6.86	10.68	8.72	8.19	14.40
Bahçe Tesis Tutarı (TL/da)	5865.00	10900.00	4591.00	10640.00	3384.26	10294.00	10053.00	10053.00	10370.00	5560.00
Çıplak Arazi Değeri (TL/da)	30000.00	35000.00	30000.00	35000.00	30000.00	35000.00	35000.00	35000.00	35000.00	30000.00
Bahçe Tesis Süresi (Yıl)	7.00	5.00	5.00	6.00	4.00	5.00	5.00	5.00	4.00	3.00
Bahçenin Ekonomik Ömrü (Yıl)	53.00	25.00	35.00	44.00	36.00	25.00	25.00	15.00	26.00	47.00
Ağaç Sayısı (adet/da)	20.00	25.00	30.00	18.00	20.00	30.00	25.00	25.00	50.00	111.00
Satış Fiyatı (TL/kg)	270.00	17.00	55.00	65.00	20.00	12.00	30.00	14.00	10.00	22.00
<b>Toplam üretim değeri (TL/da)</b>	<b>27000.00</b>	<b>10200.00</b>	<b>13200.00</b>	<b>20150.00</b>	<b>10000.00</b>	<b>10800.00</b>	<b>16500.00</b>	<b>10500.00</b>	<b>7500.00</b>	<b>7304.00</b>
<b>Brüt Kar (TL/da)</b>	<b>24657.97</b>	<b>6742.87</b>	<b>10574.47</b>	<b>16435.10</b>	<b>5192.05</b>	<b>7254.67</b>	<b>13226.62</b>	<b>7069.12</b>	<b>3941.55</b>	<b>4376.60</b>
<b>Net Kar (TL/da)</b>	<b>22813.58</b>	<b>4071.66</b>	<b>8727.89</b>	<b>14027.65</b>	<b>3357.44</b>	<b>4626.26</b>	<b>10624.44</b>	<b>3959.57</b>	<b>1354.18</b>	<b>2523.42</b>
<b>Nispi Kar</b>	<b>6.45</b>	<b>1.66</b>	<b>2.95</b>	<b>3.29</b>	<b>1.51</b>	<b>1.75</b>	<b>2.81</b>	<b>1.61</b>	<b>1.22</b>	<b>1.53</b>

#### 4. Sonuç

Bu araştırmada, Batman ilinde üretilen meyvelerin (antepfıstığı, armut, badem, ceviz, dut, elma, incir, kayısı, nar, üzüm) karlılık durumu Tarım ve Orman Bakanlığı Batman İl Müdürlüğü'nün 2023 dönemi verileri ile analiz edilmiştir. Batman ilinde üretilen tarla bitkileri ürünlerinin üretim masrafları, brüt üretim değerleri, brüt karları, net karları ve nispi karları incelenmiştir. Araştırmadan elde edilen sonuçlarına göre, antep fıstığı üretiminin ortalama üretim masrafı 4186.42 TL/da, armut üretiminin ortalama üretim masrafı 6128.34 TL/da, badem üretiminin ortalama üretim masrafı 4472.11 TL/da, ceviz üretiminin ortalama üretim masrafı 6122.35 TL/da, dut üretiminin ortalama üretim masrafı 6642.56 TL/da, elma üretiminin ortalama üretim masrafı 6173.74 TL/da, incir üretiminin ortalama üretim masrafı 5875.56 TL/da, kayısı üretiminin ortalama üretim masrafı 6540.43 TL/da, nar üretiminin ortalama üretim masrafı 6145.82 TL/da ve üzüm üretiminin ortalama üretim masrafı 4780.58 TL/da olarak hesaplanmıştır. Nispi kar açısından ele alındığında ise en yüksek değer antepfıstığı (6.45) üretimindedir. Bu sonuçlar doğrultusunda önerilerde bulunmak gerekirse, üretim maliyetlerinin azaltılması, ürün kalitesinin artırılması, dış ticarete rekabet avantajı sağlanması ve tüketici sağlığının korunması için ilaç ve gübre kullanımına yönelik çiftçiler bilinçlendirilmeli, girdiler reçeteli satılarak girdi kullanım etkinliğinin artırılması hedeflenmelidir. Böylece girdi maliyetlerinin ve dolayısıyla da üretim maliyetlerinin azalması sağlanmış olacaktır.

Üretim maliyetlerinin takip edilebilmesi için; üretimin kayıt altına alınması ve işletmelerde üretim desenlerine yönelik planlamaların yapılması gerekmektedir. Sonuç olarak bu bulgular ile Batman ilinde meyve üretimi yapan üreticilere, üreticileri birliklerine ve kooperatiflerine, konu ile ilgili diğer sivil toplum örgütlerine, politika yapıcılara üretim stratejisi geliştirme aşamasında katkıda bulunacağı düşünülmektedir.

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## ÇİFTLİK HAYVANLARINDA SICAKLIK STRESİNİN ETKİLERİNİN BELİRLENMESİ

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### **Özet**

Sıcaklık stresi, çiftlik hayvanlarının başta süt verimi olmak üzere diğer verimlerini (et, yapağı, tiftik, yumurta vs), üreme performanslarını ve metabolizmasını olumsuz olarak etkileyen önemli bir çevresel faktördür. Çevre sıcaklığının aşırı derecede artması, özellikle de yüksek sıcaklık ile yüksek nem oranlarının birlikte seyretmesi durumunda, çiftlik hayvanlarının ısı kaybını sınırlar ve vücut ısıları, rektal sıcaklıkları, nabız ve solunum sayılarının artmasıyla birlikte hayvanlar strese girerler. Bu süreç içerisinde hayvanlar, vücut ısılarını düşürebilmek için çeşitli önlemler almaya çalışırlar. Sıcaklık stresine maruz kalan çiftlik hayvanlarında süt ve döl veriminde önemli derecede düşüşler meydana gelmesi, entansif işletmelerde büyük ekonomik kayıplara neden olmaktadır. Bu çalışmanın amacı, çevre sıcaklığının aşırı derecede artması sonucunda evcil hayvanlar üzerinde nasıl bir etkide bulunduğu, hayvanların bunlara nasıl tepki gösterdiği, yine stres faktörünün etkilerinin hayvanlarda nasıl tespit edildiği ve işletmelerin bunlara karşı hangi önlemleri alması gerektiği hakkında bilgilendirmek için yapılmıştır.

**Anahtar Kelimeler:** Fizyolojik parametreler, Çiftlik hayvanları, Stres faktörleri, Sıcaklık stresi, Verim,

## **DETERMINATION OF THE EFFECTS OF HEAT STRESS ON FARM ANIMALS**

### **Abstract**

Heat stress is an important environmental factor that negatively affects farm animals' milk yield, as well as other yields (meat, wool, mohair, eggs, etc.), reproductive performance and metabolism. Excessive increases in environmental temperature, especially when accompanied by high temperatures and high humidity, limit the heat loss of farm animals and cause animals to become stressed as their body temperature, rectal temperature, pulse and respiratory rates increase. During this process, animals try to take various precautions to reduce their body temperature. Significant decreases in milk and fertility in farm animals exposed to heat stress cause major economic losses in intensive enterprises. The purpose of this study was to inform about how excessive increases in environmental temperature affect domestic animals, how animals react to them, how the effects of stress factors are detected in animals and what precautions enterprises should take against them.

**Keywords:** Physiological parameters, Farm animals, Stress factors, Heat stress, Yield,

## Giriş

Stres; çevresel faktörlerinin etkisi sonucunda hayvanların içerisinde bulunduğu olumsuz durum olarak tanımlanmaktadır. Stres faktörünün organizma üzerinde oluşturduğu olumsuz etki sonucunda, vücudun stres faktörüne karşı oluşturduğu dengeyi yani homeostasis ile başa çıkamaması olarak bilinmektedir. (Broom, 1996). Bu durum, hayvanlarda oluşturduğu stres faktörünün, hayvanın refah düzeyindeki bir göstergesi olarak hem davranışsal hem de fizyolojik değişimler ile kendini göstermektedir (Borell, 2001).

Isı stresini belirlemede ve değerlendirmede kullanılan en önemli parametre sıcaklık-nem indeksi (SNİ) değeridir. Eğer ortam sıcaklığı yüksek ise, ısı yükünün hayvanlar üzerindeki etkisinin belirlenmesinde sıcaklık-nem indeksi (SNİ) olarak bilinen bir parametre kullanılmaktadır (Silanikove, 2000; Marai ve ark., 2002; Marai ve ark., 2004).

Sıcaklık stresi evcil hayvan verimlerini olumsuz etkileyebilen önemli bir çevre faktördür. Çevre sıcaklığı türler üzerine etkileri farklılık göstermektedir. Pek çok çiftlik hayvanı 10-20 °C arasındaki sıcaklıklarda herhangi bir sıcaklık stresine maruz kalmadan rahatlıkla hayatlarını sürdürürler ki buna “Konfor Bölgesi” veya “Rahatlık Bölgesi” olarak tanımlanmaktadır (Yorulmaz ve Altın, 2015; Büyüктаş ve ark, 2016). Bu sıcaklık derecelerine evcil hayvanlar için optimum sıcaklık olarak adlandırılır. Optimum sıcaklıklarda hayvanlar en az yem tüketimi ile en yüksek verimi sağlamakta olup, en uygun sıcaklığın 10-15 °C arasında olduğu ve zorunlu hallerde bu sıcaklığın 7 °C kadar düşebileceği belirtilmiştir (Mc Arthur ve Clark 1998). Sıcaklık stresi ise çiftlik hayvanlarına ortam sıcaklığı ile nem oranının hayvanların vücut ısılarını dengeleyebileceği seviyelerin üzerine çıkması olarak tanımlanmaktadır (West, 2014). İklimsel faktörlerin etkili olduğu çevre faktörlerinden birisi de bağıl nemdir. Sıcaklık arttıkça bağıl nem de artış gösterdiğinden hissedilebilir sıcaklık daha yüksek olacaktır. Bu durum hayvanın bütün faaliyetlerini olumsuz bir şekilde etkisi olacaktır (Üreme, verim, fizyoloji vs) (Chase ve Sniffen, 1988). Sıcaklığın artması hayvanlarda solunum ve nabız sayılarının artması ile hayvanın terlemesinin artması sonucunda buharlaşma yoluyla ısı kaybına neden olmaktadır.

Ortam sıcaklığının artması hayvanlarda, iştah azalması sonucunda yem alımının azalmasına, üreme faaliyetlerinin düşmesine, canlı ağırlık kazancının azalması sonucunda düşük canlı ağırlığa sahip olmasına, bağışıklık sisteminin zayıflamasına, et, süt vs gibi verimlerin düşmesine ve özellikle süt içeriğinde olumsuzlukların görülmesi gibi sonuçları olmaktadır (Shebab-El-Deen, 2010).

Bu derleme ile yüksek çevre sıcaklığının evcil hayvanlar üzerindeki etkilerinin nasıl görüldüğü, yine yüksek sıcaklığın etkilerinin hayvanlarda nasıl tespit edildiği ve bunlara karşı hangi önlemler alınabileceği hakkında bilgilendirileceği amaçlanmıştır.

### 1. Evcil Hayvanların Sıcaklık İstekleri

Evcil hayvanların sıcaklık istekleri farklılık arz etmektedir. Her tür için optimum sıcaklık ve nem istekleri çizelge 1’de bildirilmektedir. Evcil hayvanların ortalama sıcaklık değeri 10-20 °C arasında olduğu, sıcaklığın 24 °C’ nin üstüne çıktığında ise üretilen veriminin düşeceği ve yapılan araştırmalara göre barınak içi sıcaklığının 35 °C’ nin üzerine çıktığında ise süt veriminin en az %50 azalacağı bildirilmektedir (Vercoe, 2003). Yine yapılan çalışmalara göre 0 ile 20 °C arasındaki sıcaklıklarda süt verimlerini korudukları, 25 ile 29 °C arasındaki sıcaklıklarda

hayvanların yaşamlarını sürdürebildikleri, -18 ile 24 °C sıcaklıklara adapte olabildikleri görülmektedir (Spiers, 2003). Bağıl nem durumu ise ortalama %70-80 arasında olabileceği, bağıl nemin %40' ın altına düştüğünde hayvanların solunum sıkıntıları yaşayabileceği, barınak içerisindeki bağıl nemin %30 ile 90' nın dışında olması durumunda vücut ısı dengeleme mekanizmasının olumsuz olarak etkilenmesine neden olmaktadır (Özhan ve ark., 2001). Oransal nemin %30' un altına düştüğünde ise solunum hastalıklarının ortaya çıkmasına neden olmaktadır.

**Çizelge 1.** Türler Ait Sıcaklık ve Nem İstekleri (Büyükbaş ve ark. 2016).

Tür	Sıcaklık (°C)			Nem (%)		
	Min	Max	Optimum	Min	Max	Optimum
<b>Sığır</b>	-18	32	10-15	40	80	60-75
<b>Koyun</b>	-20	32	10-13	40	80	55-75
<b>Tavuk</b>	-5	30	13-18	50	80	65-75

## 2. Sıcaklık Nem İndeksinin Hayvanlar Üzerindeki Etkileri

Sıcaklık nem indeksi; sıcaklık ve bağıl nemin birlikte hesaplanması sonucunda, inek veya diğer çiftlik hayvanlarının hissettiği çevre koşullarını ifade etmektedir. İnekler için bu indeks değerinin 70 olması ile sıcaklık stresine girmeye başlarlar ve bu değer arttıkça sıcaklık stresinin de şiddeti de artar (Mutaf ve Sönmez, 1984).

Çiftlik hayvanları sıcaklık stresine maruz kaldıklarında davranışlarında (yem tüketiminin düşmesi, daha fazla ayakta durma vs ) ve fizyolojilerinde (solunum ve nabız sayılarında artış, ruminasyonda azalma vs) bazı değişiklikler olur. Sıcaklık stresine çok az maruz kalınması halinde bile süt verimi ve diğer verimler, üreme verimleri ve sağlıklarında önemli olumsuzluklar görülmektedir. Bu dönemde hayvanlar kaba yemlerden kaçarak yem seçmeye başlar ve daha az kuru madde tüketirler. Buna bağlı olarak ruminasyonda bir düşüş yaşanır. Sıcaklık stresine maruz kalmış hayvanların geniş getirme sürelerinin gece arttığı görülmüştür (Kumar ve ark. 2011).

Sıcaklık nem indeksi değerleri hesaplanırken farklı araştırmacılar farklı formüller geliştirmişlerdir.

Sıcaklık nem indeksinin bir gün içerisinde, yaş ve kuru termometre ile ölçülen bu sıcaklıkların kombinasyonundan oluşan ve  $SNİ = 0.72(Y*C+K*C) + 40.6$  formülü ile tespit edilen bir parametredir. Burada;  $Y*C$  = Yaş termometre sıcaklığını,  $K*C$  = Kuru termometre sıcaklığını temsil etmektedir (Silanikove, 2000; Marai ve ark 2002).

Tespit edilen sıcaklık nem indeks değeri, 70 veya altındaki değerleri alıyor ise rahatlığı; 75 ve 78 aralığında veya 78 'in üzerinde ise normal vücut sıcaklığının olumsuz etkilendiği ve sıcaklık stresine maruz kaldığının bir ifadesi olarak tanımlanır.

Süt ineklerinde  $SNİ 72'$  yi geçtiği zaman süt veriminde azalma görülür ( $SNİ 72 = 25 °C$  ve %50 nispi neme eşittir).

Broucek ve ark., (2006)' nın geliştirdiği  $SNİ$  formülü ise aşağıdaki gibidir.

$$SNİ (THI) = ((0.8x Sıcaklık °C) + ((\% Nispi Nem/100) x (Sıcaklık °C -14,4)) + 46.4))$$

$SNİ$  değerleri aşağıdaki gibi sınıflandırmaya tabi tutmuştur.

$SNİ 72'$  den küçükse, stres yok demektir



SNİ 72-78 arası ise orta düzeyde stres,  
SNİ 79-89 arası ise şiddetli stres,  
SNİ 90-98 arası ise çok şiddetli stres var demektir.  
SNİ 98'den büyükse hayvanın ölümü gerçekleşir (Moran 2005).

### **3. Evcil Hayvanlarda Görülen Sıcaklık Stresine Bağlı Fizyolojik Değişimler**

Evcil hayvanlar, sıcaklık stresine maruz kaldıkları sürece bazı fizyolojik değişikliklere maruz kalmaktadırlar, bunlar; vücut sıcaklığındaki değişimler, solunum sayısındaki değişimler, rektal sıcaklık değişimleri, nabız sayısındaki değişimler, deri sıcaklığındaki değişimler hayvanların sıcaklık stresine girip girmemeleri hakkında bilgi vermektedir (Renaudeau ve ark., 2012; Ribeiro ve ark., 2014).

#### **3.1. Vücut ısısındaki Değişimler**

Vücut ısısındaki artışın hayvanlarda görülen sıcaklık stresinin en iyi ölçütlerden biri olduğunu bildirmişlerdir. Bağlı neme bağlı olarak çevre sıcaklığının artması hayvanlarda vücut ısısının artmasına neden olmaktadır. Hayvanlar bu tepkiye karşı olarak vücut ısısını düşürebilmek için yem tüketimlerini azaltırlar. Ayrıca bunun haricinde yine terleme ve solunum sayısını artırarak vücut ısılarını düşürmeye çalışmaktadırlar (Gupta ve ark., 2013).

#### **3.2. Solunum Sayısındaki Değişimler**

Hayvanlardaki solunum sayısı, sıcaklık stresinin belirlenmesinde kullanılan önemli bir fizyolojik parametredir. Evcil hayvanlarda solunum yolu ile vücuttaki fazla nemin uzaklaştırılması ve yüksek çevre sıcaklığında, vücut sıcaklığının düşmesi yani hipotermiyi önleyebilmesi için dokulardaki CO<sub>2</sub>' nin uzaklaştırılarak yerine O<sub>2</sub>' yi kazandırma işlemini gerçekleştirir. Bu sayede hayvanlar vücut sıcaklıklarını koruyarak sıcaklık stresine karşı kendileri korumuş olurlar (Taşkın ve ark., 2015).

#### **3.3. Rektal Sıcaklık Derecesindeki Değişiklikler**

Hayvanların iç sıcaklık derecesinin belirlenmesinde kullanılan bir ölçüttür. Hayvanlar yüksek sıcaklığa maruz kaldıklarında vücut sıcaklıklarını düşürerek yaşamlarını sürdürmeye çalışırlar. Bunun en belirgin göstergesi solunum sayılarını artırarak gerçekleştirirler. Sıcaklık stresine maruz kalmış bir hayvan eğer vücut sıcaklığının ısı dengesini sağlayamadığı durumda rektal sıcaklıklarını artırır (Ribeiro ve ark., 2014).

#### **3.4. Nabız Sayısındaki Değişimler**

Nabız sayısı, hayvanlardaki metabolik bir olay olup, kan basıncının dengede tutulması olayıdır. Yüksek çevre sıcaklıklarında nabız sayısı artma eğilimi göstermekle beraber ortam sıcaklıklarının aşırı derecede artması sonucunda hayvanların metabolizma hızlarının yavaşlamasına neden olmakta ve nabız atış sayısının düşmesi ile kendini göstermektedir (Marai ve ark., 2007).

#### 4. Evcil Hayvanlarda Görülen Sıcaklık Stresine Bağlı Hormonal Değişimler

Hayvan vücudu herhangi bir stres unsuruna maruz kaldığında sinir sistemlerini uyararak çeşitli hormonları salgılayarak cevap verir. Stres durumunda kandaki adrenalin ve noradrenalin, kortizol, endorfinler, büyüme hormonu, prolaktin, testosteron, T3 ve T4 vb. hormon düzeylerinde değişiklikler görülebilir. Bu durumda merkezi sinir sistemi ve hormonal sistem, hem stresin algılanmasında hem de karşı reaksiyon göstermesi ile devreye giren ilk stres tepkileridir (Durmuş ve Koluman, 2019). Hormonal tepkiler, hayvandaki uyum yeteneğinin ana düzenleyicilerinden biridir. Bu konuda yapılan çalışmaların bir çoğunda stresin, hipofiz hormonlarının salgılanmasındaki değişikliklere neden olarak, metabolizmanın, bağışıklık sisteminin yanı sıra üreme sisteminde de olumsuzluklara yol açabileceğini (Moberg, 2000) ve sıcaklık stresine adaptasyon ile ilişkili hormonların; büyüme hormonu (GH), prolaktin (PRL), tiroid hormonları (TSH, T3, T4), mineralokortikoidler (Aldosteron ve Androjenler), glukokortikoidler (Kortizon ve hidrokortizon), katekolaminler (norepinefrin veya noradrenalin) ve antidiüretik hormonu (Vazopresin) olduğu bildirilmiştir (Sheba ve ark, 2012). Aşağıda hayvanlardaki sıcaklık stresi çalışmalarda en fazla kullanılan bazı hormonlar hakkında bilgi verilecektir.

##### 4.1. Tiroit Hormonları (TH, T3 ve T4)

Tiroid bezi boynumuzun ön orta kısmında bulunur. Endokrin sistemimizin önemli bir parçası olup, vücudun enerji kullanım hızını düzenleyen T3 (triiodothyronine) ve T4 (thyroxine) hormonlarını üretip salgılamaktadır. T3 ve T4 hormonlarının üretimi hipofiz bezinden salgılanan TSH'un (Tiroid uyarıcı hormon) kontrolü altındadır. Kanda T3 ve T4 seviyesinin artması durumunda TSH salgısı azalarak tiroid hormon seviyesini düşürmeye çalışır. Kanda T3 ve T4 miktarının azalması durumunda ise TSH üretimi artarak tiroid bezini daha çok çalıştırarak T3 ve T4 miktarını artırmaya çalışır. Hayvanlar sıcaklık stresine maruz kaldığı zaman kandaki T3 ve T4 hormonlarının seviyeleri düşer (Taşkın ve ark., 2008).

Tiroid hormonu, genellikle sıcak çevre koşullarında yaşanan değişikliklere bağlı olarak farklılık arz etmektedir. Soğuk çevre koşullarında yaşayan hayvanlarda tiroid bezinin salgısı artarken, sıcak çevrede koşullarına bu hormonun etkinliği azalmaktadır. Eğer hayvanların yetersiz beslenmesi sonucu oluşan stres faktörleri durumunda da tiroid bezinin etkinliği önemli düzeyde azalmaktadır (Marai ve ark, 2002; Todoni ve ark, 2007). Bu nedenle hormon seviyelerinin yanı sıra kandaki bazı parametrelerin incelenmesi gerekmektedir. (Villar ve ark, 1998; Singh ve ark, 2006; Al-Tamimi, 2007)

Çiftlik hayvanlarında vücut ısının üretimini düzenleyecek etkiye sahiptirler. Özellikle küçükbaş hayvanlarda yapılan çalışmalarda, kandaki tiroid hormon seviyeleri ile çevre sıcaklığı arasında ters bir ilişki söz konusudur. Havaların soğuması ile tiroid hormonlarının kandaki yoğunluklarında artma görülürken, iskelet ile kalp kaslarının, karaciğer ile böbreklerin metabolizması hızlanarak hayvanların vücut ısılarında artış görülmektedir. Böylece bu hormonların metabolizmaya etki ile hayvanların vücut ısıları dengelenmiş olur (Polat ve Dellal, 2008).

## 4.2. Kortisol Hormonu

Kortisol, böbrek üstü adrenal bez tarafından üretilen bir hormondur. Kortisol vücudun herhangi bir stres unsuruna karşı tepkisinde önemli bir rol oynar. Stres hormonu olarak bilinen kortisol, herhangi bir tehdit esnasında oluşan stresin yönetiminden sorumlu olan ana steroid hormonu olarak bilinir. Ayrıca vücudun ihtiyacı olan yağ, protein ve karbonhidrat kullanımını ve mekanizmasını kontrol etmeye yardım ederken, enflamasyonun baskılamasına yardımcı olur. Kan dolaşımındaki şekeri, beynin glikoz kullanımını ve dokuları onaran maddelerin vücutta kullanılabilirliğini artırır. Kortisol karaciğere, kaslara, yağ dokusuna ve pankreasa etki eden bir hormondur. Sıcaklık stresine maruz kalındığında ise kandaki kortisol seviyesi artış göstermektedir (Taşkın ve ark, 2008).

Bu hormonun diğer görevleri arasında; kan şekerinin seviyesini artırabilmek için proteini glikoza dönüştürmek ve kan şekerini sabit kalabilmesi için insülin hormonuyla ortaklaşa çalışmak, kan basıncını dengelemek, karbonhidrat, yağ ve protein kullanımını yönetmek, vücudun su ve tuz dengesini kontrol etmek gibi görevleri mevcuttur. Hayvanlar sıcaklık stresine maruz kaldıklarında ise bu hormonun kandaki düzeyinde artış görülmektedir (Ortiz-de-Montellano ve ark. 2007).

## 5. Sıcaklık Stresinde Görülen Belirtiler

Strese maruz kalan hayvanlarda ilk görülen belirtilerden birisi verim düşüklüğüdür. Özellikle süt verimi

sıcaklıklar 25 °C üzerine çıktığında düşmeye başlar, 30 C° üzerinde ise neredeyse %50 verim kaybı söz konusudur. Sonuç olarak sıcak stresinde süt verimi kaybı % 10-25 arasında değişim gösterir. Ayrıca süt içeriğinde değişimler görülmektedir. Süt yağı ve proteinlerinde düşmeler görülür. Bu dönemde özellikle asidoz ve ayak hastalıkları problemleri başlar (Harris, 1992; Büyüktaş ve ark., 2016).

Sıcak stresi sonucu oluşan yemleme hatalarına bağlı olarak ortaya çıkan topallama diğer bir adıyla Laminitis yaklaşık 2 ay sonra kendini gösterir. Yani sıcaklık stresi Ağustos ayı sonlarında bitse bile Ekim-Kasım aylarında şiddetli topallama tabloları ortaya çıkar. Bu da hem döl verimi hem de süt verimi kayıplarının Aralık ayına kadar devam etmesine neden olabilmektedir. Ayrıca büyükbaş hayvanlarda istenmeyen bir durum olan ikiz gebelik oranında da artışlar görüle bilinmektedir. Buna bağlı olarak da hayvanlarda döl tutma oranlarında düşüşler görüle bilinmektedir. Bunların dışında; yumurtalık aktiviteleri zayıflamasına, yetersiz gelişen veya gelişmeden atılan yumurta sayısında artış, erken embriyonik ölümlerin görülmesi, yavru atma yani abortların artması, fertilitenin düşmesi (bu yüzden çoğu hayvancılık işletmeleri yaz aylarında tohumlama faaliyetlerini durdurmaktadır), bağışıklık sisteminin zayıflaması, enfeksiyonlara bağlı olarak gelişen hastalıkların ( mastitis, metritis vb.) artması, ölüm oranlarının yükselmesi ve sütteki somatik hücre sayısında artışların görülmesi görüle bilinmektedir (Bülbül, 2006).

## 6. Sıcaklık Stresini Azaltmak İçin Uygulanan Bazı Pratik Önlemler

Hayvanların sıcaklık stresine maruz kalmamaları için işletmelerin yönetsel olarak yapmaları gereken bazı önlemler kısaca aşağıda belirtilecektir.

### **6.1. Hayvan Yemlemede Alınacak Önlemler**

- Özellikle süt üretimi yapan işletmelerde yem rasyonları hazırlanırken kuru madde miktarlarının dengelenmesi gereklidir. Rasyonlarda başarılı bir kuru madde alımını sağlayabilmek için besleme aralığını azaltmak veya rasyonun enerji yoğunluğunu arttırmak gerekmektedir (Harris, 1992).
- Çok sıcak havalarda, oluşacak bir stres durumunda yetersiz protein almak zararlıdır. Yine Bu durumda rasyonlarda protein dengesini iyi ayarlamak gereklidir. Ancak, esas tehlike vücutta protein fazlası olmasıdır. Eğer rasyonlar proteince zengin ise proteininin metabolize edilmesi sırasında üretilen üre formunda amonyağın vücuttan atılması için ekstra bir enerji gerekecektir. Bu durum ise hayvanı daha fazla stres üretmesine neden olacak ve ek bir ısı yükselmesine sebep olacaktır (West, 1995).
- Yemlere katılan yağın en önemli özelliği vücutta düşük miktarda ısı üretirken, yüksek miktarda kalori oluşturmasıdır. Bu nedenle enerji tüketiminin artması için sıcaklık stresinin varlığı durumunda rasyonlara yeteri derecede yağ ilave edilmelidir (Güneyli ve Öztürk, 1993 ).
- Sıcak havalarda yem tüketiminin azalması sonucunda ter ve idrar üretim artacağından hayvanların mineral madde ihtiyacı artacaktır. Bu yüzden rasyonlara yeteri derecede mineral madde (potasyum, sodyum, magnezyum) ilavesi yapılması gereklidir (Serbester, 2007).

### **6.2. Yem Katkı İlavesi**

Çevre sıcaklığının yüksek olduğu dönemlerde hayvanların yem tüketimleri düşmektedir. Bu nedenle yemlerin besin maddesi gereksinimlerini yükselterek vücut ısısının düşürülmesi gerekir. Yemlerin kullanım etkinliklerinin artırılması için hayvanlara yem katkı maddeleri olarak bilinen tampon maddeler, probiyotikler, prebiyotikler, niasin ve mayalar vb ek olarak verilmelidir. Bu katkı maddeleri hayvanların rumen etkinliklerini arttırarak yemlerin sindirilebilirliğini arttıracaktır (Coşkun, 2006).

### **6.3. Kaba Yemlerin Islatılarak Verilmesi**

Sıcak ortamlarda hayvanların kaba yem tüketimleri düştüğünden dolayı kaba yemlere bir miktar su ilavesi yapılarak, yem tüketimlerinde artış sağlana bilinir. Eğer hayvanlara silaj veriliyorsa, biraz daha sulandırmak suretiyle, saman ve kuru ot veriliyor ise ıslatılarak verilmesi yeterli olacaktır. Rasyonun nem oranı düşük ise eğer suca zengin yemler verilmiyorsa (silaj, posa ve yeşil yemler vs) yeme su katılarak hayvanların yem tüketimleri artırılabilir (Alkoyak ve Çetin, 2016).

### **6.4. Hayvanlara Temiz ve Soğuk Su Verilmesi**

Hayvanlarda su tüketimi bir çok faktörün (vücut büyüklüğü, hava sıcaklığı, suyun sıcaklığı, havanın nemi, tüketmiş oldukları yem miktarı ve süt üretim miktarı vs) etkisine göre değişim göstermektedir. Genel olarak hayvanlar tüketmiş oldukları her kilogram yem için 2 ile 4 kg

arasında su tüketmeleri gerekmektedir. Genellikle sıcak havalarda kuru madde tüketimi ve dolayısı ile de süt veriminde bir azalma söz konusudur. Bu durumun önlenmesi için hayvanlara temiz ve soğuk su verilmesi önerilmektedir (Harris, 1992; West, 1995).

Su tüketiminin düşmemesi için hayvanların kolayca ulaşabilecekleri yerlerde bol miktarda temiz ve soğuk su verilmelidir. Su tankının gölgede olması da önemlidir. Yine su sıcaklığının yüksek olması da su tüketimini etkileyen bir faktördür. Bu nedenden dolayı sıcak dönemlerde hayvanlara verilen su sıcaklığının 13-18°C arasında olmasına dikkat edilmelidir. Bunun için su depolarının iyi şekilde izolasyonlu ve mümkün ise bir gölgelikle aşırı sıcaktan korunması gereklidir. (Coşkun, 2006).

### **6.5. Hayvan Dinlenme Alanlarının Gölgeleştirilmesi**

Sıcaklık stresine maruz kalmış hayvanları korumanın en basit ve yaygın yolu, onlara uygun gölgelik alanlar sağlamaktır. Solar radyasyonu önlemek amacıyla yapılacak ilk ve en önemli adım gölgeliklerin yapılmasıdır. Doğrudan güneş ışığına maruz kalan hayvanlarda vücut ısılarında, rektal sıcaklıklarında, nabız sayısında ve solunum sayılarında artış görülmektedir. Gölge yapmak ile hayvanların ısı yükleri giderilebilir. Hayvanlara yeterli alanda gölgelik yapılmak suretiyle ilk olarak rektal sıcaklık ve terleme oranında azalmayla etkisini gösterecektir (West, 2014; Keown ve Grant, 1993)

### **6.6. Hayvanların Dinlenme Alanlarının Serinletilmesi**

Aşırı sıcaklık ve nem hayvanlar üzerinde stres oluşturması sonucunda verimliliği yüksek oranda düşürmektedir. Bunun için hayvan barınaklarının optimum koşullar olan 10 – 15 °C kadar serinletmesi ve istenilen oranlarda (%70-75) nemlendirme yapmak gerekmektedir. Barınakların serinletmesinde yağmurlama, fanlarla ya da fanlar yardımıyla sistemden geçen suyun serinletme etkisi ile barınak içi serinletilmesi yapılabilmektedir. Yapılan çalışmalar barınakların serinletmesinde yağmurlama ve fanlarla yapılan serinletme sisteminin gölgelik ile yapılan serinletmeye göre hayvanların verimlerini %11 daha fazla artırdığını bildirmektedir (Güneşli ve Özkütük 1993).

Barınaklarda, yağmurlama ve fan sistemleri genellikle yemlemenin yapıldığı alanlarda inşa edilmelidir. Böylece barınak içerisinde yemleme alanları en serin yerler olur ve böylelikle hayvanların verimlerinin artmasında etkili olmaktadır. Yağmurlama sistemleri tesis edilirken püskürtülen su, yemlere ve ahır tabanına gelmeyecek şekilde tesis edilmeli ve hayvana doğrudan gelmesi sağlanmalıdır. Eğer yağmurlama sistemi yemleme alanları üzerine gelecek şekilde tesis edilirse hem yemler bozulacak hem de hayvanların mastitis hastalığına tutulma oranları artacaktır. Barınaklarda hem fan hem de suyla serinletmenin yapıldığı sistem tesis edilmiş ise bu durumda önce fanlar, minimum süre (14 dakika) çalıştırılmalı, daha sonra da yağmurlama sistemi maksimum sürede (45 dakika) çalıştırılmalıdır. Böylece barınak içerisindeki suyun istenmeyen yerlere gitmesi önlenmiş olacaktır (West, 2014; Beede ve Shearer, 1991).

Sonuç olarak alınacak tedbirleri özetlemek gerekirse;

- Gölgeleme yaparak sığırları doğrudan güneş ışığından korunması,
- Fanlar kullanarak ilave serinletmenin yapılması,

- Uygun protein, enerji, mineral ve vitamin içerikli rasyon hazırlanması,
- Yüksek kalitede yem sağlanması,
- Enerji desteği için rasyona yağ ilave edilmesi,
- Yem tüketimini arttırmak için öğün sayısını 5-6'ya çıkartılması,
- Günün serin saatlerinde yemleme ve sağım yapılması,
- Yem bozulmalarını önlemek için yem yataklarının günlük temizlenmesi,
- Sınırsız temiz ve serin su sağlanması şeklinde sıralanabilir (Beede ve Shearer, 1991; Alkoyak ve Çetin, 2016 ).

## **7. Sonuç**

Sonuç olarak uzun süreli ve yüksek sıcaklığa maruz kalan hayvanlar, hayvan yetiştiriciliğinin en önemli unsuru olan verimlerin (et, süt yumurta vs) düşmesine neden olmakta ve hayvancılıktan sağlanacak gelirlerin azalmasına neden olacaktır. Bunu için hayvanlar üzerinde stres oluşturacak faktörleri belirleyerek bu faktörlerin etkilerini önleyecek çözümleri üretmek gerekmektedir.

Bu derleme ile hayvanlar üzerine etkili olan sıcaklık stersinin hayvanlarda nasıl tespit edilebileceği ve bu etkilere karşı hangi önlemleri almamız gerektiğini belirlemek amacıyla yapılmıştır.

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## ARILARDA HABERLEŐME ŐEKİLLERİ

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### **Özet**

Bal arılarının birbirleri ile iletişim kurmakta kullanmış oldukları “arı dansı” belki de biyolojilerinin en ilgi çekici yönü olup, aynı zamanda arıların yaşamlarındaki en önemli davranışlardan birisidir. Kovana polen, nektar, propolis ve su ile geri dönen bir işçi arılar, gerçekleştirmiş oldukları danslar yardımı ile diğer işçi arılara kaynağın hem yerini ve ne kadar uzakta olduğunu hem de yönü işaret ederek, diğer işçi arıları kaynağa yönlendirirler. Tarlacı arılar diğer işçi arılara kaynağın yerini yapmış oldukları iki dans yardımı ile bildirmektedirler. Bu danslar; dairesel dans ve kuyruk sallama danslarıdır. Dairesel dans çoğunlukla kovanın 100 m çevresindeki kaynakların yerini bildirmek için kullanılırken, uzaklık ile yönü tanımlamaz. Kuyruk sallama dansı ise kaynağın kovana uzaklığı 100 m’den daha fazla ise ve kaynağın yönü ve uzaklığı hakkında da bilgi vermek için kullanmış oldukları dans şeklidir. Böylelikle arılar kovandan kilometrelerce uzaklıktaki besin kaynaklarına çok fazla zaman ve enerji harcamadan ulaşabilirler.

**Anahtar Kelimeler:** arı dansları, bal arısı, dairesel dans, sallanma dansı, yön bulma

## COMMUNICATION METHODS IN BEES

### **Abstract**

The “bee dance” that honey bees use to communicate with each other is perhaps the most interesting aspect of their biology and is also one of the most important behaviors in the lives of bees. Worker bees that return to the hive with pollen, nectar, propolis and water direct other worker bees to the source by indicating both the location and distance of the source and the direction with the help of the dances they perform. Forager bees inform other worker bees about the location of the source with the help of two dances they perform. These dances are; circular dance and tail wagging dance. While the circular dance is mostly used to indicate the location of sources within 100 m of the hive, it does not define the distance and direction. The tail wagging dance is the dance form they use if the source is more than 100 m away from the hive and to provide information about the direction and distance of the source. In this way, bees can reach food sources that are kilometers away from the hive without spending too much time and energy.

**Keywords:** bee dances, honey bee, circular dance, waggle dance, navigation

## 1. Giriş

Arılar, arı ürünlerini (bal, polen, propolis, arı sütü, arı zehiri, arı havası, arı ekmeği ve apilarnil) üretmenin yanı sıra polinasyonu sağlamaları nedeniyle çok önemli bir yere sahiptir. Gelişmiş ülkelerde arıcıların gelirinin %50' si polinasyonu sağlayabilmek için tarımsal işletmelerin arıcıları kiralaması sonucunda oluşmaktadır. Arıların, hayattaki bu önemli görevi aynı zamanda canlılar için hayati olan oksijen döngüsünü devamını sağlamaktadır. Kısacası, dünyadaki yaşamın büyük bir kısmı arıların görevlerini yapmalarına bağlıdır. Arıların bu görevleri yapmasında kullandıkları en önemli yöntem ise birbirleri ile kurdukları ilişkinin şekli yani haberleşme şekilleridir (Dodoloğlu, 2017).

Bal arıları, sosyal böcekler olarak yaşayan ve bu sınıf içerisinde yer alan böceklerdir. Canlıların birbirleri ile ilişki kurmasına yardımcı olan faktör etkili bir haberleşmedir. Bal arılarının kendi aralarındaki haberleşmeleri, basit olarak algılanan ve cezbedici davranış uyarılarının tür içi aktarılmasına veya uyarıyı alan bireylerdeki fizyolojik cevapları ifade etmektedir. Arılardaki haberleşme, insanlarda olduğu gibi akıl, zekâ veya farkında olma şeklinde değildir. Bal arılarında haberleşmenin temeli koku alma duyusudur (Girard ve ark. 2011).

Arılar birbirleri ile olan ilişkileri, bilgi aktarımı veya haberleşme amacıyla kullandıkları yöntemlerdir. Bu yöntemler sırasıyla; arı dansı, koku yayma, dokunma ve ses çıkarma gibi davranışlardır. Örneğin yabancı bir arı kovana girer ise onu kokusundan ayırt edebilirler. Eğer arılar doğadaki bir nektar ve polen kaynağının yeri ile uzaklığını diğer arılara, arı dansı yaparak kovandaki diğer arılara anlatırlar, yine su kaynağının yerini salgıladıkları nasanof feramonu ile bildirmektedirler. Arılar kendi kovanlarının yerini mükemmel bir şekilde tespit etmektedirler. Eğer kovanları yeni bir yere getirilmiş ise yani daha önce hiç gitmedikleri bir yere bölgeye getirilmiş ise, kovandan çıkan arılar yeni kovanın yerini tespit etmek ve bölgeyi tanıyabilmek için kovan önünde ve çevresinde çok yavaş bir şekilde uçarlar, özellikle kovanın önünü ve uçuş deliğini belirlemek amacıyla kovanın önünde uzun süre dolaşırlar. Kovandan ayrıldıklarında ise tekrar kovana sağ salim dönebilmek için gittikleri yerin adeta fotoğrafını çekerler. Arıların kendi kovanlarının yerini bulmada, kendi ana arısının kokusunun da önemli rol oynadığı bildirilmektedir (Doğaroğlu, 2009).

Bu derlemenin amacı sosyal böcekler olarak tanımlanan arıların birbirleri ile haberleşme yollarının ve bu haberleşme sırasında göstermiş oldukları davranış şekillerini bildirmek amacıyla yapılmıştır.

## 2. Arıların Genetik Yapılarının Davranış Şekillerine Olan Etkisi

Arılar, bireysel olarak taşıdıkları kalıtsal yapıya bağlı olarak farklı davranışlar göstermektedirler. Örneğin farklı uyarılara karşı kalıtsal yapılarından dolayı bireysel olarak bazıları tepki verirken diğerleri tepki vermeyebilirler. Arılar ergin hale geldikten sonra kovan içerisinde farklı yaşlarda farklı görevler yapmaktadırlar. Genetik yapının arı davranışlarına olan etkilerini daha iyi açıklayabilmek için kovan içi temizliği yaptıran bir gen örnek olarak gösterilebilmektedir. Çünkü sadece bu geni taşıyan arılar peteklerdeki ölü kuluçkanın dışarı atılması gerektiğini bilirler. Yine yalnızca peteklerin sırları açmalarını sağlayan geni taşıyan arılar, ölü kuluçkaları atmaya sağlayan genleri taşımadıklarından, ölü kuluçkalar üzerindeki sırları açtıkları halde ölü pupayı dışarı atmaya düşünememektedirler (Kendal ve ark. 2005).

Bir geninin bireylere geiři, %50 anadan ve %50 ise babadan olduėu iin kolonide ok byk farklılıklar grlebilir. Eėer genler anadan yavruya gemiř ise, btn bireyler bu genleri tařırlar nk kolonide sadece bir ana arı mevcuttur. Genler yavruya babadan gemiř ise kolonide babaların farklı bireyler olacaėından dolayı her bireyde bu genler bulunmayabilir. nk iftleřme uuřuna ıkan bir ana arı havada uygun řartlarda 10 ile 20 erkek arı ile iftleřtiėinden dolayı her bireyde bu genler bulunmaya bilinir. Bu durumda bazı bireyler temizlik yapar, bazıları da onları izler. Etkin bir temizlik ve hastalıkla savařım iin, bu genleri tařıyan bireylerin oėunlukta olması istenir (Rohrseitz, ve Tautz, 1999).

### **3. Arılarda Bilgi Aktarım Őekilleri**

#### **3.1. Bal Arılarında haberleřme dili**

Haberleřme, sosyal yařamın en temel iletiřim yollarından birisidir. Arı bireyleri arasındaki iletiřim ve etkileřim Őekilleri; dayanıřma, yardımlařma ve iř birliėi, ancak haberleřme yolu ile gerekleřebilir. Canlılardaki haberleřme araları, en genel anlamı ile; ses, dil, dokunma, hareket, sinyal ve koku gibi temel unsurlardır. Arılardaki haberleřme dili insanlardakinden farklıdır. Arılar kovan ierisindeki diėer bireylerle “Arı Dansı” olarak adlandırılan dans ile iletiřim kurarlar (Rieucau ve Giraldeau 2011).

Arılar kovandan ıktıktan sonra 5 km ap, 2.5 km yarı apınlı bir alan ierisinde faaliyetlerini srdrrler. Arılık ierisindeki kovanların yerleri deėiřtirilmek isteniyorsa, kovanlar arılıktan 5 km’ den daha fazla bir uzaklıėa en az bir hafta sre ile gtrlerek kovanlarının eski yerlerinin arıların hafızalarından silinmesi saėlandıktan sonra tekrar eski arılıkta kovanların yerleri deėiřtirilebilir. Aksi durumda kovanlar, arılık dıřına gtrlmeden, yerleri deėiřtirilirse kovandan ıkan tarlacı arılar tekrar eski kovanlarının olduėu yere giderler ve bu durum da kayıpların olmasına neden olmaktadır (ankaya ve Korkmaz, 2008).

#### **3.2. Arı dansı**

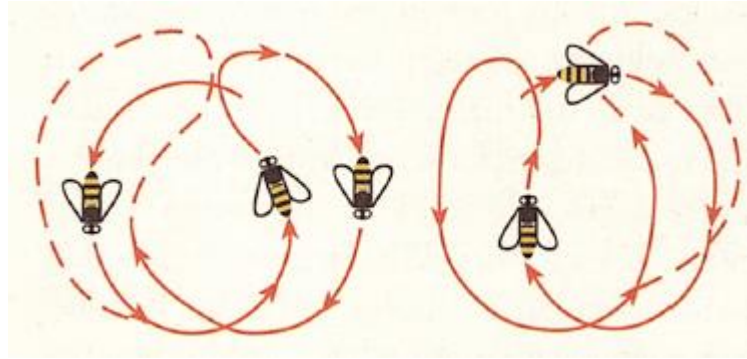
Arılar gıda kaynaklarının yerini diėer arılara tarif edebilmek iin “arı dansı” adı verilen zel bir seri hareketler yaparak kaynaėın yerini uzaklıėını ve ynn diėer arılara tarif etmektedirler. Arıların kullandıkları bařlıca danslar eřitleri řunlardır; dairesel dans, yarım ay dansı, dairesel danstan kuyruk sallama dansına geiř, kuyruk sallama dansı ve srklenme dansı olmak zere yapmıř oldukları danslarla diėer arılar ile iletiřim kurmaktadır. Arıların yapmıř oldukları dansların eřidi ve hızları zel bir anlamı iermektedir. Arılar yapmıř oldukları dansın trne ve sayısına gre kaynaėın ynn, uzaklıėını ve ne kadar zengin olduėunu anlayabilmekte ve diėer arılar ise yapılan dansı izleyerek gerekli olan mesajı alarak kovandan uzaktaki bu kaynakları kolaylıkla bulabilmektedirler (Brockmann ve Sen Sarma 2009).

Arıların yaptıkları danslar ierisinde en nemli olanları, dairesel dans (dnme dansı) ve kuyruk sallama danslarıdır. Eėer kaynak 100 m’ den daha yakın ise dairesel dans, 100 m’ den daha uzak ise kuyruk sallama danslarını kullanmaktadır. Bu dansların dıřında arıların yapmıř oldukları; alarm dansı, temizlik dansı vb. danslar da sz konusudur. Arılar dairesel dans ile kuyruk sallama danslarını az bir deėiřiklik yaparak farklı kaynaklar iin kullanılabilir (nektar, su veya propolis). Eėer arılar yapılan dansın, hangi kaynak iin yapıldıėını anlayamıyorlar ise, dansı izleyen arılar kaynaėın tr hakkında daha fazla bilgi edinmek iin dans eden arıları koklamak suretiyle kaynaėın yeri hakkında bilgi almaya alıřmaktadır. Eėer tanımlanan kaynak 5 m

içerisindeki bir alanda ise sürüklenme dansı, 8-10 m arasında ise orak dansı yaparak diğer arılara kaynağın yerini anlatmaya çalışırlar. Kaynak 10 -100 m arasında ise orak dansı ile kuyruk sallama dansı karışımı bir dans ile kaynağın yerini diğer arılara anlatmaya çalışmaktadırlar. Geçiş dansları arasındaki açı azaldıkça, kaynağın uzaklığı 100 m'ye daha yakın olduğu anlamı taşımaktadır (Abbott ve Dukas 2009).

### 3.2.1. Dairesel Dans

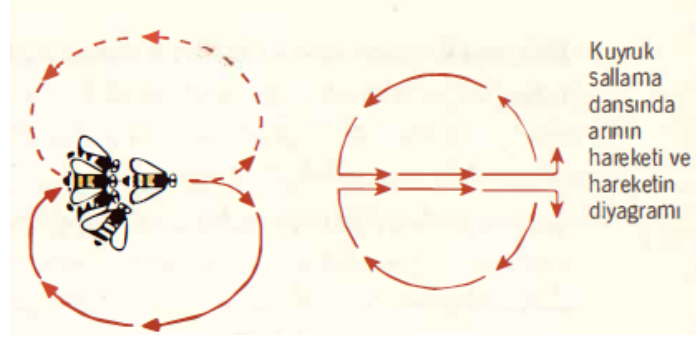
Eğer kaynağın kovana olan uzaklığı 100 m yarıçaplı bir daire içerisinde yer alıyor ise besin kaynağının yerini tanımlamada oldukça hızlı ve ani hareketlerle yapılan dairesel dans yapılarak diğer arılara kaynağın yeri hakkında bilgi vermektedirler. Bu dans arıların petek üzerinde çok dar bir alanda ve çok hızlı hareketler ile yapılmaktadır. Dans eden yani kaynağın yerini diğer arılara tarif eden arılar, kendisini izleyen 1-6 adet arıya bazen petek üzerindeki yerini değiştirerek anlatmaya çalışır. Bu arada izleyici arılar, antenleriyle dans eden arıya dokunarak dansı uygulamaya çalışsalar da hiç bir zaman aynı dansı yapmaları mümkün değildir. Dairesel dans ile kaynağın kovana uzaklığının 100 m' den daha az olduğu bildirmek için kullanılmakta olup kaynağın uzaklığı ve yönü hakkında bilgi vermezler. İzleyici arılar kaynağın çeşidini, dans eden arıya antenleri ile dokunmak suretiyle ve üzerine bulaşan materyalden anlamaya çalışırlar (Şekil 1) (Doğaroğlu, 2009).



Şekil 1. Dairesel Dans (Doğaroğlu, 1999)

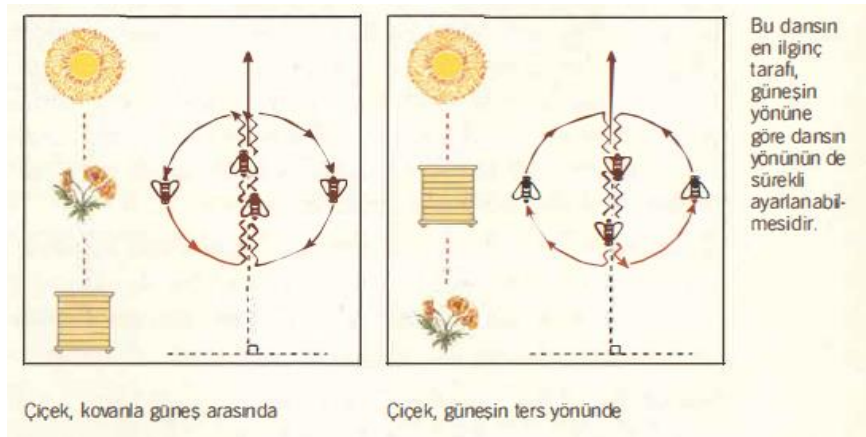
### 3.2.2. Kuyruk Sallama Dansı

Gıda kaynağının kovana olan uzaklığı 100 m'den daha fazla ise kaynağın yerini tanımlamak için arılar kuyruk sallama dansını kullanılır. Kuyruk sallama dansı ile aynı zamanda hem kaynağın hangi yönde olduğu hem de kaynağın kovana olan uzaklığı tanımlanır. Kaynağın konumunu diğer arılara iletmek için kaynak güneş yönünde ise arılar çerçeve üzerinde baş yukarıya gelecek şekilde, kaynak ters tarafta ise baş aşağı gelecek şekilde dans ederler. Kaynağın yerini diğer arılara tarif eden arı dans ederken çeşitli açılar oluşturarak kaynağın güneşe göre konumunu yani kovanın ne tarafında olduğunu ayrıntılı olarak anlatır (Thom ve ark. 2007).



Şekil 2. Bal Arılarında Kuyruk Sallama Dansı (Doğaroğlu, 1999)

Arılar kaynağın kovana olan uzaklığını yapmış oldukları dansın ne kadar sıklıkla yapıldığı ile anlatırlar. Arıların petek üzerinde 15 saniye sürede yaptıkları dans sayısı ile kaynağın uzaklığını diğer arılara anlatmaya çalışırlar. Eğer kaynağın kovana olan uzaklığı 100 m civarında ise yapmış oldukları dans sayısı 9-10 adet, kaynak uzaklığı 600 m civarında ise yapılan dans sayısı 7 adet, kaynak uzaklığı 1000 m uzaklıkta ise yapılan dans sayısı 4 adet ve eğer kaynağın uzaklığı 6000 m civarında ise 2 adet dans yaparak kaynağın mesafesi hakkında diğer arıları bilgilendirirler (Gary 1975). Arılar bu dansı yaparken önce bir yana doğru yarım daire çizer daha sonra ise aniden keskin bir dönüş yaparak başlangıç noktasına doğru düzgün bir hat üzerinde koşarak ters yönde bir yarım daire çizerler. Sonuç olarak arılar tam bir daireyi tamamlamış olurlar. Arı bu dansı yaparken düz hat üzerinde koşarken, aynı zamanda vücuduyla bir yandan kuvvetli titreme hareketleri yapar. Arı titreme hareketini yaparken 250 hertz'lik düşük frekansta ses titreşimleri meydana getirir. Arının titreşim yaparken çıkarmış olduğu bu sesleri insan kulağı algılayamaz. Arının çıkarmış olduğu ses titreşimlerinin sayısı, kaynağın uzaklığı ile yakından ilişkilidir. Arı kaynağın uzaklığını bildirmede kullandığı yollardan birisi de yaptığı dansın süresidir. Kaynak uzaklıkları farklı olan uzaklıklardan nektar, polen ve propolis toplayan arıların her 15 saniyede bir düz koşma sayıları ölçülmüş ve ölçülen bu sayıların uzaklıkla ilişkili olduğunu bildirmişlerdir (Şekil 3) (Michelsen, 2003; Dornhaus ve Chittka 2004).



Şekil 3. Bal Arılarının Besin Kaynağının yeri ve Mesafesini Diğer Arılara İletmesi (Doğaroğlu, 1999)

### **3.3. Arıların Haberleşmede Kullandıkları Diğer Danslar**

Arılar besin kaynaklarının yerlerini temelde iki dans (Dairesel dans, Kuyruk sallama dansı) yaparak diğer arıları bildirmeleri dışında farklı olayları birbirlerine anlatmak için farklı danslar kullanmaktadırlar. Bu danslar; Dairesel danstan kuyruk sallama dansına geçiş dansı, çekme ya da sürüklenme dansı, alarm dansı, temizlik dansı, sevinç dansı, masaj dansı, oyun uçuşu ve ovalama danslarıdır.

#### **3.3.1. Dairesel Danstan Kuyruk Sallama Dansına Geçiş Dansı**

Arılar dairesele dansı yaparken, dönüş noktaları arasındaki mesafeyi açarak farklı bir dans yaparlar. Dairesel dansın uçları arasındaki mesafe, besin kaynağının uzaklığı ile doğru orantılıdır. Bu dans ise, hilal veya orak dansı adlandırılır.

#### **3.3.2. Çekme ya da Sürüklenme Dansı**

Arılar herhangi bir tehlikeye maruz kaldıklarında çok acil olarak yaptıkları, hiçbir bilgi içermeyen ve diğer arıları peşinden sürükleyerek götürmeye çalıştığı bir dans şeklidir. Arılar bu dansı yaparken hem geliş güzel zikzaklar çizer hem de vızıltı şeklinde ses çıkarırlar. Arı sürüklenme dansını yaparken henüz tam olarak nedeni bilinmeyen birçok dansı da yapmaktadırlar. Günümüzde bu danslardan çözümlenmesi yapılmış olan danslar; alarm dansı, temizlik dansı, sevinç dansı ve masaj dansıdır (Doğaroğlu, 2009; Dodoloğlu, 2017).

##### **3.3.2.1. Alarm Dansı**

Hem genç olan kovan içi arılar (yumurtadan çıktıktan sonra 20 gün boyunca kovan içinde yaşayan arılar) hem de tarlacı arılar (20 günlük yaştan büyük ve kovana nektar, polen, propolis ve su taşıyan arılar) tarafından yapılan bir danstır. Arı bu dansı yaparken spiral şeklinde bir hareket ederek koşar veya düzensiz şekilde zikzaklar çizerken, karnını da yana doğru şiddetli bir şekilde sallama hareketi yapar. Bu dansı yapan arılar, uçuş etkinlikleri tamamen durdurmaktadırlar. Dansı izleyen diğer arılar ise dans yapan arıya cevap için dans etmeye başlarlar ve dans edenlerin sayıları sürekli olarak artma eğilimindedir. Arıların bu dansı yapma amacı, kovanın her hangi bir tehlikeyle karşı karşıya maruz kaldığını anlatmak için yapılır (Doğaroğlu, 2009; Dyer, 2002).

##### **3.3.3. Temizlik Dansı**

Arılar temizliğe çok önem böcekler olup vücutları her hangi bir şekilde toz, tüy veya yabancı madde bulaşmış ise ayaklarını hızlı bir şekilde yere vurarak, silkinmeye benzer iki yana sallanma hareketi yaparlar, ayrıca orta bacaklarını vücutlarını temizlemek için kullanırlar. Temizlik dansı, tüm arılar tarafından yıl boyu yapılan bir dans şeklidir. Dans eden arıya en yakın olan arı, ona antenleri ile dokunarak onun temizlenmesine yardımcı olurlar. Temizlik yapan arının çenesi ile dans eden arının göğsüne dokunması ile dans sona erdirilir. Temizlenmek isteyen arı ise kanatlarını yayar, karnını aşağıya doğru, vücudunu ise yana bükerek temizlik yapan arının çalışmasına izin verir. Temizlik yapan arılar uzaklaştığında ise temizlenen arı kendi kendine dilini, antenlerini ve vücudunun diğer kısımlarını temizlemeye devam eder. Yeniden temizlenme isteği arzu ederse yeni bir dansa başlayarak diğer arıların gelmesini bekler. Bu dansa tımarlanma dansı olarak da tanımlanmaktadır. Temizlik dansını bazen erkekler de yaparlar (Doğaroğlu, 2009; Çankaya, ve Korkmaz, 2008).



### **3.3.4. Sevinç Dansı**

Arılar herhangi bir tehlikeye maruz kalmadıklarında her şeyin yolunda gittiği dönemlerde 9 günlük yaştan 5 aya kadarki dönemde kovandaki tüm arıların zevk için yaptıkları bir dans olarak tanımlanır. En fazla tarlacı arılar tarafından yapılan bu dans, arının ön bacaklarını diğer bir arının vücudunun herhangi bir yerine koyması ve daha sonra karnını 5-6 kere aşağı yukarı doğru sallaması şeklinde yapılan bir danstır. Bu sırada arı yavaş bir şekilde öne ve arkaya doğru hareket etmektedir. Dans eden arı sık sık yer değiştirir ve başka arılarla bu dansı sürdürür. Bu dans ana arısı olmayan bir kovanın, eğer yeni ana arısını çıkarıldığı dönemde yapılır. Bazı durumlarda bu dans yeni vurulan ana arı memeleri üzerinde bile yapıldığı görülmektedir. Sevinç dansı, gece gündüz, her mevsimde ve her koşulda, anasız kovanlarda dahi yapılabilen bir danstır (Doğaroğlu, 2009; Dodoloğlu, 2017).

### **3.3.5. Masaj Dansı**

Bu dans çoğunlukla, arıların hasta oldukları dönemlerde veya ilkbahar ile sonbahar dönemlerinde uçuş deliğinde durup üşüyen arılar tarafından yapılan bir dans şeklidir. Dans arının başını ansızın bükmesi ile başlar ve bu durumu gören yakınındaki arılar heyecanlanarak onu antenleri ve ön bacakları ile incelemeye başlarlar. Etrafındaki arılar ise çeneleri ile orta ve arka bacak eklemlerini çekiştirirler. Daha fazla karnın yan alt tarafına antenleri, çeneleri ve ön bacakları ile temas ederler ayrıca antenlerini periyodik olarak temizlerler. Bu şekilde yoğun ilgiyi hisseden arı, çenesini açarak dilini besleyici arılar gibi uzatma hareketi yapar ve bu esnada dili oldukça küçültür. Daha sonra tekrar dilini çıkararak, orta çift bacaların yanlara doğru yayar ve ön bacakları ile dilini yukarıdan aşağıya doğru temizler (Doğaroğlu, 2009; Dyer, 2002).

### **3.3.6. Oyun Uçuşu**

Kovan önünde yapılan kısa uçuşlar, arıların kovanlarını ve çevreyi tanıması için yapılan uçuşlardır. Arılar ilk uçuşlarını bir haftalık yaşta oldukları zaman yaparlar. Uçuş sayısı arttıkça uçuş uzaklığı ve açıları da genişler. Yapılan ilk uçuşlar genellikle genç arıların birlikte yaptıkları uçuşlardır ve buna oyun uçuşu adı verilir. Oyun uçuşları genellikle ilkbaharda havaların ısınması ile başlar ve birkaç gün sürer. Eğer hava fırtınalı ve soğuk ise uçuş söz konusu değildir. Ancak havalar ısındığında, sıcak günün öğle saatlerinde yapılır. Genç arıların kovan önünde yapmış oldukları oyun uçuşunu, arıcılar yanılarak oğul uçuşu veya yağmacılık olarak algılamaktadırlar. Arıların kovan uçuş deliği önünde mutlu ve sakin bir şekilde uçmaları ve kovandan uzaklaşmaması onların oyun uçuşu yaptıkları anlamı taşımaktadır. Bu uçuşlar çok kısa sürmekle beraber ortalama 5 dakika kadar sürmektedir. Eğer kovanlar birbirlerine çok yakın iseler bu uçuş sırasında genç arıların yaklaşık yarısı, kovanlarını şaşırabilmektedirler (Doğaroğlu, 2009; Çankaya, ve Korkmaz, 2008).

### **3.3.7. Ovalama Dansı**

Arıların bu dansı, ağız, bacak, ve kovan yüzeylerini temizlemek veya parlatmak amacıyla yaptıkları sanılmaktadır. Arıcıların özellikle akşam üzeri arıların, kovanın ön kısmında orta ve arka bacakları üzerine dikilerek, başları ve ön bacakları aşağı doğru bükülmüş durumda vücutlarını öne ve arkaya doğru salladıkları görülmektedir. Bu sırada arılar, ön bacakları ve çeneleri ile sanki kovan yüzeyini sıyrıyorlarmış gibi hareketler de yaparlar. Bir süre sonra arıların çenelerinin alt tarafında bir şeyler birikmeye başlar (Doğaroğlu, 2009).

#### **4. Sonuç**

Arılar birbirleri ile mesajlaştıklarında yapmış oldukları dansları, günümüzde bizler için de oldukça önemli bilgiler vermektedir. Çünkü yapılan bu danslar, koloninin ihtiyacı olan besin kaynaklarının (nektar, polen, propolis ve su) yerlerini diğer arılara anlatabilmek için yapılmaktadır. Bugün hala arılar tarafından yapılan fakat çözümlenemeyen birçok iletişim yolları mevcuttur. Bal arılarının kovan içerisinde veya dışında gerçekleştirmiş olduğu farklı dans çeşitlerinin ne anlama geldiğini daha iyi anlayabilmemiz ve çok sayıda bilinmeyen soruları çözebilmemiz için diğer dans türlerinin çözümlenmesi gerekmektedir. Çünkü ortamda dans eden arıların varlığı, sağlıklı ve bol besin kaynağının bulunduğu bir çevre ve tüm canlılar için yaşanabilir bir doğal yaşamın olduğunu göstermektedir.

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## KOYUN VE KEÇİLERDE KUZU-OĞLAK VERİMİNİ ARTIRMADA KULLANILAN KUZULAMA VE OĞLAKLAMA ARALIĞININ KISALTILMASI

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### **Özet**

Küçükbaş hayvanlardan sağlanan et geliri, kuzu verimi, pazarlama yaşına ulaşmış kuzu ve oğlakların yaşama gücü ve bunlardan elde edilen karkas ağırlığına bağlı olarak değişim göstermektedir. Kuzu sayısını artırmak için ise genotipin ıslahı ve çevresel ıslah yöntemleri kullanılmaktadır. Çevresel ıslah yöntemlerinde kullanılan kuzulama aralığının kısaltılması için farklı sistemler geliştirilmiştir bunlar sırasıyla; bir yılda iki kuzulatma, iki yılda üç kuzulatma, üç yılda dört kuzulatma, Camal sistemi ve Yıldız sistemleridir. Bu sistemler de ırk, mevsim vs gibi faktörlerin etkisi altında olup işletmelerin karlılıklarını artırmada önemli etkiye sahiptir. Bu derleme, küçükbaş hayvanlarda kuzu ve oğlak veriminin artırılabilmesi için geliştirilen yöntemlerini ve bu yöntemlerin nasıl uygulandığını ve buna bağlı olarak işletmelerin karlılıklarını artırma olanakları belirlemek amacı ile yapılmıştır.

**Anahtar Kelimeler:** Çevresel Islah, Küçükbaş, Sık kuzulatma, Kuzu, Oğlak

## **SHORTENING OF LAMBING AND KIDDING INTERVAL USED TO INCREASE LAMB-KID PRODUCTIVITY IN SHEEP AND GOATS**

### **Abstract**

The meat income obtained from small ruminants varies depending on lamb yield, the survival rate of lambs and kids that have reached marketing age, and the carcass weight obtained from them. In order to increase the number of lambs, genotype improvement and environmental improvement methods are used. Different systems have been developed to shorten the lambing interval used in environmental improvement methods; these are; two lambing in one year, three lambing in two years, four lambing in three years, Camal system and Yıldız systems, respectively. These systems are also under the influence of factors such as breed, season, etc. and have an important effect on increasing the profitability of enterprises. This review was conducted to determine the methods developed to increase lamb and kid yield in small ruminants, how these methods are applied, and the possibilities of increasing the profitability of enterprises accordingly.

**Keywords:** Environmental Improvement, Small ruminant, Frequent Lambing, lamb, kid

## 1. Giriş

Küçükbaş yetiştiriciliği yapılan işletmelerde karlılık, bir yıl içerisinde koyun-keçi başına elde edilen kuzu-oğlak sayısı ile yakın ilişki içerisinde. Bunun artırılması ise ancak döl veriminin artırılmasıyla mümkündür (Kaymakçı, 1979). Tüm hayvan yetiştiriciliğinde olduğu gibi koyun ve keçi yetiştiriciliğinde de verimlerden elde edilen gelirin en büyük payını et verimi oluşturmaktadır (Wang ve ark. 2021). Diğer verimler (süt, yapağı, kıl, tiftik vs) gelir bakımından et veriminden sonra gelmektedir. Küçükbaş hayvanlarda et verimini artırmasında en önemli uygulama, döl veriminin artırılmasına yönelik çalışmalardır. Et veriminden sağlanan gelir ise kuzu-oğlak verimi, pazarlama yaşına kadarki dönemde kuzu-oğlakların yaşama gücü ile karkas ağırlıklarına bağlı olarak değişim göstermektedir (Gürsoy ve ark. 1993). Kuzu-oğlak sayısının artırılmasında iki önemli yöntem kullanılmaktadır. Bunlardan birincisi genetik ıslah metodu (saf yetiştirme ile seleksiyon ve melezleme), ikincisi ise çevresel ıslah (Koç katım döneminde ek besleme yani flushing, erken yaşta damızlıkta kullanma, kuzulama aralığının kısaltılması, koç-teke etkisi, yapay hormon uygulamaları, embrio aktarımı, genetik klonlama, yapay ışık kullanımı vb. uygulamalar) metodudur (Kaymakçı, 2006).

Kuzulama ve oğlatlatma aralığının kısaltılması yönteminin amacı, birim süreçte daha fazla yavru elde etmektir. Özellikle ülkemizdeki yerli koyun ve keçi ırklarımız yılda tek doğum yapan ırklardan oluşmaktadır. Bu durum ise yetiştiricilerin artan maliyetleri karşılamamasına neden olmaktadır. Özellikle yetiştiriciliği sadece kuzu-oğlak verimine dayalı yetiştiriciler için kuzulama aralığının kısaltılması ile yavru verimini artırarak elde edilecek fazla bir yavru ile hem artan maliyetlerini karşılayabilecekler hem de et veriminin artmasını sağlamış olacaklardır (Keskin ve ark. 2002).

Kuzulama aralığının kısaltılmasında, bir yılda iki kuzulatma-oğlaklatma, iki yılda üç kuzulatma-oğlaklatma, üç yılda dört kuzulatma-oğlaklatma sistemi, Camal yöntemi ve yıldız sistemi uygulanmaktadır. Fakat bu yöntemler içerisinde en fazla kullanılan yöntem iki yolda üç kuzulatma yöntemidir. Bu yöntemin en fazla tercih edilmesinin sebebi kuzu ve oğlakların iki aylık sürede anaların emmeleri, yani kuzu ve oğlakların yapay süt emme zorunlulukları yoktur ayrıca damızlık olarak kullanılan koyun ve keçilerin fazla yıpranmamaları yani sürü yenileme payı daha düşüktür (Keskin ve ark. 2002; Kaymakçı, 2006). Kuzulama ve oğlaklatma verimini artırmak için geliştirilen bu yöntemler koyunve keçilerin yaşamları boyunca daha fazla yavru elde edebilmek için geliştirilmiştir (Batmaz ve Başpınar, 1999).

Bu derleme, küçükbaş hayvanlarda yavru veriminin artırılabilmesi için geliştirilen yöntemlerin nasıl uygulandığının ve buna bağlı olarak işletmelerin karlılıklarını artırma olanakları belirlemek amacı ile yapılmıştır.

## 2. Kuzulama Ve Oğlaklatma Aralığının Kısaltılması

Bu yöntemlerin geliştirilmesinin amacı koyun ve keçilerden bütün hayatları boyunca daha fazla yavru elde edebilmek için geliştirilmiştir. Çünkü işletmelerin artan masraflar karşısında et verimi haricindeki verimlerin (süt, yapağı, tiftik, kıl vs) işletme masraflarını karşılayamaması bu yöntemlerin geliştirilmesine neden olmuştur (Kaymakçı, 2006).

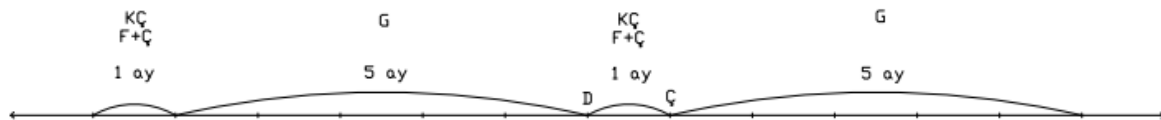
## 2.1. Bir Yılda İki Kuzulatma

Küçükbaş hayvanlar doğumlarını tamamladıktan sonra ilk ay içerisinde çiftleştirilmeleri sonucunda gebe kalırlarsa bir yılda iki kuzulatma veya oğlaklatma yapabilirler. Bu yöntemin uygulanabilmesi için bazı koşullar söz konusudur;

- Bu uygulamanın yapılabilmesi için çiftleşme mevsimi uzun olan ırkların kullanılması gerekir.
- Bu yöntemin uygulanabilmesi için kuzular yapay sütle besleme zorunluluğu söz konusudur.
- İşletmede entensif bakım ve besleme uygulanması gerekir.
- Kızgınlıkların oluşturulması için yapay hormon uygulaması yapmak gerekir.
- Bu sistem kullanılıyorsa yetiştirici sadece kuzu eti ve yapağı üretimine yönelik üretim yapması gerekir.
- Bu yöntemde damızlık hayvanlar çok yıprandığından sürü yenileme payı yüksektir.

Bu yöntemin uygulanabilmesi için birinci doğumlar tamamlandıktan hemen sonra koyunlar bir ay içerisinde ikinci çiftleşmelerine hazırlanırlar. Bu yöntemde ilk uygulama koyun ve keçileri kuruya çıkarmaktır. Bunun için koyun ve keçiler ilk hafta içerisinde besleme değeri düşük yemleme yapılmalıdır. Ayrıca su oranı yüksek yemler kesilerek, eksik ve aralıklı sağımlar uygulanarak hayvanların kuruya çıkması sağlanmalıdır (Kaymakçı, 2006).

Kuruya çıkma işlemi tamamlandıktan sonra en kısa sürede koyun ve keçilere aşım performansı sağlaya bilinmesi için enerji düzeyi yüksek yemle ek yemleme (flushing) uygulaması yapılmalıdır. Bu dönemde koyun ve keçilerde kızgınlığın toplulaştırılması amacıyla flushing uygulamasının yanında hormon uygulaması da yapılabilmektedir. Böylece bir yılda iki kuzulatma yöntemi birinci kısımda bir ay içerisinde kuruya çıkarma, flushing ve çiftleştirme uygulanarak hayvanların gebe kalmaları sağlanabilir, daha sonra beş ay gebelik ve doğumlar gerçekleştirilir, ikinci bölümde yine bir aylık süre içerisinde kuruya çıkarma, flushing ve çiftleştirme uygulanarak hayvanların gebe kalmaları sağlanır beş aylık gebelik dönemi sonunda bir yılda iki kuzulatma ve oğlaklatma sağlanmış olur (Keskin ve ark. 2002).



G:Gebelik Dönemi, L: Laktasyon, KÇ: Kuruya Çıkarma, F: Flushing

Şekil 1. Bir Yılda İki Kuzulatmaya Ait Oluşum Şeması

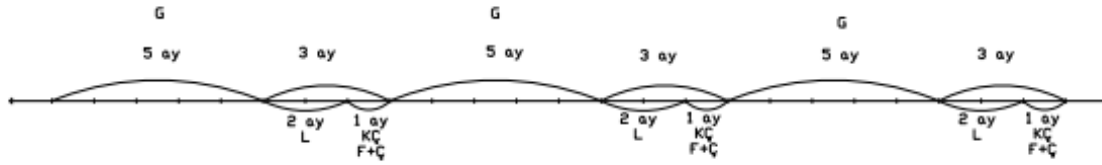
## 2.2. İki Yılda Üç Kuzulatma

İki yılda üç kuzulatma yönteminin uygulanabilmesi için bazı koşullara ihtiyaç duyulmaktadır. Bunlar;

- Bu yöntemde çiftleşme mevsimi uzun olan ırklar için geçerlidir.
- Kuzular iki ay boyunca analarını emdiklerinden dolayı yapay süt ile besleme zorunluluğu bulunmamaktadır.
- Bu yöntemde hem süt hem de kuzu üretimi için yapıla bilinir.
- Bu yöntem iki sürüde uygulandığı zaman, pazarlana bilinir süt üretimi süresi ve niceliğinde artış görülür.

Bu yöntem, koç ve teke katım dönemlerinin iyi saptanmasına bağlı olarak başarısı artar. Çünkü katım dönemi yavrulama dönemini belirlemektedir. Bunun dışında koç katım zamanını belirleyen diğer etmenler; çiftleşme mevsimi uzun olan koyun ve keçiler, doğal yem varlığının durumu (mera kalitesi), kuzu eti ve süt fiyatının durumudur (Keskin ve ark. 2005).

Bu yöntemin uygulanışı iki şekilde olmaktadır. Bunlardan ilki eldeki sürü ikiye ayrılır. Birinci grup sürüye ilk yıl bir yılda iki kuzulatma, ikinci sürüye ise normal kuzulatma-oğlatlatma uygulanır. İkinci yıl birinci sürüye normal kuzulatma-Oğlatlatma, ikinci sürüye bir yılda iki kuzulatma uygulanır. Böylelikle tüm sürüye iki yılda üç kuzulatma uygulanmış olur (Shelton, 1968; Kaymakçı 2006) .



G:Gebelik Dönemi, L: Laktasyon, KÇ: Kuruya Çıkarma, F: Flushing

Şekil 2. İki Yılda Üç Kuzulatmaya Ait oluşum Şeması

İkinci uygulama şekli ise iki yıl sekiz aylık üç periyota ayrılır. Beş aylık gebelik sonucunda doğumlar olur. Doğan kuzu ve oğlaklar iki aylık periyotta analarını emerler. Son bir ay içerisinde koyun ve keçiler süttten kesilir, flushing uygulaması ve çiftleştirmeler yapılarak hayvanların gebe kalmaları sağlanır. Böylelikle üç kere sekiz aylık periyotlarda bu işlem tekrarlanarak iki yılda üç kuzu ve oğlatlatma yöntemi gerçekleştirilmiş olur (Kaymakçı 2006).



**Çizelge 1. Koyunlarda İki Yılda Üç Kuzulatma**

Kuzulatmalar	Dönemler	Süre	Aşım Ayları	Kuzulama Ayları
<b>1. Kuzulatma</b>	Laktasyon	2 ay	Aralık	Mayıs
	Kuruya Çıkarma+Flushing+Aşım	1 ay	Ağustos	Ocak
	Gebelik+Doğum	5 ay	Nisan	Eylül
	<b>Toplam</b>	<b>8 ay</b>		
<b>2. Kuzulatma</b>	Laktasyon	2 ay	Aralık	Mayıs
	Kuruya Çıkarma+Flushing+Aşım	1 ay	Ağustos	Ocak
	Gebelik+Doğum	5 ay	Nisan	Eylül
	<b>Toplam</b>	<b>8 ay</b>		
<b>3. Kuzulatma</b>	Laktasyon	2 ay	Aralık	Mayıs
	Kuruya Çıkarma+Flushing+Aşım	1 ay	Ağustos	Ocak
	Gebelik+Doğum	5 ay	Nisan	Eylül
	<b>Toplam</b>	<b>8 ay</b>		

**Çizelge 2. İki Koyun Sürüsünde İki Yılda Üç Kuzulatma Uygulamasında Aşım ve Kuzulama Takvimi**

Kuzulatmalar	Sürüler	Aşım Ayları	Kuzulama Ayları
<b>1.Kuzulatma</b>	Sürü 1	Aralık	Mayıs
	Sürü 2	Nisan	Eylül
<b>2.Kuzulatma</b>	Sürü 1	Ağustos	Ocak
	Sürü 2	Aralık	Mayıs
<b>3.Kuzulatma</b>	Sürü 1	Nisan	Eylül
	Sürü 2	Ağustos	Ocak

### 2.3. Üç Yılda Dört Kuzulatma

Üç yılda dört kuzulatma yönteminde kuzulatmalar arasındaki süre dokuz ay olarak belirlenmiştir. Bunun beş aylık dönemi gebelikten sonra kuzulamalar gerçekleşmekte geri kalan dört aylık dönemde kuzulamasını tamamlayan koyunlar koça verilmekte, aşım koyun gebe kalana kadar üç ay boyunca devam etmektedir. Amerika’ da Morlam koyunlardaki uygulama aşağıdaki tabloda bildirilmiştir (Hogue ve ark. 1980; Hogue 1987; Keskin ve ark. 2002).

**Çizelge 3.** Marlam Koyunlarında üç Yılda Dört Kuzulatma Uygulamasında Aşım ve Kuzulama Takvimi

Kuzulatmalar	Aşım Ayları	Kuzulatma Ayları
Kuzulatma Sonrası	Ocak	Mayıs
	Nisan	Ağustos
	Temmuz	Kasım
	Ekim	Şubat

#### 2.4. Camal Sistemi

Camal sistemi ile kuzulama aralığının kısaltılması Cornell Üniversitesi tarafından Dorset koyunları ile uygulanmıştır (Iniguez ve ark. 1986). Bu sistemin temellini, iki yılda üç kuzulatma yöntemi uygulanan sürülerden 4 alt gruba ayrılmakta ve her alt grup, bir aylık aralıklarla kuzulattılmaktadır (Keskin ve ark. 2002). Camal sistemi, hem bir yılda iki kuzulatma hem de iki yılda üç kuzulatma yönteminin avantajlarına sahip bir sistemdir. Camal Sisteminde ayrıca, gruplardan birindeki koyunlar kendi döneminde gebe kalmamışlar ise iki yılda üç kuzulatma sisteminde olduğu gibi 8 ay beklemesine gerek yoktur. Gebe olmayan bu hayvanlar 2 ay sonra diğer bir grup ile çiftleştirilebilirler (Parker, 1972; Hogue ve ark. 1980; Iniguez ve ark. 1986; Hogue 1987). Çizelge 4’ de görüldüğü üzere, tüm alt gruplar farklı tarihlerde çiftleştirilen tek bir sürü gibi düşünüldüğünde, birbirini takip eden aylarda sırası ile aşım ve doğum olmaktadır.

**Çizelge 4.** Camal Çiftleştirme Sisteminde Doğum ve Çiftleştirme Tarihleri

Alt Sürüler	1. Yıl												2. Yıl											
	O	Ş	M	N	M	H	T	A	E	E	K	A	O	Ş	M	N	M	H	T	A	E	E	K	A
Sürü I	K			Ç						K		Ç								K		Ç		
Sürü II				K			Ç					K		Ç						K		Ç		
Sürü III						K			Ç					K		Ç					K		Ç	
Sürü IV		Ç						K		Ç						K		Ç					K	
Genel	K	Ç	K	Ç	K	Ç	K	Ç	K	Ç	K	Ç	K	Ç	K	Ç	K	Ç	K	Ç	K	Ç	K	

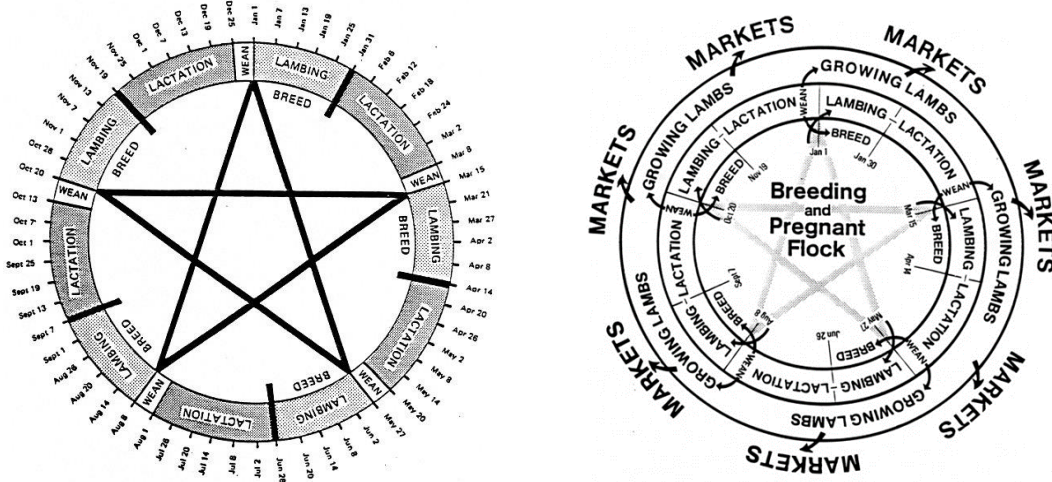
K, kuzulama / lambing ; Ç, çiftleşme / breeding; Kaynak / Source: (Hogue, 1987; Keskin ve ark. 2002).

#### 2.5. Yıldız Sistemi

Bu sistem Camal sisteminin geliştirilmesinden sonra oluşturulmuş bir çiftleştirme sistemidir. Cornell Üniversitesinde geliştirilmiş bir sistemdir. Bu sistemin esası koyunlarda gebelik süresinin 146 gün olmasına dayanmaktadır. Çünkü 146 günün yarısı olan 73 gün bir yıl yani 365 günün 1/5’ ine eşittir ve bu sebeple 365 gün olan takvim yılı 5 eşit parçaya bölünerek birbirini takip eden periyodların birleştirilmesi sonucunda yıldız şekli olduğu görülmektedir (Lewis ve ark. 1996). Bu sistemin uygulanmasında bazı avantajlar söz konusudur. Bunlar;

- Bu sistemin koyunların biyolojilerine ve takvim yılına uygun olması,
- Bu sistem en uygun kuzulama ve çiftleştirme tarihlerinin seçilmesi sonucunda işletmelerin sürü yönetim sistemlerinin daha kolay bir şekilde yapılmasının sağlanması.

- Koyunlar 3 yılda 5 kere kuzulama yapabilmeye imkânının olması nedeni ile yıllık olarak koyun başına düşen kuzu sayısının 1.67 olmasının sağlanması,
- Kuzulamaların aynı zamanda gerçekleşmesi sonucunda pazara üniform kuzuların sunulması dolayısı ile de düzenli bir para akışının olmasının sağlanması,
- İşletmedeki doğum, kuzu büyütme vb işlerde oluşan imkanların etkinliğinin artırmasının sağlanması.



Şekil 3. YILDIZ diyagramı (Hogue, 1991)

Bu sistemde çiftleştirilecek olan koyunlar Sürü I, Sürü II ve Sürü III şeklinde 3 sürü oluşturulmaktadır. Yıldız sisteminde kuzulamalar arasında 219 gün (7.2 aylık) süre en kısa olan kuzulama aralığıdır. Eğer sürü I deki koyunlardan gebe kalmayan koyunlar olursa bunların kuzulama aralıkları 292 gün yani 9.2 aylık bir süre oluşmakta eğer çiftleştirmelerde, sürü I den gebe kalmayan koyun var ise o zaman kuzulama aralıkları 365 güne uzamaktadır. Eğer bir koyun kuzulama aralığını sürekli olarak 7.2 aylık kuzulama aralığında yapıyor ise bu koyuna Yıldız koyun, her doğumda çoğuz doğum yapıyor ise buna da Süper Yıldız koyun olarak adlandırılmaktadır (Hogue 1987; Keskin ve ark. 2002). Bu sistemde oluşturulan sezonlar; Ocak 1, Mart 15, Mayıs 27, Ağustos 8 ve Ekim 20 tarihlerinde başlatılıp, her sezonun başlangıçları yıldız noktalarından birisine isabet edecek şekilde ayarlanmaktadır (Hogue 1987; Lewis ve ark. 1996; Keskin ve ark.2002).

### 3. Sonuç

Sonuç olarak; kuzulama aralığının kısaltılması birim süreç içerisinde koyun ve keçilerden sağlanan kuzu ve oğlak sayısının artmasını sağlayan bir çevresel ıslah yöntemlerinden birisidir. Geliştirilen bu sistemler ırk, mevsim, işletmenin uyguladığı yetiştiricilik şekli vb. faktörlere bağlı olarak değişim göstermektedir. Bunların dışında kuzulama aralığının kısaltılması için geliştirilen sistemlerin uygulanabilir olması pazar istekleri ve uygulamaların ekonomik olup olmamasına göre değişim göstermektedir.

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## THE CONCEPT OF GREEN EXTRACTION FOR THE RECOVERY OF BIOACTIVES FROM BIOMASS

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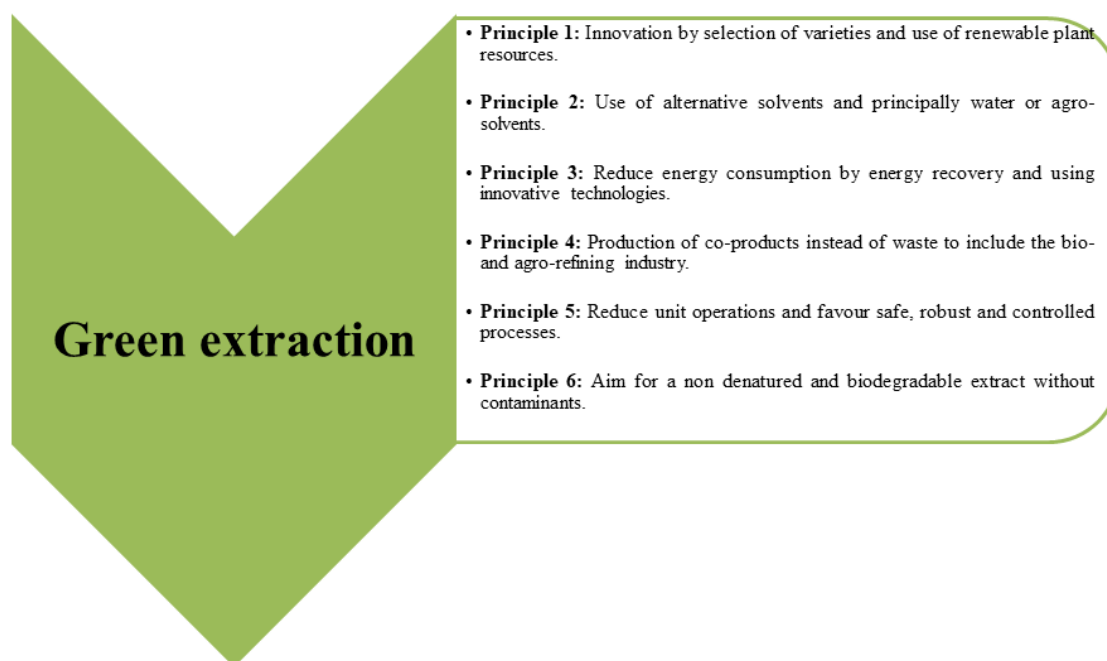
### **Abstract**

In order to enhance the yield, green chemistry and the economy, green extraction concept has been adopted recently. This term was first defined by Farid Chemat in 2012 (Chemat et al., 2012). Considering the rise in energy expenses and greenhouse gas emissions, application of green extraction methods is a must nowadays. On the other hand, fine chemicals, such as heat-sensitive bioactive substances with so many beneficial effects on health such as antioxidant and antimicrobial activities, require extra care as they might degrade during the recovery process. These methods propose alternative approaches such as ultrasound, microwave, supercritical fluid, pressure and ohmic heating to overcome the drawbacks (consumption of too much time and chemical material, requirement of elevated temperature, and obtaining of low quality product) of the traditional processes (Soxhlet extraction, maceration and steam/hydro distillation) (Chemat et al., 2020; Picot-Allain et al., 2021; Pingret et al., 2013). In this study, the most popular advanced green extraction methods such as ultrasound-assisted extraction, microwave-assisted extraction, supercritical fluid extraction, pressurized liquid extraction and automatic solvent extraction processes have been described with their advantages over the conventional processes for the recovery of bioactive ingredients from several biomass after stating the major disadvantages of the conventional methods.

**Keywords:** Environmentally friendly extraction; biorefinery; natural products.

## Introduction

Recovery of the bioactive substances from natural raw materials is of great significance particularly in cosmetic, pharmaceutical, food and nutraceutical industries due to their therapeutic potential. Although these ingredients have many health benefits such as antioxidant and antimicrobial activities, they are sensitive materials that can easily deteriorate as a result of exposure to external factors such as pH, oxygen, light, heat and temperature during their production. Therefore, the processes to be used in obtaining these products are extremely important. Solid-liquid extraction is used to extract bioactives from solid plant matrix. On the other hand, today's needs require the use of green chemistry principles, since situations such as the depletion of fossil resources, excessive greenhouse gas production and chemical consumption also force approaches that adopt green chemistry principles. So, green extraction applications have become inevitable (Lucía et al., 2022). This approach was first defined by Farid Chemat in 2012 by announcing the 6 principles of green extraction based on the natural product recovery (Chemat et al., 2012). Figure 1 presents the related principles.

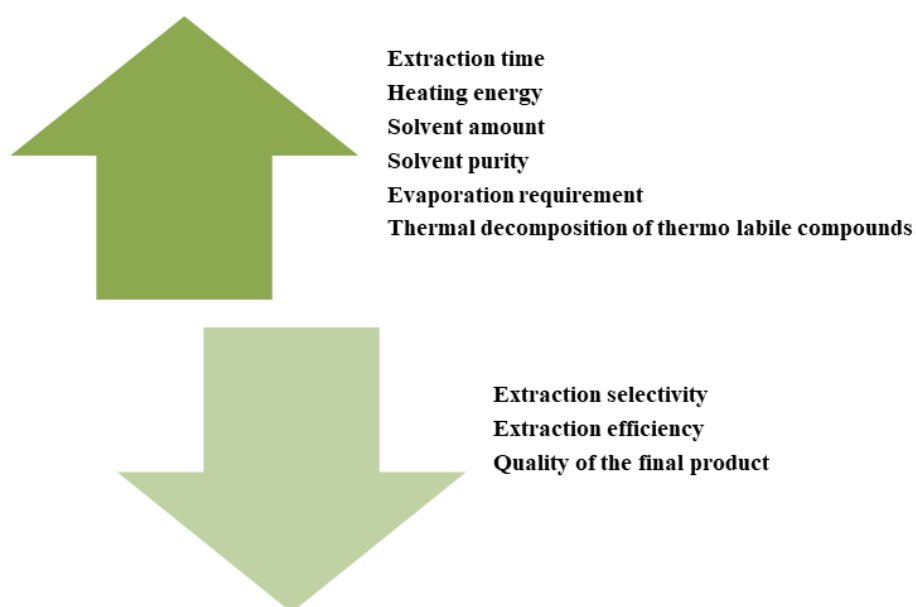


**Figure 1.** Six principles of green extraction (Chemat et al., 2012).

## Bioactive components

Bioactive components including phenolic compounds are produced in plant materials as a defense against UV radiation, and pathogens such as viruses, bacteria and fungi (Kumar et al., 2020). Due to their functional effects such as antioxidant and antimicrobial activities, bioactive components such as polyphenols are reported to be natural additives in many applications such as functional food products, nutraceuticals and cosmaceuticals (Jahan et al., 2017; Maqsood et

al., 2020; Soumya et al., 2021). The amount and quality of the active ingredient in a particular plant species depends on many factors. The way the plant is collected, the time of harvest, its storage, its origin, its genotype, geographical conditions, the methods of preparation (fresh or dried, whether it is crushed or not), and most importantly the processes applied when obtaining the product, all significantly affect the polyphenol content (Yang et al., 2018). On the other hand, they are very sensitive substances. Therefore, conventional methods such as Soxhlet extraction, maceration and hydrodistillation cannot meet the expected quality owing to their undesirable characteristics (Figure 2).



**Figure 2.** Undesirable characteristics of conventional extractions methods (Azmir et al., 2013).

### **Green extraction techniques**

The most common green extraction methods in the literature appear as follows: Ultrasound-assisted extraction, microwave-assisted extraction, supercritical fluid extraction, pressurized liquid extraction and automatic solvent extraction. Table 1 summarizes the advantages and disadvantages of the related extraction methods with mechanisms briefly.

**Table 1.** The most common green extraction methods.

Methodology	Mechanism	Advantage	Drawback	Reference
Ultrasound-assisted extraction	Ultrasound enhances the disruption of the matrix due to the cavitation phenomena, causing enhanced mass transfer.	<ul style="list-style-type: none"> <li>• Consumption of low energy</li> <li>• Consumption of extraction time</li> <li>• Consumption of less solvent</li> <li>• High cell disruption</li> <li>• Enhanced yield</li> <li>• Consumption of low energy</li> <li>• Consumption of extraction time</li> </ul>	<ul style="list-style-type: none"> <li>• Non-selective</li> <li>• Thermal decomposition of thermo labile compounds</li> <li>• Short life of ultrasound probes</li> </ul>	(Picot-Allain et al., 2021)
Microwave-assisted extraction	Dielectric heating caused by non-ionizing radiation is used.	<ul style="list-style-type: none"> <li>• Consumption of less solvent</li> <li>• Enhanced yield</li> <li>• Low capital investment</li> </ul>	<ul style="list-style-type: none"> <li>• Non-selective</li> <li>• Thermal decomposition of thermo labile compounds</li> <li>• Short penetration depth of microwave upon scaling up</li> </ul>	(Chemat et al., 2020)
Supercritical fluid extraction	Supercritical fluids plays a role (relatively low viscosity and high diffusivity) like both liquid and gas, leading to increase diffusion of the fluid into the solid matrix.	<ul style="list-style-type: none"> <li>• Enhanced mass transfer</li> </ul>	<ul style="list-style-type: none"> <li>• Need of know-how</li> <li>• High cost of investment and operation</li> <li>• Complexity of the system</li> </ul>	(Ateş et al., 2017; Chemat et al., 2020)
Pressurized liquid extraction	High temperature and pressure under supercritical conditions give rise to enhanced mass transfer due to the surface tension and viscosity of the solvent.	<ul style="list-style-type: none"> <li>• Consumption of extraction time</li> <li>• Consumption of less solvent</li> <li>• Enhanced yield</li> </ul>	<ul style="list-style-type: none"> <li>• Thermal decomposition of thermo labile compounds</li> <li>• High cost of investment and operation</li> <li>• Complexity of the system</li> </ul>	(Picot-Allain et al., 2021)
Automatic solvent extraction	An automated Soxhlet extractor without exposure to solvent.	<ul style="list-style-type: none"> <li>• Fully automatized</li> <li>• Handlings errors are avoided</li> <li>• Recovery and recycling</li> <li>• Operator-friendly</li> </ul>	<ul style="list-style-type: none"> <li>• Final extracts are not recovered at the end of the process</li> </ul>	(Chemat et al., 2019)

## Conclusion and Recommendations

Each green extraction method has its own advantages and disadvantages. However, the method to be used should be decided depending on the raw material and target product to be extracted. Although the ultrasound-assisted extraction method is a very economical method compared to supercritical fluid extraction, it will not be suitable for obtaining a volatile component that is sensitive to heat. On the other hand, phenolic compounds, which are polar compounds, cannot be obtained efficiently with supercritical CO<sub>2</sub> extraction, since CO<sub>2</sub> is a nonpolar solvent. Instead, pressurized liquid extraction might be more ideal. As a result, it is necessary to decide on the most ideal method by looking at the big picture, within the possibilities we have and looking at the end goal.



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## DEEP EUTECTIC SOLVENTS: A COMPREHENSIVE EVALUATION

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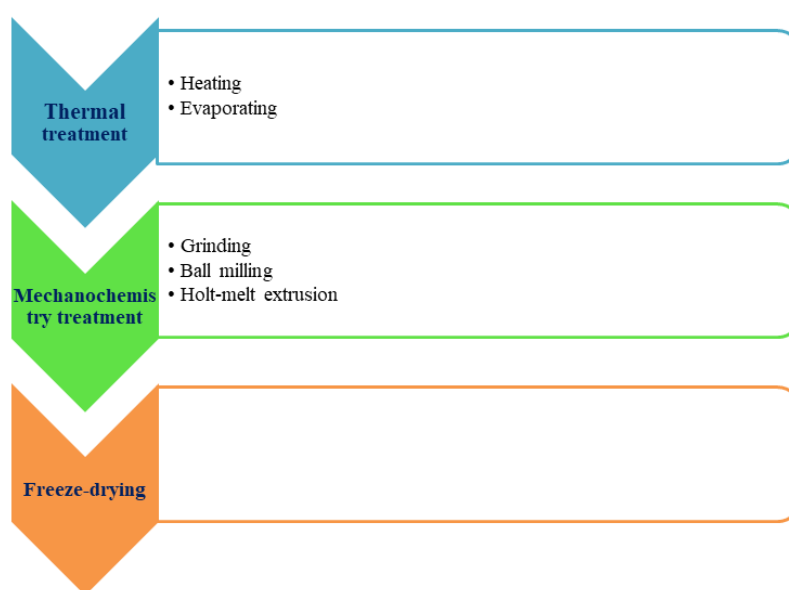
### **Abstract**

Green chemistry constantly plays a role in consuming less energy and chemicals, and producing less waste for the environment in today's research and scientific world. In this context, the solvent used in solvent extraction, which is of vital importance in the recovery of a product obtained in the final stage of production, is a very important detail. Considering the chemical consumed in this context and the energy to be spent for its recovery, it is inevitable to put green chemistry into action. Deep eutectic solvents (DESs) have been introduced as green solvents to replace the traditional petrol-based solvents in the last decade due to their distinctive properties such as being biodegradable, non-flammable, low volatile, chemically and thermally stable (Cunha & Fernandes, 2018; Zainal-Abidin et al., 2017). Furthermore, they are easily prepared with mixing 2 or more ingredients. The ingredients have roles as hydrogen bond acceptor (HBA) and hydrogen bond donor (HBD) in the mixture. Generally, quaternary ammonium halide with a metal salt, organic acids, sugars, sugar alcohols, amines and amino acids have been introduced as HBA and HBD so far (Chandran et al., 2019; Tang et al., 2015; Zainal-Abidin et al., 2017). In this study, the importance of the deep eutectic solvent, its preparation, applications and possible toxicity have been thoroughly evaluated with further prospects.

**Keywords:** Green chemistry; bio-based solvents; bioactive ingredients.

## Introduction

Deep eutectic solvents (DESs) were emerged first in 2001 with Abbot et al. by mixing (below 100 °C) choline chloride and zinc chloride to produce a liquid (Cunha & Fernandes, 2018). After that time, it started to get lots of attention since it is easily and economically prepared by mixing hydrogen bond acceptor (HBA) and hydrogen bond donor (HBD) at a moderate temperature. There are 3 main methods to prepare DESs as seen in Figure 1 (Liu et al., 2022). Each method has both advantages and restrictions. Heating is very simple, inexpensive and time-saving. However, it can be risky for the actives that are highly volatile. Grinding might be alternative for heat sensitives active substances, but its application is not widespread. On the other hand, holt-melt extrusion provides temperature control. At the same time, this approach requires high energy. Freeze-drying is also a good choice for the heat sensitives active substances. However, large-scale industrialization is not feasible for freeze-drying since it is a relatively costly and time-consuming method (Liu et al., 2022).

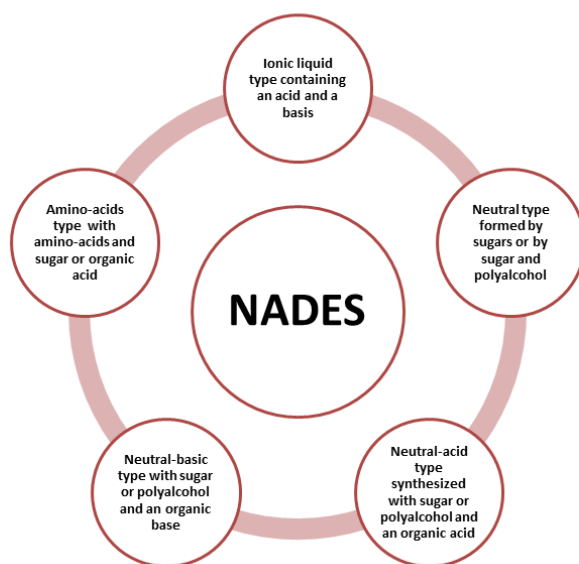


**Figure 1.** Preparations methods for DESs.

In 2011, a new term as natural deep eutectic solvent (NADES) was introduced into the literature (Tomé et al., 2018). In the preparation of NADES, only natural components such as carbohydrates, amino acids, organic acids, polyols and tertiary amines are used (Li et al., 2023). Table 1 summarizes the main HBAs and HBDs for hydrophilic and hydrophobic-based NADESs.

**Table 1.** The most used HBAs and HBDs for hydrophilic and hydrophobic-based NADESs.

Nature of the NADES	HBA	HBD
Hydrophilic	Choline chloride Betaine Proline Arginine Alanine DL-carnitine	Citric acid
		Malic acid
		Lactic acid
		Malonic acid
		Tartaric acid
		Succinic acid
		Sorbitol
		D-glucose
		D-fructose
		Urea
		Xylitol
		Glycerol
		Ethylene glycol
		Butanediol
		Hydrophobic
Camphor		
Cinnamyl alcohol		
Pyruvic acid		
Borneol		
Anise alcohol		
Fenchyl alcohol		
Oleic acid		
1,9-nonaediol		
1,2-decanediol		
1-naphthol		
1-tetradecanol		
Mandelic acid		
Nonanoic acid		
Octanoic acid		
Palmitic acid		
Ricinoleic acid		



**Figure 2.** Types of NADESs.

On the other hand, NADESs are categorized into 5 classes as seen in Figure 2 (Benvenuti et al., 2019).

### **Application of DESs**

There are various applications of deep eutectic solvents since they have unique properties such as high biodegradability, biocompatibility, low toxicity, low volatility, high boiling point (Lomba, García, et al., 2021). DESs have been reported to be used in therapeutic applications (drug delivery, anticancer agents, antimicrobial and anti-inflammatory), pharmaceutical applications (synthesis of active pharmaceutical ingredients, bioavailability of active pharmaceutical ingredients, drug polymorphism, extraction of bioactives, drug synthesis), biomedical applications (tissue engineering, DNA/RNA stability, diagnostics, bactericidal wound dressing, antifoul coating), and biotechnology applications (biotransformation, biocatalysis, polymer treatment, waste water treatment) (Mbous et al., 2017).

### **Safety of DESs**

Although the relevant liquids can be used for many applications and many advantages have been mentioned, it is necessary to mention a possible toxic effect as well. There is a disagreement in the literature regarding the potential toxicity of the DESs (Hayyan et al., 2013). Hayyan et al. reported that mixture of HBAs and HBDs showed higher cytotoxicity comparing to HBAs/HBDs alone (glycerine, ethylene glycol, triethylene glycol and urea) (Hayyan et al., 2013). In a different study, 5 choline chloride-based DESs with glucose, fructose, sucrose, glycerol and malonic acid were prepared, and evaluated in terms of cytotoxic profile (Hayyan et al., 2016). They observed that DESs with organic acids as HBD showed increasing toxicity. Similarly, Popović et al. observed that acidic DESs had the highest cytotoxic effects among the 12 choline chloride-based systems with sugars, alcohols, organic acids, and urea (HBDs) (Popović et al., 2023).

The last but not the least, Lomba et al. announced that there had been no toxicity study of DESs on human beings (Lomba, Ribate, et al., 2021).

### **Conclusion and Recommendations**

There are many potential combinations with different hydrogen bond donors and hydrogen bond acceptors in several molar ratios. Therefore, it is obvious that there is a need to conduct studies on this issue. However, the possible toxic effects of the deep eutectic solvent mixture must be considered although safe natural-based ingredients are used to prepare the mixture. On the other hand, it is really exciting for future applications due to the fact that it is versatile, recyclable and affordable. As mentioned before, DES can be prepared in countless combinations. Additionally, it should not be forgotten that the characterization of the prepared DES systems and the determination of their physicochemical properties are necessary. Therefore, more DES/NADES combinations should be prepared, and added to the literature in order to create a comprehensive database. The applications of the obtained solvents should also be studied in different research fields in order to guide future studies.

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# AKKARAMAN ve ANADOLU MERİNOSU KOYUN IRKLARINDA BMPR1B GENİNDEKİ 90 BAZLIK DELESYON POLİMORFİZMİNİN BELİRLENMESİ

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## Özet

Koyunlarda bir batında doğan yavru sayısı ekonomik önemi olan özelliklerden birisidir. Kasaplık kuzu üretimi yapan işletmeler için önemli olan bir batında doğan yavru sayısı diğer ekonomik özellikler gibi poligenik kalıtım izlemekle birlikte bazı majör genler tarafından da etkilenmektedir. Koyunlarda bir batında doğan yavru sayısı ile ilişkili, Bone Morphogenetic Protein (BMPs) ailesi ya da reseptörlerini kodlayan ve 6. kromozom üzerinde bulunan bazı majör genler tanımlanmıştır. BMPR1B geni üzerinde bulunan ve 90 bç'lik delesyon mutasyonu sonucu oluşan genotiplerden (II, ID ve DD) DD genotipi taşıyan hayvanların daha yüksek bir batında doğan yavru sayısına sahip olduğu bilinmektedir. Bu çalışmada Akkaraman ve Anadolu Merinosu koyun ırklarında BMPR1B geni üzerinde bulunan ve 90 bç'lik delesyon mutasyonu sonucu oluşan polimorfizmlerin belirlenmesi amaçlanmıştır. Bu amaç için 28 baş Akkaraman ve 36 baş Anadolu Merinosu koyundan alınan kanlardan izole edilen DNA'lar, PCR işlemiyle çoğaltılarak ilgili gen bölgesi için genotipler belirlenmiştir. Yapılan PCR işlemi sonucunda Akkaraman koyun ırkında II, ID ve DD genotip frekansları sırasıyla 0.49, 0.42 ve 0.09 olarak hesaplanırken, Anadolu Merinosu koyun ırkında ise sırasıyla 0.46, 0.44 ve 0.10 olarak hesaplanmıştır. Ki-kare testi sonucunda her iki popülasyonun da BMPR1B geni için Hardy-Weinberg dengesinde olduğu saptanmıştır. Gerçekleştirilen çalışmada elde edilen bulgular koyunlarda daha önce çoklu doğumla ilişkili olduğu gösterilen DD genotipinin Türkiye yerli koyun ırklarından Akkaraman ve Anadolu Merinosu koyun ırklarında değişen frekanslarda olduğunu ve popülasyonlarda yeterli genetik varyasyonun olduğunu göstermektedir. Bu çalışmadan elde edilen sonuçlar BMPR1B geni üzerindeki 90 bazlık delesyon mutasyonu sonucu oluşan polimorfizmlerin Akkaraman ve Anadolu Merinosu koyun ırklarında çoklu doğumun artırılması için yapılacak Marker Destekli Seleksiyon (MAS) çalışmalarında kullanılabileceğine işaret etmektedir. Ancak MAS çalışmalarına başlanmadan önce aynı gen bölgesi ile üreme özelliklerine ait fenotipik veriler arasındaki ilişki analizlerinin yapılması daha faydalı sonuçlar verebilir.

**Anahtar Kelimeler:** BMPR1B, PCR, Delesyon, Akkaraman, Anadolu Merinosu

## **DETERMINATION of 90 BASE DELETION POLYMORPHISM in BMPR1B GENE in AKKARAMAN and ANATOLIAN MERINO SHEEP BREEDS**

### **Abstract**

The litter size is one of the economically important traits in sheep. Litter size, which is crucial for slaughter lamb production enterprises, follows polygenic inheritance like other economic traits, but is also affected by some major genes. Some major genes encoding the Bone Morphogenetic Protein (BMPs) family or receptors have been located on chromosome 6 and are associated with the litter size in sheep. Of the genotypes (II, ID and DD) resulting from a novel 90 bp deletion mutation on the BMPR1B gene, it is known that sheep carrying the DD genotype have a higher litter size. The purpose of this study was to identify polymorphisms caused by 90 bp deletion mutation in the BMPR1B gene in the Akkaraman and Anatolian Merino sheep breeds. For this purpose, DNA isolated from the blood samples of 28 Akkaraman and 36 Anatolian Merino sheep were amplified by PCR and genotypes were determined for the related gene region. As a result of the PCR process, II, ID and DD genotype frequencies in Akkaraman sheep breed as 0.49, 0.42 and 0.09, respectively, while in Anatolian Merino sheep breed, they were calculated as 0.46, 0.44 and 0.10, respectively. The chi-square test indicated that both populations were in Hardy-Weinberg equilibrium for the BMPR1B gene. The study's findings show that the DD genotype, which has been previously shown to be associated with multiple births in sheep, is present at varying frequencies in Akkaraman and Anatolian Merino sheep breeds among the native sheep breeds of Türkiye and that the populations have sufficient genetic variation. The results obtained from this study indicate that polymorphisms resulting from 90 base deletion in BMPR1B gene can be used in Marker Assisted Selection (MAS) studies to increase litter size in Akkaraman and Anatolian Merino sheep breeds. However, it may be more useful to analyze the relationship between the same gene region and phenotypic data on litter size before starting MAS studies.

**Keywords:** BMPR1B, PCR, Deletion, Akkaraman, Anatolian Merino

## Introduction

Sheep (*Ovis aries*) were domesticated approximately 11,000 years ago and have always been an economically and culturally significant farm animal species for humans. Sheep breeding remains an important aspect of the agricultural industry worldwide (Argun Karsli, 2024). Türkiye makes a significant contribution to the world's animal genetic resources with approximately 30 sheep breeds or types. Sheep breeding in Türkiye is predominantly carried out with native breeds, and the country is a major producer globally, with 42 million sheep (Argun Karsli et al., 2024). The Akkaraman is the most frequently reared native Turkish sheep breed, accounting for around 40% of the entire population. It is widespread across the country, especially in central Anatolia. Merino sheep and their crossbreeds constitute 9% of Türkiye's sheep population (Argun Karsli, 2024).

The primary goal of sheep breeding is meat production in Türkiye. When the goal is meat production, the litter size becomes critical. The litter size is one of the economically important traits in sheep. Litter size, which is crucial for slaughter lamb production enterprises, follows polygenic inheritance like other economic traits, but is also affected by some major genes (Karsli and Balcıoğlu, 2010; Nenova et al., 2023) Because of the low heritability of sheep, selection process to increase the litter size can take a long time. The major genes influencing litter size can be detected immediately after birth using genetic methods. Identification of these genes can shorten the duration of selection studies to increase fertility, and a faster genetic progress can be achieved. Furthermore, with crossbreeding studies, these genes can be transferred to other breeds easily (Karsli and Balcıoğlu, 2010; Atay et al., 2023).

Over the past 20 years, a large number of major genes have been identified that have been reported to be associated with multiple birth in different sheep breeds. The Bone morphogenetic protein receptor type 1B (BMPRI1B), Growth differentiation factor 9 (GDF9), Bone morphogenetic protein 15 (BMP15) genes are some of the main genes that have been linked to multiple births in sheep (Mishra 2014; Nenova et al., 2023). Bone morphogenetic proteins (BMPs) are members of the transforming growth factor b (TGF-b) superfamily, which regulates the growth and differentiation of a range of cell types and affects animals' reproductive capacity (Li et al., 2023). The BMPRI1B gene also known as FecB or Activin-Like Kinase 6 (ALK6) on sheep chromosome 6 and are associated with the litter size in sheep. Different mutations (SNPs or indels) on the BMPRI1B gene in sheep increase fertility or litter size (Abdoli et al., 2016; Akhatayeva et al., 2023). In recent years, it has been reported that, in addition to SNPs on the BMPRI1B gene, some indels are associated with multiple births. Li et al., (2023) investigated the relationship between a 90-bp deletion on the BMPRI1B gene in East Friesian and Hu crossbred sheep and litter size. They reported that the 90-bp deletion had a significant effect on the litter size. The researchers reported that this 90-bp deletion could be detected directly by PCR and that animals carrying the DD genotype had a higher litter size among the genotypes obtained after the PCR process (II, ID and DD).

There are many studies on the determination of polymorphisms caused by SNPs on gene regions causing multiple births in native sheep breeds in Türkiye. These studies focused on the determination of SNPs on BMPRI1B, BMP15, GDF9 genes in different sheep breeds (Karsli and Balcıoğlu 2010; Karsli et al., 2011; Karsli et al., 2012; Çelikeloğlu et al. 2018; Çelikeloğlu

et al., 2021; Gedik, 2021; Kırıkçı, 2023a; Kırıkçı, 2023b). However, no study has been found in the literature to determine polymorphisms caused by indels in the BMPR1B gene in native sheep breeds in Türkiye. In this context, the purpose of the study was to identify polymorphisms caused by 90 bp deletion mutation in the BMPR1B gene in the Akkaraman and Anatolian Merino native sheep breeds of Türkiye.

## **Materials and Methods**

### **Sampling and DNA Isolation**

Sampling was carried out for each breed from two different farms in Haymana district of Ankara province, paying attention to kinship. Salting-out method reported by Miller et al. (1988) was used in DNA isolation from blood samples. The success of DNA isolation was checked using a 1% agarose gel. DNA quality and amount were evaluated using both 1% agarose gel electrophoresis and a spectrophotometer (Allsheng Nano-400A). DNA concentration was adjusted at 50 ng/μL for PCR amplification.

### **PCR Amplification for Genotyping BMPR1B gene**

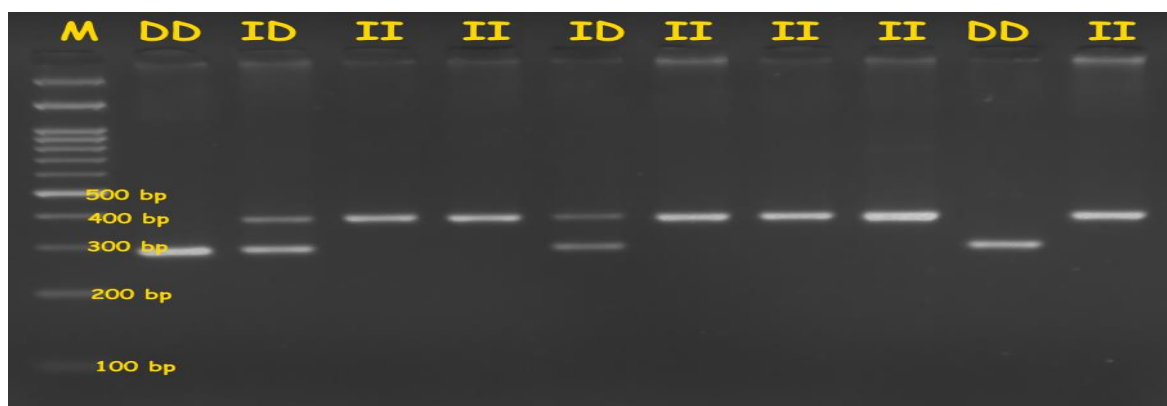
In this study, a traditional PCR process was applied to determine the 90 bp length deletion polymorphism in the BMPR1B gene. Forward: CAACCTGAGTGGTCATGTCTGT, and Reverse: GAGCAGCTGTTGCTTTTGAA primers were amplified by using PCR protocol reported by Li et al. (2023). The PCR was carried out in initial denaturation at 95 °C for 5 min, followed by 35 cycles of denaturation at 94 °C for 30 s, annealing at 55 °C for 30 s, extension at 72 °C for 30 s, and a final extension at 72 °C for 10 min. PCR amplification was performed in 50 μL reaction volume with 3 μL DNA (50 ng/μL), 5 μL 10X reaction buffer, 5 μL dNTPs (2.5 mM), 4 μL MgCl<sub>2</sub> (2,5 mM), 0.5 μL each primer (10 pM), 0.25 μl (1 U) Taq DNA polymerase and 31.75 μL nuclease-free water. All PCR products were separated on 2 % agarose gel in order to genotype individuals as follows II, ID and DD based on the presence or absence of the PCR fragments. In the agarose gel electrophoresis performed at the end of the PCR process, a single fragment of 387 bp in length was obtained for genotype II, two fragments of 387 bp and 297 bp in length for genotype ID and a single fragment of 297 bp in length for genotype DD.

### **Statistical Analysis**

Allele and genotype frequencies for BMPR1B gene in the studied sheep breeds and whether the populations were in Hardy-Weinberg equilibrium in terms of the related gene were determined by Popgene ver.1.32 (Yeh et al. 1997) package program.

### **Findings and Discussion**

The agarose gel image of the genotypes obtained for the 90 bp length deletion on the BMPR1B gene, as a result of the PCR process performed in the Akkaraman sheep breed is given in Figure 1.



**Figure 1.** Agarose gel image (2%) of polymorphisms 90-bp deletion on the BMPR1B gene in Akkaraman sheep

In the study where both breeds were found to be polymorphic, II, ID and DD genotype frequencies in Akkaraman sheep breed as 0.49, 0.42 and 0.09, respectively, while in Anatolian Merino sheep breed, they were calculated as 0.46, 0.44 and 0.10, respectively. While the I allele frequency was 0.70 in the Akkaraman sheep breed, it was calculated as 0.68 in the Anatolian Merino sheep breed. The chi-square test indicated that both populations were in Hardy-Weinberg equilibrium for the BMPR1B gene (Table 1).

**Table 1.** Gene and genotype frequencies for 90-bp deletion on the BMPR1B gene in Akkaraman and Anatolian Merino sheep breeds

Gene	Breed	n	Gene Frequencies		Genotype Frequencies			HWE
			I	D	II	ID	DD	$\chi^2$
BMPR1B	Akkaraman	28	0.70	0.30	0.49 (14)	0.42 (11)	0.09 (3)	0.141 <sup>a</sup>
	Anatolian Merino	36	0.68	0.32	0.46 (19)	0.44 (11)	0.10 (6)	3.181 <sup>a</sup>

In the study, the DD genotype frequencies obtained for the 90 bp base pair deletion polymorphism in the BMPR1B gene in Akkaraman and Anatolian Merino sheep breeds (0.09 and 0.10, respectively) were lower than the DD genotype frequencies reported by Li et al. (2023) in Hu sheep (0.875) and Hu and East Friesian crossbred sheep (first crossbred 0.202 and second crossbred 0.206). However, these frequencies were higher than the value reported in East Friesian sheep (0.003). In this study, it is expected that the DD genotype frequency observed in Akkaraman and Anatolian Merino sheep breeds would be lower than that in Hu sheep. Li et al. (2023) reported that the DD genotype for the BMPR1B 90 bp deletion mutation was associated with high prolificacy, as the Hu sheep is a Chinese native breed globally renowned for its hyper-prolificacy (Yang et al., 2022). The litter size in Akkaraman and Anatolian Merino sheep breeds is considerably lower than that in Hu sheep.

There are no studies in the literature investigating the polymorphism resulting from a 90-bp deletion in the BMPR1B gene in Akkaraman or Anatolian Merino sheep breeds. However, Karlı and Balçioğlu (2010) were unable to detect polymorphism for the FecB allele in the BMPR1B gene, which is associated with multiple births, in the Akkaraman sheep breed. Similarly, Karlı et al. (2012) for the BMP15 (FecX<sup>G</sup>, FecX<sup>I</sup>, FecX<sup>H</sup>, FecX<sup>B</sup>) alleles, Kırıkçı (2023) didn't detect polymorphisms for the BMP15 (FecX<sup>G</sup> and FecX<sup>I</sup>) and GDF9 (G1 and G4)

alleles in Akkaraman sheep breed. To date, no studies have investigated the genetic mechanisms underlying multiple births in the Anatolian Merino sheep breed.

### **Conclusion and Recommendations**

In this study, a polymorphism potentially associated with multiple births in the BMPR1B gene of Akkaraman and Anatolian Merino sheep breeds was identified for the first time. In the BMPR1B gene, a 90 bp deletion polymorphism was detected, and the desired DD genotype for multiple births was observed at varying frequencies in both breeds. The presence of the DD genotype in both breeds, along with the fact that the populations are in Hardy-Weinberg equilibrium, suggests that this gene region could be useful in MAS (Marker-Assisted Selection) studies. However, before proceeding with MAS studies, it is important to conduct association analyses between the obtained genotypes and phenotypic data on litter size in these breeds. If a relationship is established, it would be more appropriate to advance with MAS studies.

### **Thanks and Information Note**

This study is based on a section of the first author's master's thesis, titled "Investigation of the Relationship Between Litter Size and Polymorphisms in Some Genes (BMP15, GDF9, BMPR-IB, PRL, GHR, NR5A2) in Akkaraman and Merino Sheep".

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## DİJİTAL OYUN ALIŞKANLIKLARI VE BAĞIMLILIĞI HAKKINDA KISA BİR DEĞERLENDİRME

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### Özet

Teknolojik gelişmeler, iletişim, ulaşım, sağlık, eğitim ve eğlence gibi birçok alanı etkileyerek hayatımızda önemli değişikliklere yol açmaktadır. Özellikle telefon, televizyon, sosyal medya ve internet kullanımının ortaya çıkardığı bağımlılıklar giderek artmaktadır. Dijital oyun bağımlılığı özellikle çocuklar ve ergenler arasında oldukça yaygın görülmektedir. Telefon, tablet ve bilgisayarların kolayca ulaşılabilir olması, dijital oyunlara olan ilgiyi artırmıştır. Bu durum, zamanın kontrolünü kaybetme, sağlıksız beslenme, uyku bozuklukları, iskelet ve kas hastalıkları, depresyon gibi ciddi sorunlara yol açabilmektedir. Bu çalışma, dünyada dijital oyun bağımlılığı üzerine yapılan çalışmaları incelemekte ve güncel istatistikleri yorumlamayı hedeflemektedir. Dünyadaki dijital oyun bağımlılığı istatistikleri ile ülkemizdeki istatistikler karşılaştırılarak yorumlanmıştır.

**Anahtar Kelimeler:** Oyun, Dijital Oyun Bağımlılığı, İnternet Bağımlılığı

## **A BRIEF REVIEW OF DIGITAL GAMING HABITS AND ADDICTION**

### **Abstract**

Technological developments affect many areas such as communication, transportation, health, education and entertainment, and lead to significant changes in our lives. In particular, addictions caused by the use of phones, television, social media and the internet are increasing. Digital game addiction is especially common among children and adolescents. The easy accessibility of phones, tablets and computers has increased the interest in digital games. This situation can lead to serious problems such as losing control of time, unhealthy nutrition, sleep disorders, skeletal and muscular diseases and depression. This study examines the studies conducted on digital game addiction in the world and aims to interpret current statistics. The statistics on digital game addiction in the world and in our country have been also compared and interpreted.

**Keywords:** Game, Digital Gaming Addiction, Internet Addiction

## **1. Introduction**

Technological advances have major impacts on many areas of life, such as communication, transportation, health, education and entertainment. These developments cause significant changes in our lifestyles and habits. Until recent history, games were usually played in public areas, gardens, parks or streets with peers (Irmak and Erdoğan, 2016). With the developing technology, the perception of traditional games has changed and the concept of digital games has emerged (Ülker et al., 2017)(Hazar et al., 2017). While developing technology makes life easier, it also brings some negative effects. For example, a new concept called technological addiction has emerged among behavioral addictions (Denizci Nazlıgül and Yılmaz, 2019). Technological addictions are divided into various categories such as internet, social media, phone, game, computer, and television addiction (Özdemir, 2023). Game addiction is a type of addiction that occurs due to excessive and uncontrolled use of technological devices such as game consoles, tablets, televisions, phones and computers. Digital game addiction affects individuals of all age groups, but is generally more common among adolescents (Duran, 2020)(Yiğit, 2017). Digital game addiction attracts attention not only because of the time spent on games, but also because of its various negative consequences. For example, violent games played uncontrollably threaten mental health. In addition, adolescents may experience problems such as physical developmental delays, eye disorders, weight loss or excessive weight gain, hand, shoulder and spine problems due to sitting for long periods of time and psychomotor skills disorders. (Irmak and Erdoğan, 2016). Contrary to all their negative effects, playing educational, development-supporting digital games at appropriate times and in a controlled manner can make positive contributions to the development of adolescents.

Technological developments have affected many areas of daily life. With digitalization, many analog materials such as data, sound, music, and photographs have been transferred to digital media (Değirmencioglu, 2016: 593). Digitalization has accelerated the exchange of information between people and allowed for the rapid transmission of large amounts of data. This process emerged with the beginning of Web 1.0 and accelerated with the spread of social media. The speed of interaction and communication increased through platforms such as social networks, blogs, microblogs, content sharing sites, podcasts, and wikis brought by Web 2.0. In a short time, Web 2.0 technologies were replaced by Web 3.0 technologies, which are the beginning of a transition that machines can understand and interpret (Alptekin, 2020: 140). Digital Games continue to exist as an important content category in every phase of the internet.

### **1.1. The Concept Of “Game”**

In fact, the concept of game is as old as human history and have been defined in various ways in different cultures. In archaeological excavations, it was seen that two girls were playing with ankle bones in wall paintings dating back to 800 BC. In ancient wall paintings in India and Egypt, traces of games played with dice on a game board and children's top and hand-clapping games were found (Karaduman & Aciyan, 2020: 459). Many games have been transferred from one culture to another and have survived to the present day. Every society has created games and entertainment suitable for its own cultural structure (Biricik and Atik, 2021: 449). Figure 1 shows an illustration of children playing marble games in 2nd century of Rome.



**Figure 1.** Illustration of children playing marble games (McCormack, 2024)

Games take place in a specific area and within the framework of specified rules. Time also ensures that the game progresses without interruption (Huizinga, 2006: 27). Games generally affect children's social relationships and help them develop their mental skills. In addition, games create many effects in terms of physical, psychological, sociological and mental aspects (Yalçın & Bertiz, 2019: 28-29). Games have both beneficial and harmful aspects. One of the harmful aspects is the potential to encourage violence. People can reveal their true personalities through games (Mustafaoğlu, 2018: 85). According to Huizinga, games should be considered as a phenomenon that exists together with culture (Huizinga, 2006: 14-20). Games, which differ from culture to culture, have been stripped of cultural distinctions with the development of communication technologies. As a result of digitalization, traditional street games have turned into a virtual socialization tool (Akgöl, 2019: 212). However, functional games are at the forefront in children's development process. Children shape games using their own bodies (Söylemez and Ayas 2023). The biggest reasons why digital games have replaced traditional outdoor games are urbanization, security concerns and easy access to digital games at home (Biricik & Atik, 2021: 447-452). Today, families try to keep their children as close as possible to ensure children's safety. For this reason, digital games that allow playing at home have become attractive. Street games that used to be played are now less preferred. The interest in digital games has led many companies to invest in the digital game sector and the emergence of different types of games. The emergence of play options on various platforms such as computers, consoles, mobile phones and tablets, and virtual reality equipment has also led to the diversification of games. Thus, digital games have begun to be seen as an industrial product (Karaduman & Acıyan, 2020: 459-462). Children have begun to get away from stress by establishing social interaction within games. Many games offer complex challenges to the player and aim to motivate players with constant new goals. This has a positive effect on

children's development processes, entertainment style and game culture (Söylemez and Ayas 2023).

After the 2000s, digital games have gained great popularity. In recent years, digital games have been designed that offer players experiences as if they were in the real world. The rich scenarios, impressive stories and character diversity of the games have increased the interest in digital games (Öztürk, 2007). Crawford divides digital games into two categories; skill/action games and strategy games (Crawford, 1982). In the skill/action games category; there are various subclasses such as maze games, fighting games, racing games, mixed games and sports games, and similarly in the strategy category; multiplayer games, adventure games, educational and children's games, role-playing games, war games and games of chance. Skill games require psychomotor skills, while strategy games require cognitive effort. According to another classification in the literature, digital games are divided into categories such as educational games, puzzle games and violent games (Şengül and Büber, 2016). Ögel, on the other hand, divided digital games into ten different categories; action, adventure, fighting, puzzle, role playing, simulation, sports, strategy, entertainment and mission content games (Ögel, 2012). Strategy games are among the most popular game types, where players develop the ability to position themselves against other players. In fighting games, players can become desensitized to real-world violence by experiencing long-lasting fights in a virtual environment. Among digital games, there are educational and sports games, as well as war games that encourage violence, especially among adolescents. (Torun et al., 2015: 28). Some examples of games that encourage violence are Blue Whale and PUBG. While PUBG encourages violence, the Blue Whale game has led to fatal consequences. The third most preferred game category is adventure and action games. These type of games require hand, eye and body coordination. However, in addicts, it can cause involuntary hand movements, dry eyes and joint disorders (Ögel, 2012).

### **1.2. Digital Games-Related Habits**

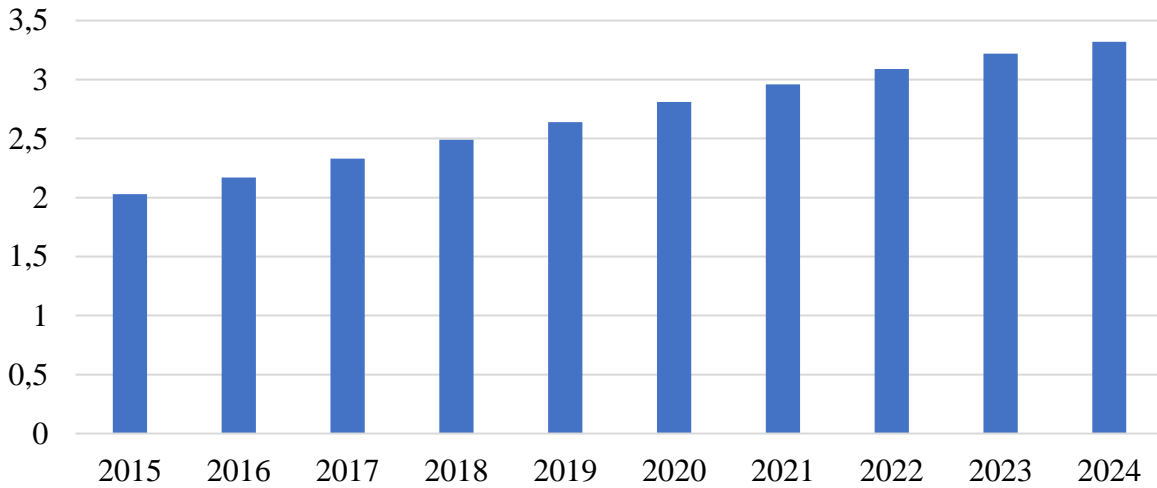
Digital games are frequently preferred entertainment tools for the purpose of spending free time. They have many positive effects such as increasing hand-eye coordination, strengthening spatial abilities, developing imagination, supporting mathematical and geometric thinking skills (Yalçın & Bertiz, 2019: 30), reducing fatigue, coping with stress, increasing self-confidence (Kesgin, 2019), and accelerating learning (Irmak & Erdoğan, 2016: 133-134). Digital game designers create entertaining designs where players can experience various emotional experiences with realistic simulations. Avatars and characters in many games can be developed by players for a long time. Players can experience feelings of success and value that they cannot experience in the real world through the characters they develop. During the game, momentary emotional changes such as losing, achieving, being happy, and getting angry can be experienced. The desire to be the most successful in interactive games and to maintain this success can lead players to continue playing the game continuously. Factors such as the tendency to extend the duration of playing games, the feeling of control, the search for entertainment, being immersed in the game, and the feeling of curiosity also cause game addiction to increase (Yumrukuz, 2021) and negatively affect the player's social relationships in daily life (Yalçın and Bertiz, 2019).

Addiction represents a pathological condition that expresses an involuntary and constant desire and need. Individuals have always been highly interested in various objects, phenomena, substances, people and behaviors at certain periods as a result of their experiences, and this interest has turned into addiction over time and has made people captive (Ayhan & Köseliören, 2019: 3-4). For the diagnosis of addiction which is a psychiatric syndrome, it is sufficient that only three of the following criteria are seen together (Macit et. al., 2018);

- Tolerance development in the used substance
- The manifestation of withdrawal symptoms when the substance is cut or reduced
- Efforts to control or abandon the use of drugs
- Spend a lot of time to provide, use or leave the substance
- Adverse effects in social, occupational and personal activities because use of substance
- Taking the substance in a long time and higher quantities
- Continue use of substance despite the emergence or increase of physical or mental problems

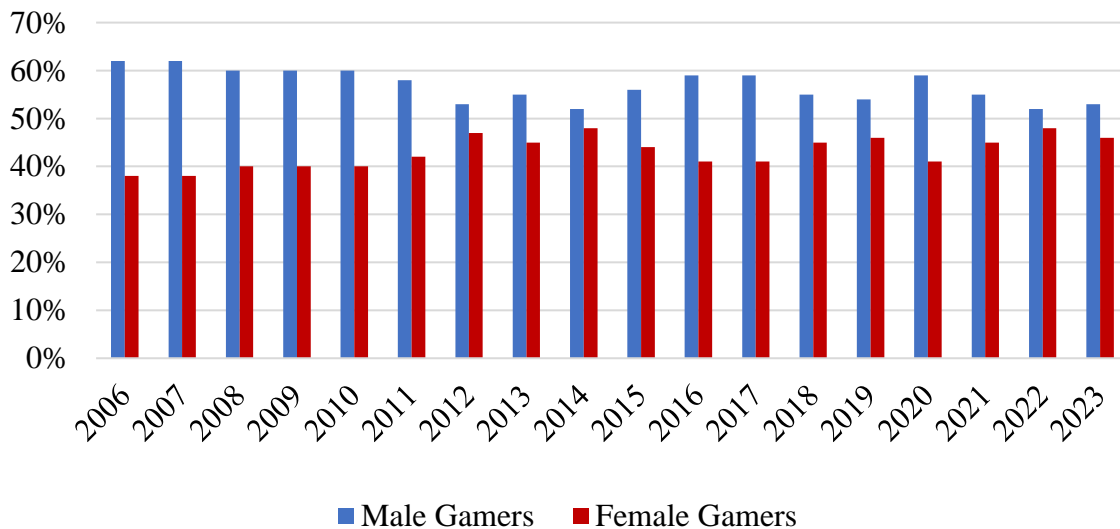
Digital game addiction is considered a subtype of internet addiction. Internet addiction, also called pathological internet use, excessive internet use, compulsive internet use, problematic internet usage, can be defined as going to excessive nervous and aggressive state when deprived of using the internet (Arısoy, 2009: 56). Digital game addiction is expressed with terms such as excessive use of games, obsessive-compulsive gaming, pathological gaming behaviors and problematic gaming behaviors (Hazar, 2016: 65). Diagnosing addiction becomes difficult due to the widespread use of technological devices. The fact that each individual has different personality traits shows that addiction can occur in various ways and for various reasons. The symptoms of digital game addiction are similar to other types of addiction and negatively affect the individual's life. Game addiction can cause the individual to distance himself from his daily responsibilities, uncontrollable gaming periods and psychological changes (Hazar, 2016: 68). The criteria used to detect digital game addiction are similar to the criteria for pathological gambling. These criteria include how important gaming behavior has become in a person's life, and the uncontrolled direction of game-focused thoughts, emotions, and behaviors (Irmak & Erdoğan, 2016: 131-132). Digital game addiction is especially common among young people and can lead to physical and psychological health problems. Therefore, it is of great importance to prevent and control this addiction (Festl, 2012).

There are numerous academic studies on digital game addiction in Turkey and around the world. However, due to cultural and genetic differences, as well as differences in scales and methodologies, inconsistent results can be obtained even within the same country. The rapid change in the number of digital players also affects the results of the studies. The number of digital gamers has increased by more than 50% in the last 10 years. Figure 2 shows the estimated change in the number of digital gamers worldwide over the last 10 years (Howarth, 2024).



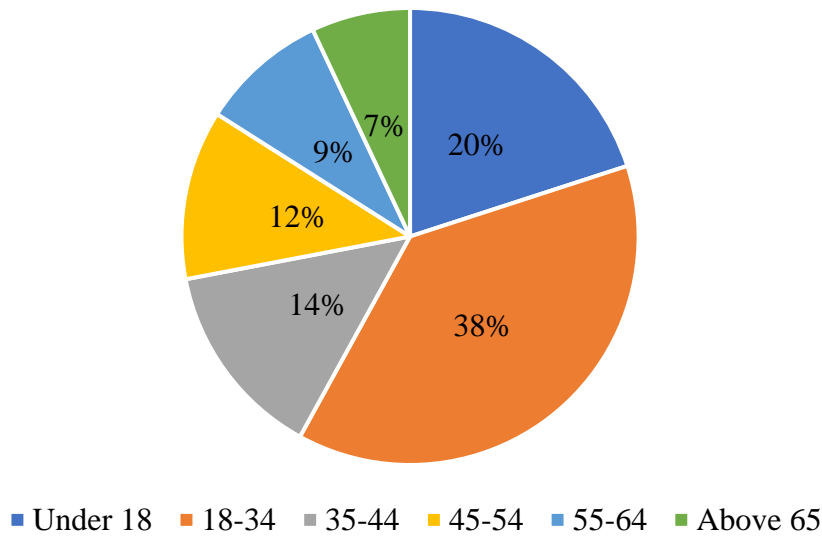
**Figure 2.** Global active gamers over years (x billion)

The gender distribution of digital gamers by year is given in Figure 3 (Gilpress, 2024). As can be seen, there are more male gamers than female gamers.



**Figure 3.** The gender distribution of digital gamers

Figure 4 shows the worldwide age distribution of digital gamers. The largest population of gamers worldwide comes under the age group of 18 to 34 years with 1.17 billion. While there are only 7% of gamers who are above the age of 65 (Howarth, 2024).



**Figure 4.** The worldwide age distribution of digital gamers

The social restrictions imposed due to the Covid19 pandemic have increased interest in digital games. This interest continues after the pandemic. For example, in 2022, 90% of gamers spent the same amount of time on digital games as during the pandemic. Gamers put forward different reasons for spending time on games. For example, according to a research conducted by Olson on children, children generally suggested that games are interesting, fun, useful for spending time when bored, competitive and relaxing (Olson, 2010). Table 1 shows the results of a study conducted by the Entertainment Software Association (ESA) on 13.000 individuals over the age of 16 across 12 countries in 2022 (Stuart, 2023).

**Table 1.** Results of the study conducted by ESA

Percentage	Declaration
67%	Video games can introduce people to new friends and new relationships.
53%	I have had positive experiences meeting people through video games that I otherwise would not have met.
50%	Video games have helped me make lasting memories.
46%	Video games help me stay connected to friends/family.
43%	Video games help me develop deeper relationships with others.
41%	Video games strengthen my relationships with friends/family.

64% of gamers stated that they get away from the stress of daily life by playing games. 26% stated that they socialize by playing online games regularly every day. 53% stated that they feel less lonely when they play games. Young adults between the ages of 18-24 play games for comfort, relaxation, excitement and friendship, while individuals aged 65 and over prefer games for spending time and improving themselves. The proportion of online games decreased from 77% in 2022 to 65% in 2023. In 2022, players played games for an average of 13 hours per week, while this time decreased to an average of 12.8 hours per week in 2023 (ESA, 2023). According to the 2023 Digital Gaming Sector Report of Gaming in Turkey Agency, while there were 44 million players in Turkey in 2022, this figure reached 47 million in 2023. Same year, 44 million players have played mobile games. Most of the players are individuals between the



ages of 25-34 and 55% of the players are male. PUBG was the game that generated the most revenue in Turkey in 2023 with \$11 million. Players in Turkey reported that they play games mostly for entertainment, comfort, stress reduction and freedom. 45% of the players reported that they play games for an average of 1 hour or less per day, while 45% reported that they play games for an average of 1-4 hours per day. Approximately 10% of the players reported that they play games for an average of more than 4 hours per day (Gaming in Turkey, 2024).

In the study published by Bayzan et.al in Turkey in 2024, it was aimed to determine the digital game playing habits of middle and high school students. The sample of the study consisted of 28,096 students. As a result, approximately 35% of the students were seen as at risk for digital game addiction. In addition, it was seen that male students were at higher risk of becoming game addicts than female students. The variables that had the most impact on students' game addictions were; internet addiction levels, social media addiction levels, cyberbullying levels, loneliness levels, distress levels and happiness levels. While all other variables except students' happiness levels increased Digital Game Addiction levels, Digital Game Addiction levels decreased as happiness levels increased. As a result of the research, the following practices were suggested to be carried out to combat digital game addiction (Beyzan et.al., 2024);

- Developing cooperation programs between educational institutions and families
- Strengthening cooperation between educational institutions, relevant civil society organizations and families to increase social awareness
- Conducting studies to determine social, interactive and educational areas of interest
- Combating cyberbullying with cooperation among students, teachers, schools and families, and developing strategies specific to gender, age and other factors in this fight
- Conducting studies with cooperation between educational institutions, families and health professionals to better understand the perceptions of loneliness that emerge in students

## **2. Results and Conclusion**

This study aims to address the causes, types, prevalence and consequences of digital game playing behaviors and addiction based on literature. Adolescents in particular are prone to digital games. This propensity can turn into addiction. Digital game addiction, as in physical addiction types, can lead to negative social, economic, cultural and biological outcomes. It is known that digital games provide positive contributions in cognitive, emotional and social aspects. However, game addiction can result in many negative effects in individuals such as sleep and nutritional disorders, skeletal, muscular and eye diseases and obesity. Violent games threaten the psychological health of individuals. Digital game addiction, which is widespread worldwide, is also observed intensively in our country, especially among the young population. It is very important for families, educational institutions, health institutions and non-governmental organizations to work together to prevent and treat digital game addiction. Adolescents in particular should be directed to sports activities. Parents should communicate well with their children, especially during adolescence.

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## YAŞAM TEMASININ YENİLENEN ORTAÖĞRETİM BİYOLOJİ PROGRAMINDAKİ YERİ

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### Özet

Ders programlarının değişmesi elbetteki bir neslin yetişmesi üzerinde çok etkili olacaktır. Bu araştırmanın amacı MEB tarafından kabul edilen yeni biyoloji müfredatında ki yaşam temasının yerinin belirlenmesidir. Dökümantasyon analizi yöntemi kullanılmıştır. Bu amaçla MEB'in 2024 yılında kabul ettiği ve bu yıl uygulamaya konulacak olan ortaöğretim biyoloji öğretim programı incelenmeye alınmıştır. Çalışma sonunda yaşam temasının biyoloji öğretim programında 9. sınıfta olduğu, 7 tane öğrenme çıktısı olduğu, 38 ders saatinin temanın öğretimi için ayrıldığı tespit edilmiştir. Yaşam teması konusunda ele alacak konular programda biyoçeşitlilik, sınıflandırma, bilim, bilimsel araştırma süreçleri başlıkları altında olduğu görülmektedir. Yaşam temasında yer alan hedefler şöyle sıralanabilir: Güncel olarak biyolojide gerçekleşen yeniliklerin bireyin hayatına nasıl etki edeceğini düşünmek, bilimin tabiatına anlam vermek, bilimsel çalışmalarda ve bilim öğretmede ahlaki kuralların önemini kavramak, yaşanan çevredeki canlıları kategorilendirerek onları tanımak, tabiatteki yaşayan varlıklarda ortak olarak neyin olduğunun farkına varmak. Bu amaçlara uygun olarak tema ile alakalı 7 öğrenme ürünü yazılmıştır. Çıktı olarak adlandırılan bu kazanımlar ise şöyle sıralanabilir: Biyolojideki yeni gelişmeler üzerinde düşünme, ne kadar gerçek olduğunu düşünmek ve toplumdaki bireylerin üzerinde olan olumlu veya olumsuz etkileri üzerinde düşünmek ve şüphe ile yaklaşmak, bilimsel çalışma yaparken ahlak kurallarına uymanın önemini anlamak, bilimsel çalışma süreçlerine anlam vermek, canlıları kategoriye ayırmak ve isimlendirmek, domainde yer alan varlıkları tüm süreçleri ile anlamamak ve öğrenmek olarak ifade edilebilir. Yaşam temasında yer alan biyoloji konuları ise yaşam bilimi: biyoloji, sınıflandırma ve biyoçeşitlilik olduğu görülmektedir. Biyoloji programlarının etkililiğini artıracak öneriler ise programda açık alan etkinliklerine daha fazla yer verilmesi, öğretmenlere informal öğrenme ortamları hakkında eğitim verilmesi, programda velilere yönelik bilgilendirme toplantısı veya seminerlerin verilmesi olarak verilebilir.

**Anahtar Kelimeler:** Biyoloji Eğitimi, Yaşam Teması, Biyoloji Öğretim Programı.

## THE PLACE OF LIFE CONTACT IN THE NEW SECONDARY EDUCATION BIOLOGY PROGRAM

### **Abstract**

Changes in curricula will certainly have a great impact on the upbringing of a generation. The reason for this research is to determine the place of the life theme in the new biology curriculum adopted by the Ministry of National Education. Documentation analysis method was used. For this purpose, the high school biology curriculum adopted by the MEB in 2024 and to be implemented this year was examined. At the end of the study, it was found that the life theme was in the 9th grade in the biology curriculum, there were 7 learning outcomes, and 38 lesson hours were allocated for the teaching of the theme. It is seen that the topics to be addressed in the life theme are under the titles of biodiversity, classification, science, scientific research processes in the program. The objectives in the life theme can be listed as follows: To think about how current innovations in biology will affect the individual's life, to make sense of the nature of science, to understand the importance of ethical rules in scientific studies and science teaching, to recognize living things in the environment by categorizing them, to realize what living things in nature have in common. In accordance with these objectives, 7 learning products related to the theme were written. These learning outcomes can be listed as follows: Thinking about new developments in biology, thinking about how real they are and thinking about their positive or negative effects on individuals in society and approaching them with suspicion, Understanding the importance of following ethical rules while doing scientific work, Giving meaning to scientific work processes, Categorizing and naming living things, Understanding and learning all the processes of the entities in the domain. Biology topics in the life theme are life science: biology, classification and biodiversity. Suggestions to increase the effectiveness of biology programs can be given as giving more space to open field activities in the program, giving training to teachers about informal learning environments, giving informative meetings or seminars for parents in the program.

**Keywords:** Biology Education, Life Theme, Biology Curriculum

## 1. Giriş

İnsan var olduğu andan itibaren doğada meydana gelen olayları ve bunların oluş sebeplerini merak etmiştir. Aynı zaman da doğada var olan farklı canlılarda onların her zaman merakını canlı tutmuştur. Bilim tarihi üzerine yazılan kaynaklarda bilimin Çin'den başlayıp diğer uygarlıkları etkilediği ifade edilmiştir. Bilimin ne olduğu konusunda farklı görüşler vardır. Aristo bilimi neden sonuç ilişkisindeki neden olarak açıklarken, Mbarga ve Fleury ise bilimin doğanın ve doğa olaylarının olduğu şekli ile betimlenmesi olarak tanımlamıştır (Topdemir ve Unat, 2008'den akt: Şahin, 2022). Biyolojik çeşitlilik farklı sebeplere bağlı olarak geçmişten günümüze gözle görülür bir farkla azalmaktadır. Nüfusun yıllar içinde sürekli artması insanoğlunun kendine daha fazla pay edinme gayesi nedeniyle diğer canlıların yaşam alanını yok etmesi bu azalmanın sebeplerin başında gelmektedir (Wilson 1988'den Akt: Dervişoğlu, 2007). Bilimsel okuryazarlığı kavramı oldukça geniş bir kapsamı vardır. Alan yazanında bilimsel okuryazarlığı tarif eden çeşitli görüşler vardır. İnsanların bilimi özümsemesi, ona anlam verebilmesi, kavraya bilmesi, hayatına aktarabilmesi bilimsel okuryazarlık olarak adlandırılır. Bilimsel okuryazarlık tanımı içinde bilimin doğasını anlamakta vardır (Murat, 2022). Tüm derslerde olduğu gibi biyoloji disiplindeki kazanımlar ülkenin siyasi görüşleri ve dönemin felsefesine uygun olarak belirlenmektedir. Biyoloji alanının temel bilimler arasında en hızlı farklılaşan bölüm olduğu düşünülmektedir. Bu biyoloji alanındaki farklılaşma elbetteki insan yaşamını her alandan etkileyecektir (Kızıroğlu, 1988). Biyoloji bilimine bakıldığında diğer bilimlerle olan bağlantısı açısından bir balans görevi gördüğü düşünülebilir. Bir denge mekanizması olduğu düşüncesinden yola çıkılarak bu alanın herkes tarafından anlaşılması ve öğrenilmesi gerektiği kabul edilebilir. Biyolojinin, sağlık alanıyla, teknoloji alanıyla, toprak vb. alanları ile alakası düşünüldüğünde biyolojideki, bir dönüm noktasının herkesmi etkileyeceği apaçık ortadadır (Brawn, 1995'ten akt: Özkan, 2011). Bilim insanların yaptığı çalışmalara göre günümüzde yaşayan hayvanların 1.8 milyon tür olduğu, yaşayan bitkilerin ise sayı olarak 900 bin tür olduğu söylenebilir. Ancak bilim insanların öngörüsüne göre doğada 3-10 milyon kadar türün henüz sistematikteki yerini almadığı belirtiliyor. Dünya oluşumundan günümüze 500 bin türün soylarının tükendiği uzmanlar tarafından ifade edilmektedir. Doğadaki canlıların farklı oluşlarını ortaya çıkaran bilim taksonomidir. Tıp, eczacılık, mühendislik v.d alanlarda kullanılan varlıları ve onların değerlerini belirleyen alan taksonomidir. Taksonomi alanındaki çalışmalar dünya oluşumundan günümüze değin canlılardaki farklılaşmayı canlıların kökenini anlamamıza katkı sağlamıştır (Aygün, 2012). Öğretim programı farklı kişilerin farklı bakış açıları ile tanımlanmaktadır. Örneğin, Güven, Çıray, Küçükyılmaz (2015)'e göre öğretim programları adeta bir harita gibi eğitim kurumlarının kendi bünyesinde veya eğitim kurumları harici yapılacak tüm faaliyetlere rehberlik eden bir plandır. Gregg ve Thompson (1997)'a göre öğretim programı eğitim kurumlarının gayelerine varmak için gereken asli bir vasıta. Hunkins ve Ornstein (1988)'e göre ise eğitim programı eğitim kurumunda kazandırılmak istenen, eğitimcilerin bizzat denetiminde olan, okuldaki eğitim alan kişilerin yapmakla yükümlü oldukları aktiviteleri yansıtan bir düzenektir (Oktay, Üner ve Şen, 2021).

## 2. Yöntem

Bu çalışma dökümantasyon metodu ile yapılmıştır. Bilimle ilgili çalışan kişiler çalışma konularını araştırırken elbetteki daha önce yapılmış çalışmalarını incelemektedirler. Özellikle belge niteliği taşıyan dökümanlar sıklıkla araştırmalarda kaynak olarak kullanılmaktadır. Döküman olarak kullanılan kaynak materyalin bulunması, kavranması ve özümsemesi gerekir. Bu gerekli şartlar sağlandıktan sonra dökümana ilişkin içerik analizi yapılabilir. Özellikle içerik çözümlemesi yapılırken konular, temel başlıklar ve datalar belirli özelliklere göre kategorilendirilebilir (Kıral, 2020). Bu çalışmayı yapmak için MEB 2024 yılında ‘Türkiye Yüzyılı Maarif Modeli’ olarak onaylanan tüm sınıfları kapsayan ‘Ortaöğretim Biyoloji Dersi Öğretim Programı’ incelenmiştir. Milli eğitim Bakanlığı’na bağlı Talim ve Terbiye Kurulu’nun WEB sayfasında olan tüm sınıfları kapsayan biyoloji programı incelenmeye alınmıştır.

## 3. Bulgular

**Yaşam Temasının Hedef ve Des Saatleri Sayısı**

Tema Adı	Sınıf Düzeyi	Haftalık biyoloji ders saati	Temadaki Öğrenme Çıktıları Sayısı	Ders Saatinin Süresi	Yüzde Oranı %
Yaşam	9	2	7	38	53

**Tablo 1.** Yaşam Temasının Hedef ve Des Saatleri Sayısı

Tablo 1’de yaşam temasına ait bilgiler görülmektedir. Tablo incelendiğinde yaşam temasının biyoloji öğretim programında 9. sınıfta olduğu, 7 tane öğrenme çıktısı olduğu, 38 ders saatinin ( Toplam ders saatinin %53’lik kısmı) temanın öğretimi için ayrıldığı tespit edilmiştir.

### Yaşam Temasının Amacı

Bu ünitenin amacı öğretim programında öğrencilerin sınıflandırma becerisi kazanmalarını, biyoçeşitliliği anlamalarını, bilimin tabiatını kavramalarını ve bilim etiğini öğrenmeleri olarak belirtilmektedir.

### Yaşam Temasında Ele Alınacak Konular

Yaşam teması konusunda ele alacak konular programda biyoçeşitlilik, sınıflandırma, bilim, bilimsel araştırma süreçleri başlıkları altında olduğu görülmektedir.

**Tablo 2:** Yaşam temasında yer biyoloji konuları

Yaşam Bilimi: Biyoloji	Sınıflandırma ve Biyoçeşitlilik	Anahtar Kavramlar
Biyolojinin Önemi, Biyoloji Biliminin Gelişimindeki Dönüm Noktaları, Bilimin Doğası, Bilimsel Araştırma Süreçleri, Bilim Etiği, Canlıların Ortak Özellikleri (Hücresel Yapı, Organizasyon, Beslenme, Enerji Üretimi ve Tüketimi, Boşaltım, Büyüme ve Gelişme, Metabolizma, Uyarılara Tepki, Homeostazi, Üreme, Varyasyon ve Adaptasyon)	Sınıflandırmada Temel Yaklaşımlar ve Modern Sınıflandırma (Linne ve İkili Adlandırma, Sınıflandırma Kategorileri), Üç Üst Âlem (Domain) Sisteminde Yer Alan Canlılar ve Genel Özellikleri [Bakteriler, Arkeler, Ökaryotlar (Protistler, Bitkiler, Mantarlar, Hayvanlar)], Biyoçeşitlilik	bilimsel yöntem, bilim etiği, prokaryot, ökaryot, beslenme çeşitleri, sınıflandırma kategorileri, ikili adlandırma, domain, tür, arke, bakteri, protista, bitki, mantar, hayvan, endemik tür.



Tablo 2.'de yaşam temasında işlenecek konular verilmektedir. Konu olarak yaşam bilimi biyoloji ve sınıflandırma- biyoçeşitlilik verilmiştir. Aynı zamanda konu içerisinde yer alan anahtar kavramlar verilmektedir. 17 tane anahtar kavram vardır.

### **Yaşam Temasında Kazandırılmak İstenen Hedefler**

Yaşam temasına bakıldığında öğrencilere kazandırılmaması ve ulaşılması gereken hedefler olduğu görülmektedir. Bu hedefler şöyle sıralanabilir:

- Güncel olarak biyolojide gerçekleşen yeniliklerin bireyin hayatına nasıl etki edeceğini düşünmek
- Bilimin tabiatına anlam vermek
- Bilimsel çalışmalarda ve bilim öğretilmede ahlaki kuralların önemini kavramak
- Yaşanılan çevredeki canlıları kategorilendirerek onları tanımak
- Tabiatdaki yaşayan varlıklarda ortak olarak neyin olduğunun farkına varmak

Bu amaçlara uygun olarak tema ile alakalı 7 öğrenme ürünü yazılmıştır. Bu çıktı olarak adlandırılan kazanımlar ise şöyle sıralanabilir:

- Biyolojideki yeni gelişmeler üzerinde düşünme, ne kadar gerçek olduğunu düşünmek ve toplumdaki bireylerin üzerinde olan olumlu veya olumsuz etkileri üzerinde düşünmek ve şüphe ile yaklaşmak.
- Bilimsel çalışma yaparken bilimin ve bilimsel çalışmanın temelini öğrenmek ve bunları özümsemek.
- Bilimsel çalışma yaparken ahlak kurallarına uymanın önemini anlamak
- Çevresindeki var olan canlıları gözlemlemek ve onları sistematik olarak kategorilere bölmek
- Bilimsel çalışma süreçlerine anlam vermek
- Canlıları kategoriye ayırmak ve isimlendirmek
- Domainde yer alan varlıkları tüm süreçleri ile anlamayak ve öğrenmek.

### **Yaşam Temasında Kazandırılması İstenen Beceriler**

Yaşam temasında eleştirel düşünme, öz düzenleme, çalışkanlık, merak, sorgulama, sorumluluk, iletişim v.b becerilerin kazandırılması beklenmektedir. Ayrıca görsel, kültür, bilgi, veri, dijital olmak üzere 5 adet okuryazarlık becerisi geliştirmeye çalışılmaktadır. Bu becerilerin geliştirilmesinde yaşam teması içeriğinin diğer derslerde de ele alınması önerilmektedir. Özellikle coğrafya, kimya ve fizik derslerinde yaşam temasında yer alan konular işlenmektedir.

### **Öğrenmenin Değerlendirilmesi**

Yaşam temasında öğrenmenin değerlendirilmesi için önerilen bazı yollar vardır. Bunlar:

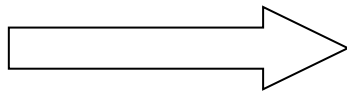
Yapılandırılmış grid

Performans ödevi

Gözlem formu

Zihin haritası

Açık uçlu soru



Analitik puanlama anahtarı

Yaşam temasının öğretim programında değerlendirme yapmak için genellikle analitik puanlama anahtarı önerilmektedir. Öğretim metodu olarak yapılandırılmış grid, performans ödevi, gözlem formu, zihin haritası, açık uçlu soru kullanımasını ve sonrasında da

değerlendirme için analitik puanlama anahtarı kullanılması önerilmektedir. Örnek olarak (MEB, 2024):

- Öğrenci kendi kurduğu cümlelerle bilim doğasına yönelik bilgi aktırırken zihin haritalarını kullanır. Öğrencinin hazırlığı zihin haritaları ayrıntılı puanlama anahtarı ile değerlendirilir.
- Farklı canlılar arasındaki farklılaşma veya ilişkileri açığa çıkaran açık uçlu sorular sorulur. Sorulara verilen yanıtlar ayrıntılı puanlama anahtarı ile değerlendirilir.
- Öğrencilerin doğayı gözlemlemeleri istenir. Gözlem sonuçlarını gözlem formlarına yazmaları istenir. Daha sonra öğrencilerden gözlem sonuçları hakkında ayrıntılı bir araştırma raporu yazmaları istenir. Öğrencinin hazırladığı rapor ayrıntılı puanlama anahtarı ile değerlendirilir.

### **Ön Koşul Öğrenmeler**

Yaşam teması 9. Sınıfın ilk temasıdır. Bu tema ele alınırken öğrencilerin önceki öğrenmelerinin ele alınıp alınmadığı önem taşır. Bu sınıf düzeyi öncesinde 3., 4., 5., 6. ve 8. Sınıf fen bilgisinde çeşitli konular içerisinde yaşam teması konularının öğrenciler tarafından öğrenildiği görüşü vardır. Canlıların özellikleri ve bilimin doğasının 3. ve 4.sınıfta işlendiğini, 5. Sınıfta hücre biyolojinin işlendiği, 6. Sınıfta biyolojik çeşitliliğin ele alındığı ve 8. Sınıfta genetik konuları var olduğundan bunların öğrenildiği kabul edilmektedir. Öğrencilerin ön bilgilerini ortaya çıkarmak için soru sormak, beyin fırtınası yapmak, video ve belgesel izlemek olabilir.

### **4. Tartışma Sonuç ve Öneriler**

Yaşam temasına ait bilgiler incelendiğinde yaşam temasının biyoloji öğretim programında 9. sınıfta olduğu, 7 tane öğrenme çıktısı olduğu, 38 ders saatinin (Toplam ders saatinin %53'lik kısmı) temanın öğretimi için ayrıldığı tespit edilmiştir. Yaşam teması konusunda ele alacak konular programda biyoçeşitlilik, sınıflandırma, bilim, bilimsel araştırma süreçleri başlıkları altında olduğu görülmektedir. Yaşam temasına bakıldığında öğrencilere kazandırılması ve ulaştırılması gereken hedefler olduğu görülmektedir. Bu hedefler şöyle sıralanabilir: Güncel olarak biyolojide gerçekleşen yeniliklerin bireyin hayatına nasıl etki edeceğini düşünmek, bilimin tabiatına anlam vermek, bilimsel çalışmalarda ve bilim öğretilerinde ahlaki kuralların önemini kavramak, yaşanan çevredeki canlıları kategorilendirerek onları tanımak, tabiattaki yaşayan varlıklarda ortak olarak neyin olduğunun farkına varmaktır. Bu amaçlara uygun olarak tema ile alakalı 7 öğrenme ürünü yazılmıştır. Bu çıktı olarak adlandırılan kazanımlar ise şöyle sıralanabilir: Biyolojideki yeni gelişmeler üzerinde düşünme, ne kadar gerçek olduğunu düşünmek ve toplumdaki bireylerin üzerinde olan olumlu veya olumsuz etkileri üzerinde düşünmek ve şüphe ile yaklaşmak. Bilimsel çalışma yaparken bilimin ve bilimsel çalışmada temelini öğrenmek ve bunları özümsemek. bilimsel çalışma yaparken ahlak kurallarına uymanın önemini anlamak, çevresindeki var olan canlıları gözlemlemek ve onları sistematik olarak kategorilere bölmek, bilimsel çalışma süreçlerine anlam vermek, canlıları kategoriye ayırmak ve isimlendirmek, domaine yer alan varlıkları tüm süreçleri ile anlamayak ve öğrenmek. Yaşam temasında yer biyoloji konuları yaşam bilimi: biyoloji sınıflandırma ve

biyoçeşitlilik olduğu görülmektedir. Türkmen ve Yalçın (2010) yılında yaptıkları araştırma çalışmasında bilimin doğasını ve bunun eğitimdeki yerini araştırmışlardır. Çalışmada öncelikli olarak bilimin doğasının farklı yorumlanmasına yer verilmiştir. Bunlar: bilimin süreli değişebileceği, bilimde tek bir doğrunun olamayacağı, bilimin yapılış şeklinin ve ele alınışının kişiden kişiye değişebileceği şeklindedir. Türkiye’de diğer ülkelere kıyasla fen alanlarında bilimin doğasının verilmesinin çok yakın bir tarihte programlarda yer aldığı bildirilmiştir. Özellikle ülkemize özgü bir bilim doğası programı olmadığı genellikle başka ülkelerden alınan programın bizim ülkemizde verildiği belirtilmiştir. Aynı çalışmada öğrencilerin fene ilişkin bilgileri öğrenmekte çok sıkıntı yaşadıklarını belirtmişlerdir. Bunun temel sebebi olarak öğretmen ve öğrencilerin bilimin doğasını kavramamış olmaları gösterilmektedir (Türkmen ve Yalçın, 2010).

Taş ve Çetinkaya (2011) yılında yaptıkları çalışmada fen alanında öğrencilerin özellikle canlıların sınıflandırılması konusunda yoğun kavram yanılgıları içinde olduklarını belirtmişlerdir. Araştırma kapsamında eğitim fakültesinde fen bilgi eğitim programında olan 50 kişi ele alınmıştır. 50 kişilik grubu yarı yarıya ayırmışlardır. Bir yarı deney grubu iken diğer grup kontrol grubu olmuştur. Kontrol grubuna sınıflandırma konusu geleneksel denilen klasik metodla aktarılan deney grubuna WEB tabanlı kavram haritası ve anlam çözümleme tablosu kullanmışlardır. Çalışma sonunda deney grubunda hem başarı hemde tutum açısından diğer gruptan %12 daha iyi durumda olduklarının gözlemleniyorlar. Özellikle WEB tabanlı kavram haritasının ve bilgisayarda hazırlanan anlam çözümleme grafiklerinin kullanılmasının öğrencilerin sınıflandırma ve biyoçeşitlilikte yönelik daha olumlu tutum içine girip daha kolay öğrendiklerini belirtmişlerdir (Taş ve Çetinkaya, 2011). Dervişoğlu (2007)’nin yaptığı doktora çalışmasının nitel sonuçlarına göre öğrenciler biyoçeşitlilik denince akıllarına hayvan veya bitki çeşitliliği geldiğini tespit etmiştir. İnsanın bu çeşitlilikteki yeri nedir sorusuna öğrencilerden tam bir cevap alamadıklarını veya çelişkili cevaplar aldıklarını belirtmiştir. Öğrencilerin biyolojik çeşitliliği azaltan nedir sorusuna öğrencilerin cevabı ekolojik nedenler gösterilmiştir. Dervişoğlu, öğrencilerde yoğun olarak ekolojik bağlantı konusunda kavram yanılgısına sahip olduklarını belirtmiştir. Biyolojik çeşitliliğin kaybolmasında öğrencilerin devlete yükledikleri ve bir insan olarak kendisinin bu azalmanın neresinde olduğu konusunda bir düşünce içerisinde olmadıklarını belirtmiştir. Ayrıca çalışmada çevre bilincinin ve sorumluluğun bölgelere görede farklılaştığı tespit edilmiştir. Güneydoğu Anadolu ve Marmara bölgesinde olan öğrencilerin çevre ile kurdukları ilişkinin Akdeniz bölgesine göre daha aşağı bir düzeyde olduğunu tespit etmiştir (Dervişoğlu, 2007). Almalı (2022) yaptığı yüksek lisans çalışmasında canlılar ve yaşam ünitesinin öğretimde aktif çalışma yapılarının etkisini araştırmıştır. Bunun için 16 öğrenci üzerinde çalışma yapılmıştır. Bu öğrencilerin yarısı kaynaştırma öğrencisiyken diğer yarıda normal öğrencilerden oluşmaktadır. Bu iki farklı öğrenci grubuna çalışma yapıları, tahmin-gözlem-açıklama, çeşitli aktif öğrenme şekilleri ve akıllı telefonlardaki uygulamalardan faydalanılarak dersler yapılmıştır. Süreç sonunda görüşme testleri ve formlarından öğrencilerdeki bilgi artışı anlaşılmalı çalışmışlardır. Sonuç olarak özellikle tahmin-gözlem-açıklama ve öğrencilerin aktif olarak süreçte oldukları yöntemleri kullanmanın hem normal öğrencilerde hemde kaynaştırma öğrencilerinde bilgi artışına olumlu katkı sağladığını görmüşlerdir (Almalı, 2022).

**Öneri olarak:**

1. Programda açık alan etkinliklerine daha fazla yer verilmesi.
2. Öğretmenlere informal öğrenme ortamları hakkında eğitim verilmesi.
3. Programda velilere yönelik bilgilendirme toplantısı veya seminerlerin verilmesi.
4. Liselerde herbaryum, müze gibi alanların kurulması.
5. Sanatsal etkinliklere, video kullanımına, bilgisayar teknolojiden yararlanılacak etkinliklerin programda yerinin artırılması.
6. Bilimin felsefesi dersinin ayrı bir ders olarak 9. Sınıf düzeyinden itibaren verilmesi önem taşımaktadır. Bilim felsefesi dersi bilimin doğasının kavranmasına pozitif katkı sağlayacaktır.

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# DİJİTAL OYUN BAĞIMLILIĞI KONUSUNDA EĞİTİM VE ÖĞRETİM ALANINDA YAPILMIŞ OLAN ÇALIŞMALARA YÖNELİK BETİMSSEL BİR ARAŞTIRMA

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## Özet

Bu araştırma dijital oyun bağımlılığı alanında yapılmış olan çalışmalarını incelemek amacıyla yapılmıştır. Araştırma, dijital oyun bağımlılığında eğitim alanında yapılmış olan çalışmalarla sınırlandırılmıştır. Araştırmada sistematik derleme yöntemi kullanılmış ve analizi betimsel analiz yöntemi ile gerçekleştirilmiştir. Veri kaynağını Yüksek Öğretim Kurulu Ulusal Tez Merkezi ve Google Akademik Araştırma Motoru oluşturmaktadır. Çalışmalar seçilirken sadece dijital oyun bağımlılığı konusunda eğitim alanında yapılmış olan çalışmalar seçilmiş olup eğitim alanı kapsamı dışında kalan çalışmalar dahil edilmemiştir. Dijital oyun bağımlılığı konusunda sadece eğitim alanında yapılmış olan toplam 80 tez çalışmasına ulaşılmıştır. Dijital oyun bağımlılığının alt başlıklarını içeren çalışmalar mevcuttur fakat araştırmanın amacına uymadığı için bu araştırmada yer verilmemiştir. Bu araştırmada araştırmacılar tarafından hazırlanan sınıflama formu kullanılmıştır. Sınıflandırma formu kategorilendirme yöntemi ile eşleştirilerek betimsel analiz kullanılarak analiz gerçekleştirilmiştir. Araştırmanın sonucunda dijital oyun bağımlılığı çalışmalarının eğitim alanında daha alt konularda ele alınabileceği kapsamın daraltılabileceği sonucuna varılmıştır. Yapılan araştırmalar her öğretim kademesinde gerçekleştirilmiş fakat bütüncül olarak ele alınmamıştır ve yetişkin grupta daha az sayıda çalışmanın hazırlanmış olduğu belirlenmiştir. Sonuçlar doğrultusunda üniversite öğrencileri, mezunlar ve yetişkin yaş gruplarında boylamsal çalışmaların yapılabileceği ve farklı içeriklerin dahil edilebileceğine yönelik öneriler verilmiştir.

**Anahtar Kelimeler:** Dijital Oyun Bağımlılığı, Betimsel Analiz, Sistematik Derleme.

## **A DESCRIPTIVE RESEARCH ON STUDIES CONDUCTED IN THE FIELD OF EDUCATION AND TRAINING ON DIGITAL GAME ADDICTION**

### **Abstract**

This research was conducted to examine the studies done in the field of digital game addiction. The research is limited to studies conducted in the field of education on digital game addiction. The systematic review method was used in the research and the analysis was carried out with the descriptive analysis method. The data source is the Council of Higher Education National Thesis Center and Google Scholar Research Engine. When selecting studies, only studies conducted in the field of education on digital game addiction were selected and studies outside the scope of education were not included. A total of 80 thesis studies on digital game addiction, conducted only in the field of education, were reached. There are studies containing the subheadings of digital game addiction, but they were not included in this research because they did not comply with the purpose of the research. In this study, a classification form prepared by the researchers was used. Analysis was carried out using descriptive analysis by matching the classification form with the categorization method. As a result of the research, it was concluded that the scope of digital game addiction studies can be narrowed down to sub-topics in the field of education. The research was carried out at all levels of education, but it was not addressed holistically and it was determined that fewer studies were prepared in the adult group. In line with the results, suggestions were made that longitudinal studies could be conducted in university students, graduates and adult age groups and different contents could be included.

**Keywords:** Digital Game Addiction, Descriptive Analysis, Systematic Review.

## **Giriş**

Küreselleşen dünyada teknolojinin her geçen gün gelişmesi ile dijital oyunlara erişim oldukça artmaktadır. Dijital oyunların tarihçesi incelendiğinde televizyon 1926 yılında icat edilmesine rağmen oyun kavramı 1958lerde yerini almıştır. İlk fikir televizyon üzerinden geliştirilmiş ve oyun televizyonu fikri üreticiler tarafından çok olumlu karşılanmamıştır. Dijital oyunlar küreselleşmenin etkisiyle küresel bir dünya insanı profilini yaratmak için üretilmiş oyunlar olarak nitelendirilmektedir. Küreselleşmenin hız kazandığı 1980 yıllarında dijital oyunlar ilk başlarda kaset, atari, çizgi film karakterlerinin özendirilmesi şeklinde farklı boyutlarda yayılmıştır. İlk dijital oyunlar televizyona uyumlu konsollar ve kutu konsol oyunları olarak yerini almıştır (Irmak & Erdoğan, 2016).

Dijital oyunlarda, oyun karakterleri dikkat çekici olarak tasarlanıp her kesime hitap edecek oyunlar tercih edilmiştir (Akdemir & Akgül, 2024). Bilgisayarın icadı ile bilgisayar oyunları yerini almış ve daha küçük ekranlarda insanları saatlerce ekran karşısında tutan oyunlar geliştirilmiştir. Bilgisayarın her evde olması ile yayılan teknolojik küreselleşme akımının etkisinden sonra bilgisayar oyunları televizyon oyunlarının yerini almıştır (Hazar & Hazar, 2017). Teknolojinin de gelişmesiyle telefonlara indirilebilen oyunlar hazırlanmış ve bu oyunlar taşınabilirlik ve ulaşılabilirlik açısından oldukça avantajlı hale getirilmiştir. Dijital oyun üreticileri tüketici profilini belirledikten sonra her kesime hitap eden oyunlar üretmeye başlamıştır (Griffiths & Meredith, 2009). Dijital oyun platformları insanlara günlük hayatlarında neler yapıyorlarsa aynı şekilde bunları dijital ortamda oluşturabilecek simülasyon oyunlar sunmaktadır (Uzmen, 2001). Pandemi dönemi insanların büyük çoğunluğunun evde olması sebebiyle zaman geçirmek için dijital oyunlara yönelmesini fırsat bilen dijital oyun platformları ücretsiz denemeler, indirimli oyunlar altında insanları kademeli olarak dijital oyuna bağımlı hale getirmiştir (Şahin, 2021).

Araştırmalarda farklı değişkenler ve yaş grupları kullanılarak dijital oyun bağımlılığı farklı açılardan incelenmiştir. Araştırmalarda kullanılmış olan değişkenlerin ilişkisine ve sonuçlara bütüncül olarak bakabilmek için bu çalışma doküman analizi tekniği kullanılarak incelenmiştir. Dijital oyun bağımlılığı alanında yapılan tez çalışmalarına YÖK tez sayfasından ulaşılmıştır.

## **Problem Durumu**

Dijital alanda gerçekleşen yenilikler insan ilişkilerini de etkilemektedir. Oyun çağındaki çocuklar kendileri oyun kurmak yerine tablet, bilgisayar ve dijital oyun konsollarını tercih etmektedir. Küreselleşmenin bir popüler kolu olarak dijital oyunların ücretsiz sürümleri, kolay erişilebilirliği ve kazanç sağlama yönü bağımlılığın gelişmesinde etken olmaktadır (Saygılı, 2021). Küreselleşen dünyada dijital oyunlar hayatımızda büyük bir yer kaplamaktadır. Geçmişte sokaklarda oyun oynayan çocukların yerini tablet ve dijital oyunların onlara sunmuş olduğu alan kadar yaşayan çocuklar, sosyalleşmeyi dijital oyunlarda arayan yetişkinler almıştır (Günay, 2011).

Dijital oyun bağımlılığı okul öncesi dönemden itibaren başlayarak her yaş grubunda görülmektedir. Okul öncesi çağdan üniversiteye kadar olan tüm kademelerde dijital oyun bağımlılığının sebebi, dijital oyun bağımlılığına sebep olan demografik etkenler, psikolojik ve sosyal açılardan sonuçları bulunmaktadır. Dijital oyun bağımlılığının her okul kademesinde farklı değişkenler ve ilişkiler açısından incelenmesi bu çalışma için önem arz etmektedir. Tüm



bunlar dikkate alındığında dijital oyun bağımlılığı konusunda eğitim ve öğretim alanında yapılmış olan çalışmaların benzer ve farklılık temaları nelerdir? sorusuna yanıt aranmıştır.

### **Araştırmanın Amacı**

Bu çalışmada 2013-2024 yılları arasında dijital oyun bağımlılığı konusunu içeren ve YÖK Ulusal Tez Merkezinde erişime açık olan 80 tezin yıl ve türlere göre nasıl dağıldığını, hangi konularda, hangi üniversitede, hangi enstitüde ve anabilim dalında, hangi öğretim kademesinde, hangi model ve desenin kullanıldığı, hangi örnekleme yönteminin kullanıldığı, hangi veri toplama araçları ile hangi veri analiz yöntemleri kullanıldığını, çalışılan konunun çeşitliliği ile birlikte hangi bulgu ve sonuçlara ulaşıldığını derinlemesine inceleyerek belirlemek amaçlanmıştır. Bu bağlamda çalışılmış dijital oyun bağımlılığı konusunda yapılmış olan tezlerin taranması ve meta-sentez yöntemi kullanılarak çalışmalardaki yönelimin belirlenmesi amacıyla aşağıdaki sorulara yanıt aranmıştır: Dijital oyun bağımlılığını konu alıp meta-senteze dahil edilen;

1. Çalışmaların yıllara göre dağılımları nasıldır?
2. Çalışmaların yayın türü çeşitliliği nasıldır?
3. Çalışmaların konu alanlarına göre dağılımları nasıldır?
4. Çalışmaların üniversitelere göre dağılımları nasıldır?
5. Çalışmaların enstitüye göre dağılımları nasıldır?
6. Çalışmaların ana bilim dalına göre dağılımları nasıldır?
7. Çalışmaların öğretim kademesine göre dağılımları nasıldır?
8. Çalışmaların modeline göre dağılımları nasıldır?
9. Çalışmaların desenine göre dağılımları nasıldır?
10. Çalışmaların örnekleme yöntemine göre dağılımları nasıldır?
11. Çalışmaların veri toplama araçlarına göre dağılımları nasıldır?
12. Çalışmaların veri analiz programları ve yöntemlerine göre dağılımları nasıldır?

### **Yöntem**

Bu araştırma, nitel araştırma modeli türünde olup çalışmada meta-sentez yöntemi kullanılarak dahil edilme kriterlerine uygun tezler, belirlenen kategorilere göre incelenmiştir. Meta-sentez; belli bir konu üzerine yapılan nitel sonuçlu çalışmaların tema ve alt tema oluşturularak detaylı bir eleştirel okuma ile analiz edilmesi ve bulguların kritiğinin yorumlanmasıdır (Creswell, 2007). Sınırlı bir konu alanında yapılmış çalışmaların nitel temelli inceleme ile benzerlik ve farklılıkların karşılaştırılarak sonuçlandırılması olarak tanımlanmaktadır (Çalık & Sözbilir, 2014). Dijital oyun bağımlılığı alanında yapılmış olan 80 tez çalışması bu araştırmanın örneklemini oluşturmaktadır. Örnekleme oluşturan tezler Ek-1' de gösterilmiştir. Verilerin analizinde betimsel analiz kullanılmıştır. Betimsel analizlerde elde edilen sonuçlar, önceden belirlenmiş kategoriler doğrultusunda değerlendirilir. Bu aşamada amaç, verileri düzenli ve yorumlanmış bir şekilde sunmaktır (Yıldırım & Şimşek, 2016, s. 239).

### **Bulgular**

2013-2024 yılları arasında yapılmış olan tez çalışmalarına YÖK Ulusal Tez Merkezinden ulaşılmıştır. 2013-2024 yılları arasında yapılmış olan 80 tez çalışması; çalışmanın yılı, yayın

türü, konu alanı, üniversite adı, enstitü adı, ana bilim dalı, öğretim kademesi, çalışmanın modeli, çalışmanın deseni, örnekleme yöntemi, veri toplama aracı ve veri analiz yöntemi kategorileri araştırmacı tarafından oluşturulup Excell'e aktarıldıktan sonra analizi yapılmıştır. Oluşturulan kategoriler aşağıda tablolar halinde sunulmuştur. Dijital oyun bağımlılığı alanında yapılmış olan tez çalışmalarının yıllara göre dağılımı Tablo 1'de sunulmuştur. Dijital oyun bağımlılığı alanında en çok tez çalışmasının toplam 21 tez çalışmasıyla 2023 yılında hazırlanmış olduğu belirlenmiştir.

**Tablo 1:** Dijital oyun bağımlılığı alanında yapılmış olan tezlerin yıllara göre dağılımı.

Yıl	f
2013	1
2015	1
2016	1
2017	2
2018	4
2019	4
2020	9
2021	18
2022	15
2023	21
2024	4
TOPLAM	80

Dijital oyun bağımlılığı alanında yapılan tez çalışmalarının yayın türü çeşitliliğine göre dağılımı Tablo 2'de sunulmuştur. Dijital oyun bağımlılığı alanında 78 yüksek lisans tezi çalışması ve 2 doktora tezi çalışması bulunmaktadır.

**Tablo 2:** Dijital oyun bağımlılığı alanında yapılmış olan tezlerin yayın türüne göre dağılımı.

Yayın Türü	f
Yüksek Lisans	78
Doktora	2
Toplam	80

Dijital oyun bağımlılığı alanında yapılmış olan tezlerin konu alanlarına göre dağılımı Tablo 3'de sunulmuştur. Dijital oyun bağımlılığı alanında en çok beden eğitimi alanında çalışma yapılmıştır. İkinci sırada eğitim ve öğretim alanında, üçüncü sırada psikoloji alanında çalışmalar yapılmıştır.

**Tablo 3:** Dijital oyun bağımlılığı alanında yapılmış olan tezlerin konu alanlarına göre dağılımı.

Konu Alanı	f
Beden Eğitimi	14
Eğitim ve Öğretim	13
Psikoloji	11
Spor	9
Bilgisayar	5
Okul Öncesi	5
Rehberlik	4
Sosyal Bilgiler	4
Çocuk Gelişimi	3
İletişim Bilimleri	2
Din Psikolojisi	1
İstatistik	1
Matematik	1
Medya ve İletişim	1
Sınıf Öğretmenliği	1
Sosyal Hizmet	1
Sosyoloji	1
Turizm	1
TOPLAM	80

Dijital oyun bağımlılığı alanında yapılmış olan tezlerin hazırlandığı üniversitelere göre dağılımları Tablo 4’te sunulmuştur. Dijital oyun bağımlılığı alanında en çok tez hazırlanan üniversiteler Haliç Üniversitesi, Niğde Ömer Halisdemir Üniversitesi ve Van Yüzüncü Yıl Üniversitesi olmuştur. Dijital oyun bağımlılığı konusu toplamda 46 üniversitede tez konusu olarak tercih edilmiştir.

**Tablo 4:** Dijital oyun bağımlılığı alanında yapılmış olan tezlerin üniversitelere göre dağılımı.

Üniversite Adı	f
Haliç Üniversitesi	5
Niğde Ömer Halisdemir Üniversitesi	5
Van Yüzüncü Yıl Üniversitesi	5
Gazi Üniversitesi	4
İnönü Üniversitesi	4
Pamukkale Üniversitesi	4
Bahçeşehir Üniversitesi	3
Sakarya Uygulamalı Bilimler Üniversitesi	3
Üsküdar Üniversitesi	3
Çankırı Karatekin Üniversitesi	2
Ege Üniversitesi	2
İstanbul Gelişim Üniversitesi	2
Mersin Üniversitesi	2
Sivas Cumhuriyet Üniversitesi	2
Yıldız Teknik Üniversitesi	2
Akdeniz Üniversitesi	1
Aksaray Üniversitesi	1
Ağrı İbrahim Çeçen Üniversitesi	1
Aydın Adnan Menderes Üniversitesi	1
Bayburt Üniversitesi	1
Bursa Uludağ Üniversitesi	1
Bitlis Eren Üniversitesi	1
Çağ Üniversitesi	1
Çanakkale Onsekiz Mart Üniversitesi	1
Çukurova Üniversitesi	1
Gaziantep Üniversitesi	1
Gaziosmanpaşa Üniversitesi	1
Hasan Kalyoncu Üniversitesi	1
İstanbul Aydın Üniversitesi	1
İstanbul Medipol Üniversitesi	1
İstanbul Rumeli Üniversitesi	1
İstanbul Sabahattin Zaim Üniversitesi	1
İstanbul Üniversitesi-Cerrahpaşa	1
Işık Üniversitesi	1
Karamanoğlu Mehmetbey Üniversitesi	1
Lokman Hekim Üniversitesi	1
Mardin Artuklu Üniversitesi	1
Marmara Üniversitesi	1
Necmettin Erbakan Üniversitesi	1
On Dokuz Mayıs Üniversitesi	1
Ordu Üniversitesi	1
Selçuk Üniversitesi	1
Sinop Üniversitesi	1
Süleyman Demirel Üniversitesi	1
Ufuk Üniversitesi	1
Trakya Üniversitesi	1
TOPLAM	80

Dijital oyun bağımlılığı alanında yapılmış olan tezlerin hazırlandığı enstitüye göre dağılımları Tablo 5’te sunulmuştur. Dijital oyun bağımlılığı alanında en çok tezin sosyal bilimler enstitüsünde hazırlanmış olduğu belirlenmiş olup ikinci sırada eğitim bilimleri enstitüsünde hazırlanmıştır.

**Tablo 5:** Dijital oyun bağımlılığı alanında yapılmış olan tezlerin hazırlandığı enstitüye göre dağılımı.

Enstitü Adı	f
Sosyal Bilimler Enstitüsü	27
Eğitim Bilimleri Enstitüsü	25
Lisansüstü Eğitim Enstitüsü	17
Sağlık Bilimleri Enstitüsü	10
Fen Bilimleri Enstitüsü	1
TOPLAM	80

Dijital oyun bağımlılığı alanında yapılmış olan tezlerin ana bilim dalına göre dağılımları Tablo 6’da sunulmuştur. Dijital oyun bağımlılığı alanında en çok beden eğitimi ve spor öğretmenliği ana bilim dalında tez yazılmış olup ikinci sırada temel eğitim ana bilim dalında hazırlanmıştır.

**Tablo 6:** Dijital oyun bağımlılığı alanında yapılmış olan tezlerin ana bilim dalına göre dağılımı.

Ana Bilim Dalı Adı	f
Beden Eğitimi ve Spor Öğretmenliği Ana Bilim Dalı	17
Temel Eğitim Ana Bilim Dalı	10
Eğitim Bilimleri Ana Bilim Dalı	8
Psikoloji Ana Bilim Dalı	8
Bilgisayar ve Öğretim Teknolojileri Eğitimi Ana Bilim Dalı	6
Çocuk Gelişimi Ana Bilim Dalı	4
Eğitim Teknolojisi Ana Bilim Dalı	2
İletişim Bilimleri Ana Bilim Dalı	2
Klinik Psikoloji Ana Bilim Dalı	2
Rehberlik ve Psikolojik Danışmanlık Ana Bilim Dalı	2
Spor Bilimleri Ana Bilim Dalı	2
Spor Yönetimi Ana Bilim Dalı	2
Antrenörlük Eğitimi Ana Bilim Dalı	1
Din Psikolojisi Ana Bilim Dalı	1
Matematik ve Fen Bilimleri Eğitimi Ana Bilim Dalı	1
Sınıf Eğitimi Ana Bilim Dalı	1
Sınıf Öğretmenliği Ana Bilim Dalı	1
Sosyal Hizmet Ana Bilim Dalı	1
Sporda Psiko Sosyal Alanlar Ana Bilim Dalı	1
Sosyoloji Ana Bilim Dalı	1
Yeni Medya ve İletişim Ana Bilim Dalı	1
Turizm İşletmeciliği Ana Bilim Dalı	1
Türkçe ve Sosyal Bilimler Ana Bilim Dalı	1
TOPLAM	80

Dijital oyun bağımlılığı alanında yapılmış olan tezlerin öğretim kademesine göre dağılımları Tablo 7’de sunulmuştur. Dijital oyun bağımlılığı alanında en çok ortaokul kademesinde ve lise kademesinde tez çalışması yapılmıştır. En az ilkökul kademesinde tez çalışması yapılmıştır.

**Tablo 7:** Dijital oyun bağımlılığı alanında yapılmış tezlerin öğretim kademesine göre dağılımı.

Öğretim Kademesi	f
Ortaokul	24
Lise	22
Üniversite	15
Anaokulu	12
İlkokul	7
TOPLAM	80

Dijital oyun bağımlılığı alanında yapılmış olan tezlerin modeline göre dağılımları Tablo 8’de sunulmuştur. Dijital oyun bağımlılığı alanında en çok nicel yöntem kullanılmıştır. Nitel araştırma modeli en az kullanılmaktadır.

**Tablo 8:** Dijital oyun bağımlılığı alanında yapılmış olan tezlerin modeline göre dağılımı.

Çalışmanın Modeli	f
Nicel	75
Karma	3
Nitel	2
TOPLAM	80

Dijital oyun bağımlılığı alanında yapılmış olan tezlerin modeline göre dağılımları Tablo 9’da sunulmuştur. Dijital oyun bağımlılığı alanında en çok ilişkisel tarama modeli kullanılmıştır. En az tercih edilen model durum çalışması olarak belirtilmiştir.

**Tablo 9:** Dijital oyun bağımlılığı alanında yapılmış olan tezlerin desenine göre dağılımı.

Çalışmanın Deseni	f
İlişkisel Tarama Modeli	62
Tarama Modeli	9
Deneysel Desen	4
Karma Desen	4
Durum Çalışması	1
TOPLAM	80

Dijital oyun bağımlılığı alanında yapılmış olan tezlerin örnekleme yöntemine göre dağılımı Tablo 10’da sunulmuştur. Dijital oyun bağımlılığı alanında en çok kolay ulaşılabilir ve amaçsal örnekleme yöntemi kullanılmıştır. En az kullanılan örnekleme yöntemi kota örnekleme ve tabakalı örnekleme yöntemleri olarak belirlenmiştir.

**Tablo 10:** Dijital oyun bağımlılığı alanında yapılmış olan tezlerin örnekleme yöntemine göre dağılımı.

Örnekleme Yöntemi	f
Kolay Ulaşılabilir Örnekleme	29
Amaçsal Örnekleme	24
Uygun Örnekleme	12
Seçkisiz Örnekleme	6
Basit Seçkisiz Örnekleme	3
Kartopu Örnekleme	2
Kota Örnekleme	1
Tabakalı Örnekleme	1
TOPLAM	80

Dijital oyun bağımlılığı alanında yapılmış tezlerin veri toplama araçlarına göre dağılımı Tablo 11’de sunulmuştur. Dijital oyun bağımlılığı alanında en çok kullanılan veri toplama aracı ölçek olarak belirtilmiştir. En az kullanılan veri toplama aracı test olarak belirtilmiştir. En çok kullanılan ölçek ise Dijital Oyun Bağımlılığı Ölçeğidir. Çalışmaların çoğunda birden fazla ölçek kullanıldığı belirtilmiştir.

**Tablo 11:** Dijital oyun bağımlılığı alanında yapılmış olan tezlerin veri toplama araçlarına göre dağılımı.

Veri Toplama Yöntemi	f
Ölçek	122*
Form	6
Anket	3
Test	2
TOPLAM	133

\*Tezlerde birden fazla ölçek kullanıldığından toplam rakam belirlenmiştir.

Dijital oyun bağımlılığı alanında yapılmış tezlerin veri analiz yöntemlerine göre dağılımı Tablo 12’de sunulmuştur. Dijital oyun bağımlılığı alanında en çok kullanılan veri analiz programı SPSS programı olup bu durum nicel veri analizlerinin en çok kullanıldığını ifade etmektedir. SPSS programının farklı sürümleri tercih edilmektedir. Bu kapsamda en fazla kullanılan istatistik yöntemi ANOVA testidir.

**Tablo 12:** Dijital oyun bağımlılığı alanında yapılmış olan tezlerin veri analiz programı ve yöntemlerine göre dağılımı.

Veri Analiz Programı ve Yöntemi	f
SPSS programı	71
ANOVA	40
t-testi	13
Kolmogorov Smirnov Testi	10
Kruskall Wallis Testi	8
Mann U Whitney Testi	8
Shapiro Wilks Testi	7
İstatistiksel hesaplamalar	6
Betimsel analizler	5
Pearson ve regresyon analizi	5
Ki-kare testi	3
Chi Square Testi	2
Kategorilendirme	2
Spearman korelasyon	2
Tukey Testi	2
Chaid Analizi	1
Levene Testi	1
Lisrel Paket Program	1
MANOVA	1
Wilcoxon İşaretli Sıralar Analizi	1
TOPLAM	189

### **Tartışma, Sonuç ve Öneriler**

Bu araştırmada 2013-2024 yılları arasında dijital oyun bağımlılığı alanında yapılmış olan yüksek lisans ve doktora tezleri betimsel analiz yöntemiyle incelenerek yüksek lisans ve doktora tezlerinin mevcut durumu ortaya konulmuştur. Tezlere YÖK Ulusal Tez Merkezinden erişilmiştir. Dijital oyun bağımlılığı alanında yapılmış 80 teze erişim sağlanmıştır. Ulaşılan tezlerden 78'i yüksek lisans tezi ve 2'si doktora tezidir. Dijital oyun bağımlılığı alanında yapılmış olan tez çalışmalarının en çok 2023 yılında yapılmış olması gelişen teknolojinin dijital bağımlılığı da beraberinde getirdiğini göstermektedir. 2013 yılında 1 çalışma bu alanda yapılmış olup 11 sene önce dijital oyun bağımlılığının bu kadar gündemde olmadığı çıkarımı yapılabilir. Bu sonuca teknolojinin gelişmesiyle dijital oyun bağımlılığının paralel ilişkisi ile ulaşılabilir. Dijitalleşen dünya teknolojinin gelişmesiyle beraber dijital bağımlılığı da olumsuz bir etken olarak hayatımıza dahil etmiştir. Yıllara baktığımızda 2020 yılından itibaren pandeminin de etkisiyle alanda yapılmış olan tez sayısında artış görülmektedir. İnsanların evde olma zorunluluğunu fırsat bilen oyun üreticileri dijital oyun alanlarında indirimler, promosyonlar tanımlayarak dijital oyuna olan bağımlılığı arttırmıştır.

Dijital oyun bağımlılığı alanında yapılmış olan tezler konu alanına göre incelendiğinde en çok tez çalışması beden eğitimi alanında yer almaktadır. Dijital oyun bağımlılığı ve spor ilişkisi en çok çalışılan konu olarak dikkat çekmektedir. İkinci sırada eğitim ve öğretim yer almaktadır. Eğitim ve öğretim alanında çeşitli değişkenlerle dijital oyun bağımlılığının ilişkisi incelenmektedir. Üçüncü sırada ise psikoloji alanı yer almaktadır. Psikoloji alanında yapılan çalışmalarda daha çok bağımlılığa sebep olan faktörler ve alt boyutlar ele alınarak çalışılmıştır. Dijital oyun bağımlılığı farklı konu alanlarında çalışmaların çıkarılabileceği oldukça kapsamlı bir konudur.



Dijital oyun bağımlılığı alanında yapılmış olan tezlerin hazırlandığı üniversiteler incelendiğinde Haliç Üniversitesi ve Van Yüzüncü Yıl Üniversitesi en çok tez hazırlanmış olan üniversiteler olarak dikkat çekmektedir. Genel olarak bakıldığında çoğu üniversitede bu konu alanında tez hazırlanmıştır. Dijital oyun bağımlılığı konusunda toplam 46 üniversitede tez hazırlanmıştır.

Dijital oyun bağımlılığı alanında yapılmış tezler incelendiğinde en çok Sosyal Bilimler Enstitüsünde çalışılmış olup ikinci sırada eğitim bilimleri enstitüsünde ve üçüncü sırada lisansüstü eğitim enstitüsünde tez çalışmaları yapılmıştır. Sosyal Bilimler Enstitüsünde 27 tez çalışması, Eğitim Bilimleri Enstitüsünde 25 tez çalışması ve Lisansüstü Eğitim Enstitüsünde 17 tez çalışması yapıldığına YÖK Ulusal Tez Merkezinden erişilerek belirlenmiştir.

Dijital oyun bağımlılığı alanında yapılmış olan tezler incelendiğinde; en çok beden eğitimi ve spor öğretmenliği ana bilim dalında hazırlanmış olduğu belirlenmiştir. Bu kapsamda Beden Eğitimi ve Spor Öğretmenliği Ana Bilim Dalında 17 tez çalışması, Temel Eğitim Ana Bilim Dalında 10 tez çalışması ve Eğitim Bilimleri Ana Bilim Dalında 7 tez çalışmasına YÖK Ulusal Tez Merkezinden erişilmiştir. Beden eğitimi alanında daha çok çalışma olmasının sebebi olarak daha çok e-spor ile ilişkisel tarama çalışmalarına yer verilmesi olarak açıklanmaktadır.

Tezlerin hazırlandığı öğretim kademeleri açısından yapılan incelemede en çok tez çalışmasının ortaokul kademesinde 24 tez çalışmasıyla hazırlandığı, ikinci sırada lise kademesinde 22 tez çalışması ve üçüncü sırada üniversite kademesinde 15 tez çalışmasının hazırlandığı belirlenmiştir. İlkokul kademesinde en az çalışma bulunmasının sebebi çocukların bağımlılık seviyesinde oyun oynamaması, okul ve ebeveyn faktörleri yer almaktadır.

Dijital oyun bağımlılığı alanında yapılmış olan çalışmalar incelendiğinde örnekleme yöntemi olarak kolay ulaşılabilir örneklem ile yapılmış 29 tez çalışması, amaçsal örneklem ile yapılmış 24 tez çalışması ve uygun örneklem kullanılarak yapılmış 12 tez çalışması bulunmaktadır. Nicel çalışmanın ağırlıklı olduğu ve verilerin kaybını en aza indirmeye adına en çok kolay ulaşılabilir örnekleme kullanılmıştır.

Dijital Oyun Bağımlılığı alanında yapmış olan tez çalışmalarında en çok kullanılan veri toplama aracı ölçektir. Ölçekler daha çok dijital oyun bağımlılığı ve tutum ölçekleri altında alt boyutlara ayrılmaktadır. Her çalışmada en az 1 ölçek kullanılmış olup birden fazla ölçeğin bir arada kullanıldığı tez çalışmaları da bulunmaktadır.

Verilerin analiz yönteminde daha çok istatistiksel hesaplamalar hakim olmakla beraber en çok SPSS programı ile analiz yapılmıştır. SPSS programının farklı sürümlerinin kullanıldığı ve SPSS programında yapılan analizler sonrasında farklı analiz yöntemlerinin de güvenilirliği arttırmak için yapıldığı görülmektedir. ANOVA ve t-testinin de oldukça yaygın kullanıldığı belirlenmiştir.

Yapılan çalışmalarda dijital oyun bağımlılığına sebep olan faktörler ve değişkenlerin ilişkisi incelendiğinde okul dışı öğrenmenin de önemini ortaya koymaktadır. Yapılan çalışmalar öğrenmenin her zaman olumlu sonuçlarının olmadığını, okul dışı öğrenmelerde farklı etkenlerin yer aldığını ve öğrenmenin olumsuz etkilerle de sonuçlanabileceği durumunu ortaya koymaktadır (Mutlu & Çelik, 2019). Okul içinde planlı bir öğrenme sisteminin olması olası sonuçlar meydana getirirken okul dışında plansız bir sistemin olması okul dışı öğrenmeler için de gerekli bir eğitimin olması ihtiyacını ortaya koymaktadır. Teknolojinin olumlu yanları

bireylerin gelişimini sağlarken olumsuz yanları da dijital oyun bağımlılığında olduğu gibi bireylerde çeşitli sorunlara yol açmaktadır. Bu konuda okuryazar bireylerin yetiştirilmesi ve hayat boyu öğrenme ilkesi hedeflenerek geliştirici çalışmalar yürütülebilir.

### **Öneriler**

Dijital oyun bağımlılığı alanında disiplinler arası çalışmalar yürüterek bilgisayar ve psikoloji alanında, psikoloji ve eğitim alanında ortak çalışmalar yürütülebilir.

Eğitim alanında en alt kademedен itibaren dijital oyun farkındalığını öğrencilere çeşitli seminerler, uygulamalar ve örnek çalışmalarla desteklenen geniş kapsamlı bir tarama çalışması yapılabilir.

Doktora tezlerinde çok az yer verilen bir konu olduğu için doktora tezlerinde karma desen kullanılarak dijital oyun bağımlılığı ölçeği, tutum ölçeği kullanılarak bu ölçeklerin sonucunda görüşmeler yapılarak bağımlılığın altında yatan faktörler tespit edilerek alana katkı sağlanabilir. Dijital Oyun Bağımlılığı ölçeği uygulandıktan sonra olumsuz etkenlerin fazla olduğu kategoriler belirlenerek bireylerle, çocukların velileri ile görüşmeler yapılması dijital oyun bağımlılığının farklı etkenlerini de ortaya çıkarabileceği düşünülmektedir.

## **Kaynakça**

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## QUERCETIN TREATMENT AS A PROTECTIVE IN DIABETIC RATS

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### Abstract

The history of medicinal plants is as old as human history. It can be said that most of the drugs available today are of plant origin. Diabetes Mellitus is a chronic metabolic disease that can cause organ and function losses due to possible complications of insulin that develop due to diabetes, and that negatively affects life expectancy and quality. Although new drugs and drug application techniques have been developed for diabetes and efforts have been made to find insulin genes to protect against diabetes, the nature of the complications that occur chronically in these patients and reduce life quality has not been fully determined. 21 male rats weighing 250-300 gr were used in our study. 14 subjects were injected with a single dose of 40 mg/kg streptozotocin intraperitoneally (IP) and a total of 3 groups were formed as the study design. The first group was determined as the control and 1cc of IP saline was administered. The second group received 40 mg/kg streptozotocin (STZ) dissolved in citrate buffer and administered IP, and the third group received 50 mg/kg/day quercetin via gavage for three weeks after STZ was administered. At the end of the study, the pancreatic tissues removed under anesthesia were examined with histochemical methods after the histological follow-up phase. Significant differences were detected in terms of inflammation and regeneration in the pancreatic tissues. As a result, it is important to elucidate the relationship between quercetin and diabetes with more comprehensive studies, to determine the molecular mechanisms of medical importance and to reflect them in the clinic.

**Keywords:** Diabetes, quercetin, pancreas, histopathology

## 1. Introduction

Diabetes is a metabolic disease in which hyperglycemia occurs as a result of the deterioration in the secretion of the insulin hormone and/or the effect of the insulin hormone, and is called non-insulin-dependent diabetes (NIDDM) (1). In type 2 diabetes, resistance to the insulin hormone usually occurs in the liver, muscle tissues, as well as in different target tissues. Insulin resistance is the situation in which insulin at normal levels cannot create an adequate response in the body. In type 2 diabetes, changes in insulin secretion or effect (low, normal insulin secretion) cause hyperglycemia (2). Hyperglycemia causes non-enzymatic glycation and oxidative destruction in proteins, as well as glucose oxidation. This entire chain of events causes the formation of free radicals, and free radicals cause oxidative stress (3). Under normal conditions, there is a balance between free radicals and the antioxidant system. In diabetic conditions, the shift of this balance towards oxidants paves the way for many complications such as atherosclerosis, nephropathy, neuropathy and retinopathy (4). Antioxidants are substances that can render oxidants inactive or scavenge them from the environment, and with these properties, they provide protection in cells and tissues and contribute positively to the organism. Antioxidants are classified as enzymatic (such as glutathione peroxidase (GSH-Px), superoxide dismutase (SOD), glutathione reductase (GR), paraoxonase (PON1)) and non-enzymatic (such as vitamins A, C, E) (5). Since diabetes is a chronic disease, the high costs of health care services and the side effects of the drugs used have led to an increase in interest in alternative or supportive/complementary treatments. It is noteworthy that nowadays, diabetic patients use herbal medicines with high antioxidant and antihyperglycemic properties in addition to antihyperglycemic drugs (such as insulin and metformin) in the fight against hyperglycemia.

Quercetin is a common dietary flavonoid that can be found in many vegetables and fruits, such as onions, lettuce, tomatoes, hot peppers, broccoli, apples, and strawberries (6,7). In particular, quercetin is one of the most potent natural antioxidants with various pharmacological effects, including anti-inflammatory, anti-allergic, anti-ulcer, anti-cancer, cardioprotective, neuroprotective, and anti-atherogenic activities. In addition, quercetin has been reported to have antidiabetic potential in several preclinical studies. Therefore, the inclusion of quercetin as a natural therapeutic product to prevent diabetes and its complications has gained considerable interest (8,9).

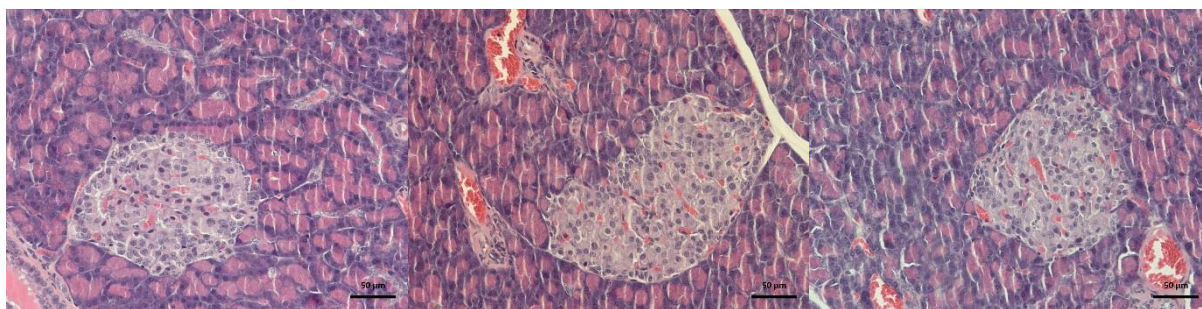
## 2. Material Method

A total of 21 rats were used in the study. 14 subjects were injected intraperitoneally with a single dose of 40 mg/kg streptozotocin. Blood glucose levels were checked before streptozotocin injection. Fasting blood glucose levels were measured in blood taken from the tail vein 1 day after the injection. Values exceeding 250 mg/dl were considered diabetic. After the treatment was completed, the subjects were sacrificed under ketamine/xlazine anesthesia with cervical dislocation and pancreatic tissue samples were placed in immunofix fixative and histological follow-up was performed. The blocked tissue samples were cut with a microtome at 5 micron thickness and placed on a slide, stained with Hematoxylin Eosin and photographed for histopathological examination.

**Ethical approval:** All applicable international, national, and/or institutional guidelines for the care and use of animals were followed Çanakkale Onsekiz Mart University Ethics Committee for Animal Research (Protocol number: 2020/11-03).

### 3. Results

Blood glucose levels of all subjects were measured with a glucometer before and after STZ application. When the blood glucose levels of the subjects belonging to the control, diabetes and treatment groups were evaluated, it was determined that the blood glucose level of all groups was approximately 100 mg/dl at the beginning. No statistically significant difference was found in the blood glucose level of the control group from the beginning to the end of the experiment. After quercetin was administered, the blood sugars measured were found to be significant as  $p < 0.01$  in the diabetes group. In histological staining with Hematoxylin-Eosin, no histopathological findings were found in the pancreases of the rats in the first group, the control group. It was observed that the connective tissue capsule extended septa into the tissue, dividing the tissue into lobules, and normal-looking endocrine and exocrine sections. In the pancreatic tissue of the diabetic group, atrophy occurred in the Langerhans islets, their diameter decreased, pyknotic cells increased, vacuolization and mononuclear cell infiltration were observed in the endocrine structure. In the treatment groups that received quercetin, it was observed that histopathological formations began to disappear in the general appearance of the pancreas (Figure 1a,b,c).



**Figure 1.** Pancreatic tissue of control and treatment groups after diabetes was induced, H&E staining, X20 (Star: islet of Langerhans, arrow: inflammation).

### 4. Discussion

Plants and plant-isolated compounds are effective in diabetes management. In this study, we showed that quercetin, a plant-derived compound, exhibited antidiabetic effects in an STZ-induced diabetes model by improving glucose metabolism enzymes. In general, STZ is considered an optimum model for inducing diabetes in animals. STZ induces diabetes by a mechanism involving its consumption by pancreatic beta cells, which produces excessive ROS leading to diabetic symptoms such as hyperlipidemia and hyperglycemia (10). Therefore, we used this model to develop DM in Wistar rats. To overcome the hyperglycemic effect on the rats, they were treated with 50 mg/kg quercetin. The treatment dose was decided based on body mass index and available literature for both compounds. The compounds are therapeutically

effective in reducing the hyperglycemic effect in STZ-induced diabetic rats. Mukhopadhyay and Prajapati noted that quercetin has the ability to reduce hyperglycemia by stimulating the pancreatic islets to release adequate insulin. Flavonoids are known to enhance the pancreatic islets of Langerhans to produce and secrete insulin and glucagon into the bloodstream (11).

Quercetin is known to have many benefits on human health. Although clinical studies have been conducted in some cases, all or most of the current research in other areas is preclinical (12). Quercetin is a powerful antioxidant and reactive oxygen and nitrogen species (ROS and RNS) scavenger under *in vitro* and *in vivo* conditions (13). It has a strong scavenging activity against superoxide and hydroxyl radicals, nitric oxide and peroxynitrite (14). It is also known to reduce oxidative stress and protect against lipid peroxidation in experimental diabetes studies. Like many other antioxidants, the concentration of Quercetin determines the level of antioxidant activity. At low concentrations (1  $\mu\text{M}$ ), quercetin exhibits antioxidant activity, while at high concentrations (100  $\mu\text{M}$ ), it is an oxidant and is known to cause double-stranded DNA breaks (15). In a study in which quercetin was administered to male rats with experimental diabetes induced by STZ, it was reported that quercetin played a balancing role in blood sugar control (16). In another study examining the effect of quercetin on protein and lipid damage occurring in experimentally diabetic rats, it was determined that quercetin did not have an effective protective feature against protein damage caused by DM, but it had a protective role against lipid peroxidation (17). In a study in which quercetin was applied to rats, it was reported that it prevented the formation of free oxygen radicals in cells and provided protection against lipid peroxidation (18). In addition to studies reporting that quercetin application resulted in the inhibition of lipid peroxidation (19), there are also studies reporting that it reduced lipid peroxidation in human lymphocytes (20). In this study, in which the negative effects of diabetes in terms of the parameters examined were observed in rats in which experimental diabetes was induced with STZ, it seems remarkable that the application of quercetin, an effective antioxidant, did not have any negative effects on healthy rats, but it alleviated these negative effects in diabetic rats. In light of the findings we obtained in this study, it was determined that quercetin has a strong antioxidant feature. It was determined that quercetin was effective in diabetic rats. It was seen that diabetic complications could be prevented by using this compound.

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## **EXPERIMENTAL ALLERGIC RHINITIS MODEL**

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### **Abstract**

Allergic rhinitis is a chronic upper respiratory tract disease characterized by congestion, rhinorrhea, itching, sneezing and postnasal drip that occurs with inflammation in the nasal mucosa. Exposure to any allergen and immunological sensitivity to this allergen are required for its formation. Allergic rhinitis is one of the chronic diseases with the highest prevalence; it is quite common all over the world and is reported to affect 10-25% of the population. However, considering that this figure does not reflect the truth and that there are patients who do not take their symptoms seriously enough to see a doctor, it is thought that allergic rhinitis is a more common disease. The frequency of allergic rhinitis has also been increasing over the years. Allergic rhinitis typically begins before the age of 40, with the average onset between the ages of 12-15. In the presence of this chronic disease, which causes a decrease in the quality of life, the incidence of sinusitis and otitis media increases, and allergic rhinitis is also a major risk factor for the development of asthma. During the search for treatment, numerous animal experiments have been conducted to create an allergic rhinitis model and to investigate the effects of certain drugs. Various substances have been used to create allergic rhinitis in animal experiments. In this study, studies on the experimental rhinitis model and their clinical implications were discussed.

**Keywords:** Rhinitis, respiratory system, sinusitis, experimental model.



## 1. Introduction

Allergic rhinitis is a chronic upper respiratory tract disease characterized by nasal congestion, rhinorrhea, itching, sneezing and postnasal drip caused by inflammation in the nasal mucosa. Exposure to any allergen and immunological sensitivity to this allergen are required for its formation. Allergic rhinitis is the most common form of atopic diseases. A wide variety of etiological agents have been reported in allergic rhinitis. Atopic allergens smaller than 5 $\mu$  can reach the distal end bronchioles. In order for atmospheric inhalant allergens to be effective, they must have two characteristics; the first is that they carry specific antigens and the second is that they can pass through the mucosa. Allergens are antigens that stimulate the formation of specific IgE antibodies and react with this antibody. Allergens are generally protein or glycoprotein in structure. There are many antigens in an allergen extract. Not all of these antigens cause sensitization; those that cause sensitization in a small number of patients are called minor allergens. Allergens that cause sensitization in more than half of the patients are called major allergens and constitute 1% of the total weight of the extract (1,2).

Allergic rhinitis affects approximately 20% of industrialized societies and causes a decrease in the quality of life. The incidence of acute sinusitis and otitis media is increased in patients with allergic rhinitis; allergic rhinitis is also a major risk factor for the development of asthma (3, 4). The pathogenesis of allergic rhinitis includes vasodilation, increased vascular permeability, increased mucus, and many inflammatory processes due to the effect of released mediators. The steps in the formation of these events are as follows:

1. Antigen presentation,
2. T cell differentiation,
3. IgE synthesis,
4. Mast cell degradation (5).

1. Antigen Presentation and Sensitization: At the beginning of allergic rhinitis, the body first becomes sensitized to the allergen. The respiratory mucosa is exposed to many allergens ranging from picograms to nanograms, such as pollen and house mite feces. Antigens stored in the mucosa are taken up by Langerhans cells and antigen presenting cells (APC) found here, proteolytically cleaved into 7-14 amino acid peptides and bind to the antigen recognition regions of molecules called MHC-Class II. These APCs are dendritic cells, mononuclear phagocytes, B lymphocytes and vascular endothelial cells for T lymphocytes. After endocytosis in APC, the peptides bind to MHC II molecules and are transported to the cell surface. They are then transported to regional lymph nodes in ASHs. At an unknown point, antigen presentation to undifferentiated T cells (Th0) occurs by ASH. In individuals with atopic diathesis, Th0 cells are transformed into Th2 cells by recognizing the antigenic peptide presented by MHC II on their receptors ASH. Many mediators and cells play a role during this transformation (5).

CD4 (T helper) is activated and forms the Th2 cell as a result of the interaction between MHC II, CD28-B7. CD4 cells differentiate into Th1 cells in the presence of IL2 and IL18, and into Th2 cells in the presence of IL4. Th2 cells secrete their own characteristic cytokines, IL4, IL5, IL9, IL13, and GmCSF. As seen here, IL4 creates a positive feedback effect by creating a proatopic environment. Cytokines perform three main functions in this formation (5). 2.

Synthesis of IgE: After the complex consisting of CD3 and T cell receptor on the T cell surface binds with MHC II, CD40 ligand rapidly appears on the T cell surface. This ligand combines with CD40, which is already present on the B cell surface. This combination becomes stronger with the connection between CD28 (T cell) and B7 (B cell). This connection between CD28 and B7 also increases the release of IL4 from the Th2 cell (5). Two stimuli are required for the initiation of IgE secretion from the B cell. These are the formation of IL4 and CD40-CD40 ligand. After these stimuli, epsilon heavy chain synthesis begins in the B cell. Early and late phase reactions are observed after provocation with allergen (5).

3. Early Phase Response: The early phase response begins within minutes after exposure to the allergen. The leading role in the early phase response is played by mast cells. As a result of mast cell degranulation, histamine, leukotrienes (cysteinyl LT, LT C4, LT D4, LT E4), prostaglandins (PGD<sub>2</sub>, PGI<sub>2</sub>, PGE<sub>2</sub>, PGF<sub>2</sub>α), kinins and cytokines are released. The most prominent symptoms of this phase are nasal congestion, rhinorrhea, sneezing and nasal itching.

4. Late Phase Response: The late phase response begins 4-8 hours after the early phase reaction. In this phase, it is clinically observed that the nasal mucosa thickness and airflow resistance increase and there is minimal change in other nasal findings (6). Eosinophils, basophils, neutrophils and mononuclear cells are responsible for the late phase. Mediators such as interleukin, leukotriene and PAF (platelet activating factor) induce the exit of inflammatory cells from the vasculature into the interstitial space. Inflammatory reactions such as mucus hypersecretion, edema, nasal congestion and airway hyperactivity occur. Eosinophils play the leading role in the late phase. In addition to cytokines and mediators, eosinophils also release polypeptides such as major basic protein and eosinophil cationic protein, eosinophil peroxidase and eosinophil-derived neurotoxin. These polypeptides cause epithelial damage and cell death. Another cell that increases in the late phase reaction is lymphocytes. There is an increase in CD4 T helper cells, CD4 CD45 T memory cells and even CD8 T cytotoxic cells (1).

Research conducted in the last century has provided us with information about the formation and treatment of allergic diseases. In the treatment of allergic rhinitis, protection from the responsible specific allergen is the first and most important step. If protection is not possible or inadequate, drug treatment is started. Antihistamines, leukotriene inhibitors, systemic and topical steroids, cromolyn sodium and decongestants are used in drug treatment. Immunotherapy can be applied in cases where appropriate drug and environmental control are inadequate (2). During the search for treatment, many animal experiments were conducted to create an allergic rhinitis model and to investigate the effects of certain drugs. Various substances were used to create allergic rhinitis in animal experiments. In the study conducted by Wen et al. (7) on rats, ovalbumin was first given intraperitoneally at a dose of 0.3 mg with 30 mg aluminum hydroxide and 1 ml of 0.9% physiological serum once every 2 days for 14 days for immunization; Then, 10 µl of 10% ovalbumin was administered intranasally for seven days to create an allergic rhinitis model. In addition to these, 10 U of Botox was administered to the treatment group to prevent allergic symptoms. Typical allergic symptoms such as sneezing, nose scratching, and runny nose were observed in the OVA-sensitized group, while a significant decrease in these symptoms was observed in the treatment group. While an increase in eosinophils, vascular dilatation, congestion, edema, and hyperplasia in serous glands were

detected in the OVA-sensitized group, it was observed that Botox application significantly reduced these changes.

In the study conducted by Sugimoto et al. (8) on mice, ovalbumin was first administered intraperitoneally at a dose of 1 mg together with 2 mg aluminum hydroxide gel and pertussis toxin for immunization and the application was repeated five days later. Then, OVA (10  $\mu$ l, 1 mg/ml) was administered intranasally with a micropipette daily between days 14-42. Some of these animals were orally administered H1 receptor antagonists chlorpheniramine, ketotifen, astemizole and epinastine one hour before intranasal sensitization and it was reported that typical allergic rhinitis symptoms such as nose scratching and sneezing were significantly reduced in the animals treated in this way. In the study conducted by Shimuzu et al. (9) on mice, ovalbumin was administered intraperitoneally at a dose of 200  $\mu$ g with 10 mg aluminum hydroxide gel and pertussis toxin for immunization, and a solution of 5 mg ovalbumin in 0.1 ml serum was administered intranasally for three days, 18 days after the first immunization. Some of these animals were given suplatast tosylate, a Th2 cytokine inhibitor, and it was observed that nasal eosinophilia was significantly reduced in these animals. In these studies, it was observed that typical allergic rhinitis symptoms such as sneezing and nose scratching movements occurred in rats with repeated topical intranasal OVA applications. It was revealed that the agents given for treatment significantly reduced sneezing and nose scratching movements that developed due to antigen-antibody interaction. In patients with allergic rhinitis, structural changes such as basement membrane thickening, epithelial cell loss, epithelial metaplasia, mucous gland hypertrophy, goblet cell hyperplasia, vascular proliferation and chondrocyte hypertrophy have also been reported. These pathological changes are called tissue remodeling and are caused by matrix metalloproteinases released by epithelial cells, fibroblasts and inflammatory cells (10). In the study conducted by Lim et al. (11), tissue remodeling and MMP-9 expression were investigated in mice in which allergic rhinitis was induced with ovalbumin, and some of the mice were treated with intraperitoneal dexamethasone. In the group in which allergic rhinitis was induced, significant tissue remodeling findings such as goblet cell hyperplasia and submucous gland hypertrophy and significant MMP-9 expression were observed; however, these findings were not observed in the group in which dexamethasone was administered.

## **2. Conclusion**

It is thought that a new option in the treatment of allergic rhinitis may emerge as a result of research conducted with multicenter double-blind randomized controlled clinical trials based on evidence obtained from experimental animal models.

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## **THE EFFECT OF SKIN-TO-SKIN CONTACT ON BREASTFEEDING AND NURSING APPROACH**

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### **Abstract**

Skin-to-skin contact is defined as placing a naked baby on the mother's naked abdomen or chest. The World Health Organization, recommends that skin-to-skin contact be initiated and encouraged as soon as possible after birth for the mother and baby. It is reported that skin-to-skin contact has many benefits for both the health of the mother and the baby. Early skin-to-skin contact and initiation of breastfeeding within the first hour after birth positively affects the physiological and psychological health of not only the baby but also the mother. Mothers who practice early skin-to-skin contact with their babies develop sensitivity to their babies' needs more quickly, and early initiation of breastfeeding in babies reveals various positive effects of skin-to-skin contact on the breastfeeding process. For this purpose, the review was conducted to examine the effects of skin-to-skin contact on breastfeeding, and the nursing approaches. When studies evaluating the effects of skin-to-skin contact on breastfeeding are examined, it is reported that it has positive effects on breastfeeding success, increases the initiation and continuation of breastfeeding, and increases the rates of exclusive breastfeeding. It is also among the reported benefits that it positively affects the baby's grasping and sucking behaviors. It is also stated that it has positive effects on the mother's self-confidence regarding breastfeeding, and attitudes towards breastfeeding. It is reported that all of these contribute to the successful and ideal breastfeeding process of mothers and babies. As a result, it is emphasized that nurses and midwives have a key role in the application of skin-to-skin contact, which has many benefits reported for breastfeeding. It is thought that timely and effective implementation of mother-baby skin-to-skin contact by nurses and midwives can positively affect the health of mothers and babies.

**Keywords:** Breastfeeding, Nurse, Skin-to-Skin Contact.

## **Introduction**

The first hours after birth are important for the newborn's adaptation to the external environment both physiologically and psychologically. The adaptation of the newborn to the external environment can be achieved through skin-to-skin contact between the mother/father and the baby (Ünal Toprak, Turan, & Şentürk Erenel, 2017). Skin-to-skin contact (SSC) is defined as the naked baby, sometimes with a nappy or a cap on, being placed on the mother's bare skin, with the baby's exposed side covered with blankets or towels (Stevens, Schmied, Burns, & Dahlen, 2014; Zavala-Soto, Hernandez-Rivero, & Tapia-Fonllem, 2022). The bare newborn is laid naked on the mother's bare chest in the prone position and the head is turned to the side so that the respiratory tract of the newborn remains open (Yerlikaya & Çalım, 2021). It is recommended that SSC be started as soon as possible after birth and continued for at least one hour (Jurgelėnė, Kuzmickienė, & Stonienė, 2024; Sampaio Á, Bousquat, & Barros, 2016). SSC has been shown to be a part of basic neonatal care with beneficial effects on maternal and newborn health (Agudelo et al., 2021). The World Health Organization (WHO) recommends its routine use in infant care and is a recommended practice worldwide (Goudard et al., 2022; Jurgelėnė et al., 2024). Because SSC has been reported to have many benefits for both mother and baby (Goudard et al., 2022). Among its benefits for the baby, it is reported that it reduces the negative consequences of stress of being born (Karimi, Sadeghi, Maleki-Saghooni, & Khadivzadeh, 2019), helps the newborn regulate heat and maintain blood sugar levels, reduces the risk of jaundice, and promotes breastfeeding and the attachment between the mother with the newborn (Stevens et al., 2014). Benefits for the mother include reduced postpartum bleeding, increased breastfeeding self-efficacy and reduced maternal stress levels (Karimi et al., 2019). Mothers who practice early SSC with their babies develop sensitivity to their babies' needs more quickly, and early initiation of breastfeeding in babies reveals various positive effects of skin-to-skin contact on the breastfeeding process. For this purpose, the review was conducted to examine the effects of SSC on breastfeeding, and the nursing approaches.

## **The Effect of Skin-to-Skin Contact on Breastfeeding**

Breastfeeding plays an important role in protecting and maintaining the health of mothers and babies. The important benefits of breastfeeding for the growth, development and health of newborns are emphasized (Juan et al., 2022). Initiating SSC and breastfeeding as soon as possible for newborns with adequate clinical conditions in the postpartum period are practices that help reduce morbidity and mortality in newborns (Santos et al., 2021). The Baby Friendly Hospital Initiative, supported by the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF), recommends ten steps for successful breastfeeding, including skin-to-skin contact between mother and baby. This is an important practice for encouraging breastfeeding (Sampaio Á et al., 2016; UNICEF & WHO, 2018). The Baby Friendly Hospital Initiative recommends that skin-to-skin contact should be initiated immediately, regardless of the method of delivery, and if possible, should be applied continuously for at least 60 minutes (UNICEF & WHO, 2018).

The main effect of SSC on neonatal health is reported to be due to the consequences of breastfeeding (Agudelo et al., 2021). SSC of mother and newborn after birth is an effective way

to improve the initiation and duration of breastfeeding. It is recommended to perform SSC as soon as possible after birth, as this is the time when the newborn is most likely to follow its natural instinct to find the breast and then breastfeed (Juan et al., 2022). Newborns who have skin-to-skin contact with their mothers develop behaviors such as crawling to the breast and sucking more effectively (Zavala-Soto et al., 2022). Many beneficial effects of SSC on breastfeeding are reported (Karimi et al., 2019). When the literature on the subject is examined, it is stated that SSC creates the most suitable environment for newborn babies to adapt to life and helps to develop the mother-baby attachment (Sharma, 2016). According to a meta-analysis, it is stated that SSC may increase the success rate and duration of first breastfeeding (Karimi et al., 2019). In their Cochrane review, Moore et al. (2016) reported that skin-to-skin contact provides more effective breastfeeding, longer breastfeeding duration, and early initiation of breastfeeding (Moore, Bergman, Anderson, & Medley, 2016; Zhang et al., 2023). It is also reported that it contributes positively to the rate of exclusive breastfeeding (Karimi, Miri, Khadivzadeh, & Maleki-Saghooni, 2020; Sharma, 2016; Srivastava, Gupta, Bhatnagar, & Dutta, 2014). In addition, it has been reported that SSC after cesarean section may increase the initiation of breastfeeding, reduce formula supplementation in the hospital, increase bonding and maternal satisfaction, maintain the warmth of newborns and reduce neonatal stress (Stevens et al., 2014). Based on all these results, it is thought that using SSC application to encourage breastfeeding would be beneficial, as stated in the literature (Moore et al., 2016).

### **Skin-To-Skin Contact and Nursing Approach**

Given the evidence and recommendations regarding the benefits of SSC for both mother and baby, it is recommended that it be implemented in care by healthcare professionals (Mukherjee, Chandra Shaw, Venkatnarayan, & Dudeja, 2020). Nurses should use current evidence-based practices in their care practices to protect and improve maternal and infant health in the postpartum period (Ünal Toprak et al., 2017). Nurses' knowledge on the subject should be supported with education in order to use evidence-based practices in their care practices (Safari, Saeed, Hasan, & Moghaddam-Banaem, 2018). In SSC practice, nurses should assess the mother and baby, take safety precautions to prevent any problems. Ensure safe positioning of the newborn and monitor the baby frequently in the first few hours after birth (Stevens et al., 2014). It is important for them to support the mother by health professionals to provide skin-to-skin contact and breastfeed as soon as possible (UNICEF & WHO, 2018). Specially trained nurses play a major role in initiating and maintaining breastfeeding and solving breastfeeding-related problems (Tiryaki & Altınkaynak, 2021). It is emphasized that nurses and midwives play an important role in the timely and effective implementation of skin-to-skin contact. They will be able to positively affect the physiological and emotional states of the mother and the newborn with the SSC they will apply (Çelik & Kök, 2022).

### **Conclusion**

When the literature is examined, it is seen that SSC application provides many benefits on breastfeeding. Among the beneficial effects it provides are; it improves mother-infant attachment during the breastfeeding process, reduces the use of formula, increases the initiation

of breastfeeding and the rate of exclusive breastfeeding, and positively affects the continuity of breastfeeding and the breastfeeding process. Based on all these results, it is thought that using SSC application to encourage breastfeeding will be beneficial. It is important for nurses to initiate positive mother-infant interaction in the postpartum period, to determine situations where this interaction cannot be established, and thus to prevent problems that may affect the child's entire life. It is important for mother-infant health that nurses initiate skin-to-skin contact, support breastfeeding, and provide counseling in the postpartum period. Considering the positive effects of SSC, it is thought that increasing awareness about its use in practice will contribute to breastfeeding and the protection and development of mother-newborn health.



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## VETERİNER KLİNİKLERİNİN MOBİLYA VE İÇ MEKAN TASARIM ÖZELLİKLERİ AÇISINDAN KAPSAMLI BİR ANALİZİ

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### Özet

Veteriner kliniklerinin iç mekan tasarımları ve mobilyalar bakımından incelenmesi, hayvan ve hayvan sahiplerinin deneyimleri üzerindeki etkileri nedeniyle kritik bir öneme sahiptir. Klinik iç mekan tasarımı hasta konforunu ve stresini önemli ölçüde etkileyebileceği gibi potansiyel olarak iyileşme sonuçlarını dolaylı olarak etkileyebilir. Ek olarak, çalışanların motivasyonunu arttırabilir ve daha etkili hizmet sunumunu kolaylaştırabilir. Bu çalışma ile Kayseri’de (n:32) faaliyet gösteren veteriner kliniklerinin mevcut iç mekan tasarımları ile mobilyalarının incelenmesine odaklanılmıştır. Araştırma kapsamında, çalışmaya katılmaya gönüllü olanlara bir anket uygulanmıştır. Anket sonuçları tanımlayıcı istatistik yöntemleri kullanılarak analiz edilmiştir. Çalışmadan elde edilen veriler ile mevcut durumda iyi işleyen veya işlemeyen unsurlar tespit edilerek hayvan sahiplerinin ve veteriner hekimlerin deneyimlerini iyileştirmek, kliniğin işlevselliğini arttırmak ve daha verimli bir çalışma ortamı yaratmak için öneriler geliştirilmesi amaçlanmaktadır. Bu bağlamda, kliniklerin fiziksel düzeni, kullanılan malzemeler, renkler gibi unsurlar ile kullanıcıların iç mekan ve mobilyalara karşı olan memnuniyet düzeyleri araştırılmıştır. Araştırma sonuçlarına göre, klinikler de iç mekan tasarımı, öncelikli olarak tıbbi ihtiyaçlara yönelik geniş alanların oluşturulması üzerine odaklanmıştır. Giriş ve lobi bölümleri, sandalye, sehpa gibi basit mobilyalarla donatılmış olup, duvarlarda raflar ve bilgilendirici posterlerle sade bir dekorasyon tercih edilmiştir. Kliniklerde genel olarak ana renk beyaz tercih edilmiştir. Zemin, duvar, tavan, kapı, pencere ve mobilyalarda pürüzsüz dokular ve düz formlar daha yaygındır. Zeminler genellikle karolarla kaplanmışken, duvar ve tavan gibi iç cephelerde boya uygulaması daha yaygındır. Aydınlatmada LED gibi ekonomik aydınlatma gereçleri ve beyaz ışık kullanımı daha çok tercih edilmiştir. Isıtmada merkezi kaloriferli ısıtma daha yaygınken, havalandırma ve soğutma için ise doğal havalandırma ve klima gibi bölgesel çözümler tercih edilmiştir. Muayene odaları, estetik, fonksiyon, ergonomiden hijyene kadar bir çok özellik bakımından en iyi şartlara sahip mekanlardır.

**Anahtar Kelimeler:** Veteriner klinikleri, İç mekan tasarımı, Mobilya

## **A COMPREHENSIVE ANALYSIS OF VETERINARY CLINICS WITH RESPECT TO FURNITURE AND INTERIOR DESIGN CHARACTERISTICS**

### **Abstract**

The study of the interior design and furniture of veterinary clinics is of critical importance because of their impact on the experiences of animals and their owners. Moreover, the interior design of veterinary clinics can influence patient comfort and stress, potentially recovery, staff motivation and service delivery. This study focuses on examining the current interior design and furniture of veterinary clinics operating in Kayseri (n: 32). Within the scope of the research, a questionnaire was applied to the participants. Questionnaire results were analyzed using descriptive statistical methods. The efficiency of the current situation was analyzed with data from the study. In this way, it is aimed to develop recommendations to improve the experience of animal owners and veterinarians, increase the functionality of the clinic and create a more efficient working environment. In summary, elements such as the physical design of the clinics, the materials and colors used, and the satisfaction levels of the users towards the interior space and furniture were investigated. According to the results of the research, interior design in clinics is primarily focused on the creation of large spaces for medical needs. The entrance and lobby areas are decorated with simple furniture such as chairs and coffee tables, with shelves and informative posters on the walls. White is generally preferred as the main color in clinics. Smooth textures and flat forms are more common on floors, walls, ceilings, doors, windows and furniture. While floors are usually covered with tiles, paint application is more common on surfaces such as walls and ceilings. For lighting, economical fixtures such as LEDs and white light are preferred. It is more common to use central radiators for heating and natural ventilation and air conditioning for ventilation and cooling. Consultation rooms have the best conditions in terms of aesthetics, function, ergonomics and hygiene.

**Keywords:** Veterinary clinics, Interior design, Furniture

## **Introduction**

Veterinary clinics are centers where it is easier to protect and monitor animal health in our age. The services offered in these clinics also contribute to the awareness of animal owners. These places allow early diagnosis of diseases by regularly checking the health status of animals. In this way, both the quality of life of animals increases and less costly treatment processes are possible for their owners. The existence of such clinics enables animal owners to intervene quickly and effectively in emergencies, while at the same time allowing veterinarians to increase their experience. By making use of these services, animal owners can better protect the health of their beloved friends and improve the quality of the time they spend with them (Ackerman, 2015).

The interior design of clinics plays a crucial role in improving patient care, enhancing staff performance and providing efficient healthcare services. A well-designed healthcare environment can significantly influence the healing process, patient satisfaction and operational efficiency. To achieve this, for example, patient-centred design can be used in hospitals or clinics and the impact of design can be increased in such interiors. Such interiors can be designed to suit patient preferences including comfort, safety and social needs. Combining natural elements and aesthetically pleasing environments can significantly contribute to patient satisfaction and recovery (Adelita & Astuti, 2024). For example, artworks such as ceramics can be integrated into hospital interiors and can contribute to the healing process by providing visual and tactile stimulation (Özgen & Çetinkaya, 2023). Incorporating natural elements such as green plants and water into interior design can create a calming atmosphere conducive to healing. According to Rangga et al. (2024), the integration of sensory and psychological elements such as soothing colours, artwork and acoustic comfort can reduce stress and fear among patients. These elements contribute to a calming environment that promotes mental and emotional well-being (Rangga et al., 2024). Environmental graphic design elements can enhance the healing environment by providing both informative and relaxing visual elements (Aziz & Iskandar, 2023).

Functional layout, flexibility and efficiency also have an important impact on the interior design of hospitals and clinics. In order to increase flexibility and functionality in interior spaces, interior space and furniture needs can be determined more effectively by taking the opinions of both clinic staff and animal owners. According to Mars et al. (2020), involving patients and healthcare professionals in the design process ensures that the spaces meet the needs of end users (Mars et al., 2020). Again, in the design process, efficient workflow should be created to ensure easy transport of materials, patients and personnel. In addition, in the design of health centres, priority should be given to functional areas that allow easy movement and efficient workflow. To create such spaces, daylight positioning, airways and the special needs of medical equipment should be taken into account. It is also important that the design is flexible and expandable to accommodate future changes and technological developments (Garg & Dewan, 2022). Using sustainable materials in design, optimising energy efficient systems, incorporating natural light and ventilation in healthcare environments can promote healing, improve patient well-being and reduce carbon footprints (Bayır, 2024).

The furniture of health centres such as hospitals and clinics plays a very important role in ensuring the comfort, safety and efficiency of health environments. This is a variety of furniture such as beds, chairs, tables and storage units designed to meet specific needs. The design and functionality of this furniture can significantly affect patient care, staff productivity and the overall health experience. According to Time & Time (2022) furniture in hospitals and clinics should be wear-resistant, long-lasting and safe. In addition, comfortable designs also improve the quality of patient care (Zaman & Zaman, 2022). According to Nóbrega et al. (2019), these furniture should be easy to clean, ergonomic and durable. They should also be regularly maintained (Nóbrega et al., 2019). These furniture should be produced with materials resistant to microbial growth and should comply with cleaning protocols (Van Der Velden et al., 2013). In the field of interior and furniture design, the lobbies of medical centres such as hospitals and clinics are the most prominent spaces. The design and layout of such lobbies contribute positively to patient experience and hospital image (Nurfitriani et al., 2022). Good design increases patient satisfaction and loyalty (Asmaryadi et al., 2020). In summary, furniture in places such as hospitals and clinics should be designed to increase safety, functionality and patient comfort while creating a therapeutic and supportive environment. However, in the design of furniture and interiors in health centres, it is important to consider financial and practical constraints as well as creating healing environments. Although balancing optimal design with cost and legal requirements can be challenging, innovative strategies and collaboration can contribute to significant improvements in interiors and enhanced quality of care.

## **Materials and Methods**

The interior layout of veterinary clinics plays an important role for both animal owners and veterinarians; therefore, it is of great importance to make clinics more comfortable, efficient and functional. This study aims to examine in detail the current interior design of veterinary clinics operating in Kayseri and the design features of the furniture used.

A comprehensive questionnaire was designed for this study. This questionnaire was applied to the target group in face-to-face survey type. The survey was carried out in 2023. The main mass of the survey was designed according to the number of veterinary clinics operating in Kayseri province. It was determined that the number of the main mass was 160 with the data obtained from the Kayseri Chamber of Veterinary Surgeons according to the year 2022. The sample size was calculated according to the formula below. According to this formula, the sample size was calculated as 34. The survey was carried out face-to-face with clinic owners or responsibilities who volunteered to participate in the study. The study was completed with 32 veterinary clinics. No questionnaire form was encountered that disrupted the validity and reliability of the data set.

$$n = \frac{N \cdot t^2 \cdot p \cdot q}{(N - 1) \cdot d^2 + t^2 \cdot (p \cdot q)}$$

In the above formula 'n: Sample size; p: Prevalence of the phenomenon to be analysed (97% was taken); N: Size of the main mass; d: Accepted sampling error (0,05); t=(1-a): Confidence coefficient (95%= 1,96); q=(1-p): Probability of absence of the phenomenon to be examined'.

The questionnaire study included questions to measure the level of satisfaction with the interior spaces and furniture of the clinics. The questionnaire consists of four sections. In the first part, demographic characteristics of the survey participants and some characteristics of the clinics subject to the research were analysed. In the second section, the current design features of the interior spaces of veterinary clinics were analysed. In the sub-headings of this section, the evaluation of the entrance and lobby sections in terms of interior design and furniture and the current design features of the interior elements of the veterinary clinics were examined. In the third section, the satisfaction with the furniture in the interior spaces of veterinary clinics is analysed. In the last section, user opinions about how the ideal interior design should be for veterinary clinics were evaluated.

SPSS package programme was used for statistical analysis of the survey data. The results of the questionnaires were analysed using descriptive statistical methods and as a result of these analyses, it was determined which elements of the clinics function well or which aspects should be improved. These factors include the physical layout of the clinics, the quality of the materials used, the choice of colours and the layout of the furniture. The impact of these factors on animal owners and veterinarians was also considered.

## **Findings and Discussion**

### **Information about the veterinary clinic and its owners**

In this section, information about the 32 veterinary clinics and users are given. According to the findings of the study, 96.9% of the clinic owners are male physicians. 56.3% of these individuals are young adults aged between 26-35 years. In addition, 53.1% of these individuals have a master's or doctorate degree and their monthly income is between 25,520.4 TL-34,027.2 TL (1,064-1417 \$) (approx.) (34.4%). According to the Turkish Ministry of Labour and Social Security [CSGB] (2023), the monthly net minimum wage in Turkey in 2023 is 8,506.80 TL (CSGB, 2023).

**Table 1.** Information about the veterinary clinic and its owners

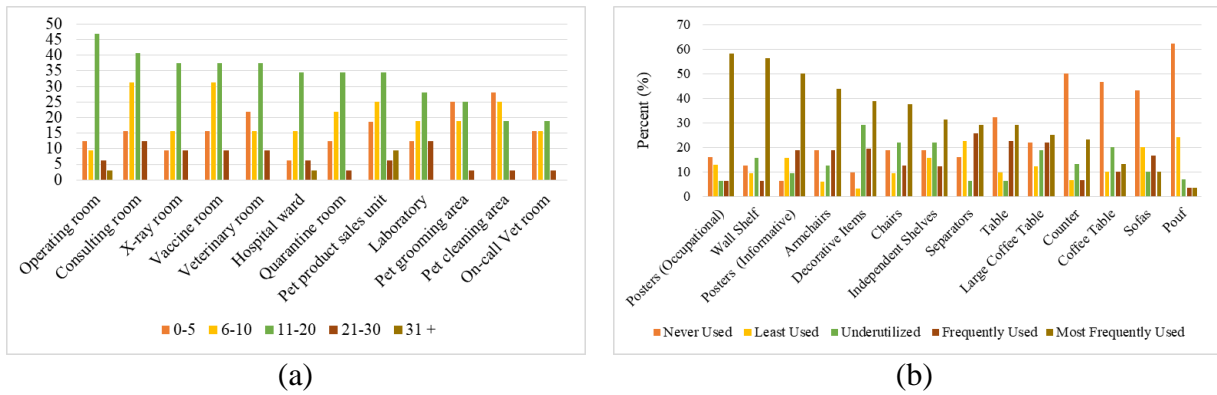
Features	F. Detail	N	%	Features	N	%	
<b>Gender</b>	Female	1	3.1	Ownership of the clinic	Owner	22	68.8
	Male	31	96.9		Tenant	10	31.3
<b>Age</b>	18-25	3	9.4	Building type	Detached building	3	9.4
	26-35	18	56.3		Apartment	2	6.3
	36-45	7	21.9		Under-building workplace	25	78.1
	46 -55	4	12.5		Other	2	6.3
	56 years and older	-	-		Location	Main street (busy)	19
<b>Education</b>	Lisans	15	46.9	Street (less busy)		8	25
	Master/ Ph.D	17	53.1	By streets		4	12.5
<b>Income*</b>	Minimum wage (8.506,80 TL/355\$)	1	3.1	Size	Other	1	3.1
	17.013,6TL/709\$ (approx.)	10	31.3		100 m <sup>2</sup> and below	11	34.4
	25.520,4-34.027TL/1.064-1.417\$ (approx.)	11	34.4		Between 101-200 m <sup>2</sup>	8	25
	34.028-42534TL/1.418-1.773\$ (approx.)	1	3.1		Between 201 and 300 m <sup>2</sup>	7	21.9
	51.040,8TL/2.127\$ (approx.)	9	28.1		301 m <sup>2</sup> and above	6	18.8

\*The US dollar equivalent of the Turkish Lira (TL) is based on the average of the buying and selling dollar exchange rate in 2023 (1TL=\$24).

According to the findings, these clinics are located in the city centre of Kayseri (96.9%), are generally located on busy streets (59.4%), operate on the ground floors of buildings (78.1%), and are mostly tenants (68.8%). In addition, more than half of these clinics (56.3%) have been in service for 2-5 years (Table 1).

An evaluation of the dimensions of the interior spaces of the clinics was made within the scope of this study. According to the findings, veterinary clinics in Kayseri have small areas between 0-5 m<sup>2</sup>. The staff toilets (53.1%), the entrance area/reception (46.9%), the waiting area (43.8%), the kitchen (34.4%) and the animal washing area (28.1%) are generally small. In addition, most of the departments of these clinics have environment sizes between 11-20 m<sup>2</sup>. These departments are operating theatre (46.9%), consultation room (40.6%), veterinarian's room (37.5%), x-ray room (37.5%), vaccination room (37.5%), hospital ward (34.4%), quarantine room (34.4%), on-call veterinarian's room (18.8%), pet products sales department (34.4%), laboratory (28.1%), pet hairdresser (25%) (Fig.1/a).





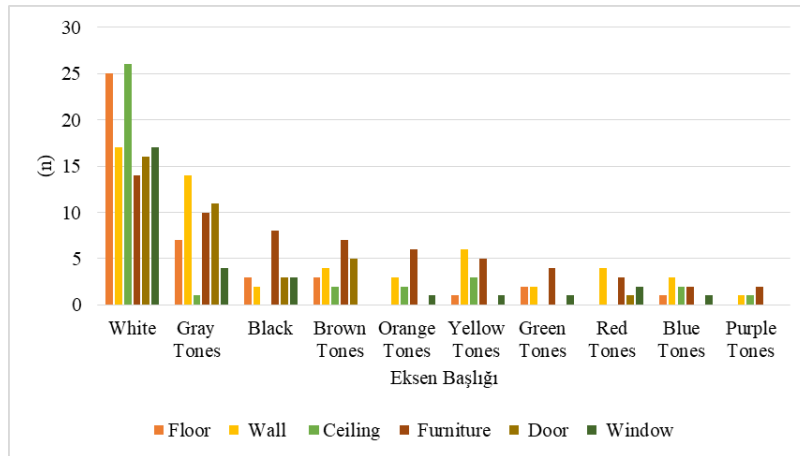
**Figure 1.** a-Sizes of Vet clinic interiors (square meters), b-Furniture and other interior items in the entrance and lobby

### Current design features of the interiors of veterinary clinics

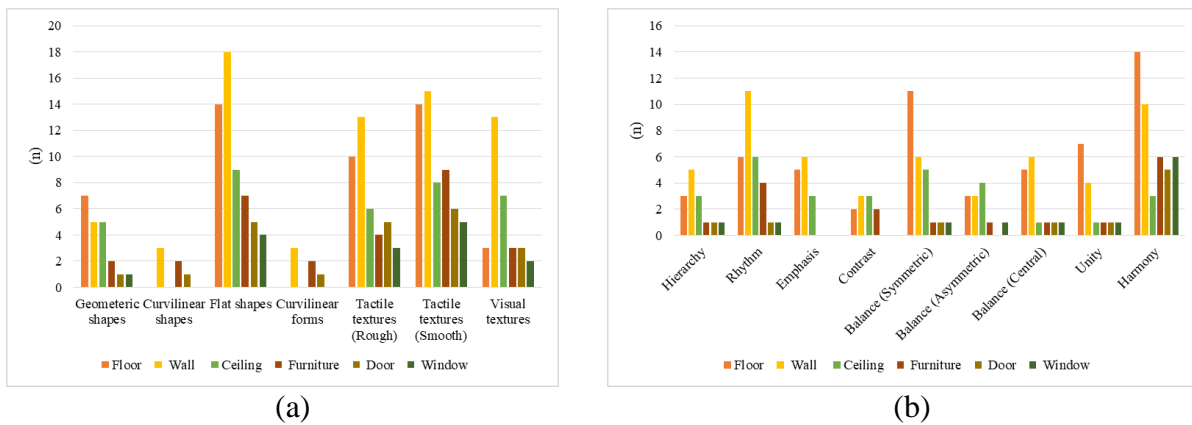
Evaluation of the interior design and furnishing of the entrance and lobby areas:

Entrance and lobby areas are the most free spaces for a designer to work in clinics. Firstly, the location and frequency of furniture and other items in the entrance and lobby interiors of veterinary clinics were investigated and a 5-point Likert scale was developed (1: Never Used, 2: Least Used, 3: Less Used, 4: Frequently Used, 5: Most Frequently Used). According to the findings, the most frequently used elements are Posters (occupational) (58.1%) wall shelf (56.3%) and posters (informative) (50%). the most frequently used furniture are armchairs (43.8%), chairs (37.5%) and large coffee table (25%) (Fig.1/b).

It is also examined how the basic design elements and principles are handled in the creation of interior spaces in veterinary clinics. First of all, the colours used were discussed and the dominant colours in interior elements such as floors, walls, ceilings, doors and windows and furniture were investigated. According to Dong (2014), the dominant colour in an environment, in other words the primary colour, typically accounts for more than 60% of the space. The main colour forms the basis for the correct use of accessory colours and ornamental colours, making it a very important element in interior design (Dong, 2014). According to the findings, it was determined that the main colour in all interior elements and furniture in the clinics was white, followed by grey and its shades (Fig. 2). It was observed that the least preferred colour was pink and the least preferred colour was purple and its shades. According to these findings, it is understood that the entrance sections of the veterinary clinics in Kayseri are decorated in a simple decoration approach with mini seating groups consisting of armchairs, chairs and coffee tables and generally with posters and shelves on the walls.



**Figure 2.** The most preferred colors for the Vet decoration in entrance/lobby



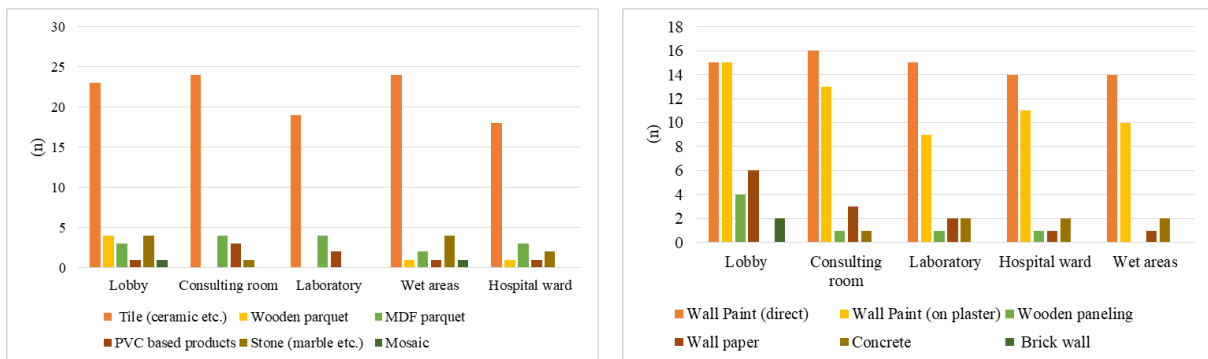
**Figure 3.** a & b-) Presence and use of basic design elements in the entrance and lobbies of clinics

The extent to which the basic design elements are used in the interior of the entrance and lobbies of veterinary clinics was also analysed within the scope of this research. According to the findings, there are mostly tactile but smooth textures and flat shapes on floors, walls, ceilings, doors, windows and furniture. It is understood that the main lines of decoration are formed by adhering to the principle of harmony and symmetrical balance in floor designs; harmony and rhythm in wall designs; harmony and symmetrical balance in ceiling designs; harmony and rhythm in furniture; and harmony in doors and windows. According to the findings here, it is concluded that the clinics are mostly designed in a simple environment with white colour, flat forms, smooth surfaces, floors, walls, ceilings, doors, windows and furniture in harmony with each other (Fig. 3/a and b).

Existing design features of interior elements of veterinary clinics:

In the research, the design features of the existing decorations of the interior elements such as walls, floors and ceilings in the clinics were examined in detail. Firstly, floors were analysed. The most frequently used colours on the floors are white by far (71.9%). White is followed by grey and its shades (25%). Floor coverings such as simple carpets, rugs and the like are generally used (87.5%). The most frequently used flooring material is tile (ceramic etc.)

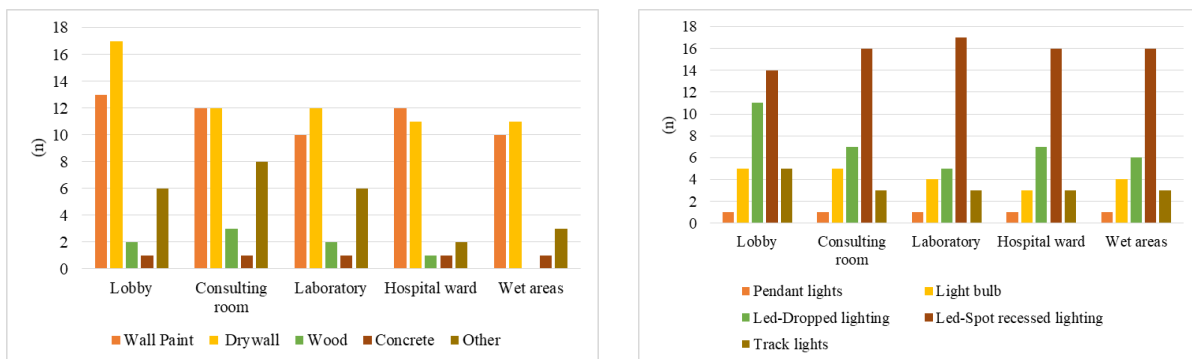
(Fig.4/a). In summary, the floors are covered with white coloured tiles which have advantages in terms of cleanliness and hygiene.



**Figure 4.** a-) Dominant material in clinic floors b-) Dominant material in clinic walls

The most frequently used material types on the clinic walls were also analysed within the scope of the research. While paint application was seen on the walls of almost all of the spaces such as waiting area, consulting room, hospital ward, laboratory and wet areas, brick wall application was found only in the entrance sections of two spaces (Fig.4/b). The most frequently used types of lighting elements on the clinic wall were also investigated. LED lighting is used more frequently among the lighting types. Especially LED spot lighting (65.6%) followed by LED linear (21.9%) lighting types are more common.

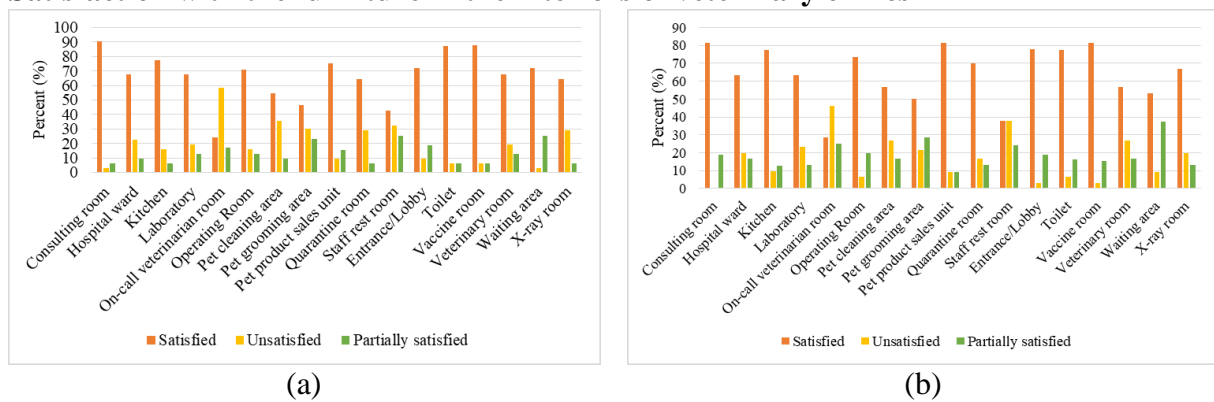
Ceiling paint application is common in ceilings throughout the clinic (59.4%), but suspended ceilings with metal frames (21.9%) and plasterboard (9.4%) are also seen (Fig.5/a). Especially in the ceilings of the entrance and lobby sections, plasterboard wall decoration is more common. While the most common spot lighting model is used on the ceilings, the most commonly used bulb type is LED (84.4%), the most preferred lighting colour is white (100%) and the intensity of the lighting is adjusted so that the spaces are very bright (96.9%) (Fig.5/b). According to the findings, as a result, a simple wall paint application and spot lighting were used on the clinic walls and very bright spaces were created by using economical white LED bulbs. While the ceilings have a simple ceiling paint application, there are more decorative ceiling applications in the entrance and lobby parts.



**Figure5.** a-) Dominant material in clinic ceilings, b-) Dominant lighting types in clinic ceilings

Finally, heating, cooling and ventilation conditions in the clinics were analysed. According to the findings, the clinics are heated by radiator heating system (81.3%) and by using a central heating system (71.9%). To cool the space, district cooling types that can create a solution within the clinic were preferred (59.4%). Generally, air conditioning (51.3%) and natural cooling (37.5%) are used to cool the interiors. Air circulation in clinics is mostly provided by natural ventilation (56.3%). As a result, centralised heating for heating and regional solutions for ventilation and cooling that can be practically implemented within the clinic itself are more prominent in clinics.

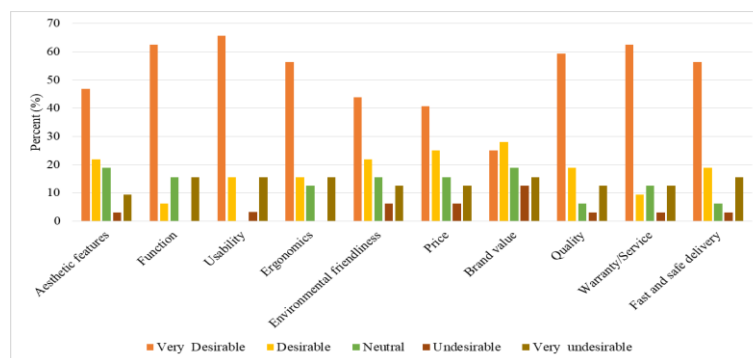
### Satisfaction with the furniture in the interiors of veterinary clinics



**Figure 6.** a-) Satisfaction with the aesthetic qualities of the furniture, b-) Satisfaction with the functional qualities of the furniture

It was investigated how the clinic staff evaluated the aesthetic, functional, ergonomic, quality, durability, durability and healthy and hygienic status of the existing furniture used in the interior spaces of veterinary clinics as a space user. Firstly, the personnel were asked whether they were satisfied with the aesthetic features of the existing furniture used. According to the findings, the most satisfied furniture was located in the consultation room (90.6%), while the least satisfied furniture was located in the on-call veterinarian room (58.6%) (Fig. 6/a). In the study, the personnel were also asked whether they were satisfied with the functional features of the furniture. According to the findings, it was determined that they were satisfied with the furniture in the consultation room, vaccination room and pet products sales unit at the same rate (81.3%). The least functionally dissatisfied furniture was the furniture in the on-call veterinarian room (46.4%) (Fig. 6/b). When the quality of the furniture in the clinic was evaluated, it was observed that most of the patients were satisfied with the furniture in the pet products sales unit (84.4%) and the consultation room (80.6%). The furniture that was not satisfied in terms of quality was in the on-call physician room (33.3%). The durability of the existing furniture in the clinic was also analysed. According to the findings, as a user, the clinic staff reported that the furniture in the lobby (84.4%), pet products sales unit (84.4%), vaccination room (84.4%) and consultation room (84.4%) were equally durable. In addition, it was determined that the furniture in the on-call physician room (34.5%) and staff rest room (26.7%) were not satisfied in terms of durability. While the users were satisfied with the ergonomics of the furniture in the consultation room (81.3%), vaccination room (81.3%) and toilet (81.3%), they were not

satisfied with the ergonomics of the furniture in the on-call physician room (39.3%) and staff rest room (35.7%). Finally, the study investigated whether the users in the clinic were satisfied with the healthy and hygienic properties of the existing furniture as a space user. While the users were satisfied with the healthy and hygienic aspects of the consultation room (93.8%), pet products sales unit (87.5%), vaccination room (87.5%), they were not satisfied with the furniture in the on-call physician room (27.6%) and staff rest room (23.3%). According to the results obtained from the findings; it was determined that the best conditioned place in terms of aesthetic, functional, ergonomics, quality, durability, healthy and hygienic properties of the existing furniture in the interior spaces of veterinary clinics was the consultation room in general, while the worst conditioned place was the on-call physician room. In the research, it is investigated how clinic owners imagine an ideal clinic interior design without any budget problems. In this context, the focus of this chapter is on what the owners, as a user, would consider when choosing furniture and accessories for their clinics. Participants were presented with options such as aesthetic features, function, usefulness, ergonomics, environmental friendliness, price, brand value, quality, warranty/service, fast and safe delivery when purchasing furniture and accessories. When choosing furniture and accessories, it was investigated which features in these options they were more influenced by and wanted more, and which ones they wanted less (Fig. 7). A 5-point Likert scale was developed for this research (1: Most Desirable, 2: Desirable, 3: Neutral, 4: Undesirable, 5: Least Desirable). According to the findings, the first three features that clinic owners want in purchasing are usefulness (65.6%), function (62.5%) and warranty/service (62.5%). The least desired feature is brand value (25%). In the results obtained from the findings, even if there is a sufficient spending budget, clinic owners, as a consumer, tend to purchase products that are primarily useful and then fully fulfil their functions when choosing furniture and accessories. In addition, it is also very important for these individuals that the product they buy has a guarantee and a good service. For these consumers with a utilitarian attitude, the brand value of the product is the last feature they are interested in.



**Figure 7.** Factors to consider when purchasing furniture and accessories

## Conclusion and Recommendations

The results obtained from this study are as listed below:

- It is understood that the entrance sections of the veterinary clinics in Kayseri are designed in a utilitarian, plain and simple decoration approach with mini seating groups

consisting of armchairs, chairs and coffee tables and generally with posters and shelves on the walls. In this context, interior designers should emphasise customer and animal welfare, practicality and sanitation while designing decoration for veterinary clinics. By choosing a minimalist style, a clean, spacious and tidy atmosphere can be provided in the interior. Ergonomic, durable, easy-to-clean and comfortable furniture should be preferred and furniture should be placed in a way to support the functionality of the space.

- It has been determined that the clinics are mostly designed in a simple environment with white colour, flat form, smooth surfaces, floors, walls, ceilings, doors, windows and furniture in harmony with each other. Interior designers can create a hygienic and spacious environment by choosing white and smooth surfaces with flat forms for clinics. They can add natural wood textures and soft lighting to make this environment more inviting. In terms of furniture, they can maintain the minimalism of the space by prioritising comfort and functionality.
- As a result of the research, it is understood that veterinary clinics have simple interiors with walls and ceilings decorated with paint and supported by economical white LED lighting. However, there are more aesthetic ceiling designs in the entrance and lobbies. Interior designers can provide a clean and healthy environment by using quality paints with hygienic and durable, anti-bacterial properties on the clinic walls. In particular, they can use antibacterial paint alternatives containing low VOC (volatile organic compounds) to promote sustainability and ecological balance. In ceiling applications, different aesthetic solutions can be brought to ceiling designs with decorative, functional, long-lasting and easy-to-clean materials.
- In veterinary clinics, consultation room furniture has the most ideal conditions in terms of aesthetic, functional, ergonomic, quality, durability and hygiene features, while the on-call physician room and staff room have the lowest conditions. Designers should ensure that the rooms have a standardised level of comfort and hygiene by adding ergonomic, durable and easy-to-clean furniture with similar conditions for all clinic staff rooms in interior design. In addition, storage and resting areas can be optimised with functional arrangements. Thus, it can contribute to increasing employee motivation and work efficiency.
- This research revealed that clinic owners prioritize functionality and usefulness in their furniture and accessory choices, even if they have sufficient budget. Product warranties and quality service are critical considerations for these consumers, while brand value is of minimal interest. Designers understand that clinic owners prioritize functionality and longevity and prefer products with warranties and good service over brand value. Designers can guide such customers in their choice of furniture and accessories to products with high durability and functionality, longevity, and a reliable warranty and service. This will help clinic owners ensure that the investment is protected in the long term by meeting their needs.

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# RECOVERY PROCESS OF THE PHENOLIC-RICH EXTRACT FROM BEETROOT (*Beta vulgaris* L.) POWDER: AN OPTIMIZATION STUDY

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## Abstract

This study aims to investigate the extraction process of antioxidative phenolic components from beetroot (*Beta vulgaris* L.) powder, and to present the best extraction conditions to achieve the highest yield. Since beetroot was proposed as a strong antioxidant source in earlier studies (Guine et al., 2018; Kaur et al., 2021; Tumbas Šaponjac et al., 2016), its powder has been used as raw material in the present study. Homogenizer-assisted extraction (HAE) has been used for obtaining the target extract for the first time. Aqueous ethanol (80%, v/v) was used as solvent to propose a relatively green extraction method. Response surface method (RSM) was adopted to model and optimize the HAE process. Box-Behnken design was selected through RSM. HAE parameters were solid mass (0.1-0.5 g), time (60-90 sec), and speed of the homogenizer (7000-10000 rpm), while total phenolic content (TPC) was the dependent variable. The highest yield was 8.961 mg-GAE (gallic acid equivalence) per g dried powder under the optimum conditions (0.1 g powder, 60 sec and 9500 rpm) depending on the RSM results. The verification study was also hold to approve the predicted condition with satisfactory findings (the error was less than 1%). The extract samples were also tested in terms of antioxidant activity assays. DPPH (2,2-diphenyl-1-picrylhydrazyl) and ABTS (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonate)) methods were used to present reliable findings. The samples measured with both DPPH and ABTS methods gave results that were highly consistent with each other ( $r>0.92$ ).

**Keywords:** Antioxidant activity; DPPH; ABTS; bioactive ingredients; Box-Behnken design.



## Introduction

Beetroot (*Beta vulgaris* L.) was introduced as a strong antioxidant source in many studies (Guine et al., 2018; Kaur et al., 2021; Tumbas Šaponjac et al., 2016). Its antioxidant power was attributed to its phenolic compounds such as ferulic acid, protocatechuic acid, vanillic acid, p-coumaric acid, p-hydroxybenzoic acid and syringic acid (Kujala et al., 2000). Therefore, it is significant to extract the related phenolic-rich substance from the concerned raw material. In this situation, solid-liquid extraction process must be applied to recover the bioactive material from the solid matrix. Nowadays, there is a trend towards green extraction methods due to their advantages (reduction in time, energy and chemicals) over the conventional methods (Chemat et al., 2019). So, homogenizer-assisted extraction (HAE) as an environmentally friendly method has been adopted in this study. HAE system was reported to be successful in previous studies on the bioactive extraction from several biomass (Eyiz et al., 2020; Márquez et al., 2022; Pereira et al., 2017).

Total phenolic content (TPC) was selected as the response (dependent) variable in this system, while solid mass, extraction time and speed were determined as independent variables. 3-factor 3-level Box-Behnken design of response surface method (RSM) was used in order to model and to optimize the HAE system for the maximum TPC yield. The extracts were also analyzed in terms of antioxidant activity. DPPH and ABTS free radical scavenging activity tests were applied, respectively. The correlation between the 2 test results was also calculated.

## Materials and Methods

### Materials

Dried and ground beetroot powder was purchased from a herbalist shop. Chemical materials were all from Sigma-Aldrich (St. Louis, MO, USA).

### Extraction

HAE was performed by a digital homogenizer (IKA T25 ULTRA TURRAX, Staufen, Germany). HAE conditions are given in Table 1. The solvent of the system was 80% ethanol (v/v).

**Table 1.** Process parameters, units, symbol, and coded levels.

Process Parameter	Units	Symbol	Coded levels		
			-1	0	1
Solid mass	(g)	A	0.1	0.3	0.5
Extraction time	sec	B	60	75	90
Speed	rpm	C	7000	8500	10000

### Spectrophotometric analysis

In this study, 3 spectrophotometric methods were utilized for the determination of the bioactive properties such as TPC and antioxidant activity. TPC was determined under 765 nm by following the Folin-Ciocalteu method, while DPPH and ABTS test results were identified under 517 nm and 734 nm, respectively. The detailed information about the test methods was presented in our previous study (Şahin et al., 2021).

### Box-Behnken design

3-factor 3-level Box-Behnken design was applied by Design-Expert 12 software (Stat-Ease Inc., USA). As seen in Table 2, 17 runs were produced by this design. Analysis of variance test (ANOVA) through the Design-Expert software was used to identify the fit statistics such as F-values, p-values,  $R^2$ , adjusted  $R^2$  and predicted  $R^2$ , lack of fit and coefficient of variance (C.V.).

### Findings and Discussion

Table 2 gives the experimental findings of the HAE system for the extraction of TPC rich extract from beetroot powder. TPC yields were between  $3.815 \pm 0.001$  mg-GAE/g-DM and  $8.957 \pm 0.001$  mg-GAE/g-DM. Kumar et al. reported similar TPC values (4.05 mg-GAE/g-DM-8.31 mg-GAE/g-DM) by using citric acid and aqueous ethanol through ultrasound-assisted extraction (Kumar et al., 2023). Furthermore, our findings seem superior over those of Lazăr et al. (1.64 mg-GAE/g-DM-2.74 mg-GAE/g-DM), where acidified aqueous ethanol was used with an orbital shaker (Lazăr et al., 2021).

**Table 2.** Process parameters and experimental results for the total phenolic content.

Run	A: Solid mass (g)	B: Extraction time (sec)	C: Speed (rpm)	TPC (mg-GAE/g-DM)
1	0.3	90	10000	$5.057 \pm 0.003$
2	0.3	75	8500	$4.914 \pm 0.000$
3	0.5	75	10000	$4.363 \pm 0.002$
4	0.3	90	7000	$5.057 \pm 0.003$
5	0.1	90	8500	$8.743 \pm 0.000$
6	0.3	60	7000	$4.914 \pm 0.000$
7	0.3	75	8500	$4.629 \pm 0.004$
8	0.5	90	8500	$4.361 \pm 0.001$
9	0.3	75	8500	$4.986 \pm 0.002$
10	0.1	75	7000	$8.743 \pm 0.000$
11	0.3	75	8500	$5.129 \pm 0.001$
12	0.1	60	8500	$8.957 \pm 0.001$
13	0.5	75	7000	$3.891 \pm 0.004$
14	0.5	60	8500	$3.815 \pm 0.001$
15	0.1	75	10000	$8.957 \pm 0.002$
16	0.3	75	8500	$5.129 \pm 0.002$
17	0.3	60	10000	$4.894 \pm 0.000$

Abbreviations: DM, dried matter; GAE, equivalents of gallic acid; TPC, total phenolic content

\* Each value is the mean $\pm$ standard deviation of three replicate analyses.

#### Model fitting

The second-order model equation in terms of coded factors was generated as given in Equation 1. This might be applied to estimate about the response for given levels of each factor.

$$Y_{\text{TPC}} = 4.96 - 2.37 A + 0.0797 B + 0.0832 C + 0.1901AB + 0.0643 AC + 0.0051 BC + 1.51 A^2 + 0.0020 B^2 + 0.0215 C^2 \quad (1)$$

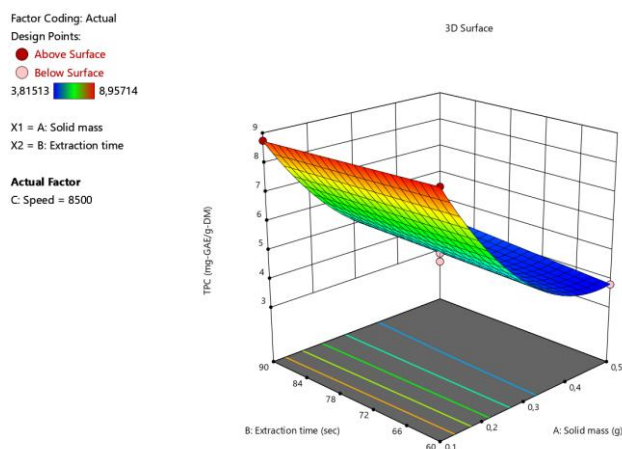
Table 3 is ANOVA for the quadratic model. The model was found significant at  $p < 0.0001$ . additionally, non-significant lack of fit value,  $R^2 (>0.99)$ , Adjusted  $R^2 (>0.99)$ , Predicted  $R^2 (>0.97)$ , and C.V. ( $<10\%$ ) demonstrate that the second-order model is reliable.

**Table 3.** ANOVA for quadratic model.

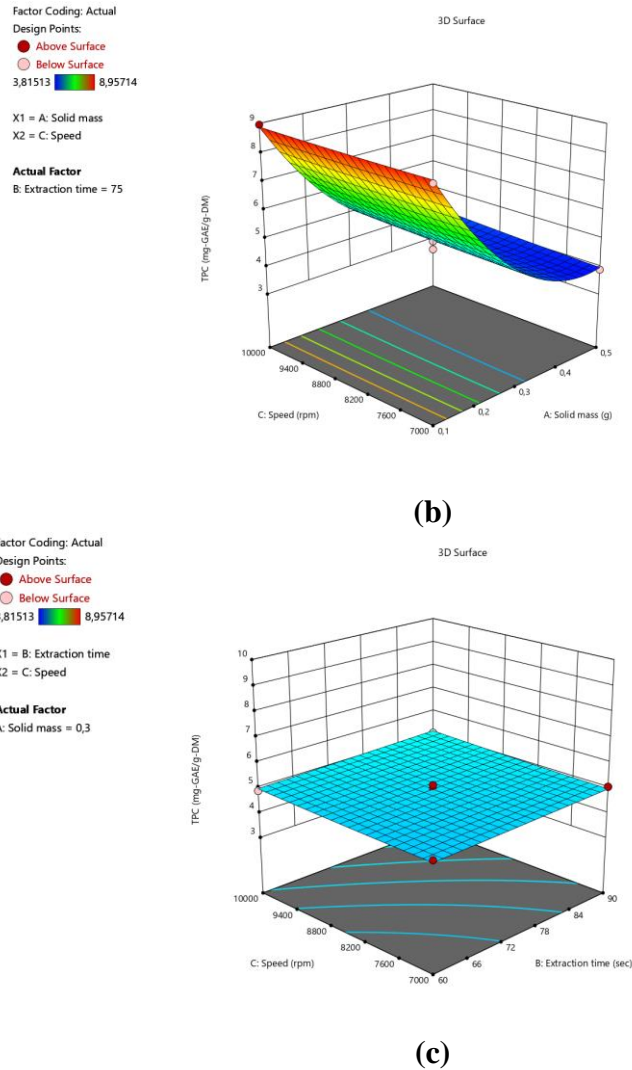
Source	Sum of Squares	df	Mean Square	F-value	p-value	
<b>Model</b>	54.92	9	6.10	183.70	< 0.0001	significant
A-Solid mass	44.98	1	44.98	1354.02	< 0.0001	
B- Extraction time	0.0509	1	0.0509	1.53	0.2558	
C-Speed	0.0554	1	0.0554	1.67	0.2378	
AB	0.1446	1	0.1446	4.35	0.0754	
AC	0.0165	1	0.0165	0.4976	0.5033	
BC	0.0001	1	0.0001	0.0031	0.9572	
A <sup>2</sup>	9.60	1	9.60	288.99	< 0.0001	
B <sup>2</sup>	0.0000	1	0.0000	0.0005	0.9825	
C <sup>2</sup>	0.0019	1	0.0019	0.0585	0.8159	
<b>Residual</b>	0.2325	7	0.0332			not significant
Lack of Fit	0.0631	3	0.0210	0.4970	0.7039	
Pure Error	0.1694	4	0.0423			
<b>Cor Total</b>	55.15	16				
C.V.: 3.21%	R <sup>2</sup> =0.9958	Adjusted R <sup>2</sup> =0.9904	Predicted R <sup>2</sup> =0.9769			

ANOVA table (Table 3) also enables the determinations of the process parameters, their second powers and their interactions. The most effective process parameter seems solid mass with the highest F-value at  $p < 0.0001$ . This was followed by the second power of solid mass at  $p < 0.0001$ . Effects of process parameters

3 dimensional response surface plots (3Ds) are also produced by the Design-Expert software. These figures are very valuable to comprehend the effects of the parameters. Figure 1 is the 3Ds of the HAE system. Figure 1a shows the effects of solid amount and time on the TPC yield. Increasing the solid mass decreased the yield regularly. This result is in good agreement with the mass transport principles. The solvent amount is stable while the solid material rises. So, more solvent is required to be able to diffusion of the solvent into the plant matrix. Otherwise, it cannot break down the cell walls of the matrix since the solvent present is not sufficient to extract the target components (Moreira et al., 2020). As seen in Figures 1a, 1b and 1c, the time and speed are not influential on the HAE system. This observation can be also verified by ANOVA (Table 3), where these 2 parameters were not found statistically effective ( $p > 0.05$ ).



(a)



**Figure 1.** Effects of solid mass and extraction time (a), solid mass and speed on the (b), and extraction time and speed (c) on the total phenolic content of beetroot powder (*Beta vulgaris* L.).

### Optimization and validation

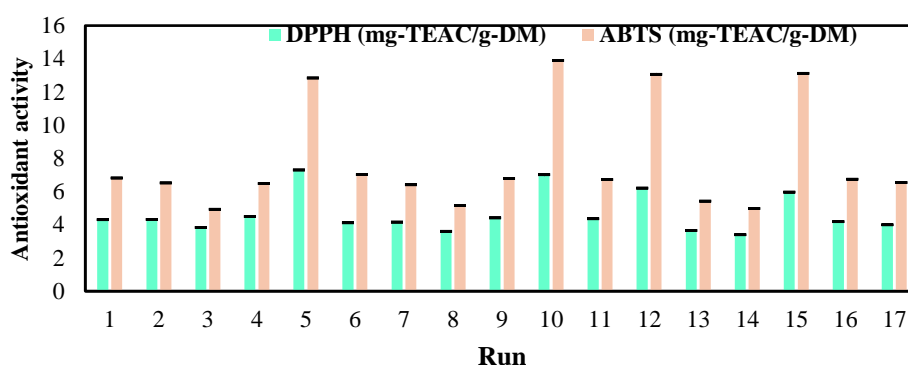
Table 4 shows the optimum conditions for the maximum TPC in the beetroot powder extract. The verification study under the given conditions were also performed. The difference between the actual data and the predicted data was extremely convincing (<1%).

**Table 4.** Optimum HAE conditions for the highest total phenolic content and validation of the conditions.

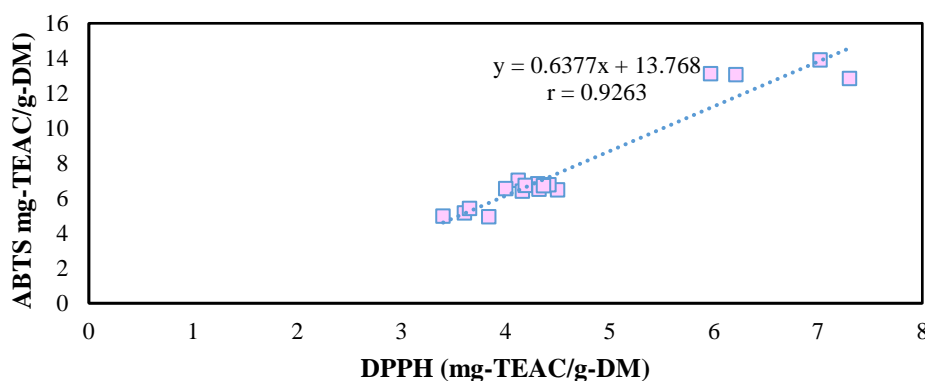
Optimum conditions			Response	Predicted	Experimental	Error (%)
A (g)	B (sec)	C (rpm)				
0.1	60	9538	TPC (mg-GAE/g-DM)	8.961	8.857	0.59

## Antioxidant activity

Figure 2 shows the antioxidant activity test results of the extracts obtained at the given conditions (Table 2) according to DPPH and ABTS methods. Antioxidant activity of the samples changed between  $3.400 \pm 0.004$  mg-TEAC/g-DM and  $7.303 \pm 0.001$  mg-TEAC/g-DM in case of DPPH method, while ABTS test results varied from  $4.936 \pm 0.004$  mg-TEAC/g-DM to  $13.122 \pm 0.005$  mg-TEAC/g-DM. The correlations between the TPC and antioxidant activity values were both higher than 0.92. This means that phenolic substance is the responsible for the antioxidant activity of the beetroot powder extract. Furthermore, the correlation between the DPPH data and ABTS data ( $r=0.9263$ ) also points out that the antioxidant activity findings are confident (Figure 3).



**Figure 2.** Antioxidant activity of the beetroot powder extract measured by 2 tests (DPPH and ABTS).



**Figure 3.** The relationship between the DPPH data and the ABTS data.

## Conclusion and Recommendations

This study has developed a green extraction method for the recovery of phenolic antioxidants from dried and ground beetroot powder. The proposed method for the optimum conditions to achieve the best total phenolic content ( $8.961$  mg-GAE/g-DM) is calculated as  $0.1$  g powder,

60 sec of extraction time and 9500 rpm of homogenizing speed. The modelling study also gave satisfactory results depending on the statistical indicators (p-value, lack of fit value, coefficients of determination and coefficient of variance). The most effective parameter of the system was determined to be the beetroot powder amount at  $p < 0.0001$ . Antioxidant activity of the beetroot powder extract was also approved by the results of 2 antioxidant activity assays. Individual phenolic compounds should be measured chromatographically in the future studies in order to establish a more reliable relationship between the major compounds and bioactive properties.

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## MULTI-RESPONSE OPTIMIZATION OF ULTRASOUND-ASSISTED EXTRACTION FOR THE BIOACTIVES IN *Ocimum basilicum* L.

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### **Abstract**

In the present study, dried and ground purple basil (*Ocimum basilicum* L.) was subjected to ultrasound-assisted extraction (UAE) to obtain phenolic-rich extract. For this purpose, 50% (v/v) ethanol was used depending on our earlier findings (Toprakçı Yüksel & Şahin Sevgili, 2024). Purple basil extract indicated many health benefits such as antioxidant, anti-inflammatory, anticarcinogenic, anti-hyperglycemic and neuroprotective activities (Altemimi et al., 2020; Özkan Karabacak et al., 2021). Therefore, it was unavoidable to investigate this source in terms of bioactive properties. The system was designed by Box-Behnken design through Response Surface Methodology (RSM). The responses were selected as total phenolic content (TPC), antioxidant activity measured by DPPH (2,2-diphenyl-1-picrylhydrazyl) test and antioxidant activity measured by ABTS (2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonate)) test. The independent variables of the UAE process was determined as amplitude of the ultrasound (10-40%), solid mass (0.1-0.5 g) and treatment time (10-20 min) depending on the preliminary experiments. TPC levels in the samples changed between 44.906 mg-GAE (gallic acid equivalence (GAE)/g-DM (dried matter) and 68.743 mg-GAE/g-DM. Antioxidant activity values measured by DPPH varied from 13.636 mg-TEAC (trolox equivalence)/g-DM to 69.511 mg-TEAC/g-DM, while antioxidant activity values measured by ABTS were between 16.036 mg-TEAC/g-DM and 69.344 mg-TEAC/g-DM. So, the two antioxidant test results were in good agreement considering the very convincing correlation ( $r>0.99$ ) between them.

**Keywords:** Sonication; natural antioxidants; multivariate optimization; RSM

## Introduction

Ultrasound-assisted extraction (UAE) was introduced as a novel technology by integrating the ultrasound treatment into the system in order to achieve higher yields with less energy, time and chemical consumptions at atmospheric pressures (Tiwari, 2015). Therefore, it was unavoidable to apply this technology to extract sensitive active substances from various plant matrix (Medina-Torres et al., 2017). In this case, we used UAE to extract phenolic antioxidants from purple basil (*Ocimum basilicum* L.) in the present study. Due to its phenolic substance, purple basil was reported to possess antioxidant, anti-inflammatory, anticarcinogenic, anti-hyperglycemic and neuroprotective effects (Altemimi et al., 2020; Özkan Karabacak et al., 2021).

On the other hand, Response Surface Methodology (RSM) is a method to optimize process parameters for the best yield. In this study, Box-Behnken design as a sub-type of RSM was used to produce a design matrix for the experimental study. After the experimental data was produced, the UAE system was modelled and optimized in order to generate the maximum total phenolic content (TPC) and antioxidant activity values measured by 2 different tests (DPPH and ABTS methods). So, the current system owns a multi-response optimization with 3 dependent variables (responses). Input variables of the UAE system were amplitude of the ultrasound, solid mass and extraction time with 3 levels.

## Materials and Methods

Figure 1 summarizes the experimental work. The dried sample was provided from a herbalist shop. As described earlier, 50% ethanol (v/v) was used as solvent based on the previous study (Toprakçı Yüksel & Şahin Sevgili, 2024).



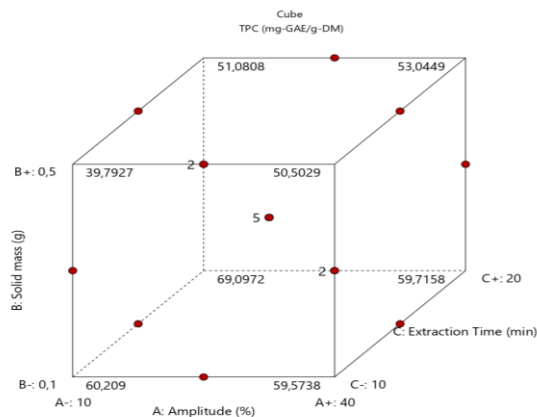
**Figure 1.** Experimental setup

Table 1 shows the UAE conditions performed by a system with a probe (VCX 750; Sonics and Materials Inc., Newtown, USA).

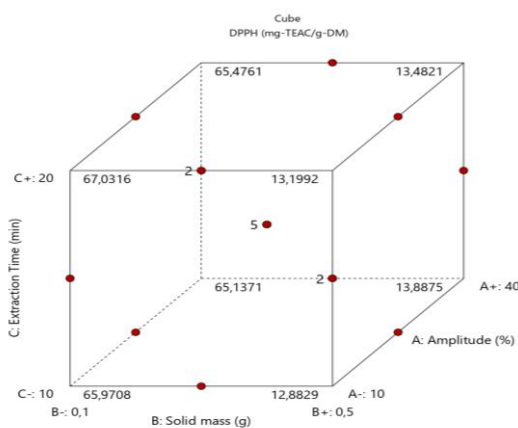
**Table 1.** Process parameters, units, symbol, and coded levels.

Process Parameter	Units	Symbol	Coded levels		
			-1	0	1
Amplitude	%	A	10	25	40
Solid mass	g	B	0.1	0.3	0.5
Extraction time	min	C	10	15	20

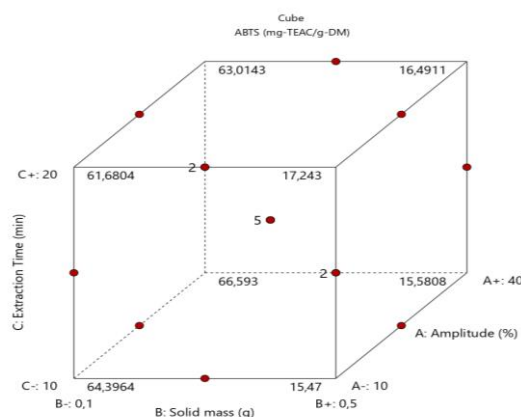
Bioactive properties of the purple basil extracts were measured by in vitro tests. TPC was determined by application of Folin-Ciocalteu method with some modifications as described earlier (Şahin et al., 2021). In terms of antioxidant activity, DPPH and ABTS free radical scavenging activity assays were utilized as described earlier (Şahin, 2015). For the statistical experimental design (RSM), Design-Expert software (12.0.1.0 version, StatEase Inc., USA) was used. Box-Behnken design was selected through 3 factors and 3 levels. Figure 2 demonstrate Box-Behnken design cubes for 3 responses ( $Y_{TPC}$ ,  $Y_{DPPH}$ , and  $Y_{ABTS}$ ).



(a)



(b)



(c)

**Figure 2.** Box-Behnken design cube for (a) total phenolic content, (b) DPPH free radical-scavenging activity, and (c) ABTS free radical-scavenging activity.

## Findings and Discussion

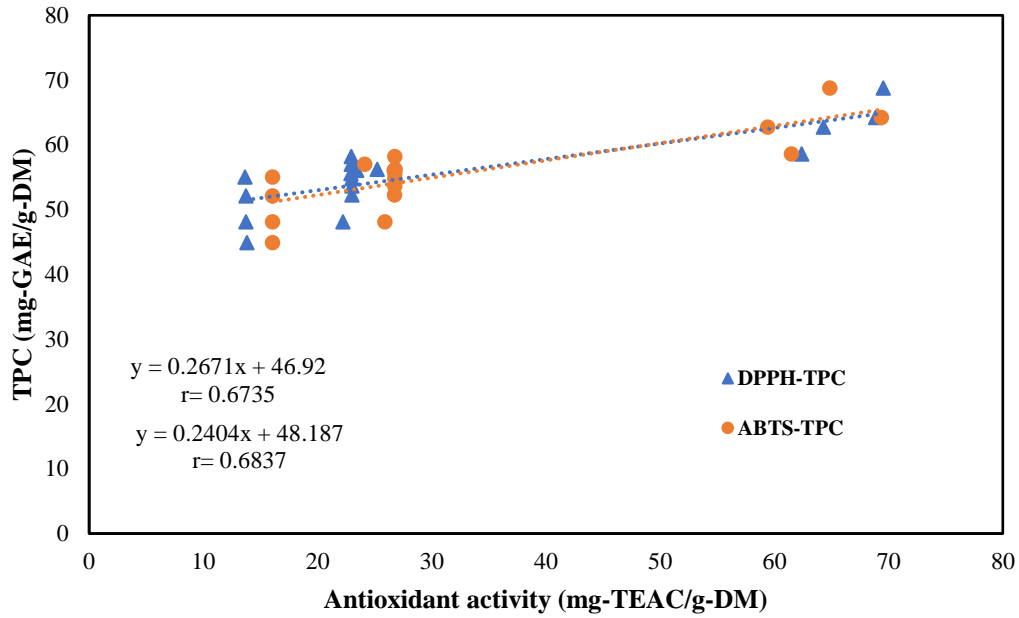
### Bioactive properties

Box-Behnken design generated 17 experimental runs as seen in Table 2. The maximum TPC, DPPH free radical-scavenging activity, and ABTS free radical-scavenging activity values were  $68.743 \pm 0.004$  mg-GAE/g-DM,  $69.511 \pm 0.001$  mg-TEAC/g-DM, and  $64.844 \pm 0.004$  mg-TEAC/g-DM, respectively. In case of minimum values, TPC, DPPH free radical-scavenging activity, and ABTS free radical-scavenging activity values were observed as  $44.906 \pm 0.004$  mg-GAE/g-DM,  $13.636 \pm 0.000$  mg-TEAC/g-DM, and  $16.036 \pm 0.000$  mg-TEAC/g-DM, respectively. There was a satisfactory correlation between the TPC and antioxidant values as seen in Figure 3. So, phenolic substance play a significant role in the antioxidant activity. On the other hand, the correlation between the DPPH free radical-scavenging activity and ABTS free radical-scavenging activity values is also remarkable as seen in Figure 4. The r value is so close to 1, which points out that the 2 data sets are in perfect agreement with each other. In addition, the fact that both are in harmony with each other confirms the reliability of antioxidant activity values.

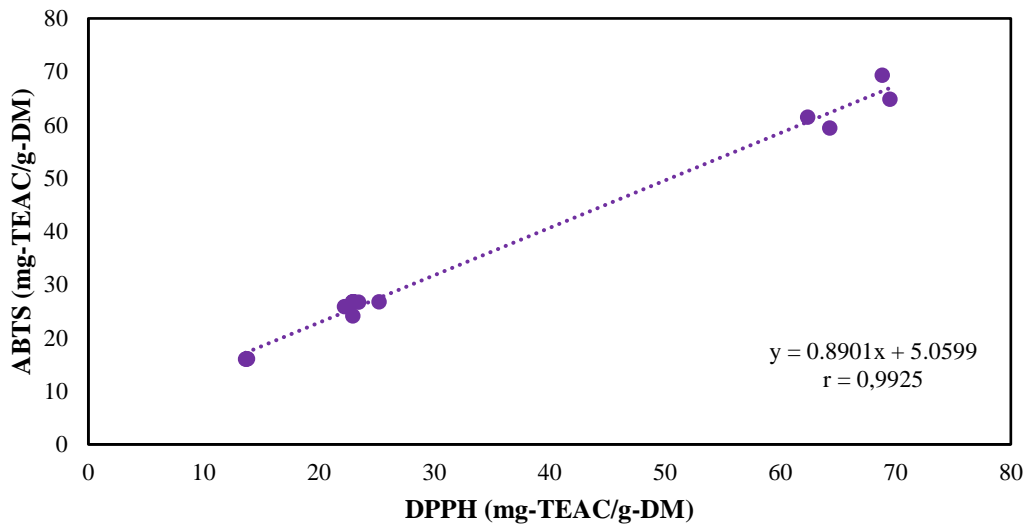
**Table 2.** Process parameters and experimental results for the TPC and antioxidant activity.

Run	A: Amplitude (%)	B: Solid mass (g)	C: Extraction Time (min)	TPC (mg-GAE/g-DM)	DPPH (mg-TEAC/g-DM)	ABTS (mg-TEAC/g-DM)
1	40	0.1	15	58.597 ± 0.001	62.384 ± 0.000	61.475 ± 0.001
2	10	0.3	10	48.097 ± 0.005	22.208 ± 0.001	25.882 ± 0.001
3	40	0.3	10	52.271 ± 0.002	23.004 ± 0.001	26.726 ± 0.000
4	10	0.3	20	58.200 ± 0.003	22.930 ± 0.001	26.763 ± 0.000
5	25	0.5	20	55.020 ± 0.001	13.636 ± 0.000	16.036 ± 0.000
6	25	0.3	15	54.771 ± 0.003	22.985 ± 0.000	26.763 ± 0.000
7	25	0.3	15	56.986 ± 0.002	22.930 ± 0.001	24.115 ± 0.000
8	40	0.3	20	53.629 ± 0.003	23.004 ± 0.001	26.744 ± 0.001
9	25	0.1	10	64.243 ± 0.001	68.844 ± 0.000	69.344 ± 0.003
10	25	0.3	15	55.557 ± 0.005	22.911 ± 0.000	26.744 ± 0.001
11	10	0.1	15	62.743 ± 0.001	64.289 ± 0.004	59.400 ± 0.003
12	10	0.5	15	44.906 ± 0.004	13.791 ± 0.000	16.047 ± 0.001
13	25	0.1	20	68.743 ± 0.004	69.511 ± 0.001	64.844 ± 0.004
14	25	0.3	15	56.200 ± 0.006	25.207 ± 0.001	26.781 ± 0.000
15	40	0.5	15	52.106 ± 0.003	13.724 ± 0.001	16.036 ± 0.000
16	25	0.3	15	56.057 ± 0.001	23.430 ± 0.001	26.689 ± 0.001
17	25	0.5	10	48.120 ± 0.000	13.713 ± 0.001	16.047 ± 0.001

Abbreviations: DM, dried matter; GAE, equivalents of gallic acid; TEAC, trolox equivalent; TPC, total phenolic content; AA, antioxidant activity. \* Data are given as the mean (n=3) ± standard deviation.



**Figure 3.** The relationship between the total phenolic content and DPPH free radical-scavenging activity/ABTS free radical-scavenging activity.



**Figure 4.** The relationship between the DPPH free radical-scavenging activity and the ABTS free radical-scavenging activity.

### Box-Behnken design study

Based on the given data in Table 2, three quadratic models were produced as given in Equations 1-3:

$$Y_{TPC} = 55.91 + 0.3322 A - 6.77 B + 2.86 C + 2.84 AB - 2.19 AC + 0.6000 BC - 3.65 A^2 + 2.33 B^2 + 0.7892 C^2 \quad (1)$$

$$Y_{DPPH} = 23.49 - 0.1377 A - 26.27 B + 0.1638 C + 0.4596 AB - 0.1804 AC - 0.1861 BC - 1.79 A^2 + 16.85 B^2 + 1.09 C^2 \quad (2)$$

$$Y_{ABTS} = 26.22 + 0.3612 A - 23.86 B - 0.4514 C - 0.5215 AB - 0.2157 AC + 1.12 BC - 1.51 A^2 + 13.53 B^2 + 1.82 C^2 \quad (3)$$

The analysis of variance (ANOVA) test for the given models is presented by Table 3. ANOVA was used to identify the fit statistics such as F-values, p-values,  $R^2$ , adjusted  $R^2$  and predicted  $R^2$ , lack of fit and coefficient of variance (C.V.). The fit statistics demonstrate that the 3 models are adequate for the estimation depending on the  $p < 0.0001$ , non-significant lack of fit value ( $p > 0.05$ ),  $R^2 (> 0.98)$ , Adjusted  $R^2 (> 0.96)$ , Predicted  $R^2 (> 0.84)$ , and C.V. ( $< 10\%$ ). Moreover, the amount of the dried and ground purple basil was found the most effective parameters based on the highest F-value at  $p < 0.0001$  for the 3 responses.

**Table 3.** Analysis of variance findings on total phenolic content and antioxidant activity (DPPH free radical scavenging activity and ABTS free radical scavenging activity), respectively

	Source	Sum of Squares	df	Mean Square	F-value	p-value	
TPC	<b>Model</b>	563.46	9	62.61	54.94	< 0.0001	significant
	A-Amplitude	0.8830	1	0.8830	0.7748	0.4079	
	B-Solid mass	366.86	1	366.86	321.90	< 0.0001	
	C-Extraction time	65.32	1	65.32	57.32	0.0001	
	AB	32.18	1	32.18	28.24	0.0011	
	AC	19.12	1	19.12	16.78	0.0046	
	BC	1.44	1	1.44	1.26	0.2980	
	A <sup>2</sup>	56.23	1	56.23	49.34	0.0002	
	B <sup>2</sup>	22.82	1	22.82	20.02	0.0029	
	C <sup>2</sup>	2.62	1	2.62	2.30	0.1731	
	<b>Residual</b>	7.98	7	1.14			
	Lack of Fit	5.29	3	1.76	2.63	0.1866	not significant
	Pure Error	2.68	4	0.6709			
	<b>Cor Total</b>	571.44	16				
C.V.: 1.92%		R <sup>2</sup> =0.9860		Adjusted R <sup>2</sup> =0.9681		Predicted R <sup>2</sup> =0.8444	
DPPH	<b>Model</b>	6736.77	9	748.53	233.71	< 0.0001	significant
	A-Amplitude	0.1518	1	0.1518	0.0474	0.8339	
	B-Solid mass	5521.10	1	5521.10	1723.81	< 0.0001	
	C-Extraction time	0.2147	1	0.2147	0.0670	0.8031	
	AB	0.8449	1	0.8449	0.2638	0.6233	
	AC	0.1302	1	0.1302	0.0407	0.8459	
	BC	0.1385	1	0.1385	0.0433	0.8412	
	A <sup>2</sup>	13.53	1	13.53	4.22	0.0789	
	B <sup>2</sup>	1195.06	1	1195.06	373.13	< 0.0001	
	C <sup>2</sup>	4.97	1	4.97	1.55	0.2530	
	<b>Residual</b>	22.42	7	3.20			
	Lack of Fit	18.56	3	6.19	6.42	0.0522	not significant
	Pure Error	3.86	4	0.9643			
	<b>Cor Total</b>	6759.19	16				
C.V.: 5.76%		R <sup>2</sup> =0.9967		Adjusted R <sup>2</sup> =0.9924		Predicted R <sup>2</sup> =0.9552	
ABTS	<b>Model</b>	5363.95	9	595.99	132.25	< 0.0001	significant
	A-Amplitude	1.04	1	1.04	0.2316	0.6451	
	B-Solid mass	4555.31	1	4555.31	1010.81	< 0.0001	
	C-Extraction time	1.63	1	1.63	0.3617	0.5665	
	AB	1.09	1	1.09	0.2414	0.6383	
	AC	0.1861	1	0.1861	0.0413	0.8448	
	BC	5.04	1	5.04	1.12	0.3255	
	A <sup>2</sup>	9.59	1	9.59	2.13	0.1880	
	B <sup>2</sup>	770.77	1	770.77	171.03	< 0.0001	
	C <sup>2</sup>	13.94	1	13.94	3.09	0.1221	
	<b>Residual</b>	31.55	7	4.51			
	Lack of Fit	26.01	3	8.67	6.26	0.0543	not significant
	Pure Error	5.54	4	1.38			
	<b>Cor Total</b>	5395.49	16				
C.V.: 6.49%		R <sup>2</sup> =0.9942		Adjusted R <sup>2</sup> =0.9866		Predicted R <sup>2</sup> =0.9213	

### Response surface plots

3 dimensional plots were drawn by the Design-Expert program as seen in Figures 5, 6 and 7. It is easy to understand the impacts of the process parameters by means of these plots. Figure 5 shows the effects of amplitude and solid mass on the TPC, DPPH free radical-scavenging activity, and ABTS free radical-scavenging activity, respectively.

As described above, the 3 dependent variables were found in compatible with each other based on the r values. We can see this finding in Figures 5a, 5b and 5c. All of them decreased by

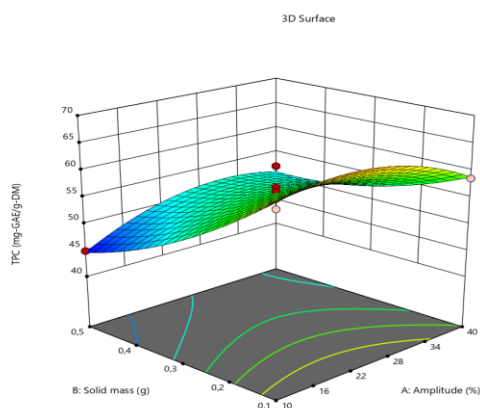


increase in the amount of the raw material. This is expectable indeed considering the driving force of the mass transport (Moreira et al., 2020). Mass transfer is from the high concentration to the low concentration. In other words, as the amount of mass to be extracted increases, the amount of solvent to extract it will not be sufficient since it is constant in this study.

Factor Coding: Actual  
 Design Points:  
 ● Above Surface  
 ○ Below Surface  
 44,9057 68,7429

X1 = A: Amplitude  
 X2 = B: Solid mass

**Actual Factor**  
 C: Extraction Time = 15

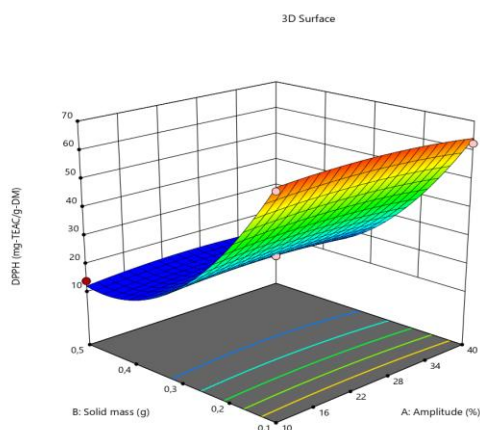


(a)

Factor Coding: Actual  
 Design Points:  
 ● Above Surface  
 ○ Below Surface  
 13,6356 69,5111

X1 = A: Amplitude  
 X2 = B: Solid mass

**Actual Factor**  
 C: Extraction Time = 15

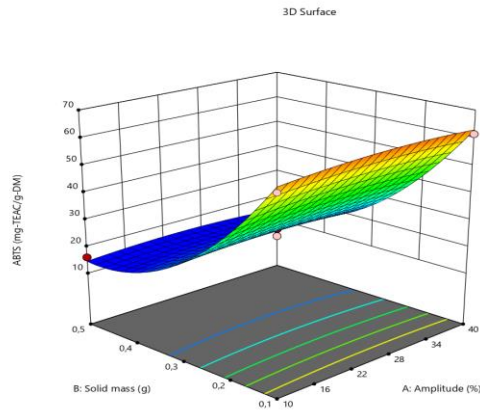


(b)

Factor Coding: Actual  
 Design Points:  
 ● Above Surface  
 ○ Below Surface  
 16,0356 69,3444

X1 = A: Amplitude  
 X2 = B: Solid mass

**Actual Factor**  
 C: Extraction Time = 15



(c)

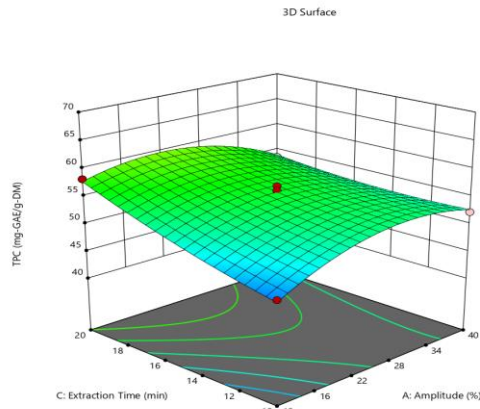
**Figure 5.** Effects of amplitude and solid mass on the (a) total phenolic content, (b) DPPH free radical-scavenging activity, and (c) ABTS free radical-scavenging activity of purple basil (*Ocimum basilicum* L.).

Figure 6 indicates the effects of amplitude and extraction time on the same yields. Amplitude did not influence the system as seen in Figure 6a, 6b and 6c. This result was also reported in Table 3, where the amplitude was not statistically significant for the responses at  $p > 0.05$ .

Factor Coding: Actual  
 Design Points:  
 ● Above Surface  
 ○ Below Surface  
 44,9057 68,7429

X1 = A: Amplitude  
 X2 = C: Extraction Time

**Actual Factor**  
 B: Solid mass = 0,3

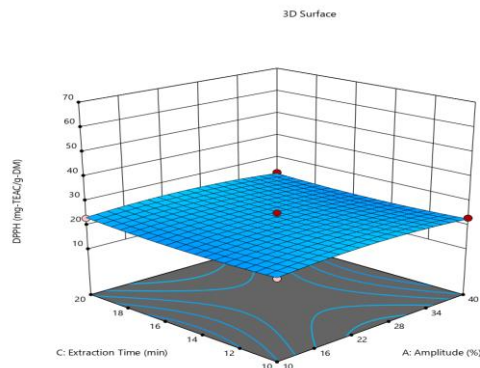


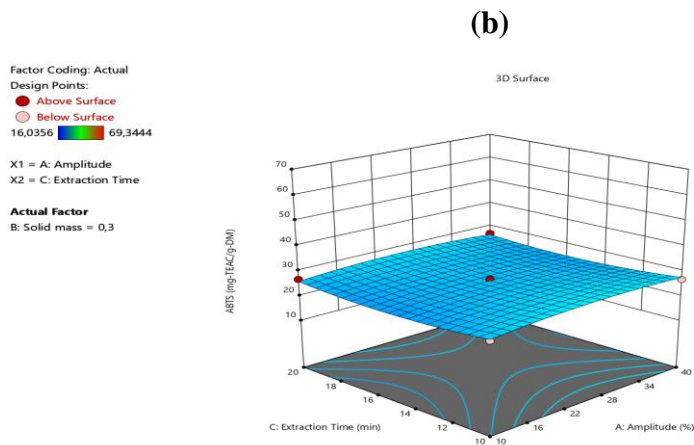
(a)

Factor Coding: Actual  
 Design Points:  
 ● Above Surface  
 ○ Below Surface  
 13,6356 69,5111

X1 = A: Amplitude  
 X2 = C: Extraction Time

**Actual Factor**  
 B: Solid mass = 0,3

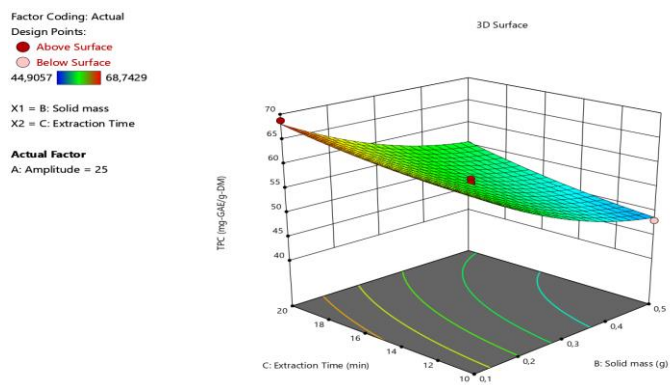




**(c)**

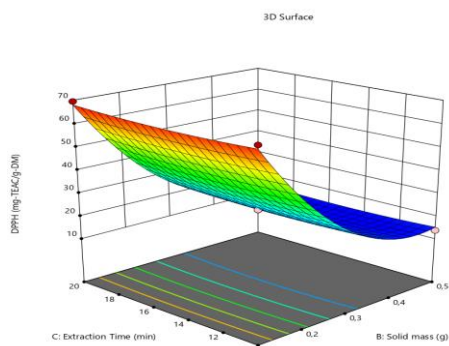
**Figure 6.** Effects of amplitude and extraction time on the (a) total phenolic content, (b) DPPH free radical-scavenging activity, and (c) ABTS free radical-scavenging activity of purple basil (*Ocimum basilicum* L.).

Figure 7 shows the effects of solid mass and extraction time on the TPC, DPPH and ABTS yields. Time effect played different roles in the systems. Regarding TPC, time favoured the yield as seen in Figure 7a. However, time was not effective on the DPPH and ABTS values (Figures 7b and 7c). Table 3 also shows that time was not statistically effective on the DPPH and ABTS yields ( $p > 0.05$ ).



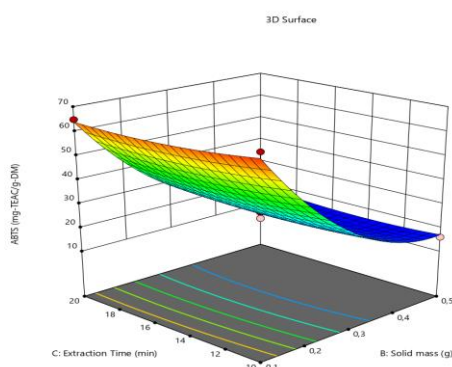
**(a)**

Factor Coding: Actual  
 Design Points:  
 ● Above Surface  
 ○ Below Surface  
 13,6356 69,5111  
 X1 = B: Solid mass  
 X2 = C: Extraction Time  
 Actual Factor  
 A: Amplitude = 25



(b)

Factor Coding: Actual  
 Design Points:  
 ● Above Surface  
 ○ Below Surface  
 16,0356 69,3444  
 X1 = B: Solid mass  
 X2 = C: Extraction Time  
 Actual Factor  
 A: Amplitude = 25



(c)

**Figure 7.** Effects of solid mass and extraction time on the (a) total phenolic content, (b) DPPH free radical-scavenging activity, and (c) ABTS free radical-scavenging activity of purple basil (*Ocimum basilicum* L.).

### Optimization study

Table 4 presents the optimum UAE conditions for the maximum yields with verification study results. The error (difference between actual and predicted) values are all less than 0.5%, pointing out the reliability of the optimizational conditions.

**Table 4.** Optimum UAE conditions for the highest total phenolic content and antioxidant activity and validation of the conditions.

Optimum conditions			Response	Predicted	Experimental	Error (%)
A (%)	B (g)	C (min)				
22.49	0.1	20	TPC (mg-GAE/g-DM)	68.743	68.551	0.28
			DPPH (mg-TEAC/g-DM)	68.126	68.023	0.15
			ABTS (mg-TEAC/g-DM)	63.703	63.812	0.16

### **Conclusion and Recommendations**

The purpose of this study is to propose a green extraction method based on the ultrasound-assisted extraction for the highest yield of phenolic-rich extract from purple basil (*Ocimum basilicum* L.). The system has been optimized with satisfactory findings (F-values, p-values, coefficient of determination values and coefficient of variance values) based on the Box-Behnken design of Response Surface Method. On the other hand, the high correlation between the amount of phenolic substances and antioxidant activity values is an indicator of the extent to which the amount of phenolic substances is responsible for the antioxidant activity value. However, chromatographic studies are essential in order to understand the relationship between the individual phenolic compounds and total phenolic content as well as antioxidant activity of the purple basil extract.

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## UÇUCU YAĞLARIN KANSER ÜZERİNE ETKİLERİ VE ETKİ MEKANİZMALARI

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### Özet

Doğal ürünler ve bunların türevleri, yeni terapötik moleküllerin önemli kaynaklarıdır. En önemli kaynaklardan birisi olan esansiyel yağlar bitkilerin yaprak, kök ve çiçek gibi organlarından elde edilen, çoğunlukla yapısında terpenoidlerden ve terpenoid olmayan bileşiklerden oluşan uçucu yapıdaki bitkisel sekonder metabolitlerdir. Aromatik bitkilerin yapılarında bulunan uçucu yağ bileşenleri arasında monoterpenler, seskiterpenler, oksijenli monoterpenler, oksijenli seskiterpenler ve fenolikler yer alır. Uçucu yağlar genel olarak antibakteriyel, antifungal, antiviral ve antioksidan özellikler göstermektedir. Antioksidan, antimutajenik ve antiproliferatif, bağışıklık fonksiyonunun artırılması ve sürveyansı, enzim indüksiyonu ve detoksifikasyonun artırılması, çoklu ilaç direncinin modülasyonu ve uçucu bileşenlerin sinerjistik mekanizması gibi çeşitli mekanizmalar kemopreventif özelliklerinden sorumludur. Literatürde yapılan inceleme sonucunda, çeşitli uçucu yağların kolon kanseri, meme kanseri ve insan karaciğer kanseri hücreleri gibi çeşitli hücre türleri üzerinde anti-kanser etkisi gösterdiği belirtilmiştir. Kanser dünyadaki en önemli ölüm nedenlerinden biridir, ancak etkileri eşit şekilde yayılmamaktadır. Kanser, vücudun herhangi bir bölümünü etkileyebilen, anormal hücre büyümesi ve vücudun farklı bölümlerine yayılma veya yayılma potansiyeli gibi tipik özellikler gösteren bir hastalıktır. Bu çalışmada birçok farklı bitkiden elde edilen farklı esansiyel yağların anti-kanser aktivitesini ve bunların etki mekanizmalarını, hücre döngüsü hedefleri anlatılacaktır.

**Anahtar Kelimeler:** uçucu yağ, anti kanser, etki mekanizması, bitki

## EFFECTS AND MECHANISMS OF ESSENTIAL OILS ON CANCER

### **Abstract**

Natural products and their derivatives are important sources of new therapeutic molecules. One of the most significant sources is essential oils, which are volatile plant secondary metabolites obtained from various plant organs such as leaves, roots, and flowers. These oils are primarily composed of terpenoids and non-terpenoid compounds. The volatile oil components found in aromatic plants include monoterpenes, sesquiterpenes, oxygenated monoterpenes, oxygenated sesquiterpenes, and phenolics. Essential oils generally exhibit antibacterial, antifungal, antiviral, and antioxidant properties. Various mechanisms, such as antioxidant, antimutagenic, and antiproliferative effects, enhancement of immune function and surveillance, enzyme induction, increased detoxification, modulation of multidrug resistance, and the synergistic mechanisms of volatile components, are responsible for their chemopreventive properties. According to a review of the literature, various essential oils have demonstrated anti-cancer effects on different cell types, such as colon cancer, breast cancer, and human liver cancer cells. Cancer is one of the leading causes of death worldwide, though its impact is not uniformly distributed. It is a disease characterized by abnormal cell growth with the potential to invade or spread to different parts of the body. This study will discuss the anti-cancer activity of different essential oils derived from various plants, their mechanisms of action, and their targets in the cell cycle.

**Keywords:** essential oil, anticancer, mechanism of action, plant



## **Giriş**

Uçucu yağlar, hastalıklara karşı koruma, önleme ve tedavi etme özellikleri taşıyan bileşenler içerir. Ayrıca, birçok bitkiden elde edilen konsantre aromatik bileşenlerdir (Edris, 2007). Uçucu yağlar, antioksidan, antikanser, antiviral, antienflamatuvar, antimikrobiyal, analjezik, sedatif, spazmolitik ve lokal anestezi gibi çeşitli etkileri olan aromatik bileşenlerdir. Tarih boyunca tedavi amaçlı kullanımları sürdürülmüş ve günümüzdeki önemi daha da artmıştır. Kanser tedavisinde kullanılan doğal kaynaklı anjiyogenez inhibitörleri, düşük yan etki profilleri ve farklı etki mekanizmaları sayesinde klasik sitotoksik ilaçlara alternatif olarak değerlendirilmektedir. Bu doğal bileşiklerin büyük bir kısmını, aromaterapi ve kozmetik alanlarında yaygın olarak kullanılan uçucu yağlar oluşturmaktadır (Kıyan, 2010). Kemoterapi uygulamalarında genellikle hücre çoğalmasını inhibe etmeyi hedefleyen sitotoksik ajanlar kullanılmaktadır. Ancak, bu seçici olmayan ilaçlar vücutta hızlıca çoğalan bazı normal hücreler, özellikle kemik iliği ve mide-barsak kanalı gibi dokularda yan etkilere yol açabilmektedir. Bu yan etkiler, sitotoksik ilaçların kullanımını sınırlayan bir faktördür. Etki mekanizmaları bu ilaçlardan farklı olan uçucu yağlar, kanser tedavisinde ve antikanser aktivite çalışmalarında önemli bir rol oynamaktadır (Edris, 2007; Wei ve Shibamoto, 2009). Bilinen yaklaşık 3000 esansiyel yağdan yaklaşık 300'ü ticari açıdan önemli olup, bu yağlar veya içeriklerindeki bazı bileşenler farmakoloji, tarımsal uygulamalar, gıda sanayiinde koruyucu ve lezzet verici olarak, alkollü içkilerde, hayvan beslemede, sanitasyon, kozmetik ve parfümeri ürünlerinde ve doğal tedavi edici halk tıbbında kullanılmaktadır. Günümüzde bazı bitki esansiyel yağları, Amerikan Gıda ve İlaç Dairesi (FDA) tarafından "GRAS" (Genel olarak Güvenilir-Zararsız) tat-koku veya gıda katkıları olarak sınıflandırılmıştır (Bayaz, 2014). Geleneksel farmakopinin önemli bir kısmını oluşturan uçucu yağlar, genellikle sıcak tropik ülkeler ile ılıman Akdeniz bölgesi ülkelerinde yetişen çeşitli aromatik bitkilerden elde edilmektedir. Bu yağlar, bitkilerin yaprak, çiçek, kabuk, tohum ve köklerinden, genellikle su buharı distilasyonu veya farklı ekstraksiyon yöntemleriyle elde edilir. Oda sıcaklığında genellikle sıvı formda olup, kolayca kristalleşme özelliğine sahip olan bu yağlar çoğunlukla renksiz veya açık sarı renkli yağlı karışımlardır. Buldukları bitkilere karakteristik koku ve tat veren bu bileşenlerin en belirgin özellikleri, oda sıcaklığında uçucu ve kokulu olmalarıdır (Bakkali, 2008; Çelik, 2007; Sevinç, 1995). Genellikle renksiz olup, yağda ve organik çözücülerde çözünebilirler. Çoğu uçucu yağın yoğunluğu, tarçın ve karanfil yağı hariç, sudan daha düşüktür (Kıyan, 2010). Bu çalışmada, esansiyel yağların antikanser aktiviteleri ve etki mekanizmalarıyla ilgili son yıllarda yapılan araştırma sonuçları derlenmiştir.

## **Araştırma ve Bulgular**

### **Antikanser aktiviteleri**

Karsinogenezin başlangıç aşamasında, vücudu karsinogenlerin DNA ile etkileşimlerine karşı koruyarak kemopreventif etki gösterirler. Karsinogenezin gelişim aşamasında ise, tümör hücrelerinin çoğalmasını inhibe ederek, tümörlerin ölümüne ve hücre farklılaşmasına yol açarlar. Bu etkileri, uçucu yağların kemoterapötik özellikleri olarak tanımlanır (Bakkali ve ark., 2008; Wei ve Shibamoto, 2009).

Uçucu yağlar, kanser tedavisinde potansiyel faydaları ile dikkat çekmektedir. İşte bu yağların kanser üzerindeki etkilerine dair bazı önemli noktalar:

#### 1. Antikanser Etkileri

- Apoptoz İndüksiyonu: Bazı uçucu yağlar, kanser hücrelerinde programlı hücre ölümünü (apoptoz) teşvik edebilir. Örneğin, çay ağacı yağı ve lavanta yağı, kanser hücrelerini hedef alarak onların ölümünü tetikleyebilir.

- Proliferasyonun Baskılanması: Uçucu yağlar, kanser hücrelerinin çoğalmasını inhibe etme özelliğine sahiptir. Kekik yağı, kanser hücrelerinin büyümesini engelleyici etkilere sahip olduğu gösterilmiştir.

#### 2. Anti-inflamatuar Etkiler

- Kanser genellikle iltihap ile ilişkilidir. Uçucu yağlar, anti-inflamatuar özellikleri sayesinde tümör gelişimini azaltma potansiyeline sahiptir. Özellikle nane yağı ve frankinsens yağı, iltihaplanmayı azaltma konusunda etkilidir.

#### 3. Antioksidan Aktivite

- Uçucu yağlar, serbest radikallerle savaşarak hücresel hasarı önleyebilir. Biberiye ve portakal yağları, güçlü antioksidan özellikleri ile bilinir.

#### 4. Hedefe Yönelik Etkiler

- Bazı uçucu yağlar, kanser hücrelerinin belirli özelliklerine odaklanarak etki gösterebilir. Bergamot yağı, belirli kanser türlerinde hücresel sinyal yollarını modüle edebilir.

#### 5. Kombinasyon Terapileri

- Uçucu yağlar, geleneksel tedavi yöntemleriyle birlikte kullanıldığında sinerjik etkiler gösterebilir. Kemoterapiye eklenmesi, tedavi etkinliğini artırabilir ve yan etkileri azaltabilir.

#### 6. Ruhsal ve Fiziksel Destek

- Kanser tedavisi sürecinde uçucu yağlar, stresi azaltarak ve genel iyilik hali sağlayarak dolaylı yoldan fayda sağlayabilir. Aromaterapi, hastaların ruhsal durumunu iyileştirmeye yardımcı olabilir.

### **Etki Mekanizmaları**

Uçucu yağların bileşimi ve miktarı, bitkinin cinsine, hangi kısımdan elde edildiğine, üretim yöntemine, yetiştirildiği bölgenin coğrafi özelliklerine ve iklim koşullarına bağlı olarak değişiklik göstermektedir (Özgüven ve Kırıcı, 1999; Baydar, 2005; Couladis ve ark., 2002; Angioni ve ark., 2006). Uçucu yağların elde edilmesinde su buharı distilasyonu, tarihsel olarak yaygın bir yöntem olmuştur. Bu yöntem, daha fazla yağ elde edilmesine olanak tanısa da, nitelikli ürünler sağlamada sınırlı kalmaktadır. Ayrıca, uzun damıtma süresi maliyetleri artırmaktadır. Elde edilecek ürünün kullanım amacına bağlı olarak, tercih edilen yöntem değişiklik göstermektedir. Örneğin, turunçgillerden bakterisidal, fungisidal, gıda katkı maddesi ve farmasötik amaçlı sentetik kimyasallara alternatif ürünler elde etmek için genellikle mekanik ekstraksiyon ve buhar distilasyonu tercih edilirken; parfümeri endüstrisi için esansların üretiminde çözücü ekstraksiyonu veya süperkritik karbondioksit ekstraksiyonu yöntemi kullanılmaktadır. Esansiyel yağ elde etme yöntemleri Tablo 1’de sunulmuştur. Son yıllarda aromatik bitkilerden esansiyel yağ elde etme yöntemleri üzerine yapılan araştırmalar, önemli bir çalışma alanını oluşturmaktadır.

**Tablo 1.** Esansiyel yağ eldesinde kullanılan yöntemler (Bayaz, 2014)

1. Damıtma (destilasyon) yöntemi: Bileşenleri kaynama noktaları arasındaki farklardan yararlanarak ayırma işlemidir.	a) Su ile damıtma (Hydro distillation) b) Su buharında damıtma (Steam distillation) c) Vakum altında damıtma (Vacuum distillation)
2. Ekstraksiyon yöntemi: Uçucu yağın bir çözücü içerisinde çözündürülerek alınması işlemidir.	a) Çözücü ekstraksiyonu (Solvent extraction) b) Süperkritik sıvı ekstraksiyonu (Supercritical fluid extraction) c) Mikrodalga yardımıyla ekstraksiyon (Microwave-assisted extraction) d) Sıkıştırılmış çözücü ekstraksiyonu (Pressurised solvent extraction) e) Katı faz mikro ekstraksiyon (Solid phase microextraction) f) Çok yönlü ekstraksiyon (Simultaneous distillation extraction)
3. Presleme yöntemi (mekanik ekstraksiyon): Ürünün bez torba içerisinde hidrolik pres altında sıkılmasıyla uçucu yağlarının alınması işlemidir.	

Uçucu yağların antibakteriyel, antiviral, antifungal, antienflamatuvar, antiseptik, antioksidan, sindirim uyarıcı, antiparazitik, antitoksijenik ve insektisidal özellikleri bulunmaktadır. Yapılan araştırmalar, bu bileşiklerin antibiyotiklere direnç kazanmış mikroorganizmaların ortadan kaldırılmasında kullanılabilirliğine odaklanmıştır. Ayrıca, bu bitkisel ürünlerin gıdaların korunmasında da potansiyel olarak etkili olduğu bilinmektedir. Tablo 2’de sık kullanılan bazı aromatik bitkiler, içeriklerindeki aktif bileşenler ve etki mekanizmaları sunulmuştur.

**Tablo 2.** Bazı aromatik bitkiler, içerdikleri aktif bileşikler ve etki mekanizmaları (Bayaz, 2014; Çabuk ve ark, 2003; Kamel, 2000; Şengezer ve Güngör, 2008)

Bitki adı	Bitkinin bölümü	Başlıca aktif bileşik	Etki mekanizması
Adaçayı	Yaprak	Sineol	Sindirim uyarıcı, antiseptik
Anason	Tohum	Anetol	Sindirim uyarıcı
Bayır turpu	Kök	Allil izotiyosiyanat	İştah arttırıcı
Biber	Tohum	Sabinen	Sindirim uyarıcı, ishal önleyici
Biberiye	Yaprak	Sineol	Sindirim uyarıcı, antiseptik
Defne	Yaprak	Sineol	İştah arttırıcı, sindirim uyarıcı, antiseptik
Hardal	Tohum	Allil izotiyosiyanat	Sindirim uyarıcı
Hindistan cevizi	Tohum	Sabinen	Sindirim uyarıcı ve ishal önleyici
Karabiber	Meyve	Piperin, sabinen	Sindirim uyarıcı
Karanfil	Çiçek	Öjenol	İştah arttırıcı ve sindirim uyarıcı, antiseptik
Kekik	Tüm bitki	Timol ve karvakrol	Sindirim uyarıcı, antiseptik, antioksidan
Kereviz	Yaprak, kök	Fitalid	İştah arttırıcı, sindirim uyarıcı
Kimyon	Tohum	Kumin aldehit	Sindirim uyarıcı
Kişniş	Yaprak, tohum	Linalool	İştah arttırıcı, sindirim uyarıcı
Maydanoz	Yaprak	Apiol	İştah arttırıcı, sindirim uyarıcı, antiseptik
Mercanköşk	Yaprak, çiçek	Karvakrol	Antiseptik, antiviral
Nane	Yaprak	Mentol	İştah arttırıcı, sindirim uyarıcı, antiseptik
Sarımsak	Soğan	Allisin	Sindirim uyarıcı, antiseptik
Tarçın	Kabuk	Sinnamaldehyt	İştah arttırıcı, sindirim uyarıcı, antiseptik
Zencefil	Rizom	Zingerol	Sindirim uyarıcı

## Sonuç

Son yıllarda, kanser hastaları arasında tamamlayıcı terapi yöntemlerinin kullanımı artış göstermiştir. Uçucu yağlar, kanser tedavisinde potansiyel faydalar sunan doğal bileşenlerdir.

Ancak, bu yağların etkinliđi ve güvenliđi hakkında daha fazla klinik alıřma yapılması gerekmektedir. Herhangi bir tedavi planında, doktor önerisi ve gözetimi altında kullanılması önemlidir. Bu yöntemin etkinliđini netleřtirmek için aromaterapinin farklı bitkiler ve diđer kimyasal ilaçlarla etkilerini karşılařtıran daha fazla alıřmanın yapılması gerekmektedir.

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# YOZGAT İLİ ŞEKER PANCARI EKİM ALANLARINDA GÖRÜLEN CERCOSPORA YAPRAK LEKE HASTALIĞI (*Cercospora beticola* Sacc.)'NİN BULUNMA ORANI VE YAYGINLIĞININ TESPİTİ

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## Özet

Bu çalışma Yozgat ilindeki şeker pancarı ekim alanlarında görülen *Cercospora* yaprak lekesi hastalığının bulunma oranı ve yaygınlığını belirlemek amacıyla yapılmıştır. Merkez, Boğazlıyan, Sarıkaya ve Şefaati ilçelerinde şeker pancarı üretim alanlarında tesadüfi örnekleme yöntemiyle 2022 yılı Haziran ve Ekim ayları arasında yapılan gözlem ve örnekleme sonucunda hastalığın bulunma oranı ve yaygınlığı saptanmıştır. Merkez ilçede toplamda 1000 da olmak üzere 8 köy 43 tarlada sürvey yapılmıştır. Bu sürvey sonuçlarına göre incelenen 8 köyün 7'sinde hastalık bulunmuştur. Boğazlıyan ilçesinde toplamda 600 da'lık alanda 13 köy ve 32 tarlada şeker pancarı sürveyi yapılmıştır. Bu sürvey sonuçlarına göre 13 köyün 9 tanesinde hastalık tespit edilmiştir. Sarıkaya ilçesinde toplamda 500 da olmak üzere 7 köyde 25 tane tarlada şeker pancarı sürveyi yapılmıştır. Sürvey yapılan 7 köyün 6 tanesinde hastalık bulunmuştur. Şefaati ilçesinde toplam olarak 400 da alanda 6 köy 20 tarlada şeker pancarı sürveyi yapılmıştır. Sürvey yapılan 6 köyün 3 tanesinde hastalıklı alanlar tespit edilmiştir. Hastalık yaygınlık oranları sırasıyla, Merkezde (%41,8), Boğazlıyan (%46,8), Sarıkaya (%52) ve Şefaati ilçesinde ise (%55) oranında bulunmuştur

**Anahtar Kelimeler:** Şeker pancarı, *Cercospora beticola*, hastalık oranı, yaygınlık oranı

**DETERMINATION OF THE OCCURENCE RATE AND PREVALENCE OF  
CERCOSPORA LEAF SPOT DISEASE (*Cercospora beticola* Sacc.) SEEN IN SUGAR  
BEET CULTIVATION AREAS OF YOZGAT PROVINCE**

**Abstract**

This study was conducted to determine the rate and prevalence of *Cercospora* leaf spot disease seen in sugar beet cultivation areas in Yozgat province. The incidence rate and prevalence of the disease were ascertained through observations and sampling conducted via a random sampling method from June to October 2022. This was carried out in the sugar beet production areas located in the Merkez, Boğazlıyan, Sarıkaya, and Şefaati districts. In the central district, the survey covered 43 fields across 8 villages, encompassing a total area of 1000 acres. The survey results indicated that the disease was present in 7 out of these 8 villages. In the Boğazlıyan district, sugar beet surveys were conducted across 13 villages and 32 fields, covering a total area of 600 decares. According to the survey results, the disease was detected in 9 out of the 13 villages. Sugar beet surveys were conducted in 25 fields across 7 villages, covering a total area of 500 decares in the Sarıkaya district. The disease was detected in 6 of the 7 surveyed villages. A sugar beet survey was conducted in 6 villages and 20 fields, covering a total area of 400 decares in the Şefaati district. Diseased areas were detected in 3 of the 6 surveyed villages. The disease prevalence rates were found to be 41.8% in the Center, 46.8% in Boğazlıyan, 52% in Sarıkaya, and 55% in Şefaati district, respectively.

**Keywords:** Sugar beet (*Beta vulgaris* L.), *Cercospora beticola*, disease rate, prevalence rate,

## Giriş

Şeker pancarı (*Beta vulgaris* L.) Chenopodiaceae familyasına ait bir kültür bitkisidir ve şeker sanayisinin temel hammaddesi olarak yetiştirilmektedir. İçerdiği yüksek enerji ve şeker oranıyla, beslenmede insanlar için büyük önem taşıyan şeker pancarı, dünya şeker üretiminin yaklaşık olarak yarısını karşılamaktadır (Oral, 1979). Şeker pancarı bitkisinin işlenmesi sonucunda oluşan küspe ve melas, hayvan yemi olarak kullanılmaktadır. İçki sanayisi ve ispiro üretimi için önemli bir hammaddedir (Eştürk, 2018).

2022 yılı verilerinden hareketle ülkemizde yaklaşık olarak 3 milyon dekar şeker pancarı üretim alanı bulunmakla beraber en büyük üretim alanına Konya ili %31,4 oranıyla sahip olurken, Yozgat ili %5,71 oranıyla ikinci sırada yer almakta ve bu ili takiben %5,58 oranıyla Eskişehir ili gelmektedir (Anonim, 2023).

Şeker pancarında yüksek verim sağlanabilmesi için sertifikalı tohum kullanımı, çapalama, gübreleme, uygun sulama vb. tarımsal faaliyetlerin yanı sıra, hastalık, zararlı ve yabancı ot mücadelesi de önem taşımaktadır. Şeker pancarı çeşitli fizyolojik hastalıkları dışında çok sayıda fungal, viral ve bakteriyel hastalığı bulunan bir bitkidir. Bakteriyel ve fungal patojenler içerisinde ekonomik önem taşıyan hastalıklar; *Cercospora* yaprak lekesi (*Cercospora beticola* Sacc.), *Alternaria* yaprak lekesi (*Alternaria alternata* (Fr.) Keissler.), *Phoma* yaprak leke hastalığı (*Phoma betae* A. B. Frank.), külleme (*Erysiphe betae* Weltzien.), kök çürüklükleri (*Fusarium oxysporum* Schlecht., *Fusarium solani* Mart. , *Fusarium avenaceum*, *Rhizoctonia solani* Kühn. , *Pythium ultimum* Trow. , *Macrophomina phaseolina* (Tassi) Goid.), *Erwinia* kök çürüklüğü (*Erwinia carotovora* subsp. *betavasculorum*), beyaz çürüklük (*Sclerotium rolfsii* Sacc.), hastalıklarıdır (Karadimos ve ark., 2006; Karaca ve ark., 2007; Özgünen ve Çulal-Kılıç, 2009).

Bu hastalıklar şeker pancarı bitkisinde büyük ölçüde verim kaybına neden olduğu için çeşitli mücadele yöntemlerinin uygulanmasını zorunlu hale getirmektedir. Bu kontrolü mecburi hale getiren, kalite ve verim üzerinde olumsuz yönde etkileri olan hastalık etmenlerinden biri de *Cercospora beticola* Sacc.'nın neden olduğu yaprakta leke hastalığıdır (Brewbaker ve ark., 1950; Farus ve ark., 1962; Schlosser, 1971; Smith ve Ruppel, 1973; Skylakakis, 1974). Şeker pancarı yaprak lekesi hastalığı, ülkemizde olduğu gibi dünyada şeker pancarının en önemli hastalığı olarak bilinmektedir (Weiland ve Koch, 2004).

Hastalık şiddeti, bölgeye ve ülkeye göre değişmekle beraber; kontrol altına alınmadığı zaman, şeker oranı %13, artırılmış şeker oranı %18, şeker pancarının kök verimi %26 ve şeker veriminde de %55'e ulaşan oranda düşürmektedir (Kaya, 2015).

Hastalık, ülkemizde üretim yılının sıcaklık, nem ve yağmur durumuna göre haziran ayının ilk haftasından başlayarak ilk önce yaşlı dış kısımdaki yaprakların üstünde tekli daireler şeklinde, orta alanı açık kahverengi-gri, çevresi koyu kahverengi-kırmızı, geniş veya dar bir sınırla kaplanmış 2-5 mm boyutunda küçük lekelenmeler meydana getirmektedir. Ağır salgınlarda çok sayıda yaprak ölür ve bu durumda bütün yapraklarını kaybeden bitkiler yeni yapraklar sürerler. (Giannopolitis, 1978; Rossi, 1998). *Cercospora beticola*'nın yaprak üzerindeki ilk lekeler ve zamanla yaprak dokusuna yayılması Şekil 1'de verilmiştir.





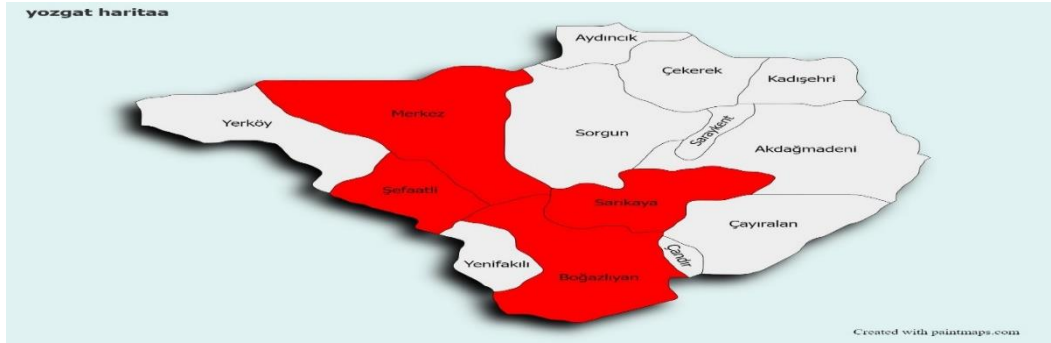
**Şekil 1.** Cercospora beticola'nın yaprak üzerindeki ilk lekeler ve zamanla yaprak dokusuna yayılması

Hem hastalığın yayılım göstermesinde hem de salgın oluşturmasında iklim koşullarının bulaşma için uygun olması ile yakın bir ilişkinin olduğu farklı araştırmacılar tarafından bildirilmiştir (Özgüven ve Çulal Kılıç, 2009; Altınok, 2012; Kaya, 2015; Tunalı ve ark., 2018). Entegre mücadele yöntemi uygulanarak Cercospora yaprak lekeli hastalığı kontrol altına alınabilmektedir. Entegre mücadele ile oluşturulacak programlarla, epideminin başlangıcından itibaren bütün üretim alanlarında oluşturulan bir sistemin yönetimi ile mücadele yapılması önemlidir. Bu çalışmada da Yozgat ili ve bazı ilçelerinde 2022 yılında şeker pancarı üretimi yapılan alanlarda Cercospora yaprak leke hastalık oranı ve yaygınlığı belirlenmiştir.

## Materyal ve Metot

### Materyal

Çalışmanın materyalini, Yozgat ili merkez, Boğazlıyan, Sarıkaya ve Şefaattli ilçeleri şeker pancarı ekim alanları (Şekil 2) bu alanlardan alınan hastalıklı bitki örnekleri, bu örneklerden izole edilen fungus izolatu, besi ortamları, şeker pancarı yaprak ekstraktı agar (SBLEA), Potato Dekstroz Agar (PDA), Malt Extract agar (MEA), Water Agar (WA), kimyasal maddeler, laboratuvar malzemeleri oluşturmuştur.



**Şekil 2.** Yozgat ilinde 2022 yılında sürvey yapılan ilçeler

### Yöntem

Çalışma, şeker pancarı üretiminin yüksek olduğu Yozgat Merkez ilçe, Boğazlıyan, Sarıkaya ve Şefaattli ilçelerinde yürütülmüştür. Yozgat ilinde sürvey yapılan ilçe, tarla sayısı ve ekim alanları Tablo 1'de verilmiştir.

**Tablo 1.** Yozgat ilinde srvey yapılan ile, tarla sayısı ve ekim alanları

İl	İle	Tarla Sayısı	Ekim Alanı(da)
Yozgat	Merkez	43	1.000
	Boğazlıyan	32	600
	Sarıkaya	25	500
	Şefaati	20	400
Toplam		120	2.500

Srvey iin seilen ilenin konumu ve retim alanlarının byklğne baėlı homojen rnekleme mesafeleri belirlenmiřtir. Rastgele rnekleme yntemiyle ile toplamında řeker pancarı retim alanlarının en az %1 'inde, rnek olarak seilen tarlanın byklėi esas alınarak 2022 yılında Haziran ve Ekim aylarında gzlem ve rnekleme yapılmıřtır.

- Tarlanın alanı 1-5 da kadar ise 3 noktadan 30 bitki
- Tarlanın alanı 5-10 da ise 5 noktadan 50 bitki
- Tarlanın alanı 10-50 da ise 10 noktadan 100 bitki
- Tarlanın alanı 50 da zerinde ise 15 noktadan 150 bitki hastalık ynnden sayılmıřtır.

Srvey sonucunda her tarlada hastalık belirtisi grlen bitkiler, incelenen toplam bitki sayısına oranlanarak hastalığın tarlada bulunma oranı belirlenmiřtir. İncelenen tarlalarda bulunma oranı belirlendikten sonra, tartılı ortalama ile ilelere ait bulunma oranı belirlenmiřtir (Bora ve Karaca, 1970). İledeki srvey yapılan tm tarlaların bulunma oranı toplanmıř ve srvey yapılan tarla sayısına blnmřtir. Bylece ilelere ait bulunma oranı bulunmuřtur. Srveyler sresince hastalığın grldėi tarlaları bulařık kabul edilmiř, incelenen řeker pancarı tarla sayısına oranlanarak da hastalığın ilelere gre yaygınlık oranı belirlenmiřtir (Karman, 1971).

### **Bulgular ve Tartıřma**

İlelerde hastalık bulunma oranı (%) ile il ve ile bazında yaygınlık oranı Tablo 2 'de verilmiřtir. Tablo 2 incelendiėinde, Merkez ilede toplamda 1000 da olmak zere 8 ky 43 tarlada srvey yapılmıřtır. Bu srvey sonularına gre incelenen 8 kyn 7 'sinde hastalık bulunmuřtur. Ky bazında incelendiėinde, Osmanpařa kyne 5 tarladan 3 'nde, Karabıyık kynde 4 tarladan 3 'nde, Battal kynde 19 tarladan 6 'sında, Kařkışla kynde 4 tarladan 2 'sinde, Esenli kyne 3 tarlanın 2 'sinde, zlce kynde ve Bayatren kynde ise 2 tarladan 1 'inde hastalıkla bulařık olduėu saptanmıřtır. Sarınınren kynde ise hastalıklı alanlara rastlanmamıřtır.

Boğazlıyan ilesinde toplam 600 da 'lık alanda, 13 ky ve 32 tarlada hastalık srveyi yapılmıřtır. Sonuta 13 kyn 9 tanesinde hastalık tespit edilmiřtir. Ovakent kynde 5 tarlanın 2 'sinde, Bahariye 'de 3 alandan 2 'sinde, Yoėunhisar 'da 5 tarladan 2 'sinde, zler kynde 3 alanın 1 'de Yapalak 'ta 2 alandan 1 'inde, Yeřilhisar ve Yukarı mahalle kylerinde ise srvey yapılan tm alanlarda hastalık tespit edilmiřtir. Kemaliye, alapverdi, arşı ve akmak, Gveli ve Yukarıkarako kylerinde ise hastalığa rastlanılmıřtır.

**Tablo 2.** Köylere ait hastalık bulunma ve hastalık yaygınlık oranları

İl	İlçe	Köyü	Tarla No	Hastalık Bulunma Oranı (%)	Hastalık Yaygınlık Oranı (%)
Yozgat	Merkez	Osmanpaşa	1	0	60,0
			2	0	
			3	15	
			4	27	
			5	72	
		Karabıyık	1	0	75,0
			2	9	
			3	14	
			4	22	
		Sarınnören	1	0	0,0
			2	0	
			3	0	
			4	0	
		Battalköy	1	0	31,5
			2	0	
			3	0	
			4	0	
			5	0	
			6	0	
			7	0	
			8	0	
			9	0	
			10	0	
			11	0	
			12	0	
			13	0	
			14	13	
			15	14	
			16	16	
			17	28	
			18	57	
			19	88	
		Özlüce	1	0	50,0
			2	22	
		Esenli	1	0	66,6
			2	6	
			3	21	
		Bayatören	1	0	50,0
			2	18	
		Kaşkışla	1	0	50,0
			2	0	
			3	7	
			4	25	

**Tablo 2.** Köylere ait hastalık bulunma ve hastalık yaygınlık oranları (Devamı)

İl	İlçe	Köyü	Tarla No	Hastalık Bulunma Oranı (%)	Hastalık Yaygınlık Oranı (%)
Yozgat	Boğazlıyan	Ovakent	1	0	40,0
			2	0	
			3	0	
			4	5	
			5	14	
		Çalapverdi	1	0	0,0
			2	0	
			3	0	
		Güveçli	1	10	100
		Bahariye	1	0	66,6
			2	12	
			3	14	
		Kemaliye	1	0	0,0
			2	0	
		Yeşilhisar	1	46,6	100
			2	86	
			3	93	
		Yoğunhisar	1	0	40,0
			2	0	
			3	0	
			4	14	
			5	16	
		Yapalak	1	0	50,0
			2	14	
		Özler	1	0	33,3
			2	0	
			3	8	
		Çakmak	1	0	0,0
	Yukarı karakoç	1	72	100	
	Yukarı mahalle	1	7	100	
		2	63		
	Çarşı	1	0	0,0	
	Sarıkaya	Çokumeşme	1	0	50,0
			2	0	
			3	16	
			4	85	
		Kayapınar	1	0	50,0
			2	10	
		Cumhuriyet	1	0	66,6
			2	5	
3			16		
Karayakup		1	0	33,3	
		2	0		

**Tablo 2.** Köylere ait hastalık bulunma ve hastalık yaygınlık oranları (Devamı)

İl	İlçe	Köyü	Tarla No	Hastalık Bulunma Oranı (%)	Hastalık Yaygınlık Oranı (%)
Yozgat	Sarıkaya	Karayakup	3	0	33,3
			4	0	
			5	8	
			6	39	
		İlisu	1	0	66,6
			2	0	
			3	26	
			4	27	
			5	44	
		Kadılı	1	0	75,0
			2	7	
			3	15	
			4	18	
		Akbenli çiftliği	1	0	0,0
	Şefaati	Paşaköy	1	0	63,6
			2	0	
			3	0	
			4	0	
			5	6,6	
			6	14	
			7	20	
			8	48	
			9	57	
			10	76	
			11	78	
		Koç	1	19	100
			2	50	
		İnceşehir	1	0	66,6
			2	20	
			3	26	
		Kızılyer	1	0	0,0
			2	0	
		Saçlı	1	0	0,0
		Güzelli	1	0	0,0
<b>Toplam</b>	<b>4</b>	<b>34</b>	<b>120</b>		

Sarıkaya ilçesinde toplamda 500 da olmak üzere 7 köyde 25 tane tarlada hastalık sürveyi yapılmıştır. Sürvey yapılan 7 köy içerisinde Akbenliçiftliği köyü dışında kalan diğer köylerde hastalık tespit edilmiştir. Karayakup'ta 6 tarlanın 2'sinde, Çokumeşme ve Kadılı köylerinin 4'er tarlada sürvey yapılmıştır. Çokumeşme köyünde 2 ve Kadılı köyünde 3 alanda hastalık tespit edilmiştir. Ilisu köyüne 5 tarladan 3'ünde, Cumhuriyet köyünde 3 tarladan 2'sinin, Kayapınar köyünde ise sürvey yapılan 2 alandan 1'inde hastalık tespit edilmiştir.

Şefaati ilçesinde toplam olarak 400 da alanda 6 köy 20 tarlada hastalık sürveyi yapılmıştır. Paşaköy köyünde 11 tarladan 7'sinde, Koç köyünde 2 tarlanın 2'sinde, İnceşehir köyünde 3 alanda 2'sinde hastalık tespit edilmiştir. Sürvey yapılan Güzelli, Kızılyer ve Saçlı köylerinde ise hastalıkla bulaşık alanlara rastlanılmamıştır.

Merkez, Boğazlıyan, Sarıkaya ve Şefaati ilçelerindeki köylerin hastalık yaygınlık oranı ise, Sarınınören köyünde hastalık saptanmadığı için yaygınlık oranı %0'olarak bulunmuştur.

Battalköy köyünde %31,5, Bayatören, Kaşkışla ve Özlüce köylerinde %50, Osmanpaşa köyünde %60, Esenli köyüne ise %66,6 olarak bulunmuştur. Hastalık yaygınlık oranı en yüksek köy ise %75 oranıyla Karabıyık köyü olmuştur.

Boğazlıyan ilçesinde, Çalapverdi, Çakmak, Çarşı ve Kemaliye köylerinde gözlem yapılan hiçbir yerde hastalığa rastlanılmadığı için hastalık yaygınlık oranı %0 olarak bulunmuştur. Özler köyünde %33,3, Ovakent ve Yoğunhisar köylerinde %40, Yapalak köyünde %50, Bahariye köyüne ait hastalık yaygınlık oranı ise %66,6 olarak bulunmuştur. Güveçli, Yeşilhisar, Yukarımahalle ve Yukarıkarakoç köylerinde ise bütün tarlalarda hastalık yaygınlık oranı %100 olarak bulunmuştur.

Sarıkaya ilçesinde Akbenliçifliği köyünde hastalığa rastlanılmadığı için yaygınlık oranı %0'dır. Karayakup köyüne ait hastalık yaygınlık oranı %33,3 olarak bulunmuştur. Çokumeşme ve Kayapınar köylerinde %50, Cumhuriyet ve Iısu köyleri %66,6 ve en fazla yaygınlık oranına sahip köy %75 ile Kadılı köyü olmuştur.

Şefaati ilçesinde Güzelli, Saçlı ve Kızılyer köylerinde hastalığa rastlanılmadığı için hastalık yaygınlık oranı %0 olmuştur. Paşaköy köyünde %63,6, İnceşehir köyünde %66,6 ve en fazla yaygınlık oranı %100 ile Koç köyünde bulunmuştur.

İlçelerdeki tarlaların tartılı ortalamaya göre hastalık bulunma oranları ile ilçelerdeki hastalık yaygınlık oranları Tablo 3'te verilmiştir.

**Tablo 3.** İlçelere ait hastalık bulunma oranı ve hastalık yaygınlık oranları

İlçe	Hastalık Bulunma Oranı (%)	Hastalık Yaygınlık Oranı (%)
Merkez	11,02	41,80
Boğazlıyan	14,83	46,80
Sarıkaya	12,64	52,00
Şefaati	20,73	55,00

Hastalık bulunma oranları incelendiğinde en fazla oranın Şefaati ilçesine ait olduğu tespit edilirken bu ilçeleri sırasıyla Boğazlıyan, Sarıkaya ve Merkez ilçenin takip ettiği görülmektedir. Hastalık yaygınlık oranı ilçe bazında incelediğinde ise ilk sırada Şefaati ilçesi gelirken bu ilçeyi takiben Sarıkaya, Boğazlıyan ve en son olarak Merkez ilçenin takip ettiği görülmektedir. Sonuç olarak hem hastalık bulunma oranı hem de hastalık yaygınlık oranı en fazla Şefaati ilçesinde tespit edilmiştir.

Skaracis ve ark. (2010), Cercospora yaprak lekesi hastalığının patojeni olan Cercospora beticola patojeninin şeker pancarında en yaygın görülen ve en çok zararı veren yaprak hastalığına neden olduğunu bildirmişlerdir. Bu hastalığın ülkemizde olduğu gibi dünyada da şeker pancarının en önemli hastalıklarından biri olduğunu bildiren birçok çalışma yapılmıştır. Holschulte (2000), dünya üzerinde bulunan Cercospora beticola'nın tüm şeker pancarı ekim alanlarının yaklaşık % 30'undan fazlasında yüksek ve orta derece şiddetinde hastalığa yol açtığını tespit etmiştir. Kudou ve ark. (2001), yapmış oldukları çalışmada Cercospora yaprak lekesi hastalığının patojeni olan Cercospora beticola'nın neden olduğu lekelenmelerin aşırı sıcak ve nemli iklimden kaynaklandığını ve bu sebeple epidemiy yaptığını tespit etmişlerdir. Ülkemizde sorun olan Cercospora yaprak leke hastalığının bulunma oranı ve yaygınlığı hakkında birçok çalışma yürütülmüştür. Altınok (2012), çalışmasında Kayseri ili merkez, Bünyan, Develi, Yeşilhisar ve Sarioğlan ilçelerinde şeker pancarında Cercospora yaprak leke hastalığının şiddeti ve yaygınlık

oranı tespit edilmiştir. Hastalığın şiddeti ve yaygınlığı sırasıyla % 45 ve % 80 oranlarıyla en yüksek Sarıoğlan ilçesinde olduğunu ve bu ilçeyi Merkez, Develi ve Bünyan ilçelerinin sırasıyla takip ettiğini bildirmişlerdir. Tunalı ve ark. (2018), ülkemizin kuzey ve iç kesiminde yoğun bir şekilde şeker pancarı üretiminin yapıldığı toplam 11 ilde 2011 yılı Temmuz-Eylül ayları arasında Cercospora yaprak lekesi hastalığının yaygınlık oranını tespit etmişlerdir. Toplamda 391 tarla incelenmiş, 193 (%49.4)'ünün C. beticola ile bulaşık olduğu tespit edilmiştir. Cercospora yaprak lekesi hastalığının en yaygın olduğu il, %82,4 oran ile Yozgat ili olurken bu ili sırasıyla Kırşehir (%75) ve Kastamonu (%72,7) illeri takip etmiştir. Sarı ve Boyraz (2019), Konya İli Çumra dolaylarında şeker pancarı üretim sahalarında tarla gözlemleri yapılmış, her iki yıl da da Cercospora yaprak leke hastalığının görülme oranı %60'ların üstünde olduğu saptanmıştır. Bayar ve ark. (2022), Kırşehir ilçelerinde şeker pancarı üretim sahasında Cercospora yaprak lekesinin bulunma oranı, şiddeti ile yaygınlığını belirlemek için survey çalışmaları yapmışlardır. Surveylerde belirti incelemelerinde, 60 adet şeker pancarı tarlasının %15'inin Cercospora beticola ile bulaşık olduğu saptanmıştır. İlçe bazında yapılan incelemeler neticesinde Kaman ilçesinde %50, Merkez ilçede %50, Mucur ilçesinde %20, Akpınar ilçesinde %12,5 ve Boztepe ilçesinde %0 C. beticola fungusu ile bulaşık tarlalar olduğu tespit edilmiştir. Bu çalışmada Yozgat ili ve bazı ilçelerinde şeker pancarı üretilen alanlarda Cercospora yaprak leke hastalık oranı ve yaygınlığı belirlenmiştir. Diğer yerlerde yapılan çalışmalarla paralellik göstermektedir.

Hastalık bulunma oranları incelendiğinde en fazla oranın Şefaati ilçesine ait olduğu tespit edilirken bu ilçeyi sırasıyla Boğazlıyan, Sarıkaya ve Merkez ilçenin takip ettiği görülmektedir. Hastalık yaygınlık oranı ilçe bazında incelendiğinde ise ilk sırada Şefaati ilçesi gelirken bu ilçeyi takiben Sarıkaya, Boğazlıyan ve en son olarak Merkez ilçenin takip ettiği görülmektedir. Sonuç olarak hastalık bulunma oranı ile yaygınlık bulunma oranı en çok Şefaati ilçesinde bulunmuştur. Haziran-Ekim ayları arasında yapılan surveylerde hastalık rakımı düşük ve nemli yerlerde daha erken görülmüştür.

## **SONUÇ ve Öneriler**

Bu çalışma Yozgat ili Merkez, Boğazlıyan, Sarıkaya ve Şefaati ilçesinde 2022-2023 yılları arasında gerçekleştirilmiş olup bu ilçelerdeki şeker pancarı üretim bölgelerinde görülen Cercospora yaprak lekesinin bulunma oranı ve yaygınlığı tespit edilmiştir. Hastalık belirtisi gösteren bitkiler laboratuvara getirilerek izolasyon ve teşhis yapılmıştır. Örnek alınan bitki dokularının Cercospora beticola Sacc. ile bulaşık olduğu tespit edilmiştir. Hastalık bulunma oranları incelendiğinde en fazla oranın Şefaati ilçesine ait olduğu tespit edilirken bu ilçeyi sırasıyla Boğazlıyan, Sarıkaya Merkez ilçenin takip ettiği görülmektedir. Hastalık yaygınlık oranı ilçe bazında incelendiğinde ise ilk sırada Şefaati ilçesi gelirken bu ilçeyi takiben Sarıkaya, Boğazlıyan ve en son olarak Merkez ilçenin takip ettiği görülmektedir. Sonuç olarak hem hastalık bulunma oranının hemde hastalık yaygınlık oranının en fazla oranda saptandığı ilçe Şefaati olarak tespit edilmiştir.

Kültürel mücadele yöntemlerine odaklanmak da bu hastalıkla mücadelede önemli bir stratejidir. Münavebe uygulamaları, hastalığın konukçusu olan yabancı otlarla etkin mücadele ve hastalıktan ari tohum kullanımı gibi yöntemler, hastalığın yayılımını engelleyebilir ve şeker

pancarı üretimini sürdürülebilir kılar. Ayrıca, hastalığa karşı dayanıklı şeker pancarı çeşitlerinin geliştirilmesi ve kullanılması, hastalık riskini azaltabilir.

Sulama yöntemlerinin optimizasyonu da hastalığın kontrolünde önemlidir. Özellikle yağmurun hastalığın yayılmasında etkili bir faktör olduğu göz önünde bulundurulduğunda, damla sulama gibi kontrollü sulama yöntemlerinin benimsenmesi önerilmektedir. Bu yöntemler, su kullanımını optimize ederken hastalığın yayılma riskini de azaltacaktır.

Kimyasal mücadelenin doğru ve dengeli bir şekilde uygulanması, hastalıkla mücadelede son çare olarak görülmelidir. Farklı etki mekanizmasına sahip fungusitlerin dönüşümlü olarak kullanmak, hem hastalıkla mücadelede etkinliği artırır hem de fungusit direncinin önlenmesine yardımcı olur.

### **Bilgi notu**

Bu yayın, Siirt Üniversitesi, Fen Bilimleri Enstitüsü, Bitki koruma Anabilim Dalında, Seher ÇAĞLAR tarafından yürütülmüş “Yozgat ili Şeker pancarı ekim alanlarında görülen Cercospora yaprak leke hastalığı (Cercospora beticola Sacc.)’nın bulunma oranı ve yaygınlığı ile üreticilerin bu hastalığa karşı yaklaşımlarının belirlenmesi” adlı yüksek lisans tez çalışmasının bir kısmını kapsamaktadır.



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# YOZGAT İLİ ŞEKER PANCARI EKİM ALANLARINDA GÖRÜLEN CERCOSPORA YAPRAK LEKE HASTALIĞI (*Cercospora beticola* Sacc.) KARŞI ÜRETİCİLERİN YAKLAŞIMLARININ BELİRLENMESİ

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## Özet

Şeker pancarı üretilen birçok alanda, *Cercospora* yaprak leke hastalığı (*Cercospora beticola* Sacc.), ekomik kayıplara yol açan en önemli hastalıklardan biridir. İklimsel koşullar hastalığın gelişimine uygun olduğunda, epidemiler meydana gelmektedir. Bu çalışma Yozgat ilindeki şeker pancarı ekim alanlarında görülen *Cercospora* yaprak lekesi hastalığına karşı üreticilerinin yaklaşımlarını belirlemek amacıyla yapılmıştır. Toplam 18 köyde 50 üretici ile anket çalışması yapılmıştır. Anket çalışması incelendiğinde hastalığın ortaya çıkmasında yağmurun etkili bir faktör olduğunu bildiren çiftçiler hastalık görülmeden önce önlem olarak koruma ilaçlamasını tercih etmişlerdir. Aynı şekilde üreticilerin bu hastalığa karşı % 96 oranında ve en çok kimyasal mücadele yöntemini kullandıkları saptanmıştır. Şeker pancarı yaprak leke hastalığının belirtileri nelerdir sorusuna üreticilerin verdiği en yaygın cevap olan %54 oranında yapraklarda beneklenme ve daha sonrasında yaprakta kuruma cevabı verilmiştir. Bunu takiben diğer %24 ile en yüksek orana sahip olan yapraklarda kahverengi benekler, lekeler cevabı verilmiştir. Araştırmada Şeker pancarı yaprak leke hastalığı ile ilgili eğitim aldınız mı sorusuna verilen cevaplar %30 eğitim aldım ve %70 eğitim almadım şeklinde olmuştur.

**Anahtar Kelimeler:** Şeker pancarı, *Cercospora beticola*, üretici yaklaşımı

**DETERMINATION OF PRODUCERS' APPROACHES AGAINST CERCOSPORA  
LEAF SPOT DISEASE (*Cercospora beticola* Sacc.) SEEN IN SUGAR BEET  
CULTIVATION AREAS IN YOZGAT PROVINCE**

**Abstract**

In numerous regions where sugar beet cultivation is prevalent, the *Cercospora* leaf spot disease (*Cercospora beticola* Sacc.) emerges as a principal disease causing significant economic losses. Epidemics occur when climatic conditions are suitable for the development of the disease. This study was conducted to determine the approaches of sugar beet producers against this disease. A total of 50 producers in 18 villages were surveyed. Upon analyzing the survey results, it was noted that farmers identified rainfall as a significant contributing factor to the emergence of the disease, and as a precaution, they preferred to undertake preventive spraying before the onset of the disease. Similarly, it has been determined that producers mostly use chemical control methods (96%) against this disease. To the question of what are the symptoms of sugar beet leaf spot disease, 54% of the producers gave the most common answer of mottling on the leaves and then drying of the leaves. This was followed by the answer of brown spots and stains on the leaves, which had the highest rate with 24%. In the research, the answers given to the question of whether you received training on sugar beet leaf spot disease were as follows: 30% received training and 70% did not receive training.

**Keywords:** Sugar beet (*Beta vulgaris* L.), *Cercospora beticola*, the approaches of producers

## Giriş

Şeker pancarı, ülkemizin de yer aldığı kuzey yarım küre için 60° kuzey enlemlerine kadar, güney yarım kürede ise 30° güney enlemlerine kadar farklı iklim kuşaklarında yetiştirilebilmektedir (Gencer, 1988). İçerdiği yüksek enerji ve şeker oranıyla, beslenmede insanlar için büyük önem taşıyan şeker pancarı, dünya şeker üretiminin yaklaşık olarak yarısını karşılamaktadır (Oral, 1979). Şeker pancarı üretiminin Türkiye ekonomisi ve tarımına kazandırdığı faydalar şu şekilde özetlenebilir. Şeker pancarı, ekonomik değerle birlikte istihdam ve tarımda sürekliliği desteklemektedir. Yaklaşık olarak 350 bini aşan çiftçi ailesi, 300 bin hektar üzerinde bir alanda şeker pancarı üretimi yapmaktadır (Eştürk, 2018). Şeker pancarı ekiminden sonra hububatta %20 verim artışı sağlamaktadır. Bir dekarının fotosentez ile ortaya çıkardığı oksijen miktarı, 6 kişi ile bir yılda tükettiği oksijene denk olmakla beraber yaklaşık bir dekarlık orman alanından üç katı daha fazla oksijen üretir. Şeker pancarı bitkisinin işlenmesi sonucunda oluşan küspe ve melas, hayvan yemi olarak kullanılmaktadır. İçki sanayisi ve ispiroto üretimi için önemli bir hammaddedir (Eştürk, 2018). Aynı zamanda şeker pancarının, bitkisel üretim sosyoekonomisi üzerine önemli bir rolü vardır. İstihdama katkı sağlamasıyla birlikte göçün önlenmesi veya azaltılması, kırsal kesimin kalkınmasında ve bölgelerarası gelişmişlik farklılıklarının azaltılmasında önemli bir katkısı bulunmaktadır (Bayar ve ark., 2022). Türkiye’de şeker pancarı yetiştiriciliği, tarımsal üretimin önemli bir parçasıdır ve 64 ilde, 5,877 köyde yaklaşık olarak 500 bin üretici tarafından şeker pancarı tarımı yapılmaktadır (Kıymaz, 2002).

2022 yılı verilerinden hareketle ülkemizde yaklaşık olarak 3 milyon dekar şeker pancarı üretim alanı bulunmakla beraber en büyük üretim alanına Konya ili %31,4 oranıyla sahip olurken, Yozgat ili %5,71 oranıyla ikinci sırada yer almakta ve bu ili takiben %5,58 oranıyla Eskişehir ili gelmektedir (Anonim, 2023). İl bazında 2022 yılına ait şeker pancarı üretim verileri incelendiğinde toplam olarak 19,254 milyon ton olan şeker pancarı üretiminde en büyük payın %35,45 Konya ilinde olduğu görülürken, Yozgat ilinde %6,32’si ve Kayseri’de de %5,54’ü gerçekleşmiştir (Anonim, 2023). Dünya şeker pancarı üretimi toplam olarak 287 milyon ton olmak üzere bu üretimin %57,2’lik kısmını karşılayan ülkelerin en büyük üreticisi konumunda olan ülke Rusya (14,8) olurken, ABD (%12), Fransa (12,4), Almanya (11,5) ve ülkemizin payı ise (%6,6) oranında olmuştur (Anonymous, 2023).

Şeker pancarı etkileyen bir çok hastalık vardır. Bu hastalıklar büyük ölçüde verim kaybına neden olduğu için çeşitli mücadele yöntemlerinin uygulanmasını zorunlu hale getirmektedir. Bu kontrolü mecburi hale getiren, kalite ve verim üzerinde olumsuz yönde etkileri olan hastalık etmenlerinden biri de *Cercospora beticola* Sacc.’nın neden olduğu yaprakta leke hastalığıdır (Brewbaker ve ark., 1950; Farus ve ark., 1962; Schlosser, 1971; Smith ve Ruppel, 1973; Skylakakis, 1974). Şeker pancarı yaprak lekesi hastalığı, ülkemizde olduğu gibi dünyada şeker pancarının en önemli hastalığı olarak bilinmektedir (Weiland ve Koch, 2004). Ülkemizde, son zamanlarda şeker pancarı üretimi yapılan bölgelerde *Cercospora beticola*’nın oluşturduğu şeker pancarı yaprak lekesi hastalığının yaygınlaştığı bilinmektedir. Özellikle Karadeniz ve Marmara Bölgeleri’nde hastalığın çok yaygın görüldüğü tespit edilmiştir (Kaya, 2012). Ayrıca, geçit bölgelerdeki akarsu vadileri ile kapalı havzalarda ve İç Anadolu Bölgesi’nde; genellikle

Mayıs, Haziran ve Temmuz dönemlerinin yağışlı olduğu zamanlarda, hastalığın salgın yaptığı bilinmektedir (Kaya, 2015).

Hem hastalığın yayılım göstermesinde hem de salgın oluşturmasında iklim koşullarının bulaşma için uygun olması ile yakın bir ilişkinin olduğu farklı araştırmacılar tarafından bildirilmiştir (Özgünen ve Çulal Kılıç, 2009; Altınok, 2012; Kaya, 2015; Tunalı ve ark., 2018). Entegre mücadele yöntemi uygulanarak Cercospora yaprak lekesi hastalığı kontrol altına alınabilmektedir. Dayanıklı çeşit kullanımı ve münavebeyle beraber kimyasal mücadelenin de bir arada uygulandığı entegre yöntemle, ürünün hastalıktan korunması sağlanmaktadır (Wiedemann ve Merdinoglu, 1991; Brent, 1995; Schaufele ve Wevers, 1996; Smith ve Campbell, 1996; Meriggi ve ark., 2000).

Bu çalışmada da Yozgat ili ve bazı ilçelerinde 2022 yılında şeker pancarı üretimi yapılan alanlarda Cercospora yaprak leke hastalığının yaygın olarak bulunduğu alanlarda, üreticilerinin bu hastalığa karşı yaklaşımları belirlenmiştir. Böylece, önemli şeker pancarı üretim merkezlerinden biri olan Yozgat ilinde bu hastalığın durumunun belirlenmesi, ileride hastalığın yaratabileceği olası zararlara karşı sorumlu kuruluşların hızlı davranması ve mücadelesinde önlemlerin en uygun zamanda uygulanabilmesini sağlayacaktır.

### Materyal ve Metot

Çalışma verileri, Yozgat merkez, Boğazlıyan, Sarıkaya ve Şefaati ilçelerine bağlı köylerden rastgele seçilmiş olan, her bölgeden en az 10 üreticiyle ve toplam 50 çiftçi ile yüz yüze görüşülerek toplanmıştır. Anket yapılan köyler ve üretici sayısı, Tablo 1’de verilmiştir. Hastalığın yaygın olarak tespit edildiği alanlarda, üreticilerinin bu hastalığa karşı yaklaşımlarını belirlemek amacıyla Tablo 2’deki ankette yer alan toplamda 13 adet soruyu cevaplandırmaları istenmiştir.

**Tablo 1.** Yozgat ilinde anket yapılan köyler ve üretici sayısı

İl	İlçe	Köyü	Üreticisi Sayısı
Yozgat	Merkez	Qsmanpaşa	2
		Karabıyık	5
		Sarınınören	3
		Battalköy	4
		Esenli	1
	Boğazlıyan	Ovakent	6
		Çalapverdi	3
		Özler	3
		Yoğunhisar	2
		Güveçli	1
	Sarıkaya	Çokumeşme	2
		Kayapınar	3
		Karayakup	2
		İhsu	3
	Şefaati	Paşaköy	3
		Koç	3
		Saçlı	2
İnceşehir		2	
<b>Toplam</b>	<b>4</b>	<b>18</b>	<b>50</b>

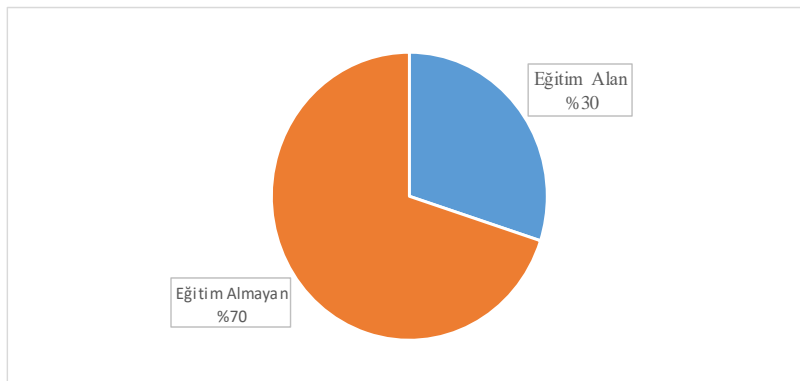
**Tablo 2. Üreticilere sorulan sorular**

Hangi tohum Çeşidini kullanıyorsunuz?	
Bu hastalıkla ilgili eğitim hiç aldınız mı?	1. Evet 2. Hayır
Eğitim aldıysanız hangi kurumdan eğitim aldınız?	
Bu hastalığın belirtileri nelerdir?	
Hastalık her yıl görülüyor mu?	1. Evet 2. Hayır
Sizce hastalık hangi koşullarda ortaya çıkıyor?	1. Yağmurdan sonra 2. Sulamadan sonra 3. Rüzgarlı havada Diğer.....
Hastalığı görmeden önce önlem alıyor musunuz?	1. Evet 2. Hayır
Cevabınız evet ise hangi önlemleri alıyorsunuz?	1. Münavebe 2. Çeşit seçimi 3. Koruma ilaçlaması
Hastalığa karşı hangi mücadele yöntemlerini uyguluyorsunuz?	1. Mekanik 2. Kültürel 3. Kimyasal 4. Hiçbiri
Kimyasal mücadele yapıyorsanız hangi ilacı kullanıyorsunuz?	İlaç İsmi:..... Doz:.....
Zirai mücadele konusunda ve ilaç seçiminde en çok danıştığınız kişi ve kuruluşlar hangileridir?	1. İlaç bayileri 2. Firmalar 3. Tarım ve orman il/ilçe müdürlükleri 4. Çevredeki üreticiler 5. İnternette araştırıyorum 6. Danışmıyorum kendi tecrübem ile 7. Diğer
Kullandığınız ilaçlarda etkisinin düştüğünü hissediyor musunuz?	1. Evet 2. Hayır 3. Fikrim yok
Çeşitleri arasında bu hastalık yönünden bir fark görüyor musunuz?	1. Evet 2. Hayır 3. Fikrim yok

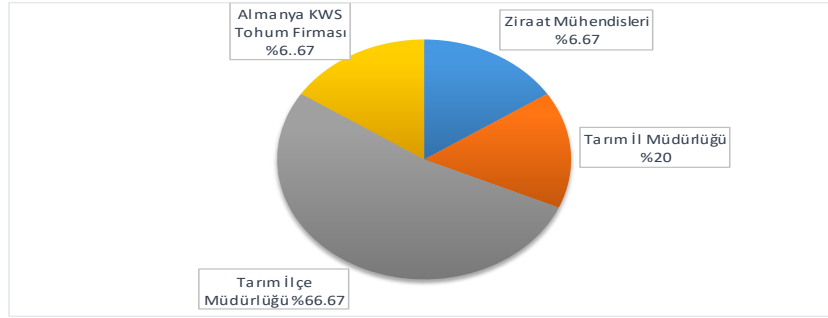
Toplanan tüm veriler, SPSS paket programına aktarılarak, analiz edilmiştir. Bu analizde ortalama, yüzde gibi temel istatistiksel ölçütler kullanılmıştır.

### Bulgular ve Tartışma

Anket çalışmasında Şeker pancarı yaprak leke hastalığı ile ilgili eğitim aldınız mı sorusuna verilen cevaplar %30 eğitim aldım ve %70 eğitim almadım şeklindedir (Şekil 1). Çoğunlukla eğitim almadım cevabını veren üreticiler şeker pancarı üretimiyle ilgili bilgi ve birikimlerinin aileleri tarafından öğretildiğini belirtmişlerdir.

**Şekil 1. Üreticilerin hastalıkla ilgili eğitim alma durumu**

Eđitim alan üreticilere hangi kurumdan eğitim aldınız sorusu sorulduğunda %66,67 ile en yüksek oran Tarım ilçe müdürlüğü olmakla beraber bunu sırasıyla %20 oranıyla Tarım il müdürlüğü, %6,67 ile Almanya KWS tohum firması ve %6,67 oranıyla Ziraat mühendisleri cevabı alınmıştır (Şekil 2).



Şekil 2. Üreticilerin hastalıkla ilgili eğitim aldıkları yerler

Üreticilere hangi tohumu kullanıyorsunuz sorusu sorulduğunda hem eğitim alanların hem de eğitim almayanların verdiği en yaygın cevabın %46 oranıyla KWS Salama tohum çeşidi olduğu belirlenmiştir. Bu oranı takiben %18 ile KWS cappadocia ve %12 ile KWS serenada tohum çeşidinin tercih edildiği saptanmıştır. Eğitim alanların Consivo smart, KWS popularia, Mohican ve Turbata tohum çeşidini tercih etmedikleri tespit edilmiştir. Aynı zamanda eğitim alan üreticilerin %40'ı KWS salamayı tercih ederken %33,33'ü KWS cappadocia tohum çeşidini kullanmaktadır. Eğitim almayan üreticilerin ise sadece Coyote tohum çeşidini kullanmadıkları saptanmıştır. Bunun yanında KWS salama tohum çeşidini %48,57 ile en yüksek oranda tercih ettikleri belirlenmiştir (Tablo 3).

Tablo 3. Eğitim durumuna göre üreticiler tarafından kullanılan tohumlar ve oranları

Kullanılan Tohum	Eđitim Alan (15)		Eđitim Almayan (35)		Genel (50)	
	Sayı	Oranı (%)	Sayı	Oranı (%)	Sayı	Oranı (%)
Convivo smart	0	0,00	1	2,86	1	2,00
Coyote	1	6,67	0	0,00	1	2,00
KWS cappadocia	5	33,33	4	11,43	9	18,00
KWS gregoria	1	6,67	2	5,71	3	6,00
KWS populara	0	0,00	2	5,71	2	4,00
KWS salama	6	40,00	17	48,57	23	46,00
KWS serenada	2	13,33	4	11,43	6	12,00
Mohican	0	0,00	1	2,86	1	2,00
Turbata	0	0,00	4	11,43	4	8,00
<b>Toplam</b>	<b>15</b>	<b>100</b>	<b>35</b>	<b>100</b>	<b>50</b>	<b>100,00</b>

Şeker pancarı yaprak leke hastalığının belirtileri nelerdir sorusuna üreticilerin verdiği en yaygın cevap %54 oranında yapraklarda beneklenme ve daha sonrasında yaprakta kuruma şeklinde

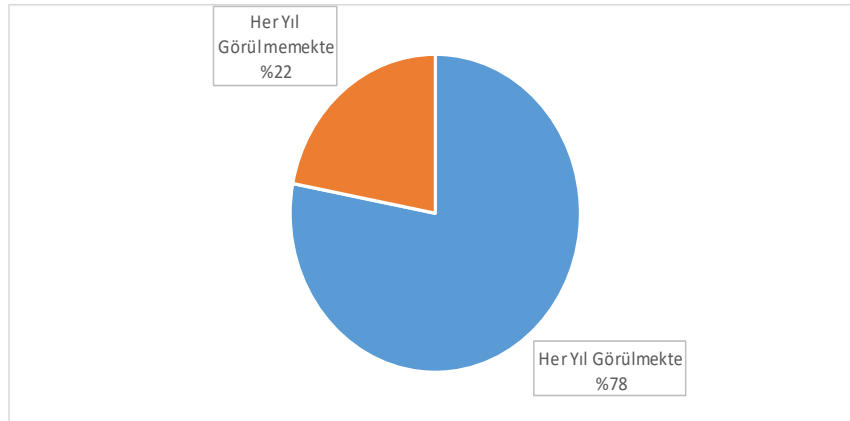


olmuştur. Bunu %24 oranı ile yapraklarda kahverengi benekler, lekeler cevabı verilmiştir. Farklı oranlarda başka cevaplarda verilmiştir (Tablo 4).

**Tablo 4.** Üreticiler tarafından bildirilen hastalık belirtileri

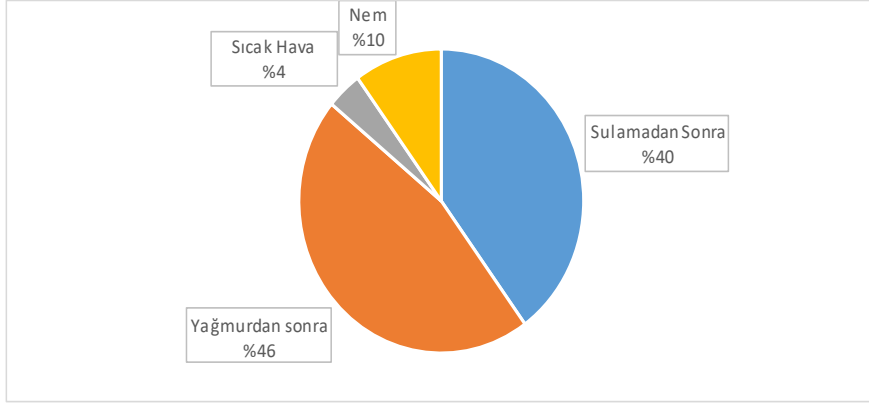
Hastalık Belirtileri	Üretici Sayısı	Oranı (%)
Yaprakta kahverengi benekler (Lekeler)	12	24.00
Yapraklarda beneklenme ve kuruma	27	54.00
Yapraklarda sararma, gazelleme ve beneklenme	1	2.00
Yaprakta beneklenme, sararma ve kuruma	3	6.00
Yaprakta kahverengi leke oluşuyor yaprak ölüyor ve daha sonra pancar yeni yaprak sürüyor	1	2.00
Yaprakta kuruma ve sararma	2	4.00
Yaprakta kuruma, çürüme sararma ve beneklenme	2	4.00
Yaprakta nokta şeklinde kahverengi çürüme	1	2.00
Yaprakta sararma ve pancarda gerileme	1	2.00
<b>Toplam</b>	<b>50</b>	<b>100.00</b>

Şeker pancarı yaprak leke hastalığının her yıl görülüp görülmediği hakkındaki sorunun cevabı incelendiğinde ise %78 oranıyla hastalığın her yıl görüldüğünü bildiren üreticilerin yanı sıra %22 oranında da üretici ise her yıl görülmediğini bildirmiştir (Şekil 3).



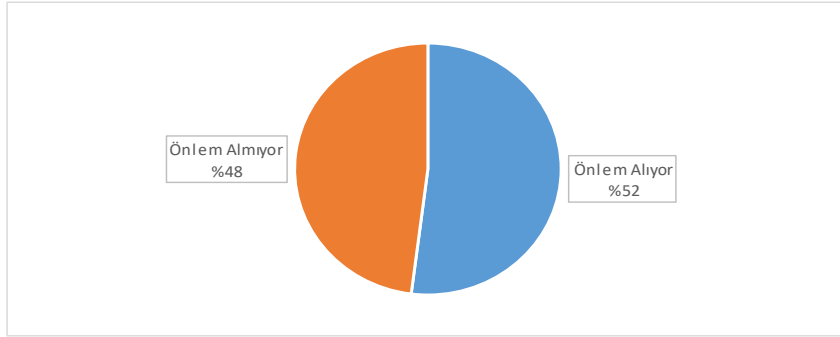
**Şekil 3.** Hastalığın her yıl görülme durumu

Üreticilere sorulan sizce hastalık hangi koşullarda ortaya çıkıyor sorusunun cevapları incelendiğinde, %46 ile yağmurdan sonra hastalık ortaya çıkıyor cevabı olduğu tespit edilmiş ve bunu %40 oranı ile sulamadan sonra hastalık ortaya çıkıyor cevabı verilmiştir (Şekil 4). Bu durum bize suyun yani nemin Cercospora yaprak lekesi hastalığında önemli bir rol oynadığını göstermektedir.



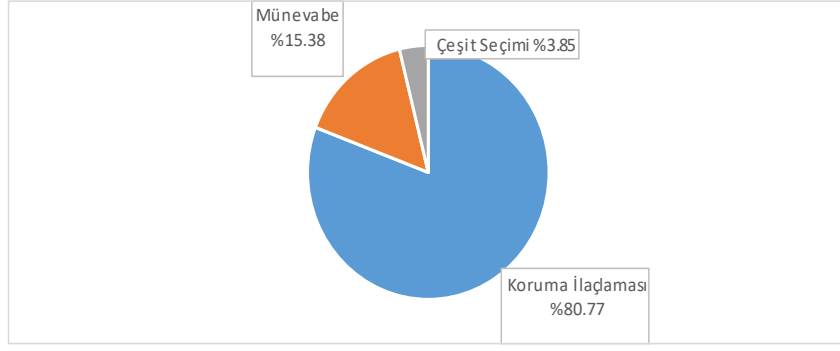
**Şekil 4.** Hastalığın ortaya çıkma koşulu ile ilgili verilen cevaplar

Üreticilerin hastalığı görmeden önce önlem alıp almadıklarıyla ilgili soruya vermiş oldukları cevaplar Şekil 5’de verilmiştir. Buna göre üreticilerin %52’si hastalığı görmeden önlem aldığını belirtirken geriye kalan %48’lik dilim ise herhangi bir önlem almadığını bildirmiştir.



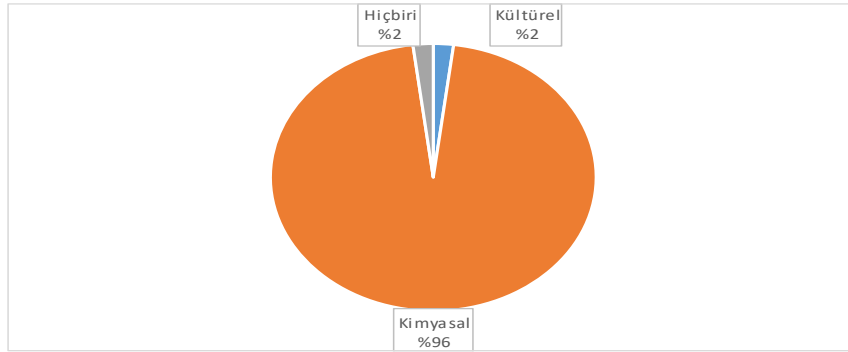
**Şekil 5.** Üreticilerin hastalığı görmeden önce önlem alma durumu

Hastalık öncesi önlem alan üreticilerin %80,77’si koruma ilaçlaması yaptıklarını bildirmişlerdir. Koruma ilaçlamasıyla hastalığın o yıl içinde hiç görülmemesini aynı zamanda hastalık görülecekse bile daha geç bir döneme denk gelmesini amaçladıklarını belirtmişlerdir. Geriye kalan üreticilerin %15,38’i münavebeyi tercih ederken %3,85’i ise önlem olarak hastalığa karşı daha dayanıklı olan çeşitleri seçtiklerini bildirmişlerdir (Şekil 6).



**Şekil 6.** Üreticilerin hastalığı görmeden önce aldıkları önlemler

Hastalığa karşı uygulanan mücadele yöntemlerini belirlemek amacıyla sorulan soruya üreticilerin %96'sı kimyasal mücadeleyi tercih ettiklerini bildirirken kültürel mücadeleyi tercih eden üreticilerin ise sadece %2 oranına sahip olduğu saptanmıştır. Geriye kalan %2'lik kısım ise hastalığa karşı herhangi bir mücadele yöntemini kullanmadıklarını bildirmişlerdir (Şekil 7).



**Şekil 7.** Hastalığa karşı uygulanan mücadele yöntemleri

Kimyasal mücadele uygulayan üreticilerin kullandıkları kimyasal ilaçların dağılımı Tablo 5'te verilmiştir. Üreticileri en fazla tercih ettiği kimyasal ilaç %29,92 ile Priaxor (10 da/ 1 lt) olmuştur. Bu ilacı takiben en fazla kullanılan ikinci ilaç %22,92 oranıyla Yamato (10 da/ 1 lt) olurken en fazla kullanılan üçüncü ilaç ise %10,42 oranıyla Amistar Gold (10 da/ 1lt) olmuştur.

**Tablo 5.** Üreticilerin hastalığa karşı kullandıkları kimyasal ilaçların dağılımı

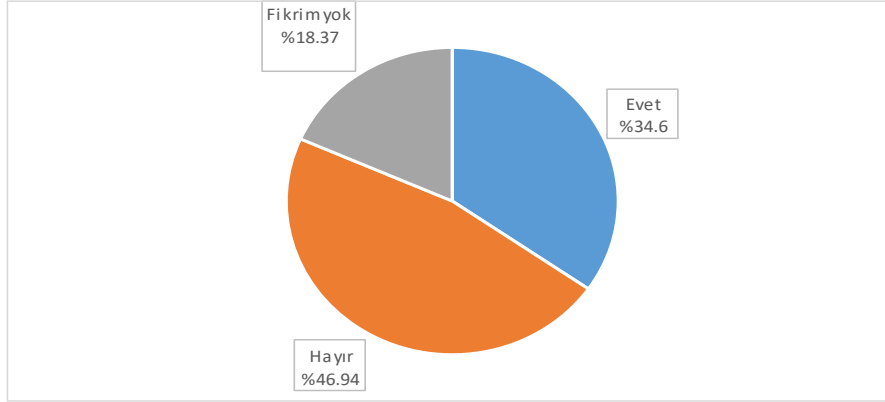
Kimyasal İlaç	Üretici Sayısı	Oranı (%)
Amistar Gold (10 da /1 lt)	5	10,42
Amistar Gold (75 ml / da))	1	2,08
Amister Gold ( 50 ml / da)	1	2,08
Belvedere Forte (7 da / 1 lt)	1	2,08
Betenal Progress Of (10 da / 1 lt	3	6,25
Conviso Smart (100 ml /da)	2	4,17
Goltix ( 10 da / 1 lt)	2	4,17
Goltix ( 7 da / 1 lt)	1	2,08
Hektaş Tess (10 da / 1 lt)	1	2,08
Nativo (25 gr/ da)	2	4,17
Operamax (150 ml / da)	2	4,17
Priaxor (10 da / 1 lt)	14	29,17
Priaxor (140 ml / da)	1	2,08
Yamato (10 da / 1 lt)	11	22,92
Zamir (10 da / 1 lt)	1	2,08
<b>Toplam</b>	<b>48</b>	<b>100</b>

Zirai mücadele konusunda ve ilaç seçiminde en çok kime danışsınız sorusu hakkındaki üreticilerin görüşlerine ait veriler Tablo 6'da verilmiştir. Üreticiler zirai mücadele ve ilaç seçiminde %38 oranıyla en çok ilaç bayilerine danıştıklarını belirtmişlerdir. İlaç bayilerini takiben sırasıyla %18 ile Tarım ilçe müdürlükleri, %14 ile Tarım il müdürlükleri, %12 ile firmalar, %10 ile çevredeki üreticilerden, %6 oranı ile internetten araştırma yaparken en son olarak %2 oranında üretici ise diğer cevabını vermiştir.

**Tablo 6.** Üreticilerin ilaç seçiminde danıştıkları kanal

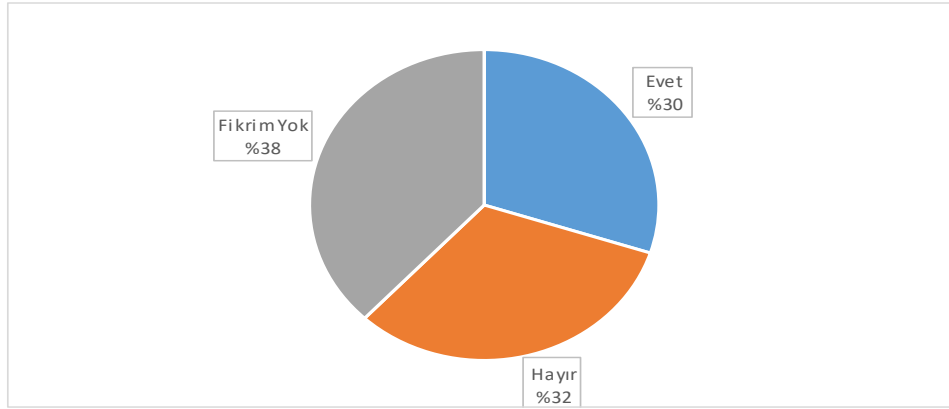
Danışmanlık Hizmeti	Sayı	Oranı(%)
Çevredeki Üreticiler	5	10,00
Firmalar	6	12,00
İlaç bayileri	19	38,00
İnternetten Araştırma	3	6,00
Tarım İl Müdürlükleri	7	14,00
Tarım İlçe Müdürlükleri	9	18,00
Diğer	1	2,00
Toplam	50	100,00

Üreticilere kullandığınız ilaçlarda etkisinin düştüğünü hissediyor musunuz sorusuna vermiş oldukları cevaplar Şekil 8'de verilmiştir. Üreticilerin %46,94 oranıyla en çok hayır cevabını verdikleri saptanmıştır. %34,69 oranında ise evet cevabı verilirken herhangi bir fikrim yok diyen %18,37 oranında üretici olduğu tespit edilmiştir.



**Şekil 8.** Üreticiler tarafından kullanılan ilacın etki durumu

Çeşitleri arasında bu hastalık yönünden bir fark görüyor musunuz sorusuna, üreticilerin %30'u çeşitler arasında hastalık yönünden bir fark gördüklerini belirtirken %32'lik kısım ise herhangi bir fark görmediklerini belirtmişlerdir. Geriye kalan %38 oranındaki üreticiler ise bu konuda herhangi bir fikre sahip olmadıklarını belirtmişlerdir (Şekil 9).



**Şekil 9.** Çeşitler arasında hastalık yönünden fark görme durumu

Şeker pancarı ekimi yapılan alanlarda hem verimi hem de kaliteyi olumsuz yönde etkileyen birçok hastalık bulunmaktadır. Son zamanlarda en çok karşılaşılan ve çeşitli mücadele yöntemlerini zorunlu kılan Cercospora yaprak leke hastalığı olmuştur. Bu çalışmada hastalığın bulunduğu alanlarda üreticilerin yaklaşımı da araştırılmıştır. Ortaya çıkan en önemli verileri özetlersek; Üreticilerin büyük çoğunluğunun şeker pancarı hastalıklarıyla ilgili yeterli oranda eğitim alamadıkları, hastalığı tanımlamada farklı cevaplar verdikleri, yarısına yakınının hastalığa karşı önceden önlem almadıklarını, ezici çoğunluğunun mücadelesinde kimyasalları tercih ettiği, ilaç tercihinde de kamu kuruluşları yerine firmalara danıştıklarını bildirmişlerdir. Ayrıca hastalık varlığında çeşitlerinin farklılıklarını yeterince görmediklerini ve kültürel önlemlere yeterince önem vermedikleri anlaşılmaktadır. Şeker pancarında Cercospora yaprak lekesi hastalığıyla mücadelede, birçok yöntemi entegre ederek kontrol altına almak

mümkündür. Münavebe, inokulum kaynaklarının azaltılmasında önemlidir. Yine dayanıklı çeşitlerin kullanılması, hastalığın daha geç görünmesine neden olacak ve son aşamada kimyasal mücadele uygulanmasıyla birlikte, bitki bu hastalıktan korunabilmektedir (Brent, 1995; Schaefe ve Wevers, 1996; Smith ve Campbell, 1996).

### **Sonuç ve Öneriler**

Anket verilerine göre şeker pancarı üreticilerinin Cercospora yaprak lekesine karşı yaklaşımları belirlenmiştir. Böylece şeker pancarı üretiminde önemli bir paya sahip olan Yozgat ilinde bu hastalığın yaygın olarak saptandığı şeker pancarı üretim alanlarında hastalığın durumunun belirlenmesi, gelecek yıllarda bu patojenin neden olduğu hastalığa karşı konu ile ilgili kuruluşların çabuk davranmasını ve hastalığın mücadelesinde alınacak önlemlerin zamanında uygulanmasını sağlayacaktır. Ayrıca daha sonra yapılacak çalışmalara yönelik veri elde edilecektir.

Eğitim ve farkındalık programlarının artırılması, bu çalışmanın ortaya koyduğu en önemli gerekliliklerden biridir. Üreticilerin hastalık hakkında yeterli bilgiye sahip olmadıkları tespit edilmiştir, bu nedenle tarım ilçe müdürlükleri, yerel tarım kooperatifleri ve tarım danışmanları tarafından düzenlenecek eğitim seansları, üreticilerin hastalıkla mücadelede daha bilinçli ve etkili olmalarını sağlayacaktır. Bu eğitimler, hastalığın tanımlanması, yayılımı ve kontrol yöntemleri hakkında kapsamlı bilgi sunmalıdır.

### **Bilgi notu**

Bu yayın, Siirt Üniversitesi, Fen Bilimleri Enstitüsü, Bitki koruma Anabilim Dalında, Seher ÇAĞLAR tarafından yürütülmüş “Yozgat ili Şeker pancarı ekim alanlarında görülen Cercospora yaprak leke hastalığı (*Cercospora beticola* Sacc.)’nın bulunma oranı ve yaygınlığı ile üreticilerin bu hastalığa karşı yaklaşımlarının belirlenmesi” adlı yüksek lisans tez çalışmasının bir kısmını kapsamaktadır.

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# UYGUN İSTATİSTİKSEL TEKNİĞİ BELİRLEMEDE CHATGPT’NİN ARAŞTIRMAYA YÖNELİK TEMEL VE SINIRLI BİLGİYLE KULLANIMI

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## Özet

Bu çalışma, ChatGPT'nin araştırmacılara, araştırmalarıyla ilgili temel ve genel bilgilere dayanarak uygun istatistiksel teknikleri bulma konusunda ne kadar iyi yardımcı olabileceğini değerlendirmeyi amaçlamaktadır. Bu amaç doğrultusunda, maksimum çeşitlilik örnekleme ile Web of Science (WoS) veri tabanından 2020 ile 2024 yılları arasında yayınlanan, çeşitli araştırma modellerini ve istatistiksel teknikleri kapsayan 20 makale belirlenmiştir. Makaleler, belirsiz veya aşırı karmaşık tekniklere sahip olanlar hariç olmak üzere, çeşitli metodolojileri temsil edecek şekilde seçilmiştir. ChatGPT kullanımında, temel yeterliliklere sahip araştırmacıları temsil edecek şekilde, araştırma amacı, modeli, örneklem özellikleri ve veri toplama araçlarına yönelik genel bilgilerin verilmesini içeren, geçerlik çalışmaları ve optimizasyonu sağlanmış bir “prompt” tasarlanmıştır. Bu prompt kullanılarak ChatGPT’den uygun istatistiksel teknik önerileri istenmiştir. ChatGPT'nin önerileri makalelerde kullanılan gerçek tekniklerle karşılaştırılmış ve uzlaşma seviyeleri 0'dan (uzlaşma yok) 4'e (tam uzlaşma) kadar ölçeklendirilmiştir. Bulgulara göre üç makale için ChatGPT'nin önerilerinin, makalelerde belirtilen ve kullanılan tekniklerle hiç uyum göstermemiştir. Bu çalışmalar yeterli düzeyde ayrıntı içermeyen, ayrıca amaç ve metodolojik geri plan arasında uyumsuzluklar gözlenen araştırmalardır. Diğer taraftan, ayrıntılı ve açık metodolojik bilgilerin sağlandığı dört makalede kullanılan teknikler, ChatGPT’nin öneriler ile tam uyum göstermiştir. Toplam 20 makale için ortalama uzlaşma seviyesi 1.8 olarak belirlenmiştir ve bu da orta derecede uyumun göstergesidir. Sonuç olarak; ChatGPT'nin uygun istatistiksel tekniğin belirlenmesinde orta düzeyde destek sağlayabildiğini, ancak etkinliğinin girdi bilgilerinin ayrıntısına ve kullanıcıların yeterliliğine bağlı olduğu sonucuna varılmıştır. Kötü tasarlanmış “prompt” veya yetersiz bilgi girişi, yanlış veya hatalı önerilere yol açabilmektedir. Bu kapsamda ChatGPT'nin etkin kullanımı, öncelikle kullanıcıların metodoloji ve istatistik yeterliliklerine, sonra iyi yapılandırılmış “prompt” yazımlarına bağlıdır. İleri araştırmalarda, özellikle değişkenlerin karakteristikleri hakkında daha ayrıntılı bilgilerin dâhil edilmesiyle, bir “prompt” tasarımının geliştirilmesine odaklanabilir.

**Anahtar Kelimeler:** istatistiksel yetkinlik, araştırma tasarımı, prompt yazarlığı, dijital sohbet robotu

## USING CHATGPT WITH BASIC AND LIMITED INFORMATION OF THE RESEARCH TO FIND THE APPROPRIATE STATISTICAL TECHNIQUE

### Abstract

This study aims to evaluate how well ChatGPT can assist researchers in finding appropriate statistical techniques based on basic and general information of their research. For this purpose, 20 articles published between 2020 and 2024, covering various research models and statistical techniques, were identified from the Web of Science (WoS) database through maximum variability sampling. Articles were selected to represent a variety of methodologies, excluding those with unclear or overly complex techniques. In the use of ChatGPT, a "prompt" that includes general information about the research purpose, model, sample characteristics and data collection tools has been designed to represent researchers with basic competencies, and has been validated and optimized. Using this prompt, appropriate statistical technique suggestions were requested from ChatGPT. ChatGPT's recommendations were compared to actual techniques used in the articles, and agreement levels were scaled from 0 (no agreement) to 4 (complete agreement). According to the findings, ChatGPT's recommendations for three articles did not comply with the techniques stated and used in the articles. These studies do not contain sufficient detail and also show inconsistencies between the purpose and methodological background. On the other hand, the techniques used in the four articles in which detailed and clear methodological information was provided were fully compatible with the recommendations of ChatGPT. The average level of agreement for a total of 20 articles was determined as 1.8, indicating moderate agreement. In conclusion, ChatGPT can provide moderate support in finding the appropriate statistical technique, but its effectiveness depends on the detail of the input information and the competency of the users. Poorly designed prompts or insufficient information input about the research can lead to biased or incorrect recommendations. In this context, effective use of ChatGPT depends primarily on the users' methodological and statistical competencies, and then on well-structured "prompt" writing. Further research could focus on the development of a "prompt" design, particularly by incorporating more detailed information about the variable structure.

**Keywords:** statistical competency, research design, prompt writing, chat boot

## **Introduction**

The use of AI-driven technologies such as ChatGPT has become widespread. Designed to produce human-like responses, ChatGPT generates feedback to a wide range of natural language input using deep learning algorithms. Despite some ethical and security concerns and some technical and algorithmic challenges and limitations, dedicated AI-driven tools like ChatGPT can provide users with personalized learning experiences and effective support.

One of the potential benefits of ChatGPT is that it could provide useful recommendations while writing an essay and assist in improving academic writing (Su & Yang, 2023). Despite possible bias in response, ChatGPT has a potential to improve engagement and provide personalized assistance even in a technical learning area such as statistics and data analytic (Pan & Gu, 2023). It's known that most researchers have difficulty with statistical issues in their research. Even if they have taken many courses throughout their academic careers, they may encounter challenges in finding appropriate statistical techniques and making decisions (Pallant, 2010). ChatGPT has a potential to provide a certain support for the researchers in their research process including literature reviews, research design, data analysis. In the academic field, it is seen that researchers are already using AI-driven technologies in their studies such as writing articles, literature review, reshaping ideas, as well as data processing (Giray et al., 2024). Moreover, there is a growing body of studies on using AI-driven tools such as ChatGPT for qualitative and quantitative data analysis (Şen et al., 2023; Baytak, 2024; Theelen et al., 2024).

On the other hand, it should also be taken into consideration that the AI-generated responses may contain misleading information due to the lack of control mechanism and validation (Li, Enkhtur and Cheng, 2024; Theelen et al., 2024). At this point, how to interact with ChatGPT repeatedly with an effective prompt comes to the fore. To achieve qualified responses from ChatGPT, interaction should continue until an effective prompt is created. And it mostly depends on the competencies of the users (Cronje, 2023).

Researchers with limited learning experience in statistics and research design are expected to seek assistance in finding the appropriate statistical technique for their data analysis. They may often consider contacting academic advising, reading major sources in the field or doing a basic search on the internet. Moreover, ChatGPT can be an alternative to such a challenge.

In this context, this study aims to evaluate how well ChatGPT can assist researchers in finding appropriate statistical techniques by inputting basic and general information about their research. Practically, the focus is on understanding the level of agreement between ChatGPT's recommendations and the actual statistical techniques used in research articles.

## **Materials and Methods**

This is a phenomenological research focusing on the extent to which AI-based tools such as ChatGPT can be used in specific areas and for technical purposes. Phenomenology is often considered as a philosophical approach to describe a phenomenon according to perceptions and to explore the meaning of lived experiences regarding this phenomenon (Sokolowski, 1999).

For the purpose of this study, 20 articles were selected from WoS using maximum variation sampling. All articles are indexed in SSCI, open access, and published between 2020 and 2024. Articles were chosen to represent a variety of research models, including descriptive, survey type, experimental, quantitative, and correlational, and included 22 different statistical

techniques and 8 different research designs. Articles that did not specify a statistical technique, were unclear, or included multiple complex techniques were excluded and reselected.

A prompt was designed for ChatGPT representing researchers with basic competencies but not advanced expertise, who can make inquiries with just basic information about their research intention. The prompt required basic and main information about the research such as aim, research model, sample characteristics, data collection tools, or data sources. The prompt was validated and optimized by controlling repeatedly.

Basic information for each article was provided to ChatGPT using the prompt and recommendations were obtained. The statistical technique or techniques used in the articles were compared with ChatGPT's recommendations. Agreement levels were scaled between 0 and 4, with 0 indicating "no agreement", 1 indicating "low agreement", 2 indicating "moderate or partial agreement", 3 indicating "high agreement", and 4 indicating "full agreement". The agreement levels and the average agreement level were considered to obtain findings and further discussions.

### Findings and Discussion

In this study, totally 20 articles with different methodological and statistical background were used to get statistical technique recommendations from ChatGPT. Information and agreement levels for these articles are shown in Table 1 below.

**Table 1.** Information and agreement levels for the articles

No	Research Model/Design	Statistical Technique Used in the Research	ChatGPT Recommendations	Agreement Level
1	Scale development and descriptive	Partial credit Rasch model	1. Descriptive Statistics 2. Item Analysis (such as Cronbach's alpha and item-total correlations) 3. Factor Analysis	0
2	Web-based Survey	Repeated Measures MANOVA	1. Descriptive Statistics 2. Correlation Analysis (such as Pearson or Spearman correlation coefficients) 3. Comparative Analysis (such as ANOVA or Kruskal-Wallis tests) 4. Regression Analysis	0
3	Online Survey	- Content analysis - One-way ANOVA	1. Descriptive Statistics 2. Correlation Analysis (such as Pearson or Spearman correlations) 3. Structural Equation Modeling (SEM) 4. Multiple Regression Analysis <b>5. Qualitative Analysis (such as thematic analysis or content analysis)</b>	1
4	Experimental	- Mixed ANOVA model 2x2 - t-test.	1. Descriptive Statistics 2. Paired t-Tests 3. Independent t-Tests 4. Analysis of Covariance (ANCOVA) 5. Effect Size Calculation	1

No	Research Model/Design	Statistical Technique Used in the Research	ChatGPT Recommendations	Agreement Level
5	Quasi Experimental	Multivariate analysis of covariance (MANCOVA)	1. Descriptive Statistics 2. Paired t-Tests <b>3. Analysis of Covariance (ANCOVA)</b> <b>4. Multivariate Analysis of Variance (MANOVA)</b> 5. Effect Size Calculation	2
6	Associational/Correlational	Discriminant Function Analysis (DFA)	1. Descriptive Statistics 2. Correlation Analysis 3. Multiple Regression Analysis 4. Factor Analysis 5. Structural Equation Modeling (SEM)	0
7	Longitudinal Survey	Cluster analysis	1. Descriptive Statistics 2. Repeated Measures ANOVA 3. Multivariate Analysis of Variance (MANOVA) 4. Growth Curve Modeling <b>5. Cluster Analysis</b>	1
8	Descriptive based on secondary analysis	Multilevel CFA and SEM	1. Descriptive Statistics 2. Reliability Analysis (such as Cronbach's alpha) 3. Factor Analysis 4. Generalizability Analysis <b>5. Multilevel Modeling</b> 6. Validation Studies	2
9	Scale Development	- Exploratory factor analysis (EFA) - Confirmatory factor analysis (CFA).	1. Reliability Analysis (Cronbach's alpha) <b>2. Factor Analysis (EFA and CFA)</b> 3. Construct Validity 4. Inter-Rater Reliability 5. Descriptive Statistics	3
10	Longitudinal Correlational	- Descriptive statistics - Stepwise multiple regression analyses	<b>1. Descriptive Statistics</b> 2. Content Analysis 3. Correlation Analysis <b>4. Regression Analysis</b> 5. Thematic Analysis 6. Multivariate Analysis	3
11	Survey	- Chi-square tests - Nonparametric tests - Logistic regression analysis	1. Descriptive Statistics 2. Correlation Analysis 3. Multiple Regression Analysis <b>4. Chi-Square Tests</b> 5. MANOVA (Multivariate Analysis of Variance) 6. Cluster Analysis	1
12	Associational/Correlational	Logistic regression	1. Descriptive Statistics <b>2. Logistic Regression</b> 3. Moderation Analysis 4. Multilevel Modeling 5. Survival Analysis	4
13	Longitudinal descriptive	Multilevel modeling (MLM).	1. Descriptive Statistics 2. Repeated Measures ANOVA 3. Growth Curve Modeling 4. Correlation Analysis 5. Cross-Lagged Panel Analysis <b>6. Multilevel Modeling</b> 7. Structural Equation Modeling (SEM)	1

No	Research Model/Design	Statistical Technique Used in the Research	ChatGPT Recommendations	Agreement Level
14	Longitudinal trend descriptive	Multilevel regression	1. Descriptive Statistics <b>2. Multilevel Modeling (Hierarchical Linear Modeling)</b> 3. Cross-National Comparative Analysis 4. Regression Analysis 5. Structural Equation Modeling (SEM) 6. Longitudinal Analysis	4
15	Nonexperimental explanatory	Categorical Principal Component Analysis (CATPCA)	1. Descriptive Statistics 2. Correlation Analysis 3. Multiple Regression Analysis 4. Structural Equation Modeling (SEM) <b>5. Factor Analysis</b> 6. ANOVA (Analysis of Variance)	1
16	Experimental (Effectiveness of a program)	Repeated Measure of Variance Analysis	1. Descriptive Statistics 2. Paired Sample t-Tests 3. Independent Sample t-Tests <b>4. Repeated Measures ANOVA</b> 5. Qualitative Analysis (Thematic Analysis, Content Analysis) 6. Mixed-Methods Integration	2
17	Survey (Based on Document Analysis)	Content Analysis	1. Descriptive Statistics 2. Frequency Analysis 3. Cross-Tabulation <b>4. Thematic Analysis</b> 5. Inferential Statistics (Chi-Square Tests, ANOVA) 6. Correlation Analysis	2
18	Design Based Research	Video-based interaction analysis	<b>1. Qualitative Analysis (Thematic Analysis, Interaction Analysis)</b> 2. Descriptive Statistics 3. Content Analysis 4. Case Study Analysis 5. Triangulation 6. Comparative Analysis	4
19	Qualitative (Exploratory)	- Descriptive statistics - Text mining	<b>1. Descriptive Statistics</b> <b>2. Qualitative Analysis (Thematic Analysis, Content Analysis)</b> 3. Mixed-Methods Integration 4. Cluster Analysis 5. Cross-Tabulation	2
20	Associational/Correlational	- Mean analysis - Factor analysis - Correlation - Hierarchical multiple regression	1. Descriptive Statistics <b>2. Correlation Analysis (Pearson or Spearman Correlation)</b> 3. Multiple Regression 4. Path Analysis 5. ANOVA 6. Cluster Analysis	2
<b>Average</b>				<b>1.8</b>

As seen in Table 1, for 3 articles, there were no matches between ChatGPT's recommendations and the techniques used in the articles. It was observed that these articles did not contain sufficient detail and that there were some incompatibilities between the research purpose and

methodological background and the statistical techniques used. For 3 articles, there were full matches. Unlike previous articles, these articles contain more technical details and also the relationship between purpose, methodology and statistical background is stronger and clearer. The total mean agreement level was 1.8, indicating a moderate level of agreement.

These findings indicate that ChatGPT can provide moderate support in recommending statistical techniques based on basic and key information about the research, including purpose, research model, sample characteristics, and data collection tools. However, its accuracy is affected by the clarity and detail of the input information and the competence of the users. The possible lack of detail, especially in articles written by researchers with poor knowledge of statistics, can lead to biased feedback when using ChatGPT. As emphasized by Giray et al. (2024), benefiting from ChatGPT to reshape scientific inquiry depends on using it conscientiously and making a balance between AI and human interactions.

Second, prompt writing is important to use ChatGPT. If the prompt is based on basic and general information, ChatGPT can only provide moderate recommendations for appropriate techniques, and the accuracy of the recommendations will be lower. Moreover, in this case, ChatGPT's feedback may mislead users. Ultimately, effective use of ChatGPT depends on the specificity of the prompt, the detail and accuracy of the input information provided, and the competencies of the users. Improving the prompt design and providing detailed information can improve recommendation accuracy. As Cronje (2023) stated, the quality of feedback mostly depends on the value of the prompt. And, a well-designed prompt is essential for using ChatGPT.

### **Conclusion and Recommendations**

The results of this study indicate that it's difficult to obtain precise and accurate statistical technique recommendations when interacting with ChatGPT without sufficiently specific and technical details of research. It would be better that some specific details about the data characteristics should be inputted into the ChatGPT besides purpose, methodology, sample characteristics and data collection tools. This requires some certain level of methodological and statistical proficiency. Besides, the quality and characteristics of the prompt is crucial for getting the significant response from ChatGPT. At that point, "prompt writing" comes front.

In conclusion, while ChatGPT has a potential in aiding researchers with basic competencies in selecting statistical techniques, getting assistance mostly depends on users ability, competency and proficiency. This is a multidimensional subject that includes at least some certain skills of prompt writing, methodology and statistics. Without adequate methodological and statistical competencies, and also prompt writing skills, it is unlikely to be able to use ChatGPT effectively in finding appropriate statistical techniques. The researchers who want to get support from ChatGPT in this subject may consider improving their own skills in these areas. Future research could focus on improving prompt design, particularly by adding information about variable structure.

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## 3PL MODELDE PARAMETRE KESTİRİMİNDE BAYESÇİ VE KLASİK EN ÇOK OLABİLİRLİK YÖNTEMLERİNİN KARŞILAŞTIRILMASI

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### Özet

Psikometrik araştırmalarda, özellikle üç parametrelili lojistik (3PL) model bağlamında, titiz madde parametre kestirimi için uygun istatistiksel tekniklerin seçilmesinde bir zorluk vardır. Bu çalışma, örneklem büyüklüğü ve madde sayısının etkisine odaklanarak, 3PL modelinde parametre kestiriminde Bayesçi ve klasik maksimum olabilirlik (ML) tahmin yöntemlerinin performansını araştırmaktadır. Simülasyona dayalı bir deneysel tasarımla yürütülen bu çalışmada, madde sayısı (10, 20 ve 40) ve örneklem büyüklüğü (100, 250, 500, 1000 ve 2000) değişimlenmiştir. Veriler 3PL modeline uygun olarak klasik Monte Carlo yöntemiyle ve koşul başına 10 tekrarlar üretilmiştir. Üretilen veri setleri üzerinde hem Bayesian hem de klasik ML yöntemleriyle madde parametreleri kestirilmiştir. Sonraki analizler, gerçek ve kestirilen madde parametreleri arasındaki korelasyonların hesaplanmasını, kestirim yanlışlıklarının değerlendirilmesini ve denekler-arası (yöntem, parametre türü, madde sayısı ve örneklem büyüklüğü) ve denekler-içi (tekrarlama sayısı) etkilerin manidarlığını test etmek için hesaplanan korelasyonlar üzerinde karma model MANOVA gerçekleştirilmeyi içermektedir. Simülasyon algoritmalarının hazırlanmasında, istatistiksel analizlerde, çıktılarının düzenlenmesi ve görselleştirmelerde R 4.4.1'den yararlanılmıştır. Bulgular, hem Bayesçi hem de klasik yöntemlerin artan örneklem büyüklüğü ve madde sayısı ile daha yüksek korelasyonlar sağladığını göstermektedir. Örneklem büyüklüğü madde sayısından daha etkilidir. Özellikle Bayesçi kestirimler, klasik yöntemlere kıyasla, tüm parametrelerde daha yüksek korelasyonlar üretmiştir. Özellikle daha küçük örneklem büyüklükleri için daha iyi performans göstermiştir. Daha büyük örneklem büyüklüklerinde (örneğin, 1000 ve 2000), her iki yöntemin performansı birbirine yaklaşmaktadır. Bununla birlikte, özellikle küçük örneklemelerde a- ve c- parametrelerinin titiz bir şekilde kestirilmesi konusunda güçlükler devam etmektedir. Örnek boyutunun artırılması a- parametresi için yeterli titizliği sağlayabilmekte, ancak c parametresi için sağlayamamaktadır. Sonuç olarak bu çalışma, 3PL gibi karmaşık psikometrik modellerde parametre kestirmeyi iyileştirmek için daha gelişmiş algoritmalara olan ihtiyacı göstermektedir.

**Anahtar Kelimeler:** Bayesçi kestirim, en çok olabilirlik, madde parametre kestirimi, üç parametrelili lojistik model, simülasyon, kestirim yanlışlığı

## A COMPARISON OF BAYESIAN AND CLASSICAL MAXIMUM LIKELIHOOD ESTIMATION METHODS ON ITEM RECOVERY IN THE 3PL MODEL

### Abstract

In psychometric research, especially in the context of the three-parameter logistic (3PL) model, there is a challenge in selecting appropriate statistical techniques for accurate item recovery. This study investigates the performance of Bayesian versus classical maximum likelihood (ML) estimation methods for parameter recovery in the 3PL model, with a focus on the impact of sample size and number of items. In this study, conducted with a simulation-based experimental design, the number of items (10, 20 and 40) and sample size (100, 250, 500, 1000 and 2000) were varied. Data were generated with the classical Monte Carlo method in accordance with the 3PL model and with 10 replications per condition. Item parameters were estimated with both Bayesian and classical ML methods on the generated data sets. Further analyses included calculating correlations between true and estimated item parameters, assessing estimation biases, and performing a mixed-model MANOVA on the calculated correlations to evaluate the significance of between-subject factors (method, parameter type, number of items, and sample size) and within-subject factors (number of replications). R 4.4.1 was used in the preparation of simulation algorithms, statistical analysis, editing of outputs and visualizations. Findings indicate that both Bayesian and classical methods provide higher correlations with increasing sample size and number of items. Sample size is more effective than the number of items. In particular, Bayesian estimations produced higher correlations in all parameters compared to classical methods. It performed especially better for smaller sample sizes. At larger sample sizes (e.g., 1000 and 2000), the performance of both methods approaches each other. However, difficulties remain in accurate estimating a- and c-parameters, especially in small samples. Increasing the sample size can provide sufficient accuracy for the a-parameter, but not for the c-parameter. In conclusion, this study demonstrates the need for more advanced algorithms to improve item recovery in complex psychometric models such as 3PL.

**Keywords:** Bayesian estimation, maximum likelihood, item recovery, three-parameter logistic model, simulation study, estimation bias

## **Introduction**

In the Item Response Theory (IRT) framework, “item recovery” refers to the accuracy with which the true parameters of the items (such as difficulty, discrimination, and guessing) can be estimated from the observed response data. Basically, “item recovery” focuses on how well the estimated item parameters (from the model) match the true, underlying item parameters. Selection of an appropriate model is crucial to obtain accurate estimations or item recovery. At this point, model-data fit issues come to the fore in the context of model validity.

In IRT, particularly when simulating or applying models like the 3PL (three-parameter logistic) model, you often work with item characteristics that describe how individuals of various abilities will respond to the items. Three parameters estimated for each item in the 3PL model; difficulty (b-parameter), discrimination (a-parameter) and guessing (c-parameter). The b-parameter expresses the probability of answering the item correctly. The a-parameter expresses how well the item distinguishes individuals at different ability levels. And, c-parameter refers to the probability that a person with the lowest ability will guess the correct answer.

In the 3PL model, the estimation of the c-parameter might be challenging due to the limitations of the model, even when using unbiased estimation methods. The c-parameter is designed to capture the likelihood of guessing by low-ability examinees. In practice, there are often few examinees in the lower tail of the ability distribution who respond to items correctly. This makes it hard for the model to get enough data to accurately estimate the guessing parameter, leading to noisy or unstable estimates. If an examinee with low ability answers an item correctly, it can be difficult to determine whether this was due to guessing or an accurate assessment of the person's ability. This confounding effect reduces the accuracy of the guessing parameter estimates. Moreover, parameter estimations, especially c-parameters, are sensitive to the method used. Often, maximum likelihood methods can overestimate the guessing parameter because they try to account for any correct responses among low-ability respondents as guessing. For such reasons, item recovery for c-parameters in 3PL can often be low. Some solutions can be considered to solve these problems, such as (1) fixing the c-parameters to a known or reasonable value, (2) using Bayesian estimation methods with informative priors, (3) expanding the sample size or number of items.

In this context, this study addresses the challenge of selecting appropriate statistical techniques for item parameter estimation in psychometric research, specifically within the context of the three-parameter logistic (3PL) model. The primary objective of this study was to evaluate item recovery in the context of the 3-Parameter Logistic (3PL) model. Specifically, the study aimed to compare the performance of Bayesian and classical maximum likelihood (ML) estimation methods in recovering item parameters in different conditions. The hypothesis was that Bayesian estimation would outperform classical ML estimation, particularly in scenarios with smaller sample sizes and fewer items.

## **Materials and Methods**

This study was conducted based on Monte Carlo simulation. Considering the manipulation of conditions, randomisation of initial parameters, replications for each condition, and effects of between-within subject factors, this study can be described as an experimental design. In an

experimental research, independent or treatment variables can be manipulated to observe their effects on dependent variables (Fraenkel, Wallen, & Hyun, 2012). Such manipulations allow causal relationships to be tested and established.

In this simulation-based study, the effectiveness of item parameter recovery for the 3PL model was investigated under different conditions and using different parameter estimation methods. Two main simulation conditions were taken into account in the study: Number of items (10, 20, and 40) and sample size (100, 250, 500, 1000, and 2000). There were  $3 \times 5 = 15$  different conditions in the simulation design. The datasets for 3PL model were generated with Monte Carlo simulations under these conditions. 10 replications were provided for each condition. In total, 150 different datasets were generated.

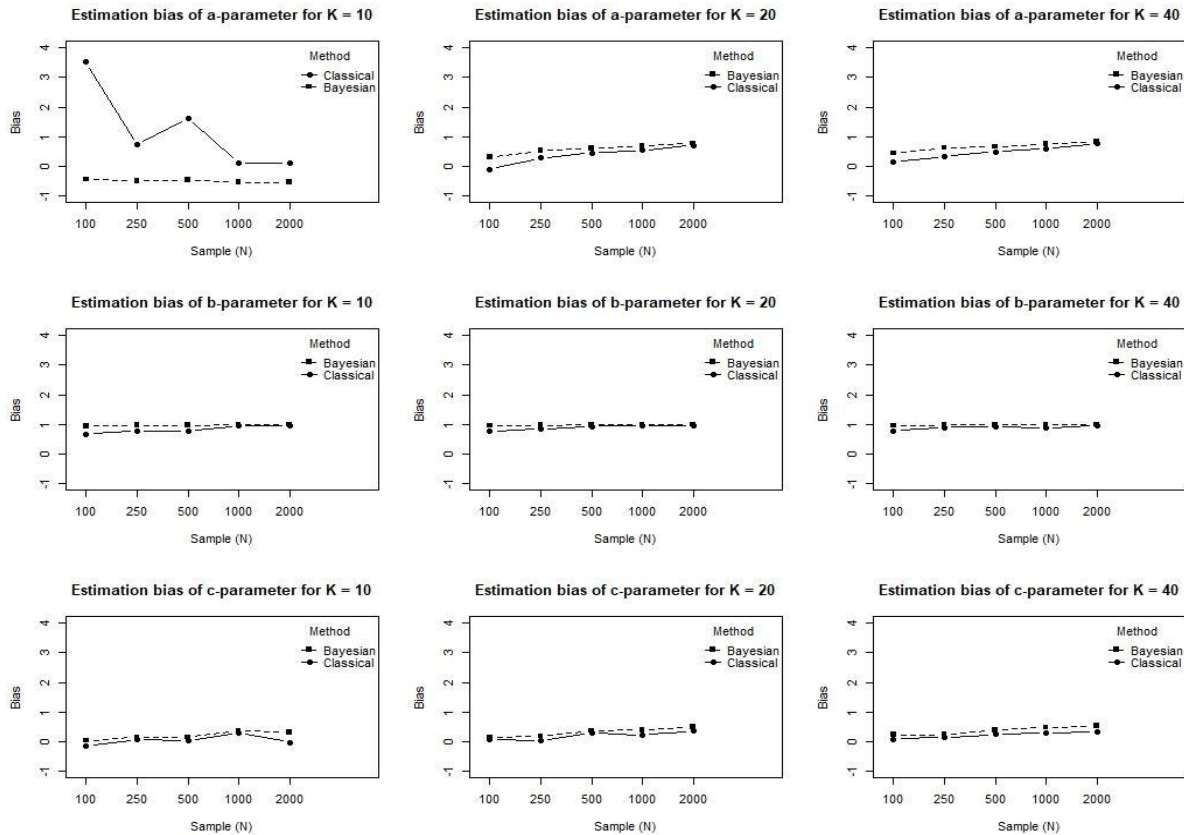
Data generation process was executed with R 4.4.1 software language (R Core Team, 2024). The codes for data generation were written by the writer and given below.

```
generate_3pl_data <- function(num_items, num_persons) {
  a <- rlnorm(num_items, 0.3, 0.2)
  b <- rnorm(num_items, 0, 1)
  c <- rbeta(num_items, 20, 90)
  theta <- rnorm(num_persons)
  p_3pl <- function(a, b, c, theta) { c + (1 - c) / (1 + exp(-a * (theta - b))) }
  responses <- matrix(NA, nrow = num_persons, ncol = num_items)
  for (i in 1:num_persons) {
    for (j in 1:num_items) {
      prob_correct <- p_3pl(a[j], b[j], c[j], theta[i])
      responses[i, j] <- rbinom(1, 1, prob_correct)
    }
  }
}
```

After data generation, item parameters were estimated using both Bayesian and classical ML methods. In estimating the item parameters, the R packages *mirt* (Chalmers, 2012) for classical ML estimations and *IRTBEMM* (Shaoyang et al., 2020) for Bayesian estimation were used. Assuming the initial parameters given in the above codes as “true” parameters, the correlations between true and estimated item parameters were computed. Besides, estimation biases were calculated for each method and for each condition and replications. Also, mixed-model MANOVA was conducted to assess the significance of between-subject factors (method, parameter type, number of items, and sample size) and within-subject factors (number of replications). The results were visualized in R to provide clear understanding.

## Findings and Discussion

Estimation biases for each item parameters and for the simulation conditions are given in Graph 1 below.



**Graph 1.** Estimation biases of item parameters for each simulation conditions

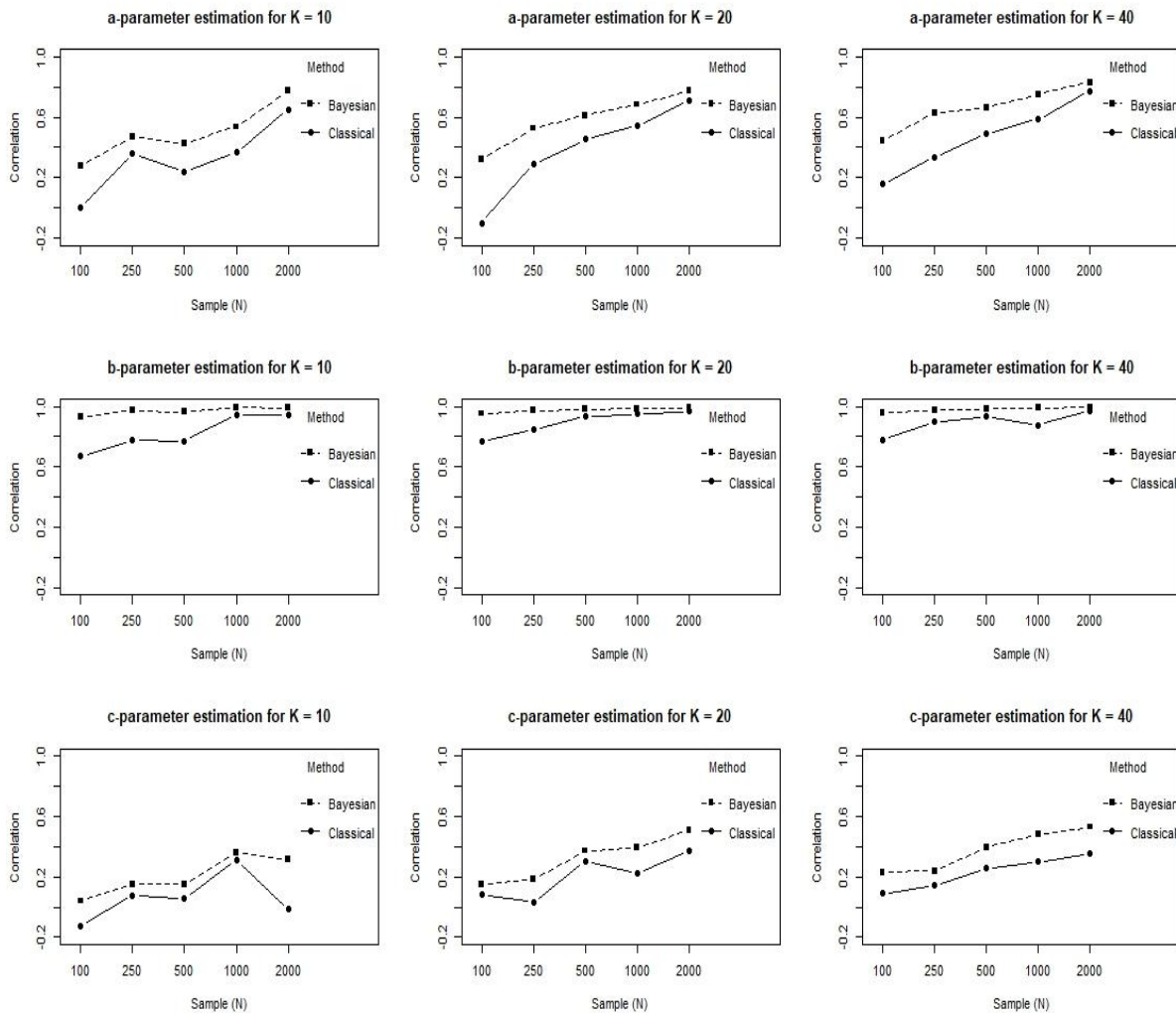
As seen in Graph 1, except for the 10-item condition in ML estimates for a-parameter, there is generally no estimation bias problem in other cases and conditions. In this condition, it might be possible for the a-parameter estimates to be biased when the sample size is low (e.g. 100). In all other conditions, for both ML and Bayesian estimation methods, estimation biases are stacked around 0-1 range.

It can be argued that the estimates obtained are sufficiently accurate, as no serious estimation bias is observed. And then correlations between the true and estimated parameters for each parameter and both ML and Bayesian methods were calculated separately. These correlation coefficients were considered as dependent variables. To test the effects of the factors on these correlations, mixed-MANOVA was conducted by including main effects and interaction effects. The results of mixed-MANOVA are presented in Table 1 below.

**Table 1.** The results of mixed-MANOVA for the between-subject effects of factors on correlations.

Source	Df	Test Stat	Approx F	Num Df	Den Df	Pr(>F)
(Intercept)	1	0.99612	1000.53	10	39	0.0000
Method	1	0.80449	16.05	10	39	0.0000
Parameter	2	1.4417	10.33	20	80	0.0000
Num_Items	2	0.7765	2.54	20	80	0.0018
Num_Persons	4	1.61343	2.84	40	168	0.0000
Method:Parameter	2	0.49081	1.3	20	80	0.2034
Method:Num_Items	2	0.36756	0.9	20	80	0.5871
Parameter:Num_Items	4	1.09541	1.58	40	168	0.0239
Method:Num_Persons	4	0.65403	0.82	40	168	0.7653
Parameter:Num_Persons	8	2.51127	2.1	80	368	0.0000
Method:Parameter:Num_Items	4	0.68671	0.87	40	168	0.6903
Method:Parameter:Num_Persons	8	0.97968	0.64	80	368	0.9913

As seen at Table 1, all main effects are statistically significant on the correlations between the true parameters and the estimated parameters. Pairwise and triple effects are generally not significant or indicate no serious effects. According to these findings, correlation coefficients are varied significantly depending on different methods, parameter types, number of items and sample size. The correlation coefficients obtained for different simulation conditions according to different estimation methods are presented in Graph 2.



**Graph 2.** Correlations between true and estimated item parameters according to the estimation methods and sample size (separated by number of items)

As seen in Graph 2, the correlations between true and estimated item parameters were influenced by the estimation method, parameter type, sample size, and number of items. First, it can be observed that both Bayesian and classical ML methods provide increasing correlations with larger sample sizes and more items. There is some research to support this. For instance, Hulin et al. (1982) recommended the samples of 1,000 examinees with tests of 60 items for highly accurate estimation. Similarly, Mislevy (1986) indicated that the 3PL model would work well in recovering item parameters with a sample size of 1000 and a 20-item instrument. Such recommendations are general and do not include the details for specific parameters.

Second, the findings of this study indicate that item parameters are affected differently in the context of recovery. The b-parameters provide the highest correlations and the level of item recovery is high in all conditions. This means there are no recovery problems for b-parameters. On the other hand, a-parameters are affected by the sample size and number of items. Larger samples (e.g., 1,000 or more) and number of items (e.g., 40 or more) are required to obtain

accurate estimates of this parameter. Considering the c-parameters, it is seen that the recovery problem continues even if the sample size and number of items are high. This means increasing the sample size or number of items can provide higher item recovery for a- and b- parameters, but not sufficient for c-parameters.

Third, it can be seen that a-parameter and c-parameter are affected by each other. de Ayala (2009) stated that estimating the c-parameter was problematic and this problem can influence the estimation of the other item parameters, especially a-parameter because of the paucity of observations at the lower level of the theta continuum. For this lower group, it can be anticipated the items have low estimated discrimination parameters.

Fourth, Bayesian estimation generally produces higher correlations for all parameters, particularly in smaller samples (e.g., 500 and below). In small samples (e.g., 100), classical ML method might yield non-significant correlations for a- and c-parameters. De Ayala (2009) emphasized that Bayesian approach can provide some advantages over classical ML estimations because finite theta definitions are available. On the other hand, there is a potential risk for bias due to the mismatching between individuals' theta and the means of theta priority in Bayesian modeling. This means, Bayesian modeling can provide estimation accuracy if the priorities are sufficiently valid. Additionally, there is some research indicating how sensitive the ML estimation methods are to sample size and number of items. For instance, Yen (1987) compared Joint-ML and Marginal-ML estimation methods in different simulation conditions. And, he indicated that MML estimations were more robust than JML estimations, even though ML estimates were sensitive to the sample size and number of items.

Although the Bayesian method works well in small samples and fewer items, for large samples (e.g., 1000 and 2000), the performance of both methods converges with high correlations for b-parameters (over 0.90). However, correlations range between 0.60 and 0.80 for a-parameters and between 0.20 and 0.40 for c-parameters.

### **Conclusion and Recommendations**

The study demonstrated that Bayesian estimation offers advantages in item recovery, particularly for small sample sizes and fewer items. However, challenges remain in accurately recovering a- and c-parameters. Bayesian methods, while more effective than classical methods especially in the condition of small samples and lower number of items, still have limitations. As sample sizes increase, the performance of both methods becomes more comparable. Even if the sample size and number of items are large and even both ML and Bayesian methods are applied, the problem in item recovery for the c-parameter still remains. Future research should focus on refining algorithms for better recovery of a- and c-parameters and exploring the relationship between these parameters in the context of item recovery.



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## ***Spartium junceum* L. TÜRLERİ ÜZERİNE SİSTEMATİK ÇALIŞMALAR**

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### **Özet**

*Spartium junceum* L., Türkiye'nin biyolojik çeşitliliğine katkıda bulunan ve çeşitli amaçlarla etnobotanik kullanımı olan önemli tıbbi ve aromatik bitkilerden biridir. Bu çalışma ile öncelikle türün geçmiş yıllarda göz ardı edilen genel morfolojik özelliklerine odaklanarak taksonomik sınıflandırma süreçlerine katkı sağlanması amaçlanmıştır. Bu kapsamda, bitki yaşam formu, kök, gövde ve yaprak özellikleri, çiçek durumu ve kısımları, meyve ve tohum makromorfolojik yapılarına ait karakterler güncellenerek tanımlama süreçlerine daha fazla netlik kazandırılmıştır. Türün tohum ve meyve yüzey mikromorfolojik yapıları Taramalı Elektron Mikroskobu ile ortaya çıkarılmış ve bu karakterlerin sistematik öneminin olup-olmadığı sorgulanmıştır. Tohumlar mikromorfolojik olarak konkav periklinal hücre duvarlarına, yükseltilmiş antiklinal hücre duvarlarına ve retikulat yüzey ornamentasyonuna sahiptirler. Polen karakterleri ışık ve taramalı elektron mikroskobu ile ayrıntılı bir şekilde araştırılmıştır. Türün polenleri sırasıyla  $31,67 \pm 0,18 \mu\text{m}$  ve  $22,39 \pm 0,12 \mu\text{m}$  kutup ve ekvator eksenine sahip radyal, prolat ve izopolardır. Polenler trikolpat açıklıklara sahiptirler. Polen ornamentasyonu mikroretikulattır. Bu çalışma ile *S. junceum* türünün makromorfolojik, mikromorfolojik ve palinolojik karakterleri çalışılarak türün sistematik bilgisine katkıda bulunulmuştur.

**Anahtar Kelimeler:** Deskripsiyon, Polen, SEM, *Spartium junceum*, Tohum

## SYSTEMATIC STUDIES ON *Spartium junceum* L. SPECIES

### **Abstract**

*Spartium junceum* L. is one of the important medicinal and aromatic plants that contribute to Turkey's biological diversity and has ethnobotanical use for various purposes. This study aims to contribute to the taxonomic classification processes by focusing primarily on the general morphological features of the species that have been ignored in the past years. In this context, the characters of plant life form, root, stem and leaf characteristics, flower status and parts, fruit and seed macromorphological structures have been updated and the identification processes have been clarified. The seed and fruit surface micromorphological structures of the species have been revealed by Scanning Electron Microscope, and it has been questioned whether these characters have systematic importance. Micromorphologically, the seeds have concave periclinal cell walls, raised anticlinal cell walls and reticulate surface ornamentation. Pollen characters have investigated in detail using light and scanning electron microscopy. The pollen of the species is radial, prolate and isopolar, with polar and equatorial axes of  $31.67 \pm 0.18 \mu\text{m}$  and  $22.39 \pm 0.12 \mu\text{m}$ , respectively. Pollen is tricolpate, and its ornamentation is microreticulate. This study has contributed to the systematic knowledge of the species by studying the macromorphological, micromorphological and palynological characters of *S. junceum*.

**Keywords:** Description, Pollen, SEM, *Spartium junceum*, Seed

## Introduction

Turkey is among the countries that are important in terms of medicinal and aromatic plants and is also considered a gene center for many plants (TÜBİVES, 2012). Although our country has a very wide flora richness in terms of the special plant material needed in these studies due to its geographical location, natural plants are not used sufficiently in planting studies. In recent years, interest in healthy and sustainable lifestyles has been rapidly increasing. This trend includes individuals' efforts to review their nutritional habits, become interested in herbal treatment methods, and fulfill their environmental responsibilities more consciously. The desire to focus on environmental and social sustainability, as well as a healthy life, directs individuals to more conscious and thoughtful lifestyles.

*Spartium junceum* L., which is a medicinal and aromatic plant, is species native to the Mediterranean region, including Southern Europe and North Africa, Turkey and the Middle East, it is now found in many tropical, subtropical and temperate regions of the world (Sanhueza & Zalba, 2012; Gavilán et al., 2016). In our country, it grows mainly in shrubs close to the sea in Northern and Southern Anatolia (Seçmen et al., 1995). The provinces in our country are reported as Antalya, Çanakkale, Hatay, Mersin, Istanbul, Izmir, Kastamonu, Kocaeli, Muğla, Samsun, Sinop and Trabzon (TÜBİVES, 2012). *Spartium junceum* is known by different Turkish names such as Katırtırnağı, Spanish mulecat, Katırkuyruğu, Kuş Çubuğu, Boruk (Nadaf et al., 2012). *Spartium junceum* belongs to the Fabaceae family. It is a perennial plant in shrub form. It can spread up to 600 m altitude. It can grow up to approximately 3 meters tall. Its trunk and shoots are green and very branched. Its leaves are simple and small. Its flowers have a strong scent, are light yellow in color and are in sparse clusters. The flowering period is May-July. flowers; The corolla is butterfly-shaped and bright golden yellow. Its fruit is 6-9 cm long, hairless, in pod form and may contain 15-20 seeds (TÜBİVES, 2012). There are many studies in the scientific world that show that plants show antioxidant, anti-inflammatory and antimicrobial effects through the bioactive molecules they contain, thus contributing to the treatment of many diseases. For this reason, plant-based nutrition and treatment methods are now considered important strategies based on scientific foundations.

Ethnobotany helps us understand the cultural significance of plants and people's deep connection with nature. It also emphasizes that local knowledge and traditional practices are elements that should be protected and valued. For this reason, ethnobotany is an important field of research and action for the purpose of protecting biological diversity and cultural heritage (Koçyiğit, 2005). Ethnobotanical studies help to evaluate plants scientifically (Kendir & Güvenç, 2010). Determining how to benefit from plants will only emerge through ethnobotanical studies, and in this way, the information obtained from the public will contribute to the public's economy (Kendir & Güvenç, 2010). Examining the medicinal values of plants identified through systematic research in different geographical regions and containing traditional knowledge is important to determine the potential therapeutic properties of plants that have not yet been medically researched. Systematic analysis of such plants will go beyond the mere numerical data of our country's plant diversity and contribute to our understanding of the medicinal importance and potential uses of these plants. In ethnobotanical use, some reports of *S. junceum* being used against certain health problems can be found in various cultures.

However, scientific research does not provide sufficient information about the deficiencies in the description of this plant taxon and how effective it is medicinally. Due to its scientifically proven effects, studies on the *S. junceum* plant are increasing day by day. *S. junceum* flower infusions are used in ethnobotanical use in the treatment of stomach ulcers (Yeşilada & Takaishi, 1999); It has also been shown that methanol extracts prepared from the flowers of the species have an in vivo anti-ulcerogenic effect against ethanol-induced gastric lesions in rats, due to an oylene-type triterpenoid saponin called spartitrioside (Yeşilada & Takaishi, 1999). It has been reported that its flowers show mild sedative and diuretic activities (Baytop, 1984), anti-inflammatory and analgesic activities (Menghini et al., 2006).

Before starting to study the extract to be isolated from a species for various purposes; It is essential to be sure of the identification of the species and to complete its description. For this purpose, in the literature review, it is seen that the description of the *S. junceum* species contains deficiencies in terms of macro and micro morphology, and palynology, and that the description of the species needs to be completed with systematic studies. In this study, the deficiencies in the description of the species were eliminated by macromorphological studies to be carried out on samples collected from the areas where *S. junceum* species are distributed; Fruit and seed surfaces were examined in detail with a scanning electron microscope and micro morphological descriptions were revealed; and pollen morphological characters were studied, contributing to the systematic knowledge of the species.

## **Materials and Methods**

The *S. junceum* species, which is widely used in ethnobotanical use in the study, was taken from its natural locations in Bartın in May-September, identified according to the Flora of Turkey and descriptions of various researchers, and turned into herbarium material to be used in subsequent studies.

Morphological measurements were carried out on living material in the field and on herbarium samples. In these studies, the taxonomic characters in the Flora of Türkiye used in the identification of *S. junceum* species were revised. The detected morphological characters were measured at least 20 times from 20 different individuals for each taxon. The descriptions of the examined taxa were expanded with the characters used. Macromorphological features of fruits and seeds, such as shape, size, color and number of seeds in the loculus, were photographed with a Canon camera connected to a stereo microscope (Olympus ZS51). In addition, measurements were made regarding the specified characters on the photographs with the help of the KAMERAM Imaging Software computer program. Harris & Harris (1994) was used to define fruit and seed morphological characters.

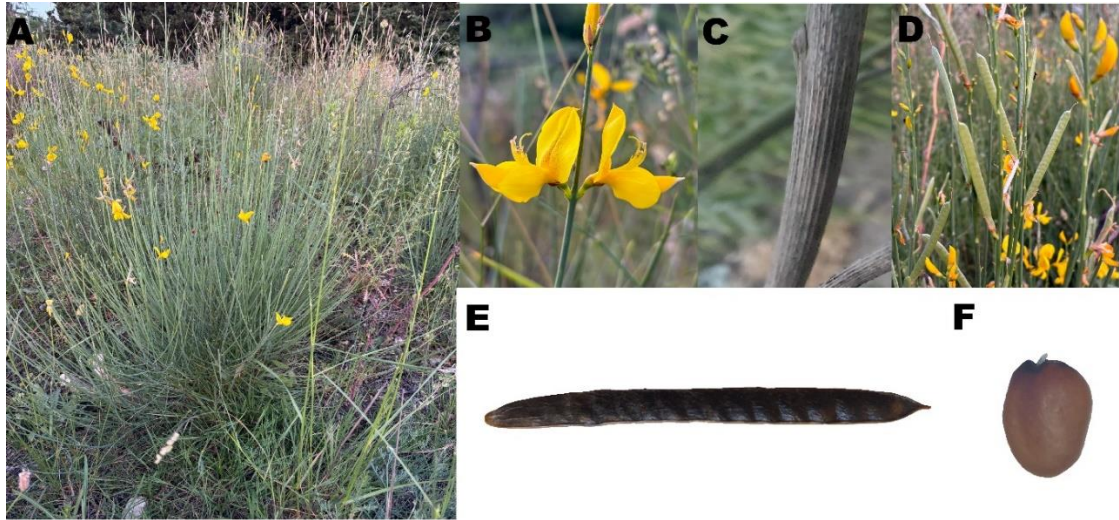
Micromorphological features such as surface ornamentations, cell wall and epidermal cell structures of fruits and seeds were studied with scanning electron microscopy (SEM). First of all, fruits and seeds were glued to a sample tray (Stub) with silver glue (Agar Silver Paint) or double-sided carbon tape. Then coated 90 seconds with gold palladium and finally imaged in TESCAN MAIA3 XMU branded SEM, pictures were recorded and micromorphological structures were named. Stearn (1992) was used to determine the surface ornamentations of seeds and fruits.

For micromorphological observations of pollen, samples were prepared for electron microscopy. First, the samples were fixed on a stub with silver-agar or double-sided carbon tape. Afterwards, it was coated with gold-palladium and micrographs were taken using a TESCAN MAIA3 XMU scanning electron microscope. Pollen preparations for light microscope observations were prepared using the Wodehouse method (1935). Floral samples of each taxon were fixed in Carnoy's solution. The flowers were separated from the solution and then the anthers taken from the mature flower buds with the help of a dissecting needle were coated with a mixture of glycerin-gelatin-liquid safranin. Examinations were made with 50 or more pollen from five preparations (Karaismailoğlu & Erol, 2019). The prepared preparations were examined under an Olympus CX21FS1 light microscope and photographed with the computer program called KAMERAM Imaging Software. The used pollen terminology was consistent with Faegri & Iversen (1989), Brochmann (1992) and Punt et al. (1994)

### **Findings and Discussion**

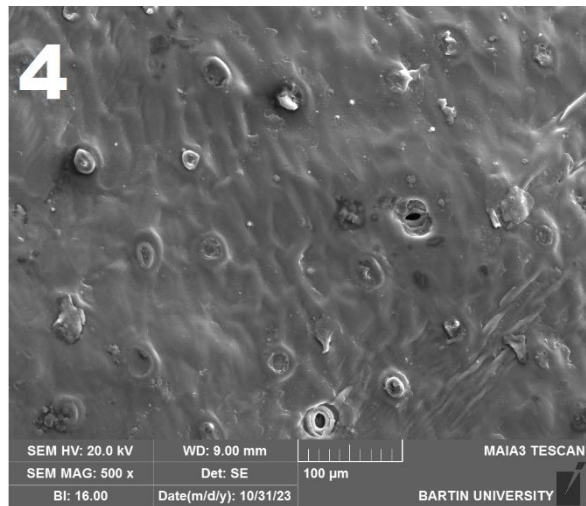
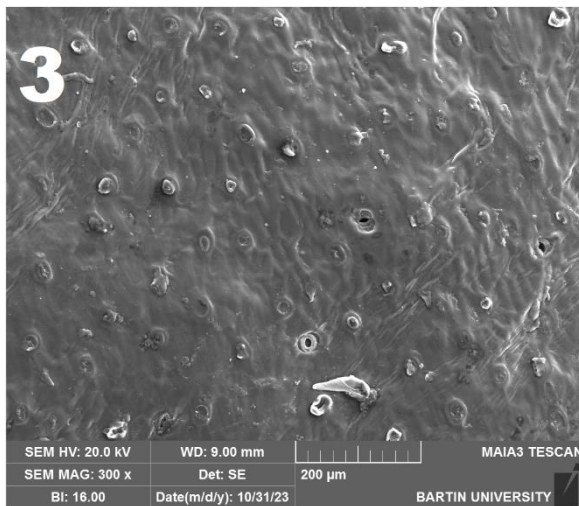
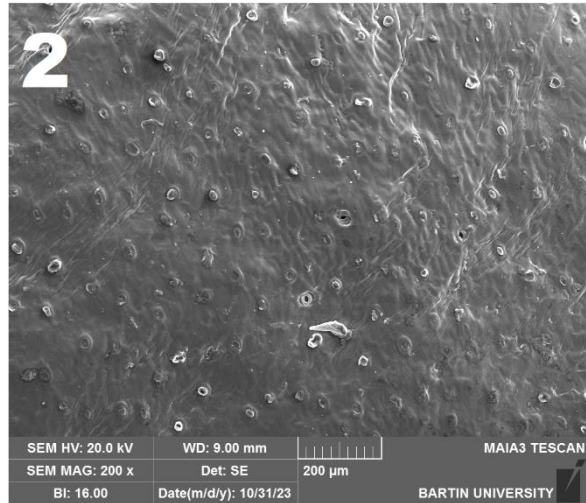
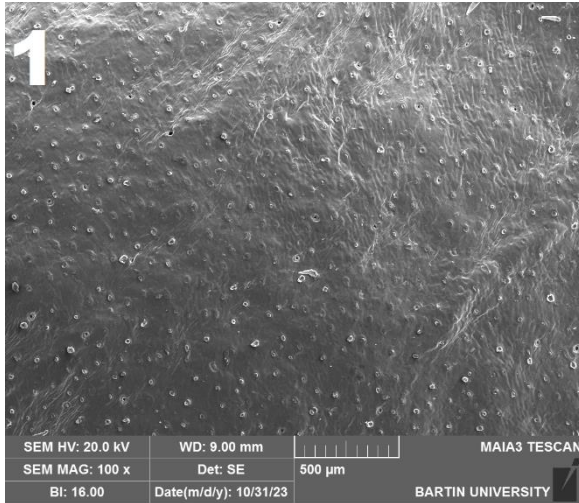
Photographs of the vegetative and generative parts of the species are given in Figure 1. The updated macromorphological description of the species is given below;

**Plant:** Perennial, singly or in clusters, 1 – 5 m tall, in shrub form. **Root:** Thickened woody, tap root. **Stem:** Erect, heavily branched, ribbed, glabrous. **Leaves:** gray-green shoots, sparse, simple, deciduous, stipules absent, 1 – 5 cm long x 2 – 5 mm wide, leaf tip acute or obtuse, leaf margins toothless. **Inflorescence:** racemose, flowers arranged circumferentially, clusters loose, number of flowers in clusters 5 – 30, elongated in fruit, cluster length 4 – 25 cm. **Calyx:** with 5 sepals united. **Sepals:** oval, brown-yellow, 4 – 7 mm long x 3 – 4.5 mm wide. **Petals** are in the form of flaglets, winglets and boatlets, golden yellow, with flaglets and boatlets protruding outward at the tip in the form of a beak. **Flaglet** is oval, 22 – 31 mm long x 14 – 18 mm wide. **Winglets** oval-rectangular, 13 – 20 mm long x 4 – 7 mm wide, rounded or obtuse at the tip. **Boats** are oval-rectangular, 17 – 22 mm long x 4 – 6 mm wide. **Stamens:** monodelf. **Anthers:** 1.7 – 2.1 mm long. **Filaments:** straight 14 – 18 mm long. **Ovary:** linear, 6 - 8 mm long x 1 – 1.2 mm wide, hairy. **Fruit:** a horizontally compressed legume, brown, linear-oblong, 50 – 110 mm long x 5 – 9 mm wide, with 10 – 24 seeds, self-opening. **Seed:** oval-rectangular, 4 – 5.5 mm long x 3 – 4 mm wide, brown, surface structure smooth. **Flowering:** 5 – 7. **Fruiting:** 6 – 8.



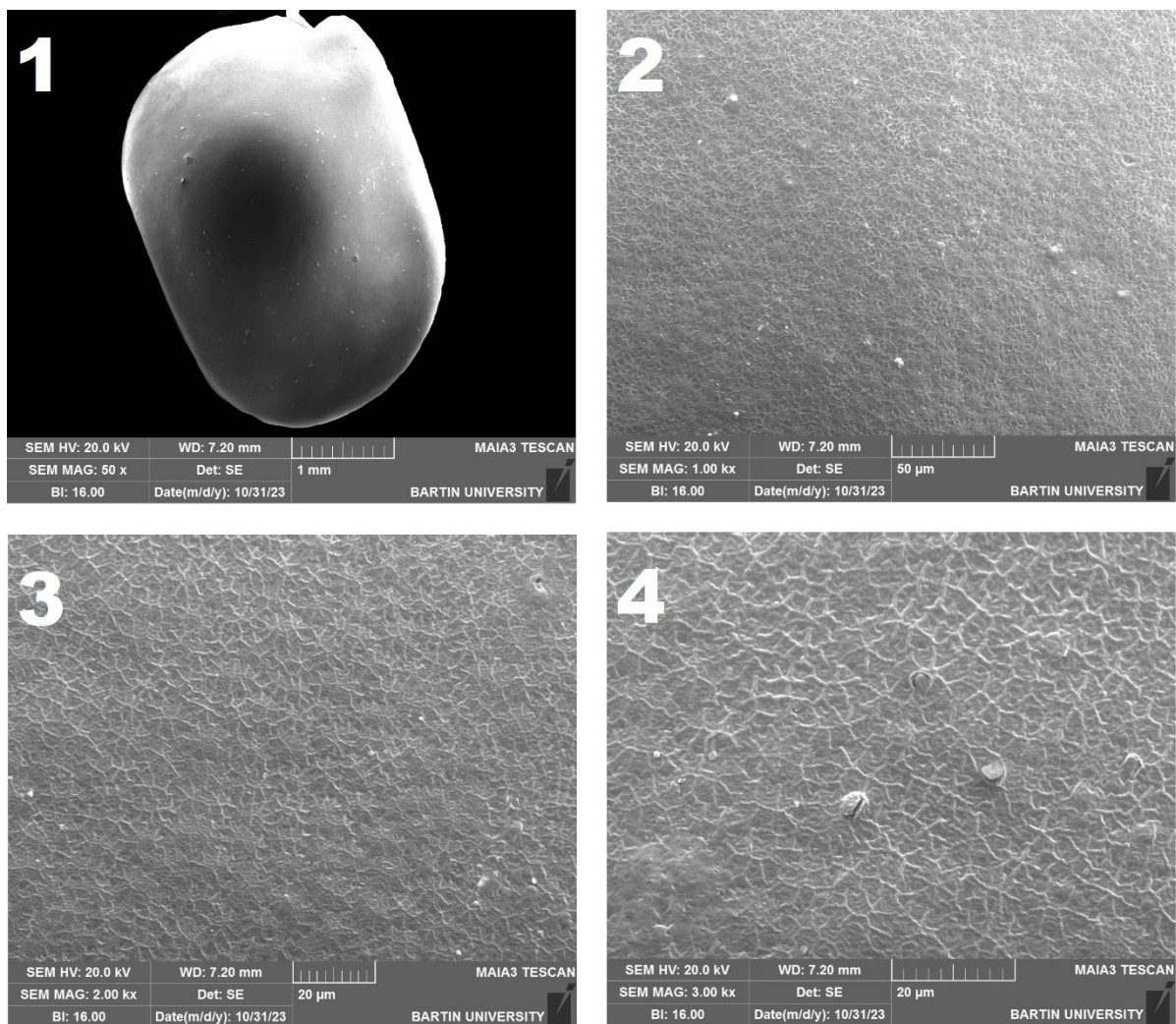
**Figure 1.** *Spartium junceum*; **A:** general view, **B:** flower, **C:** stem, **D and E:** fruit, **E:** seed.

The fruit and seed surface micromorphological structures of the species have been revealed by Scanning Electron Microscope (SEM) and the systematic importance of these characters is questioned. Micromorphologically, vague anticlinal and periclinal cell walls and tuberculate surface ornamentation are observed in the fruits (Figure 2). The seeds have concave periclinal cell walls, raised anticlinal cell walls and reticulate surface ornamentation (Figure 3).



**Figure 2.** Fruit micro morphological structures; **1:** 100 X, **2:** 200 X, **3:** 300 X and, **4:** 500 X.



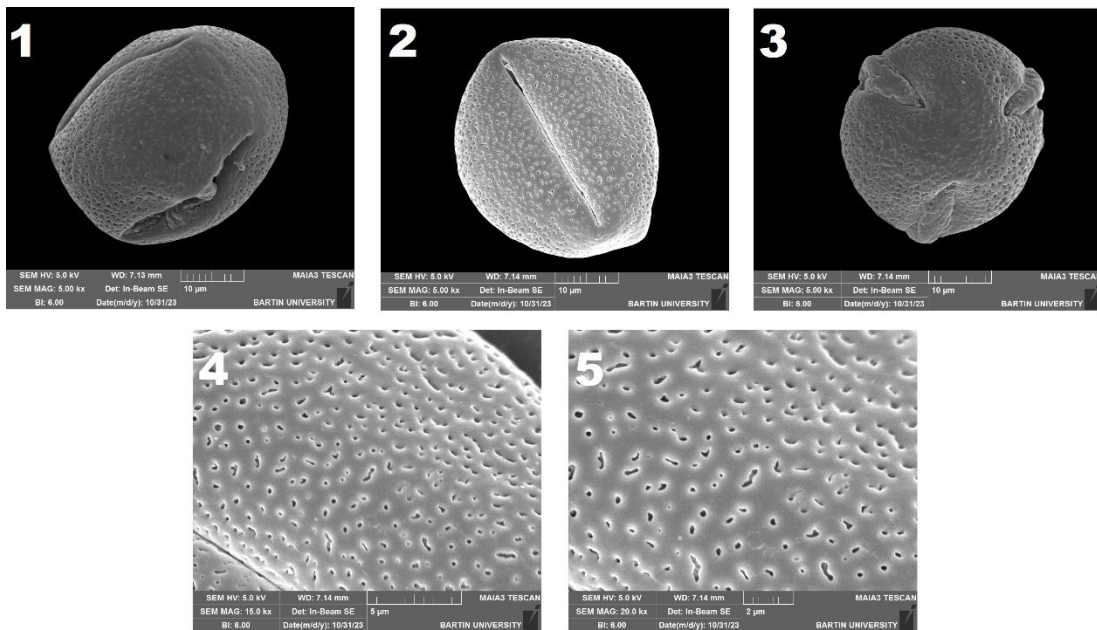


**Figure 3.** Seed micro morphological structures; **1:** 50 X, **2:** 1000 X, **3:** 2000 X and, **4:** 3000 X.

Pollen characters have been investigated in detail using light and scanning electron microscopy (Figures 4 and 5). The pollen of the species is radial, prolate and isopolar, with polar and equatorial axes of  $31.67 \pm 0.18 \mu\text{m}$  and  $22.39 \pm 0.12 \mu\text{m}$ , respectively. Pollens have tricolpate openings. The edges are regular, and the top is narrow. Pollen ornamentation is microreticulate (Figure 5).



**Figure 4.** Light microscope images of the studied pollen: 1: equatorial axis, 2: polar axis.



**Figure 5.** Micrographs of the studied pollens: 1 and 2: equatorial axes, 3: polar axis, 4 and 5: surface ornamentation.

### **Conclusion and Recommendations**

This study has contributed to the systematic knowledge of the species by studying the macromorphological, micromorphological and palynological characters of *S. junceum*.

### **Thanks and Information Note**

This study is a part of the first author's Master Thesis.

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## ARPA (*Hordeum vulgare* L.) GENOTİPLERİNDE ÇEVRE KOŞULLARININ TANE VERİMİNE ETKİSİ

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### Özet

Bu çalışmada, Diyarbakır'ın Bismil ve Çınar ilçelerinde 2023-2024 üretim sezonunda, ekilen arpa (*Hordeum vulgare* L.) genotiplerinin tane verimi performansı incelenmiştir. Araştırmada, incelenen arpa genotiplerinin verim potansiyelleri, farklı çevresel koşullardaki uyumları ve stabiliteilerinin değerlendirilmesi amaçlanmıştır. Çalışmada kullanılan dört farklı arpa hattı ve iki standart çeşit (Ramata ve Finola), tesadüf blokları deneme desenine 4 tekrarlı olarak ekilmiştir. Araştırma sonuçlarına göre en yüksek tane verimi Bismil lokasyonunda 872,7 kg da<sup>-1</sup> (T3) ve Çınar lokasyonunda 704.6 kg da<sup>-1</sup> (T4) elde edilmiştir. Lokasyon ortalamalarına göre tane verimi bakımından en iyi performans gösteren T3 hattı (788.6 kg da<sup>-1</sup>) olmuştur. Genotiplerin lokasyonlarındaki çevresel etkiler genotiplerin tane veriminde önemli farklılıklara yol açmıştır. Ayrıca, biplot analizi, Finola genotipinin her iki lokasyonda da stabil performans gösterdiği, T3 genotipinin ise ortalamanın üzerinde tane verimine sahip olmuştur.

**Anahtar Kelimeler:** Arpa, tane verim, biplot, stabilite

## **EFFECT OF ENVIRONMENTAL CONDITIONS ON GRAIN YIELD OF BARLEY (*Hordeum vulgare* L.) GENOTYPES**

### **Abstract**

In this study, the grain yield performance of barley (*Hordeum vulgare* L.) genotypes sown in Bismil and Cinar during the 2023-2024 growing season was investigated. The aim of the study was to evaluate the yield potential, adaptability and stability of the barley genotypes under different environmental conditions. Four barley advanced lines and two standard varieties (Ramata and Finola cv.) were sown in a randomized complete block design with 4 replications. According to the results of the study, the highest grain yield was obtained at Bismil location 872.7 kg da<sup>-1</sup> (T3) and Çınar location 704.6 kg da<sup>-1</sup> (T4). According to the location averages, T3 line (788.6 kg da<sup>-1</sup>) showed the best performance in terms of grain yield. Environmental effects at the locations of the genotypes caused significant differences in grain yield of the genotypes. Furthermore, biplot analysis showed that Finola genotype was stable at both locations, while T3 genotype had above-average yield.

**Keywords:** Barley, grain yield, biplot, stability

## Giriş

Arpa (*Hordeum vulgare* L.) eski ve önemli bir tahıl ürünüdür. Bugün dünyada kuru madde üretiminde mısır (*Zea mays*), buğday (*Triticum* spp.), pirinç (*Oryza sativa*) ve soya fasulyesinin (*Glycine max*) ardından tüm ürünler arasında beşinci sırada yer almaktadır (Baik ve Ullrich 2008). Tahıl grubunda önemli bir yere sahip olan arpa hayvan beslenmesinde, malt ve bira endüstrisinde, az da olsa insan beslenmesinde kullanılan ve birçok marjinal alanda başarılı bir şekilde yetiştirilmesi mümkün olan bir bitkidir. Arpa hem baklagil bitkisiyle yetiştirme olanağı hem de ıslah çalışmaları sonucu geliştirilen türler ile verim de Dünya genelinde ürün yetiştirme stratejisine büyük katkı sunabilecektir. Farklı çeşitlerin değişen bölgelere karşı gösterdikleri tepkiler farklı olmaktadır. Dolayısıyla farklı çevrelere uyum sağlayabilen stabil ve marjinal koşullarda bile yüksek verimli yeni arpa genotipleri ıslahçılar tarafından araştırılması gereklidir. Kızılgöçü vd. (2019) ıslah çalışmaları sonucu geliştirilen arpa genotiplerinin ve bölgede geliştirilen arpa çeşitlerinin verim potansiyelinin farklı çevresel koşullarda kıyaslanması gerektiğini bildirmiştir. Bu çalışmada bazı arpa genotiplerinin tane verimi yönünden farklı lokasyonlarda performansını belirlemek amacıyla yürütülmüştür.

## Materyal ve Metot

Çalışma, Diyarbakır iline bağlı Bismil ve Çınar ilçelerinde 2023-2024 üretim sezonunda yürütülmüştür. Çalışmada materyal olarak 4 ileri hat (T1, T2, T3 ve T4) ve 2 standart çeşit (Ramata ve Finola) kullanılmıştır. Denemenin yürütüldüğü aylara ve uzun yıllara ait iklim verileri Tablo 1'de verilmiştir. Lokasyonların ortalama sıcaklık değeri ile uzun yıllar benzerlik gösterirken, lokasyonlara düşen yağış miktarı uzun yıllardan düşük olmuştur. Çalışma tesadüf blokları deneme desenine göre 4 tekrarlı olarak 25.11.2023 tarihinde ekimi gerçekleştirilmiştir. Ekim deneme mibzeriyle yapılmış, her parsel büyüklüğü 6 m<sup>2</sup> (4 x 1.5) ve 6 sıradan oluşturulmuştur. Ekim ile birlikte dekara 4 kg saf N ve 4 kg saf fosfor ve sapa kalkma döneminde 7 kg saf N uygulanmıştır. Araştırmada parsellerine sapa kalkma ve süt olum devresinde iki defa yağmurlama sulama sistemiyle su verilmiştir. Deneme sahasında görülen dar ve geniş yapraklı yabancı otlarla mücadele için kardeşlenme döneminde yabancı ot ilaçlaması ve hastalıklara karşı kimyasal ilaç uygulaması yapılmıştır. Hasat deneme biçerdöver makinasıyla 24. 07.2024 tarihinde gerçekleştirilmiştir.

**Tablo 1.** Deneme alanının 2023 yılı ve uzun yıllarına ait iklim verileri

Aylar	Aylık Sıcaklık (°C)			Aylık Toplam Yağış (mm)		
	Bismil	Çınar	Uzun yıllar (1929-2023)	Bismil	Çınar	Uzun Yıllar (1929-2023)
Ocak	3	2	1.8	44.2	39.8	69.7
Şubat	5	4	3.7	53.3	48.0	67.2
Mart	9	8	8.3	50.9	46.6	67.2
Nisan	14	14	13.8	48.3	44.4	68.3
Mayıs	20	19	19.3	27.9	25.6	44.4
Haziran	26	26	26.1	6.7	6.0	8.6
Temmuz	31	30	31	0.7	0.6	1.3
Ort /Toplam	15.4	14.7	14.9	232	211	326.7

Tane verimi, hasat sonunda her parselden elde edilen tane ürünün 0.01 g hassas terazide tartılarak elde edilen değerlerin kg da<sup>-1</sup>'a çevrilerek bulunmuştur. Elde edilen sonuçlara ait veriler JMP Pro-17 istatistik paket programı ve biplot grafiği GenStat 12th paket programı kullanılarak analiz edilmiştir.

### Bulgular ve Tartışma

Araştırmada kullanılan arpa genotipleri arasında tane verimine ait ortalama değerler ve önemlilik grupları Çizelge 2'te verilmiştir. Her iki lokasyon ortalamasında ve lokasyonlarda genotipler arasında tane verimi istatistiksel olarak önemli farklılıklar bulunmuştur.

**Tablo 2.** Arpa genotiplerine ait tane verim değerlerinin ortalama varyans değerleri

Genotip	Bismil	Çınar	Genel Ortalama (kg da <sup>-1</sup> )
	Tane Verimi (kg da <sup>-1</sup> )	Tane Verimi (kg da <sup>-1</sup> )	
T1	639.5 c	501.1 c	570.3 c
T2	689.5 bc	467.4 c	578.4 c
T3	872.7 a	704.6 a	788.6 a
T4	743.0 b	666.9 a	704.9 b
Ramata	740.6 b	680.1 a	710.3 b
Finola	734.7 b	600.7 b	667.7 b
Hatların Ortalaması	736.2	585	660.6
Standart Ortalaması	737.7	640.4	689
Lokasyon Ortalaması	736.6	603.5	670
F	7.89**	13.85***	21.20***
CV (%)	6.29	7.07	6.4
LSD	69.93	64.33	43.8

\*\*,\*\*\*: Sırasıyla 0.01 ve 0.001 düzeyinde önemli

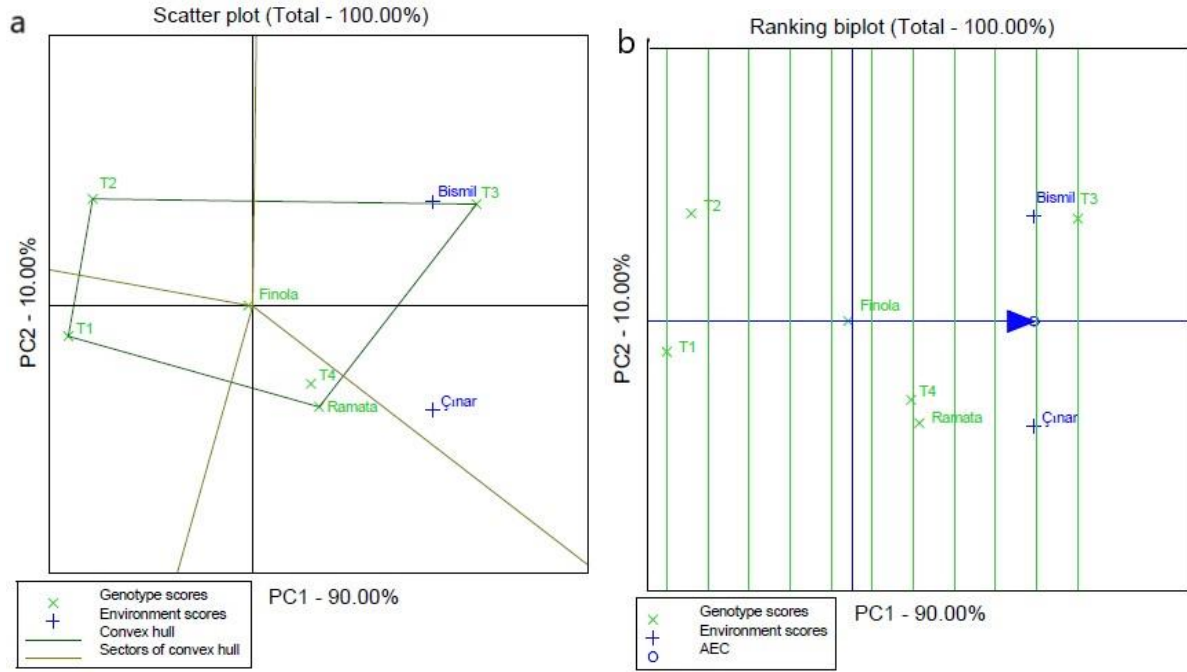
Tane verimi Bismil lokasyonunda 639.5-872.7 kg da<sup>-1</sup> ve Çınar lokasyonlarında 467.4-704.6 kg da<sup>-1</sup> arasında değişim gösterdiği belirlenmiştir. Genotiplerin lokasyon ortalamalarına göre en yüksek tane verimi T3 (788.6 kg da<sup>-1</sup>) hattında belirlenirken en düşük tane verimi T1 (570.3 kg da<sup>-1</sup>) ve T2 (580.4 kg da<sup>-1</sup>) hatlarında olduğu görülmüştür. Lokasyon ortalamalarına bakıldığında ise Bismil lokasyonunda hatların ve standartların ortalamaları arasında önemli farklılık oluşmamakla birlikte, Çınar lokasyonunda standart ortalamaları hatların ortalamalarından yüksek olduğu belirlenmiştir. Bismil ve Çınar lokasyonlarında ekolojik farklılıklar tane verimi üzerine farklı etkiye sahip olduğundan genotiplerin farklı çevrelerde farklı performans göstermesi beklenen bir etkidir. Bismil lokasyonundaki genotiplerin Çınar lokasyonunda farklı verim değerlerine sahip olması bunun bir göstergesidir. Birçok araştırmacı

arpa genotiplerinin tane verimi performansı üzerine yaptıkları çalışmalarında, çevre faktörlerinin ve kültürel işlemlerin etki ettiğini belirlemişlerdir (Aydoğan vd. 2011; Sirat ve Sezer 2014; Kızılgöçü vd., 2016; Kızılgöçü vd. 2018; Kızılgöçü vd. 2019).

Öztürk vd. (2017) 3 lokasyonda arpa genotipleriyle ilgili yürüttükleri çalışmada lokasyon ortalama sonucunu çalışma bulgularından yüksek, (Oral vd., 2017), Adıyaman ve Şanlıurfa lokasyonlarında yağışa dayalı koşullarda yürüttükleri çalışmada tane verim değerlerini bulgulardan çok düşük, Kızılgöçü vd. (2016) ve Kızılgöçü vd. (2019) Mardin ve Diyarbakır lokasyonlarında arpa genotipleri ile ilgili çalışmasında ortalama lokasyon verim değerlerini bulgulardan düşük, (Kendal vd., 2010) Diyarbakır ve Adıyaman lokasyonlarının ortalama tane verim değerlerini bulgulardan düşük olarak elde edildiği gözlemlenmiştir. Aynı zamanda bu çalışmanın bulgularının diğer çalışmalara kıyasla daha yüksek veriler elde etmesi baklagillerin ön bitki olarak kullanılmasının arpa verimini artırabileceğini ve yetiştirme sezonu boyunca yapılan 2 defa sulamanın avantaj sağladığı düşünülmektedir.

Tane verimi bakımından genotiplerin stabilitesini ve verim sıralamasını görsel olarak sunan biplot analiz grafikleri Şekil 1a ve b'de verilmiştir. Şekil 1a'da PC1 (%90) + PC2 (%10) = %100'sini temsil ettiği ve genotiplerin 3 sektöre dağıldığı görülmüştür. Buna göre, poligonun köşelerinde yer alan T3 Bismil lokasyonu için, Ramata ve T4 genotipleri Çınar lokasyonları için en yüksek değerlere sahip genotipler olmuştur. Finola ise tane verim bakımından her iki lokasyonda da istikrarını koruyarak stabil genotip olarak belirlenmiştir. Şekil 1b de, tüm ortamları temsil eden ortalama ortam noktasını biplot orijinine bağlayan ortalama ortam koordinatı (AEC) çizilmiştir. Bu şekilde AEC'nin apsisi oluşturulmuştur. AEC'nin ordinatı biplot orijininin geçeri ve AEC apsisine ortogonaldır (Yan ve Kang, 2003). AEC apsisindeki ok, düşük genotip etkisinden yüksek genotip etkisine doğru olan yönü göstermektedir. AEC ordinatı çift yönlü etkiyi ifade eder ve AEC apsisinden uzaklaştıkça azalan stabiliteyi gösterir (Yan, 2001). AEC ordinatından AEC apsisi boyunca yüksek performansla doğru genotipler sırasıyla Ramata, T4 ve Finola olarak sıralanmıştır. T1 ve T2 genotipler ortalamanın altında kalmıştır. T3 genotipi yüksek lokasyon ortalama değerlerine ve AEC apsisine uzak genotip olmuştur. Bu da ortalamanın üzerinde olmasına rağmen, değişen ortamlarda istikrarlı performans sergileyemediği ile ilişkilendirilebilir. AEC apsisine göre nispeten daha yakın olması stabil genotipler olarak ifade edilmiştir. T4 ve Ramata lokasyon ortalamasının üzerinde olması ve AEC apsisine en yakın genotipler olması bu genotiplerin daha stabil ve farklı çevrelerde istikrarlı olduğu kanısını göstermektedir.





**Şekil 2.** Genotip ve lokasyonların tane verim stabilitesine ait Biplot analiz grafiği

## Sonuç

Araştırma incelenen arpa genotiplerin tane verimi lokasyonlarındaki çevresel etkilerden etkilenmiştir. Ayrıca, biplot analizi, Finola genotipinin her iki lokasyonda da stabil performans gösterdiği, T3 genotipinin ise ortalamanın üzerinde tane verimine sahip olduğu görülmüştür.

## Kaynakça

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# **KURAKLIK VE SICAKLIK STRESINE TOLERANSLI ICARDA MAKARNALIK BUĞDAY HATLARININ DIYARBAKIR KOŞULLARINDA DEĞERLENDİRİLMESİ**

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## **Özet**

ICARDA tarafından kuraklık ve sıcaklık stresine karşı geliştirilen ileri makarnalık buğday hatlarının Diyarbakır ekolojik koşullarına uygunluğunun belirlenmesi ve seçilen hatların ıslah programlarında kullanılması amacıyla yürütülmüştür. Araştırmada ICARDA'dan temin edilen 68 hat ve 2 kontrol çeşit (Miki-3 ve Omrabi-5) materyal olarak kullanılmıştır. Çalışmada tane verimi, protein, nişasta, yağ içeriği ve yaş gluten özellikleri incelenmiştir. Tane verimi; en yüksek IDON45-35 ve IDON45-19 (275.2-251.2 kg da<sup>-1</sup>), en düşük IDON45-06 ve IDON45-13 (52 kg da<sup>-1</sup>), protein oranı en yüksek IDON45-93, IDON45-84 ve IDON45-33 (%17.7, %17.6 ve %17.4), en düşük IDON45-41 ve IDON45-38 (%13.6), yaş gluten oranı en yüksek IDON45-93, IDON45-84, ve IDON45-33 (%37.50, %37.50 ve %37.00), en düşük IDON45-38 (%28.5) hatlarında tespit edilmiştir. Cluster analizine göre genotipler 8 ve özellikler 2 grup altında toplanmıştır. Bu grupta birbirine genetik olarak en uzak IDON45-04 ile IDON45-08 olurken en yakın IDON45-84 ile IDON45-93 nolu genotipler olmuştur. İncelenen özellikler arasındaki korelasyon analizi sonuçlarına göre tane verimi önemli seviyede olmamakla birlikte protein ve yağ değeriyle negatif, nişasta ve gluten değeriyle pozitif korelasyon ilişkisi göstermiştir. Protein içeriği ise nişasta değeriyle negatif ve gluten değeriyle doğrusal önemli ilişkili bulunmuştur. Nişasta değeri ise yağ ve gluten değeriyle negatif ve önemli korelasyon ilişkisi göstermiştir.

**Anahtar Kelimeler:** Makarnalık hatları, tane verim, gluten değeri, cluster analizi

## EVALUATION OF DROUGHT AND HEAT STRESS-TOLERANT ICARDA DURUM WHEAT LINES UNDER DIYARBAKIR CONDITIONS

### Abstract

This study was conducted to determine the suitability of advanced durum wheat lines developed by ICARDA against drought and heat stress to Diyarbakır ecological conditions and to use the selected lines in breeding programs. The study utilized 68 lines obtained from ICARDA and two control varieties (Miki-3 and Omrabi-5) as materials. Grain yield, protein, starch, oil content, and wet gluten properties were examined. The highest grain yields were recorded in lines IDON45-35 and IDON45-19 (275.2-251.2 kg da<sup>-1</sup>), while the lowest yields were in IDON45-06 and IDON45-13 (52 kg da<sup>-1</sup>). The highest protein contents were found in IDON45-93, IDON45-84, and IDON45-33 (17.7%, 17.6%, and 17.4%, respectively), while the lowest protein content was in IDON45-41 and IDON45-38 (13.6%). The highest wet gluten contents were observed in IDON45-93, IDON45-84, and IDON45-33 (37.50%, 37.50%, and 37.00%, respectively), with the lowest being in IDON45-38 (28.5). Cluster analysis grouped the genotypes into 8 groups and the traits into 2 groups. The most genetically distant genotypes were IDON45-04 and IDON45-08, while the closest genotypes were IDON45-84 and IDON45-93. Correlation analysis between the examined traits showed a negative correlation between grain yield and protein and oil content, and a positive correlation with starch and gluten content, though not statistically significant. Protein content exhibited a significant negative correlation with starch content and a positive linear relationship with gluten content. Starch content showed a significant negative correlation with both oil and gluten content.

**Keywords:** Durum wheat lines, grain yield, wet gluten content, cluster analysis

## **Giriş**

Akdeniz ülkeleri dünyanın makarnalık buğday yetiştirme alanının yaklaşık %75'ini temsil etmektedir. Bu ülkelerin başında Suriye, Türkiye, İtalya, Fas, Cezayir, İspanya, Fransa ve Tunus gelmektedir (Elias vd., 2005). Akdeniz havzasının bir bölümü küresel iklim değişikliğinin sıcaklık ve yağış profilleri üzerinde önemli bir etki oluşturacağı tahmin edilmektedir. Bu etki sonucu makarnalık buğday yetiştirmeye uygun alanların kaybolacağı veya üretimde büyük düşüşler olacağı öngörülmektedir (Habash vd., 2009). Hükümetler arası İklim Değişikliği Paneli (IPCC) dördüncü değerlendirme raporuna göre, ortalama küresel sıcaklık artışın 2100 yılına kadar 6,4 °C'ye kadar olacağını ve sadece 20 yıl öncesine kıyasla atmosfere 1,3 kat daha fazla CO<sub>2</sub> yayılacağını tahmin etmektedir (IPCC, 2007, Solomon vd., 2007). Mevcut iklim değişikliğine uyum sağlamak ve gelecekteki iklim değişikliğine hazırlanmak için Akdeniz ülkelerinin bir kısmı tarım sistemlerinde hâlihazırda çeşitli uyum önlemleri uygulamaktadır. Bunlar arasında suyu muhafaza etme teknikleri, kuraklık ve seller için erken uyarı sistemleri, iyileştirilmiş mevsimsel tahmin raporları, bölgesel yönetim uygulamalarının güçlendirilmesi ve entegre edilmesi, koruma stratejilerinin iyileştirilmesi ve iyileştirilmiş çeşitlerin üretilmesi yer alır (Habas vd., 2009).

Tahıl grubu olan makarnalık buğday, güçlü gluten içeriği, camsı ve sarı renkli tane özelliği, düşük glisemik indeksi ve daha uzun dayanıklılık karakteriyle ön plana çıkmaktadır. Birçok kullanım alanı olan makarnalık buğdayın özellikle makarna, bulgur, kuskus, irmik ürünlerinin üretiminde ve bunun gibi diğer birçok temel gıda yapımında kullanılması önemini daha da vurgulamakta ve Doğu Akdeniz kökenli olan makarnalık buğdayın bu havzadaki durumunu koruması bakımından küresel iklim şartlarına uygun çeşitlerin geliştirilmesi gerekmektedir (Royo vd., 2005; Ceglaz vd., 2021; Royo vd., 2014).

Bu çalışma, Diyarbakır ekolojik koşullarında ICARDA'dan temin edilen ileri makarnalık buğday hatlarının (i) terminal sıcaklık ve sıcaklık stresine toleranslarının belirlenmesi, (ii) ıslah programlarında kullanılması için uygun genotiplerin belirlenmesi amacıyla yürütülmüştür.

## **Materyal ve Metot**

Çalışma 2021-2022 üretim sezonunda, Diyarbakır'da faaliyet gösteren Teknobiltar AR-GE deneme istasyonunda yağışa dayalı koşullarda yürütülmüştür. Çalışma materyalleri olarak ICARDA'nın kuraklık ve sıcak stresi için geliştirdiği setlerden seçilen ileri kademe makarnalık hatlardan oluşturulmuştur (Tablo 1).

Deneme augmented deneme desenine göre 68 makarnalık hat, 4 blok ve her blokta 17 hat ve 2 kontrol çeşit (Miki-3 ve Omrabi-5) olacak şekilde kurulmuştur.

Her genotip 2 m uzunluğunda iki sıra halinde sıra aralığı 20 cm olan parsellere elle ekimi yapılmıştır. Ekim ile birlikte dekara 6 kg saf N ve 6 kg saf fosfor olacak şekilde 20-20 kompoze gübre uygulanmıştır. Sapa kalkma döneminde 6 kg saf azot üre formunda uygulanmıştır. Deneme sahasında görülen yabancı otlar elle uzaklaştırılmış ve hastalıklara karşı kimyasal ilaç uygulaması yapılmıştır. Hasat olgunluğuna gelen parseller elle hasadı yapılarak harman makinasında tohumlar elde edilmiştir.

Çalışmada; tane verimi, protein içeriği, nem, nişasta içeriği, yağ ve yaş gluten özellikleri incelendi. Tane verimi her parselden elde edilen değerler parsel verimi olarak belirlendi. Protein, nem, nişasta, yağ ve yaş gluten değeri GrainSense cihazıyla taneden tayin edilmiştir.

**Tablo 1.** Denemede Kullanılan ileri kademe makarnalık hatların Pedigrieleri

Genotip	Pedigri
IDON45-04	ICDGSM17r1-11-0GC-1GC-0SAN-1MCH-0SAN-0AUB
IDON45-05	ICDL16-161-0STR-020TR-0STR-3TR-0STR-1TR-0STR-0STR-0AUB
IDON45-06	ICDL16(F2)-171-0STR-020TR-0STR-4TR-0STR-2TR-0STR-0STR-0AUB
IDON45-07	ICDL16(F2)-170-0STR-020TR-0STR-2MCH-0SAN-2MCH-0SAN-0AUB
IDON45-08	ICDL16(F2)-169-0STR-020TR-0STR-1MCH-0SAN-2MCH-0SAN-0AUB
IDON45-09	ICDL16(F2)-172-0STR-020TR-0STR-2TR-0STR-1TR-0STR-0STR-0AUB
IDON45-10	ICDL16(F2)-175-0STR-020TR-0STR-2TR-0STR-2TR-0STR-0STR-0AUB
IDON45-11	ICDL16(F2)-198-0STR-020TR-0STR-03MCH-0SAN-2MCH-0SAN-0AUB
IDON45-12	ICDL16-095-0STR-020TR-0STR-3MCH-0SAN-1MCH-0SAN-0AUB
IDON45-13	ICDL16-095-0STR-020TR-0STR-4TR-0STR-1TR-0STR-0STR-0AUB
IDON45-14	ICDL16(F2)-190-0STR-020TR-0STR-4TR-0STR-1TR-0STR-0STR-0AUB
IDON45-15	ICDL16(F2)-189-0STR-020TR-0STR-1MCH-0SAN-1MCH-0SAN-0AUB
IDON45-16	ICDL16(F2)-189-0STR-020TR-0STR-2TR-0STR-2TR-0STR-0STR-0AUB
IDON45-18	ICDL16-092-0STR-020TR-0STR-2MCH-0SAN-2MCH-0SAN-0AUB
IDON45-19	ICDL16(F2)-178-0STR-020TR-0STR-2TR-0STR-1TR-0STR-0STR-0AUB
IDON45-22	ICDL16(F2)-235-0STR-020TR-0STR-1MCH-0SAN-1MCH-0SAN-0AUB
IDON45-23	ICDL16-162-0STR-020TR-0STR-3TR-0STR-2TR-0STR-0STR-0AUB
IDON45-33	ICDL16(F2)-145-0STR-020TR-0STR-3TR-0STR-1TR-0STR-0STR-0AUB
IDON45-24	ICDL16(F2)-157-0STR-020TR-0STR-2TR-0STR-2TR-0STR-0STR-0AUB
IDON45-27	ICDL16(F2)-151-0STR-020TR-0STR-1TR-0STR-2TR-0STR-0STR-0AUB
IDON45-28	ICDL16(F2)-153-0STR-020TR-0STR-4MCH-0SAN-2MCH-0SAN-0AUB
IDON45-29	ICDL16(F2)-153-0STR-020TR-0STR-3MCH-0SAN-1MCH-0SAN-0AUB
IDON45-31	ICDL16(F2)-154-0STR-020TR-0STR-3MCH-0SAN-2MCH-0SAN-0AUB
IDON45-32	ICDL16(F2)-145-0STR-020TR-0STR-2MCH-0SAN-1MCH-0SAN-0AUB
IDON45-34	ICDL16(F2)-165-0STR-020TR-0STR-3TR-0STR-1TR-0STR-0STR-0AUB
IDON45-35	ICDL16-008-0STR-020TR-0STR-1MCH-0SAN-2MCH-0SAN-0AUB
IDON45-36	ICDL16-008-0STR-020TR-0STR-2TR-0STR-1TR-0STR-0STR-0AUB
IDON45-37	ICDL16-013-0STR-020TR-0STR-3MCH-0SAN-1MCH-0SAN-0AUB
IDON45-38	ICDL16-013-0STR-020TR-0STR-1MCH-0SAN-1MCH-0SAN-0AUB
IDON45-39	ICDL16(F2)-223-0STR-020TR-0STR-2TR-0STR-1TR-0STR-0STR-0AUB
IDON45-40	ICDL16(F2)-217-0STR-020TR-0STR-1TR-0STR-2TR-0STR-0STR-0AUB
IDON45-41	ICDL16(F2)-007-0STR-020TR-0STR-2MCH-0SAN-2MCH-0SAN-0AUB
IDON45-42	ICDL16(F2)-007-0STR-020TR-0STR-2TR-0STR-1TR-0STR-0STR-0AUB
IDON45-43	ICDL16(F2)-008-0STR-020TR-0STR-4MCH-0SAN-1MCH-0SAN-0AUB
IDON45-45	ICDL16(F2)-008-0STR-020TR-0STR-1MCH-0SAN-1MCH-0SAN-0AUB
IDON45-46	ICDL16(F2)-015-0STR-020TR-0STR-3MCH-0SAN-2MCH-0SAN-0AUB
IDON45-47	ICDL16(F2)-013-0STR-020TR-0STR-4TR-0STR-2TR-0STR-0STR-0AUB

IDON45-49	ICDL16(F2)-014-0STR-020TR-0STR-3MCH-0SAN-2MCH-0SAN-0AUB
IDON45-51	ICDL16(F2)-017-0STR-020TR-0STR-2MCH-0SAN-1MCH-0SAN-0AUB
IDON45-54	ICDL16(F2)-022-0STR-020TR-0STR-2MCH-0SAN-1MCH-0SAN-0AUB
IDON45-56	ICDL16(F2)-010-0STR-020TR-0STR-4TR-0STR-2TR-0STR-0STR-0AUB
IDON45-57	ICDL16(F2)-011-0STR-020TR-0STR-2TR-0STR-1TR-0STR-0STR-0AUB
IDON45-58	ICDL16-131-0STR-020TR-0STR-2MCH-0SAN-1MCH-0SAN-0AUB
IDON45-60	ICDL16(F2)-040-0STR-020TR-0STR-1TR-0STR-2TR-0STR-0STR-0AUB
IDON45-61	ICDL16(F2)-040-0STR-020TR-0STR-1MCH-0SAN-1MCH-0SAN-0AUB
IDON45-63	ICDL16(F2)-026-0STR-020TR-0STR-3TR-0STR-2TR-0STR-0STR-0AUB
IDON45-64	ICDL16(F2)-028-0STR-020TR-0STR-2TR-0STR-1TR-0STR-0STR-0AUB
IDON45-65	ICDL16(F2)-034-0STR-020TR-0STR-4TR-0STR-2TR-0STR-0STR-0AUB
IDON45-66	ICDL16(F2)-036-0STR-020TR-0STR-3MCH-0SAN-2MCH-0SAN-0AUB
IDON45-67	ICDL16(F2)-131-0STR-020TR-0STR-3MCH-0SAN-2MCH-0SAN-0AUB
IDON45-69	ICDL16(F2)-103-0STR-020TR-0STR-3TR-0STR-2TR-0STR-0STR-0AUB
IDON45-70	ICDL16(F2)-103-0STR-020TR-0STR-4MCH-0SAN-2MCH-0SAN-0AUB
IDON45-72	ICDL16(F2)-121-0STR-020TR-0STR-4TR-0STR-2TR-0STR-0STR-0AUB
IDON45-73	ICDL16(F2)-112-0STR-020TR-0STR-1MCH-0SAN-1MCH-0SAN-0AUB
IDON45-75	ICDL16(F2)-109-0STR-020TR-0STR-4TR-0STR-1TR-0STR-0STR-0AUB
IDON45-77	ICDL16(F2)-134-0STR-020TR-0STR-2MCH-0SAN-2MCH-0SAN-0AUB
IDON45-80	ICDL16(F2)-074-0STR-020TR-0STR-1TR-0STR-1TR-0STR-0STR-0AUB
IDON45-81	ICDL16(F2)-083-0STR-020TR-0STR-3TR-0STR-2TR-0STR-0STR-0AUB
IDON45-83	ICDL16(F2)-085-0STR-020TR-0STR-4TR-0STR-1TR-0STR-0STR-0AUB
IDON45-84	ICDL16(F2)-085-0STR-020TR-0STR-3TR-0STR-1TR-0STR-0STR-0AUB
IDON45-85	ICDL16(F2)-089-0STR-020TR-0STR-4TR-0STR-2TR-0STR-0STR-0AUB
IDON45-86	ICDL16(F2)-089-0STR-020TR-0STR-2TR-0STR-1TR-0STR-0STR-0AUB
IDON45-87	ICDL16(F2)-079-0STR-020TR-0STR-1MCH-0SAN-1MCH-0SAN-0AUB
IDON45-89	ICDL16(F2)-072-0STR-020TR-0STR-3TR-0STR-2TR-0STR-0STR-0AUB
IDON45-91	ICDL16(F2)-071-0STR-020TR-0STR-3MCH-0SAN-1MCH-0SAN-0AUB
IDON45-93	ICDL16(F2)-071-0STR-020TR-0STR-1TR-0STR-2TR-0STR-0STR-0AUB
IDON45-94	ICDL16-076-0STR-020TR-0STR-4TR-0STR-2TR-0STR-0STR-0AUB
IDON45-95	ICDL16-073-0STR-020TR-0STR-4TR-0STR-1TR-0STR-0STR-0AUB
Miki-3	Kontrol
Omrabi-5	Kontrol

### **Bulgular ve Tartışma**

64 makarnalık buğday genotipinin tane verimi ve kalite özellikleri ait değerler Tablo 2’de gösterilmiştir. Elde edilen sonuçlara göre tüm genotiplerin ortalama tane verimi dekara 111.4 kg’dır (Tablo 3). Tane verimi değerleri 52.0 ile 275.2 kg da<sup>-1</sup> arasında değişim göstermiştir. 17 makarnalık buğday hattının kontrollerden önemli seviyede daha yüksek tane verimi değerine sahip olduğu bulunmuştur. En yüksek tane verimi değerleri IDON45-19, IDON45-24, IDON45-60, IDON45-66 ve IDON45-95 hatlarından elde edilmiştir.

**Tablo 2.** ICARDA ileri kademe hat ve çeşitlerin araştırmada incelenen özelliklerine ait değerleri

Genotip	Tane Verim (kg da <sup>-1</sup> )	Protein (%)	Nişasta (%)	Yağ (%)	Yaş Gluten (%)	Genotip	Tane Verim (kg da <sup>-1</sup> )	Protein (%)	Nişasta (%)	Yağ (%)	Yaş Gluten (%)
IDON45-04	130.4	16.0	81.7	2.3	34.0	IDON45-46	132.8	14.6	83.3	2.1	30.5
IDON45-05	107.2	15.5	82.2	2.3	32.5	IDON45-47	137.6	15.5	82.4	2.1	32.5
IDON45-06	52.0	15.6	82.2	2.2	33.0	IDON45-49	68.8	15.5	82.5	2.0	32.5
IDON45-07	148.0	16.2	81.8	2.0	34.0	IDON45-51	150.4	15.9	81.8	2.3	33.5
IDON45-08	111.2	15.0	83.0	2.0	31.5	IDON45-54	64.8	14.7	83.3	2.0	31.0
IDON45-09	70.4	15.9	82.1	2.1	33.5	IDON45-56	134.4	15.5	82.5	2.0	32.5
IDON45-10	134.4	15.4	82.1	2.5	32.5	IDON45-57	111.2	15.8	81.9	2.3	33.5
IDON45-11	85.6	15.0	82.8	2.2	31.5	IDON45-58	84.0	15.8	81.9	2.3	33.5
IDON45-12	168.8	14.6	83.2	2.2	30.5	IDON45-60	190.4	15.6	82.4	2.0	33.0
IDON45-13	52.0	15.6	82.3	2.1	33.0	IDON45-61	60.0	16.2	81.8	2.0	34.0
IDON45-14	83.2	16.1	82.0	1.9	34.0	IDON45-63	144.8	14.6	83.2	2.2	30.5
IDON45-15	136.8	16.1	81.6	2.3	34.0	IDON45-64	76.0	15.5	82.4	2.0	32.5
IDON45-16	108.0	15.6	82.2	2.1	33.0	IDON45-65	68.0	15.2	83.0	1.8	32.0
IDON45-18	172.8	14.2	83.7	2.1	29.5	IDON45-66	184.8	15.6	82.4	2.0	33.0
IDON45-19	251.2	15.1	82.0	1.9	34.0	IDON45-67	98.4	15.5	82.2	2.2	32.5
IDON45-22	196.8	16.2	81.8	2.0	34.5	IDON45-69	62.4	15.4	82.4	2.2	32.5
IDON45-23	64.0	14.8	83.2	2.1	31.0	IDON45-70	68.0	15.5	82.4	2.2	32.5
IDON45-24	180.0	15.3	82.6	2.1	32.0	IDON45-72	60.0	15.9	81.7	2.4	33.5
IDON45-27	103.2	16.0	81.5	2.5	34.0	IDON45-73	150.4	14.8	82.8	2.4	31.0
IDON45-28	85.6	15.5	82.2	2.3	32.5	IDON45-75	136.0	16.1	82.0	1.9	34.0
IDON45-29	145.6	14.9	82.9	2.3	31.0	IDON45-77	164.8	16.7	81.3	1.9	35.5
IDON45-31	58.4	14.5	83.2	2.4	30.0	IDON45-80	66.4	15.9	81.8	2.3	33.5
IDON45-32	56.8	15.3	82.6	2.1	32.0	IDON45-81	53.6	15.6	82.2	2.2	33.2
IDON45-33	75.2	17.4	80.2	2.4	37.0	IDON45-83	96.0	15.3	82.3	2.4	32.5
IDON45-34	107.2	14.9	82.9	2.2	31.5	IDON45-84	88.8	17.6	79.9	2.5	37.5
IDON45-35	275.2	15.3	82.7	2.1	32.0	IDON45-85	168.8	14.4	83.6	2.0	30.0
IDON45-36	60.8	14.9	83.0	2.1	31.5	IDON45-86	104.8	15.9	82.1	2.1	33.5
IDON45-37	73.6	13.7	84.1	2.2	28.5	IDON45-87	169.6	16.1	81.6	2.3	34.0
IDON45-38	82.4	13.6	84.0	2.4	28.5	IDON45-89	66.4	14.5	83.5	2.1	30.0
IDON45-39	133.6	14.6	83.1	2.3	30.5	IDON45-91	67.2	14.7	83.3	2.1	30.5
IDON45-40	73.6	14.6	83.3	2.2	30.5	IDON45-93	76.0	17.7	79.9	2.5	37.5
IDON45-41	120.0	13.6	84.4	2.0	28.5	IDON45-94	76.0	16.2	81.6	2.2	34.0
IDON45-42	80.8	16.0	81.7	2.3	34.0	IDON45-95	180.8	15.3	82.3	2.4	32.0
IDON45-43	96.0	13.9	84.1	2.0	29.0	Miki 3	79.7	15.1	82.8	2.1	31.8
IDON45-45	134.4	14.9	83.1	2.1	31.0	Omrabi 5	139.0	15.5	82.3	2.2	32.5



**Tablo 3.** Araştırmada kullanılan ileri kademe hat ve çeşitlerin incelenen özelliklerine ait ortalama ve istatistikî değerleri

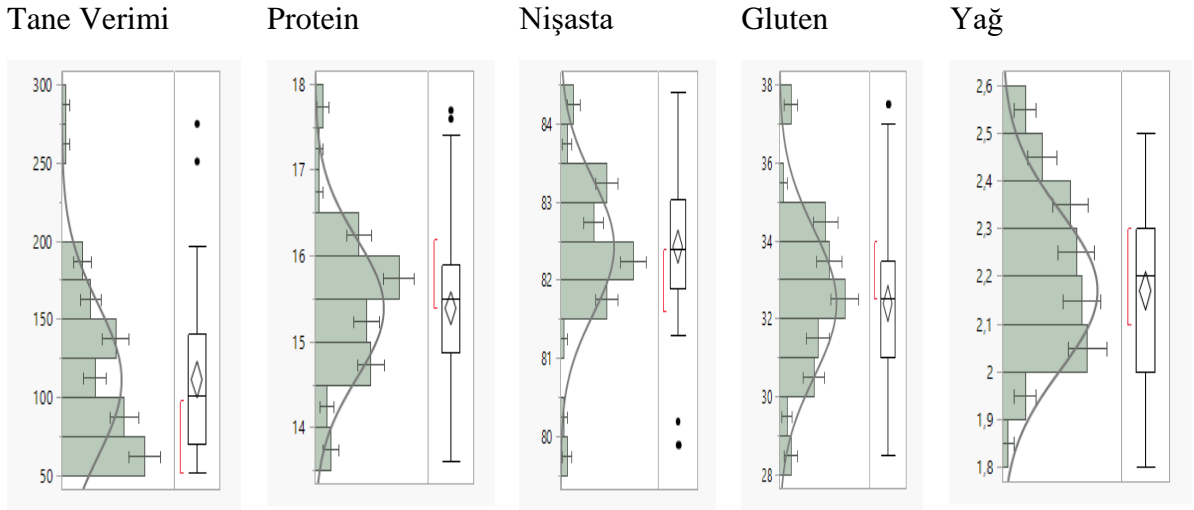
	Tane Verim (kg da <sup>-1</sup> )	Protein İçeriği (%)	Nişasta İçeriği (%)	Yaş Gluten (%)	Yağ İçeriği (%)
Std Dev.	48.57	0.81	0.87	1.88	1.67
Std Error Mean	5.81	0.097	0.103	0.225	0.019
En Düşük	52.0	13.6	79.9	28.5	1.8
En Yüksek	275.2	17.7	84.4	37.5	2.5
Ortalama	111.38	15.39	82.43	32.41	2.17
Kontrolleri Geçen Hat Sayısı	17	36	22	35	23

Ortalama protein oranı %15.4 olarak bulunurken, en düşük protein oranı %13.6 ile IDON45-41 genotipinden en yüksek protein oranı ise %17.7 ile IDON45-93 genotipinden elde edilmiştir. 36 makarnalık buğday hattının kontrollerden önemli seviyede daha yüksek protein oranına sahip olduğu bulunmuştur. En yüksek protein oranı değerleri IDON45-22, IDON45-22, IDON45-61, IDON45-77, IDON45-84, IDON45-93 ve IDON45-94 hatlarından elde edilmiştir. Ortalama yağ içeriği %2.17 olarak bulunurken, en düşük yağ içeriği %1.8 ile IDON45-65 genotipinden en yüksek yağ içeriği ise %2.5 ile IDON45-84 genotipinden elde edilmiştir. 23 makarnalık buğday hattının kontrollerden önemli seviyede daha yüksek yağ içeriğine sahip olduğu bulunmuştur. En yüksek yağ içeriği değerleri IDON45-10, IDON45-27, IDON45-31, IDON45-33, IDON45-72, IDON45-73 ve IDON45-84 hatlarından elde edilmiştir.

Ortalama yaş gluten oranı %35.41 olarak bulunurken, en düşük gluten oranı %28.5 ile IDON45-38 genotipinden en yüksek gluten oranı ise %37.5 ile IDON45-84 genotipinden elde edilmiştir. 35 makarnalık buğday hattının kontrollerden önemli seviyede daha yüksek gluten içeriğine sahip olduğu bulunmuştur. En yüksek gluten değerleri IDON45-33, IDON45-84 ve IDON45-93 hatlarından elde edilmiştir. Makarnalık buğdaydan makarna, bulgur ve irmik gibi ürün eldesinde kalite kriterleri önemli rol oynamaktadır. Bu çalışmada kullanılan genotiplerin büyük çoğunluğunun kalite yönünden standartları geçmesi genetik kaynak olarak büyük önem taşımaktadır.

IDON45-04, IDON45-07, IDON45-15, IDON45-22, IDON45-51, IDON45-60, IDON45-66, IDON45-77 ve IDON45-87 nolu hatların hem kalite hem de verim yönünden anaçlardan yüksek olması seleksiyon ıslahı yönünden önemli potansiyele sahip olduklarını göstermektedir.

Elde edilen bulgular Eliş vd., (2023)'nin kurak koşullarda yetiştirdikleri makarnalık hatlarının ortalama kalite değerlerinden yüksek, verim değerleriyle benzer aralıkta olduğunu, makarnalık genotiplerinde geç ekim ile yetiştiren Günen vd., (2023) ortalama verim ve protein değerini bulgulardan yüksek, nişasta değerini bulgulardan düşük, Kızılgeçi ve Yıldırım, (2019)'ın çalışmasında protein içeriği ve yaş gluten içeriği değerleri benzer aralıkta, nişasta içeriği ise bulgularımızdan düşük olduğu görülmüştür. Farklı çevrelerde 13 makarnalık genotip ile çalışma yapan Kızılgeçi vd., (2019) protein ve gluten içeriği değerleri bulgularımız ile aynı aralıkta ve nişasta içeriği ise bulgularımızdan düşük olduğu görülmüştür. Kızılgeçi vd., (2016) farklı azot dozlarını makarnalık buğday F2 melez kombinasyonlarını çalıştıkları denemede protein değerlerini bulgularımızla benzer, yaş gluten içeriğini ise bulgularımızdan yüksek olduğu görülmüştür.



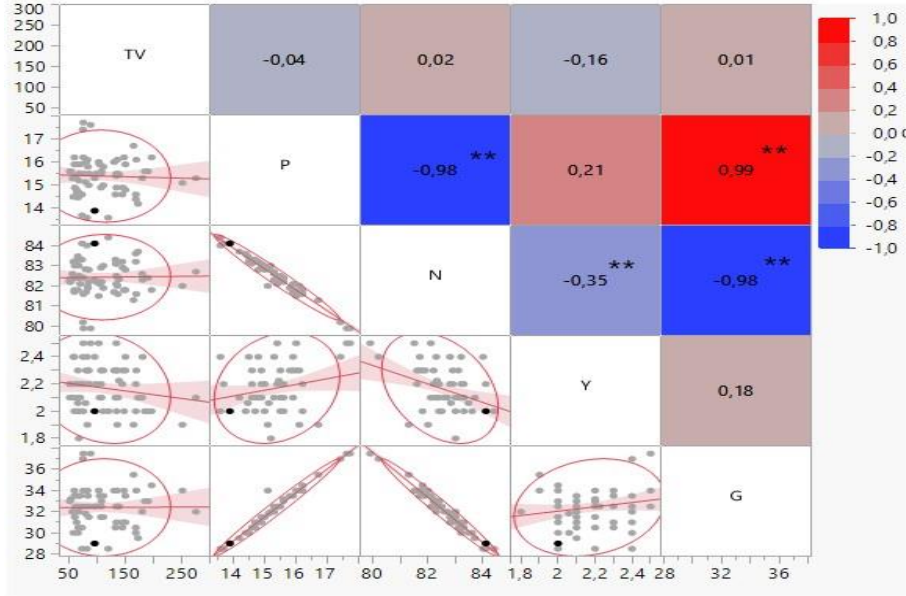
**Şekil 1.** İncelenen özellikler için genotiplerin sayısal dağılımına ait histogram ve frekans poligonu

Kullanılan makarnalık buğday hatlarının incelenen özellikler için histogram ve frekans poligonu Şekil 1’de verilmiştir. Şekil incelendiğinde genotiplerin tane verimi değişim değerlerinin Eliş vd., (2023)’nin bulgularıyla benzer şekilde normal dağılımdan farklılık gösterdiği görülmektedir. Tane verimi için en yüksek kümelenme düşük tane verimi yönünde oluşmuştur. Bu durum deneme yılında yaşanan iklim koşullarının olumsuz etkisinden kaynaklanmaktadır. Ekstrem değerlere sahip genotiplerin bulunması bu genotiplerin stresli koşullara tolerant olabileceğini göstermektedir. Diğer özelliklerde genotipler frekans sayısı olarak normal dağılıma benzer gruplanmışlardır. En yüksek genotip frekansları protein içeriğinde %15-16, nişastada %82-83, glutende %31-33 ve yağ içeriğinde ise %2.0 ile 2.2 değer aralığında kümelenmiştir.

Pearson’s korelasyon analizi sonuçlarına göre tane verimi ile diğer özellikler arasında önemli ilişki bulunmamıştır (Tablo 3 ve Şekil 2). Gluten ile protein içeriği arasında kuvvetli ilişki belirlenmiştir. Nişasta içeriği ise protein, gluten ve yağ içerikleri ile zıt yönde ilişki göstermiştir. Kızılgöçü ve Yıldırım, (2019) bulgularımızla benzer şekilde protein ile nişasta arasında ters ve gluten içeriği arasında doğrusal önemli ilişki tespit etmişlerdir.

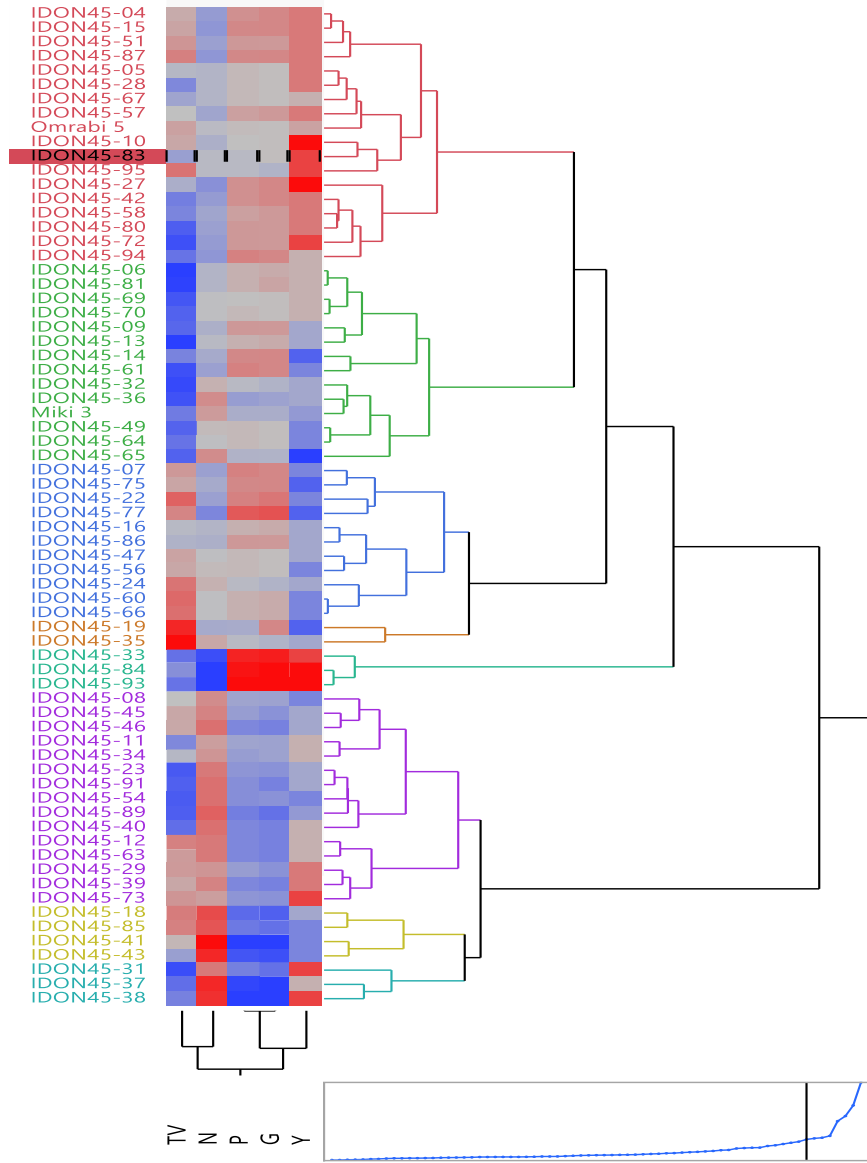
**Tablo 3.** Özellikler arası multivaryete korelasyon analizi

Özellikler	Tane Verim	Protein	Nişasta	Yağ
Protein	-0,0389			
Nişasta	0,0160	-0,9776**		
Yağ	-0,1610	0,2079	-0,3528**	
Gluten	0,0064	0,9856**	-0,9810**	0,1823



**Şekil 2.** Özellikler arası ilişkilerin veri dağılım grafiği ile gösterilmesi, TV; Tane Verimi, P; Protein oranı, N; Nişasta oranı, Y; Yağ oranı, G; Gluten içeriği

Kullanılan makarnalık buğday genotiplerinin incelenen tüm özellikler yönünden birbirlerine yakınlık ve uzaklıklarını belirlenmesi için oluşturulan dendrogram grafiği Şekil 3'te verilmiştir. Bu şekilde genotiplerin 8 farklı grupta yer aldığı görülmüştür. Cluster analizine göre tane verimi ve nişasta içeriği aynı ana grupta yer almıştır. Protein, gluten ve yağ içerikleri ise 2. ana grupta bulunmaktadır. Bu gruplamada birbirinden en uzak genotipler IDON45-04 ile IDON45-08 olurken en yakın genotipler IDON45-84 ile IDON45-93 nolu genotipler olmuştur. Bu analiz ile incelenen özellikler yönünden birbirine yakınlık gösteren genotipleri görsel olarak kolayca belirlememize yardım etmektedir. Böylelikle seleksiyon sürecinde birbirinden farklı genotipik yapıya sahip genotiplerin seçilmesi ve varyasyonun geniş tutulması sağlanmış olacaktır. Örneğin IDON45-33, IDON45-84 ve IDON45-93 nolu makarnalık buğday genotiplerinin tamamen aynı özelliklere sahip oldukları görülmüştür (Şekil 3). Performanslarının yüksek olması durumunda bu genotiplerden bir tanesinin seçilmesi daha farklı tabanlardan da genotip seçilmesine imkân sağlayacağı için çeşit geliştirmede genel başarıyı artıracaktır.



Şekil 3. Makarnalık buğday genotiplerine ait hiyerarşi cluster grafiği

### Sonuç

Bu çalışma, ICARDA makarnalık buğday hatlarının Diyarbakır koşullarında başarılı bir şekilde yetiştirilebileceğini ve bazı hatların hem yüksek verim hem de kalite özellikleri açısından oldukça umut verici olduğunu göstermiştir. İncelenen genotiplerden bazıları hem yüksek verim hem de istenen kalite özelliklerine sahip olduğu için ıslah programlarında kullanılmak üzere potansiyel adaylardır. Özellikle IDON45-04, IDON45-07, IDON45-15, IDON45-22, IDON45-51, IDON45-60, IDON45-66, IDON45-77 ve IDON45-87 numaralı hatların, ıslah programlarında kullanılmak üzere önemli genetik kaynaklar olarak değerlendirilebilme potansiyeline sahip oldukları görülmüştür.

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## YEŞİL ALTYAPININ AFET DİRENÇLİ ŞEHİRLERE KATKISI

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### Özet

Afet dirençli şehirler, sadece doğal felaketlere karşı değil, aynı zamanda toplumsal dayanıklılığı artırma konusunda da önemli bir rol oynamaktadır. Toplumun bir araya gelmesi, sosyal bağların güçlenmesi ve dayanışma duygusunun artması, afet sonrası iyileşme süreçlerini hızlandırmaktadır. Bu bağlamda, yeşil alanların artırılması, toplumsal etkileşimi teşvik eden unsurlar arasında yer almaktadır. Dirençlilik kavramı, 1970'lerde ekoloji alanında, bir sistemin kesinti veya bozulma durumunda işlevselliği sürdürme veya kurtarma kapasitesini tanımlamak için ortaya çıkan bir terimdir. Kentsel dirençlilik UN-Habitat tarafından; herhangi bir kentsel sistemin, sakinleriyle birlikte, sürdürülebilirliğe olumlu bir şekilde uyum sağlarken ve bunun için dönüşürken tüm şoklar ve stresler süresince bu sürekliliği sürdürme yeteneğine sahip olması şeklinde tanımlanmaktadır. Son yıllarda, dünya genelinde afet dirençli şehirler ve yeşil altyapıya yönelik projeler artış göstermiştir. Kopenhag, Singapur, New York ve Tokyo gibi şehirler, bu konuda örnek teşkil eden uygulamalara imza atarak, hem çevresel hem de sosyal açıdan sürdürülebilir çözümler geliştirmiştir. Bu projeler, şehirlerin gelecekteki zorluklara karşı daha hazırlıklı olmasını sağlamaktadır. Afetlerin etkilerini azaltmak için atılan adımlar, sadece yerel yönetimlerin değil, aynı zamanda bireylerin ve toplumların da sorumluluğundadır. Toplumun bilinçlendirilmesi, afet yönetimi süreçlerinin etkinliğini artırmakta ve dayanıklılığı güçlendirmektedir. Bu nedenle, eğitim ve farkındalık çalışmaları, afet dirençli şehirlerin oluşturulmasında önemli bir yer tutmaktadır. Bu çalışmada afet ve afet yönetimi kavramlarından bahsedilerek kentlilerin dirençliliği üzerinde durulmuş, dirençli kentlerde afet yönetimi konusuna ilişkin dünyada uygulanmış örnekler üzerinden değerlendirmeler yapılmıştır.

**Anahtar Kelimeler:** Afet, Yeşil Altyapı, Dirençlilik, Afet Dirençli Şehirler

## CONTRIBUTION OF GREEN INFRASTRUCTURE TO DISASTER-RESILIENT CITIES

### **Abstract**

Disaster-resilient cities play a significant role not only in responding to natural disasters but also in enhancing social resilience. The coming together of communities, the strengthening of social bonds, and the increase in the sense of solidarity accelerate the recovery processes after disasters. In this context, increasing green spaces is one of the elements that promote social interaction. The concept of resilience emerged in the 1970s in the field of ecology, defining a system's capacity to maintain functionality or recover in the event of disruption or disturbance. Urban resilience is defined by UN-Habitat as the ability of any urban system, along with its inhabitants, to maintain continuity during all shocks and stresses while positively adapting to sustainability and transforming for it. In recent years, there has been an increase in projects aimed at disaster-resilient cities and green infrastructure worldwide. Cities such as Copenhagen, Singapore, New York, and Tokyo have set examples by implementing practices that develop both environmental and social sustainable solutions. These projects ensure that cities are better prepared for future challenges. The steps taken to mitigate the effects of disasters are the responsibility of not only local governments but also individuals and communities. Raising community awareness enhances the effectiveness of disaster management processes and strengthens resilience. Therefore, education and awareness initiatives play a crucial role in the establishment of disaster-resilient cities. This study discusses the concepts of disaster and disaster management, focusing on urban resilience, and evaluates examples of disaster management in resilient cities implemented worldwide.

**Keywords:** Disaster, Green Infrastructure, Resilience, Disaster-Resilient Cities

## **1. Introduction**

Today, climate change and urbanization are increasing the frequency and impact of natural disasters. Earthquakes, floods, fires, and other natural calamities are significant factors threatening the sustainability of cities. In this context, the concept of disaster-resilient cities emerges as an approach aimed at enhancing urban resilience against such events.

Disaster-resilient cities are shaped not only by strengthening physical infrastructure but also by considering social and environmental elements together. In these cities, strategic planning is undertaken to mitigate the effects of disasters, and community awareness is raised. In this process, the role of green infrastructure is critically important.

Green infrastructure aims to solve environmental problems by utilizing the benefits offered by natural ecosystems. Applications such as green roofs, parks, rain gardens, and natural waterways help cities maintain ecological balance and cope with climate change. These practices provide both environmental and social benefits.

Among the advantages provided by green infrastructure are improvements in air quality, enhanced water management, and preservation of biodiversity. These benefits increase the livability of cities and positively impact community health. Therefore, green infrastructure practices not only enhance disaster resilience but also improve overall quality of life.

## **2. Disaster and Disaster Management**

A disaster, derived from Arabic, is defined as an event that can affect a community by halting or interrupting people's material, economic, and social lives, and that prevents the affected community from utilizing its own resources (Özey, 2011). It is described as unexpected, destructive events that seriously disrupt the functioning of a society.

The term "disaster" is also used as a synonym for several key words, such as "catastrophe," "destruction," "calamity," and "flood" (Yazıcı and Kalın, 2018). According to another definition, the concept of disaster refers to destruction caused by various natural events (Sancaktar, 2017). These events can occur due to natural phenomena, technological failures, or human actions, leading to numerous deaths, injuries, and property losses, leaving deep damage to the country's natural environment, housing, agricultural lands, and infrastructures like communication and transportation networks (Yaman and Düger, 2017).

While disasters vary in their occurrence, they possess some common characteristics (AFAD, 2018):

- They put lives at risk for both humans and living beings in nature from the moment they occur.
- They halt life and disrupt it for a certain period.
- Some disasters can generally be predicted in advance, while others can occur suddenly and unpredictably.
- The onset of some disasters is gradual, while others are very rapid and sudden.

Disasters are events that can be mitigated with proper practices and timely interventions. To achieve this, a good disaster management plan is essential. According to Toprak Karaman (2017), disaster management encompasses the identification of risky areas and issues that make it difficult or impossible for people to live in a healthy and safe environment; the regulation of



natural, technological, social, human, and political conditions; the development of rational plans, policies, and methods; training decision-makers and implementers; and includes all details from "planning to control," centering around public administration as an interdisciplinary effort (Yaman and Düger, 2017).

Disaster management can be expressed as a multifaceted management approach that requires the entire community and higher authorities to utilize resources toward the common goal of determining necessary steps for mitigating disaster damage, preparedness, recovery, and intervention. Successful combat against disasters is said to be possible through effective disaster management that involves cooperation among the entire community and top-level managers (Oğul, 2019).

Moreover, disaster management includes taking precautions to predict disasters well in advance and minimize disaster risk. These precautions encompass strengthening infrastructure, making buildings disaster-resistant, constructing shelters, establishing early warning systems, and educating communities about disaster preparedness.

### **3. The Concept of The Resilient City**

The concept of resilience emerged in the 1970s in the field of ecology to describe a system's capacity to maintain functionality or recover in the event of disruption or disturbance (Arup and The Rockefeller Foundation, 2016). Resilience has been incorporated into the literature for use in various fields, with its most common applications related to disasters and ecological systems (Yaman and Tezer, 2011). However, the definition of resilience is flexible, allowing different fields to come together around a common terminology without needing to agree on a precise definition. Nevertheless, this ambiguity makes it difficult to establish and apply universal criteria for resilience (Meerow et al., 2016; Arslan, 2022).

Urban resilience is defined by UN-Habitat as the ability of any urban system, along with its inhabitants, to maintain continuity during all shocks and stresses while positively adapting to sustainability and transforming accordingly. In addition to this definition, the mentioned shocks and stresses, including disaster events, are categorized into three classes: natural, human-made, and hybrid (resulting from interactions between natural and human factors). This classification is as follows:

- Natural: Tsunamis, natural climate changes, earthquakes, volcanic eruptions.
- Human-made: Financial crises, geopolitical crises, industrial accidents.
- Hybrid: Pollution, human-induced climate change, deforestation, floods, droughts, epidemics (UNDP, 2021; Arslan, 2022).

Urban systems are inherently dynamic and continuously change through non-linear paths. Therefore, making urban systems resilient is an appropriate approach to cope with future disaster/climate uncertainties and risks, such as pandemics, while promoting and sustaining sustainable development (UNDP, 2021; Arslan, 2022).

In the context of cities, resilience is an approach that strengthens the connection between disaster risk reduction and adaptation to climate change. In this sense, urban resilience differs from traditional disaster risk management, which is solely based on risk assessments. This resilience approach aims to enhance system performance in the face of hazards rather than just preventing or reducing losses and damages (Arup and The Rockefeller Foundation, 2016).

According to Lang (2011), the opportunities that cities possess to ensure resilience include production-consumption chains, diversity of demographic structures, institutional arrangements and organizations, ecosystem services, and urban landscapes as primary urban elements. These elements can also be decisive in measuring the resilience of cities. Cities are affected by socioeconomic transformations in different ways; some utilize these transformations to aid their development, while for others, such transformations can lead to structural issues. The urban resilience approach helps explain these differences (Yaman and Tezer, 2011; Arslan, 2022).

#### **4. Green Infrastructure**

According to the European Commission (2013), green infrastructure is a strategically planned network composed of natural and semi-natural areas created to provide a wide range of ecosystem services. The concept of green infrastructure first emerged in the United Kingdom in the 1850s and later in the mid-1990s in the United States. In the UK, examples are seen as green belts, while in the US, they are referred to as urban open space networks (IUCN, 2016). The European Commission defines green infrastructure as a tool that helps understand the benefits nature provides to humans while delivering economic, social, and ecological advantages through nature-based solutions. Green infrastructure is based on the principle of integrating the benefits humans derive from nature into spatial planning and regional development. Additionally, green infrastructure contributes to enhancing the resilience of cities in combating climate change through nature-based solutions (European Commission, 2013; Deveci, 2023).

Urban green infrastructure elements can provide numerous functions and benefits in their spatial areas. These functions are categorized into ecological and socio-economic groups. Subsequently, urban green infrastructure is further classified based on biotic, abiotic, and cultural elements. In this context, the integration of various functions and services makes urban green infrastructure an effective approach to enhancing the resilience of cities. At the same time, it supports ecological and economic sustainability by ensuring the protection of ecosystems (Reza et al., 2021; Deveci, 2023) (Table 1).

**Table 1.** Urban green infrastructure elements and functions (Reza et al. 2021; Deveci, 2023)

ECOLOGICAL	BIOTIC	Wildlife/Vegetation	Biodiversity control, habitat creation, species movement routes and corridors, maintenance of life cycles of migratory species, biomass production, maintenance of genetic diversity, etc.
		Terrain/Surfaces	Controlling urban land use incompatibility, reducing urban sprawl and fragmentation, increasing surface permeability, etc.
	ABIOTIC	Water	Water management includes urban sustainable drainage, preventing flood storage, managing or eliminating irrigation requirements, recharging groundwater, creating comfortable microclimates, etc.
		Soil/Land	Biodiversity, soil fertility, soil erosion, soil formation etc.
		Weather	Air pollution removal, dust control, carbon sequestration, etc.
		Climate	Local climate control, wind control, thermal comfort, humidity control, etc.
SOCIO-ECONOMIC	CULTURAL	Culture	Opportunities for education and social interaction, environmental aesthetics, tourism opportunities, spiritual experience, inspiration for culture, art and design, etc.
		Economy	Tourism has positive impact on land and property, income and expenditure, employment, raw material production, etc.
		Society	Social capital, place attachment, identity, territorial defense, social empowerment, social education, sense of place and nature, recreation, etc.
		Health	Cleaner air, well-being, thermal comfort, medical resources, water supply, climate regulation, mitigation of extreme events, waste treatment, especially water treatment, food provision, etc.

Examples of green infrastructure applications implemented in cities include natural areas, city parks, squares, individual and institutional gardens, botanical gardens, agricultural areas, cemeteries, planted parking lots, school yards, green areas, road trees, vertical gardens, and green roofs (Figure 1).



**Figure 1.** Examples of green infrastructure (European Commission, 2022)

Green infrastructure, which predominantly encompasses environments featuring wetlands, shrubs, trees, and vegetation, is seen as a fundamental element for creating livable and

sustainable living spaces. Due to its multifunctionality, it integrates various land uses at the neighborhood, city, and landscape scales (such as parks, nature reserves, surface waters, cemeteries, etc.), urban design (such as landscaping and street trees), and functional features (like green roofs and sustainable urban drainage systems). Green infrastructure also contributes significantly to combating climate change by preventing flood risks in cities, ensuring the sustainability of biodiversity, reducing harmful pollutants, and mitigating the urban heat island effect (Sinnott et al., 2018; Deveci, 2023).

## **5. Conclusion**

The essential components for a good quality of life include material needs such as sufficient and secure livelihoods, adequate food, shelter, and clothing; health components that encompass feeling strong, well, and having a healthy physical environment; social relationship components that involve social cohesion and healthy relationships; security components that ensure safe access to resources, the safety of individuals and property, and living in a protected environment where disaster precautions are taken; and the freedom of choice and action component, which allows individuals to make decisions for their well-being (MEA, 2003; Arslan, 2022).

In rapidly developing cities, traditional methods have become inadequate to address increasing environmental problems, leading to the adoption of nature-assisted solutions. Green infrastructure systems, which highlight the necessity of replacing traditional methods with natural ones, rank among the most widely implemented methods in cities worldwide. As many cities renew their infrastructure through green systems, it is crucial to reach ecologically sensitive cities that aim for sustainability (Semiz, 2016; Bolat, 2022).

Green infrastructure systems create significant opportunities for the future and sustainability of cities. They help mitigate issues like the urban heat island effect, concrete expansion, and air pollution by creating ecologically and aesthetically pleasing spaces and landscapes (Bolat, 2022).

Green infrastructure aims to provide a sustainable environment by protecting the natural resources and ecosystems of cities. Resilient cities must be robust against environmental changes and natural disasters. In this context, green infrastructure enhances cities' capacity to cope with climate change. Green spaces take on the role of maintaining the natural balance of cities through functions such as rainwater management, improving air quality, and temperature control.

Moreover, green infrastructure also boosts the social and economic resilience of cities. Parks, gardens, and green roof initiatives facilitate social interaction and bring individuals together. These areas provide spaces for people to relax, exercise, and engage in social activities. Thus, while supporting the physical and mental health of urban residents, they also contribute to the local economy.

In conclusion, green infrastructure plays a crucial role in biodiversity conservation. The loss of natural habitats during urbanization processes threatens many species. Green infrastructure helps protect these species and ensures the continuity of ecosystem services. Through green spaces and natural corridors, cities can maintain ecosystem balance, enhance resilience, and improve urban quality of life, representing a significant step forward.

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## İŞLEVİNİ YİTİRMİŞ ENDÜSTRİYEL ALANLARIN YENİDEN KULLANILMASI

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### Özet

Sanayi Devrimi ile başlayan modern dünya düzeni insanoğluna bir takım avantajlar sunmuş olmakla birlikte, nüfusu ve buna bağlı olarak da ihtiyaçların artmasına, yeryüzünün birçok farklı bölgesinde sanayi tesislerinin kurularak endüstriyel alanların oluşturulmasına, yapılaşmanın artmasına, yaşam tarzının değişmesine vb. neden olmuştur. Açılan ve kullanılan her bir sanayi tesisi ya da endüstriyel alan, ihtiyacın azalması, yerine yenisinin yapılması, sanayinin değişimi ya da ekonomik dönüşüm süreçleri vb sebeplerle belirlenmiş süreler sonunda işlevlerini yitirmişler ve belirli bir süreden sonra atıl durumda kalmışlardır. Geçmişte önemli ekonomik faaliyetlerin merkezleri olan bu alanlar, işlevleri bitince ne yazık ki anlamsız birer yer gibi görünmüş ve hem fiziksel hem de sosyal açıdan birtakım sorunlar yaratmıştır. Ancak, bu alanların yeniden kullanımı, sürdürülebilir kalkınma ve şehirlerin dönüşümü açısından büyük bir potansiyele sahiptir. Bugün artık endüstriyel alanların yeniden kullanımının birçok açıdan faydalı olacağı görüşü benimsenmektedir. Bu alanların dönüştürülerek yeniden işlevlendirilmesi, çevresel sürdürülebilirliği destekleyerek hem fonksiyonel ve hem de ekolojik açıdan alana değer katmaktadır. Endüstriyel alan ve çevresindeki peyzajların rehabilitasyonu sonucunda yeniden işlevlendirilmiş bu gibi yerler gerek bulunduğu yörenin peyzaj kalitesini ve gerekse de yaşam kalitesini arttırmaktadır. Bunun yanı sıra ekonomik gelişimi destekleyerek yerel istihdamın artmasına, toplumsal bilincin ve duyarlılığın gelişmesine de katkıda bulunabilmektedir. Bu çalışmada endüstriyel alan ve peyzaj dönüşümü kavramlarından bahsedilerek işlevini yitiren bu alanların yeniden kullanımına ilişkin dünyada ve Türkiye’de uygulanmış örnekler üzerinden değerlendirmeler yapılmıştır.

**Anahtar Kelimeler:** Endüstriyel alan, Yeniden Kullanım, Peyzaj

## REUSE OF DEFAULTED INDUSTRIAL AREAS

### **Abstract**

The modern world order that began with the Industrial Revolution has offered a number of advantages to humanity, but it has also led to an increase in population and, accordingly, needs, the establishment of industrial facilities in many different parts of the world, the creation of industrial areas, increased construction, changes in lifestyles, etc. Each industrial facility or industrial area that was opened and used lost its function at the end of certain periods due to reasons such as decreased need, construction of a new one, change in industry or economic transformation processes, etc. and remained idle after a certain period of time. These areas, which were once the centers of significant economic activities, unfortunately appear as meaningless places once their functions have ceased, creating various problems both physically and socially. However, the reuse of these areas holds great potential for sustainable development and urban transformation. Today, the view that the reuse of industrial areas will be beneficial in many aspects is widely accepted. The transformation and re-functioning of these areas not only support environmental sustainability but also add value to the area both functionally and ecologically. As a result of the rehabilitation of industrial sites and their surrounding landscapes, these repurposed locations enhance both the landscape quality of the region and the quality of life for its residents. Additionally, they contribute to economic development by increasing local employment and fostering social awareness and sensitivity. In this study, the concepts of industrial area and landscape transformation are discussed, and evaluations are made based on examples of the reuse of these defunct areas implemented around the world and in Turkey.

**Keywords:** Industrial area, Reuse, Landscape



## **1. Introduction**

With the Industrial Revolution, the structural and economic dynamics of cities underwent a profound transformation. During this process, factories, workshops, and other industrial facilities were of great importance in terms of production and employment. However, over time, factors such as technological advancements, globalization, and economic crises have led to the obsolescence of many industrial sectors. This situation has left deep impacts on both local economies and social structures.

Obsolete industrial areas are significant not only as physical structures but also as parts of cultural and social memory. While these areas represent past production processes and labor, they have also become symbols of social memory and identity. However, the abandonment of these structures has brought about new problems, such as environmental issues, safety risks, and social isolation.

Re-functioning offers a promising solution for the future of such areas. The transformation of old industrial facilities allows for the reshaping not only of physical spaces but also of social dynamics. New functions, such as cultural centers, artistic event spaces, offices, or housing projects, facilitate the revitalization of these places. In this way, they contribute to both economic development and social integration processes.

Re-functioning processes require a multidisciplinary approach, bringing together various disciplines. Fields such as architecture, urban planning, landscape architecture, sociology, and environmental sciences complement each other to produce sustainable solutions during this process. In this context, community participation, identifying community needs, and considering environmental impacts are among the fundamental elements of a successful re-functioning process.

## **2. Industry and Industrialization**

The Industrial Revolution is a period that began in the late 18th century in England and spread worldwide. Technological advancements fundamentally changed the production process by transitioning from manual labor to machine production. Although this process initially started in the textile industry, it later expanded to other sectors. With the Industrial Revolution, the demand for large and complex production facilities increased, leading to the establishment of industrial areas on the outskirts of cities and accelerating rural-to-urban migration (Emuce 2023).

Industry is a term that encompasses all production areas where commercial activities are conducted. This concept can be defined as the entirety of processes involving the processing of raw materials, the production of energy sources, and the tools and methods used in these processes. As an alternative definition, industry or manufacturing refers to the field of activity that conducts mass production by continuously or periodically using machinery and similar equipment to change the nature or form of a substance or energy (Anonymous 2013).

Industrialization, urbanization, and migration to large cities can negatively impact both the city and its residents. Modern individuals require spaces where they can be close to nature, away from stressful and exhausting environments. However, green spaces that are lost among tall buildings are becoming insufficient as places for urban dwellers to spend their leisure time.

With the increasing urban population, the selection of urban open spaces and methods to protect against the negative effects of urban industrial areas are becoming increasingly important in cities filled with construction (Oğuz et al., 2010; Kaya et al., 2015).

### **2.1. Industrial Areas**

Industrial areas are defined, according to the Environmental Terminology Dictionary, as areas located within or around a city designed to accommodate industrial facilities and for the use of industrial parks (Anonymous 2013).

Industrial zones are typically areas where large-scale production, processing, or storage activities occur intensively. These areas include industrial facilities, warehouse buildings, factories, workshops, and similar infrastructures. Industrial areas often have complex infrastructure systems, specialized equipment, and customized facilities.

These areas can host extensive industrial activities, encompassing sectors such as manufacturing, energy production, storage, and logistics. Industrial zones are usually found in areas that are either distant from urban regions or designated as special industrial zones. These regions are supported by infrastructure suitable for industrial functions, security measures, and environmental regulations.

### **2.2. Industrial and Landscape Transformation**

With the occurrence of the Industrial Revolution, people living in rural areas began to move towards cities. Over the last 50 years, large cities that once had a population of around 1 million have transformed into metropolises and mega-cities with populations exceeding 5 million today (Başkaya and Yıldızcı, 2011). The increasing population, unhealthy living conditions, and spatial inadequacies of cities—issues that have emerged alongside industrialization—triggered the first major transformations in urban areas during the industrial period (Yerliyurt and Aysu, 2008). Saygı (2008) notes that our cities are currently experiencing a collapse due to various reasons, including excessive population density, economic conditions, a lack of social awareness, poor site selection choices, and imbalances between supply and demand. This collapse is observed not only in underdeveloped countries struggling with settlement issues, as seen worldwide, but also in developed countries that have witnessed rapid transformation processes since the 19th century (Kaya et al., 2015).

#### Industrial Transformation

This term refers to the evolution of industrial activities in a region influenced by economic, technological, or environmental changes. This process involves the repurposing of old industrial infrastructures, facilities, or areas into structures that serve more sustainable and diverse purposes (Florida, 2008).

#### Landscape Transformation

Landscape transformation refers to the process of improving the physical characteristics of a region in aesthetic and functional terms. This transformation typically occurs through urban development projects, environmental restoration efforts, or land planning initiatives. The goal is to enhance environmental sustainability and the rate at which community needs are met by integrating natural and artificial elements (Ahern, 2013).

As stated by Tolga (2006), the continuous increase in population and urban land value in cities, the increasing value of industrial areas, and the emergence of new urban spatial needs

necessitate the restructuring of these areas within the framework of sustainable urban understanding. Since the second half of the 20th century, changes in industrial structures parallel to technological advancements have brought forth the idea of relocating production outside the city, creating a need to reassess industrial areas that have lost their function within the city. Transforming these areas into parks allows city residents, who are overwhelmed by building density, to engage in essential life activities such as living, resting, entertaining, and exercising, thereby improving their quality of life (Büyükoğ, 2013).

Koçan (2011) notes that with the relocation of production away from cities, the remaining industrial areas within urban spaces have taken on significant roles in the urban restructuring process through new forms of use. Particularly in Europe, the reassessment of industrial areas has had a significant impact due to the large surfaces they occupy (Tolga, 2006).

### **3. Refunctioning**

Technological advancements and improvements in building materials following the Industrial Revolution have transformed production methods and influenced the formation of industrial structures. However, this change has led to the obsolescence of some industrial buildings. These structures are often left neglected and abandoned, impacting the urban landscape. Yet, their historical and cultural significance underscores the need for their preservation and re-functioning. Maintaining the physical characteristics of these buildings while aligning them with new functions constitutes an essential part of the historical heritage to be passed on to future generations.

In the re-functioning process, preserving the original qualities of the structures is a priority, and necessary changes can be made without damaging the buildings. Re-functioning not only involves the preservation of structures but also contributes to urban culture and society. This process should be planned using relevant regulations and insights from similar projects (Emuce, 2023).

Re-functioning, in terms of landscape architecture, refers to the process of planning and organizing an area differently from its original intended use. This concept promotes spatial transformation in line with sustainable urban development goals and emphasizes the ability of landscape architects to preserve, enhance, and adapt the natural and cultural characteristics of a space for new purposes.

### **4. Examples of Reuse of Defaulted Industrial Areas**

The transformation projects of obsolete industrial areas play a significant role in the restructuring of cities and ensuring environmental sustainability. These projects contribute to the aesthetic, economic, and social health of cities by re-evaluating former industrial zones.

Initially, discussions about recycling abandoned industrial areas into parks or landscape spaces often focus on the design stages and the considerations that must be taken into account during these phases. For example, it is necessary to determine whether there will be any dangers for children, whether the presence of dogs and other pets might affect the area, and whether wild animals can access the region, along with the precautions that need to be taken regarding these issues.

Considerations should also include which plant species are currently present or should be included, whether the building materials used will have a negative impact on the climate, or whether they would be a good step towards sustainability. Furthermore, aspects such as the project's cost, whether this design will be the desired and beneficial one, or if it will be a poor choice, should also be evaluated (Aydoğdu, 2018).

#### 4.1. High Line Park

New York City, known as one of the largest metropolitan cities in the world, features the 'High Line Park,' a pioneering example that demonstrates urban transformation is not synonymous with concrete sprawl. High Line Park stands out among designs that enable the revaluation of public spaces (Figures 1 and 2). The High Line is a new public park project, 1.5 miles long, built on an abandoned elevated railway that stretches from the Meatpacking District to the Hudson Rail Yards in Manhattan.

Constructed in the early 1930s as part of a comprehensive investment in New York's transportation infrastructure, the High Line railway line was designed to serve the factories and warehouses on the West Side of the city. This line aimed to alleviate traffic by allowing freight trains in the dense industrial area to operate separately from city traffic. However, following World War II, the rise of road transportation led to a decline in rail transport's share, resulting in the gradual disuse of the High Line. After freight train services ended in 1980, the line was partially demolished, and today, only the section between 34th Street and Gansevoort Street on Manhattan's West Side has turned into an untouched piece of nature.



**Figure 1.** The use of the High Line Park in 1950 (Aydoğdu, 2018)

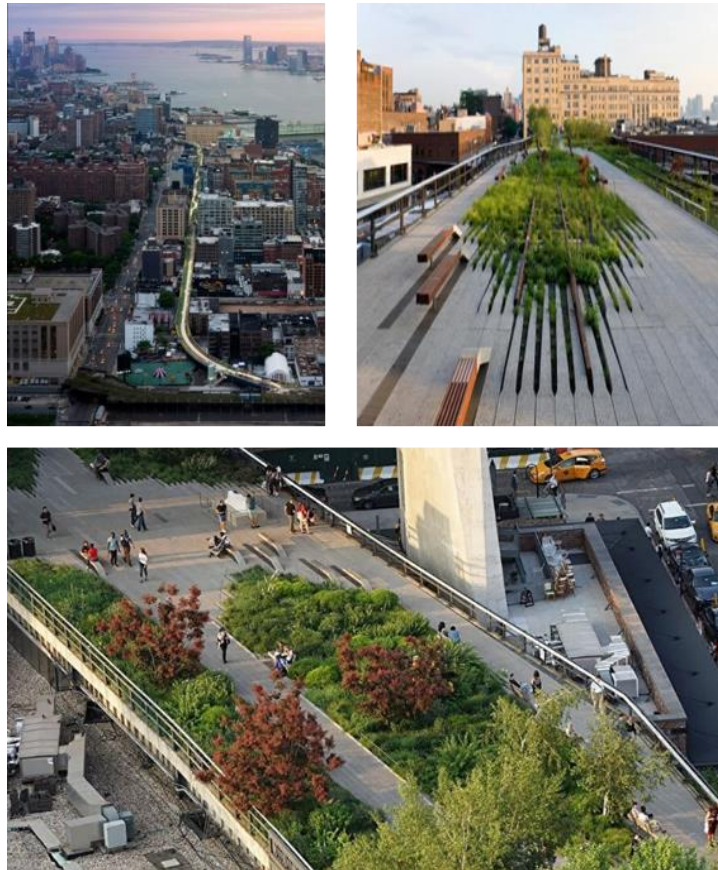


Figure 2. Current use of the High Line Park (Çimen, 2020)

#### 4.2.Emscher Park

The Emscher River is located in western Germany. Emscher Park is one of the largest ecological urban projects planned in the West. It was created through the transformation of Germany's most densely industrialized region. The park encompasses 17 cities (Figure 3) and is designed with the "Garden City" concept, as it includes both industrial buildings and residential areas. The area, which operated as a steel and coal factory in the 1970s, gradually lost its function, and the natural environment suffered significant damage.

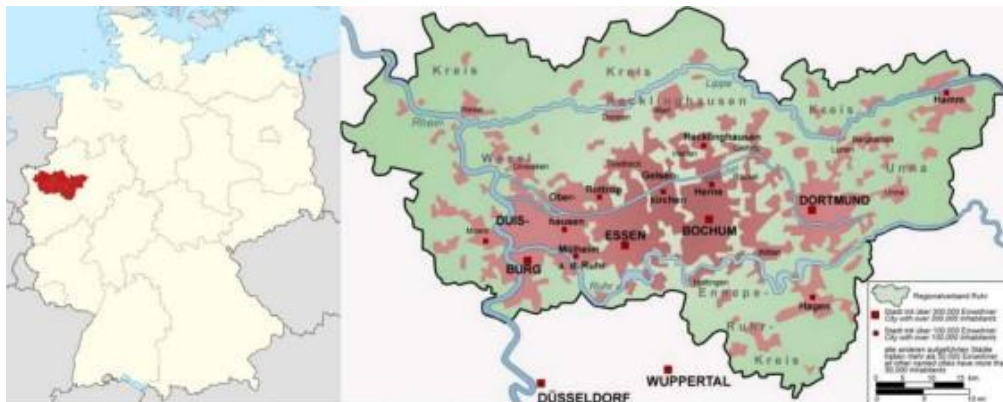


Figure 3. Locations of Emscher Park and 17 cities (Senna, 2023)



Before the renewal process, the river, which was used as a sewage system, was later utilized as a reservoir for industrial waste. Following the rehabilitation process, the river was reintroduced to the city by revealing its ecological potential and utilizing local landscape features. During the rehabilitation efforts, issues such as leakage control and flooding were addressed, and renewal plans were implemented using geographic information systems. Additionally, on-site research was conducted, existing dams were raised, and drainage systems were added. The park was designed by Peter Latz. The implementation project was selected through an international competition, and public participation was emphasized. All plans were proposed under three strategies:

1. Regional open space systems
2. Individual (independent) projects
3. Exhibition parks

Open space systems for users included corridors for the north and south axes, allowing people to visit structures with cultural and historical significance. Triangular areas were created in the exhibition parks, selected for both visual harmony and user relaxation. This plan includes 24 independent projects. Natural habitat planning, residential production, pedestrian and bicycle path planning, lighting, and landscape designs are part of this initiative.

As a result of the planning, the green network established in the project was integrated with areas, the Emscher River was renewed (Figure 4), obsolete industrial buildings and landscapes were jointly assessed, existing residential areas were rehabilitated, and industrial heritage was preserved. A sustainable rainwater management model was designed for the city.



**Figure 4.** Emscher River integrated water management scheme (Senna, 2023)

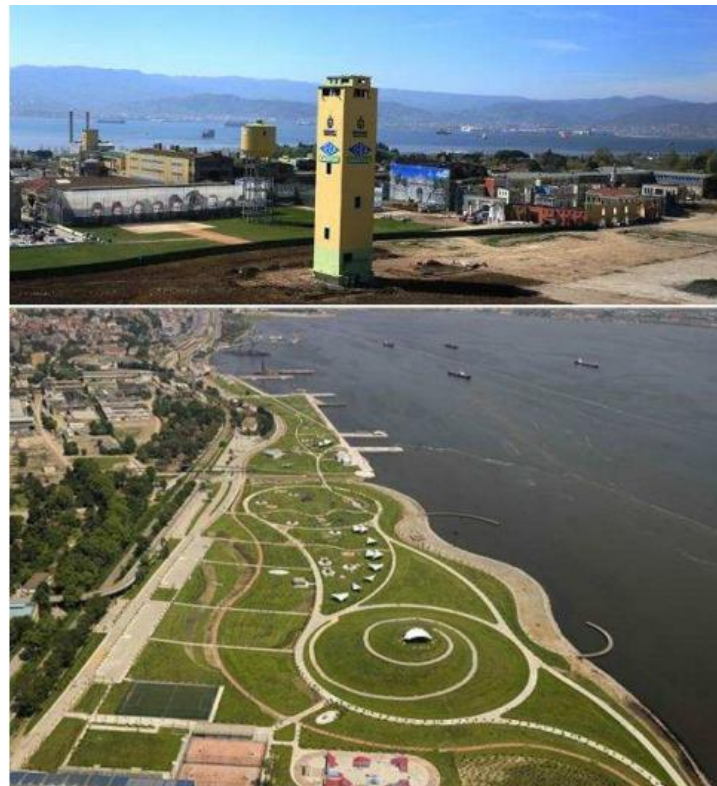
In the Emscher Park project, 7 green corridors are proposed on the north-south axis connecting 17 cities (Figure 5).



**Figure 5.** Green corridors (Senna, 2023)

### 4.3. İzmit Sekapark

Kocaeli, one of the most important industrial cities of Turkey, has many reserve areas that can be pilot cities in this sense. The most notable of these areas is the Seka Paper Factory located on the coastline of İzmit, the central district of Kocaeli (Kaya et al., 2015) (Figure 6).



**Figure 6.** Old and new view of Sekapark (Kaya et al., 2015)

The establishment of the Seka Paper Factory began in the 1930s. After the factory was transferred to the Kocaeli Metropolitan Municipality, it lost its identity as a paper factory and became a city park in 2005, and its name was changed to Sekapark (Figure 7 and Figure 8).



**Figure 7.** Sekapark project design map and plan images (Uzun, 2014)



**Figure 8.** A) Seka Paper Factory Before 2005 B) Current View of Sekapark (Uzun, 2014)

With the transformation of urban industrial areas in İzmit Sekapark and its surroundings, different types of coastal uses have been created that aim for sustainable use in the coastal area. Given its urban location, historical significance, and new image, Sekapark has become an urban development center that guides the growth of the entire city.

Built on an area of 1,100 acres, Sekapark features a massive artificial grass hill that is 15 meters high and 150 meters in diameter, the fifth-largest climbing wall in Europe, an artificial sandy beach, a concert and performance platform with a capacity of 10,000 people, hundreds of thousands of square meters of grassy areas, walking and cycling paths, an 800-vehicle parking lot, and silo cafés, among many other amenities (Kaya et al., 2015).



#### 4.4.Eskişehir City Park

In the 1990s, the area where Kentpark, one of the industrial zones of Eskişehir, was located was home to small-scale industrial enterprises, workshops and storage areas. Over time, industrial facilities were closed or moved, and the area became largely idle and unusable. Then, the area was transformed into a large park with the urban transformation project (Figure 9).



**Figure 9.** Eskişehir, City Park project (Arkitera, 2019)

In 2005, the Eskişehir Metropolitan Municipality decided to create a modern park that would meet the city's needs. As part of an urban transformation project, efforts were initiated to convert the old industrial area into a park, including environmental cleanup, removal of industrial remnants, and infrastructure development for the park. In 2006, construction work was completed, and Kentpark was officially opened to the public. The park quickly gained popularity among the public due to its modern landscape and various social amenities (Figure 10).

Eskişehir Kentpark encompasses approximately 300 acres. Within this vast area, there are various social facilities, ponds, walking paths, swimming pools, and picnic areas.



Figure 10. Kentpark photographs (Arkitera, 2019)

## 5. Conclusion

As a result of technological changes, industrial facilities in Europe began to lose their function starting in the 1950s. The necessity of preserving these vacant facilities has been emphasized, as they are seen as indicators of the development and technological achievements of European countries (Industrial Heritage, 2008; Yükselir, 2022).

The reorganization of abandoned industrial areas in alignment with sustainable development strategies using ecological landscape design techniques is a significant issue faced by many countries today. This situation, which emerged as a problem experienced only by countries that advanced technologically by completing the industrial revolution until the 1980s, has now become a global phenomenon attracting attention to the concepts of sustainable urban and industrial transformation. Moreover, states have formalized the concept of sustainability through international agreements such as the European Landscape Convention (ELC) and the Kyoto Protocol. Particularly, the ELC highlights the importance of addressing degraded landscapes and imposes significant obligations on the contracting states (Sarihan, 2013).

In projects proposed for obsolete industrial areas, various unforeseen factors that both restrict and guide the designer influence the determination of the design approach. Basic criteria should be established to evaluate the suitability of proposed design projects for the area. During the project development process, local governments, universities, non-governmental organizations, stakeholders, the public, and design teams should collaborate. Tools such as scientific research, surveys, SWOT analyses, and workshops should be used to determine which design approaches should be adopted. Areas that have hosted industrial activities and have been abandoned should be addressed differently compared to other landscape areas. Due to their existing physical conditions, these areas require specific measures and solutions, while their historical, cultural,

and industrial heritage characteristics are also significant factors influencing the design (Sarihan, 2013).

Transforming obsolete industrial areas through landscape design not only enhances the sustainability and livability of cities but also offers numerous economic and cultural opportunities. However, the needs and preferences of local residents must be considered during this process. Only in this way can projects be aligned with the social fabric of the city. In conclusion, landscape design in obsolete industrial areas emerges as an important tool in the urban transformation process. By implementing these approaches, vacant and underutilized areas can be revitalized and add value to urban life.

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## YAPI BETONUNA EKLENEN AGREGALARIN ENERJİ PERFORMANSINA ETKİLERİ ÜZERİNE ÖRNEK BİR ÇALIŞMA

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### Özet

Ülkemizde enerjide dışa bağımlılık günden güne artmaktadır. Enerjinin en yoğun olarak tüketildiği sektör ise bina sektörüdür. Bu sebeple binaların enerji tüketimini azaltmaya yönelik olarak çözüm yöntemleri oluşturulmalı ve bu yöntemler bir an önce uygulanmalıdır. Bu amaca yönelik olarak bu çalışmada Ankara ili iklim özelliklerinde bir endüstriyel bina tasarlanmıştır. Tasarlanan endüstriyel bina Autodesk Revit programında modellenerek Green Building Studio (GBS) programı ile enerji tüketimleri belirlenmiştir. Çalışmada tasarlanan endüstriyel binanın duvar malzemeleri ve çatı malzemeleri için farklı alternatifleri oluşturulmuştur. Bu alternatifler oluşturulurken duvar malzemesi olarak; kireç puzolanlı beton, Portland betonu, Portland puzolanlı beton, Portland kireç betonu, normal egregalı beton, hafif aregalı beton, kırık tuğla agregalı ve kapalı dokulu beton, çakıl veya kırma taş agregalı ve kapalı dokulu beton ve alçı beton kullanılmıştır. Çalışmada yalıtım malzemesi olarak XPS ve poliüretan kullanılmıştır. Ayrıca çalışmada çatı türü olarak iki farklı çatı kaplama malzemesi üzerinden kil kiremit çatı ve çimento kiremit çatı belirlenmiştir. Belirlenen malzemeler üzerinden farklı varyasyonlar oluşturularak 36 farklı alternatif elde edilmiştir. Bu alternatifler üzerinden yapılan enerji analizleri belirlenen iklim şartlarında yapılmıştır. Çalışmanın sonucunda belirlenen iklim koşullarında en iyi enerji tüketimi gösteren alternatifler belirlenmeye çalışılmıştır.

**Anahtar Kelimeler:** enerji analizi, enerji verimliliği, GBS

## **A SAMPLE STUDY ON THE EFFECTS OF AGGREGATES ADDED TO CONSTRUCTION CONCRETE ON ENERGY PERFORMANCE**

### **Abstract**

External dependence on energy is increasing day by day in our country. The sector where energy is consumed most intensively is the building sector. For this reason, solution methods should be created to reduce the energy consumption of buildings and these methods should be applied as soon as possible. For this purpose, an industrial building with climatic characteristics of Ankara province was designed in this study. The designed industrial building was modeled in the Autodesk Revit program and energy consumption was determined with the Green Building Studio (GBS) program. Different alternatives for the wall materials and roof materials of the industrial building designed in the study have been created. When creating these alternatives, lime-pooled concrete, Portland concrete, Portland pooled concrete, Portland lime concrete, normal egragated concrete, light-areg concrete, broken brick aggregate and closed textured concrete, gravel or crushed stone aggregate and closed textured concrete and gypsum concrete were used as wall materials. XPS and polyurethane were used as insulation materials in the study. In addition, clay tile roof and cement tile roof were determined as the roof type in the study over two different roofing materials. 36 Different alternatives were obtained by creating different variations based on the determined materials. The energy analyses carried out on these alternatives were carried out under the determined climatic conditions. As a result of the study, it was tried to determine the alternatives that show the best energy consumption under the determined climatic conditions.

**Keywords:** energy analysis, energy efficiency, GBS

## **Giriş**

Günümüzde sürdürülebilir yapıların tasarımı; maliyet, malzeme ve enerji tasarrufu açısından oldukça önemlidir [1]. Enerji tüketimini azaltmak ve kaynakların tüketilmesini engellemek büyük bir sorun haline gelmiştir. Bu sebeple tasarımcılar farklı malzeme türlerini kullanarak bina enerji performansını karşılaştıran simülasyon yazılımları kullanmaktadır.

Bu çalışmada son zamanlarda mimarlık, mühendislik ve inşaat alanlarında yeşil bina tasarımı amacıyla sıkça kullanılmaya başlanan bina bilgi modelleme kavramı kullanılmıştır. BIM araçları sayesinde tasarımcılar erken zamanlarda farklı alternatifleri karşılaştırabilmektedir. Ayrıca BIM araçları hızlı simülasyon ve değişim olanağı sunmaktadır. Bu çalışmada Autodesk Revit ve Green Building Studio (GBS) yazılımları kullanılarak yapı betonuna eklenen agregalar ile oluşturulan farklı yapı malzemeleri enerji tüketimleri açısından karşılaştırılmıştır.

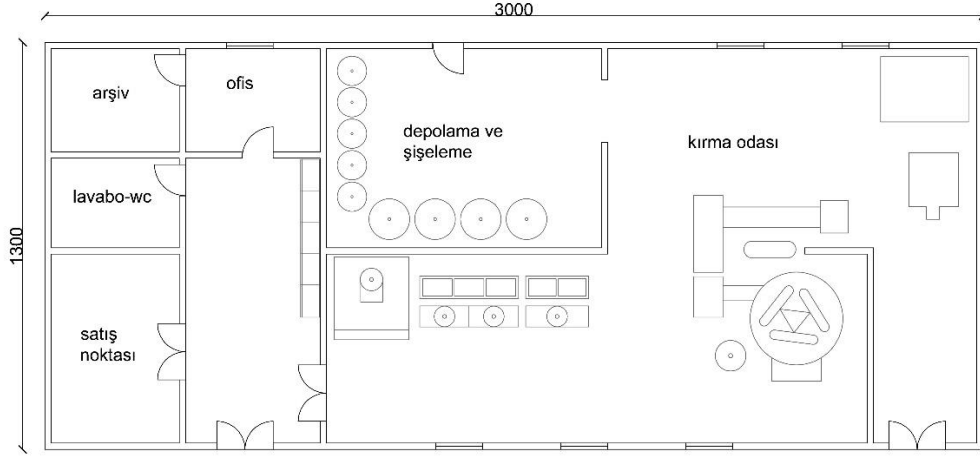
BIM teknolojisi üretkenlik, veri tutarlılığı, koordinasyon, görselleştirme simülasyon imkanları sağlamaktadır. BIM sayesinde projelerde; disiplinler arası hata ve tutarsızlıklar azalır, yapım, tadilat ve bakım için planlanan zaman azalır, maliyet azalır, tasarımcı ve uygulayıcı arasındaki bilgi akışı kolaylaşır, farkı ve karmaşık seçenekler hızlı ve kolay değerlendirilir ve iletişim ile entegrasyon artar.

Geleneksel yöntemler kullanılarak binaların performansını analiz etmek ve enerji tüketimlerini hesaplamak fazlaca emek ve zaman gerektirmektedir. Bu sebeple projelerin tasarım, inşa ve yıkım aşamasına kadar enerji tüketimini ve bina performansını ölçmek imkansız hale gelmektedir. Fakat simülasyon yöntemi ile projenin farklı aşamalarında tasarımcıların seçimleri karşılaştırılarak tasarımın verimliliği artırılırken aynı zamanda enerji kullanımı ve maliyetin iyileştirilmesi sağlanabilir. Bu sebeple bu çalışmada binalarda enerji verimliliğinin artırılması için enerji analizlerinin yapılması önerilmektedir. Böylelikle bu çalışmada, Bina Bilgi Modelleme (BIM) teknolojisi kullanılarak sürdürülebilir tasarım ile üç boyutlu model arasındaki bağlantının sağlanmasında simülasyon yazılımlarının kullanılabilirliğinin gösterilmesini hedeflemektedir.

## **Materyal Metod**

Bu çalışmada mimari çözümler için alternatiflerin gözden geçirilmesi ve enerji tüketimini azaltılması amaçlanmıştır. Bu amaçla çalışmada bina bilgi modelleme (BIM) yazılımları kullanılarak binanın enerji tüketimi simüle edilmiştir. Öncelikle Autodesk Revit programında bir zeytinyağı fabrikası modellenmiştir. Çalışmada tasarlanan ve daha sonra Autodesk Revit programında modellenen 13m\*30m boyutlarında zeytinyağı fabrikasının kat planı Şekil 1.'de verilmiştir.





**Şekil 1.** Zeytinyağı fabrikası kat planı

Tasarımı yapılan fabrika yapısının enerji etkin çözümler sunması adına bina kabuğu malzemeleri değişken olarak kullanılarak alternatifler belirlenmiştir. Bina kabuğunda ilk olarak yapı duvar bölümü için farklı agregalar kullanılarak yapı betonu alternatifleri belirlenmiştir. Bu yapı betonu alternatifleri; kireç puzolanlı beton, portland betonu, portland puzolanlı beton, portland kireç betonu, normal agregalı beton, hafif agregalı beton, kırık tuğla agregalı ve kapalı dokulu beton, çakıl veya kırma taş agregalı ve kapalı dokulu beton, alçı beton olmak üzere dokuz çeşittir. Yapı betonu çeşitlerine ait malzeme termal değerleri Tablo 1.'de verilmiştir [2].

**Tablo 1.** Yapı betonu malzeme termal değerleri

<i>Yapı Betonu</i>	<i>Isı İletkenlik Katsayısı (W/m.K)</i>	<i>Yoğunluk (kg/m<sup>3</sup>)</i>
<i>Kireç puzolanlı beton</i>	1,45	2260
<i>Portland betonu</i>	1,255	2160
<i>Portland puzolanlı beton</i>	1,75	2300
<i>Portland kireç betonu</i>	1,265	2150
<i>Normal agregalı beton</i>	1,4	2000
<i>Hafif agregalı beton</i>	0,92	1800
<i>Kırık tuğla agregalı ve kapalı dokulu beton</i>	1,05	2000
<i>Çakıl veya kırma taş agregalı ve kapalı dokulu beton</i>	2,03	2000
<i>Alçı beton</i>	0,87	1860

Bina kabuğunda duvar bölümü için ikinci olarak iki farklı duvar yalıtım malzemesi alternatifi belirlenmiştir. Bu yalıtım malzemeleri XPS ve poliüretan olarak seçilmiştir. Duvar yalıtım malzemelerine ait termal değerler Tablo 2.'de verilmiştir [2].

**Tablo 2.** Duvar yalıtım malzemeleri termal değerleri

<i>Duvar Yalıtım Malzemesi</i>	<i>Isı İletkenlik Katsayısı (W/m.K)</i>	<i>Yoğunluk (kg/m<sup>3</sup>)</i>
<i>XPS</i>	0,04	35
<i>Poliüretan</i>	0,03	25

Bina kabuğunu oluşturan bir diğer bölüm olan çatı için de çalışmada farklı alternatifler belirlenmiştir. Çalışmada kil kiremit ve çimento kiremit olmak üzere iki farklı çatı kaplama

malzemesi belirlenmiştir. Bu çatı kaplama malzemelerine ait termal değerler Tablo 3.'de verilmiştir [2].

**Tablo 3.** Çatı kaplama malzemeleri termal değerleri

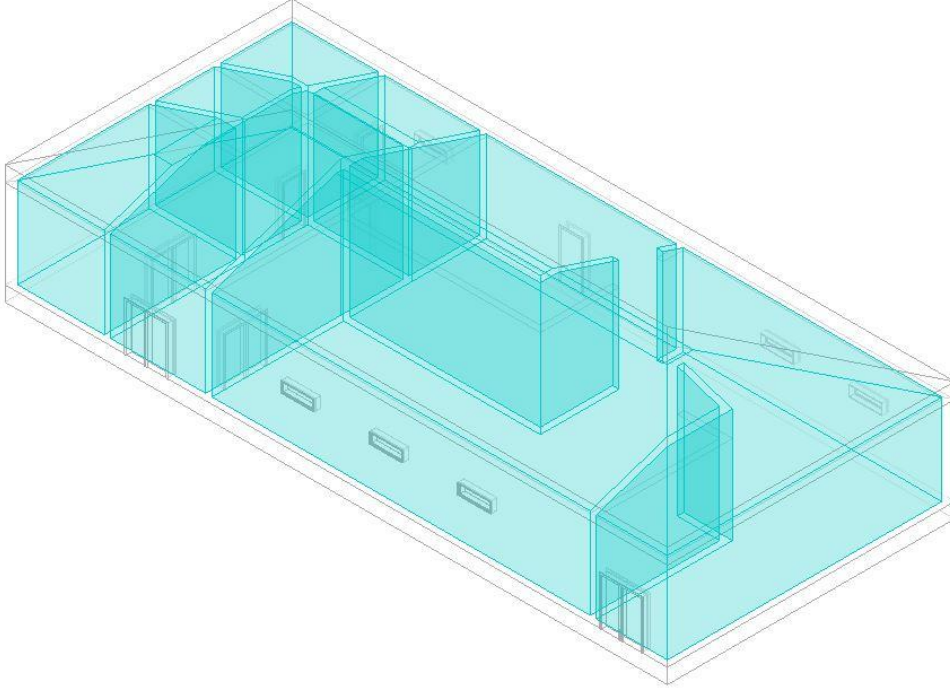
Çatı Kaplama Malzemesi	Isı İletkenlik Katsayısı (W/m.K)	Yoğunluk (kg/m <sup>3</sup> )
Kil kiremit	0,7106	1790
Çimento kiremit	0,4733	2160

**Tablo 4.** Çalışmada belirlenen malzemeler ile oluşturulan alternatifler

Alternatif	Dış Duvar (İçten - Dışa(cm))						Çatı Türü
<i>Tip-1</i>	Boya (0.10)	Sıva (2.00)	Kireç puzolanlı beton (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-2</i>	Boya (0.10)	Sıva (2.00)	Portland betonu (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-3</i>	Boya (0.10)	Sıva (2.00)	Portland puzolanlı beton (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-4</i>	Boya (0.10)	Sıva (2.00)	Portland kireç betonu (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-5</i>	Boya (0.10)	Sıva (2.00)	Normal agregalı beton (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-6</i>	Boya (0.10)	Sıva (2.00)	Hafif agregalı beton (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-7</i>	Boya (0.10)	Sıva (2.00)	Kırık tuğla agregalı ve kapalı dokulu beton (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-8</i>	Boya (0.10)	Sıva (2.00)	Çakıl veya kırma taş agregalı ve kapalı dokulu beton (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-9</i>	Boya (0.10)	Sıva (2.00)	Alçı beton (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-10</i>	Boya (0.10)	Sıva (2.00)	Kireç puzolanlı beton (20.00)	Poliüretan (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-11</i>	Boya (0.10)	Sıva (2.00)	Portland betonu (20.00)	Poliüretan (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-12</i>	Boya (0.10)	Sıva (2.00)	Portland puzolanlı beton (20.00)	Poliüretan (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-13</i>	Boya (0.10)	Sıva (2.00)	Portland kireç betonu (20.00)	Poliüretan (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-14</i>	Boya (0.10)	Sıva (2.00)	Normal agregalı beton (20.00)	Poliüretan (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-15</i>	Boya (0.10)	Sıva (2.00)	Hafif agregalı beton (20.00)	Poliüretan (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-16</i>	Boya (0.10)	Sıva (2.00)	Kırık tuğla agregalı ve kapalı dokulu beton (20.00)	Poliüretan (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-17</i>	Boya (0.10)	Sıva (2.00)	Çakıl veya kırma taş agregalı ve kapalı dokulu beton (20.00)	Poliüretan (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>
<i>Tip-18</i>	Boya (0.10)	Sıva (2.00)	Kireç puzolanlı beton (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	<b>Kil Kiremit Çatı</b>

Çalışmada belirlenen bina kabuğu malzemeleri dıştan yalıtımlı duvar türüne göre eşlemeler yapılarak 36 farklı alternatif türü oluşturulmuştur. Bu alternatiflerin her birini uygulanma şekli Tablo 4.'de verilmiştir. Çalışmada oluşturulan 18 alternatif tabloda gösterildiği gibi kil kiremit çatı malzemesinden oluşurken diğer 18 alternatif ise çimento kiremit çatı malzemesinden oluşmaktadır.

Çalışmada daha sonra bu alternatiflerin her biri Autodesk Revit programında modele entegre edilerek enerji modelleri oluşturulmuştur. Autodesk Revit programında oluşturulan enerji modeli Şekil 2.'de verilmiştir.



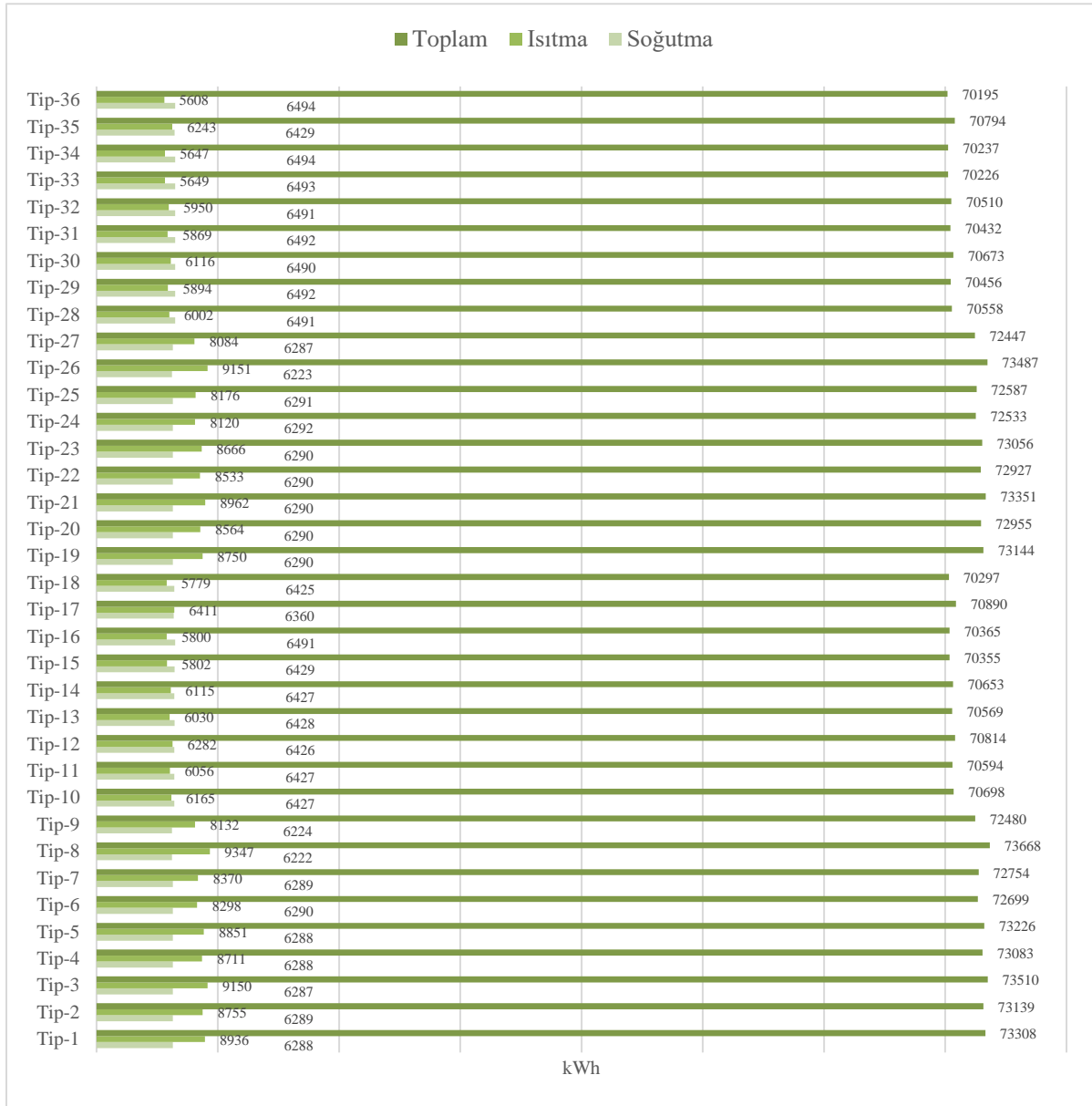
Şekil 2. Bina enerji modeli

Bu çalışma, iki farklı araç üzerinden ilerlemektedir. BIM tabanlı Autodesk Revit yazılımı modelleme, malzemelerin programa girilmesi ve enerji modeli oluşturulması amaçları için kullanılırken; Autodesk Green Building Studio yazılımı ise enerji analiz aşaması için kullanılmıştır. BIM tabanlı Autodesk Revit programından enerji analiz programı olan Autodesk Green Building Studio programına dosya aktarımı gbXML formatında gerçekleştirilmiştir.

### **Bulgular ve Sonuç**

Bu çalışma, Revit ve GBS olarak iki farklı yazılım aracı kullanılarak fabrika binasının enerji performansını belirlemek için uygulanan malzeme stratejilerini incelemiştir. Çalışma ılıman-kuru iklim özellikleri gösteren Ankara ili koşullarında fabrika yapısı üzerinden ilerlemiştir. Sonuçlar incelendiğinde (Şekil 3.) alternatiflerin ilk olarak çatı kaplama malzemesinde çimento kiremit çatının kil kiremit çatıya göre toplam enerji ve ısıtma enerjisi harcamaları için daha az enerji tükettiği gözlemlenmiştir. Fakat soğutma enerjisi tüketiminde kil kiremit çimento kiremit çatıya göre daha az enerji harcamıştır. Analiz sonuçları duvarlar için kullanılan yapı betonu

bakımından incelendiğinde en iyi ısıtma enerjisi ve toplam enerji tüketimi gösteren alternatifin alçı beton olduğu; fakat soğutma enerjisi tüketiminde en avantajlı olanın çakıl veya kırma taş agregalı ve kapalı dokulu beton olduğu görülmüştür. Sonuçlar duvar yalıtım malzemesi açısından incelendiğinde XPS yalıtım malzemesi kullanımının ısıtma ve toplam enerji tüketiminde poliüretan dan daha iyi sonuç verdiği fakat soğutma enerjisi tüketiminde poliüretanın daha iyi sonuç verdiği belirlenmiştir.



Şekil 3. Alternatiflerin enerji analiz sonuçları

Toplam enerji tüketiminde analiz edilen alternatifler arasında yıllık %4,71 oranında enerji tasarrufu elde edilirken, soğutma enerjisi bakımından yıllık %4,22, ısıtma enerjisi tüketiminde ise yıllık %40 tasarruf belirlenmiştir.

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# GREEN BUILDING STUDIO SİMÜLASYONUyla ENERJİ ETKİN KÜTÜPHANE TASARIMI

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## Özet

Dünya genelinde ve ülkemizde enerji maliyetleri giderek artmakta, fosil yakıtlar tükenmekte, yenilenebilir enerji kaynaklarında henüz istenilen seviyeye erişilememektedir. Bu sebepler neticesinde ülkemiz enerjide dışa bağımlı olmaktadır. Bu durum ve çevresel sorunlar enerjinin verimli kullanımını zorunlu kılmıştır. Özellikle konut sektörü ve kamu kurumlarından başlanarak tüm yapılar için enerji tasarrufu sağlanmaya çalışılmaktadır. Bu amaçla bu çalışmada Artvin ilinde tasarlanan kütüphane yapısı üzerinden enerji analizleri yapılmıştır. Çalışmada Artvin ili iklim koşulları dikkate alınarak farklı malzemeler üzerinden alternatifler geliştirilmiş ve oluşturulan alternatifler analiz edilmiştir. Çalışmada duvar örgü malzemesi olarak adi tuğla, yanmamış kil tuğla, seramik tuğla ve beton tuğla kullanılmıştır. Çalışmada ayrıca yalıtım malzemesi olarak XPS, EPS, cam yünü, taş yünü, poliüretan, poli izosiyanür ve kuzu yünü malzemeleri kullanılmıştır. Çalışmada belirlenen çatı türü tek tip olarak kırma kiremit çatı olarak belirlenmiştir. Çalışmada belirlenen farklı duvar malzemeleri ile 28 farklı alternatif oluşturulmuştur. Çalışmada tasarlanan kütüphane yapısı Autodesk Revit programında modellenmiştir. Modellenen kütüphane yapısına çalışmada oluşturulan alternatifler entegre edilerek her bir alternatif için enerji modellemeleri yapılmıştır. Daha sonra bu enerji modelleri ile her bir alternatif için Green Building Studio (GBS) programı ile enerji analizi yapılmıştır. Çalışmanın sonucunda Artvin ili iklim koşulları için oluşturulan alternatifler arasında en enerji verimli olanı tespit edilerek enerji etkin tasarım amaçlanmıştır.

**Anahtar Kelimeler:** enerji analizi, enerji etkin tasarım, Revit

## ENERGY EFFICIENT LIBRARY DESIGN WITH GREEN BUILDING STUDIO SIMULATION

### **Abstract**

Energy costs are increasing worldwide and in our country, fossil fuels are depleting, and the desired level of renewable energy sources has not yet been reached. As a result of these reasons, our country is dependent on foreign sources for energy. This situation and environmental problems have made it necessary to use energy efficiently. Energy saving is being attempted for all structures, especially starting from the housing sector and public institutions. For this purpose, energy analyses were conducted on the library structure designed in Artvin province in this study. In the study, alternatives were developed using different materials, considering the climate conditions of Artvin province, and the alternatives created were analyzed. In the study, ordinary brick, unburned clay brick, ceramic brick and concrete brick were used as walling material. In addition, XPS, EPS, glass wool, stone wool, polyurethane, poly isocyanide and lamb's wool materials were used as insulation materials. The roof type determined in the study was determined as a single type of hipped tile roof. 28 different alternatives were created with the different wall materials determined in the study. The library structure designed in the study was modeled in the Autodesk Revit program. The alternatives created in the study were integrated into the modeled library structure and energy models were made for each alternative. Then, energy analysis was performed for each alternative with these energy models using the Green Building Studio (GBS) program. As a result of the study, the most energy efficient alternative among the alternatives created for the climate conditions of Artvin province was determined and energy efficient design was aimed.

**Keywords:** energy analysis, energy efficient design, Revit

## Giriş

Dünya genelinde ülkeler yenilenemeyen enerji kaynaklarının tüketilmesi neticesinde çevreye verilen zarar ve bu kaynakların zamanla azalması sebebiyle sürdürülebilir tasarım ve temiz enerji kullanımına yönelmiştir [1]. Bu kapsamda en önemli çözüm yollarından biri, enerji tüketimini azalmayı sağlayan parametreleri bilmek ve binaları tasarlarken farklı iklim bölgeleri için uygun olan parametreleri belirleyerek kullanmaktır [2]. Bu doğrultuda binaların enerji tüketiminin azaltılmasını amaçlayan bileşenler ve parametreler kapsamlı bir şekilde değerlendirilmelidir. Bu çalışmanın amacı, enerji tüketimini azaltmak amacıyla etkili ve önemli parametreleri belirleyerek planlamacılara ve araştırmacılara etkili faktörler hakkında bir bakış açısı sunmaktır. Araştırma nicel türde olup, simülasyon hesaplama yöntemi olarak belirlenmiştir. Bu amaç doğrultusunda Green Building Studio (GBS) yazılımı kullanılmıştır. Çalışmada ayrıca Autodesk Revit yazılımı modelleme amacı ile kullanılmıştır. Bu çalışmada ılıman-nemli iklim bölgesi özellikleri gösteren Artvin ili temelinde kütüphane binası planlanmıştır.

Çalışmanın temel adımları şu şekildedir;

- 1) Modelin tanımlanması ve iklim özelliklerinin belirlenmesi; Çalışmanın bu aşamasında Artvin ili için iklim özellikleri analiz edilerek binanın modeli ve malzemeler yazılım programında simüle edilmektedir.
- 2) Enerji analizi; Çalışmanın bu aşamasında malzemeler ile oluşturulan alternatiflerin karşılaştırmalı olarak enerji analizleri yapılmaktadır.
- 3) Optimum yapı özelliklerinin belirlenmesi; çalışmanın bu aşamasında ise enerji analizleri neticesinde elde edilen veriler doğrultusunda optimum yapı özellikleri belirlenmiştir.

Artvin ili 40° 35' ile 41° 32' kuzey enlemleri ve 41° 07' ile 42° 00' doğu boylamları arasında yer almaktadır. Artvin ili merkezinin denizden yüksekliği 530 m dir. Ayrıca Artvin şehri ılıman-nemli iklim bölgesinde yer almaktadır. İlıman nemli iklimde; yazlar ılıman kışlar ise az soğuk özelliktedir. Şiddetli kış ayları ve aşırı sıcak yaz ayları görülmemektedir. Yaz ayı ile kış ayı arasında sıcaklık farkı az olmak ile birlikte insan konforuna en yakın özellikler göstermektedir. Fakat deniz kenarında bulunma ve yükseklik durumlarına göre sıcaklık farkları oluşabilmektedir. Yağış mevsimlere dağılmış şekilde genel olarak Ocak, Şubat ve Haziran aylarında oluşmaktadır. En sıcak aylar ise Temmuz, Ağustos ve Eylül aylarıdır. İlıman-nemli iklimin en önemli özelliği ise nemin ve yağışın yüksek olmasıdır [3]. Artvin ili için 1949-2023 yılları arasındaki aylara göre ortalama sıcaklık, ortalama en yüksek sıcaklık, ortalama en düşük sıcaklık, ortalama güneşlenme süresi, aylık toplam yağış miktarı ortalaması ile en yüksek ve en düşük sıcaklıklar Şekil 1.'de verilmiştir [4].



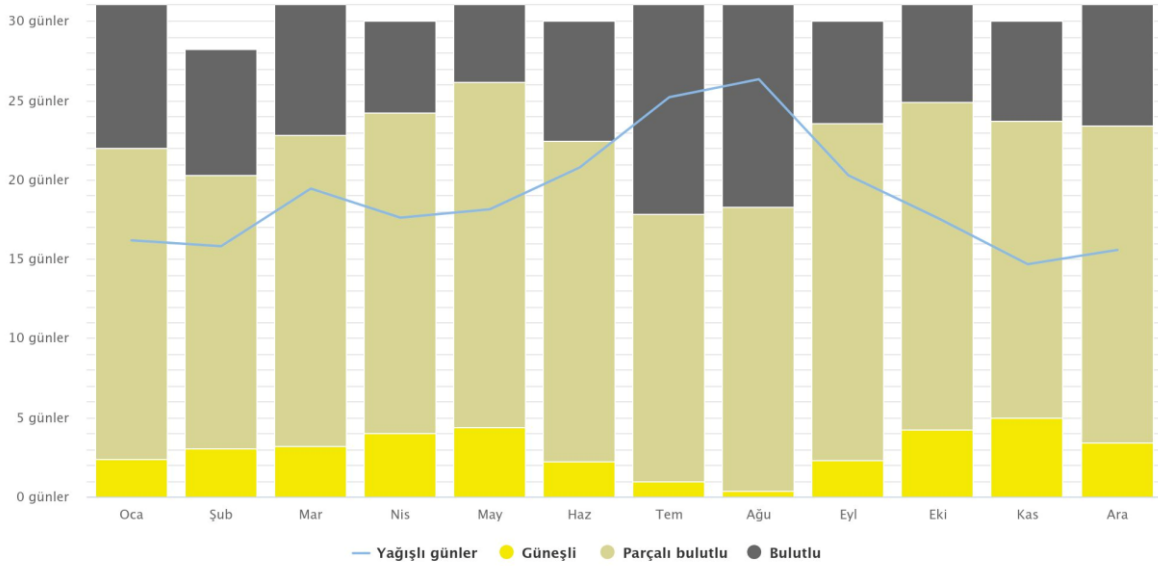
ARTVIN	Ocak	Şubat	Mart	Nisan	Mayıs	Haziran	Temmuz	Ağustos	Eylül	Ekim	Kasım	Aralık	Yıllık
Ölçüm Periyodu ( 1949 - 2023)													
Ortalama Sıcaklık (°C)	2,7	3,8	7,0	11,9	15,9	18,8	20,9	21,2	18,3	14,2	9,1	4,5	12,4
Ortalama En Yüksek Sıcaklık (°C)	6,4	8,4	12,4	17,9	21,9	24,3	25,8	26,4	24,0	19,7	13,5	8,0	17,4
Ortalama En Düşük Sıcaklık (°C)	-0,1	0,5	3,0	7,2	11,2	14,4	16,9	17,3	14,3	10,3	5,8	1,8	8,5
Ortalama Güneşlenme Süresi (saat)	2,4	3,4	4,2	5,2	6,3	7,0	6,7	6,8	6,3	4,7	3,2	2,1	4,9
Ortalama Yağışlı Gün Sayısı	13,00	12,76	13,56	12,79	14,13	12,79	8,24	8,17	8,61	10,99	11,00	11,73	137,8
Aylık Toplam Yağış Miktarı Ortalaması (mm)	84,6	71,5	60,8	53,2	53,1	49,2	31,1	29,1	37,9	60,4	75,1	85,6	691,6
Ölçüm Periyodu ( 1949 - 2023)													
En Yüksek Sıcaklık (°C)	18,9	21,5	28,4	34,4	36,7	39,0	42,0	43,0	41,5	33,9	27,9	20,9	43,0
En Düşük Sıcaklık (°C)	-16,1	-11,9	-9,8	-7,1	-0,6	3,7	9,5	9,5	4,2	-1,6	-8,2	-10,8	-16,1

Şekil 1. Artvin ili aylara göre ortalama sıcaklık ve yağış değerleri

Artvin ili bulutlu, güneşli ve yağışlı gün sayısı Şekil 2.'de verilmiştir. Buna göre bulut oranı %20 den az olan günler güneşli, %20 ile %80 arası olan günler parçalı bulutlu ve %80'den fazla olan günler kapalı günler olarak belirlenmiştir [5].

#### Artvin

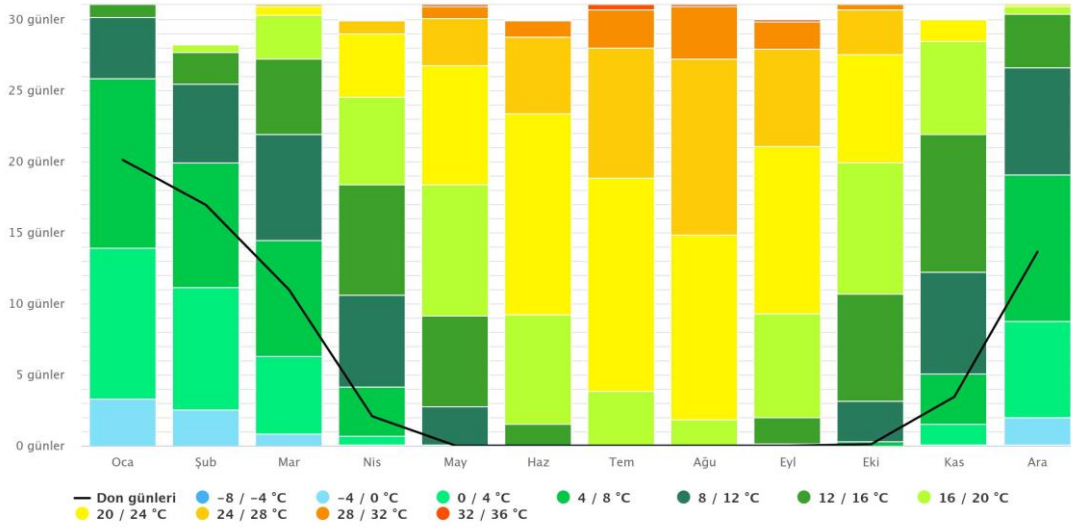
41.18°N, 41.82°E (517 m rakım).  
Model: ERA5T.



Şekil 2. Artvin ili aylara göre bulutlu, güneşli ve yağışlı günler

Artvin ili için Şekil 3.'de verilen maksimum sıcaklık diyagramı aylara göre kaç günün belirli sıcaklığa ulaştığını göstermektedir [5].

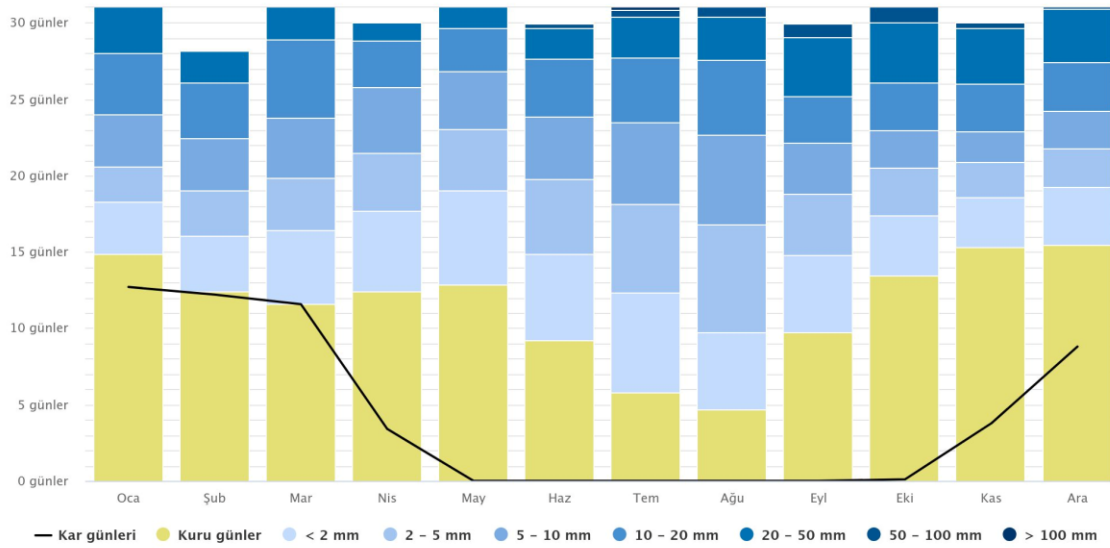
Artvin  
41.18°N, 41.82°E (517 m rakım).  
Model: ERA5T.



Şekil 3. Artvin ili aylara göre sıcaklık miktarları

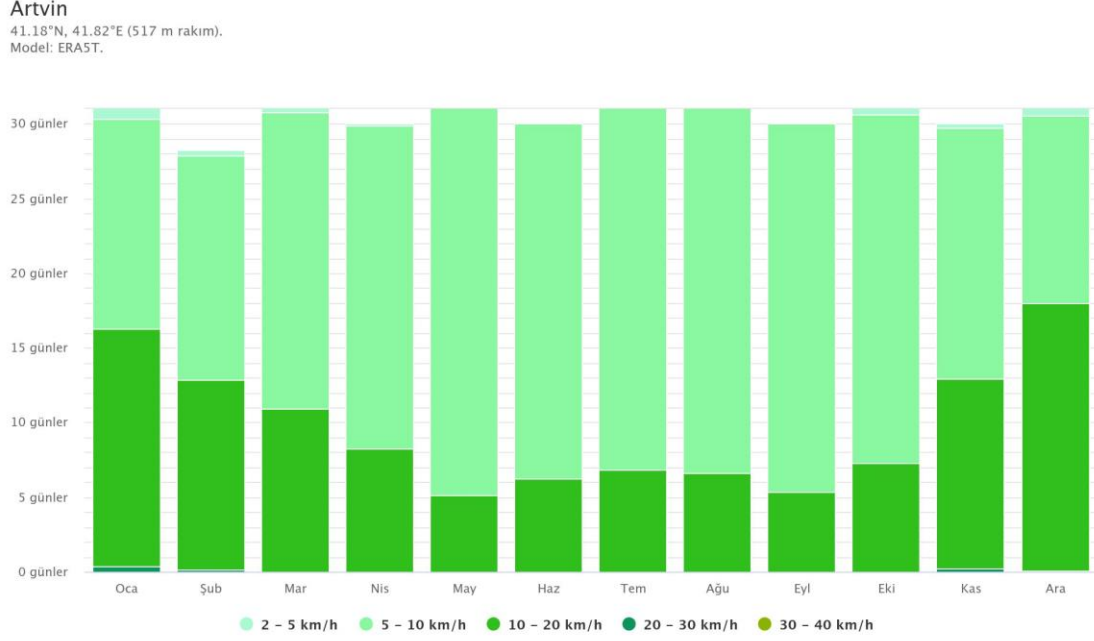
Artvin ili için Şekil 4.'de verilen yağış miktarları diyagramı aylara göre kaç günün belirli yağış miktarına ulaştığını göstermektedir [5].

Artvin  
41.18°N, 41.82°E (517 m rakım).  
Model: ERA5T.



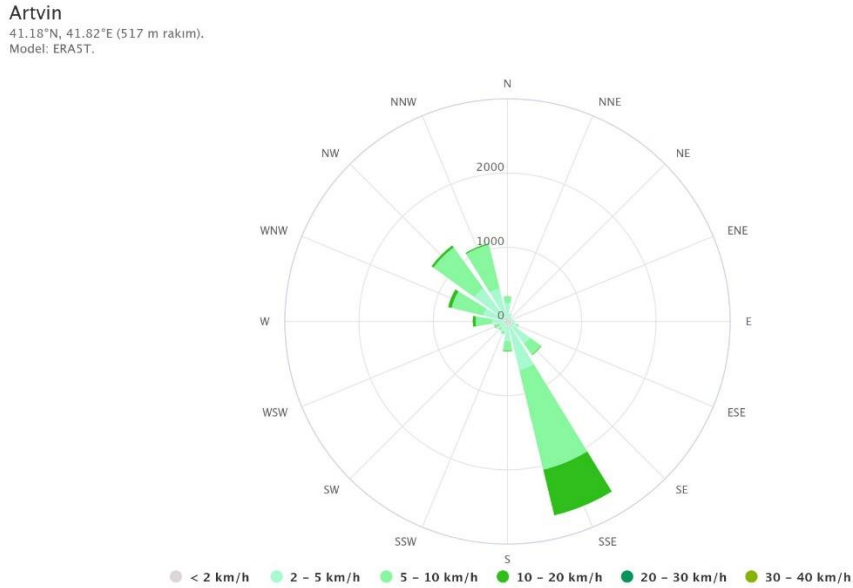
Şekil 4. Artvin ili aylara göre yağış miktarları

Artvin ilinde Aralık ayından Nisan ayına kadar güçlü rüzgarlar, Haziran ayından Ekim ayına kadar sakin rüzgarlar görülmektedir. Artvin ili için her ay rüzgar hızının belirli bir hıza ulaştığı günler Şekil 5.'de verilmektedir [5].



Şekil 4. Artvin ili aylara göre rüzgar hızı

Artvin ili için Şekil 5'de rüzgar gücü belirtilen yönde yılda kaç saat rüzgar estiğini göstermektedir [5].



Şekil 5. Artvin ili rüzgar gücü

## Materyal Metod

Sürdürülebilir bir kütüphane tasarımında uygun malzemelerin kullanımı ile ısıtma ve soğutma harcamalarında tasarruf sağlanabilir. Artvin ilinin ılıman-nemli iklim özellikleri göstermesi ve iklime uygun malzeme kullanımı enerji tüketiminde iyileşmeler sağlayacaktır.

Bu çalışma bina zarfında en fazla enerji kaybı gerçekleşen dış duvar alternatifleri üzerinden oluşturulmuştur. Çalışmada duvar malzemesi olarak en çok tercih edilen tuğla yapı malzemesinin farklı türleri ile değişken yalıtım malzemeleri kullanılmıştır. Çalışmada farklı tuğla türleri olarak; adi tuğla, yanmamış kil tuğla, seramik tuğla, beton tuğla kullanılmıştır. Kullanılan yalıtım malzemeleri ise; XPS, EPS, cam yünü, taş yünü, poli izosiyanür ve kuzu yünü olarak belirlenmiştir. Çalışmada kullanılan malzemeler duvara dıştan yalıtımlı biçimde uygulanarak 28 farklı alternatif elde edilmiştir. Bu alternatifler Tablo 1.'de gösterilmiştir.

**Tablo 1.** Çalışmada oluşturulan alternatifler

Alternatif	Dış Duvar (İçten – Dışa(cm))					Çatı Türü	
Tip-1	Boya (0.10)	Sıva (2.00)	Adi tuğla (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-2	Boya (0.10)	Sıva (2.00)	Yanmamış kil tuğla (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-3	Boya (0.10)	Sıva (2.00)	Seramik tuğla (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-4	Boya (0.10)	Sıva (2.00)	Beton tuğla (20.00)	XPS (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-5	Boya (0.10)	Sıva (2.00)	Adi tuğla (20.00)	EPS (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-6	Boya (0.10)	Sıva (2.00)	Yanmamış kil tuğla (20.00)	EPS (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-7	Boya (0.10)	Sıva (2.00)	Seramik tuğla (20.00)	EPS (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-8	Boya (0.10)	Sıva (2.00)	Beton tuğla (20.00)	EPS (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-9	Boya (0.10)	Sıva (2.00)	Adi tuğla (20.00)	Cam yünü (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-10	Boya (0.10)	Sıva (2.00)	Yanmamış kil tuğla (20.00)	Cam yünü (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-11	Boya (0.10)	Sıva (2.00)	Seramik tuğla (20.00)	Cam yünü (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-12	Boya (0.10)	Sıva (2.00)	Beton tuğla (20.00)	Cam yünü (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-13	Boya (0.10)	Sıva (2.00)	Adi tuğla (20.00)	Taş yünü (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-14	Boya (0.10)	Sıva (2.00)	Yanmamış kil tuğla (20.00)	Taş yünü (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-15	Boya (0.10)	Sıva (2.00)	Seramik tuğla (20.00)	Taş yünü (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-16	Boya (0.10)	Sıva (2.00)	Beton tuğla (20.00)	Taş yünü (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-17	Boya (0.10)	Sıva (2.00)	Adi tuğla (20.00)	Poliüretan (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı

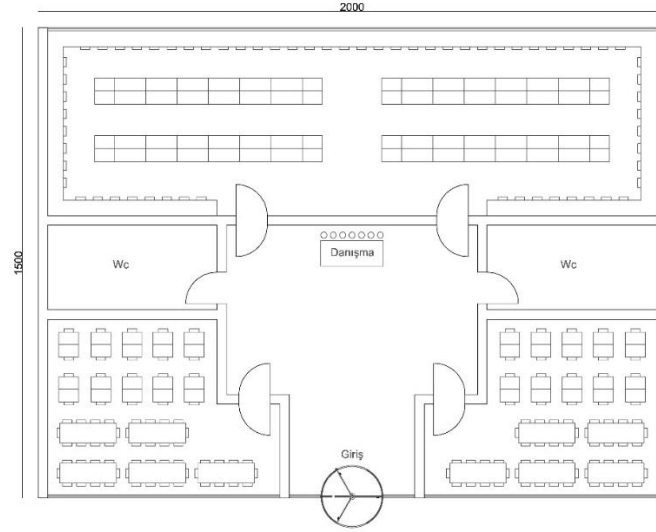
Tip-18	Boya (0.10)	Sıva (2.00)	Yanmamış kil tuğla (20.00)	Poliüretan (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-19	Boya (0.10)	Sıva (2.00)	Seramik tuğla (20.00)	Poliüretan (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-20	Boya (0.10)	Sıva (2.00)	Beton tuğla (20.00)	Poliüretan (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-21	Boya (0.10)	Sıva (2.00)	Adi tuğla (20.00)	Poli izosiyandır (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-22	Boya (0.10)	Sıva (2.00)	Yanmamış kil tuğla (20.00)	Poli izosiyandır (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-23	Boya (0.10)	Sıva (2.00)	Seramik tuğla (20.00)	Poli izosiyandır (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-24	Boya (0.10)	Sıva (2.00)	Beton tuğla (20.00)	Poli izosiyandır (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-25	Boya (0.10)	Sıva (2.00)	Adi tuğla (20.00)	Kuzu yünü (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-26	Boya (0.10)	Sıva (2.00)	Yanmamış kil tuğla (20.00)	Kuzu yünü (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-27	Boya (0.10)	Sıva (2.00)	Seramik tuğla (20.00)	Kuzu yünü (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı
Tip-28	Boya (0.10)	Sıva (2.00)	Beton tuğla (20.00)	Kuzu yünü (5.00)	Sıva (2.00)	Boya (0.10)	Kırma Kiremit Çatı

Çalışmada Artvin ili iklim özellikleri dikkate alınarak analiz edilen kütüphane yapısı Autodesk Revit programında modellenmiştir. Çalışmada alternatifler oluşturulurken kullanılan malzemelerin termal özellikleri programa girilmiştir [6]. Bu malzemelerin termal özellikleri Tablo 2.'de verilmiştir.

**Tablo 2.** Çalışmada kullanılan malzemelerin termal özellikleri

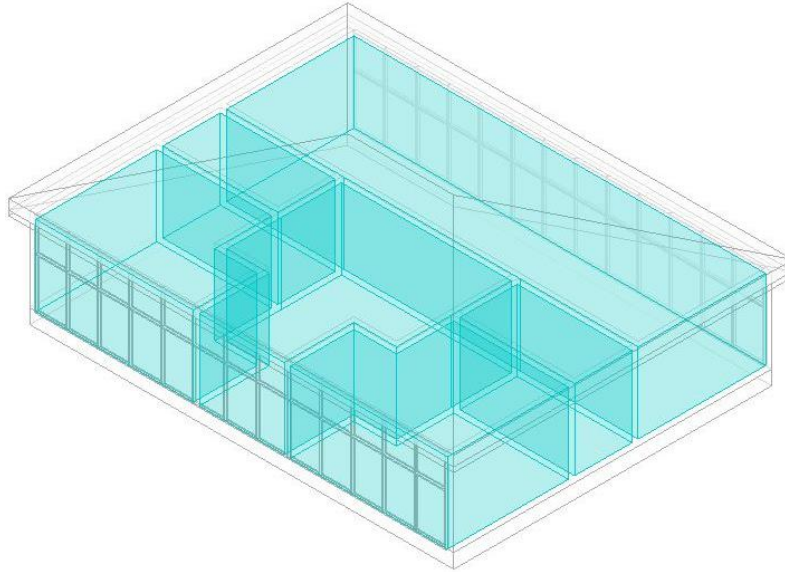
Alternatif	Isı İletkenlik Katsayısı (W/m.K)	Yoğunluk (kg/m <sup>3</sup> )
Adi tuğla	0,692	1602
Yanmamış kil tuğla	0,21	1000
Seramik tuğla	1,3	880
Beton tuğla	0,5	1250
XPS	0,031	25
EPS	0,039	15
Cam yünü	0,046	120
Taş yünü	0,04	210
Poliüretan	0,024	29
Poli izosiyandır	0,023	38
Kuzu yünü	0,036	13

Çalışmada Autodesk Revit programında modellenen kütüphane yapısına ait kat planı Şekil 6.'da verilmiştir.



Şekil 6. Kütüphane kat planı

Çalışmanın bir sonraki aşamasında alternatiflerin enerji modelleri oluşturulmuştur. Oluşturulan enerji modeli Şekil 7.'de verilmiştir.



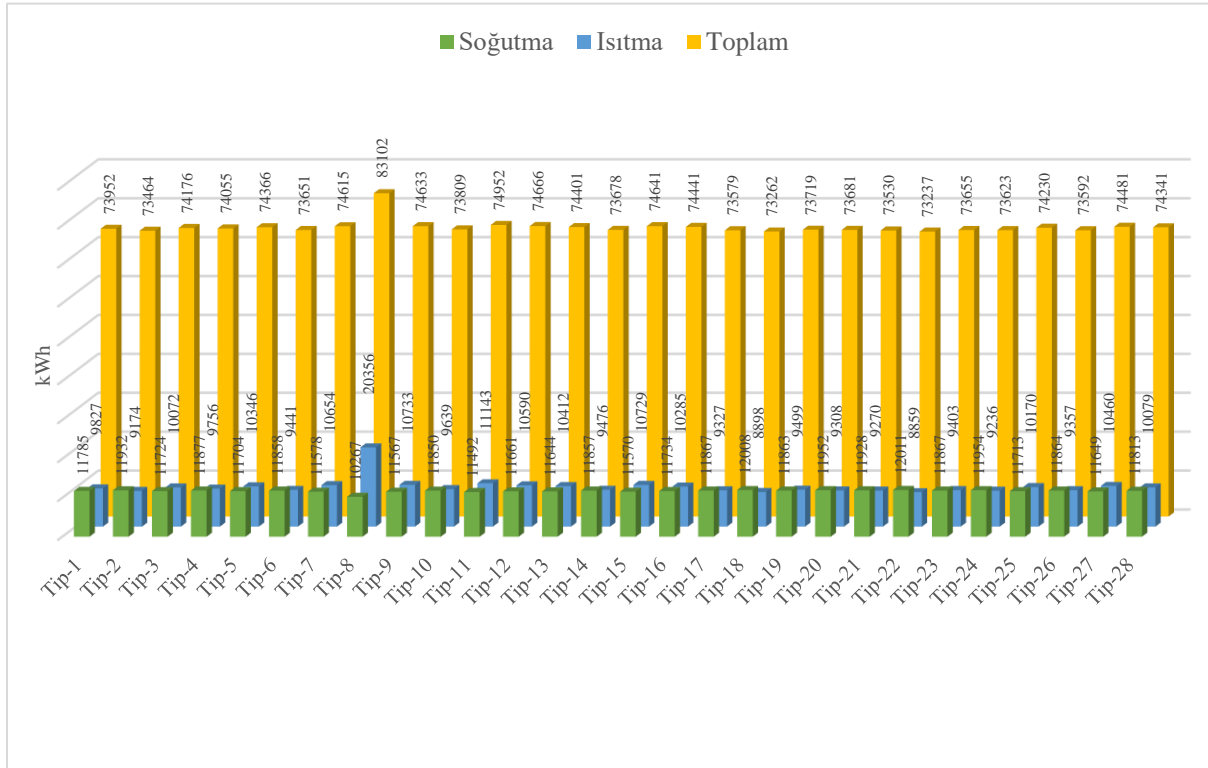
Şekil 7. Enerji modeli

Çalışma kapsamında oluşturulan enerji modeli bina enerji simülasyonu yazılımı olan ve web tabanlı çalışan Autodesk Green Building Studio programına aktarılarak enerji analizleri yapılmıştır.

### **Bulgular ve Sonuçlar**

Simülasyon analizinin sonucunda ılıman-nemli iklim özelliğine sahip Artvin ilinde kullanılan duvar malzeme türüne göre optimum şartlar belirlenmeye çalışılmıştır. Çalışmanın örnek yapısı

olarak tasarlanan kütüphane binasında kullanılan malzemeler arasında optimum enerji tüketimi seviyesi gösteren termal özelliğine bağlı olmaktadır. Çalışmada yıllık soğutma, ısıtma ve toplam enerji tüketimleri incelenmiştir (Şekil 8.).



Şekil 8. Yıllık enerji tüketim miktarları

Bu çalışmanın sonucunda soğutma enerjisinde tuğla malzemeleri için incelendiğinde malzemenin ısı iletkenlik kat sayısı arttıkça genel olarak soğutma enerjisi azalmıştır. Bununla birlikte soğutma enerjisi için yalıtım malzemeleri incelendiğinde tuğla malzemeleri ile aynı şekilde ısı iletkenlik kat sayısı arttıkça genel olarak soğutma enerjisi azalmıştır. Fakat ısıtma ve toplam enerji tüketimi açısından incelendiğinde bu durumun tam tersi olarak hem tuğla malzemeleri hem de yalıtım malzemeleri için ısı iletkenlik kat sayısı arttıkça genel olarak enerji tüketimi artmıştır. Çalışmada elde edilen analiz sonuçlarına göre optimum soğutma enerjisi tüketimi miktarı olarak 10267 kWh ile en çok tüketim miktarı olan 11954 kWh arasında %14,1 enerji tasarrufu sağlanmıştır. Isıtma enerjisinde optimum enerji tüketimi olarak 8859 kWh ile en çok ısıtma enerjisi tüketimi olan 11143 kWh arasında %20,5'lik enerji tasarrufu sağlanmıştır. Toplam enerji tüketiminde optimum enerji tüketimi olan 73237 kWh ile, en çok toplam enerji tüketimi olan 83102 kWh arasında %11,9'luk enerji tasarrufu belirlenmiştir. Bu çalışma ile ılıman-nemli iklime sahip olan Artvin ili için kütüphane tasarımı ile enerji tüketiminde tasarruf hedeflenmiştir. Ayrıca çalışmada Autodesk Revit ve GBS yazılımları kullanılarak enerji simülasyonunun tasarım aşamasında enerji tüketimine olan katkısı belirlenmiştir. Bu çalışma belirlenen iklim koşullarında optimum enerji tüketimi sağlayarak enerji tasarrufunun önemi göstermektedir.

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## ELAZIĞ İLİ FEVZİ ÇAKMAK MAHALLESİ 134 ADA 1 PARSELDE BULUNAN FERİT BEY KONAĞI'NIN BELGELENMESİ VE SORUNLARININ TESPİTİ

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### Özet

Modern Elazığ; geç Osmanlı döneminde Harput kentinin siyasi nedenlerden dolayı taşınmasıyla oluşmuştur. Taşınma sonucunda Harput ve çevresinde bulunan geleneksel sivil mimari örneklerinin birçoğu terk edilmelerine bağlı doğal ve insan eliyle meydana gelen değişme ve bozulmalar sebebi ile köhneme ve sonrasında da yıkılma sürecine maruz kalmıştır. Günümüze ulaşan çok az sayıdaki yapıdan birini de; Harput'un taşınmasından sonra inşa edilen, Elazığ İli Fevzi Çakmak Mahallesi 134 Ada 1 Parsel'de bulunan Ferit Bey Konağı oluşturmaktadır. Seyrek kalan dokunun önemli temsilcilerinden olan bu yapı, inşasından günümüze kadar çeşitli işlevlerle kullanılmış olup, yapım tekniği ve mekân organizasyonu açısından geleneksel Elazığ konut mimari özelliklerini taşımaktadır. Büyük oranda özgün özelliklerini korumasına rağmen kullanım ve doğal afetler sebebiyle değişme ve bozulmaya maruz kalan yapı, köhneme ve yıkım sürecinde kritik bir konumdadır. Bu çalışma ile amaçlanan, Elazığ sivil mimari örneklerinden özgün özelliklerini halen daha koruyan çok az sayıdaki örneğin bir temsilcisi olan Ferit Bey Konağı'nın belgelenmesi ve problemlerinin saptanarak çözüm öneriler sunulmasıdır. Bu kapsamda yapılan alan çalışması kapsamında lazer tarayıcı ve geleneksel yöntemle elde edilen verilerin vektörel çizim yazılımına entegrasyonu ile rölöve oluşturulmuş; detaylı eskiz ve fotoğrafların alınması ile görsel belgeleme tamamlanmış; problemler saptanmış, sınıflandırılmış ve bu tespitlerin değişme ve bozulma analizleri kapsamında detaylandırılması yapılarak sunulmuştur.

**Anahtar kelimeler:** Elazığ, Harput, sivil mimari, konut, restorasyon

## **DOCUMENTATION AND DETERMINATION OF PROBLEMS OF FERIT BEY MANSION LOCATED IN PARCELS 134, FEVZI ÇAKMAK NEIGHBORHOOD, ELAZIG PROVINCE**

### **Abstract**

Modern Elazığ was established following the relocation of the city of Harput due to political reasons during the late Ottoman period. As a consequence of this relocation, many examples of traditional civil architecture in and around Harput were abandoned and subsequently subjected to deterioration and collapse due to both natural causes and human intervention. Among the few remaining structures from this period is the Ferit Bey Mansion, located at Parcel 1, Block 134, Fevzi Çakmak Neighborhood, Elazığ Province, which was constructed after the relocation of Harput. This building, a significant representative of the sparsely remaining architectural fabric, has served various functions since its construction and embodies the architectural characteristics of traditional Elazığ residential architecture in terms of construction technique and spatial organization. Although the mansion has largely preserved its original features, it is currently in a critical state of deterioration and potential collapse due to usage and natural disasters. The aim of this study is to document Ferit Bey Mansion, a rare representative of the few remaining examples of traditional Elazığ civil architecture, and to identify its problems, offering solutions to address them. Within the scope of this study, a survey was conducted through the integration of data obtained using laser scanning and traditional methods into vector drawing software; visual documentation was completed through detailed sketches and photographs; problems were identified, classified, and presented with detailed analyses of changes and deterioration.

**Keywords:** Elazığ, Harput, civil architecture, residence, restoration

## Giriş

Kültür varlıkları, geçmiş ve geleceği birbirine bağlayan köprülerdir. Bu köprüler, geçmişini anlamamızı sağlayan projeksiyonlar olduğu gibi gelecek vizyonumuz için de bize yol göstermektedir. Uzun yıllar farklı medeniyetlere ait kültür varlığı izlerini taşıyan Anadolu’da, geçmişten günümüze birçok anıt yapı bulunmaktadır. Bu yapılar; şehirleşme, doğal afetler, köhneme gibi nedenlerle kaybolmaktadır. Yok olan kültürel miras, kümülatif kültür belleğimiz için bir kayıptır. Bu nedenle, bu varlıkları korumak-yaşatmak elzemdir.

Elazığ İli Fevzi Çakmak Mahallesi 134 Ada 1 Parsel’de bulunan Ferit Bey Konağı, Sultan Abdülaziz döneminde taşınan Harput Sancağı’nın Mamuret’ül Aziz adıyla modern Elazığ’a taşınmasından sonraki dönemde (H.1320-M.1902/03) ya da (H.1330-M.1911/12) Harput’a 5 km mesafede bulunan bugünkü Fevzi Çakmak Mahallesi’nde yapılmıştır.



Resim 1. Ferit Bey Konağı’na ait kitabe

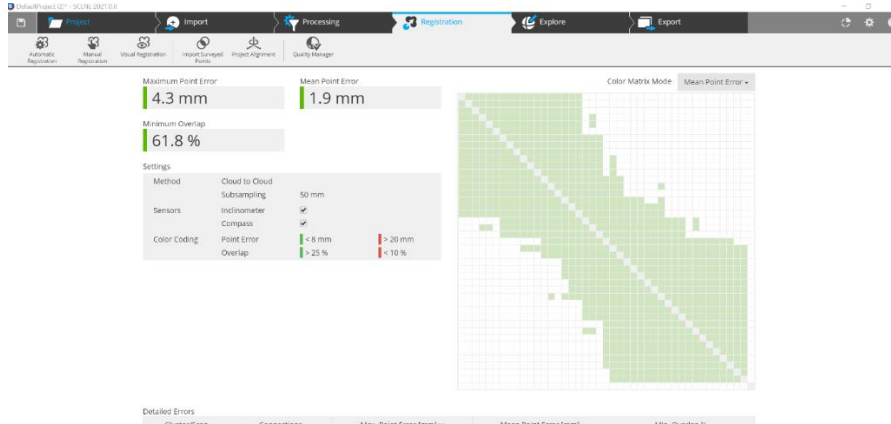
Bağ evi olarak inşa edildiği düşünülen bu yapı, inşasından günümüze kadar çeşitli işlevlerle kullanılmış olup, yapım tekniği ve mekân organizasyonu açısından geleneksel Elazığ konut mimari özelliklerini taşımaktadır. Büyük oranda özgün özelliklerini korumasına rağmen kullanım ve doğal afetler sebebiyle değişme ve bozulmaya maruz kalan yapı, köhneme ve yıkım sürecinde kritik bir konumdadır.

Bu çalışma ile amaçlanan, Elazığ sivil mimari örneklerinden özgün özelliklerini halen daha koruyan çok az sayıdaki örneğin bir temsilcisi olan Ferit Bey Konağı’nın belgelenmesi ve problemlerinin saptanarak çözüm önerilerinin sunulmasıdır.

## Araştırma ve Bulgular

Alan çalışması kapsamında Ferit Bey Konağı’nın ölçümleri, 3 boyutlu lazer tarayıcı Faro Focus3D X 130 lazer tarama cihazıyla 24.01.2024 tarihinde gerçekleştirilmiştir. İlgili cihaz mesafeyi ölçmek için faz değişim teknolojisini kullanır. Bu teknoloji, lazer ışınının farklı uzunluklardaki sabit dalgalarla modüle edilmesini sağlar. “Tarayıcının nesneye olan uzaklığı, kızılötesi ışık dalgalarındaki faz değişimlerinin ölçülmesiyle kesin bir şekilde belirlenir” (FARO Technologies Inc, 2015:2). Tek nokta ölçümleri saniyede 976.000 pt/s kadar tekrarlanır. Bu da, tarayıcı ortamının üç boyutlu bir veri kümesi olan bir nokta bulutu oluşturmasını sağlar. Seçilen çözünürlüğe bağlı olarak, her nokta bulutu milyonlarca tarama noktası içerebilir. Lazer taramaları, çıkarılabilir bir SD hafıza kartına kaydedilir ve FARO'nun nokta bulutu işleme yazılımı SCENE'e aktarılır.

Ferit Bey Konağı'nda 44 tarama noktası kurulmuştur. Elde edilen veriler SCENE yazılımı ile birleştirilip nokta bulutuna çevrilmiştir. Elde edilen nokta bulutundan iki boyutlu ortofotolar elde edilmiştir.



Şekil 1. Ölçüm sonucunda elde edilen veriler

Cluster/Scan	Connections	Max. Point Error [mm]	Mean Point Error [mm]	Min. Overlap %
Ferit...-043	0	-	-	-
Ferit...-017	29	4.3	2.2	61.8
Ferit...-000	17	4.3	2.6	61.8
Ferit...-016	29	4.1	2.2	62.8
Ferit...-002	17	4.1	2.5	74.9
Ferit...-015	27	4.1	2.3	63.7
Ferit...-001	17	4.0	2.4	72.9
Ferit...-019	29	4.0	2.3	68.9
Ferit...-003	18	4.0	2.1	77.0
Ferit...-004	18	4.0	2.0	78.2
Ferit...-012	23	3.6	2.1	71.9
Ferit...-035	22	3.6	1.7	67.6
Ferit...-018	27	3.5	2.1	67.6
Ferit...-022	32	3.5	2.1	73.3
Ferit...-010	21	3.5	1.9	73.3
Ferit...-007	20	3.4	1.9	69.7
Ferit...-013	24	3.4	1.9	74.0
Ferit...-020	26	3.4	2.1	69.0
Ferit...-006	20	3.4	2.0	75.8
Ferit...-005	17	3.4	2.0	78.9
Ferit...-014	23	3.4	2.0	74.8

Şekil 2. Nokta hata paylarını ve bulut çakışma oranlarını gösteren veriler

Ferit...-009	21	3.1	1.9	78.2
Ferit...-027	26	3.0	1.8	77.2
Ferit...-031	23	3.0	1.7	69.0
Ferit...-029	25	2.9	1.7	71.1
Ferit...-033	23	2.9	1.7	77.4
Ferit...-032	23	2.9	1.6	74.7
Ferit...-030	27	2.9	1.8	74.0
Ferit...-021	27	2.9	1.9	71.8
Ferit...-036	20	2.9	1.6	75.2
Ferit...-023	29	2.8	1.9	74.2
Ferit...-028	25	2.8	1.6	79.2
Ferit...-034	20	2.7	1.6	79.5
Ferit...-037	20	2.5	1.5	71.8
Ferit...-039	20	2.5	1.5	77.1
Ferit...-038	20	2.5	1.4	73.4
Ferit...-024	26	2.4	1.8	77.4
Ferit...-042	19	2.1	1.4	74.8
Ferit...-041	19	2.0	1.3	74.7

Şekil 3. Nokta hata paylarını ve bulut çakışma oranlarını gösteren veriler



**Resim 2.** Nokta bulutlarının birleştirilmesiyle oluşturulmuş güney cephe ortofotosu.

İlgili ortofotoların vektörel çizim yazılımı olan AutoCAD'e entegresi ile rölöve oluşturulmuş; detaylı eskiz ve fotoğrafların alınması ile de görsel belgelem tamamlanmıştır. Oluşturulan rölövede bulunan mahallere ve mahallerin içerisinde bulunan elemanlara poz numaraları verilmiştir (Z-01, K-01, P-01 gibi).

### **Ferit Bey Konağı'nın Özellikleri**

Ferit Bey Konağı, İnönü Caddesi ve Gökalp Sokak'ın kesiştiği noktada, Tunceli ve Elazığ'ı birbirine bağlayan, yerel ağızda "Pertek Yolu" olarak anılan aksta konumlanmaktadır. Kitabesinden anladığımız kadarıyla 1902/03-1911/12 yılları arasında yapıldığı anlaşılmaktadır. Konak, sözlü kaynaklardan alınan bilgilere göre yapıldığı tarihten itibaren bağ evi, askerlik şubesi, kaymakamlık, okul ve marangozhane olarak kullanılmıştır.

Yapı, Elazığ İli Fevzi Çakmak Mahallesi 134 Ada 1 Parsel'de bulunmaktadır. 5714 m<sup>2</sup>'lik bir parselde bulunan yapının oturma alanı 195,53 m<sup>2</sup>'dir. Yapı; güney, doğu ve batı cephelerinde üç katlı, kuzey cephede ise Gökalp Sokak'ın üst kotta bulunmasından dolayı iki katlıdır. Giriş, yapının güney cephesinde bulunmakta olup, İnönü caddesi üzerindeki tali yol üzerinden çift kanatlı ahşap kapı üzerinden yapılmaktadır.

### **Güney Cephesi**

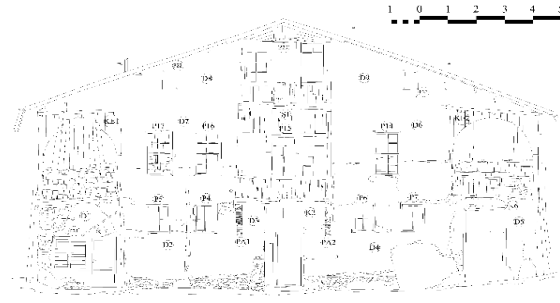
Yapının ana girişinin olduğu cephe. Cephe, subasman kotuna kadar moloz taş, sonrasında ahşap hatıllı kerpiç tuğla ile örülmüştür. Kerpiç örüntü, ahşap hatıllara sabitlenmiş rabiz telli sıva ve boya ile kapatılmıştır. Yer yer sıva ve boya çatlakları ve döküntüler mevcuttur. Ana giriş, cephenin simetrik orta aksında bulunmaktadır. Depo olarak kullanılan Z-04 ve Z-06 mahallerinden güney cepheye açılan sonradan eklenen ahşap kapılar (K17 ve K6) görülmektedir. Birinci kat ve çatı katını da kapsayan şahnişin (Ş1) bu cephede bulunmaktadır. Şahnişinin cephede zemin kat tavanına denk geldiği kotta iki adet dekoratif ahşap payanda (PA1 ve PA2) vardır. Özgünlüğünü koruyan 11, sökülen 4, sonradan eklenen 1 olmak üzere toplam 16 pencere boşluğu mevcuttur. Cephenin doğu ve batı uçlarında 1. kat kotuna denk gelen bölümlerde, teraslar bulunmaktadır. Çatı katı döşemesinin teraslara gelen kısımları ahşap dikmeler tarafından taşınmaktadır. Ahşap dikmelerin arasında dekoratif kemerler

bulunmaktadır (KE1 ve KE2). Terası çevreleyen ve deforme olmuş korkulukların olduğu yerlere ateş tuğladan duvar örüntüsü yapılmıştır.



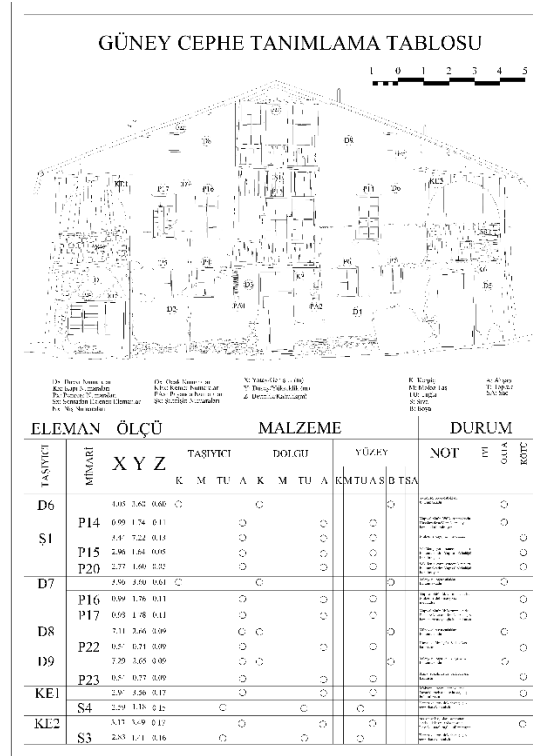
Resim 3. Güney cephe fotoğrafı

GÜNEY CEPHE TANIMLAMA TABLOSU



ELEMEN	ÖLÇÜ	MALZEME										DURUM											
		X	Y	Z	TAŞIYICI			DOLGU		YÜZEY					NOT	İTİ	ORTA	KUÇUC					
TASIVICI	NUMARASI				K	M	TU	A	K	M	TU	A	K	M	TU	A	B	T	S	A			
D1	P24	2.47	2.66	0.15	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○
	K17	1.72	1.32	0.09																			
D2	P4	2.94	2.54	0.51	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○
	P5	0.87	1.17	0.09																			
D3	K3	0.81	1.15	0.02																			
	PA1	3.57	3.72	0.61	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○
	PA2	1.78	2.10	0.12																			
D4	P6	0.19	1.45	0.04	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○
	P7	4.55	2.68	0.64	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○
D5	P7	0.93	1.15	0.09																			
	K6	0.45	1.15	0.09																			
	K6	2.15	3.35	0.11																			
	K6	1.43	2.91	0.11	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○		○	○

Şekil 4. Güney cephe tanımlama tablosu



Şekil 5. Güney cephe tanımlama tablosu

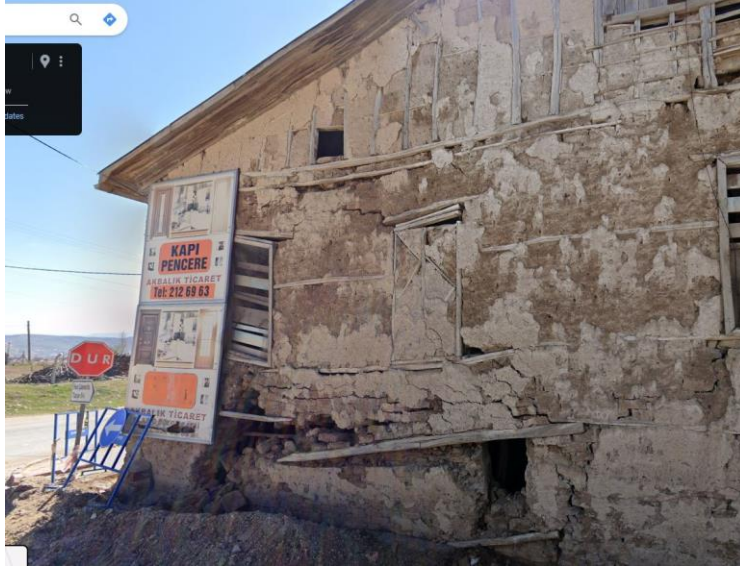
### Kuzey Cephesi

Gökalp sokağa paralel konumlanmıştır. Subasman kotuna kadar moloz taş, birinci kat tavan kotuna kadar ahşap hatıllı kerpiç tuğla, sonrasında çatı saçak kotuna kadar ahşap çatıklı kerpiç dolgu duvar ile örülmüştür. Örüntü üzeri sıva ve boya ile kapatılmıştır ancak büyük oranda dökülmüş, kerpiç tuğla örüntüsü açığa çıkmıştır. Cephe üzerinde özgünlüğünü koruyan ancak malzeme kaybı yaşayan P12, P11, P21 ahşap pencereleri bulunmaktadır. P26 penceresinin ise kasası sökülmüş, boşluğu ateş tuğla ile kapatılmıştır. Cephede D1 ve D3 duvarlarının olduğu bölümlerde yapısal yıkımlar mevcuttur. D1 duvarındaki yıkılan kısım dışarıdan yapıya girişi engellemek amacıyla kereste çatki ile kapatılmıştır (S1). D3 duvarındaki yıkılan bölüm ise ateş tuğla ile kapatılmıştır (S2).



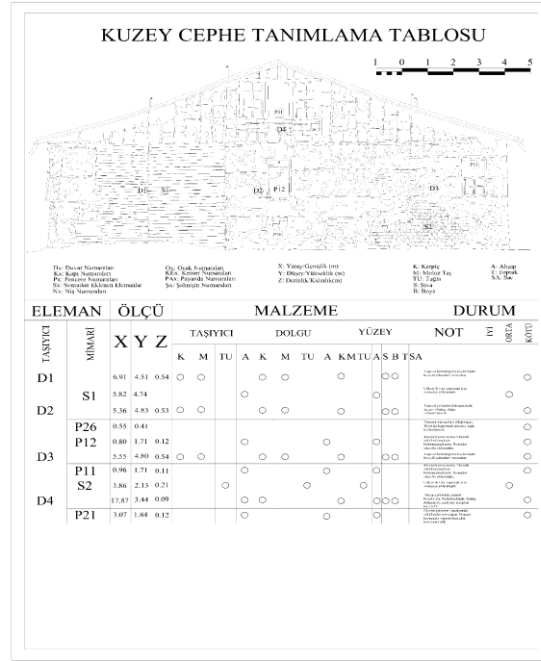


**Resim 4.** Kuzey cephe fotoğrafı



**Resim 5.** Yıkılmadan önce D1 duvarı (Google Street View, 2020)





Şekil 6. Kuzey cephe tanımlama tablosu

### Batı Cephesi

Gökalp sokağa dik konumlanmıştır. Subasman kotuna kadar moloz taş, saçak kotuna kadar ahşap hatıllı kerpiç tuğla duvar örüntü mevcuttur. Kerpiç örüntü sıva ve boya ile kaplanmıştır. Büyük oranda sıva kaybı bulunmaktadır. P10, P9 pencereleri özgün yapısını korumakla birlikte malzeme kayıpları vardır. P1 penceresinin kasası sökülmüş olup, sadece pencere boşluğu kalmıştır. P2 penceresine sonradan ekleme kereste çatki yapılmıştır. Birinci kat döşemesi ve çatı saçak kotu arasındaki terasta ahşap kemerler (KE4) bulunmaktadır. Kemerler zamanla deforme olmuş, korkuluklar ise bütünlüğünü yitirmiştir. Terasın bir bölümüne sonradan tuvalet mahali (1-02) eklenmiş, duvarları ateş tuğladan yapılmıştır. Cephenin su basman kotunda kerpiç ve taş malzeme kayıpları bulunmaktadır.



Resim 6. Batı cephe fotoğrafı

**BATI CEPHE TANIMLAMA TABLOSU**

ELEMEN	ÖLÇÜ			MALZEME										DURUM								
	TANIMI	X	Y	Z	TASIVICI			DOLGU			YUZZEY				NOT	BTI	KOTI					
	MERKEZİ				K	M	TU	A	K	M	TU	A	K	M	TU	A	B	TSA				
D1		4.23	0.41	0.54																		
	P1	0.90	0.63																			
	P2	0.73	0.77	0.11																		
	P9	0.95	1.71	0.09																		
	P10	0.98	1.70	0.09																		
D2		4.77	0.27	0.57																		
	P3	0.44	0.48	0.07																		
D3		4.45	0.55	0.63																		
KE4		6.90	3.36	0.17																		
SS		2.23	3.34	0.20																		
S1		1.62	7.22	0.13																		
	P15	0.76	1.06	0.05																		
	P20	0.76	1.05	0.05																		

Şekil 7. Batı cephe tanımlama tablosu

### Doğu Cephesi

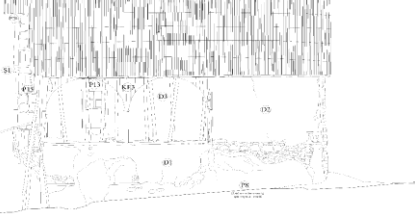
İnönü caddesine paralel konumlanmıştır. D1 duvarı, birinci kat döşeme kotuna kadar devam etmekte olup moloz taştan imal edilmiştir. D2 ve D3 duvarları kerpiç tuğla örüntüsüne sahip olup çatı saçak kotuna kadar devam etmektedir. Duvar yüzeylerinde sıva dökülmeleri ve boya çatlakları mevcuttur. Özgünlüğünü koruyan fakat kaybedilen kanadı bulunan P13 ahşap penceresi bu cephede bulunmaktadır. Z-08 mahalinde bulunan P8 pencere boşluğu ateş tuğla ile kapatılıp üzeri sıvandığından dolayı cephede gözlenememektedir. Birinci kat döşeme kotundan çatı saçak kotuna kadar ahşap kemer (KE3) mevcuttur. Terasta korkuluk gözlenememiştir.



Resim 7. Doğu cephe fotoğrafı

**DOĞU CEPHE TANIMLAMA TABLOSU**

1 0 1 2 3 4 5



D1: Duvar Numarası      D2: Çelik Sönmeler      X: Yatay Yataylık (m)      K: Kirişler      A: Aşlar  
 D3: Kiriş Numarası      D4: Kiriş Numarası      Y: Dikey Yataylık (m)      M: Mutfak      L: L. Kat  
 F: Çelik Sönmeler      S: Sönmeler (Eski) Esmalar      Z: Dikey Yataylık (m)      B: Banyo      D: D. Kat  
 P: Sönmeler Numarası      S: Sönmeler Numarası

ELEMEN	ÖLÇÜ			MALZEME			DURUM			
	X	Y	Z	TASIVICI	DOLGU	YÜZEY	NOT	İN	ORTA	DIŞI
D1	11.88	2.89	0.47	○	○	○	○	○	○	○
P8	0.52	0.72								
D2	4.20	3.03	0.48		○					○
KE3	6.63	3.09	0.17							○
D3	7.11	3.18	0.61		○					○
S1	P13	1.01	1.77	0.09		○				○
	P14	1.02	2.22	0.13		○				○
	P15	0.77	1.67	0.05		○				○
	P20	0.79	1.68	0.05		○				○

Şekil 8. Doğu cephe tanımlama tablosu

### Çatı

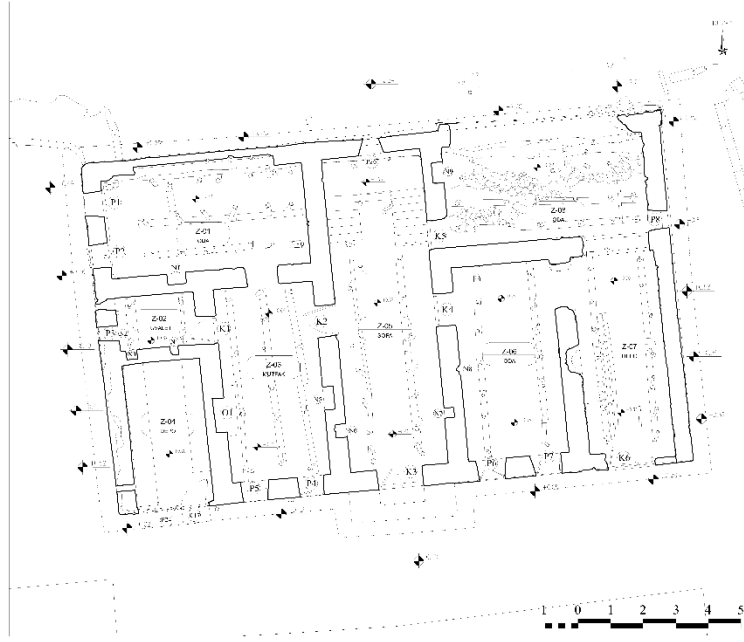
Özgün çatı kaybedilmiştir. Yapıldığı dönem bilinmemekle birlikte ahşap karkas taşıyıcılı trapez sac kaplama beşik çatı yapılmıştır. Doğu cephede iki, batı cephede üç adet baca çıkışı gözlenmektedir.



Resim 8. 2-03 mahalinden çekilen çatı fotoğrafı

### Zemin Kat

Yapının ana girişinin bulunduğu , genel olarak servis mekanlarını barındıran, toplamda 8 mahalden oluşmaktadır.



Şekil 9. Zemin kat anahtar planı

### Z-01

Dikdörtgen şekilli olup 6.08m x 3.14m ölçülerindedir. Oda olarak kullanıldığı düşünülmektedir. Batı duvarında özgünlüğünü kaybetmiş P1 ve P2 pencereleri bulunmaktadır. Kuzey duvarının kerpiç tuğla örüntüsünün bir kısmı su basman seviyesine kadar yapısal yıkılma uğramış olmakla birlikte sonradan ateş tuğla ile kapatılmıştır. Güney duvarındaki kapı boşluğu Z-03 mutfak mahaline açılmaktadır. Aynı duvarda malzeme kaybına uğrayan bir niş (N1) bulunmaktadır. Zeminde kayrak taşı izleri görülmekte olup, özgünlüğünü kaybetmiştir. Tavanı ahşap kaplamadır, taşıyıcısı tomruktur. Mahalde sehim bulunan 1-01 mahal döşemesini desteklemek amacıyla ahşap dikmeler bulunmaktadır.



Resim 9. Z-01 mahal fotoğrafı

### Z-02

Dikdörtgen şekilli olup 2.41m x 1.67m ölçülerindedir. Tuvalet olarak kullanılmaktadır. Batı duvarında özgünlüğünü kaybetmiş P3 penceresi ve N2 nişi bulunmaktadır. Aynı duvarda tuvalet gideri oluşturmak için su basman kotunda yaklaşık 40cm x 40cm ölçülerinde yapısal boşluk oluşturulmuştur. Güney duvarında N3 ve N4 nişleri bulunmaktadır. Doğu duvarında Z-03 mutfak mahaline açılan K1 kapısı bulunmaktadır. Özgün zemin kaplaması kaybolmuştur. Üst kat döşemesini desteklemek için ahşap dikmeler bulunmaktadır.



Resim 10. Z-02 mahali fotoğrafı

### Z-03

Dikdörtgen şekilli olup 3.04m x 6.06m ölçülerindedir. Mutfak olarak kullanılmaktadır. Batı duvarında Z-02 mahaline açılan K1 kapısı ve özgünlüğünü koruyan O1 ocağı bulunmaktadır. Kuzey duvarında Z-01 mahaline açılan B1 boşluğu bulunmaktadır. Doğu duvarında Z-05 mahaline açılan K2 kapısı ve N5 nişi bulunmaktadır. Güney duvarında kanat kayıpları olan özgün P4 ve P5 pencereleri bulunmaktadır. Özgün zemin kaplaması kaybolmuştur. Tavanı ahşap kaplamadır, taşıyıcısı tomruktur. Zeminde bir üst katta bulunan 1-04 mahalinin döşemesini desteklemek amacıyla ahşap dikmeler bulunmaktadır. Boya olan duvarlarda yüzeysel çatlaklar bulunmaktadır.





**Resim 11.** Z-03 mahali fotoğrafı

#### **Z-04**

Dikdörtgen şekillidir. 2.38m x 4.45m ölçülerindedir. Depo olarak kullanılmaktadır. Batı duvarında soba borusu boşluğu oluşturulmuştur. Güney duvarına sonradan bir pencere (P24) ve bir kapı (K17) eklenmiştir. Bu elemanları yapmak için özgün duvarın yıkıldığı düşünülmektedir. Bu duvarın beden duvarı harman tuğladan yapılmış, pencere ve kapı üstü duvar ise kerpiç tuğla ile imal edilmiştir. Zemin sonradan şap ile kapatılmıştır. Tavandaki ahşap kirişlerde yanma izleri görülmektedir. Tavan, sonradan sunta ile kapatılmıştır.



**Resim 12.** Z-04 mahali fotoğrafı

### Z-05

Dikdörtgen şekilli olup 3.02m x 9.97m ölçülerindedir. Sofa olarak kullanılmaktadır. Yapının ana girişi bu mahalin güney duvarındaki çift kanatlı ahşap kapıdan (K3) yapılmaktadır. Batı duvarında Z-03 mutfak mahaline açılan K2 kapısı ve N6 nişi bulunmaktadır. Doğu duvarında Z-06 mahaline açılan ve kanadını kaybetmiş K4 kapısı ve Z-08 mahaline açılan ve kanadını kaybetmiş K5 kapısı vardır. Aynı duvarda N7 nişi de bulunmaktadır. Üst kata geçiş kuzey duvarına mesnetli merdiven tarafından gerçekleştirilmektedir. Merdiven sahanlığında boşluğu ateş tuğla ile kapatılmış P26 penceresi bulunmaktadır. Kuzey ve doğu duvarında yapısal çatlaklar ve ayrılma mevcuttur. Özgün zemin kaybolmuştur, kayrak taşı izleri görülmektedir. Tavanı ahşap kaplamadır, taşıyıcısı tomruktur. Bir üst kattaki 1-05 mahalini desteklemek amacıyla ahşap dikmeler bulunmaktadır.



Resim 13. Z-05 mahali fotoğrafı

### Z-06

Dikdörtgen şekillidir. 6.10m x 3.07m ölçülerindedir. Oda olarak kullanılmaktadır. Batı duvarında Z-05 mahaline açılan K4 kapısı bulunmaktadır. Aynı duvarda sonradan kerpiçle kapatılmış N8 nişi vardır. Güney duvarında kanatlarının bir kısmını kaybetmiş özgün P6 ve P7 ahşap pencereleri vardır. Doğu duvarında Z-07 mahaline açılan, insan eliyle oluşturulmuş ve yapısal bütünlüğü bozan B2 boşluğu bulunmaktadır. Özgün zemin kaybolmuştur. Sıva ve boya dökülmeleri mevcuttur. 1-07 mahalini desteklemek amacıyla ahşap dikmeler bulunmaktadır. Tavanı ahşap kaplamadır, taşıyıcısı tomruktur.



**Resim 14.** Z-06 mahali fotoğrafı

### **Z-07**

Dikdörtgen şekilli olup 2.53m x 6.46m ölçülerindedir. Ahır/Depo olarak kullanıldığı düşünülmektedir. Duvarlarında sıva ve boya dökülmeleri mevcuttur. Batı duvarında Z-06 mahaline açılan, insan eliyle yapılmış ve yapısal bütünlüğü bozan B2 boşluğu bulunmaktadır. Aynı duvarın orta aksında defineciler tarafından tahrip edilmiş bir bölüm bulunmaktadır. Kuzey duvarında Z-8 mahaline açılan ve insan eliyle yapılmış B3 boşluğu bulunmaktadır. Yapısal bütünlüğünü kaybeden güney duvarı özgünlüğünü kaybetmiş olup ateş tuğla ile tekrardan örülmüştür. Sonradan eklenen K6 kapı boşluğu mevcuttur. Üst kat döşemesini desteklemek amacıyla ahşap dikmeler eklenmiştir. Tavanı ahşap kaplamadır, taşıyıcısı tomruktur.



**Resim 15.** Z-07 mahali fotoğrafı



## Z-08

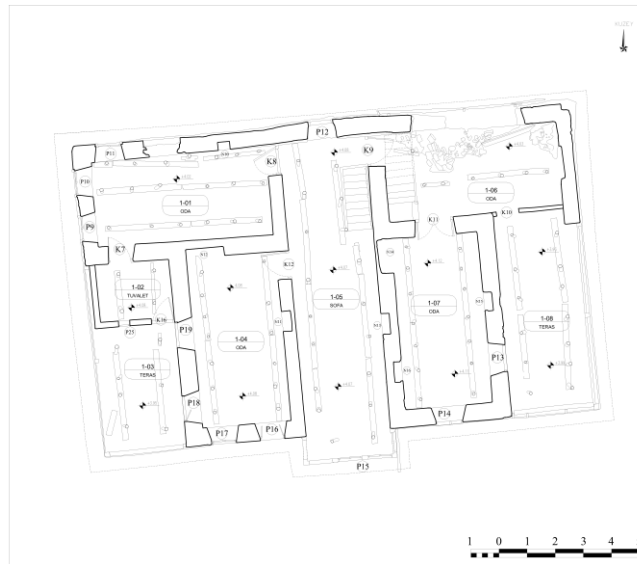
Dikdörtgen şekillidir. 6.10m x 3.13m ölçülerindedir. Oda olarak kullanılmaktadır. Batı duvarında Z-05 mahaline açılan yapısal bütünlüğünü kaybetmiş K5 kapısı ve N9 nişi bulunmaktadır. Kuzey duvarı yapısal yıkıma uğramıştır. Doğu duvarında özgünlüğünü kaybetmiş ve ateş tuğla ile kapatılan P8 penceresi bulunmaktadır. Güney duvarında Z-07 mahaline açılan ve insan eliyle oluşturulmuş B3 boşluğu bulunmaktadır. Bu boşluk kereste çatki ile kapatılmaya çalışılmıştır. Özgün zemin kaybolmuştur, zeminde kuzey duvarına ait moloz yığıntısı mevcuttur. Tavan kaplaması ahşap olup taşıyıcısı tomruklar yapısal bütünlüklerini kaybetmiştir. Tavanı destelemek amacıyla ahşap dikmeler eklenmiştir.



Resim 16. Z-08 mahali fotoğrafı

## Birinci Kat

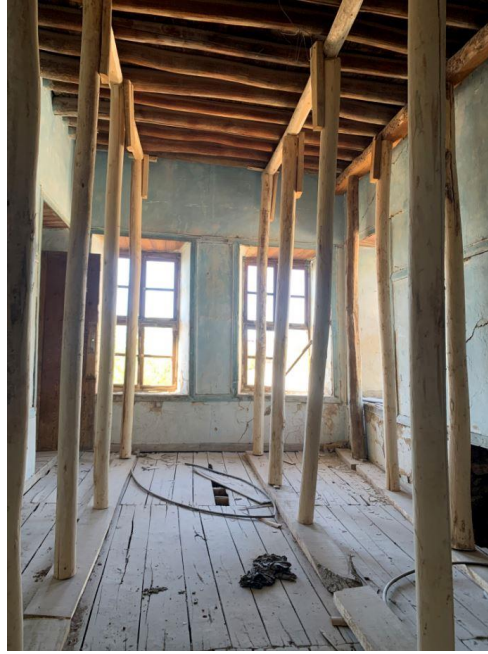
Genel olarak yaşamsal işlevlere sahip 8 mahal mevcuttur.



Şekil 10. Birinci kat anahtar planı

### 1-01

Dikdörtgen şekilli olup 6.20m x 3.20m ölçülerindedir. Oda olarak kullanılmaktadır. Kuzey ve doğu duvarında yapısal çatlaklar bulunmaktadır. Batı duvarında özgünlüğünü koruyan ancak bütünlüğünü kaybetmiş P9 ve P10 pencereleri bulunmaktadır. Kuzey duvarında özgün P11 penceresi ve N10 nişi bulunmaktadır, yıkıma uğrayan bölümü ateş tuğla ile kapatılmıştır. Doğu duvarında özgün fakat yapısal bütünlüğü bozulmuş ve 1-05 mahaline açılan K8 kapısı bulunmaktadır. Güney duvarında 1-02 mahaline açılan özgün K7 kapısı bulunmaktadır. Döşeme kaplaması ahşaptır ve eskime mevcuttur. Sehimlenme vardır. Pencere ve kapılar birbirlerine ahşap bordür ile bağlanmıştır. Üst kat döşemesini desteklemek amacıyla ahşap dikmeler bulunmaktadır. Tavan kaplaması ahşaptır.



**Resim 17.** 1-01 mahali fotoğrafı

### 1-02

Kare şekilli olup 2.04m x 2.62m ölçülerindedir. Normalde 1-03 teras mahaline dahil olup sonradan tuvalete çevrilmiştir. Kuzey duvarından K7 kapısıyla 1-01 mahaline geçilmektedir. Güney ve batı duvarı ateş tuğla ile sonradan yapılmıştır ve kaba sıva ile kaplanmıştır. Güney duvarından 1-03 mahaline özgün olmayan kapı ile geçilmektedir, özgün olmayan bir pencere mevcuttur. Döşeme üzerine sonradan şap atılmıştır. Z-02 mahaline giden bir gider borusu mevcuttur. Üst kat döşemesini desteklemek amacıyla ahşap dikmeler yerleştirilmiştir.



**Resim 18.** 1-02 mahali fotoğrafı

### **1-03**

Dikdörtgen şekilli olup 2.94m x 4.50m ölçülerindedir. Teras olarak kullanılmaktadır. 1-02 mahali sonradan bu mahale eklenmiştir. Özgün ölçüleri 2.94m x 6.00m'dir. Kuzey duvarı ateş tuğladan yapılmış olup 1-02 mahaline özgün olmayan K16 kapısı ile geçilmektedir. Gene aynı duvarda özgün olmayan P25 penceresi bulunmaktadır. Doğu duvarında özgün fakat deforme olmuş P18 ve P19 pencereleri bulunmaktadır. Batı ve güney kısmında özgün ahşap kemerler bulunmaktadır. Teras korkuluklarının bir kısmı ayakta kalsa da büyük ölçüde zarar görmüştür. Güney kısmına ateş tuğla örüntü bulunmaktadır. Özgün döşeme kaybolmuş, yerine sonradan şap atılmıştır. Üst kat döşemesini desteklemek için ahşap dikmeler eklenmiştir. Tavan, ahşap kaplamadır.



**Resim 19.** 1-03 mahali fotoğrafı

#### 1-04

Dikdörtgen şekillidir. 3.14m x 6.34m ölçülerindedir. Oda olarak kullanılmaktadır. Batı ve güney duvarlarında özgün P16, P17, P18, P19 pencereleri bulunmaktadır. Pencerelerde kanat kayıpları mevcuttur. Kuzey duvarında N12 nişi vardır. Doğru duvarında N11 nişi ve 1-05 mahaline açılan özgün K12 kapısı bulunmaktadır. Döşeme ve tavan kaplaması ahşaptır. Pencere ve kapılar birbirlerine ahşap bordür ile bağlanmıştır. Üst kat döşemesini desteklemek amacıyla ahşap dikmeler kullanılmıştır.



Resim 20. 1-04 mahali fotoğrafı

#### 1-05

Dikdörtgen şekilli olup 3.07m x 11.26m ölçülerindedir. Sofa olarak kullanılmaktadır. Döşeme ve tavan kaplaması ahşaptır. Pencere ve kapılar birbirlerine ahşap bordür ile bağlanmıştır. Tavanında, yapının kitabesi yakma tekniği ile işlenmiştir. Batı, kuzey ve doğu duvarlarında yapısal çatlaklar bulunmaktadır. Kuzey duvarında özgün fakat deforme olmuş P12 penceresi bulunmaktadır. Batı duvarında 1-01 mahaline açılan özgün K8 kapısı ve 1-04 mahaline açılan özgün K12 kapısı vardır. Doğru duvarında 1-06 mahaline açılan özgün fakat bütünlüğünü kaybetmiş K9 kapısı bulunmaktadır. Aynı duvarda N13 nişi bulunmaktadır. Mahalin kuzey bölümünde zemin kata açılan özgün merdiven bulunmaktadır. Merdiven, ihtiyaç halinde zemin kat bağlantısını kesmek amacıyla kapak ile muhafaza edilmiştir. Mahalin güney kısmında şahnişin (Ş1) bulunmaktadır. Dikdörtgen şekilli 5 adet özgün pencere (P15) ile çevrelenmiştir. Beden duvarı bağdadi teknikle kapatılmıştır. Sofa zemininde üst kat döşemesini (2-02) desteklemek amacıyla ahşap dikmeler bulunmaktadır.



**Resim 21.** 1-05 mahali fotoğrafı

### **1-06**

Dikdörtgen şekilli olup 6.16m x 2.95m ölçülerindedir. Oda-Hol olarak kullanılmaktadır. Batı duvarında yapısal çatlaklar bulunmaktadır. 1-05 mahaline açılan özgün K9 kapısı da bu duvardadır. Mahalin batı duvarına mesnetli, özgün fakat yapısal bütünlüğünü kaybetmiş çatı katına açılan bir merdiven bulunmaktadır. Kuzey duvarı yapısal yıkım görmüştür. Eski fotoğraflardan anlaşıldığı kadarıyla 2 adet dikdörtgen şekilli pencere mevcuttur. B5 boşluğunu kapatmak için kereste çatkı kullanılmıştır. Güney duvarında 1-07 mahaline açılan çift kanatlı özgün K11 kapısı ve 1-08 mahaline açılan yapısal bütünlüğünü kaybetmiş K10 kapısı bulunmaktadır. 1-08 mahaline komşu güney duvarı ahşap çatkılı kerpiç dolgudan yapılmıştır. Zemin ve tavan kaplaması ahşaptır. Çökme ve sehim gözlemlenmektedir. Üst kat döşemesini desteklemek için ahşap dikme kullanılmıştır.



**Resim 22.** 1-06 mahali fotoğrafı



### 1-07

Dikdörtgen şekillidir. 3.07m x 6.09m ölçülerindedir. Oda olarak kullanılmaktadır. Döşeme ve tavan kaplaması ahşaptır. Üst kat döşemesini desteklemek amacıyla ahşap dikmeler kullanılmıştır. Batı duvarında bütünlüğünü kaybetmiş ahşap dolap (N14) ve N16 nişi bulunmaktadır. Güney duvarında özgün P14 penceresi bulunmaktadır. Doğu duvarında özgün P13 penceresi ve N15 nişi bulunmaktadır. Kuzey duvarında 1-06 mahaline açılan çift kanatlı K11 ahşap kapısı bulunmaktadır.



Resim 23. 1-07 mahali fotoğrafı

### 1-08

Dikdörtgen şekillidir. 3.12m x 7.24m ölçülerindedir. Teras olarak kullanılmaktadır. Özgün döşeme kaybolmuş, yerine şap atılmıştır. Tavan kaplaması ahşaptır. Terasın doğu ve güney kısmında özgün ahşap kemerler bulunmaktadır. Batı duvarında özgün P13 penceresi bulunmaktadır. Ahşap çatıklı kerpiç dolgu kuzey duvarında 1-06 mahaline açılan K10 kapısı bulunmaktadır. Üst kat döşemesini desteklemek amacıyla ahşap dikmeler kullanılmıştır.



Resim 24. 1-08 mahali fotoğrafı

## İkinci Kat

Çatı katıdır. Toplamda 3 mahal bulunmaktadır.



Şekil 11. İkinci kat anahtar planı

### 2-01

Dikdörtgen şekilli olup 7.10m x 10.62m ölçülerindedir. Özgün kullanım amacı bilinmemekle birlikte depo olarak kullanıldığı düşünülmektedir. Toprak döşemedir. İki adet baca gözlemlenmiştir. Kuzey ve güney duvarları ahşap çatıklı kerpiç dolgudur. Doğu duvarı bağdadi tekniğe imal edilmiş olup, 2-02 mahaline açılan özgün K15 kapısı bulunmaktadır. Güney duvarında P22 penceresi bulunmaktadır.



Resim 25. 2-01 mahali fotoğrafı

## 2-02

Dikdörtgen şekillidir. 2.97m x 11.62m ölçülerindedir. Köşk oda olarak kullanılmaktadır. Ahşap döşemedir. Doğu ve batı duvarları bağdadi teknikle yapılmıştır. Kuzey duvarında özgün P21 penceresi, doğu duvarında 2-03 mahaline açılan özgün K13 kapısı bulunmaktadır. Batı duvarında 2-01 mahaline açılan özgün K15 kapısı vardır. Mahalin güney bölümünde şahnişin mevcuttur. Şahnişinde 5 adet giyotin pencere mevcuttur. Döşemeyi desteklemek amacıyla ahşap dikmeler eklenmiştir.



Resim 26. 2-02 mahalini fotoğrafı

## 2-03

Dikdörtgen şekilli olup 7.40m x 10.62m ölçülerindedir. Özgün işlevi bilinmemekle birlikte depo olarak kullanıldığı düşünülmektedir. Toprak döşemedir. 3 adet baca gözlenmiştir. Bağdadi teknikle yapılmış batı duvarında birinci kat merdiven sahanlığına açılan K14 kapısı bulunmaktadır. Kerpiç dolgu güney duvarında P23 penceresi vardır.



Resim 27. 2-03 mahalini fotoğrafı



### **Ferit Bey Konađı'nın Strüktürel Analizi**

Yapının temeline dair bir veriye ulaşılammıştır ancak su basman kotuna kadar yığma taştan imal edilmiştir. Taş örüntü; Z-01 ve Z-08 mahallerinde duvar yıkılan duvar nedeniyle, Z-07 mahalinde ve cephelerde ise sıva kaybı nedeniyle gözlenmektedir. Konađın ana taşıyıcı malzemesi kerpiç tuğladır ve bu örüntü ikinci kat döşeme kotuna kadar devam etmektedir. İkinci kat döşeme kotundan çatı saçağına kadar olan dış duvarlar ise ahşap çatkı arasına kerpiç dolgudan yapılmıştır. İkinci kat bölücü duvarlarının taşıyıcı özelliđi olmayıp bađdadidir. Şahnişin, birinci ve ikinci kat döşemelerine mesnetlenmiş olup ahşaptan üretilmiştir. Çatı, özgünlüğünü kaybetmiş olup ahşap karkas üzeri trapez sac kaplamadır. Yapıda 6 noktada taşıyıcı birim eleman kaybı bulunmaktadır. Kuzey duvarının beden altı bölümü çökmüş, sonradan insan eliyle kapatılmaya çalışılmıştır. Döşemeler; işlenmiş tomrukların kerpiç duvar örüntüsüne mesnetlenmesiyle taşınmaktadır. Deforme olan döşemeleri desteklemek amacıyla sonradan ahşap dikmeler eklenmiştir.



**Resim 28.** Yığma taş örüntü



**Resim 29.** Kerpiç örüntü



**Resim 30.** Çatı katındaki bağdadi duvar



**Resim 31.** Ahşap çatki kerpiç dolgu duvar

### **Ferit Bey Konağı'nda Tespit Edilen Değişme ve Bozulmalar**

Ferit Bey Konağı'nın içinde ve dışında gerek doğal sebeplerle gerek insan eliyle gerçekleşmiş değişme ve bozulmalar gözlemlenmiştir.

#### **Doğal Koşullarla Gerçekleşen Bozulmalar**

**Yapısal Çatlaklar:** Taşıyıcı sistemde meydana gelen ve duvar örüntüsünün derinlerine inen afetler sonucu oluşmuş çatlaklardır.

**Duvarda Ayrılma:** Duvar örüntüsünün aksını kaybedip taşıyıcı sistemden ayrılmasıdır.

**Çökme-Sehimlenme:** Taşıyıcı özelliğini kaybeden döşeme ve tavan örüntüsünün iç bükey şekilde deforme olmasıdır.

**Duvarda Yıkılma:** Kerpiç ve taş örüntüsünün bütünlüğünü kaybederek yapısal bütünlüğünü kaybetmesidir.

**Birim Eleman Kaybı:** Devam eden ahşap-taş-kerpiç örüntüde meydana gelen lokal birim kayıplarıdır.

**Yanma:** Yangın sebebiyle ahşap malzemede oluşan deformasyonlardır.

**Ahşapta Bozulma:** Ahşap malzemenin zamansallık etkisiyle kirlenmesi, eskimesi, çürümesi, nemlenmesi ve malzeme kaybı yaşamasıdır.

**Sıva-Boya Kaybı:** Duvarlarda bulunan sıva-boya kaplamalarının dökülerek altında bulunan kerpiç-taş örüntünün açığa çıkmasıdır.

**Sıva-Boyada Bozulma:** Sıva-Boya kaplamalarda oluşan yüzeysel çatlaklar, kirlenmelerdir.

**İslenme:** Yangın sebebiyle açığa çıkan dumanın duvarlarda is birikintisi oluşturmasıdır.

**Yığıntı:** Yıkılan duvarlar nedeniyle açığa çıkan yapı birim elemanlarının gelişigüzel yığılarak mahal erişimini engellemesidir.

**Birikinti:** Toprak, talaş, toz gibi maddelerin döşemelerde oluşturduğu katmandır.

### **İnsan Eliyle Gerçekleşen Bozulmalar**

**Kaybedilmiş Ahşap Eleman:** Sökülen kapı, pencere kanatları ve kasalarıdır.

**Sonradan Yapılan Eklemeler:** Yapının döşeme, tavan, duvar, çatı, cephe gibi bölümlerine sonradan eklenen ve özgün olmayan niteliksiz yapı elemanlarıdır.

**İnsan Eliyle Yıkılan Duvarlar:** Bilinen ve bilinmeyen sebeplerle taşıyıcı sisteme ait kerpiç, taş duvar örüntülerinin yıkılmasıdır.

### **Yapıdaki Bozulmalar**

#### **Kuzey Cephe**

Cephenin büyük bölümünde sıva-boya kaybı bulunmaktadır. D1 duvarında yıkım mevcuttur. Yıkılan bölüm kereste çatki ile kapatılmıştır. D1 ve D2 duvarlarında yapısal çatlaklar bulunmaktadır. D3 duvarında yıkılan duvar ateş tuğla ile kapatılmıştır. Cephede bulunan ahşap hatıllar ve çatı katının duvarlarını oluşturan ahşap çatkılarda bozulmalar gözlemlenmektedir. P21, P12, P11 pencerelerinin ahşap elemanları deforme olmuş olup kaybedilmiş elemanlara sahiptirler. P26 penceresinin kasası tamamen sökülmiş olup oluşan boşluk ateş tuğla ile kapatılmıştır. D4 duvarında ahşap çatkılar arasındaki kerpiç dolgularda malzeme kayıpları gözlemlenmiştir.



**Resim 32.** Kuzey cephedeki bozulmalar

### **Güney Cephe**

Cephenin büyük bölümünde boya bozulması bulunmaktadır. Yüzeysel çatlaklar mevcuttur. Subasman seviyesindeki sıvalar dökülmüş, taş örüntü açığa çıkmıştır. Z-04 ve Z-07 mahallerinin girişlerinin bulunduğu duvarlar özgün olmayıp, sonradan örülmüştür. Cephenin doğu ve batı kısımlarındaki ahşap kemerlerde malzeme bozulması vardır. Korkulukların olduğu kısımlara ateş tuğla duvar örülmüştür. Cephede bulunan pencerelerde malzeme bozulması ve kanat kayıpları mevcuttur. Şahnişin yapısal bütünlüğünü korumasına rağmen eskimeye uğramıştır.



**Resim 33.** Güney cephedeki bozulmalar

### **Doğu Cephe**

D1 duvarında sıva ve boya kayıpları vardır, taş örüntü açığa çıkmıştır. Kapatılıp üstü sıvanan P8 penceresi de bu duvardadır. D2 duvarında kirlenme ve yüzeysel çatlaklar mevcuttur. Duvarın doğu kısmında kerpiç tuğla kayıpları vardır.





**Resim 34.** Doğu cephedeki bozulmalar

### **Batı Cephe**

Cephedeki sıva büyük ölçüde dökülmüş, kerpiç örüntü açığa çıkmıştır. Ahşap hatılarda eskimeye dayalı bozulmalar vardır. Subasman seviyesindeki kerpiç ve taş örüntüde malzeme kayıpları gözlemlenmiştir. 1-02 mahaline gider açmak için yaklaşık 40cm x 40cm'lik insan eliyle açılmış bir boşluk bulunmaktadır. Cephedeki pencerelerde malzeme bozulmaları ve kanat kayıpları mevcuttur. Teras bölümündeki ahşap kemerlerde eskime ve korkuluk kayıpları bulunmaktadır.



**Resim 35.** Batı cephedeki bozulmalar

### **Çatı**

Özgün çatı kaybedilmiş, yerine trapez sac beşik çatı yapılmıştır.



**Resim 36.** Çatıdaki bozulmalar

### **Z-01**

Kuzey duvarının bir kısmı su basman seviyesine kadar yıkılmıştır. Yıkılan bölüm ateş tuğla ile kapatılmıştır. Özgün zemin kaybolmuş, toprak-talaş birikinti kaplamıştır. Duvarlarında sıva ve boya kayıpları mevcuttur. Duvarların diğer kısımlarında kirlenme bulunmaktadır. Batı duvarındaki P1 ve P2 pencerelerinde malzeme kayıpları vardır. P1 penceresinin kasası tamamen sökülmüş ve açık şekilde bırakılmıştır. Güney duvarında bulunan N1 nişindeki sıvalar dökülmüştür. Tavanda sehimlenme ve çökme bulunmaktadır. Üst kat döşemesini desteklemek için ahşap dikmeler eklenmiştir.



**Resim 37.** Z-01 mahalindeki yıkılan kerpiç duvar yerine örülen tuğla duvar.

## Z-02

Batı duvarında özgünlüğünü kaybetmiş P3 penceresi ve N2 nişi bulunmaktadır. N2 nişindeki boya bozulmuştur. Aynı duvarda tuvalet gideri oluşturmak için su basman kotunda yaklaşık 40cm x 40cm ölçülerinde duvar yıkımı yapılmıştır. Güney duvarında N3 ve N4 nişlerinde sıva kayıpları vardır. Doğu duvarında deforme olmuş K1 kapısı bulunmaktadır. Mekanın duvarlarında genel olarak sıva-boya bozulmaları vardır. Özgün zemin kaplaması kaybolmuş olup toprak-talaş birikintisi mevcuttur. Eskimiş üst kat döşemesini desteklemek için ahşap dikmeler bulunmaktadır.



**Resim 38.** Z-02 mahalinde insan eliyle yıkılmış duvar ve gider borusu.

## Z-03

Boya olan duvarlarda yüzeysel çatlak ve boya bozulmaları gözlemlenmektedir. Batı duvarında özgünlüğünü koruyan O1 ocağında yüzeysel kirlenmeler mevcuttur. Aynı duvarda elektrik kablosu bulunmaktadır. Doğu duvarındaki özgün K2 kapısı malzeme kaybı yaşamıştır ve N5 nişindeki raf sökülmüştür. Güney duvarında kanat kayıpları olan özgün P4 ve P5 pencereleri bulunmaktadır. Özgün zemin kaplaması kaybolmuştur. Toprak-talaş birikintisi mevcuttur. Tavan kaplamasında bozulmalar gözlemlenmiştir. Üst kat döşemesini desteklemek amacıyla ahşap dikmeler bulunmaktadır.



**Resim 39.** Z-03 mahalindeki bozulmalar

#### Z-04

Batı duvarında soba borusu boşluğu oluşturulmuştur. Özgün duvarın yıkılarak harman tuğla ile yeniden oluşturulan güney duvarına sonradan bir pencere (P24) ve bir kapı (K17) eklenmiştir. Duvarlarda kirlenme ve yüzeysel çatlaklar gözlenmektedir. Zemin sonradan şap ile kapatılmıştır. Tavandaki ahşap kirişlerde yanma izleri görülmektedir. Tavan, sonradan sunta ile kapatılmıştır. Yangın nedeniyle özgün tavan ve sunta asma tavan arasında kalan bölümde islenme bulunmaktadır.



**Resim 40.** Z-04 mahal tavanındaki yanma ve sunta ile kapatılan tavan

#### Z-05

Duvar boyalarında bozulmalar ve lokal sıva kayıpları gözlenmiştir. Güney duvarındaki özgün K3 kapısında kanat kaybı bulunmaktadır. Batı duvarındaki K2 kapısı deforme olmuştur ve N6 nişinde sonradan eklenen raf izleri görülmektedir. Doğu duvarındaki K4 ve K5 kapıları kanatlarını kaybetmiş ve sadece kasaları kalmıştır. Aynı duvardaki N7 nişinde sonradan eklenen raf gözükmemektedir. Kuzey duvarına mesnetli özgün merdivenin basamaklarında sehimlenme bulunmaktadır. Merdiven sahanlığında boşluğu ateş tuğla ile kapatılmış P26 penceresi bulunmaktadır. Kuzey ve doğu duvarında yapısal çatlaklar ve ayrılma mevcuttur. Özgün zemin kaybolmuştur, toprak-talaş birikintisi bulunmaktadır. Tavan kaplamasında bozulmalar vardır. Üst kat döşemesini desteklemek amacıyla sonradan ahşap dikmeler eklenmiştir.





**Resim 41.** Z-05 mahalindeki duvarda ayrılma ve yapısal çatlaklar

### **Z-06**

Duvarlarda sıva, boya kayıpları ve kirlenme gözlenmektedir. Doğu duvarının bir kısmı Z-07 mahaline geçiş için yıkılmıştır. Batı duvarında kerpiçle kapatılmış N8 nişi bulunmaktadır. Aynı duvarda kanat kaybı olan K4 kapısı bulunmaktadır. Güney duvarındaki özgün P6 ve P7 ahşap pencerelerinde malzeme bozulmaları gözlemlenmiştir. Özgün zemin kaybolmuş, toprak-talaş birikintisi mevcuttur. Tavan kaplaması deforme olmuştur. Üst kat döşemesini desteklemek amacıyla ahşap dikmeler eklenmiştir.



**Resim 42.** Z-07 mahaline geçiş için yıkılan duvar

### **Z-07**

Kuzey ve batı duvarlarının bir kısmı insan eliyle yıkılmıştır. Batı duvarının su basman kotunda kazılma gözlemlenmiştir. Doğu duvarındaki sıva dökülmeleri görülmektedir. Mahalin güney kısmındaki duvar yıkılmış, yerine ateş tuğladan yeni bir duvar örülmüştür. Bu örüntüde yapısal bütünlüğünü kaybetmiş özgün olmayan ahşap K6 kapısı bulunmaktadır. Tavan kaplamasında eskime ve malzeme kayıpları gözlemlenmektedir. Özgün döşeme kaybolmuş, toprak-talaş birikintisi mevcuttur. Üst kat döşemesini desteklemek amacıyla ahşap dikmeler eklenmiştir.



**Resim 43.** Z-07 mahali batı duvarında kazılan bölüm

### **Z-08**

Kuzey duvarının büyük bölümü yıkılmış, oluşan boşluk kereste çatkı ile kapatılmıştır. Duvarlarda sıva kayıpları mevcuttur. Zeminde moloz yığıntıları bulunmaktadır. Batı duvarındaki K5 kapı kanadı kaybedilmiştir. Güney duvarının bir kısmı insan eliyle yıkılarak Z-07 mahaline geçiş açılmıştır. Tavanda sehimlenme ve malzeme kayıpları vardır. Tavanı desteklemek amacıyla ahşap dikmeler eklenmiştir.



**Resim 44.** Z-08 mahalinde yıkılan kuzey duvarı

### 1-01

Duvarlarda yapısal çatlaklar bulunmaktadır. Kuzey duvarının bir bölümü yıkılmış, yerine ateş tuğla örüntü yapılmıştır. Pencerelede kanat kayıpları ve malzeme deformasyonu mevcuttur. Döşemenin bir kısmı malzeme kaybına uğramış ve yapısal bütünlüğünü kaybederek sehimlenmiştir. Tavanı desteklemek amacıyla ahşap dikmeler eklenmiştir. Doğu duvarındaki özgün K8 kapısı duvar ayrılması sonucu bütünlüğünü kaybetmiştir. Güney duvarındaki K7 kapısında eskime ve bozulma vardır.



Resim 45. 1-01 mahalindeki bozulmalar

### 1-02

Sonradan eklenmiş bir mahaldir. Duvarları ateş tuğla ile örülmüştür. Döşemesinde Z-02 mahaline giden bir gider borusu mevcuttur. Özgün döşeme kaybolmuş, yerine şap atılmıştır. Güney duvarında özgün olmayan bir kapı (K16) ve bir pencere (P25) bulunmaktadır.

### 1-03

Döşemesi özgün olmayıp sonradan şap ile kapatılmıştır. Toprak, çöp birikintileri mevcuttur. Mahalin güney ve batı bölümlerindeki ahşap kemerler özgün olup, deformasyona uğramıştır. Teras korkuluklarının malzeme kayıplarının olduğu bölümler ateş tuğla ile kapatılmıştır. Ahşap dikmelerin desteklenmesi için kereste çatki çakılmıştır. Eskimiş tavan kaplaması ahşap dikmeler ile desteklenmiştir.



**Resim 46.** Kemerlerdeki deformasyonlar ve sonradan yapılan eklemeler

#### 1-04

Batı duvarında sıva kayıpları ve boya bozulması vardır. Aynı duvarda soba borusu boşluğu görülmektedir. P18 ve P19 pencerelerinde bazı kanatlar kaybedilmiştir. Kuzey ve doğu duvarlarına elektrik kabloları eklenmiştir. Aynı duvarlarda yüzeysel çatlaklar tespit edilmiştir. Güney duvarındaki P16 ve P17 pencereleri bütünlüklerini kaybetmiş olup ahşap çatkı ve ateş tuğla ile kısmen kapatılmıştır. Kuzey duvarındaki N12 nişinin 1-02 mahaline komşu olduğu bölümde gider borusu vardır. Döşemede kısmi malzeme kaybı bulunmaktadır. Deforme olmuş ahşap tavan sonradan eklenen ahşap dikmelerle desteklenmiştir.



**Resim 47.** Batı duvarındaki bozulmalar



### 1-05

Kuzey, batı ve doğu duvarlarında yapısal çatlaklar ve ayrılma tespit edilmiştir. Bu duvarlardaki özgün K8 ve K9 kapıları yapısal bozulmaya uğramıştır. Kuzey duvarındaki P12 penceresinde kanat kaybı bulunmaktadır. 1-04 mahaline geçişi sağlayan K12 kapısında ise malzeme bozulması tespit edilmiştir. Pencere ve kapıları görsel olarak bağlayan ahşap bordürlerde eskimeye bağlı bozulmalar vardır. Şahnişin üzerindeki giyotin pencerelerde kaybedilmiş kanatlar vardır. Kanat kayıplarının olduğu boşluklara ateş tuğla örüntü yapıldığı gözlemlenmiştir. Şahnişin ve duvar birleşim noktalarında çatlaklar vardır. Özgün ahşap döşemede bozulma mevcuttur. Deforme olmuş tavan ahşap dikmeler eklenerek desteklenmiştir.



**Resim 48.** 1-06 mahaline açılan K9 kapısı ve duvardaki yapısal çatlaklar

### 1-06

Kuzey duvarı kısmen çökmüştür. Çöken kısım kereste çatki ile kapatılmıştır. Moloz yığıntı döşeme üzerindedir. Ahşap döşemede ve tavanda sehimlenme ve malzeme kaybı bulunmaktadır. Destek amacıyla ahşap dikmeler eklenmiştir. Batı duvarında yapısal çatlaklar mevcuttur. 1-08 mahaline açılan kapıda kanat kaybı bulunmaktadır. Üst kata ulaşımı sağlayan özgün merdiven basamaklarında kırılan elemanlar gözlenmiştir.



**Resim 49.** Yıkılan kuzey duvarı, boşluğu kapatmak için eklenen kereste çatki

### 1-07

Duvarlarında sıva kayıpları ve boya bozulması bulunmaktadır. Kuzey duvarındaki K11 kapısı eskimeye dayalı bozulmuştur. Doğu duvarında soba borusu boşluğu görülmektedir. Aynı duvardaki P13 penceresinde kanat kaybı bulunmaktadır. Döşemede kısmi malzeme kayıpları tespit edilmiştir. Güney duvarındaki P14 penceresi bütünlüğünü kaybettiği için ahşap çatki ile sabitlenmeye çalışılmıştır. Aynı pencereye bağlanan ahşap bordür de kısmen sökülmüştür. Batı duvarında dolap olarak kullanılan N14 nişindeki kapaklar tamamen kaybolmuştur. Deforme olmuş ahşap tavanı desteklemek için ahşap dikmeler eklenmiştir.



Resim 50. 1-07 mahalindeki bozulmalar

### 1-08

Doğu ve güney cephesindeki ahşap kemerlerde bozulmalar vardır. Doğu cephesindeki korkuluklar tamamen kaybolmuştur. Güney cephedeki korkuluklar bozuma uğradığı için ateş tuğla ile kapatılmıştır. Özgün döşeme kaybolmuş yerine şap atılmıştır. Kuzey duvarındaki sıvalar dökülmüş, ahşap çatki ve kerpiç dolgu açığa çıkmıştır. Batı duvarında yüzeysel çatlaklar ve boya bozulmaları vardır. Aynı duvarda elektrik kabloları görülmektedir. Ahşap tavanda malzeme kaybına bağlı kısmi çökme bulunmakta olup tavanı desteklemek amacıyla ahşap dikmeler eklenmiştir.



Resim 51. 1-08 mahal tavanındaki kısmi çökme

## 2-01

Kerpiç dolgu duvarlarda sıva dökülmeleri mevcuttur. Bağdadi teknikle yapılan doğu duvarında sıva kayıpları bulunmaktadır. Kuzey duvarındaki kerpiç dolguda kısmi malzeme kaybı vardır. Güney duvarındaki P22 penceresindeki kanat sökülmüştür. Döşemenin kuzey bölümünde sehimlenme mevcuttur. Döşemeye kısmi şap atıldığı gözlemlenmiş olup, toprak-atık birikintileriyle kaplıdır.



**Resim 52.** 2-01 mahali döşemesindeki bozulmalar

## 2-02

Duvarlarında yüzeysel çatlaklar ve boya bozulmaları görülmüştür. Ahşap döşeme eskimeye bağlı deforme olmuştur. Kuzey duvarındaki P21 penceresi yapısal bütünlüğünü kaybetmiş olup, kanat kayıpları bulunmaktadır. 2-01 ve 2-03 mahallerine açılan K15 ve K13 kapılarında kuzey duvarındaki zafiyetten dolayı yapısal bozulmalar gözlemlenmiştir. Mekanın güney cephesinde bulunan şahnişindeki 5 adet giyotin pencerede kanat kayıpları mevcuttur. Özgün ahşap tavan kaplaması büyük oranda sökülmüş olup, döşemeye destek olması adına ahşap dikmeler eklenmiştir.



**Resim 53.** 2-02 mahalindeki sökülen ahşap tavan, döşemedeki deformasyon

## 2-03

Döşemenin kuzey ve orta bölümlerinde çökmeye bağlı sehimlenme bulunmaktadır. Sonradan kısmi şap atıldığı gözlenmiş olup toprak ve çöp birikintisi mevcuttur. 1-08 mahal tavanına denk gelen bölümünde ise malzeme kaybına bağlı kısmen çökmüştür. Kuzey duvarındaki kerpiç dolguda malzeme kayıpları bulunmaktadır. Batı ve güney duvarındaki sıva büyük oranda dökülmüştür. Mahalin güney kısmında kanatlı hayvan beslemek amacıyla ahşap-tel örgü bir mahal oluşturulmuştur. Birinci kata ulaşmayı sağlayan merdiven sahanlığına açılan K14 kapı kanadı kısmen sökülümüştür.



**Resim 54.** 2-03 mahal döşemesindeki döşeme çökmesi ve kuzey duvarındaki malzeme kaybı

## Değerlendirme ve Sonuç

Yapılan araştırmada Elazığ İli Fevzi Çakmak Mahallesi 134 Ada 1 Parsel'de bulunan Ferit Bey Konağı'nın gerek taşıyıcı sistem gerekse mimari elemanlarıyla özgünlüğünü koruduğu, doğal nedenler ile zarar görmüş bölümlerinin insan eliyle niteliksiz bir şekilde onarılmaya çalışıldığı gözlemlenmiştir. Aktif deprem bölgesinde bulunan yapının kuzey cephesindeki yıkılan duvarların ve zemin katında insan eliyle taşıyıcı sisteme zarar veren boşaltmaların uzun vadede yapının bütünlüğünü tamamen bozacak yıkıma yol açma riski bulunmaktadır. Bundan dolayı lojistik değeri yüksek Pertek yolu üzerinde bulunan Ferit Bey Konağı'nın ivedilikle yapısal problemlerinin çözülmesi ve restore edilerek seyrek kalan tarihi dokuya kazandırılması gerekmektedir.

## Bilgi Notu

Bu çalışma, Gazi Üniversitesi Fen Bilimleri Enstitüsü'nde devam eden "Elazığ Fevzi Çakmak Mahallesi 134 Ada 1 Parselde Bulunan Konağın Restorasyon Önerisi" adlı yüksek lisans tezinin altlığı oluşturmak için üretilmiştir.



## **Kaynakça**

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**THE WOMAN AS A SOURCE OF JOY AND SADNESS IN NICHITA STĂNESCU'S  
POETRY VOLUME, "A VISION OF FEELINGS" (1964)**

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**Abstract**

As a prominent figure in Romanian neo-modernism, Nichita Stănescu revived the literary tradition by creating a poetry that is both unique and surprising. In his work, he made use of abstract concepts, metaphors and myths in order to evoke the wonderful sentiment of becoming enamored and to draw an exquisite portrait of the beloved. The volume "O viziune a sentimentelor" / "A vision of Feelings", published in 1964, celebrates the mysteries of young affection in a spectacular, mesmerizing universe where love is painted as an emotion of total commitment, as a transformative force, capable of changing the poet's whole world. The present article intends to examine the depiction of the woman in some of the most beautiful poems of this volume, by showing that the feminine figure appears in the man's life both as a real being and as a dream, as a delicate presence and as a wild force, as a source of happiness and also as a catalyst for sadness.

**Keywords:** beloved, woman, love, poems, Nichita Stănescu

**Motto:**

“Every word that I speak is a transparent body  
Of a man, of a woman,  
It's a rippling line that cuts in two  
The ice of a desert that sparkles.”  
(Nichita Stănescu)<sup>1</sup>

**1. Introduction**

Nichita Stănescu was an important voice in the Romanian neo-modernist literature. His first poetry book, “Sensul iubirii” / “The Meaning of Love” (1960), surprised the readers with its ingenious and captivating style, while his second volume of poems, “O viziune a sentimentelor” / “O Vision of Feelings” (1964), was dedicated almost entirely to romantic infatuation. In this second book, Stănescu transformed “the erotic state into a complex lyrical state”<sup>2</sup>, drawing at the same time a captivating portrait of the beloved.

**2. Analysis of The Poems**

In order to convey the mesmerizing feeling of falling for someone and to emphasize the extraordinary qualities of the woman, Stănescu made use of evocative imagery, metaphors and abstract language. Thus, the poem “Oră fericită” / “Happy Hour” paints a serene, yet otherworldly scene where light becomes the bearer of life and beauty:

“The light beats upon the bricks  
With sweet beings within it.  
A ballerina appears,  
And another one shows up...  
Oh, it's a world in light,  
Unexpectedly real,  
And there's a dance, when at dusk,  
A ray beats upon the bricks  
With sweet beings within it.”<sup>3</sup>

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<sup>1</sup> My translation. Romanian, original version: “Feiece cuvânt care-l spun e un trup străveziu / de bărbat. de femeie, / e-un șir unduit tăind în două / gheața unui deșert ce scânteie.” From the poem “**Spre Andromeda**” / “**Toward Andromeda**”, volume “O viziune a sentimentelor”/ “A vision of feelings” (1964), <https://pentrunichita.wordpress.com/poezii/o-viziune-a-sentimentelor-1964/>;

<sup>2</sup> My translation. Romanian, original version: « Nichita Stănescu face din starea erotică o stare lirică complexă » (Simion, 2002: 86)

<sup>3</sup> My translation. Romanian, original version: “Bate-n cărămizi lumina / cu ființe dulci în ea. / Se-arată-o balerină / și-ncă una se arată... / Oh, e-o lume în lumină / nesperat de-adevărată, / și-i un dans, când la amurguri / bate-n cărămizi o rază / cu ființe dulci în ea.” From the volume “A vision of feelings” (1964), <https://pentrunichita.wordpress.com/poezii/o-viziune-a-sentimentelor-1964/>;

The brightness "beats upon the bricks", an action that imbues the mundane (the "bricks") with something otherworldly. At the same time, the image of the "sweet beings" carried by the radiance suggests that the light itself is alive and contains mystery and wonder. The repetition of "with sweet beings within it" emphasizes the sense of enchantment that this glowing space evokes.

The delicate ballerinas, with their captivating dance, symbolize gracefulness and art, awakening a sense of beauty. These figures seem to come to life through the brightness, hinting at a connection between light and creation. The image of the "dusk" and the phrase "unexpectedly real" emphasize the surreal nature of this moment, which exists at the secret intersection of day and night, of reality and fantasy. The overall tone of the poem is one of delight and pure joy, encapsulating the fleeting charm of a perfect dream.

In "Amfion, constructorul" / "Amfion<sup>4</sup>, the Builder", the action is set in the pre-dawn hours, that liminal space between darkness and morning when the world remains in slumber. The beginning of the poem introduces us into an atmosphere that feels archaic, dangerous and wild. The setting is an ancient landscape, where "the gods only passed by on horseback", vision that bridges the poem's present to an immemorial era. The field is hostile and perilous, with stones that "bare their white fangs" and grass that "runs scared". Nature itself feels primal and formidable, mirroring the intensity of the young man's emotions.

In this extraordinary, timeless natural environment, the poet awaits the arrival of the beloved, and this encounter, set against a backdrop of mythological significance, seems fated and vital. The meeting takes place when the stars "tilt the sky to one side", image which adds a cosmic meaning to the reunion, as if the universe itself is conspiring to bring the lovers together.

The woman is described as being "slender and wild with beauty", as if she embodied the same untamed, raw forces as the world around her. The tension in the poem builds in anticipation as the beloved approaches, until the poet feels that only "a cry" separates them. This cry, which is, at the same time, intense and intimate, symbolizes both the distance that separates the young people and their desire to reach other:

"Here, on the field where in ancient times the gods  
Only passed by on horseback,  
Where the stones bare their white fangs, and the grass  
Runs scared into the greenish horizons,  
I am meeting with you, woman  
Slender and wild with beauty,  
Before the sunrise, when the stars  
Roll over and tilt the sky to one side,

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<sup>4</sup> As Simion notices, "from among the myths, Nichita Stănescu chooses that of Amphion, the Greek who, by singing, made the city walls grow on their own. It is, of course, the symbol of the poet, turned by Nichita Stănescu now towards the themes of civic lyricism, now towards eros." My translation. Romanian, original version: "Dintre mituri, Nichita Stănescu alege pe acela al lui Amfion, grecul care, cântând, făcea ca zidurile cetății să crească singure. Este, desigur, simbolul poetului, întors de Nichita Stănescu când spre temele lirismului civic, când spre eros." (Simion, 2002: 87)

And you, approaching,  
From you  
Only a cry still separates me.”<sup>5</sup>

Another feminine figure which represents a powerful elemental force appears in “Viața mea se iluminează” / “My life lights up”, where the poet’s “queen of black and salt” seems to be tied to the sea and to nature itself. The beloved’s eyes are green at noon and “grey like the earth” at nightfall, images that reveal her strong connection to the world around her. The description of the woman’s hair being bleached by the sun symbolizes the passage of time, and also a life lived with intensity:

“Your hair is more bleached by the sun,  
My queen of black and salt.  
The shore has broken away from the sea and followed you  
Like a shadow, like a disarmed serpent.  
Ghosts of summer in decline pass by,  
The ships of my mariner soul.  
And my life lights up,  
Under your green eye at noon,  
Gray like the earth at dusk.  
Oh, I run and leap and flow.”<sup>6</sup>

The metaphor of the shore breaking away from the sea and following the girl "like a shadow, like a disarmed serpent" conveys the young man’s strong reaction in the presence of this magnetic being, his intense passion and his vulnerability in the face of this alluring figure.

Seized with nostalgia, the poet evokes the "ghosts of summer in decline", symbols of his bittersweet awareness of the transience of life. The metaphor “ships of my mariner soul” reveals the poet’s emotional depth, but also the things he has experienced while navigating through the vastness of the world. At the same time, the phrase "my life lights up" shows how the presence of the beloved brings joy and meaning to the lyrical subject's existence.

The final verses express the poet’s desperate plea to cling to the happiness of the present moment, to the passionate feeling that binds him to his beloved. The repetition of "Leave me"

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<sup>5</sup> My translation. Romanian, original version: Aici, pe câmpul unde în vechime zeii / n-au trecut decât călări, / unde pietrele-și arată colții albi, și iarba / fuge speriată în verzuiele zări, / îmi dau întâlnire cu tine, femeie / zveltă și sălbătică de frumusețe, / înainte de răsăritul soarelui, când stelele / rostogolindu-se-nclină cerul într-o parte, / și tu, venind, / de tine / doar un strigăt mă mai desparte.” From the volume “A vision of feelings” (1964), <https://pentrunichita.wordpress.com/poezii/o-viziune-a-sentimentelor-1964/>;

<sup>6</sup> My translation. Romanian, original version: “Părul tău e mai decolorat de soare, / regina mea de negru și de sare. / Țărmlul s-a rupt de mare și te-a urmat / ca o umbră, ca un șarpe dezarmat. / Trec fantome-ale verii în declin, / corabiile sufletului meu marin. / Și viața mea se iluminează, / sub ochiul tău verde la amiază, / cenușiu ca pământul la amurg. / Oho, alerg și salt și curg.” From the volume “A vision of feelings” (1964), <https://pentrunichita.wordpress.com/poezii/o-viziune-a-sentimentelor-1964/>;

emphasizes the yearning for continued affection and shared experience. The poet wishes to extend the joy of life, seeking more love in an ephemeral world:

“Leave me one more minute.

Leave me one more second.

Leave me one more leaf, one grain of sand.

Leave me one more breeze, one wave.

Leave me one more season, one year, one moment.”<sup>7</sup>

Another poem that contains a deep yearning for warmth and emotional stability is “Emoție de toamnă” / “Autumn Emotion”, which captures the sadness and vulnerability that often accompany the approaching of the cold season. Here, the poet uses the fall as a metaphor for the possible shifts in a relationship. The poet's fear of losing his beloved is rendered through vivid images, such as “sharp wings”, “stranger's eye” or “wormwood”:

“Autumn has come, cover my heart with something,

With the shadow of a tree, or better yet, with your shadow.

I fear I won't see you anymore, sometimes,

That sharp wings will grow on me, reaching the clouds,

That you'll hide in a stranger's eye,

And it will close with a leaf of wormwood.”<sup>8</sup>

### 3. Conclusion

In the analyzed poems, the woman is depicted as an overwhelming, powerful presence that brings extraordinary happiness to the lyrical subject and, at the same time, helps him fight against the insecurities of mundane existence. The feminine figure appears both as an ethereal presence and as a raw, elemental force which complements the poet and facilitates his harmonious integration into the world.

In order to evoke the marvelous feeling of being infatuated and to create a fascinating portrait of the beloved, Stanescu employs surprising images, exceptional metaphors and abstract language. For, as Picioruș affirms:

"With Nichita, abstract speech is necessary because there is no other way to express the sublime. [...] We all can have an intuition of the sublime, we can feel as though we can rise, as though there is a peak within our soul. Nichita wants to offer us a picture of these heights. It is proof that the soul lives in two realities: one perceived and the other not fully understood, and that it

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<sup>7</sup> My translation. Romanian, original version: « Mai lasă-mă un minut. / Mai lasă-mă o secundă. / Mai lasă-mă o frunză, un fir de nisip. / Mai lasă-mă o briză, o undă. / Mai lasă-mă un anotimp, un an, un timp. » From the volume “A vision of feelings” (1964), <https://pentrunichita.wordpress.com/poezii/o-viziune-a-sentimentelor-1964/>

<sup>8</sup> My translation. Romanian, original version: “A venit toamna, acoperă-mi inima cu ceva, / cu umbra unui copac sau mai bine cu umbra ta. / Mă tem că n-am să te mai văd, uneori, / că or să-mi crească aripi ascuțite până la nori, / că ai să te ascunzi într-un ochi străin, / și el o să se-nchidă cu o frunză de pelin.” From the volume “O viziune a sentimentelor”/ “A vision of feelings” (1964), <https://pentrunichita.wordpress.com/poezii/o-viziune-a-sentimentelor-1964/>;

is infinitely explorable. The poet metamorphoses reality, but this metamorphosis is, first and foremost, an inner re-dimensioning long accepted, a metamorphosis of the spirit long before it is a reconversion of reality. What is new in poetry is old in the soul. What seems absurd and entirely new in words is well-known in the mind, conceptually and ideationally, otherwise it would not find the linguistic bed in which to flow so naturally."<sup>9</sup>

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<sup>9</sup> My translation. Romanian, original version: "La Nichita, vorbirea abstractă este necesară pentru că nu se găsește un alt mod de exprimare a sublimului. [...] Noi toți putem avea intuiția sublimului, putem avea impresia că ne putem înălța, că există un pisc al sufletului nostru. Nichita vrea să ne ofere chiar *o fotografie* a acestor înălțimi. E o dovadă că sufletul trăiește în două realități, una percepută și alta neînțeleasă până la capăt, și că el este infinit explorabil. Poetul metamorfozează realitatea, dar această metamorfoză este, în primul rând, o re-dimensionare interioară de mult acceptată, o metamorfoză a spiritului cu mult înainte de a fi o reconversie a realității. Ceea ce e nou în poezie, e vechi în suflet. Ceea ce pare absurd și cu totul nou în cuvinte, e prea bine cunoscut în minte, conceptual și ideatic, altfel nu și-ar găsi matca lingvistică în care să curgă atât de natural." (Picioruș, 2002: 28-29)

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**DYNAMICS OF INEFFECTIVE AND INEFFICIENT MANAGEMENT OF HEALTH RECORDS: A CASE STUDY OF GENERAL HOSPITAL ITUK MBANG, URUAN, AKWA IBOM STATE**

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**Abstract**

Effective administration of medical records is crucial for guaranteeing high-quality patient treatment, streamlined healthcare provision, and adherence to regulatory mandates. Nevertheless, several healthcare establishments, such as General Hospital Ituk Mbang, encounter restrictions and deficiencies in efficiently overseeing health records. This study investigated the dynamics of ineffective and inefficient management of health records at General Hospital Ituk Mbang, Uruan, Akwa Ibom State, which has a workforce of around 230 employees. This study is conducted by reviewing the current literature on the limits and limitations associated with the effective administration of health records in healthcare institutions. The literature search was performed utilizing online databases. The search included keywords such as Health Records, Management, Inadequate Infrastructure, Quality of Patient Care, Poor Record-keeping Practices. A questionnaire was used to perform a physical survey of around 100 participating staff members. The collated information was then analyzed using basic percentages and pie chart statistical tools. The investigation revealed many inefficiencies in the effective administration of health records at the General Hospital Ituk Mbang, Uruan. The factors contributing to the problem were insufficient infrastructure and resources, inadequate training of personnel, substandard record-keeping methods and restricted technological accessibility. The inefficient administration of health records is hindered by inadequate infrastructure, characterized by antiquated record-keeping technologies and insufficient storage capacity. The absence of adequately qualified personnel in health information management results in inaccuracies in record-keeping and data input, hence reducing the quality and precision of health records. Inadequate record-keeping techniques,

such as insufficient or unreadable paperwork, worsen the difficulties in handling health records. In addition, the hospital's capacity to digitize and simplify health record management operations is constrained due to restricted access to technology, such as Electronic Health Record Systems. The effective administration of health records at the General Hospital Ituk Mbang, Uruan is hindered by several reasons, such as insufficient infrastructure, absence of skilled personnel, substandard record-keeping methods and restricted technological accessibility. It is essential to address these limits and limitations in order to enhance the quality of patient care, improve healthcare delivery and ensure compliance with regulatory standards. Additional study is required to investigate possible solutions and strategies for addressing these difficulties and improving the administration of health records at the General Hospital Ituk Mbang, Uruan.

**Keywords:** Health Records, Management, Inadequate Infrastructure, Quality of Patient Care, Poor Record-keeping Practices

## **1. Introduction**

Records management is defined as the unit of the organization assigned with the function of managing records in order to ensure that the organization is able to comply with business operational needs, meet community needs and properly account to the citizens (Franks, 2013). The health records in most Nigerian health institutions especially in hospitals has been facing some numbers of problems and challenges; these had affected the accessibility and utilization of health information in the treatment of people that have health challenges in those hospitals, as information needed on each patient is not being accessed on time or is not even available for immediate use (Muhammad et al., 2017). The basic challenge faced by hospital authorities in preservation and management of records in most developing countries include; Use of outdated forms; Need of constant revision; Shortage of experienced personnel; Need of trained personnel; inadequate planning in storage of inactive records; Need of effective storage and control of in-active records; Shortage of determination of records retention period; Need of determination of records retention period. Unlike analogue information which places emphasis on the preservation of physical artefacts, it is the informational contents of the digitized material that is preserved (Ajuwon, 2006). A sub-standard documentation of patient's record is associated with prolonged hospital stay of the patients and increased patient mortality. Thus, poor record-keeping practices amongst medical personnel leads to breakdown in communication amongst health care professionals (Obansa et al., 2013). Poor record-keeping does not put the patient at the centre of care but increases medico-legal risks and hinders tracking of clinical care decisions and care goals (Amin et al., 2020). Despite numerous efforts by health managers to improve record-keeping, inadequate recording remains a global challenge in public hospitals which is frequently reported in research findings of many medical researchers (Mutshatshi et al., 2018). Most medical practitioners do not record their actions to a great extent and they only record observations when there are abnormalities and such incomplete recording may lead people to think that they did not fulfil their duties (Oleribe et al., 2019). Recording consumes up to 50% of nurses' time per shift even though it serves a number of important functions, such as communication amongst health care workers for continuity of care and is essential for the provision of safe and effective care and protection of accountability of personnel who delivered that care. Also, fatigue, large number of patients, high volume of personnel actions, absence of continuous monitoring and evaluation, privation of reward system to staff by nursing management are important factors affecting proper record keeping in hospitals (Manyisa & van Aswegen, 2017). Work experience of health officers and nature of shifts is another factor that influence timeous record-keeping in public hospitals. In some public hospitals, the audit of patient records for quality assurance purposes, peer review team meetings, mortality reviews and hospital management meetings continuously led to complaints about the trend of poor record-keeping, despite all efforts to improve record-keeping challenges (Ente & Ukpe, 2022). It was against this background that this study is designed to explore the challenges experienced by record officers with regard to record-keeping at selected hospitals. One of the limitations to record-keeping is the time factor, as there is no adequate time to do the recording after all activities are done in a clinical setting. The findings of this study is that excessive time is needed for recording which leaves reduced time for patient care

(Salzarulo et al., 2011). To overcome the challenge of lots of writing, personnel's performance can be improved by using well-designed computer technology to document care, which can improve the speed and quality of documentation, resulting in more time for direct patient care. The challenge with such swift recording may only be managing the change from paper to electronic records in a constructive and supportive way to alleviate resistance amongst nurses (Zayyad & Toycan, 2018). There are many factors ranging from personnel shortage and negative attitude of record officers towards recording; who perceive that they spend much time on manual recording, leading to incomplete recording and so the requirement for more staff. The findings of this study are congruent with the findings of a study conducted by (Jooste et al., 2010) which shows that health officers continue to report the shortage of staff as a contributing factor to non-implementation of the recording process including incomplete recording. The study further indicates that when staff experience extra workload, this predisposes them to decreased morale and inadequate work practices, including poor recording practices, which puts pressure on the quality of care rendered to patients. It was observed also, that personnel find it difficult to cope with the increased workload associated with documenting patient information on the multiple records that are utilised at health facilities, leading to incomplete information documented on patient records (Ondieki, 2017). These authors recommended that the number of personnel at facilities should be increased to reduce the increased workload. In most low- and middle-income countries, dearth of recording and systems is still a major obstacle in measuring the quality of health care. Healthcare professionals are increasingly being made aware of the role of clinical records in health care litigation despite the shortage that they are experiencing, but must ensure that their notes are 'meticulous' from a legal perspective because an activity that is not documented is considered as not done (Schulz & Johnson, 2003).

## **2. Impact of Health Records**

Health Record is an important primary tool in the practice of medicine as stated by (Marutha 2011), who stressed that "the whole idea " behind it is to provide better care of the patient through careful recording of every detail having to do with his/her case. The Health Record is the, who, what, why, where, when and how of the patient care during hospitalization. He further added that "the Health Record is the only measurement of work being done by the medical staff, the only record of progress of the patient, and it is the source of information for many purposes. Health Record is valuable to the patient because physicians see many patients a day and it is impossible for them to remember the details of each separate case at the same time. The patient of today may become ill in the future, be admitted to the same or another hospital with the same or another illness, and then may be examined by the same or a different physician (Omokanye & Adepoju, 2024). In another vein, Health Record in the aspect of communication channel when they stressed that "A patient's Health Record communicates information about their progress to the physicians and other health professionals who are providing care to the patient. It is a communication link among the patient's care-givers (Bello et al., 2004). For those health professionals who provide care on subsequent occasions, the Health Record provides critical information, such as the history of illnesses and the treatment provided. Health Record is

valuable for hospitals because it contains information relative to the competency of the medical staff. From the end results of treatment, the hospital will be able to analyse the quality and quantity of service. It is also of value to the hospital for medical legal purpose. Properly written and maintained health record will be a hospital's or a practitioner's primary defence and an advocate in any official proceeding (Marutha, 2019). Furthermore, since the Health Record itself must frequently be used as evidence in court, it can serve as protection to the hospital, physician, and patient only when it clearly shows the treatment given to the patient, by whom given and when given. It must show that the care and service given by the hospital and by the physician were consistent with good medical practice (Marutha & Ngulube, 2018).

### **3. Categories of Health Records**

The different categories of Health Records are as follows:

- i. Certain records must be given to the patient as a matter of right. Discharge summary, referral notes, and death summary in case of natural death are important documents for the patient. Hence, these have to be given without charge for all including patients who leave against medical advice (Thomas, 2009). The hospital bill cannot be tied up with these sensitive documents that are necessary for continuing patient care. Thus, the above documents cannot be legally refused even when the hospital bill has not been paid.
- ii. Certain records may be issued after the patient or authorized attendant accomplishes the due requirements as stipulated by a hospital. This requires a formal application to the hospital requesting for the records. It is necessary that the hospital bills are cleared and the necessary processing fee has been paid (Adjei, 2000). The documents in this group include copies of inpatient files, records of diagnostic tests, operation notes, videos, medical certificates, and duplicate copies for lost documents. It is important that the duplicate copies should be marked appropriately. It is not unusual for an unscrupulous patient to use it for multiple insurance claims without the knowledge of the doctor.
- iii. Certain records cannot be given to patients without the direction of the Court. The outpatient file, inpatient file, and files of medico-legal cases including autopsy reports cannot be handed over to the patient or relatives without the direction of the Court. But if these medico-legal cases are being referred to another centre for management, copies of records could be given (Thomas et al., 2020). However, X-rays are given only after a written undertaking by the patient or relatives that these will be produced in the Court as and when required.

### **4. Preservation of Health Records**

Preservation refers to the means by which archives are protected for the use of present and future generations (El Zarif & Haraty, 2020). It is a word commonly used by record offices, libraries and museums to describe the ways in which their collections are safeguarded and kept in good physical condition. This can be done through a variety of measures aimed both at minimizing the risk of loss of records and slowing down, as much as possible, the processes of physical deterioration which affect most archive materials (Kumar & Kumar, 2020). Library of Congress observed that taking care when handling any record, especially large format, poor

quality paper items, is one of the more effective, cost-efficient, and easily achieved preservation measures. The library noted that taking proper care when handling paper records involve the following:

- i. Having clean hands before handling records;
- ii. Keeping records flat and fully supported on the table during use.
- iii. Keeping food and drink away from storage areas.
- iv. Never folding the paper back on itself.
- v. Refolding the paper using the original centre fold and with the edges neatly aligned.

For proper storage of paper records, the Library of Congress recommended:

- i. A cool (room temperature or below), relatively dry (about 35% relative humidity), clean, and stable environment (avoid attics, basements, and other locations with high risk of leaks and environmental extremes).
- ii. Minimal exposure to all kinds of light; no exposure to direct or intense light.
- iii. Distance from radiators and vents.
- iv. Supportive protective enclosures (Kresh, 1996).

## **5. Health Record Managers' Code of Ethics**

Health Records Management Profession has common code of ethics that guides health records practitioners in the course of carrying out their duties. These are the code of ethics or public declarations which health records practitioners publicly avow on the day of their induction into the profession (Metcalf, 2014).

- i. Conduct yourself in the practice of this profession, so as to bring honour and dignity to you, and the health records management profession.
- ii. Place service before material gain and strive at all times to provide services consistent with the need for quality health care and treatment to all patients and clients.
- iii. Preserve and secure the health records, the information contained therein, and the appropriate secondary records and existing policies and legal provisions.
- iv. Hold up the doctrine of confidentiality and the individual's right to privacy in the disclosure of personally identifiable medical and social information.
- v. Recognize the source of the authority and powers delegated to you and conscientiously discharge the duties and responsibilities thus entrusted.
- vi. Accept compensation only in accordance with service actually performed or negotiated with the health institution.
- vii. Cooperate with other health professions and organizations to promote the quality of health programs and advancement of medical care, ensuring respect and consideration for the responsibility and the dignity of medical and other health professions.

## **6. Ineffective and Inefficient Management of Health Records**

The sensitivity of Health Records presents many challenges for corporate governance. Common issues include storage, access, safety and security. Storage problems occur in hospitals that use manual Health Record systems (Ime et al., 2024). Access to Health Records is another challenge

facing users and administrators. Sometimes there is conflict on the ownership and the right of access to a patient record. The US Fair Health Information Practice Act of 1997 has tried to reduce this friction by mandating a healthcare provider to allow individuals to examine their Health Records and it also has provision for a civil and criminal penalty for failure to abide by this requirement. The safety and security of Health Records is a challenge to personnel in-charge of patient records (Yaya, et al., 2015). The study also revealed that there are numerous instances where case notes were not kept in secure conditions. It would have been easy for unauthorized persons to have had access to case notes either from open libraries or from other uncontrolled areas. Case notes, for instance, were found unattended to in out-patient clinics and were sometimes left in clinic areas overnight because the Health Records department had closed. All users of case notes (doctors, nurses, medical secretaries, ward clerks, Health Record staff and others) should be aware of the importance of security (Bossen et al., 2012). The challenges of managing Health Records are closely linked to the abuse of patient information. When Health Records are not properly managed, without proper security measures, they can be misused, which can lead to possible violations of privacy and confidentiality of Health Records. Most news worthy is the misappropriation and disclosure of Health Records for financial gain or to cause harm or embarrassment". In Nigerian healthcare sector, many reasons can be adduced to why some hospitals (private or public) do engage the services of quacks (Asuzu & Adebayo, 2015). The following may subsist:

1. Ignorance: Cases abound where some hospital proprietors particularly in the private sector ignorantly engage the services of quacks to perform health information services. And some take advantage of enforcement regulatory body which obviously lack determination to ensure compliance with standards.
2. Cost incentive: The private sector can hardly (mainly for economic reasons) afford to engage professional health information officers; they thus ultimately seek out a much cheaper alternative. Health information services rendered by unqualified persons are unusually below standard of practice for a much lower cost (Das, 2008).
3. Funding: Insufficient funding often time promotes quackery. Typically, the management of a health facility may be constrained with insufficient fund. In such situation, the health facility may not even have health information department let alone qualified health information officer (Orszag, 2008).
4. Unemployment: In this part of the world, with over dependency on oil which price is dwindling, the level of unemployment thus seems to be on the increase. Therefore applicants are so desperate to take up job without requisite for any amount.
5. Attitude: There have been immense improvement in the practice of health information and medicine in general. It is bewildering of course, to note that some hospital owners in recent years have shown the tendency towards smugness in engaging unqualified hands.

Most tends to work significantly for self and economic interest much more than for common good of the patients. Such unfortunate tendencies aid quackery and often make a caricature of the health information management profession. Most clinical encounters are still recorded by hand in a paper record. The traditional paper record is still used due to its familiarity to users,

portability, ease of recording “soft” or “subjective” findings, and its browsability for non-complex patients (Wager et al., 2005). There is also a sense of ownership of paper records, due to their being only one copy, which increases the sense of their security (although it will be noted below that this may be a false sense of security). However, paper Health Records present several challenges. The first is that the record can only be used in one place at a time (Yaya, et al., 2015). This is a problem for patients with complex medical problems who work with multiple specialists, nurses, physical therapists, etc. Another problem is that paper records can be very disorganized. Not only can they be fragmented across different physician offices and hospitals, but the record at each location itself can often be disorganized, with little overall summary (Weeks, 2013). In most paper records, pages are added to the record as they are generated chronologically, making the viewing of summarized data over time quite difficult. Another limitation with the paper-based record is security and confidentiality. Although usually ascribed as a problem of the EHR, there are attributes of the paper record that increase its vulnerability to access by non-privileged outsiders (AL Mutairi et al., 2022). It is also important to note that the misuse of medical information found in Health Records is not only manifested in paper-based records, misuse can also occur in electronic based records. Electronic tools such as the Internet, electronic mail, digital imaging and telemedicine are now indispensable for conducting business in the electronic healthcare field and are equally vulnerable. They are vulnerable because the electronic environments allow remote usage of records (Saiod et al., 2017). In this regard, effective security systems are needed to limit unauthorized access to electronic patient records. Electronic Health Record improves the quality of healthcare and access to information. Also, it reduces clinical errors often attributed to illegible physician’ handwriting. Electronic Health Records may also contribute to cost reduction measures in the management of patient records (Edwards & Moczygemba, 2004). Besides, they also improve information sharing by health practitioners thus enhancing communication of patient information.

## **7. Research Design**

This study adopts a descriptive research design. This type of research describes what exists and may help to uncover new facts and meaning. The purpose of descriptive research is to observe, describe and document aspects of a situation as it naturally occurs. In survey design, the researcher selects a sample of respondents and administers a questionnaire to collect information on variable of interest. A descriptive research is concerned with conditions, practices, structures, differences or relationships that exist, opinions held, processes that are going on or trends that are evident (Polit and Hungler, 1998). This comprises also the collection of data that will provide an account or description of individuals, groups or situations. Instruments we use to obtain data in descriptive studies include questionnaires, interviews (closed questions), and observation (checklists, etc.).

Survey research includes gathering quantitative and/or qualitative data from participants typically using a questionnaire or interview. A questionnaire could be delivered via mail, face to face or online. By using carefully controlled sampling procedures, it is assumed that samples responses to the survey will be representative of the target populations’ likely responses. The



survey was designed to gather information on the current practices and challenges related to the management of health records in General Hospital Ituk Mbang. The questionnaire will be divided into sections to cover various aspects of health record management, including record keeping practices, access to health records, data security, and staff training. The questions will be designed to elicit detailed responses from participants to provide a comprehensive understanding of the problems faced by the hospital in managing health records.

### **7.1 Population of the Study**

In this study, the target population was 120 employees on permanent, contract and temporary terms at the General Hospital Ituk Mbang, Akwa Ibom State. A high percentage of the population of the organization would need to be familiar with both the paper and electronic method of records as they were users.

### **7.2 Response Rate**

The study target was 120 respondents but only 100 filled and returned the questionnaires, resulting in a response rate of 83%. This response rate was satisfactory and representative to make conclusions for the study. According to (Mugenda and Mugenda, 2003), a response rate of 50% is adequate for analysis and reporting; a 60% is good and a 70% and above is excellent. Based on this, the response rate was excellent.

### **7.3 Sample and Sampling Technique**

The survey targeted healthcare professionals working in General Hospital Ituk Mbang who are directly involved in the management of health records. A random sampling method was used to select participants from different departments within the hospital, including medical records, nursing, and administration. The sample size was determined based on the number of healthcare professionals involved in health record management in the hospital. This technique gives all the subjects an equal chance and reduces bias and errors. This was achieved using a web based random number generator.

### **7.4 Instrumentation**

The data collection tools applied in this research include; questionnaires, interviews and observations. Questionnaires are commonly used to obtain important information about the population with emphasis put on the need for each question in the questionnaire to address a specific objective of the research question or hypothesis of the study.

### **7.5 Method of Data Analysis**

The responses from the questionnaire were analyzed using qualitative research methods to identify key issues and challenges faced by the hospital in managing health records. The data were coded and categorized to identify common themes and patterns. The findings were presented in a report using pie chart which outlines the limits of proper management of health records in General Hospital Ituk Mbang. The physical survey on the efficient and effective management of health records in General Hospital Ituk Mbang will provide valuable insights

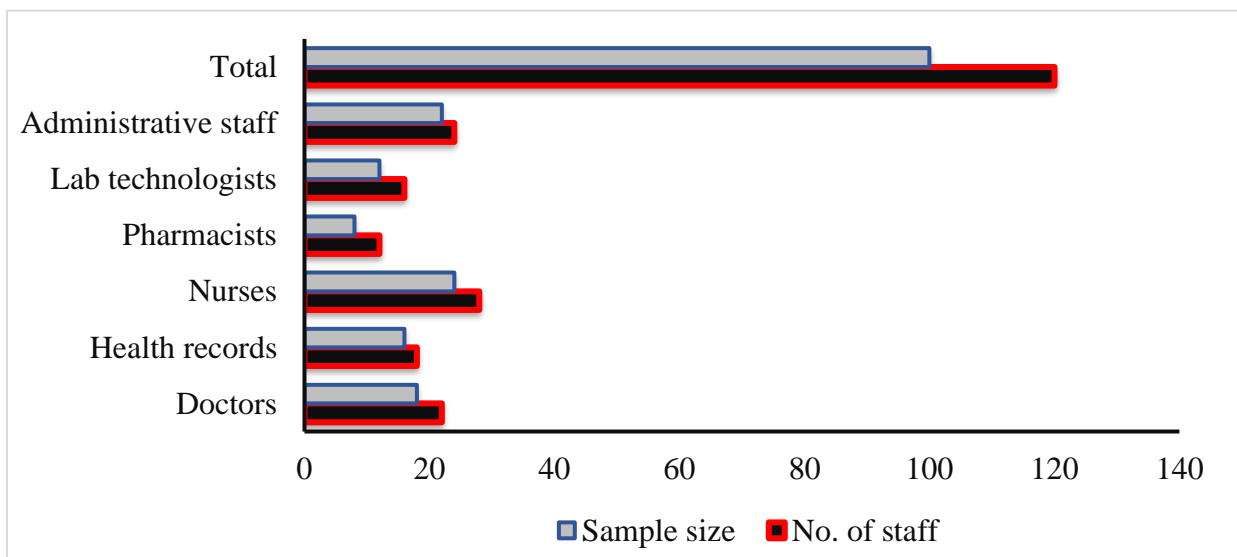
into the challenges faced by the hospital in managing health records. The findings from the survey will help identify areas for improvement and inform strategies to enhance the management of health records in the hospital. By addressing the limits identified in the survey, General Hospital Ituk Mbang can improve the efficiency and effectiveness of its health record management practices, ultimately leading to better patient care and outcomes.

### 8. Results and Discussion

This section brings in the presentation of the findings obtained and their interpretation. This section presents the results obtained from the questionnaire designed for 120 staff respondents, 100 respondents submitted the questionnaire that is used to examine the efficient and effective management of health record practice at the General Hospital Ituk Mbang. Results obtained from the questionnaire is presented in Figures 2 to 8.

**Table 1:** Target Population (Staff of General Hospital Ituk Mbang)

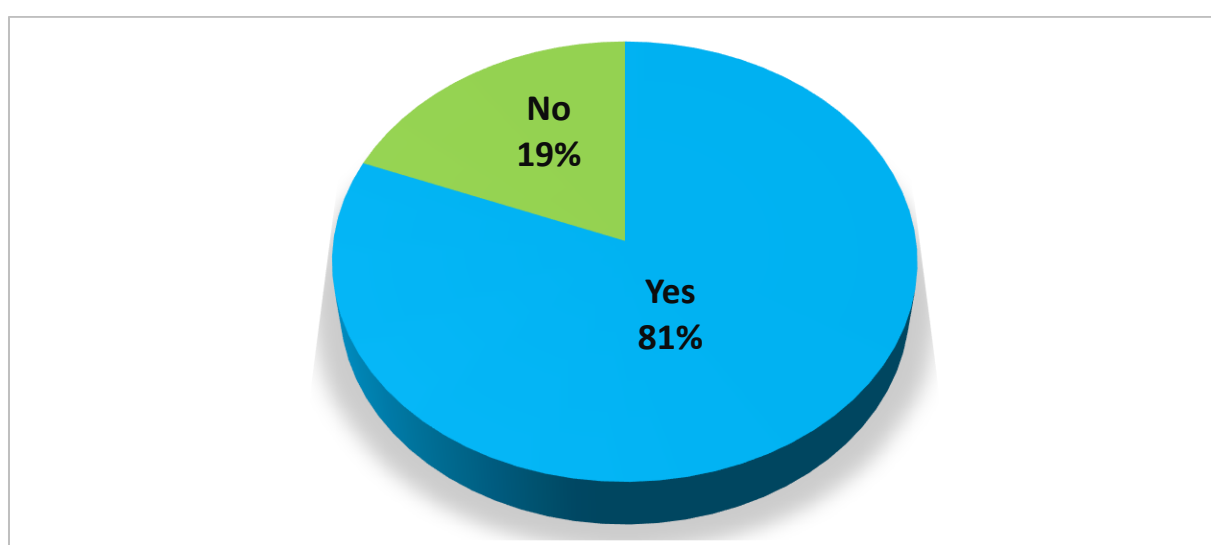
Category	No. of staff	Sample size
Doctors	22	18
Health records	18	16
Nurses	28	24
Pharmacists	12	8
Lab technologists	16	12
Administrative staff	24	22
Total	120	100



**Figure 1:** Chart of the target population (Staff of General Hospital Ituk Mbang)

**Table 2:** Possible measures of improving the preservation of health records in the General Hospital Ituk Mbang, Akwa Ibom State

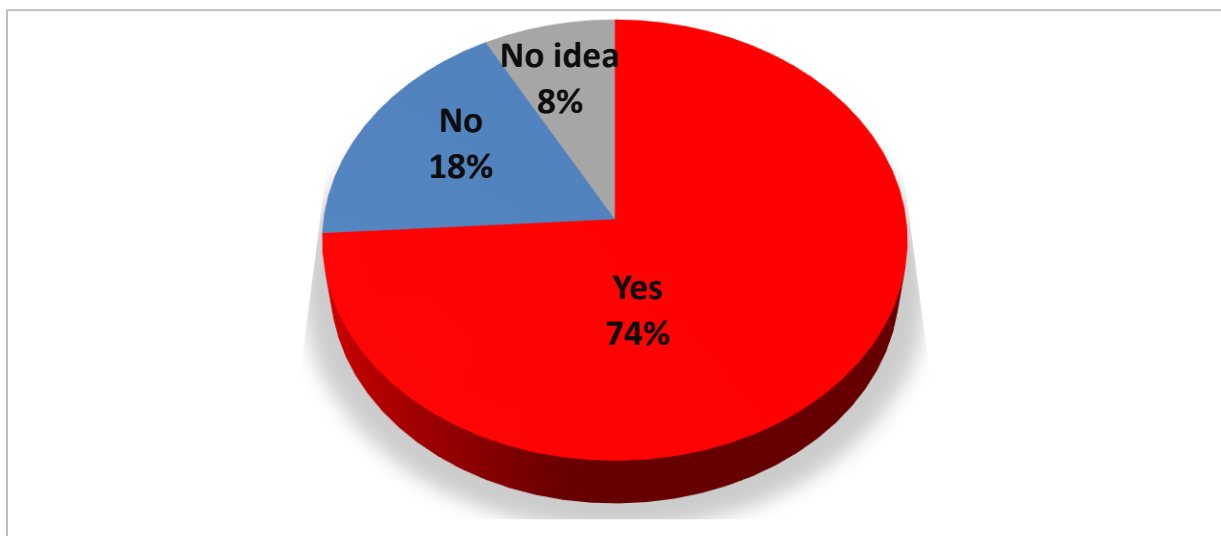
1	Do the health information management staff have professional license?	Yes	81%
		No	19%
2	Does shortage of trained and experienced health information professionals contribute to poor management of Health Information in your Hospital?	Yes	74%
		No	18%
		No idea	8%
3	Does the hospital have funds to provide for efficient management of her health information?	Yes	67%
		No	13%
		Ask the management	20%
4	Does inadequate financial allocation contributes to poor management of health information in your hospital?	Yes	84%
		No	16%



**Question 2:** Licensed health information management staff.

Health information management (HIM) is a crucial component of healthcare delivery, ensuring that patient records are accurate, secure, and accessible when needed. In hospitals, HIM staff play a vital role in managing patient information, coding diagnoses and procedures, and ensuring compliance with regulatory requirements. The debate over whether hospitals should employ professional licensed HIM staff or non-professional licensed staff has been ongoing, with arguments on both sides. Question 9 involved the health information management staff with professional license. The plot of response (see Figure 2) from the questionnaire generated in this study revealed that about 81% of the respondent's believes in professionalism and that health Records officers should be licensed with the relevant bodies and should be licensed with them while a fraction of about 19% thought otherwise. One of the main arguments in favor of having professional licensed HIM staff in hospitals is the expertise and knowledge they bring to the table. Professional licensed HIM staff, such as Registered Health Information Technicians (RHIT) or Registered Health Information Administrators (RHIA), have undergone rigorous training and education in health information management. They are well-versed in medical terminology, coding systems, and healthcare regulations, making them better equipped

to handle complex patient records and ensure accuracy and compliance. On the other hand, some argue that non-professional licensed HIM staff, such as medical office assistants or data entry clerks, can also effectively manage patient information in hospitals. While they may not have the same level of education and training as professional licensed staff, non-professional licensed staff can still perform basic HIM tasks, such as data entry and record maintenance. Additionally, employing non-professional licensed staff may be more cost-effective for hospitals, as they typically command lower salaries than professional licensed staff. However, the potential drawbacks of having non-professional licensed HIM staff in hospitals should not be overlooked. Without the specialized training and expertise of professional licensed staff, non-professional licensed staff may be more prone to errors in coding and documentation, which can have serious implications for patient care and reimbursement. Furthermore, non-professional licensed staff may not be as familiar with healthcare regulations and privacy laws, putting hospitals at risk of non-compliance and potential legal issues. While there may be arguments for employing both professional licensed and non-professional licensed HIM staff in hospitals, the benefits of having professional licensed staff far outweigh the potential drawbacks. Professional licensed HIM staff bring a level of expertise and knowledge that is essential for managing patient information accurately and ensuring compliance with regulatory requirements. Hospitals should prioritize hiring and retaining professional licensed HIM staff to maintain the integrity and security of patient records and uphold the highest standards of healthcare delivery.



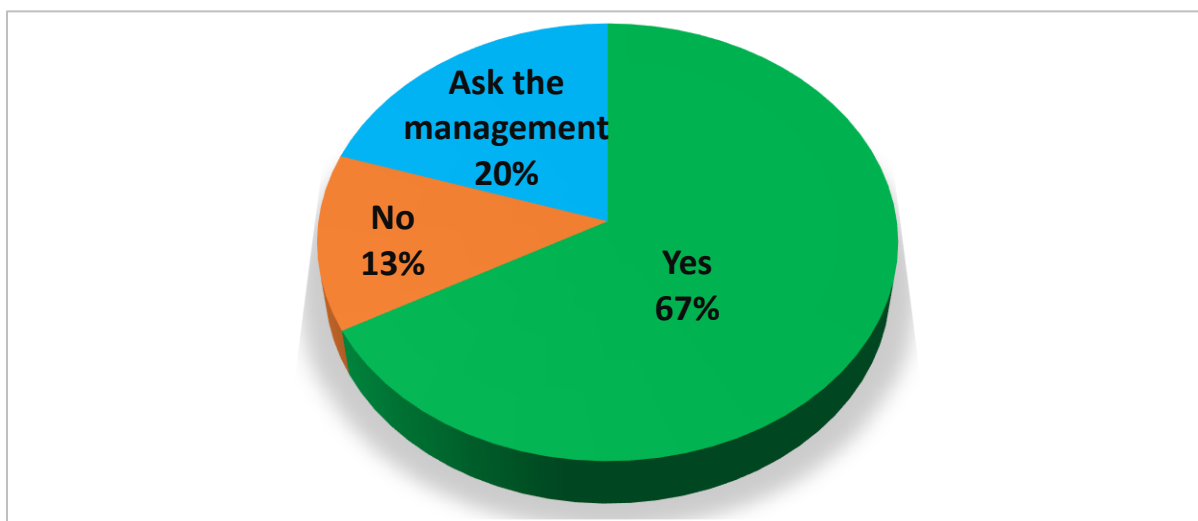
**Figure 3:** Shortage of trained and experienced health information professionals.

The management of health information in hospitals is a critical aspect of healthcare delivery. Health information professionals play a crucial role in ensuring that patient records are accurate, secure, and easily accessible. However, the shortage of trained and experienced health information professionals can contribute to poor management of health information in hospitals. The years of experience acquired by a Health Records officers is very essential in this survey, as it played a major role in ascertaining the genuinity of feedback obtained from different

respondents. In this case, the questionnaire was designed to determine if the shortage of trained and experienced health information professionals can affect the output of service rendered in the hospital. From the feedback in Figure 3, over 74% of the respondents believes that shortage of trained and experienced health information professionals contributes to poor management of health information in the hospital, 18% of the respondents thought otherwise, while 8% of the respondents don't seem to collude with others claiming not to understand the place of experience and professionalism. The key reasons why the shortage of trained and experienced health information professionals can lead to poor management of health information are stated as follows:

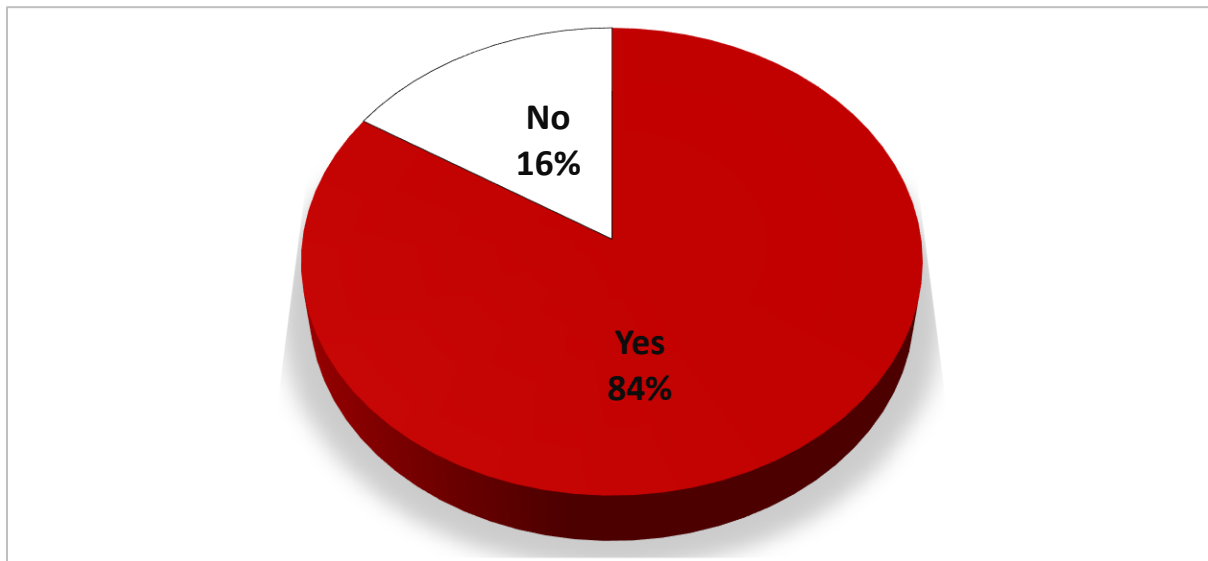
- i. The potential for errors in data entry and record-keeping: Without proper training, staff members may not be aware of the importance of accurately documenting patient information, which can lead to errors in medical records. These errors can have serious consequences for patient care, as healthcare providers rely on accurate and up-to-date information to make informed decisions about treatment.
- ii. Inadequate security measures for patient records: Health information professionals are trained to ensure that patient information is kept confidential and secure, in compliance with privacy regulations. Without proper training, staff members may not be aware of the importance of safeguarding patient information, which can lead to breaches of patient confidentiality and privacy.
- iii. Hindrance in the implementation of electronic health record (EHR) systems in hospitals: EHR systems are designed to streamline the management of health information and improve communication between healthcare providers. However, without trained professionals to oversee the implementation and maintenance of these systems, hospitals may struggle to fully realize the benefits of EHR technology.

The shortage of trained and experienced health information professionals can contribute to poor management of health information in hospitals. Errors in data entry, inadequate security measures, and challenges in implementing EHR systems are just a few of the potential consequences of a privation of trained professionals in this field. It is essential for hospitals to invest in training and development opportunities for health information professionals to ensure that patient information is managed effectively and securely.



**Figure 4:** Funding for efficient management of her health information.

Efficient management of health information in hospitals is vital for providing quality patient care and ensuring smooth operations. One of the key factors that can impact the management of health information is the availability of funds. When hospitals have sufficient funds, they are able to invest in advanced technology, hire skilled staff, and implement robust information management systems. On the other hand, when funds are limited, hospitals may struggle to maintain accurate and up-to-date health records, leading to inefficiencies and potential risks to patient safety. It is on these premise that question 3 was designed. Responses from question 3 (see plot in Figure 4) obtained from respondents in the questionnaire revealed that about 67% of the respondents agrees that sufficient funds will help in the efficient management of health information, 13% of the respondents were of a contrary opinion, while 20% suggested we should enquire from the management. The availability of funds plays a significant role in the implementation of electronic health records (EHR) systems, which are essential for storing and accessing patient information. EHR systems require substantial financial investment for software, hardware, training, and maintenance. Hospitals with limited funds may opt for cheaper, less sophisticated systems that do not fully meet their needs, resulting in inefficiencies and potential errors in health information management. Furthermore, the availability of funds also impacts the recruitment and retention of skilled health information management professionals. These professionals play a critical role in ensuring the accuracy, confidentiality, and accessibility of health information. Hospitals with limited funds may struggle to attract and retain qualified staff, leading to gaps in expertise and potential errors in health information management. Conversely, hospitals with sufficient funds are able to invest in ongoing training and professional development for their health information management staff, ensuring that they stay up-to-date with the latest technologies and best practices in the field. This, in turn, leads to more efficient and effective management of health information.



**Figure 5:** Inadequate financial allocation.

Question 4 was designed to investigate if inadequate financial allocation is a significant factor that contributes to poor management of health information in hospitals. When hospitals do not have sufficient funds to invest in proper health information management systems, it can lead to a range of issues that ultimately impact patient care and overall efficiency. In figure 5, 84% of the respondents believes it is very pertinent to allocate funds for the implementation, effective and efficient management of health information while 16 % refused to agree with some claiming that funds can be generated internally from patients and others. The federal government and state governments in Nigeria always allocate a large chunk of the yearly budget to medical care and funding of hospitals. While internally generated revenue is good, most times it could make medical expenditure from the government funded medical facilities very expensive for the poor citizens and most of them won't even have access to proper medical attention. Factors in which inadequate financial allocation affects health information management are:

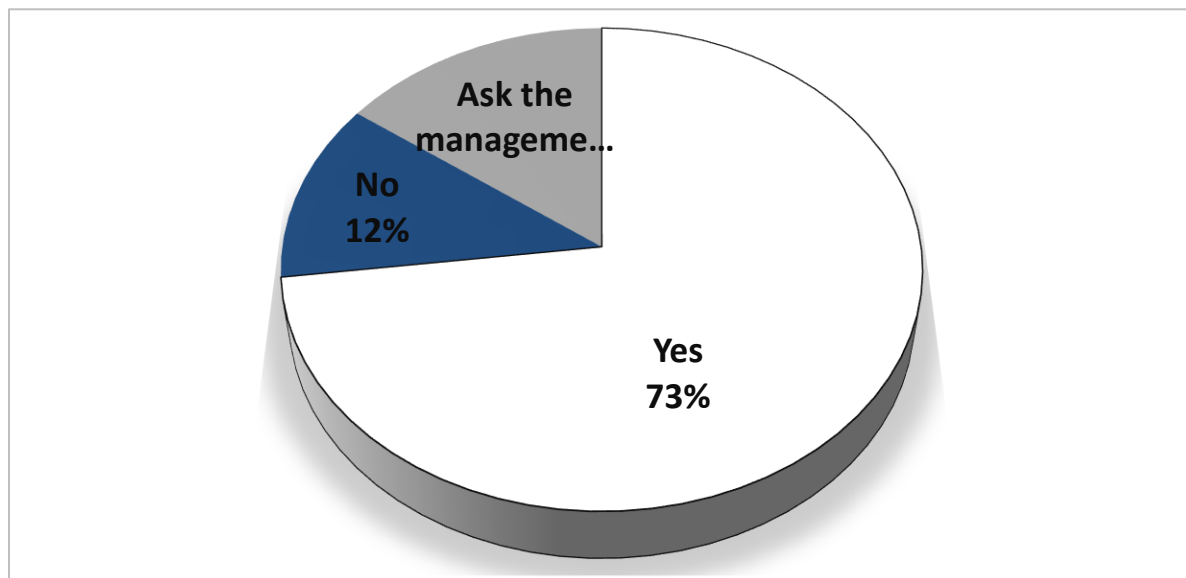
- i. The inadequate resources for implementing and maintaining electronic health record (EHR) systems: EHR systems are essential for storing and accessing patient information, and without proper funding, hospitals may struggle to implement these systems effectively. This can result in fragmented or incomplete patient records, leading to errors in diagnosis and treatment.
- ii. Inadequate financial allocation can also impact the training and education of staff members responsible for managing health information. Without sufficient funds for training programs and ongoing education, staff may not have the necessary skills and knowledge to effectively manage health information. This can result in data entry errors, security breaches, and other issues that compromise the integrity of patient information.
- iii. It can also lead to outdated or inadequate technology infrastructure in hospitals: This can make it difficult to access and share health information efficiently, leading to delays in care and communication breakdowns between healthcare providers. Inadequate

technology infrastructure can also make hospitals more vulnerable to cyber-attacks and data breaches, putting patient information at risk.

Inadequate financial allocation is a significant contributing factor to poor management of health information in hospitals. Without sufficient funding for information management systems, staff training, and technology infrastructure, hospitals may struggle to effectively manage patient information, leading to a range of negative consequences for patient care and overall efficiency. It is essential for hospitals to prioritize adequate financial allocation for health information management in order to ensure the highest quality of care for patients. Strategies for preserving medical information at the general hospital are presented in Table 3.

**Table 3:** Strategies for preserving medical information at the General Hospital Ituk Mbang.

5	Does your hospital need financial assistance to be able to manage her health information?	Yes	73%
		No	12%
		Ask the management	15%
6	Does efficient management of health records ensures availability of adequate health care information?	Yes	74%
		No	26%
7	Does poor management of health information ensure efficient care to patient?	Yes	12%
		No	88%
8	Are there strategies and methods for preserving medical information at the General Hospital Ituk Mbang?	Yes	76%
		No	24%



**Figure 6:** Financial assistance for proper management of health information.

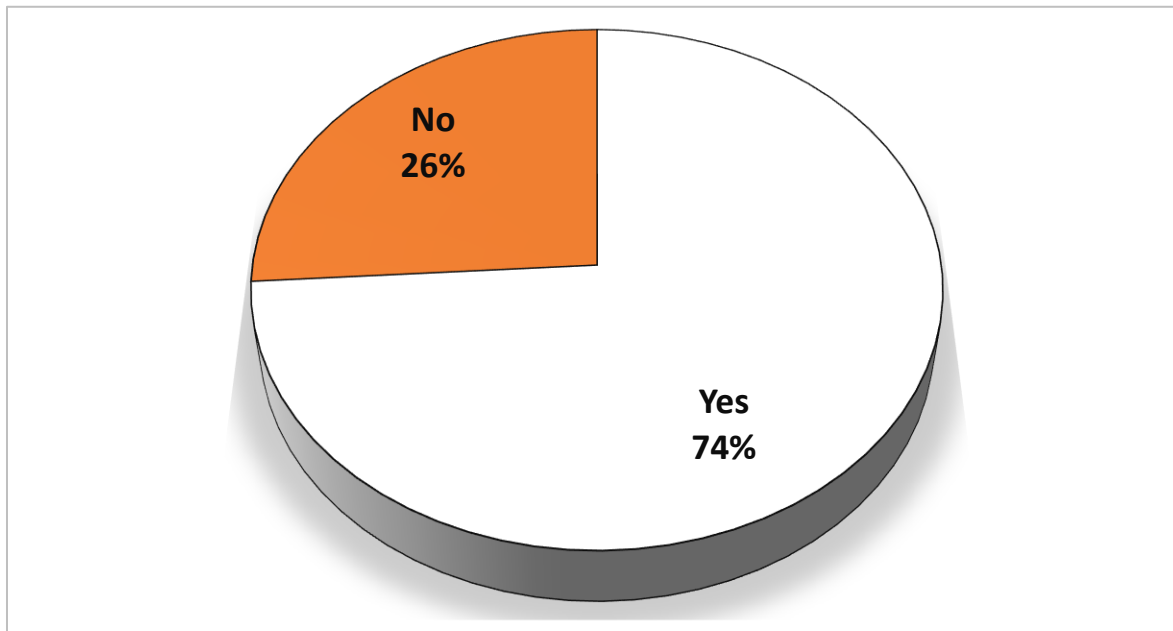
Financial assistance role in managing health information in hospitals can never be over-emphasized. It helps in ensuring that hospitals have the necessary resources to maintain accurate and up-to-date patient records, as well as to invest in technology and infrastructure for efficient data management. However, financial assistance also comes with its own set of limitations that



need to be carefully considered. Question 5 was designed to investigate the place of financial assistance in effective service delivery of proper health information management. Most of the respondents in figure 6 (about 73%), stated clearly that it is a vital cog as long as health records management is concerned, 12% submitted that finance can be generated within the context of the hospital while 15% of the total respondents insisted we should enquire from the management. The significance of financial assistance to the management of health information management includes:

- i. Financial assistance help hospitals in the establishment of EHR systems. These system have in recent years shown to improve patient care by providing healthcare providers with easy access to patient information, reducing medical errors, and streamlining administrative processes. With financial assistance, hospitals can afford to implement and maintain these systems, ultimately leading to better patient outcomes.
- ii. Financial assistance help hospitals in training their staff on proper data management practices. This is essential in ensuring that patient information is handled securely and in compliance with privacy regulations such as the Health Insurance Portability and Accountability Act (HIPAA). By investing in staff training, hospitals can reduce the risk of data breaches and protect patient confidentiality.
- iii. However, financial assistance also has its limitations. One of the main challenges is that it may not always be sufficient to cover all the costs associated with managing health information. Hospitals may still struggle to afford the latest technology or hire skilled professionals to oversee data management. This can result in inefficiencies in data collection and storage, leading to errors and delays in patient care.
- iv. Additionally, financial assistance may come with strings attached, such as restrictions on how the funds can be used or reporting requirements. This can limit hospitals' flexibility in managing their health information systems and may not always align with their specific needs and priorities.

While financial assistance is essential for hospitals to effectively manage health information, it is important to recognize both its benefits and limitations. By carefully evaluating the costs and benefits of financial assistance, hospitals can make informed decisions on how to best allocate resources to ensure efficient and secure data management. Ultimately, the goal should be to leverage financial assistance to improve patient care and outcomes while also addressing the challenges and limitations that come with it.



**Figure 7:** Efficient management of health information.

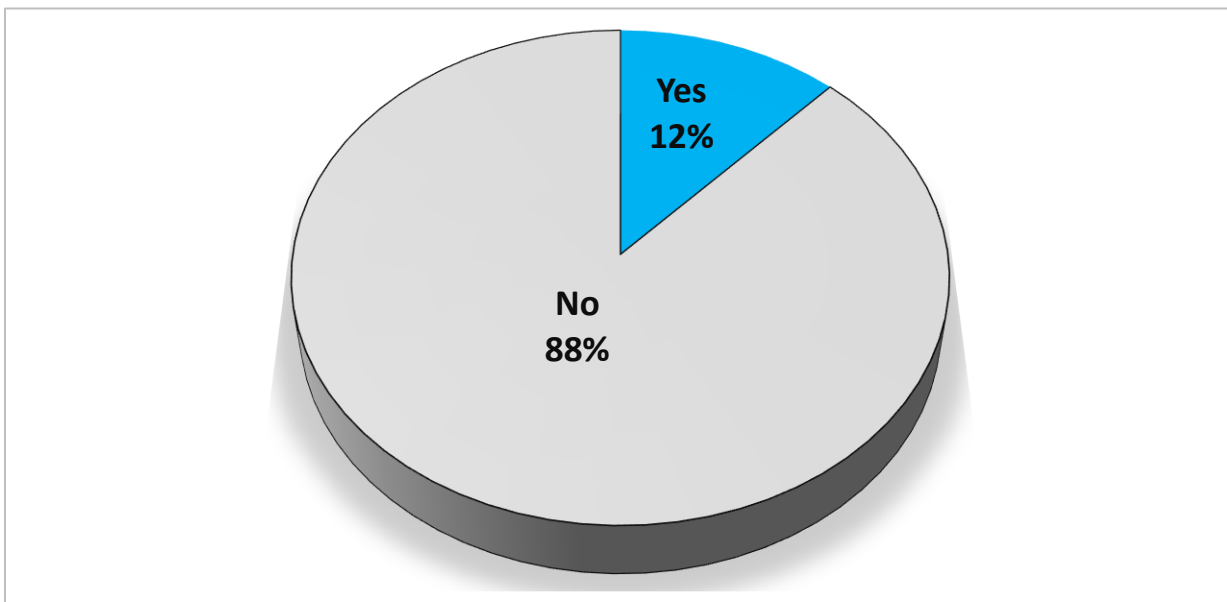
Efficient management of health records plays a role in ensuring the availability of adequate healthcare information. The ability to access accurate and up-to-date medical records is essential for healthcare providers to make informed decisions about patient care. Without proper management of health records, there is a risk of important information being lost or overlooked, which can have serious consequences for patient outcomes. Question 6 was designed to investigate if efficient management of health records ensures availability of adequate health care information. Majority of the respondents (74%) in Figure 6 were of a positive opinion that efficiency in management of every patients' health records also ensures an up to date availability of patients' information. On the contrary, 26% of the respondents had different reactions. This indicates that the feedback obtained from the survey do not lack essence and practical background but has an ideal basis considering the years that these health record officers have spent in their respective field of record management and the experience and efficiency developed in the field. The key benefits of efficient health record management are highlighted below:

- i. The ability to track a patient's medical history over time: This includes information such as past diagnoses, treatments, medications, and test results. Having access to this information allows healthcare providers to make more informed decisions about a patient's care, leading to better outcomes and potentially reducing the risk of medical errors.
- ii. Improves communication and coordination among healthcare providers: When all members of a patient's care team have access to the same information, they can work together more effectively to develop and implement a comprehensive treatment plan. This can help to avoid duplication of tests and treatments, reduce the risk of adverse

drug interactions, and ensure that all aspects of a patient's care are being properly coordinated.

- iii. It can also have a positive impact on healthcare costs: By reducing the amount of time and resources spent on searching for and organizing medical records, healthcare providers can operate more efficiently and potentially lower overall costs. In addition, having access to comprehensive health records can help to identify patterns and trends in a patient's health, allowing for more proactive and preventive care that can ultimately reduce the need for costly interventions down the line.

Efficient management of health records is essential for ensuring the availability of adequate healthcare information. By maintaining accurate and up-to-date records, healthcare providers can make more informed decisions, improve communication and coordination among care teams, and potentially reduce healthcare costs. It is clear that proper management of health records is a critical component of delivering high-quality healthcare services to patients.

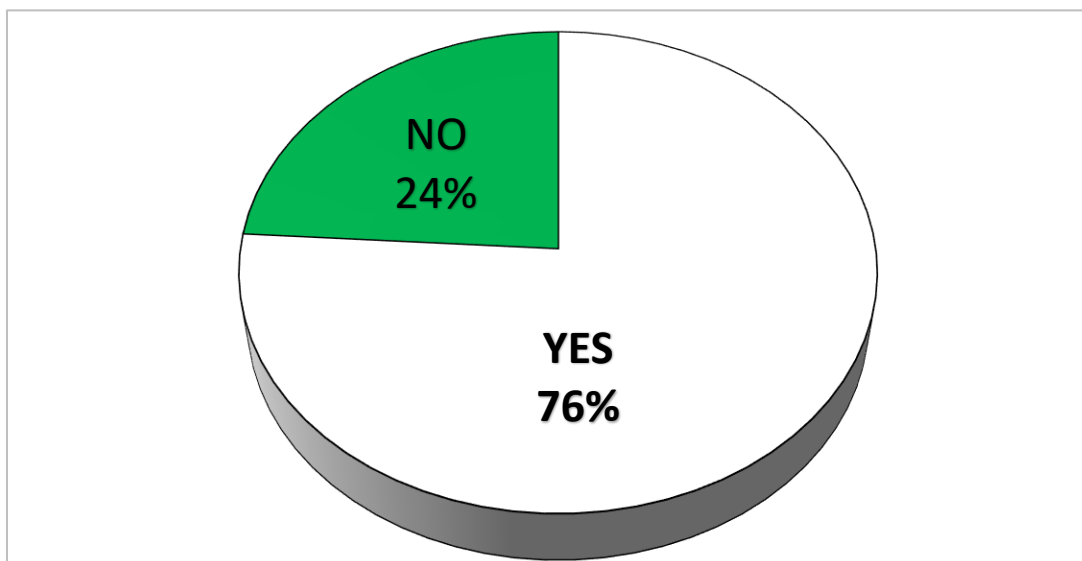


**Figure 8:** Poor management of health information.

Poor management of health information can have detrimental effects on patient care and overall efficiency in healthcare settings. Inadequate handling of patient information can lead to errors in diagnosis, treatment, and medication administration, ultimately compromising the quality of care provided to patients. The essence of question 7 was to diagnose the effect of poor management of health information on patient care. As seen in the plot (see figure 8), 88% of the respondents were of the negative opinion that poor management of health records can ensure efficient care to patient while just about 12% were of a different opinion. Some maybe did not understand the survey question and some were just adamant. The impact of poor health information management on patient care and the effective management of health information is essential for ensuring efficient and high-quality care. Some of the impacts include:

- i. **Errors in diagnosis and treatment:** When health information is not properly documented or accessible, healthcare providers may not have all the necessary information to make accurate diagnoses or develop appropriate treatment plans. This can result in misdiagnoses, unnecessary tests and procedures, and delays in treatment, all of which can have serious consequences for patients.
- ii. **Errors in medication administration:** Without accurate and up-to-date information on a patient's medication history, allergies, and potential drug interactions, healthcare providers may inadvertently prescribe the wrong medication or dosage, putting patients at risk of adverse reactions or complications. Furthermore, inadequate documentation of medication administration can lead to medication errors, such as missed doses or incorrect administration, which can have serious implications for patient safety.
- iii. **Efficiency of healthcare delivery:** When information is not readily available or easily accessible, healthcare providers may waste valuable time searching for patient records or coordinating care, leading to delays in treatment and increased healthcare costs. Inefficient information management can also result in duplication of tests and procedures, as healthcare providers may not have access to previous test results or treatment plans, leading to unnecessary expenses and potential harm to patients.

Effective management of health information is crucial for ensuring efficient and high-quality care for patients. Poor management of health information can lead to errors in diagnosis, treatment, and medication administration, as well as inefficiencies in healthcare delivery. By implementing robust information management systems and processes, healthcare organizations can improve patient outcomes, enhance patient safety, and optimize the delivery of care. It is imperative that healthcare providers prioritize the proper management of health information to ensure the best possible outcomes for their patients.



**Figure 9:** Strategies and methods for preserving medical information

Preserving medical information is crucial for the efficient functioning of any healthcare facility, including General Hospital Ituk Mbang. Question 8, explored the different strategies and methods that can be employed to ensure the preservation of medical information at the hospital. It is observed that majority of the surveyed population 76% were of the opinion that there are laid down strategies and methods for preserving medical information while 24% were of a different opinion. (See figure 9).

Some of the key strategies for preserving medical information at General Hospital Ituk Mbang are as follows:

- i. The implementation of electronic health records (EHRs): EHRs allow for the digital storage and retrieval of patient information, making it easier to access and update medical records. This not only improves the efficiency of healthcare delivery but also reduces the risk of errors and loss of information.
- ii. The use of secure and reliable storage systems: This includes physical storage solutions such as filing cabinets and lockable drawers, as well as digital storage options like cloud-based servers and encrypted databases. By ensuring that medical records are stored in a secure and organized manner, the hospital can protect sensitive patient information and prevent unauthorized access. Regular backups of medical information are also essential for preserving data at General Hospital Ituk Mbang. By creating duplicate copies of medical records and storing them in separate locations, the hospital can safeguard against data loss due to hardware failure, natural disasters, or cyber-attacks. This ensures that patient information remains accessible and intact, even in the event of unforeseen circumstances.
- iii. Staff training and education is also crucial for preserving medical information at the hospital: By providing training on data security protocols, record-keeping best practices, and compliance with privacy regulations, the hospital can empower its employees to effectively manage and protect medical information. This not only enhances the quality of patient care but also reduces the risk of data breaches and legal liabilities.

Preserving medical information at General Hospital Ituk Mbang requires a combination of strategies and methods, including the use of electronic health records, secure storage systems, regular backups, and staff training. By implementing these measures, the hospital can ensure the integrity and confidentiality of patient information, ultimately improving the quality of healthcare services provided.

## **9. Conclusion and Recommendation**

It is evident that there are numerous constraints and limitations that hinder the proper management of health records in General Hospital Ituk Mbang. These constraints include inadequate funding, shortage of trained personnel, poor infrastructure, and inadequate technology. These limitations have a significant impact on the quality of healthcare services provided to patients, as well as on the overall efficiency and effectiveness of healthcare delivery in General Hospital Ituk Mbang. Some of the major constraints facing the proper management of health records in General Hospital Ituk Mbang are as follows:

- i. **Inadequate funding:** The insufficient financial resources make it difficult for hospital to invest in the necessary infrastructure, technology, and personnel needed to effectively manage health records. This results in a shortage of proper storage facilities, outdated technology, and a shortage of trained personnel, all of which contribute to the poor management of health records.
- ii. **Shortage of trained personnel:** General Hospital Ituk Mbangs do not have enough staff who are trained in health information management. This results in a shortage of expertise in managing health records, leading to errors, inefficiencies, and delays in accessing patient information. Without properly trained personnel, hospitals are unable to maintain accurate and up-to-date health records, which can have serious implications for patient care and safety.
- iii. **Poor infrastructure:** General Hospital Ituk Mbang lacks the necessary infrastructure, such as secure storage facilities, reliable internet connectivity and adequate computer systems, to effectively manage health records. This results in a reliance on paper-based records, which are prone to loss, damage, and theft, leading to inaccuracies and inefficiencies in record-keeping.
- iv. **Inadequate technology:** General Hospital Ituk Mbang lacks the necessary technology, such as electronic health record systems, to efficiently manage health records. This results in a reliance on manual record-keeping processes, which are time-consuming, error-prone, and inefficient. Without the proper technology, hospitals are unable to securely store, access, and share patient information, leading to delays in care and potential risks to patient safety. Based on the study, the following recommendations were made:
  - a. It is essential for the government to invest in upgrading the infrastructure of General Hospital Ituk Mbang and provide them with the necessary resources to effectively manage health records.
  - b. It is important for the hospital to invest in training and capacity building for their staff in health information management. This will ensure that health records are properly managed and maintained by competent personnel.
  - c. It is important for the General Hospital Ituk Mbang to develop and implement standardized policies and procedures for the management of health records. This will help ensure that health records are managed in a systematic and efficient manner, leading to improved patient care.

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# **A STUDY ON ADOPTION OF HEAT EXCHANGERS AS INDUSTRIAL HOTSPOT IN EQUIPMENT COOLING AND EFFICIENCY**

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## **Abstract**

In today's industrial landscape, the demand for energy-efficient solution is higher than ever. With rising energy costs and increasing environmental concerns, companies are looking for ways to improve their operations while reducing their carbon footprint. One area that has gained significant attention in recent years is equipment cooling, which plays a crucial role in maintaining the performance and longevity of industrial machinery. The present study addresses the need for energy-efficient solutions in industrial equipment cooling processes. Traditional cooling methods, such as air conditioning and water cooling, are often inefficient and costly. They require a significant amount of energy to operate, leading to high electricity bills and increased carbon emissions. As a result, companies are facing pressure to find more sustainable and cost-effective alternatives for equipment cooling. Heat exchangers offer a promising solution to this problem by utilizing the principles of heat transfer to efficiently cool industrial machinery. The methodology of this study involved a comprehensive literature review and case studies of companies that have successfully implemented heat exchangers in their operations. The literature review examines the benefits of heat exchangers in equipment cooling, including improved efficiency, reduced energy consumption and lower operating costs. The results and findings of this study indicate that heat exchangers can significantly improve equipment cooling efficiency and reduce energy consumption. By transferring heat from the

equipment to a cooling medium, such as air or water, heat exchangers help maintain optimal operating temperatures and prevent overheating. This not only prolongs the lifespan of industrial machinery but also reduces the need for costly repairs and maintenance. In addition, heat exchangers can lower energy costs by minimizing the amount of electricity required to cool equipment, leading to substantial savings for companies. Hence, it is essential for industry stakeholders to recognize the benefits of heat exchangers and prioritize their integration into equipment cooling systems for optimum performance.

**Keywords:**Heat Exchangers, Energy-efficient Solution, Equipment Cooling Systems, Reduced Energy Consumption, Industrial Machinery

## 1. Introduction

Heat exchangers are essential components in industrial equipment cooling systems, playing a crucial role in maintaining efficient operation and preventing overheating. These devices are designed to transfer heat from one fluid to another, allowing for the regulation of temperature within a system. They play a crucial role in maintaining optimal temperatures in many processes, such as refrigeration, air conditioning, power generation, and chemical manufacturing (Mohammed et al., 2011). One of the key functions of heat exchangers is to remove excess heat generated during the operation of industrial equipment. This heat can be detrimental to the performance and longevity of the equipment, leading to decreased efficiency and potential damage. By transferring heat to a cooler fluid such as water or air, heat exchangers help to maintain optimal operating temperatures of the equipment within the desired range (Guo et al., 2002). This not only prevents overheating of the equipment but also improves its efficiency by ensuring that it operates at the optimal temperature. In addition to equipment cooling, heat exchangers also play a critical role in improving energy efficiency. By effectively transferring heat between fluids, heat exchangers can help to reduce energy consumption and lower operating costs (Bretado-de los Rios et al., 2021). This is particularly important in industries where energy efficiency is a key concern, such as power generation and manufacturing. The working principle of a heat exchanger is based on the fundamental laws of thermodynamics. Heat transfer occurs through conduction, convection, and radiation, with the goal of maximizing the efficiency of the process (Li & Guo, 2011). The two fluids involved in the heat exchange process flow in opposite directions, allowing for the transfer of heat from the hotter fluid to the cooler fluid. This results in a more efficient cooling process, which helps to maintain the optimal operating temperature of the equipment. By efficiently transferring heat between different fluids, heat exchangers help maintain the required temperature for chemical reactions to occur at the desired rate. This not only ensures the quality of the final product but also enhances the overall efficiency of the production process. By transferring heat between indoor and outdoor air in buildings, heat exchangers regulate the temperature inside building, thereby improving comfort and energy efficiency (Yang et al., 2019; Chen et al., 2020). This is particularly important in commercial buildings where maintaining a comfortable indoor environment is essential for the well-being of occupants and the efficient operation of equipment. Hence, industrial heat exchangers are essential components in modern industrial processes, and their proper design and operation are crucial for ensuring the optimal performance of equipment and the overall efficiency of industrial operations (Zeng et al., 2017; Singh et al., 2018). There are several types of heat exchangers, each designed for specific applications and operating conditions. Heat exchangers are crucial components in various industrial processes, enabling efficient transfer of heat between two fluids while maintaining their separation. Among the different types of heat exchangers, the shell and tube heat exchanger is widely used due to its versatility, reliability, and effectiveness in heat transfer (Petinrin & Dare, 2016). The working principle of a heat exchanger involves the transfer of heat between two fluids with different temperatures. The fluids can be either liquids or gases, and they can flow in parallel or counter-flow configurations. In a parallel flow heat exchanger, the hot and cold fluids enter at one end and flow in the same direction. This configuration is

suitable for applications where a large temperature difference is required between the fluids (Sridhar & Bicha, 2017). On the other hand, a counter-flow heat exchanger has the hot and cold fluids entering at opposite ends and flowing in opposite directions. This configuration allows for a more efficient heat transfer as the temperature difference between the fluids decreases along the length of the exchanger. Counter-flow heat exchangers are commonly used in HVAC systems, where energy efficiency is crucial. Heat exchangers find applications in various industries. In the power generation sector, they are used to extract heat from the exhaust gases of gas turbines and transfer it to a working fluid, such as water or steam, to generate additional power (Samarasinghe et al., 2019). In the chemical industry, heat exchangers are utilized for process heating and cooling, as well as for condensing or vaporizing fluids. They are also extensively used in the food and beverage industry for pasteurization, sterilization, and cooling processes. Heat exchangers are vital devices for heat transfer in numerous industrial processes (Azizi-Lalabadi et al., 2023). Shell and tube, plate, and finned tube heat exchangers are widely used due to their efficiency and versatility. The working principle and configuration of heat exchangers depend on the specific application requirements. With their diverse applications across industries, heat exchangers contribute significantly to energy efficiency and process optimization.

## **2. Recent Advancements in Heat Exchanger**

Recent advancements in heat exchanger technology have significantly improved their performance and reliability, making them a hotspot in industrial applications. Over the years, the following advancements has occurred in heat exchanger technology:

- i. The development of compact and efficient designs: Traditional heat exchangers were bulky and inefficient, leading to energy wastage and reduced cooling efficiency (Wang et al., 2014). However, modern heat exchangers are designed to be more compact and lightweight, while still maintaining high levels of heat transfer efficiency. This has allowed industries to save on space and energy costs, while also improving the overall performance of their equipment (Klemeš et al., 2020).
- ii. The use of advanced materials and coatings: Heat exchangers are often exposed to harsh operating conditions, such as high temperatures and corrosive environments. By using materials and coatings that are resistant to these conditions, heat exchangers can now operate more effectively and have a longer lifespan. This has led to reduced maintenance costs and increased equipment reliability for industrial applications (Zhang et al., 2018; Bhuvanendran et al., 2023).
- iii. The development of more efficient heat transfer mechanisms: An example is the use of micro-channel heat exchangers has allowed for higher heat transfer rates and improved thermal performance. This has enabled industries to achieve better cooling efficiency and overall equipment performance (Dixit & Ghosh, 2015).

Recent advancements in heat exchangers have made them a hotspot in industrial applications, particularly in equipment cooling and efficiency. By incorporating compact designs, advanced materials, and efficient heat transfer mechanisms, heat exchangers have become essential components in various industrial processes. As industries continue to strive for improved

performance and energy efficiency, heat exchangers will undoubtedly play a key role in achieving these goals.

### **3. Implementation Process of Industrial Heat Exchanger**

The implementation process of industrial heat exchangers for equipment cooling and efficiency are presented as follows:

- i. The first step in implementing industrial heat exchangers is to conduct a thorough assessment of the equipment and processes that require cooling: This includes identifying the heat sources, heat loads, and temperature requirements for each piece of equipment. By understanding the specific cooling needs of the system, engineers can select the most appropriate heat exchanger design and size for the application (Shah & Sekulic, 2003).
- ii. The next step is to select the type of heat exchanger that best suits the application: There are several types of heat exchangers available, including spiral-plate, printed-circuit and air-cooled, plate-fin, open-flow heat exchangers. Each type has its own advantages and limitations, so it is important to carefully consider the specific needs of the system before making a selection.
- iii. After selecting the appropriate heat exchanger type, the next step is to design the system layout and installation. This includes determining the location of the heat exchanger within the equipment or process, as well as the piping and connections required for fluid flow. Proper installation is crucial for ensuring efficient heat transfer and optimal cooling performance (reepathi & Rangaiah, 2014).
- iv. Once the heat exchanger has been installed, it is important to monitor and maintain the system regularly to ensure optimal performance. This includes checking for leaks, cleaning the heat exchanger surfaces, and replacing any worn or damaged components. Regular maintenance helps to prevent system failures and ensures long-term efficiency and reliability (Bell, 2004).

The implementation of industrial heat exchangers for equipment cooling and efficiency is a critical process that requires careful planning and execution. By following the steps outlined in this study, industry operators can ensure that their heat exchanger systems are properly designed, installed, and maintained for optimal cooling performance and energy efficiency.

### **4. Types of Heat Exchangers**

There are several types of heat exchangers available. Some of them are highlighted as follows:

#### **a. Spiral-Plate Heat Exchanger**

Among the different types of heat exchangers, the spiral-plate heat exchanger (SPHE) has gained significant attention due to its exceptional heat transfer efficiency and compact design as shown in Figure 1. Therefore, SPHE is an efficient solution for heat transfer applications (Rangasamy, 2014). It consists of two metal plates which are wound to one another. One stream of process fluid enters the heat exchanger via the mid-section and flows through the outside, while the second stream enters through the outer part and flows inwards, thereby, creating a

close-to-natural backflow. One limitation of this type of heat exchanger is that, it is not suitable for high temperature or pressure transient applications. SPHEs are characterized by a unique design that consists of two concentric spiral plates, creating multiple fluid flow channels. The spiral configuration offers a large heat transfer surface area within a compact volume, resulting in enhanced heat transfer rates (Thulukkanam, 2024). SPHEs offer several advantages which includes the following:

- i. **High Heat Transfer Efficiency:** SPHEs exhibit superior heat transfer efficiency compared to other types of heat exchangers due to their large surface area and turbulent flow patterns. This efficiency allows for smaller heat exchanger sizes, reducing material and installation costs (Pradeep et al., 2018).
- ii. **Compact Design:** The spiral configuration of SPHEs allows for a high heat transfer surface area within a limited space, making them ideal for applications with space constraints.
- iii. **Reduced Fouling and Maintenance:** The spiral flow pattern in SPHEs minimizes fouling by preventing the deposition of solids on the heat transfer surface. This feature reduces the need for frequent cleaning and maintenance, enhancing the operational efficiency and lifespan of the heat exchanger (Sabouri Shirazi et al., 2022).

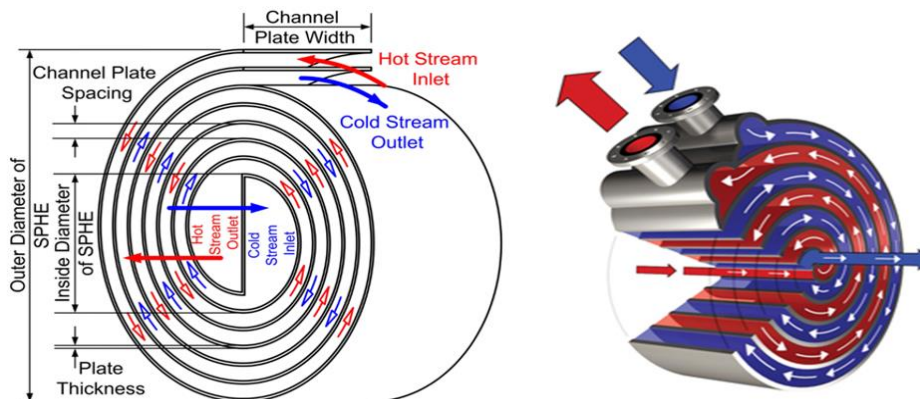


Figure 1: Spiral-plate heat exchanger (Sabouri Shirazi et al., 2020)

### b. Printed-Circuit Heat Exchanger

Traditional heat exchangers have limitations in terms of efficiency and compactness. Also, conventional heat exchangers, such as shell-and-tube or plate heat exchangers, have been widely used for many decades. However, these designs have limitations in terms of heat transfer efficiency and compactness. In recent years, researchers have focused on developing innovative heat exchanger designs to overcome these limitations. One such design is the printed-circuit heat exchanger (PCHE) (Huang et al., 2019) as shown in Figure 2. These exchangers are composed of chemically etched plates that are fused together through diffusion bonding process. The resulting block is the core of the equipment which dismisses gaskets or welded joints and allows the occurrence of heat transfer between two or more fluids employed in the system. PCHEs are compact heat exchangers that consist of multiple layers of thin plates,

typically made of metal alloys. These plates are etched with intricate circuit patterns to create channels for fluid flow. The fluid flows in counter-current or parallel paths, allowing efficient heat transfer between the fluids (Chen et al., 2016a). PCHEs offer several advantages over conventional heat exchangers which includes the following:

- i. Firstly, due to their compact design and efficient fluid flow paths, PCHEs have a higher heat transfer coefficient compared to traditional designs. This results in improved heat transfer performance and reduced size requirements (Chen et al., 2016b).
- ii. Secondly, the etched circuit patterns in PCHEs allow for precise control of fluid flow, enabling enhanced heat transfer uniformity and reduced pressure drop.
- iii. Lastly, PCHEs have a modular construction, allowing easy maintenance and replacement of individual plates, thereby reducing downtime and operational costs (Ma et al., 2022).

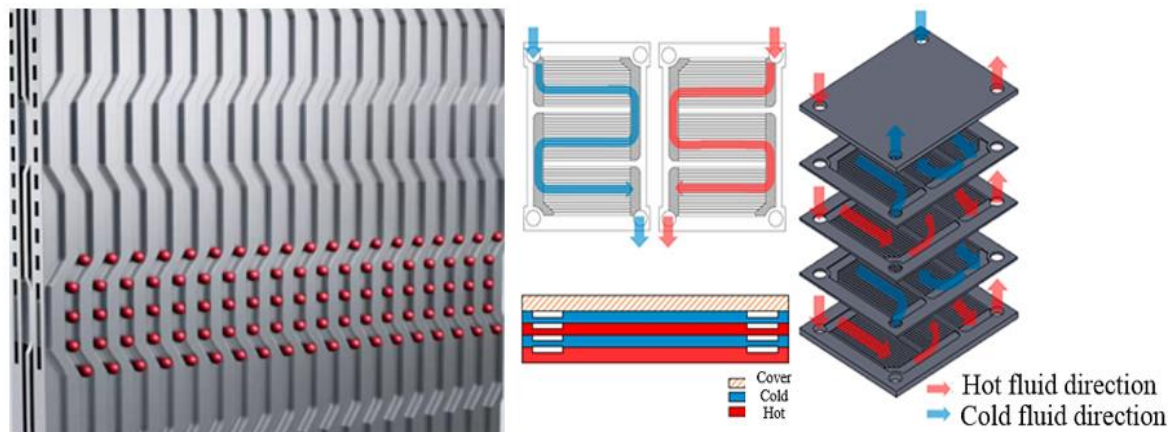


Figure 2: Printed-circuit heat exchanger (Chang et al., 2021)

### c. Air-Cooled Heat Exchangers

Air-cooled heat exchangers (ACHEs) play a crucial role in various industries, including power generation, chemical processing, and oil refining. These heat exchangers are designed to transfer heat from a process fluid to the surrounding air, utilizing convective heat transfer mechanisms. ACHEs can be classified into different types based on their configuration and mode of heat transfer. As shown in Figure 3a, the most common types include forced draft, induced draft, and natural draft heat exchangers (Koplow, 2010).



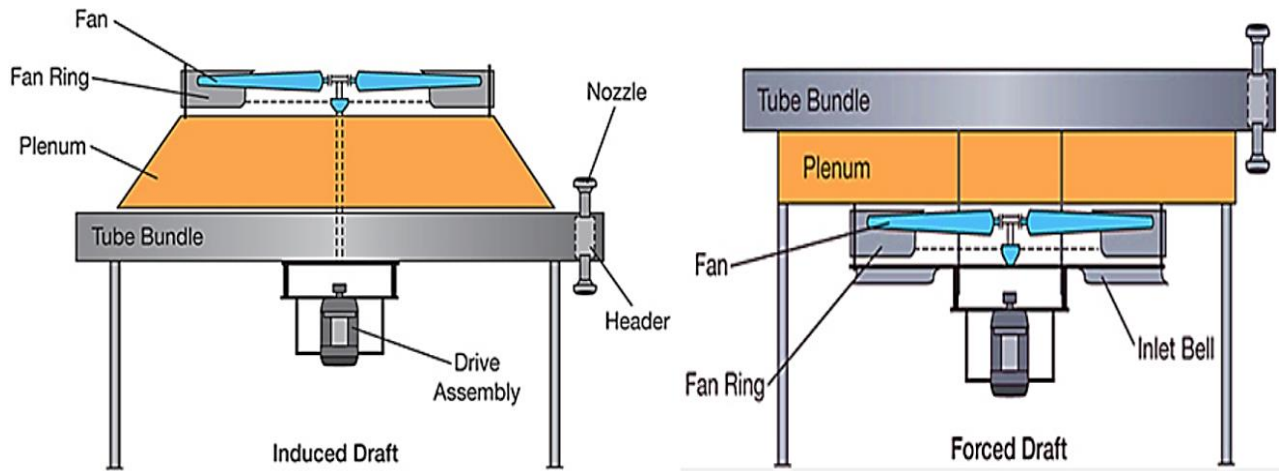


Figure 3a: Air-Cooled heat exchangers

In an ACHEs, hot process fluid flows through a finned tube, whereas, ambient air passes over the finned tube, which cools the process fluid as illustrated in Figure 3b:

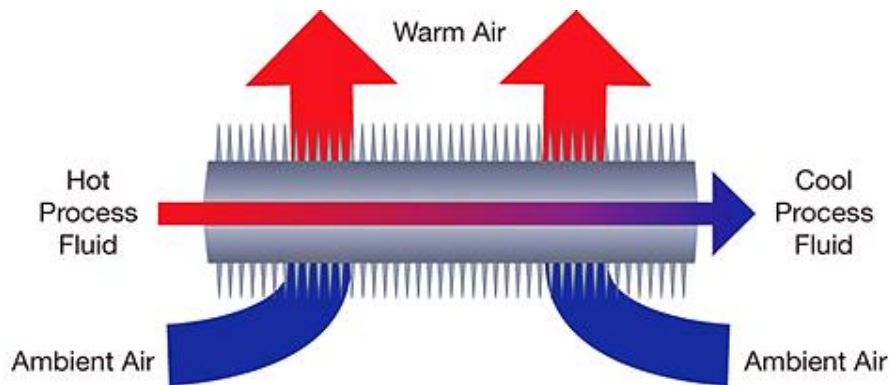


Figure 3b: Cooling process of air-cooling heat exchangers

Several factors need to be considered during the design of air-cooled heat exchangers. These include the heat duty, process fluid characteristics, ambient conditions, and available space. The heat duty determines the size and number of heat exchanger tubes required, while the process fluid characteristics dictate the choice of materials and tube configurations. Ambient conditions, such as temperature, humidity and wind speed, affect the overall performance of the heat exchanger. Additionally, the available space influences the selection of the appropriate heat exchanger type and layout. ACHEs find widespread use in various industries due to their versatility and efficiency. They are commonly employed in power plants to cool condenser water, in refineries to cool process fluids, and in chemical plants to remove heat generated during chemical reactions (Salimpour & Bahrami, 2011). Other applications include cooling of compressed air, gas turbines, and engine radiators. The ability of air-cooled heat exchangers to operate in remote locations without the need for water sources makes them particularly suitable for offshore platforms, remote power stations, and desert environments.

#### **d. Plate-fin heat exchanger**

Among the different types of heat exchangers, plate-fin heat exchangers have gained significant attention due to their compact design, high thermal efficiency, and versatility. As shown in Figure 4, plate-fin heat exchangers are widely used in various industries due to their high heat transfer efficiency and compact size. This type of heat exchanger consists of a series of parallel plates, which are finned on both sides to increase the heat transfer surface area. The fins create turbulence in the fluid flow, enhancing the heat transfer process (Xue et al., 2018). Plate-fin heat exchangers are commonly employed in applications where space is limited, such as aerospace, cryogenics, and chemical processing industries. One of the main advantages of plate-fin heat exchangers is their high heat transfer coefficient. The fins increase the effective surface area available for heat transfer, allowing for efficient heat exchange between the two fluids. This results in a compact design, as a larger heat transfer area can be achieved within a smaller footprint compared to other types of heat exchangers. Another benefit of plate-fin heat exchangers is their ability to handle a wide range of operating conditions. The design of the fins can be customized to meet specific requirements, such as high-pressure applications or low-temperature environments (Khan & Li, 2017). Additionally, plate-fin heat exchangers can be easily modified or expanded by adding or removing plates, making them versatile and adaptable to changing process conditions. Plate-fin heat exchangers also offer improved heat transfer performance for fluids with low thermal conductivity, such as gases or highly viscous liquids. The fins disrupt the boundary layer near the surface, promoting convective heat transfer and reducing the thermal resistance. This allows for efficient heat exchange even with fluids that have poor heat transfer properties (Aliabadi & Hormozi, 2013). Despite their numerous advantages, plate-fin heat exchangers also have some limitations. One limitation is the potential for fouling, especially in applications involving dirty or corrosive fluids. The narrow channels between the plates can easily become clogged, reducing the heat transfer efficiency and increasing the pressure drop. Regular maintenance and cleaning are necessary to prevent fouling and ensure optimal performance.

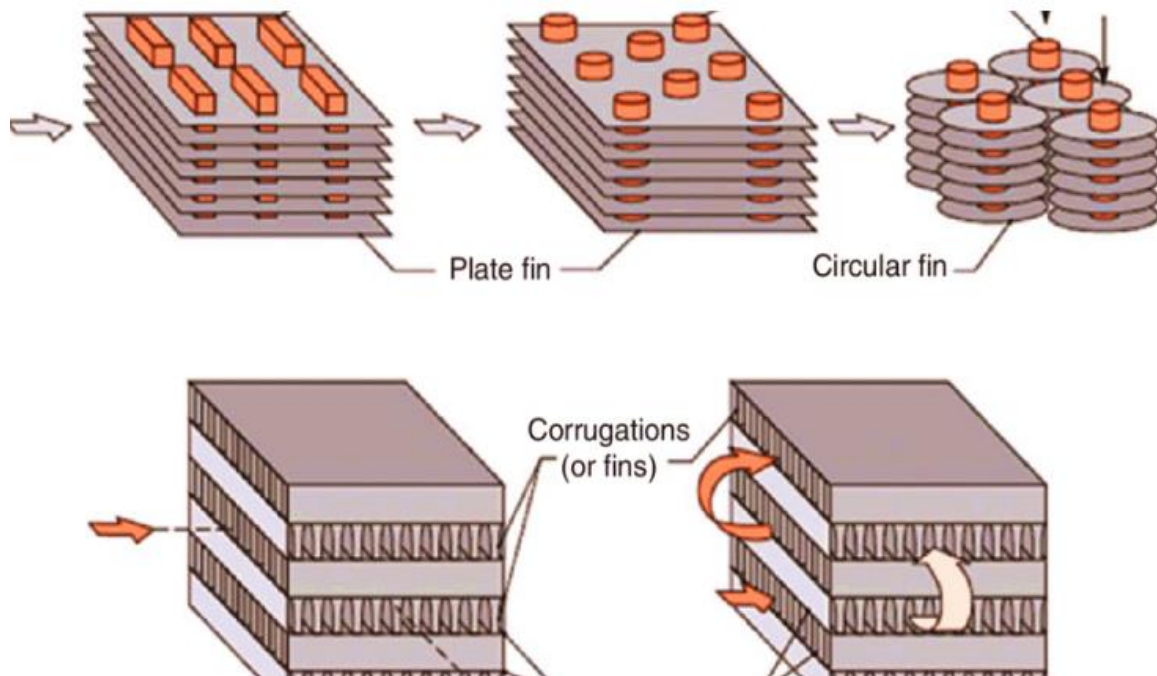


Figure 4: Plate-fin heat exchanger (Haider et al., 2021)

### e. Open-Flow in Heat Exchangers

Over the years, advancements in heat exchanger design have led to the development of open-flow configurations, which offer enhanced performance and flexibility. Open-flow heat exchangers possess several notable characteristics that make them advantageous in various applications. Firstly, their design allows for better control over the flow rates of both the hot and cold fluids, enabling precise temperature control (Reid et al., 1998). Additionally, open-flow heat exchangers have lower pressure drops compared to closed-flow configurations, resulting in reduced energy consumption. Moreover, open-flow designs offer greater flexibility in terms of scalability, maintenance, and cleaning, making them suitable for a wide range of industrial processes. Open-flow heat exchangers offer numerous advantages over traditional closed-flow configurations.

- i. Firstly, their enhanced heat transfer efficiency ensures optimal utilization of the available surface area, leading to improved thermal performance. This efficiency is particularly beneficial for applications involving high temperature differentials or limited space.
- ii. Furthermore, open-flow heat exchangers are less prone to fouling, as the flow patterns minimize the accumulation of deposits and contaminants. This characteristic reduces the need for frequent cleaning and maintenance, resulting in cost savings and increased operational uptime (Zhang & Nandakumar, 2019).

Open-flow heat exchangers can be classified into three main types namely: concurrent, counter-current flow and cross and cross/counter flows as illustrated in Figure 5.

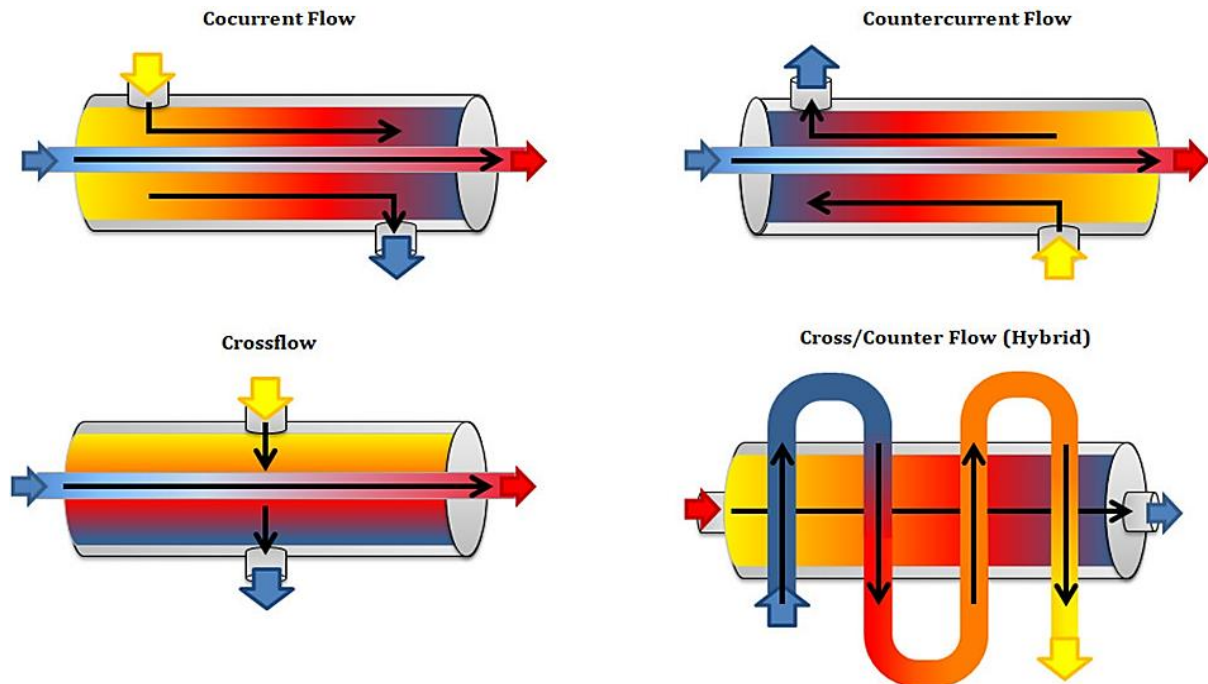


Figure 5: Open-flow in heat exchangers (Ting, 2022).

#### f. Direct Contact Heat Exchangers

As illustrated in Figure 6, direct contact heat exchangers play a vital role in various industrial processes, allowing for efficient heat transfer between two fluids. These heat exchangers operate by bringing the two fluids into direct contact, enabling the transfer of heat from one fluid to another. Direct contact heat exchangers find applications in various industries, including power generation, chemical processing, and desalination plants. In power generation, direct contact condensers are used to cool and condense steam, enhancing the efficiency of the power plant (Tadrist et al., 1985). In chemical processing, direct contact heat exchangers are employed for processes such as absorption, stripping, and scrubbing, where efficient heat transfer is crucial. Moreover, direct contact heat exchangers are utilized in desalination plants to recover waste heat and improve the overall energy efficiency of the process. These heat exchangers can handle corrosive and fouling fluids without the risk of damaging the heat transfer surface (Wang et al., 2017). However, direct contact heat exchangers may require additional equipment, such as pumps or compressors, to achieve the desired fluid flow rates (Master et al., 2006). As shown in Figure 6, the air provided by the blower (1) is heated by the heat source (2). The heated gas enters the entrance of the direct contact exchanger (3) and ascends through a high-efficiency packed bed (4) featuring over 30 square feet per cubic foot of active heat transfer surface area. Cool water is delivered at the top of the unit via a liquid distributor (5), where it engages in intimate countercurrent contact with the heated gas in the packed bed as it descends. Heat transfer occurs between the cooler water and the hot gas, leading to a fast increase in the water's temperature. The heated water flows into the sump chamber (6) and is pumped (7) through a plate and frame or shell and tube heat exchanger (8) to reheat the return heat transfer liquid in

a fully closed-loop cycle. The cleaned, reduced-temperature gas, now saturated with water vapor, emerges out the top of the unit (9).

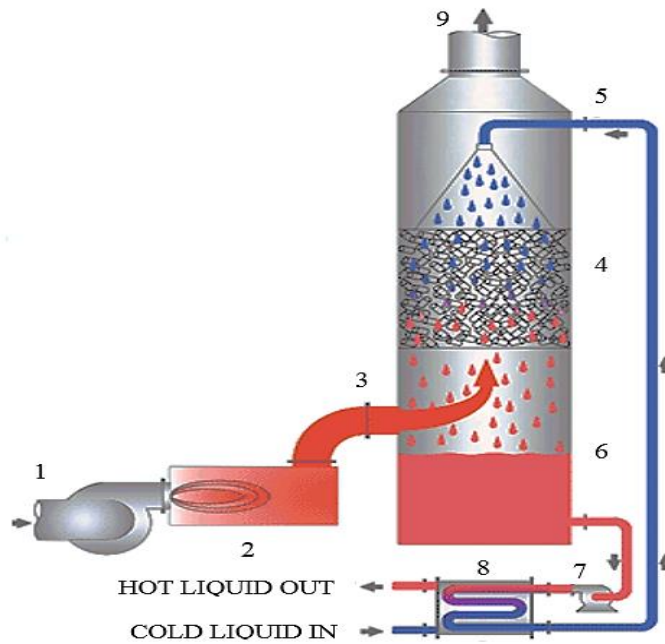


Figure 6: Direct contact heat exchangers

### 5. Factors Affecting the Performance of Industrial Heat Exchangers

The performance and efficiency of industrial heat exchangers are influenced by the following factors which can be affected by their overall performance and effectiveness. The factors include:

- i. The design of the heat exchanger, including the size and shape of the heat transfer surfaces, the flow patterns of the fluids, and the materials used in construction, can significantly impact its efficiency. A well-designed heat exchanger will have a larger surface area for heat transfer, optimized flow patterns to maximize heat exchange, and materials that are resistant to corrosion and fouling (Javadi et al., 2019).
- ii. Over time, heat exchangers can become fouled with dirt, scale, and other contaminants, which can reduce their efficiency. Regular cleaning and maintenance of heat exchangers are essential to ensure optimal performance. In addition, the choice of cleaning methods and chemicals can also impact the efficiency of the heat exchanger (Reay, 2002).
- iii. The flow rates of the fluids passing through the heat exchanger are also critical in determining its performance. Proper flow rates are necessary to ensure efficient heat transfer and prevent fouling. The velocity and turbulence of the fluids can affect the heat transfer coefficient and overall efficiency of the heat exchanger. It is important to carefully control the flow rates and ensure that they are within the recommended range for optimal performance (Reppich, 1999).
- iv. The temperature differentials between the hot and cold fluids in the heat exchanger also play a significant role in its efficiency. Larger temperature differentials can result in higher heat transfer rates and improved performance. However, extreme temperature

differentials can also lead to thermal stresses and reduced efficiency. It is important to carefully monitor and control the temperature differentials to ensure optimal performance of the heat exchanger (Lestina & Bell, 2001).

By carefully considering and optimizing these factors, industrial heat exchangers can achieve maximum efficiency and effectiveness in cooling equipment.

## **6. Components of Industrial Heat Exchangers**

The various components of industrial heat exchangers for equipment cooling are as follows:

- i. The heat transfer surface: This surface is typically made of metal, such as copper or aluminum, and is designed to maximize the heat transfer between the two fluids. The heat transfer surface is usually composed of a series of tubes or plates, which provide a large surface area for heat exchange to occur. The efficiency of the heat transfer surface is crucial in ensuring that the equipment is cooled effectively (Stehlík & Wadekar, 2002).
- ii. The heat exchanger core: This core is responsible for directing the flow of the two fluids through the heat exchanger, ensuring that they come into contact with each other for efficient heat transfer. The design of the heat exchanger core plays a significant role in determining the overall performance of the heat exchanger (Mahmoudinezhad et al., 2023).
- iii. The inlet and outlet connections: The inlet and outlet connections allow for the easy flow of the fluids through the heat exchanger.
- iv. The housing: The housing provides a protective enclosure for the heat exchanger components.
- v. The insulation: Insulation is also important in preventing heat loss and ensuring that the heat exchanger operates efficiently (Shah et al., 2020).

The various components of an industrial heat exchanger work together to ensure that equipment is cooled effectively and efficiently. By maximizing heat transfer between the two fluids, these components play a crucial role in maintaining the temperature of the equipment within a safe operating range. Industrial heat exchangers are essential for the smooth operation of equipment in various industries, and their components are carefully designed to ensure optimal performance.

## **7. Consideration Criteria for Designing Industrial Heat Exchangers**

The key consideration criteria for designing industrial heat exchangers for equipment cooling are presented as follows:

- i. The first step in designing industrial heat exchangers for equipment cooling is to determine the heat load that needs to be dissipated: This involves calculating the amount of heat generated by the equipment during operation. This information is essential for selecting the appropriate size and type of heat exchanger to effectively dissipate the heat (Rao et al., 2020).

- ii. The operating temperature range of the equipment: The heat exchanger must be able to maintain the equipment within the specified temperature limits to prevent overheating and potential damage. This criterion will influence the selection of materials and design features of the heat exchanger (Ghalandari et al., 2021).
- iii. The flow rate and pressure drop requirements of the cooling system: The heat exchanger must be designed to accommodate the required flow rate while minimizing pressure drop to ensure efficient heat transfer. This criterion will determine the size and configuration of the heat exchanger (Alam et al., 2000).
- iv. The type of heat exchanger is also a crucial consideration criterion in the design process: There are various types of heat exchangers available, such as shell and tube, plate, and finned tube heat exchangers. The selection of the appropriate type will depend on factors such as space constraints, heat transfer efficiency, and maintenance requirements.
- v. The material selection for the heat exchanger is an essential criterion in the design process. The material must be compatible with the operating conditions, corrosion-resistant, and have good thermal conductivity to ensure long-term performance and reliability (Ali et al., 2020).

Designing industrial heat exchangers for equipment cooling requires careful consideration of several criteria. By following the aforementioned approach and considering factors such as heat load, operating temperature range, flow rate, pressure drop, type of heat exchangers, and material selection, heat exchangers can be effectively designed for equipment cooling applications.

## **8. Applications of Industrial Heat Exchangers**

The applications of industrial heat exchangers for equipment cooling are numerous and diverse, ranging from cooling of electronic components in data centers to cooling of machinery in manufacturing plants. Some of the key applications of industrial heat exchangers for equipment cooling are highlighted as follows:

- i. Data centers: Data centers house a large number of servers and other electronic components that generate a significant amount of heat during operation. In order to prevent overheating and ensure the proper functioning of these components, industrial heat exchangers are used to dissipate the heat generated. By circulating cool air or liquid through the heat exchangers, the excess heat is transferred away from the equipment, thereby maintaining optimal operating temperatures (Capozzoli & Primiceri, 2015).
- ii. The manufacturing industry: Machinery used in manufacturing processes often generate heat due to friction and other factors. This heat can lead to decreased efficiency and even damage to the equipment if not properly managed. Industrial heat exchangers are used to remove this excess heat and maintain the temperature of the equipment within safe limits (Musgrove et al., 2017). By using heat exchangers, manufacturers can ensure the smooth operation of their machinery and prevent costly downtime due to overheating.
- iii. In addition to data centers and manufacturing plants, industrial heat exchangers are also used in a variety of other applications for equipment cooling. These include cooling of



engines in vehicles, cooling of compressors in refrigeration systems, and cooling of turbines in power plants. In each of these applications, industrial heat exchangers play a critical role in maintaining the temperature of equipment within acceptable limits, thereby ensuring optimal performance and longevity (Li et al., 2011).

The applications of industrial heat exchangers for equipment cooling are vast and varied. From data centers to manufacturing plants to power plants, these heat exchangers play a crucial role in maintaining the temperature of equipment within safe limits. By using industrial heat exchangers, industries can ensure the proper functioning of their equipment and prevent costly downtime due to overheating.

### **9. Advantages of Industrial Heat Exchangers for Equipment Cooling**

Some of the primary advantages of industrial heat exchangers for equipment cooling are as follows:

- i. Their efficiency in transferring heat: These devices are specifically designed to maximize heat transfer between fluids, ensuring that equipment remains at a consistent and safe operating temperature. This efficiency not only helps to prevent overheating and potential damage to machinery but also improves overall equipment performance and longevity (Anxionnaz et al., 2008).
- ii. Their versatility: These devices can be customized to suit the specific cooling requirements of different types of equipment and industries. Whether it is a small-scale operation or a large industrial plant, heat exchangers can be tailored to meet the unique cooling needs of each application. This flexibility makes them an essential component in a wide range of industries, including manufacturing, power generation, and chemical processing (Zaheed & Jachuck, 2004).
- iii. They are cost-effective solutions for equipment cooling: By efficiently transferring heat between fluids, these devices help to reduce energy consumption and operating costs. This not only leads to significant savings for businesses but also contributes to a more sustainable and environmentally friendly operation.
- iv. In addition to their efficiency and cost-effectiveness, industrial heat exchangers also offer the benefit of compact design. These devices are typically designed to be space-efficient, making them ideal for installations where space is limited. Their compact size allows for easy integration into existing equipment and systems, without compromising on performance or cooling capacity (Kew & Reay, 2011).

Industrial heat exchangers are essential components for equipment cooling in various industries. Their efficiency, versatility, cost-effectiveness, and compact design make them indispensable for maintaining optimal operating temperatures and ensuring the longevity of machinery and equipment. Businesses that invest in industrial heat exchangers can expect improved performance, reduced energy consumption, and overall cost savings.



## **10. Disadvantages of Industrial Heat Exchangers for Equipment Cooling**

While industrial heat exchangers offer several advantages, such as efficient heat transfer and cost-effectiveness, there are also several disadvantages and limitations associated with their use. These includes:

- i. Heat exchangers have a finite capacity for heat transfer, which means that they may not be able to adequately cool equipment that generates a large amount of heat. This can lead to overheating and potentially damage to the equipment, resulting in costly repairs or replacements (Sousa et al., 2014).
- ii. Their susceptibility to fouling: Fouling occurs when contaminants, such as dirt, debris, or scale, build up on the heat exchanger surfaces, reducing their efficiency. This can lead to decreased heat transfer rates and increased energy consumption, ultimately impacting the overall performance of the cooling system (Bott et al., 1999).
- iii. Industrial heat exchangers can be prone to corrosion: Especially in harsh operating environments. Corrosion can weaken the heat exchanger materials, leading to leaks and potential system failures. Regular maintenance and monitoring are required to prevent corrosion and ensure the longevity of the heat exchanger Kartal, M. A. (2024).
- iv. Industrial heat exchangers can be bulky and require a significant amount of space for installation: This can be a challenge in industries where space is limited or where equipment needs to be compactly arranged. Additionally, the installation and maintenance of heat exchangers can be complex and time-consuming, requiring skilled personnel and specialized equipment.

While industrial heat exchangers are commonly used for equipment cooling in various industries, they also have several disadvantages and limitations that need to be considered. It is important for industries to carefully evaluate these factors and consider alternative cooling solutions to ensure the efficient and reliable operation of their equipment.

## **11. Future Trends in Industrial Heat Exchangers for Equipment Cooling**

Industrial heat exchangers play a crucial role in equipment cooling in various industries. As technology continues to advance, the future trends in industrial heat exchangers are expected to evolve to meet the growing demands for efficient and sustainable cooling solutions. Some of the key future trends in industrial heat exchangers for equipment cooling are presented as follows:

- i. The development of more compact and efficient designs: With the increasing demand for smaller and more energy-efficient equipment, heat exchangers need to be designed to take up less space while still providing effective cooling. This trend is driven by the need to optimize space utilization in industrial settings and reduce energy consumption (Patel, 2023).
- ii. The use of advanced materials and coatings: These materials and coatings can improve the heat transfer efficiency of the exchangers, leading to better cooling performance. Additionally, advanced materials can also enhance the durability and longevity of the heat exchangers, reducing maintenance costs and downtime.

- iii. The integration of smart technologies and automation in industrial heat exchangers is another key trend to watch out for in the future: By incorporating sensors, actuators, and control systems, heat exchangers can be optimized for better performance and energy efficiency. This trend is in line with the broader industry shift towards Industry 4.0 and the Internet of Things, where interconnected devices and systems enable more intelligent and automated operations (Ahmed et al., 2023).
- iv. Sustainability: This is becoming an increasingly important consideration in the design and operation of industrial heat exchangers. As companies strive to reduce their environmental footprint and comply with regulations, heat exchangers are being developed with a focus on energy efficiency and reduced emissions. This trend is expected to continue in the future, with heat exchangers playing a key role in helping industries achieve their sustainability goals (Aquaro & Pieve, 2007).

The future trends in industrial heat exchangers for equipment cooling are driven by the need for more compact, efficient, and sustainable solutions. By embracing advanced materials, smart technologies, and a focus on sustainability, heat exchangers can continue to play a critical role in ensuring the reliable and efficient operation of industrial equipment. As technology continues to advance, it is important for companies to stay abreast of these trends and invest in innovative heat exchanger solutions to meet their cooling needs.

## **12. Conclusion and Recommendation**

Industrial heat exchangers are vital components in equipment cooling systems, and their design, flow rate and maintenance all play a crucial role in their performance. It is evident that the design and material of the heat exchanger significantly impact its performance. The design of the heat exchanger, including the size and shape of the tubes, fins and overall structure, plays a crucial role in determining its efficiency in cooling equipment. Also, the flow rate and temperature of the cooling fluid also play a critical role in the performance of heat exchangers. It is essential to ensure that the flow rate is optimized to maximize heat transfer while minimizing energy consumption. Additionally, maintaining the temperature of the cooling fluid within a specific range is crucial to prevent overheating of the equipment. Furthermore, regular maintenance and cleaning of heat exchangers are essential to ensure their optimal performance. Over time, heat exchangers can accumulate dirt, debris, and scale, which can reduce their efficiency in cooling equipment. Therefore, it is essential to implement a regular maintenance schedule to clean and inspect heat exchangers to ensure they operate at peak performance. By understanding these factors and implementing best practices in heat exchanger selection and maintenance, industrial facilities can ensure the efficient operation of their equipment and prolong its lifespan. Based on the findings from this study on the following recommendation are suggested to improve the efficiency and effectiveness of industrial heat exchangers for equipment cooling:

- i. It is recommended to carefully consider the design and size of the heat exchanger to ensure that it is suitable for the specific cooling requirements of the equipment. This includes taking into account factors such as the heat load, flow rate, and temperature range of the equipment being cooled. By selecting the right size and design of the heat

exchanger, it can operate more efficiently and effectively in maintaining the desired temperature levels.

- ii. Regular maintenance and cleaning of industrial heat exchangers are essential to ensure optimal performance. Over time, heat exchangers can accumulate dirt, debris, and other contaminants that can reduce their efficiency. By implementing a regular maintenance schedule and cleaning routine, the heat exchangers can operate at peak performance levels and prolong their lifespan.
- iii. It is recommended to consider the use of advanced materials and technologies in the construction of industrial heat exchangers. Materials such as stainless steel, titanium, and copper offer superior heat transfer properties and corrosion resistance, which can improve the overall performance and durability of the heat exchangers. Furthermore, incorporating advanced technologies such as micro-channel heat exchangers or heat exchanger coatings can enhance the efficiency and effectiveness of the cooling process.
- iv. It is important to consider the environmental impact of industrial heat exchangers and choose eco-friendly options whenever possible. By selecting heat exchangers that are energy-efficient and have low environmental impact, industries can reduce their carbon footprint and contribute to sustainability efforts.

By following these recommendations, industries can improve the efficiency and effectiveness of their equipment cooling systems and ensure optimal performance of their heat exchangers.

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# **A COMPREHENSIVE ANALYSIS OF PHYSICAL AND CHEMICAL VAPOR DEPOSITION METHODS FOR ADVANCED HARD COATINGS IN CUTTING TOOLS**

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## **Abstract:**

This comprehensive review explores the role of physical vapor deposition (PVD) and chemical vapor deposition (CVD) techniques in producing high-performance hard coatings for cutting applications. The study focusses on the properties, characteristics, and synthesis-structure-property relationships of various PVD and CVD coatings, including nitrides, carbides, carbonitrides, borides, boronitrides, and oxides. The advantages and limitations of these coatings are discussed. Also, the survey explores the benefits of multilayers in the hard coatings, which combine desirable properties from multiple layers, enhancing mechanical and chemical properties. The recent studies that shaped the field are highlighted, along with modern-trends in hard coating research, such as the development of nanostructured coatings. Additionally, the review identifies future challenges faced by the hard coatings manufacturing, included the need for multifunctional coatings with enhanced wear resistance, hardness, improved the estimate service time for coated cutting-tools, and reduced the oxidation damage.

**Keywords:** Hard coatings, Cutting tools, Physical vapor deposition (PVD), Chemical vapor deposition (CVD), Machining performance, Multilayer coatings

## **1. Introduction**

### **1.1. Background on the use of hard coatings in cutting applications**

The development of hard coatings for cutting applications is crucial for improving machining processes. The industry's need for multifunctional hard coatings with enhanced resistance to cracking, advanced thermal endurance, and improved wear resistance at high temperatures is increasing [1]. There is also a trend towards higher cutting speeds and reduce the use of coolants. Advanced characterization methods have enabled the design of tailored multifunctional properties in hard coatings, creating opportunities for integrating theoretical and experimental approaches to drive future developments [2].

Research focusing on material preparation processing, structural, mechanical, and tribological properties of hard coatings is essential for adjusting their performance according to specific service conditions [3]. By addressing these aspects, hard coatings can significantly contribute to prolonging tool lifespan, reducing production costs, and ensuring reliable operation of workpieces across diverse industrial applications. The future challenges for the hard coatings community revolve around optimizing coating materials, structures, and processing techniques to meet evolving industrial demands. Embracing these challenges and capitalizing on advancements in material science and engineering technologies holds promise for the development of next-generation hard coatings that enhance cutting tools' performance while driving sustainable growth in manufacturing processes [4].

### **1.2. Importance of physical and chemical vapor deposition in coating technology**

Physical and chemical vapor deposition are crucial for hard coatings in cutting applications, offering a wide range of outcomes in terms of microstructure, effectiveness, suitability, and longevity. PVD and CVD are the most effective coating methods, with PVD being adaptable to different applications and CVD offering a coating that is more energy-efficient and environmentally friendly [5].

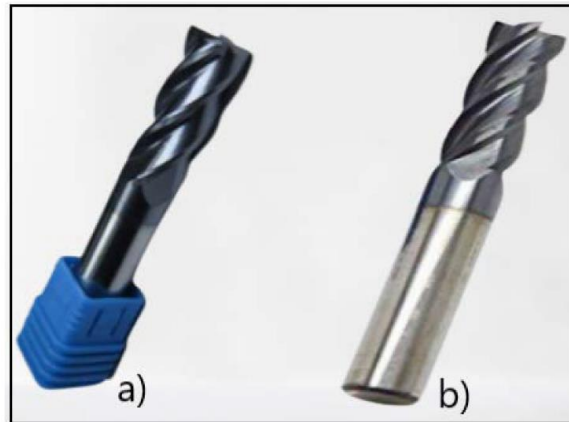
PVD coatings are better for roughing operations, while CVD coatings are more suitable for finishing operations and thicker than PVD. The selection of coating process should consider the type of tools and machining process being used. Various coating combinations have been examined, with TiCN/Al<sub>2</sub>O<sub>3</sub> coating showing exceptional performance when cutting 4340 steel. Multi-layer stacks generally yield superior results compared to single-layered and uncoated tools. In conclusion, physical and chemical vapor deposition (for the cutting tools) are pivotal in providing diverse options suitable for various types of machining processes [6].

## **2. Physical Vapor Deposition (PVD) Coatings**

### **2.1. Overview of PVD coating process**

The utilization of physical vapor deposition (PVD) for hard coatings on cutting tools is an essential technology in the field of machining (as in figure 1). Techniques such as cathodic arc evaporation and magnetron sputtering, along with their hybrid methods, play a key role in creating these coatings. Achieving adhesion strength through processes like plasma etching is critical for the success of PVD coatings [7]. One of the main advantages of PVD is its ability to deposit coatings at lower temperatures compared to CVD, making it suitable for a variety of substrates including steel and cemented carbide tools without compromising their properties.

Additionally, PVD coatings offer benefits such as lower energy consumption, no use of toxic precursors, and the ability to produce different types of coatings. The properties and industrial applications of various PVD techniques are emphasized in this process [8].



**Figure 1:** Uncoated carbide cutting tool (a) and TiAlN-coated carbide cutting tool (b) [8].

## 2.2. Types of PVD coatings used in cutting applications

Two frequently used PVD coatings in cutting tool applications are DLC ta-C (Diamond like carbon and Tetrahedral amorphous-carbon) and CrN. DLC ta-C coatings, are applied through arc deposition. This type of coating is renowned for its exceptional thermal stability, low friction coefficient, and outstanding wear resistance. On the other hand, CrN coatings are deposited using arc deposition or high-power impulse magnetron sputtering (HiPIMS). These coatings demonstrate remarkable compressive strength, making them suitable for operations under varying loads. The selection of specific PVD coatings depends on the unique requirements of the cutting application, such as cutting speed and the material being machined [8].

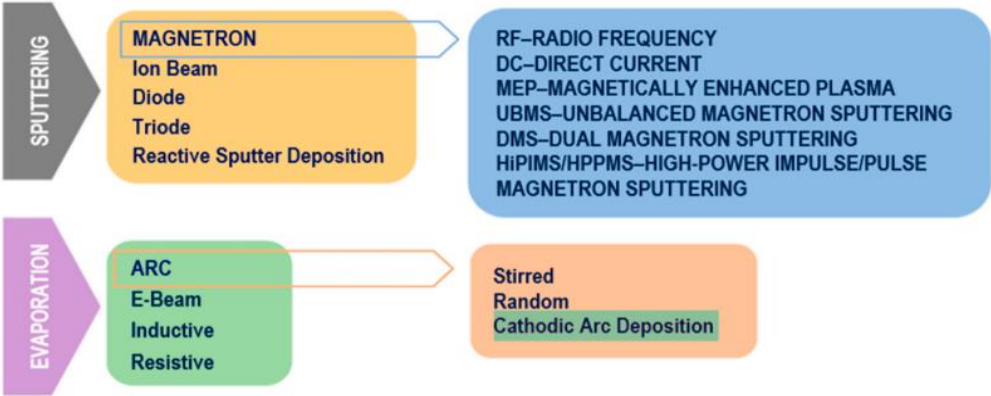
## 2.3. Properties and characteristics of PVD coatings

PVD coatings, or Physical Vapor Deposition coatings, are widely recognized for their exceptional properties that make them well-suited for cutting applications. The deposition process, whether through arc deposition or HiPIMS, plays a critical role in determining the surface morphology and topography of the coatings. Different coatings offer advantages for specific machining processes, with thin PVD coatings being ideal for finishing operations due to their sharp cutting edge and favourable compressive stresses. Recent research has compared the performance of PVD-coated tools with CVD-coated tools, showing that PVD coatings are suitable for finishing operations and result in lower surface roughness [9].

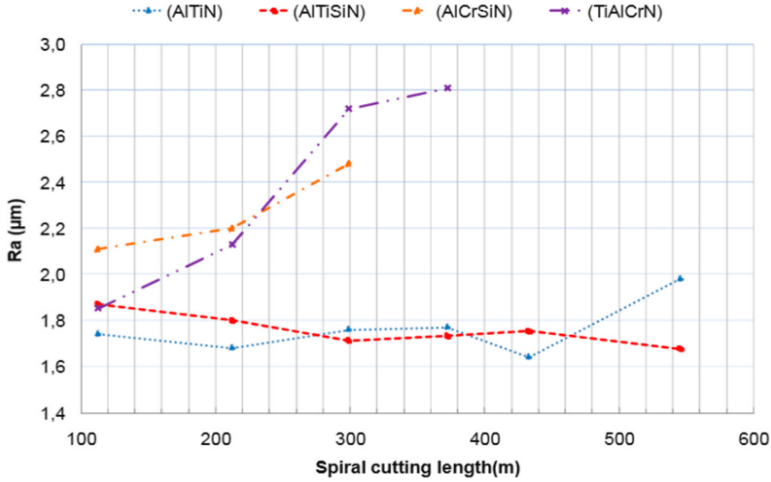
Advancements in hard coating technology have brought about new approaches for depositing thick PVD coatings, expanding their range of applications as we can see in figure 2. Nanolayered and nanocomposite coatings have also been developed to enhance tool performance. The chemical composition, architecture, and deposition method of the coating significantly influence cutting performance, with properties such as hardness, residual stress,

and chemical composition directly impacting wear patterns, chart 1 shows the surface roughness values for different PVD coatings.

PVD coatings offer high hardness, strong adhesion, low friction coefficient, low residual stress, and high chemical stability, making them highly desirable for cutting applications. These properties provide excellent wear resistance, extend tool life, reduce heat generation, improve surface finish, and ensure overall stability during cutting operations [10].



**Figure 2:** Various physical vapor deposition (PVD) techniques that are used currently in the production of advanced coatings [10].

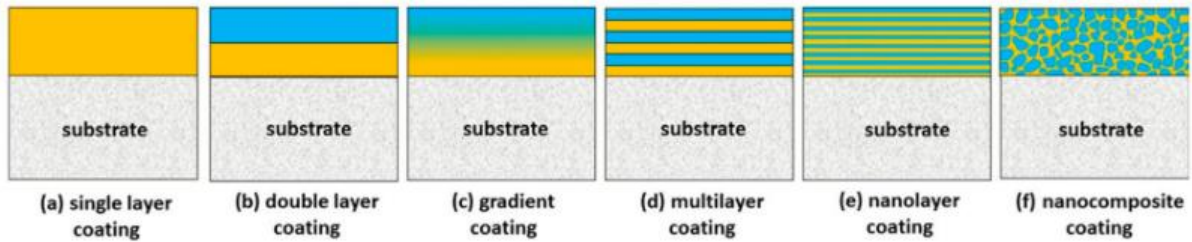


**Chart 1:** Surface roughness values (Ra) for various hard coatings [9].

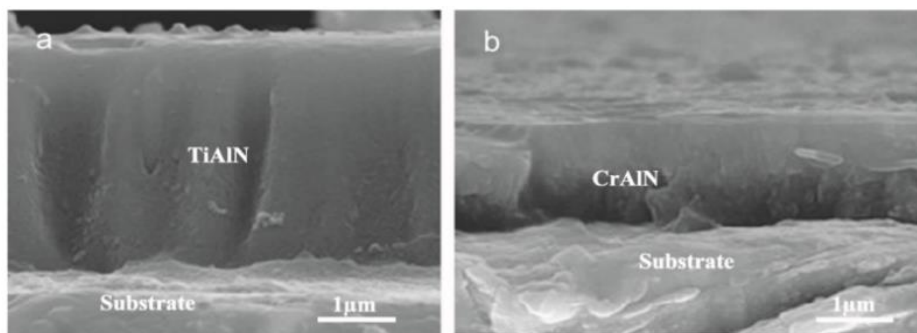
**2.4. Synthesis-structure-property relationships in PVD coatings**

The interplay between synthesis, structure, and properties of PVD coatings is crucial for their effectiveness in cutting applications. Research has focused on correlating synthesis, structure, properties, and application performance. Tool coatings act as a barrier, influencing cutting temperature and machining performance [8]. Multilayer coatings during metal-cutting processes have been extensively studied (as we can see in figure 3), with ions allowing better control of the film-substrate interface. Multi-layered hard coatings with periodic thickness

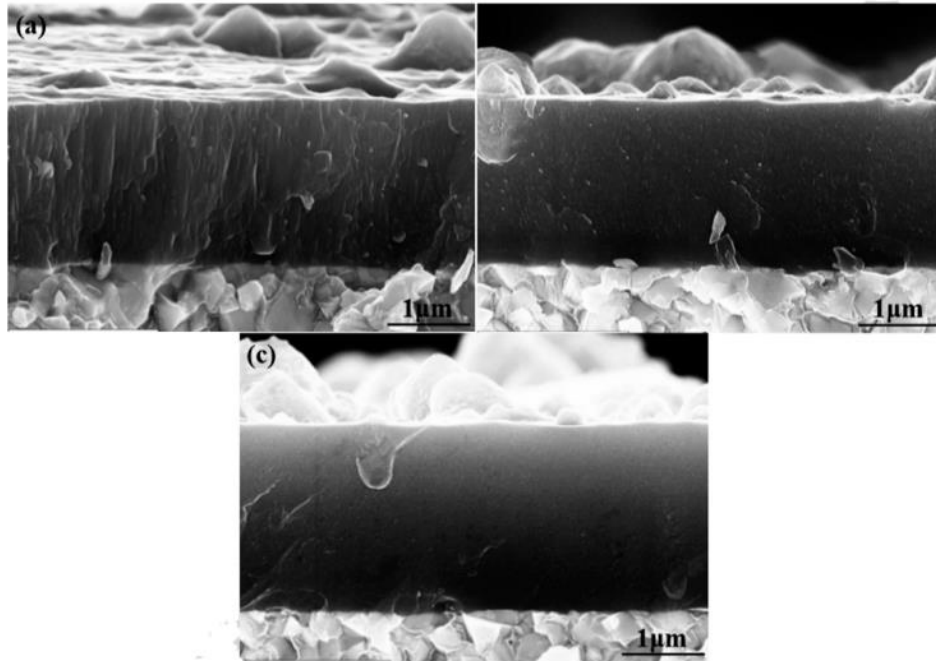
inhibit cracking and enhance fracture resistance. Comparative studies between PVD and CVD coatings show specific advantages for each type, with PVD coatings well-suited for finishing operations and CVD coatings for roughing operations. Various wear patterns emerge on coated cutting tools based on coating properties such as hardness, residual stress, and chemical composition. Advancements in hard coating technology have resulted in nanolayered and nanocomposite coatings that enhance tool performance (as in figure 4 & figure 5). However, challenges remain in improving hard coating technology [9].



**Figure 3:** Various designs of hard coatings [9].



**Figure 4:** a) TiAlN coating microstructure (b) CrAlN coating microstructure [11].

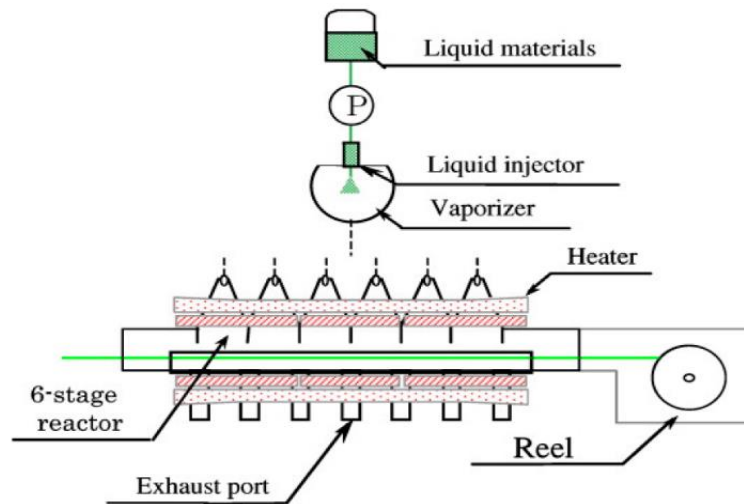


**Figure 5:** a) AlTiN coating microstructure with 0% Ni; (b) AlTiN coating microstructure with 1,5% Ni (c) AlTiN coating microstructure with 3% Ni [11].

### 3. Chemical Vapor Deposition (CVD) Coatings

#### 3.1. Overview of CVD coating process

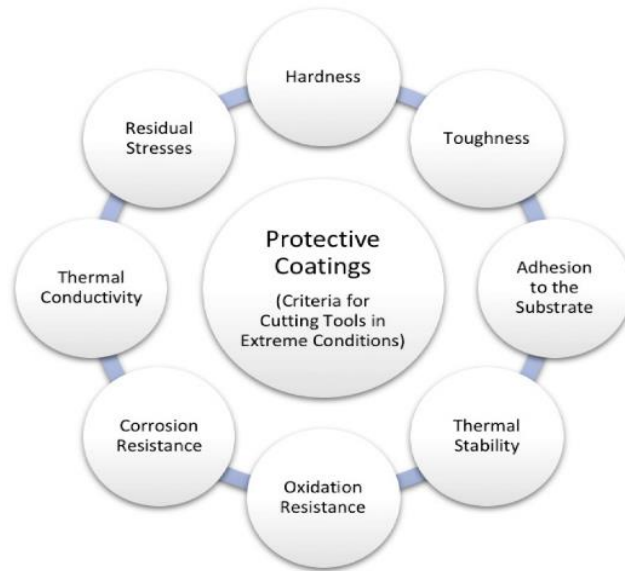
Chemical Vapor Deposition (CVD) is a reliable method for creating hard coatings with high reproducibility (figure 6 shows the operation mechanism). It enhances wear and oxidation resistance, improves thermal stability, and bolsters mechanical properties. The process involves introducing a precursor into a reactor, where the molecules deposit onto the substrate's surface to form a thin, uniform hard film [12]. CVD can produce a wide range of materials, including carbides, nitrides, oxynitrides, silicon-based compounds, carbon-based materials, polymers, graphene, and fibers/nanotubes, with various microstructures. One advantage of CVD is its simplicity using low-cost precursors, but substrates need to be heated up to 900°C, which may not be suitable for temperature-sensitive materials. However, CVD reduces material waste since only the heated area requires coating and can utilize computer-controlled lasers to selectively heat preferred areas. In summary, CVD has unique capabilities for producing hard coatings for cutting applications and holds potential for future advancements through ongoing research efforts [13].



**Figure 6:** Schematic chemical vapor deposition (CVD) setup, mechanical parts, and operation mechanism [13].

### 3.2. Types of CVD coatings used in cutting applications

CVD coatings are widely utilized in cutting applications due to their exceptional ability to provide high hardness, excellent chemical stability, and resistance to high temperature oxidation (as illustrated in figure 7). Various types of CVD coatings, such as AlTiN and AlCrN, are commonly used as protective coatings in cutting applications [9]. The CrMoN coatings have demonstrated remarkable hardness and resistance against plastic deformation, making them well-suited for cutting applications. These coatings also exhibit low friction force and improved wear resistance. The incorporation of Al atoms into the CrN phase has shown promising results in terms of thermal stability and oxidation resistance. Furthermore, multicomponent and multilayer designs are crucial for increasing the hardness of nitride coatings [14]. Boride coatings like MoBC, WBC, and TaBC display excellent fracture resistance and high hardness, making them suitable for high-friction machining operations. Additionally, TiAlN and super-hard ta-C PVD-coated tungsten carbide inserts have shown encouraging results in turning ultra-high-strength aluminum alloys [15].



**Figure 7:** Requirements for the successful protective coatings of cutting tools [16].

### 3.3. Properties and characteristics of CVD coatings

CVD coatings are widely used in cutting applications due to their ability to withstand high temperatures and exhibit qualities such as high hardness, wear resistance, and chemical stability. These coatings are commonly applied to cemented carbide cutting tools, providing the necessary strength and durability for cutting operations [16]. The microstructure of CVD coatings is influenced by the  $C/(C + N)$  ratio, resulting in different grain structures that impact overall performance. Research has shown that adding elements like B or Si can improve the hardness and microstructure of CVD coatings, enhancing their performance during cutting tests. The chemical composition of quaternary TiBCN coatings also plays a significant role in their performance during cutting tests, emphasizing the importance of understanding how different elements interact within these coatings. Recent advancements in CVD coating technology have significantly improved their mechanical properties and microstructure, making them essential for the development of cutting tools for various machining operations [17].

### 3.4. Synthesis-structure-property relationships in CVD coatings

Understanding CVD coatings is crucial for maximizing their effectiveness in cutting applications. Factors like carbon-to-nitrogen ratio and boron incorporation affect the structure and mechanical properties of these coatings. For example, high nitrogen content results in a globular structure, while high carbon content leads to columnar grains in CVD TiCN coatings. CVD TiBCN coatings are influenced by defects, and the presence of boron increases hardness. Residual stresses significantly impact the properties of CVD coatings, with compressive stresses enhancing mechanical properties and adhesion. Shot peening has been identified as a method to seal cracks and prevent crack initiation and propagation in CVD coatings [17]. Efforts to develop more complex coatings, such as multilayer and gradient variations, aim to improve heat dissipation during tool heating. Plasma-assisted chemical vapor deposition (PACVD) shows promise as a process that combines the strengths of both CVD and PVD



coating techniques, resulting in coating formation at lower temperatures. In conclusion, understanding the synthesis-structure-property relationships in CVD coatings is crucial for optimizing their performance in cutting applications. Microstructure, residual stresses, and coating architecture all play pivotal roles in determining the characteristics and behavior of these coatings during metal-cutting processes [18].

#### 4. Comparison between PVD and CVD Coatings for Cutting Applications

##### 4.1. Advantages and disadvantages of PVD coatings

PVD coatings offer numerous benefits for cutting applications, including superior adhesion to substrates, prolongs tool lifespan, and improves surface finish quality. Research shows that PVD-coated tools outperform uncoated tools, particularly in finishing operations [19]. They are also compatible with steel substrates and carbide tools without impacting their properties, and do not require toxic precursors or excessive energy consumption. However, some drawbacks include potential failure issues under certain conditions and a more brittle performance compared to CVD coatings. Additionally, PVD coatings may experience more intense wear than CVD multilayer coatings in similar machining conditions as shown in table 1. Overall, while PVD coatings offer significant advantages, they also have limitations that should be considered [20].

**Table 1:** Various wear behaviour and tool-life for different coating designs [21].

Coating Design	Wear Behavior	Tool Life
Monolayer Coating	Abrasive wear, Adhesive wear, Coating delamination/destruction	Medium tool life
Multilayer Coating	Abrasive wear, Adhesive wear, Coating delamination	High tool life
Nanostructured Coating	Abrasive wear, Adhesive wear	Very high tool life
Diamond Coating	Abrasive wear, Adhesive wear	Very high tool-life

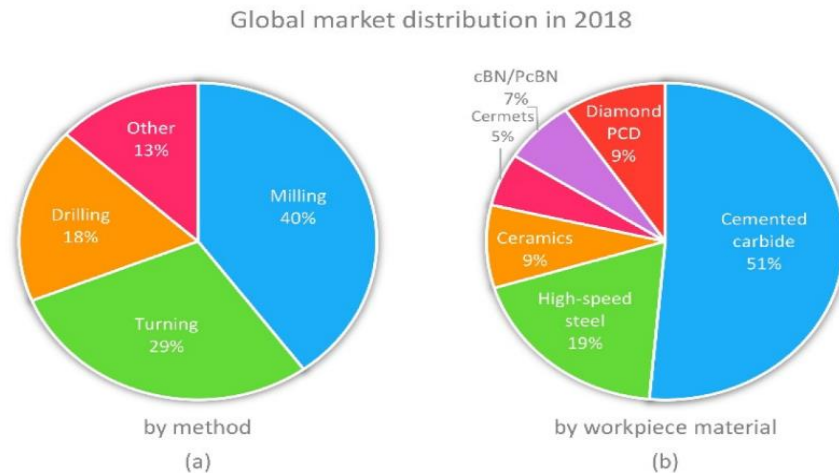
##### 4.2. Advantages and disadvantages of CVD coatings

CVD coatings have advantages like high chemical stability and strong adhesion for cutting applications, but they also cause environmental pollution. PVD coatings are gaining popularity due to their lower process temperature, environmental friendliness, and ability to control composition and structure. They offer high hardness, chemical stability, and resistance to high temperatures and oxidation, as well as a wider range of material classes. When choosing between CVD and PVD coatings for cutting applications, it's important to consider the specific machining requirements and environmental impact [22].

##### 4.3. Key differences in performance between PVD and CVD coatings

PVD and CVD coatings for cutting applications show distinct performance differences due to factors such as chemical composition, architecture, and deposition method. Research has established relationships between synthesis, structure, properties, and application performance for both types of coatings. Recent studies have compared the wear patterns of coated cutting tools, showing that thin PVD coatings are best for high-quality finishes, while CVD coatings

excel in roughing operations. Understanding wear mechanisms is crucial in comprehending how coatings develop wear patterns over time [23]. Comparative research has revealed that coating hardness, residual stress, and chemical composition directly impact wear patterns. PVD coatings offer enhanced high-speed performance and resistance to abrasive wear, while CVD coatings provide superior oxidation resistance at high temperatures. The incorporation of multiple layers influences coating properties, leading to reduced wear compared to uncoated tools. It is essential to understand these distinctions to optimize machining processes and improve tool longevity [24]. Figure 8 shows the cutting tool global market distribution by cutting technology.



**Figure 8:** Cutting tool global market distribution by cutting technology (a) and by workpiece material (b) as presented by Dedalus Consulting [16].

## 5. Material Classes Used in Hard Coatings for Cutting Applications

### 5.1. Nitrides

Hard coatings for cutting tools often utilize nitrides as a common material class. Examples of nitride coatings include TiN, TiAlN, CrN, ZrN, TiSiN, TiAlSiN, CrAlN, TiAlCrN, and cBN. These coatings offer a range of benefits in cutting applications, such as high hardness and resistance to wear [23]. Nitride coatings are frequently used in bi- or multilayer stacks to further enhance their performance and durability. They can be applied to tool steel with strong adhesive capabilities and are particularly effective in high friction machining operations like micro milling. Additionally, these coatings contribute to improving the efficiency of the milling process by providing higher material removal rates (MRR) and better surface finishes. Ongoing research continues to explore the optimal conditions for machining different materials using nitride coatings and comparing different types of nitride coatings with various structures or coating methods [25].

### 5.2. Carbides

Cemented carbides are commonly used in hard coatings for cutting tools, applied through PVD or CVD methods. These coatings improve tool longevity and effectiveness. Advancements in CVD coatings like TiAlN and TiSiCN have enhanced cutting performance, surpassing previous

generations. Studies show that ZrCN exhibits better strength and plasticity than TiCN-coated inserts, indicating superior cutting performance. Challenges facing the hard coatings community include improving thermal control, environmental friendliness, and resource conservation. Ongoing research and development are needed to address these limitations. Overall, cemented carbides are crucial for hard coatings in cutting applications, and recent advancements in CVD coatings show promise for enhancing cutting tool performance [26].

### **5.3. Carbonitrides**

Carbonitrides are essential hard coatings used in cutting applications, applied through PVD or CVD. They offer high hardness, low friction, and strong adhesion. TiCN coatings are self-lubricating but may have limitations in high-temperature cutting. In contrast, ZrCN coatings have shown improved performance in wet milling of cast iron, suggesting better cohesive strength and plasticity. Research on CVD ZrN and ZrC coatings indicates potential for enhanced machining performance due to lower friction and higher hardness. Adjusting CVD deposition parameters can influence the microstructure of carbonitride coatings, with higher temperatures resulting in smoother and denser coatings. Overall, carbonitride coatings have the potential to improve tool life and performance in cutting applications [27].

### **5.4. Borides**

Boride coatings are important for tough cutting applications due to their exceptional hardness, wear resistance, and high adhesion to the substrate. They are often used in bi- or multilayer stacks to improve performance, and their microstructure determines their suitability for different cutting tasks. Recent studies have highlighted the advantages of boride coatings in providing protection against wear and corrosion in challenging cutting environments. However, there are still challenges in improving adhesion strength to the substrate and resistance to oxidation at high temperatures. Overall, while boride coatings show promise for cutting applications, further research is needed to optimize their performance and address current challenges [28].

### **5.5. Boronitrides**

Boronitrides are tough coatings used in cutting applications, applied through physical vapor deposition (PVD) or chemical vapor deposition (CVD). They offer high hardness, low friction coefficient, and strong adhesion to substrates, ideal for high-speed machining and extending tool life in dry machining. The addition of boron enhances resistance to oxidation at high temperatures, making them suitable for demanding cutting processes. Recent research is focused on developing nanocomposite boronitride coatings with improved mechanical properties and wear behavior, as well as exploring the impact of layer thickness on performance and cutting behavior. Advances in mapping technologies have provided valuable insights into microstructure and defects, leading to enhancements in corrosion resistance [29].

Future challenges include enhancing environmental sustainability by optimizing coating processes to reduce energy consumption and developing more eco-friendly deposition methods. Addressing cost and scalability issues will be crucial for widespread adoption in industrial

applications. Boronitride coatings show promise for improving tool life and machining quality in high-speed cutting applications, with ongoing research efforts focused on further enhancing their performance characteristics [30].

## **5.6. Oxides**

$\text{Al}_2\text{O}_3$ , a commonly used oxide coating in cutting applications, provides improved corrosion resistance and enhanced wear performance. This type of oxide coating is well-known for its ability to protect against wear and corrosion. Additionally, diamond-like carbon (DLC) coatings have demonstrated effectiveness in reducing friction and minimizing wear rates during machining operations. Combining DLC coatings with tough layers has been shown to enhance their toughness and durability [31]. Research indicates that using DLC-coated tools can result in lower cutting forces and smoother polished surfaces. Moreover, recent advancements in thin-layer deposition technologies have resulted in the development of multilayer coatings with improved tribological properties [32].

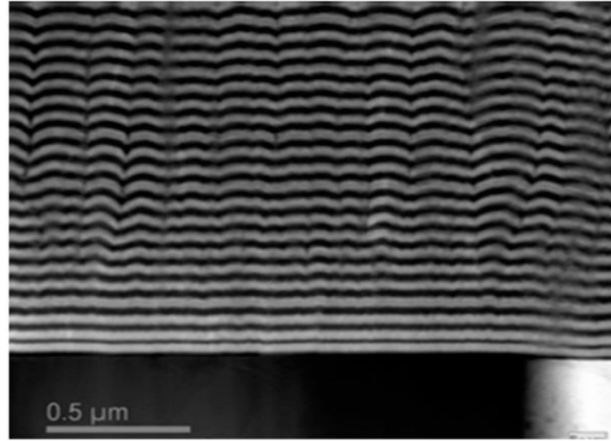
## **6. Multilayer Stacks in Hard Coatings**

### **6.1. Benefits of using multilayer stacks**

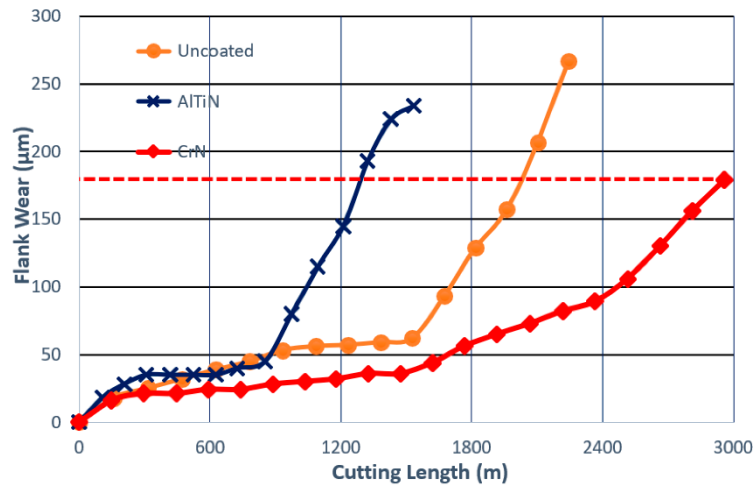
Multilayer coatings, commonly used in cutting tool applications, are known for their hardness, adhesion, and oxidation resistance. Typically composed of nitride or carbide materials and an oxide like TiN or TiC and  $\text{Al}_2\text{O}_3$ , these coatings offer strength, grain size refinement, and chemical resistance, making them practical for cutting. The multi-layered architecture serves as a crack inhibitor and enhances fracture resistance, while carbon in nanocomposite coatings reduces adhesive wear and improves cutting performance. Graded coatings also increase tool life and reduce the use of raw materials, minimizing residual stresses and the risk of coating debonding and delamination [33].

### **6.2. Examples of multilayer stack configurations**

Multilayer coatings have gained attention for cutting applications due to prolonged tool lifespan and improved machining precision. Nanocomposite coatings (figure 12) show increased tool longevity, especially for difficult materials like titanium alloys and structural steel. The presence of thin layers and multiple interfaces in these coatings contributes to their exceptional performance and resistance to crack propagation. Research has also shown that thinner nanolayers exhibit greater tool longevity than thicker ones, highlighting the importance of understanding cutting tool behavior (as illustrated in chart 2) [33]. Multilayer coatings are highly sought after in the machining industry for their resilience and resistance to crack propagation, particularly in turning and milling operations. They consistently outperform conventional monolayer coatings and offer diverse combinations of properties to thwart crack expansion and enhance wear characteristics. Ongoing research into layer thickness and composition continues to improve the performance of multilayer coatings across a wide range of materials and applications [34].



**Figure 12:** CrN/TiAlN nanolayered coating structure [35].

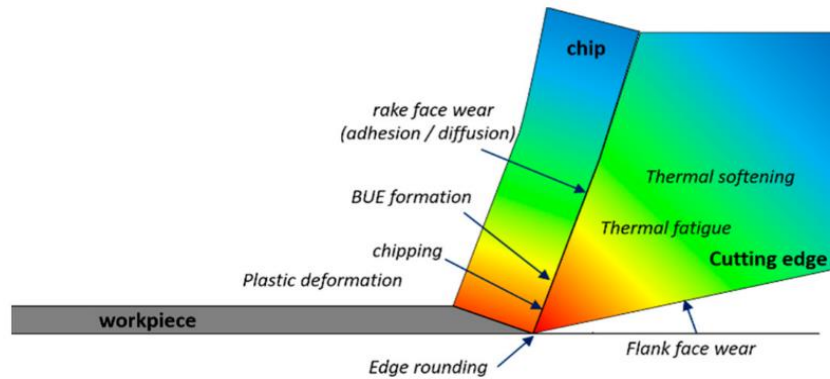


**Chart 2:** Cutting length value during turning for uncoated and coated tools [36].

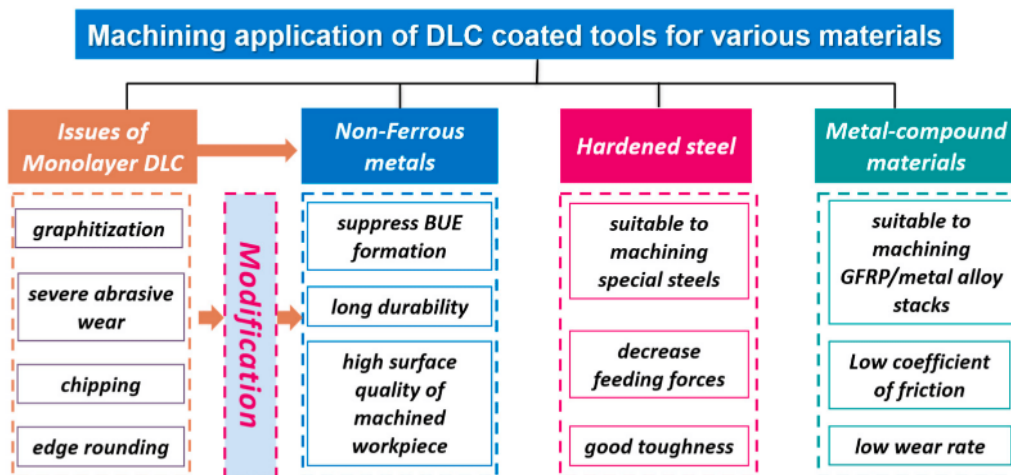
## 7. Pioneering Studies on Hard Coatings for Cutting Applications

### 7.1. Early research on hard coatings

The origins of hard CVD coatings for cutting applications can be traced back to the 1930s when the first TiC was deposited on steel substrates. It wasn't until the 1970s that the term CVD was introduced to differentiate it from PVD. Prof. Richard Kieffer pioneered TiN deposition by CVD in the 1970s, and subsequent research resulted in the development of various other compounds such as Al<sub>2</sub>O<sub>3</sub>, ZrN, Zr(C,N), Ti-Zr-C, TiB<sub>2</sub>, and different Ta<sub>x</sub>C<sub>y</sub> and Cr<sub>x</sub>C<sub>y</sub>-layers. The introduction of TiN and Ti(CN) coatings enabled machines to be utilized to their full potential in metalworking. The development progressed with the introduction of PVD coatings in the 1980s and the control of microstructure in hard coatings. Multilayer stacks were created to enhance cutting tool performance (figure 13), leading to nano-structured coatings blending two phases within one layer. Recent advancements have led to improved performance and emerging trends in hard coating research [37]. Figure 14 shows the machining applications of DLC coated tools for various materials.



**Figure 13:** Schematic illustration of cutting-tool failures [27].



**Figure 14:** Systematic diagram of machining application of DLC-coated tools for various materials [38].

## 7.2. Key findings that shaped the field

Hard coatings for cutting applications have evolved through significant findings and advancements. They are essential to protect tools from high temperatures, oxidation, corrosion, friction, and wear. Studies have focused on improving cutting tool effectiveness, such as HSS drill inserts with  $\text{TiO}_2$  coating, resulting in a 16% longer lifespan. Recent progress has led to major breakthroughs in performance and the creation of high-speed steel cutting tools with improved durability. Comparisons between PVD and CVD coatings have revealed significant differences in their properties and application for cutting tools. Research has also focused on multilayer stacks in hard coatings, showing advantages for enhanced performance. Future challenges include improving technology and addressing current challenges in hard coatings [38].

## **8. Recent Advances in Hard Coating Technology**

### **8.1. Breakthroughs leading to improved performance**

Advancements in hard coating technology have led to the development of nanolayered, and nanocomposite coatings with superior mechanical properties and wear behavior, making them highly attractive for machining operations. Studies have focused on the impact of layer thickness on coating performance and improvements to existing coating architectures. Recent research has explored the incorporation of novel additive elements to monolayered coatings and the creation of nanocomposite coatings with enhanced properties, showing heightened wear resistance when used in machining (turning & milling) operations. The advantages of multilayer stacks in hard coatings have been emphasized for enhancing tool life and machining quality. Overall, these breakthroughs in material classes, pioneering studies, and advancements in PVD and CVD processes are driving improved performance in cutting applications and laying the groundwork for future developments in hard coating technology [37].

### **8.2. Emerging trends in hard coating research**

Recent advancements in hard coating research have focused on developing nanostructured and nanolayered coatings to improve wear resistance, tool lifespan, and cutting performance. This has led to the creation of versatile coatings with enhanced resistance to breakage and efficient heat endurance, particularly beneficial for milling applications and challenging materials. Efforts have also been made to reduce friction in the cutting zone to minimize energy consumption during machining operations [33].

Developers are now emphasizing high-temperature adaptive lubrication to enhance cutting performance, creating tool coatings with the ability to form high-temperature lubricating oxides. Solid lubrication has shown benefits for energy and cost savings in dry machining operations enabled by hard coatings.

Complex architectural coatings, including multilayer and gradient types, are being developed to improve heat dissipation during tool heating. Multilayer gradient coatings aim to increase wear resistance and achieve stable high-temperature coating [39].

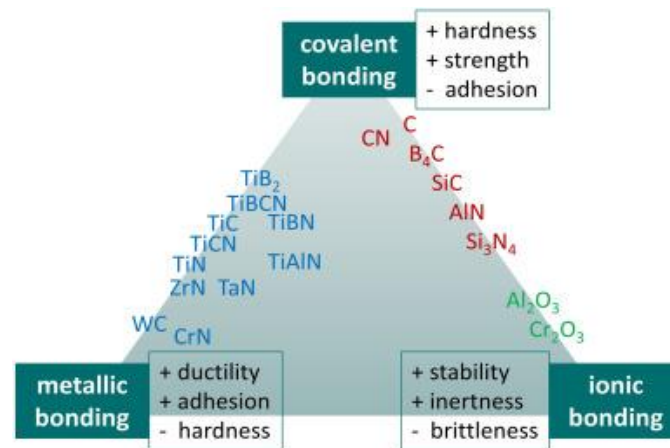
The adaptability of PVD processes has led to the development and enhancement of techniques for various processes, including deposition in mono-layered, multi-layered, and multi-graduated coating systems with special alloy composition and structures. These developments are driven by the continuous need for longer-lasting tools and improved cutting performance in the industry [40].

## **9. Future Challenges of Hard Coatings Community**

### **9.1. Areas of improvement needed in hard coating technology**

Significant areas of improvement are required in hard coating technology, given the ongoing demand for extended tool lifespans and the reduction of harmful lubricants and coolants. It is crucial to develop multifunctional hard coatings that possess qualities such as enhanced resistance to cracking, improved thermal endurance, and reduced friction to meet the ever-growing demands of the machining industry. Moreover, advanced characterization methods are necessary to allow in-depth comparisons of PVD and CVD coatings, as well as to monitor the

thermal and oxidation stability of hard coatings [41]. Figure 15 shows the chemical bonding triangle of hard materials and associated properties. Future research should concentrate on investigating the impact of cutting tool coating wear, and failure mechanism on cutting temperature and tool lifespan throughout the entire metal-cutting process with coated tools. In addition, there is a requirement for precise cutting temperature measurement techniques with fast reaction times for coated tools. Research the influence of coatings thicknesses or thermal characteristics on micro-milling temperatures, involving analytical models and trials, is essential for creating suitable coated micro-milling tools [9].



**Figure 15:** Chemical bonding triangle of hard materials and associated properties [42].

## 9.2. Potential solutions to overcome current challenges

A potential approach to addressing current challenges in hard coating technology involves examining the effects of cutting tool coating wear and failure process with the cutting temperature and tool lifespan throughout the entire metal-machining process with coated tools. This would require updating the boundary conditions in predictive models of machining temperature to align with the actual machining process, as well as developing precise cutting temperature measurement techniques with quick response times for coated tools [42]. Furthermore, research should focus on investigating the influence of coating thicknesses or thermal endurance on micro-milling temperatures, including the development of analytical models and conducting trials. Additionally, there should be a shift towards creating multifunctional hard coatings that demonstrate properties such as enhanced resistance to cracking or advanced thermal endurance. Future research should also explore advancements in energy-efficient deposition processes to minimize the energy required for synthesizing a coating, as well as finding ways to reduce leftover target material used in the PVD process or methods for their recycling [43].

## 10. Conclusion

The comprehensive review of hard coatings for cutting tools underscores a significant role of physical and chemical vapor deposition methods in producing high-performance coatings for machining applications. Both PVD and CVD techniques offer unique advantages



and a few limitations, PVD coatings excelling in hardness, abrasion resistance, and chemical stability, while CVD coatings provide superior thermal stability and oxidation resistance.

The review highlights the importance of understanding the synthesis-structure-property relationships of various coating materials, including nitrides, carbides, carbonitrides, borides, boronitrides, and oxides. This knowledge is a key for enhance coating performance. Multilayer coatings appeared as a promising approach to enhance wear resistance, hardness, increase the service-life for coated cutting-tools, and reduce the oxidation damage by combining the desirable features of multi-coating layers. Also, these studies and recent advancements in hard coating technology, such as the development of nanostructured and nanolayered coatings, have placed the foundation for further improvements in cutting tool performance.

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**LEVEL OF AWARENESS OF PUBLIC HEALTH IMPLICATION ASSOCIATED  
WITH NON-VACCINATION OF IMMUNIZATION SCHEDULES AMONG  
MOTHERS WITH CHILDREN UNDER-FIVE IN IFELODUN LOCAL  
GOVERNMENT AREA OF OSUN STATE**

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**Abstract**

Awareness of public health programs plays a pivotal role in promoting the vaccination of children under the age of 0-5 years (Smith et al., 2022). Vaccination in this age group is essential for building immunity against various infectious diseases and preventing outbreaks in the community. The public health implications of vaccination for mothers, children, government, society, and healthcare facilities are significant. Mothers benefit from the peace of mind that comes with knowing their children are protected from potentially life-threatening illnesses. Children under the age of 0-5 years benefit directly from being shielded from preventable diseases. At a broader level, the government and society benefit from reduced healthcare costs and increased productivity due to the prevention of illnesses (Brown & Johnson, 2021). Furthermore, healthcare facilities experience a decrease in the burden of treating vaccine-preventable diseases, leading to more efficient resource allocation. Families benefit from the overall well-being of their children and the broader community. Immunization schedules are predetermined timetables that delineate the recommended vaccinations for individuals at different life stages (WHO, 2020). These schedules are devised to ensure that individuals receive the requisite vaccines for protection against various infectious diseases. They typically specify the types of vaccines, the recommended ages for administration, and the number of doses required to achieve optimal immunity. Adhering to immunization schedules enables individuals to develop immunity against specific diseases, thereby reducing the risk of contracting and spreading vaccine-preventable illnesses (CDC, 2019). These schedules are formulated based on extensive scientific research and are continually updated to align with the latest recommendations from public health authorities and medical experts. Therefore, promoting awareness of public health programs and ensuring access to vaccinations for children under the age of 0-5 years has far-reaching positive implications for public health (Jones, 2023). The level of awareness of public health implications associated with non-vaccination of immunization schedules among mothers with children under-five is a crucial determinant of the efficacy of immunization programs. According to Smith, Johnson, and Brown (2021), maternal

understanding of the repercussions of non-vaccination on public health significantly impacts mothers' adherence to immunization schedules. This insight emphasizes the necessity of investigating and addressing the level of awareness among mothers with young children to enhance immunization rates and overall public health outcomes. This study seeks to contribute to the existing scholarly discourse by examining the level of awareness and its influence on maternal adherence to immunization schedules in Ifelodun Local Government Area. Adherence to healthcare programs, specifically the adherence of mothers to the immunization schedules for their children under-five, is crucial for safeguarding the health and well-being of young children. Children under the age of five are particularly vulnerable to a range of vaccine-preventable diseases due to their developing immune systems and increased exposure to pathogens (WHO, 2020). Therefore, adherence to immunization schedules is essential to ensure that children receive timely protection against these diseases. Mothers play a pivotal role in this process as primary caregivers, and their adherence to immunization schedules is essential for establishing and maintaining their children's immunity to infectious diseases (Brown, 2019). Moreover, ensuring the vaccination of children under the age of five aligns with public health efforts to control and prevent the spread of communicable diseases within this age group, ultimately contributing to the overall well-being of the community (Gupta, 2021). Non-adherence of mothers to the immunization schedules for their children under-five can have severe health implications. Children who do not receive timely vaccinations are at a higher risk of contracting vaccine-preventable diseases such as measles, diphtheria, pertussis, and polio (Omer et al., 2009). These diseases can lead to serious complications, including pneumonia, encephalitis, paralysis, and in severe cases, death (WHO, 2018). Additionally, non-adherence to immunization schedules can result in outbreaks of preventable diseases within communities, posing a threat to public health and placing unvaccinated children at an increased risk of exposure to infectious agents (Phadke et al., 2016). Furthermore, non-adherence to immunization schedules may contribute to the resurgence of infectious diseases that were previously under control, leading to a strain on healthcare systems and resources (Andre et al., 2020). Therefore, ensuring adherence to immunization schedules is crucial for the individual health of children and the broader public health landscape. Therefore, the need for adherence to immunization schedules for children under-five is paramount in safeguarding the health of young children and promoting public health at large.

## **Objectives of the Study**

- i. Determine the level of awareness of immunization schedules among mothers with children under-five in Ifelodun Local Government Area.
- ii. Determine health implication associated with non-vaccination of the under-five children.
- iii. What is the level of adherence to immunization schedules among mothers with children under-five in Ifelodun Local Government Area

## **Research Hypothesis**

H0: There is a significant positive impact of the level of awareness on the level of adherence to immunization schedules among mothers with children under-five in Ifelodun Local Government Area.

## **Methodology**

The study was a descriptive cross-sectional study, carried out among women between the age brackets of 15 to 50 years visiting Primary Health Care Centres in Ifelodun Local Government Area Ikirun on Immunization schedule date. Ifelodun LGA has an area of 114km and a population of 96,748 at the 2006 Census. The LGA Headquarter in Ikirun is about 10 minutes' drive north of Osogbo, the State capital. The Ifelodun LGA has 18 wards.

## **Study Population**

The population of this study consists of Women between the age brackets of 15 to 50 years present at Primary Health Care Centers of Ifelodun Local Government Area Ikirun on Immunization schedule dates and as well targeted age brackets of 15-50 years present during the time of research.

## **Criteria for inclusion into the study**

Those present at the selected Primary Health Care Centers in Ifelodun Local Government Area at the time of research, in Ikirun, Osun State.

## **Criteria for exclusion**

Those not present at the selected Primary Health Care Centers in Ifelodun Local Government Area at the time of research in Ikirun, Osun State.

## **Sample Size Determination**

The quantitative sample size was used to determine the sample size using a sample calculation formula known as Leslie-Kish formula:

$$N = \frac{Z_a^2 pq}{d^2}$$

Where  $Z_a$  = Standard normal deviate corresponding to level of significant (usually 5%) 1.28  
80% level of significant

P = Standard deviation 50%



P = 0.5), and

Q=1-P

d=precision confidence interval (margin of error) of 5%, d= 0.05).

Therefore  $N = \frac{(1.28)^2 \times 0.5 \times 1-0.5}{(0.05)^2}$

$$N = \frac{1.6384 \times 0.5 (0.5)}{0.0025}$$

N =163.84

N = 164

To take care of the attrition, 10 percent of the calculated selections will be added to give a new random of sample of 180.

The data collection instrument utilized in this study was a structured questionnaire, which was administered to individuals at the study area within the framework of a cross-sectional design. In instances where respondents encountered challenges in comprehension, translations were provided in their respective native languages. The requisite number of respondents was secured through a process of simple random sampling from the sampling frame, representing the totality of women aged 15 to 50 attending the Primary Health Care Centers of Ifelodun Local Government Area, Ikirun, during scheduled immunization sessions. A sample size of 180 was deemed adequate for the quantitative data analysis.

A standardized questionnaire was used for data collection through interviews at selected Primary Health Care Centers and public places. Data was analyzed using IBM SPSS version 23. Ethical approval was obtained from the Adeleke University Ethical Review Committee. The study achieved comprehensive data collection, though some respondents were reluctant to provide complete responses.

## Results

**Table 1 Socio-Economic Variable of Mothers**

Variable	Frequency	Percent (%)
<b>AGE</b>		
15-25 yrs	126	73.3
26-40 yrs	43	25.0
41-50 yrs	3	1.7
<b>MOTHERS EDUCATION</b>		
None	3	1.7
Primary education	26	15.1
Secondary education	85	49.4
Others	58	33.7
<b>OCCUPATION</b>		
Trading/business	86	50.0
Artisans	57	33.1
Teaching	29	16.9
<b>NUMBER OF CHILDREN</b>		
1 (one)	57	33.1
2 or 3 (two or three)	114	66.3
More than three	1	0.6
<b>INDEX CHILD AGE</b>		
1 yrs	85	49.4
2-5 yrs	3	1.7
2-3 yrs	55	32.0
Less than 1 year	29	16.9
<b>FAMILY TYPE</b>		
Nuclear	114	66.3
Extended	58	33.7
<b>RELIGION</b>		
Christianity	31	18.0
Islamic	141	82.0
<b>MONTHLY INCOME</b>		
Less than 30,000	115	66.9
30,000	55	32.0
More than 30,000		
Childsex	2	1.2
Male	54	31.4
Female		
<b>BIRTH ORDER</b>		
First	118	68.6
Second	83	48.3
Third	61	35.5
	28	16.3
<b>TOTAL</b>	172	100

Source: Field Work, 2023

Table 1 presents the demographic characteristics of the respondents, showing that the majority (73.3%) are aged 15-25 years. Additionally, about half (49.4%) have completed secondary education, and half (50.0%) are engaged in trading or business activities. Most respondents (66.3%) have 2 or 3 children, and a significant majority (82.0%) practice Islam. Furthermore, roughly two-thirds (66.9%) have a monthly income below 30,000, and the majority (68.6%) have female children. Additionally, birth order analysis revealed that 48.3% are first-borns, 35.5% are second-borns, and approximately 16.3% are third-borns.

OBJECTIVE1: Determine the level of awareness of immunization schedules among mothers with children under-five in Ifelodun Local Government Area.

**Table 2.** Determine The Level Of Awareness Of Immunization Schedules Among Mothers With Children Under Five In Ifelodun Local Government Area (n=172)

Question	Agree	Strongly Agree	Mean	Standard Deviation
Do you think immunizations are beneficial?	69 (98.3%)	3 (1.7%)	4.017442	0.131293
Has the child received the mandatory childhood immunization?	87 (50.6)	85 (49.4)	1.4942	0.50143
Do you follow the compulsory immunization programme listed in the immunization schedule?	118 (68.6%)	54 (31.3%)	1.3140	0.46545
How far was your place of living to the vaccination center?			1.5058	0.76851
Is the vaccination center accessible?	172 (100%)	-	1.0000	0.00000
How long does it take you to reach the immunization center?			2.5058	0.97030
Do you think that non-vaccination contributes to the spread of infectious diseases?	169 (98.3%)	3 (1.7%)	1.1686	0.37550
Are you concerned about the potential long-term consequences of not vaccinating children?	143 (83.1%)	29 (16.9%)	1.3430	0.47611
Do you believe that non-vaccination poses a threat to public health?	113 (65.7%)	59(34.3%)	1.0000	0.00000
Health Implication Associated with Non-Vaccination	-	-	1.1686	0.37550
Are you aware of the health implications of not vaccinating children?	143 (83.1%)	29 (16.9%)	1.0000	0.00000
Do you believe that non-vaccination increases the risk of preventable diseases?	172 (100%)	-	1.0174	0.13129

Source: Field Work, 2023.

The table 2 presents the outcomes of a survey consisting of several questions related to immunization beliefs and practices. It seems that the survey revealed a high level of agreement regarding the perceived benefits of immunizations, with 98.3% of respondents agreeing that they are beneficial. When it comes to adherence to mandatory childhood immunization, there is a relatively balanced response, with 50.6% confirming their child received it and 49.4% indicating their child did not. In terms of following the compulsory immunization program, 68.6% reported adhering to it, while 31.4% did not. The table presents questions about proximity to the vaccination center and its accessibility, with the mean suggesting a positive trend. Additionally, there is a high level of recognition regarding the health implications of not vaccinating children, with all respondents affirming the accessibility of the vaccination center and believing that non-vaccination increases preventable disease risks.

What is the level of adherence to immunization schedules among mothers with children under-five in Ifelodun Local Government Area.

**Table 3.** level of adherence to immunization schedules among mothers with children under-five in Ifelodun Local Government Area

Question	Response	Count	Percentage
1. How many doses of the recommended immunization schedule has your child missed?	Less than 3 doses	87	50.6%
	4-8 doses	68	39.5%
	More than 8 doses	17	9.9%
2. What is the distance you have to travel to the nearest immunization clinic?	Less than 5 km	92	53.5%
	5-10 km	63	36.6%
	More than 10 km	17	9.9%
3. Based on the number of missed doses, how would you rate your adherence to the immunization schedule?	Good (>95% adherence)	77	44.8%
	Fair (85-94% adherence)	77	44.8%
	Poor (<85% adherence)	18	10.5%
4. What are the main reasons for missing any doses of the immunization schedule? (Select all that apply)	Lack of awareness or knowledge about the importance of immunization	41	23.8%
	Difficulty accessing the immunization clinic (e.g., distance, transportation, clinic hours)	86	50.0%
	Fear or misconceptions about vaccine safety	32	18.6%
	Forgetfulness or competing priorities	69	40.1%
	Other	14	8.1%
5. How confident are you in your ability to fully immunize your child according to the recommended schedule?	Very confident	85	49.4%
	Somewhat confident	72	41.9%
	Not confident	15	8.7%
6. What would help you to improve your adherence to the immunization schedule? (Select all that apply)	Closer location of immunization clinics	94	54.7%
	Flexible clinic hours	83	48.3%
	Reminders and follow-up from healthcare providers	108	62.8%
	More education and awareness about the importance of immunization	58	33.7%
	Other	11	6.4%

This table presents the responses for 172 respondents to the Immunization Adherence Questionnaire. The data includes the count and percentage for each response option. This information can be used to identify the key challenges and facilitators of immunization adherence in the target population, and to inform the design of interventions to improve vaccination coverage.

Half of the respondents have missed less than 3 doses of the recommended immunization schedule, while around 40% have missed 4-8 doses. The majority (53.5%) live within 5 km of the nearest immunization clinic, while around 37% live 5-10 km away. Around 45% of respondents have good adherence (>95%), while another 45% have fair adherence (85-94%). The main reasons for missing doses are difficulty accessing the clinic (50%) and forgetfulness/competing priorities (40.1%). Around half of the respondents are very confident in their ability to fully immunize their child, while 42% are somewhat confident. The top factors that would help improve adherence are reminders and follow-up from healthcare providers (62.8%), closer location of clinics (54.7%), and flexible clinic hours (48.3%).

**Table For Level of Adherence**

**presents the level of adherence to immunization schedules among mothers with children under-five in Ifelodun Local Government Area (N=172):**

Adherence Level	Criteria	Number of Respondents	Percentage
Good	>95% adherence (missed <3 doses)	27	15.7%
Fair	85-94% adherence (missed 4-8 doses or 1-3 doses)	87	50.6%
Poor	<85% adherence (missed >8 doses)	58	33.7%
<b>Total</b>	-	<b>172</b>	<b>100%</b>

**Key Findings:**

**Good Adherence (>95%):**

15.7% of respondents had an adherence rate of 95% or above, indicating they missed fewer than 3 doses of the immunization schedule.

**Fair Adherence (85-94%):**

50.6% of respondents had an adherence rate between 85-94%, meaning they missed 4-8 doses or 1-3 doses, respectively.

**Poor Adherence (<85%):**

33.7% of respondents had an adherence rate below 85%, which suggests they missed more than 8 doses of the immunization schedule.

This table provides a clear and concise overview of the level of adherence to immunization schedules among the surveyed mothers. It shows that while a significant portion (50.6%) have a fair level of adherence, there is still a need to improve the overall adherence rate, as a notable percentage (33.7%) fall into the poor adherence category. Targeted interventions and education programs may be necessary to help increase the overall level of adherence to immunization schedules in the Ifelodun Local Government Area.

**Discussion of Findings**

The data presented in the tables offers important insights into the socio-economic characteristics and immunization adherence levels among mothers with children under five in Ifelodun Local Government Area of Osun State. A significant majority of respondents (73.3%) are aged between 15-25 years, suggesting a young maternal population. This demographic trend may influence perceptions and behaviors related to health and immunization. Additionally, nearly

half (49.4%) of the mothers completed secondary education, which is a positive indicator as educational attainment often correlates with health literacy. The predominant occupation reported (50.0% engaged in trading or business) reflects the economic activities common in the area, which could impact mothers' access to healthcare resources. The data also highlights that a substantial portion (66.3%) of mothers have 2 or 3 children, which may affect their ability to prioritize immunization schedules amidst other familial responsibilities. The religious affiliation noted, with 82.0% practicing Islam, may also play a role in shaping attitudes toward healthcare practices, including immunization.

On awareness of immunization schedules, a high level of awareness regarding immunization benefits, with 98.3% of respondents acknowledging their importance. However, when asked about following the compulsory immunization program, there is a notable split: while 68.6% reported adhering to the schedule, the responses concerning whether their child received mandatory immunizations were balanced (50.6% yes, 49.4% no). This discrepancy suggests that while awareness exists, actual adherence may be hindered by barriers. The findings further indicate that all respondents agreed on the accessibility of vaccination centers, which is encouraging. Proximity to these centers seems to be favorable, with a mean distance suggesting easy access. Nonetheless, the time taken to reach these centers was not explicitly detailed, indicating a potential area for further exploration.

With respect to adherence to immunization schedules, the level of adherence to immunization schedules. A concerning 39.5% of mothers reported missing 4-8 doses, and 9.9% missed more than 8 doses. This suggests that while many respondents are aware of the immunization schedules, actual adherence remains a challenge. Interestingly, 44.8% rated their adherence as good (>95%), while another 44.8% rated it as fair (85-94%). This duality highlights a critical gap between perceived adherence and actual vaccine uptake. The primary reasons for missed doses included difficulty accessing clinics (50.0%) and forgetfulness or competing priorities (40.1%). These barriers must be addressed to improve adherence rates.

The responses indicate that a majority (62.8%) believe that reminders and follow-ups from healthcare providers would enhance adherence. This suggests that structured interventions, such as reminder systems and educational programs, could significantly improve vaccination rates. Additionally, a closer location to immunization clinics (54.7%) and flexible clinic hours (48.3%) were also highlighted as crucial factors that could facilitate better adherence.

#### Conclusion

Overall, while the awareness of immunization benefits among mothers in Ifelodun Local Government Area is high, the actual adherence to immunization schedules reflects a need for targeted interventions. Addressing barriers related to access, awareness, and convenience through community health initiatives, education, and support systems could enhance vaccination coverage. The findings underscore the importance of continuous engagement with mothers to foster a supportive environment for immunization practices, ultimately aiming to improve public health outcomes for children in the region.

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**HAVALİMANI OPERASYONLARININ EMNİYETLİ BİR ŞEKİLDE  
YÜRÜTÜLEBİLMESİ İÇİN NİTELİKLİ PERSONEL İSTİHDAMI, EĞİTİM  
GEREKLİLİKLERİ VE EĞİTİMLERİN PERSONEL ÜZERİNDEKİ ETKİLERİ**

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**Özet**

Havacılık Dünya çapında ekonomik, teknolojik ve sosyal gelişmeyi en fazla etkileyen faaliyet alanlarından biridir. Havacılıkta meydana gelen teknolojik gelişmeler ile beraber Havayolu ulaşımı en güvenli ulaşım biçimi ayrıca, ekonomik büyümeye duyarlı, geniş kapsamlı düzenlemelerin geçerli olduğu, yüksek teknolojiye sahip araç ve donanım ile nitelikli insan gücünün kullanıldığı bir alan olarak tanımlanmaktadır. Havacılık faaliyetleri ve bu faaliyetlerin yürütüldüğü ortamlar ise yüksek risk taşıyan ortamlar olarak tanımlanmaktadır. Bu çerçevede değerlendirildiğinde; havalimanları havayolu ulaştırma sistemlerinin temel ögesidir. Bu çalışma ile Dünya’da havacılık faaliyetlerinin katlanarak artış göstermesi, yeni teknolojik gelişmeler ile beraber havacılık faaliyetlerinde emniyet ilkelerinin benimsenmesinin daha önemli hale gelmesi ve tüm bu bilgiler doğrultusunda Havalimanlarının işletilmesinde operasyonların emniyetli bir biçimde yürütülebilmesi ve denetlenmesi açısından nitelikli personel istihdam edilmesi, havacılıkta insan faktörünün pozitif etkisinin teşvik edilmesi amacıyla personelin eğitimlerinin aktif bir şekilde sürdürülmesinin önemi vurgulanmaktadır.

**Anahtar Kelimeler :** Havalimanı İşletmeciliği, Havacılık, Emniyet Yönetim Sistemi, Eğitim, İnsan Faktörü



# **THE RECRUITMENT OF QUALIFIED PERSONNEL, TRAINING REQUIREMENTS AND THE EFFECTS OF TRAINING ON PERSONNEL FOR THE SAFE CONDUCT OF AIRPORT OPERATIONS**

## **Abstract**

Aviation is one of the fields of activity that has the greatest impact on economic, technological and social development worldwide. With the technological developments in aviation, airline transportation is defined as the safest mode of transportation, as well as a field that is sensitive to economic growth, where comprehensive regulations are valid, high-tech vehicles and equipment and qualified manpower are used. Aviation activities and the environments where these activities are carried out are defined as high-risk environments. When evaluated within this framework; airports are the basic element of airline transportation systems. With this study, it is emphasized that the aviation activities in the world have increased exponentially, the adoption of safety principles in aviation activities has become more important with new technological developments, and in line with all this information, the importance of employing qualified personnel in the operation of airports in order to carry out and supervise the operations in a safe manner, and the importance of actively continuing the training of personnel in order to encourage the positive effect of the human factor in aviation.

**Keywords :** Airport Management, Aviation, Safety Management System, Training, Human Factor

## Giriş

Havacılık dünya çapında ekonomik, teknolojik ve sosyal gelişmeyi en fazla etkileyen faaliyet alanlarından biridir. Havacılıkta meydana gelen teknolojik gelişmeler ile beraber havayolu ulaşımı en güvenli ulaşım biçimi olarak tanımlanmakta ve Dünya’da hava trafiği katlanarak artış göstermektedir.

Ülkemizde ilk havacılık çalışmaları 1912 yılında, bugünkü Atatürk Havalimanının hemen yakınındaki Sefaköy’de küçük bir meydanda başlamış ve 1925 yılında kurulan ve daha sonraki yıllarda Türk Hava Kurumu adını alan Türk Tayyare Cemiyeti ile Türk Sivil Havacılığının kurumsal temelleri atılmıştır. İlk Sivil Hava Taşımacılığı ise 1933 yılında 5 uçaklık küçük bir filo ile “Türk Hava Postaları” adı ile başlatılmıştır.

Türk Sivil Havacılık sektörünün altyapısını oluşturan tesis ve donanımıyla, 1933 yılından bu yana değişik isim ve statülerle hizmetlerini yürütmekte olan DHMİ, 233 sayılı Kanun Hükmünde Kararname ile Ana Statüsü çerçevesinde 1984 yılından itibaren faaliyetlerini Kamu İktisadi Teşebbüsü olarak sürdürmektedir. Türkiye Havalimanlarının işletilmesi ile Türkiye Hava sahasındaki hava trafiğinin düzenlenmesi ve kontrolü görevi, Devlet Hava Meydanları İşletmesi (DHMİ) Genel Müdürlüğüne yerine getirilmektedir.

Kuruluşun Ana Statüsü ile belirlenen amaç ve faaliyet konuları ise; Sivil havacılık faaliyetlerinin gereği olan hava taşımacılığı, havalimanlarının işletilmesi, meydan yer hizmetlerinin yapılması, hava trafik kontrol hizmetlerinin ifası, seyrüsefer sistem ve kolaylıklarının kurulması ve işletilmesi, bu faaliyetler ile ilgili diğer tesis ve sistemlerin kurulması, işletilmesi ve modern havacılık düzeyine çıkarılmasını sağlamaktır.

Ayrıca, Ülkemizde bulunan havalimanlarında ve yakın çevresinde meydana gelebilecek uçak kaza kırım ve yangınları ile havalimanlarında bulunan bina tesis yangınları ve acil durumlara müdahale amacıyla Uluslararası Sivil Havacılık Teşkilatı (ICAO) tarafından belirlenen standart ve önerilen uygulamalar çerçevesinde DHMİ tarafından ARFF (Aircraft Rescue and Fire Fighting) birimleri kurulmuş ve ARFF memurları istihdamı sağlanmıştır. Bununla birlikte, özel statüde bulunan havalimanlarında da kurtarma ve yangınla mücadele birimleri bulunmaktadır. ARFF birimleri 24 saat esasına göre hizmet vermekte ve ARFF Memurları vardiyalı sistemde çalışmaktadırlar. DHMİ tarafından ARFF personel seçimlerinde belirli kriterler belirlenmiştir ve ulusal mevzuatlarda bu hususlara yer verilmiştir. Türkiye’de itfaiyecilik mesleği yerel yönetimler bünyesinde İtfaiye Teşkilatı, Devlet Hava Meydanları İşletmesi (DHMİ) Genel Müdürlüğü bünyesinde ARFF memurları tarafından yürütülmektedir. Kısaltması ARFF olan unvanın tam olarak açılımı “Aircraft Rescue and Fire Fighting” olup, anlamı “Hava Kurtarma ve Yangınla Mücadele” dir. Bu görevi ifa eden kişilere ise “ARFF Memuru” denilmektedir. ARFF memurluğu, dışarıdan her ne kadar itfaiyecilikle benzer bir meslek alanı olarak gözükse de farklı konular açısından keskin sınırlarla birbirinden ayrılmaktadır. ARFF memurluğu ICAO standartlarına göre şekil almakta ve belirli periyotlar ile uçuş güvenliği açısından denetlenmektedir.

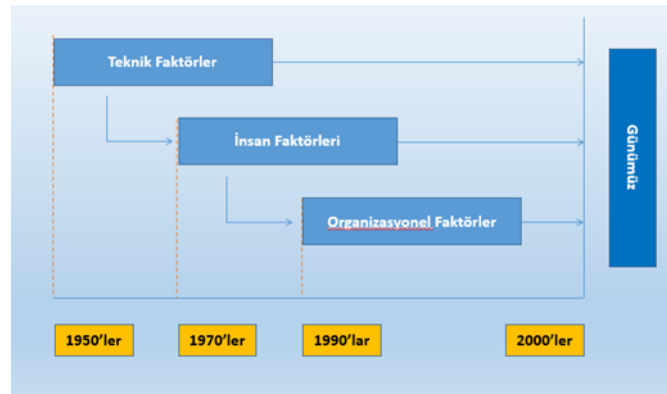
Havalimanlarında kurtarma ve yangınla mücadele hizmetlerinin herhangi bir acil durumda temel amacı hayat kurtarma operasyonunu gerçekleştirecek şekilde organize edilmesini, donatılmasını, personel istihdam edilmesini ve bu personelin eğitilmesini kapsamaktadır. İnsan hayatını kurtarma görevi cesaret, bilgi, tecrübe, grup çalışması, fiziki kabiliyet isteyen bir iştir.

Bu nedenle, ARFF hizmetlerinde görevlendirilecek personelin iyi eğitimli olması, herhangi bir olay anında değişen koşulları anlayabilmesi oldukça önemlidir.

2920 sayılı Türk Sivil Havacılık Kanununda havalimanı; “karada ve su üzerinde hava araçlarının kalkması ve inmesi için özel olarak hazırlanmış, hava araçlarının bakım ve diğer ihtiyaçlarının karşılanmasına, yolcu ve yük alınmasına ve verilmesine elverişli tesisleri bulunan yerler” olarak tanımlanmıştır. Uluslararası Sivil Havacılık Teşkilatı (ICAO) tarafından yayınlanan Ek-14 ( Annex-14) kapsamında ise havalimanı benzer şekilde “tamamen veya kısmen hava araçlarının gelişi, kalkışı ve yüzey operasyonu için kullanılması öngörülen, karada veya suda belirlenmiş tüm binalar, tesisatlar ve teçhizatlar dahil olmak üzere alanlardır” şeklinde tanımlanmıştır. Bu çerçevede değerlendirildiğinde havalimanları havayolu ulaştırma sistemlerinin temel ögesidir.

Havacılık emniyetin ön planda tutulduğu, karmaşık ve dinamik bir yapıya sahiptir. Havalimanlarının iki temel bölümü olan hava ve kara tarafı operasyonlarında en önemli unsur tüm faaliyetlerin Uluslararası düzenlemeler ve gereklilikler çerçevesinde, emniyet ve güvenlik ilkeleri benimsenerek, birbiri ile ilişkili, bütüncül bir yaklaşım içerisinde ve ortak çalışmalarla planlı olarak yürütülmesinin sağlanmasıdır. Sistem içerisinde her bir işletme, üretim hedeflerine ulaşabilmek için aynı operasyonel alanı paylaştığı diğer işletmeler ile etkileşim halindedir ve insan operasyonel süreçlerin her bir aşamasında belirleyici bir rol oynamaktadır. Bu nedenle bu yapı içerisinde insan hatası çok kötü sonuçlara yol açabilmektedir.

Havacılıkta emniyet ise “Bir hava aracının operasyonunu doğrudan etkileyen ya da ilgilendiren havacılık aktivitelerindeki risklerin azaltılması ya da kabul edilebilir seviyeye çekilmesidir.” şeklinde tanımlanmaktadır. Havacılıkta emniyet konusundan bahsedildiğinde; bu alanda yapılacak önemli faaliyetlerden biri de operasyonların emniyetli bir şekilde yapılmasını sağlayacak nitelikte personelin istihdam edilmesinin sağlanmasıdır.



EMNİYET KAVRAMININ GELİŞMESİ

1970'lere kadar havacılığın ilk yılları, İkinci Dünya Savaşı'ndan önceki ve hemen sonraki yıllar, teknolojinin tam olarak gelişmemesi nedeniyle emniyet sorunlarının genellikle teknik etkenlere bağlandığı "teknik çağ" olarak karakterize edilmiştir.

1970'lerin ilk yıllarında jet motorlarının, radarın (hem havada hem de yerde), otomatik pilotların, uçuş yönlendiricilerin, gelişmiş navigasyon ve iletişim becerilerinin ve hem havada

hem de yerde benzer performans artırıcı teknolojilerin kullanılmaya başlanması ile önemli teknolojik gelişmeler görülmüştür.

1970'lerin ortası ile 1990'ların ortası arası "insan çağının" başlangıcını müjdelemiş ve emniyetle ilgili çabaların odağı insanların performansına ve insani etkenlere yönelmiştir.

Bir operasyonel bağlamın insanların performansını nasıl etkileyebileceği ve olayları veya sonuçları nasıl biçimlendirebileceğinin tanınması ancak 1990'larda gerçekleşmiştir.

Dünya'da havacılık faaliyetlerinin katlanarak artış göstermesi, yeni teknolojik gelişmeler ile beraber havacılık faaliyetlerinde emniyet ilkelerinin benimsenmesi daha önemli hale gelmekle birlikte havacılık endüstrisinde insan faktörü rolünün de önemsenmesi gerekliliğini ortaya koymaktadır.

İnsan faktörleri (Human Factors) "Havacılık dizaynı, belgeleme, eğitim, uçuş/yer operasyonları ve bakım uygulamalarında; insan performansının doğru olarak göz önünde bulundurulmasıyla, insan ve diğer sistem elemanları arasında emniyetli bir uyumu sağlayan prensipler" olarak tanımlanmaktadır. Havacılıkta insan faktörleri birçok durumda etkileri örtüşen ve birbirini etkileyen faktörler olarak değerlendirilmekle birlikte bir faktörün diğerini etkileyebilecek derecede yakından ilişkili olduğu da gözlemlenmektedir.

### **Araştırma ve Bulgular**

1980'lerin sonu ve 1990'ların başında meydana gelen birçok uçuş kazası ve uçuş olayı bağlamında Kanada Taşımacılığı (Transport Canada), bakım hatalarına yol açabilen, kişilerin etkili ve güvenli hareketlerini kısıtlayan 12 insan faktörü tanımlamıştır. Bu faktörlerden birisi de bilgi ve tecrübe eksikliğidir.

**Tenerife faciası**, 27 Mart 1977 tarihinde, İspanya'nın Tenerife Adasında bulunan Los Rodeos Havalimanı'nda iki Boeing 747 uçağının yerde çarpışmasıyla oluşmuş bir kazadır. Kaza, pek çok ihmalin ve "İsviçre Peynir Modeli"ne göre pek çok peynir deliğinin bir araya gelmesi ile oluşmuştur. Dünya havacılık tarihinin bu en ölümlü kazası yerde gerçekleşmiş ve 583 kişi ölmüştür. Kaza sonrasında havacılıkta ve hava trafik kontrol yönetiminde çok köklü değişiklikler yapılmıştır. İspanya Sivil Havacılık Kaza İnceleme Komisyonu (CIAIAC) tarafından 70 kadar personelin, Amerikalı ve Hollandalı yetkililerin ve havayolu şirketi temsilcilerinin katıldığı soruşturmada kazanın asıl nedeni "yanlış iletişim ve yanlış varsayımlar" olarak belirlenmiştir. Bu kaza soruşturma yetkililerinin insan faktörlerini de hesaba kattığı ilk kaza olma özelliğini taşımaktadır.

**Linate Havaalanı faciası**; 8 Ekim 2001 Pazartesi sabahı İtalya'da Milano'daki Linate Havaalanı'nda meydana gelmiştir. Danimarka'nın Kopenhag kentine giden ve 110 kişi taşıyan McDonnell Douglas MD-87 tipi Scandinavian Airlines System Flight 686, kalkış sırasında Fransa'nın Paris kentine giden ve dört kişi taşıyan bir iş jeti Cessna Citation ile çarpışmıştır. Her iki uçaktaki 114 kişinin tamamı ve yerdeki dört kişi hayatını kaybetmiştir. İtalyan havacılık tarihinin en ölümcül kazası olmaya devam etmektedir. 16 Nisan 2004 tarihinde Milano'da bir mahkeme dört kişiyi faciadan dolayı suçlu bulunmuş, Havaalanı müdürü ve hava trafik

kontrolörü sekiz yıl hapis cezasına çarptırılmış, Havaalanının eski müdürü ve hava trafik kontrol ajansının eski müdürü ise altı buçuk yıl ceza almıştır.

Genel olarak bakıldığında havacılık kazalarının nedenlerinin teknoloji, çevresel etki ve insan faktörü olarak ortaya çıktığı tüm araştırmalarda görülebilmektedir. Havacılık istatistiklerine göre kaza nedenleri arasında %80'e yakın bir oranla insan hatası birinci sırada yer almaktadır.

## **Sonuç**

Havacılık sektörü için insan kaynağı önemli bir yere sahiptir. Uçak kazaları insan hataları ve ihlallerinden kaynaklanabildiği gibi, yetenekli ve dikkatli personel tarafından fark edilip önlenmektedir. Bu nedenle havacılık sektöründe yer alan personelin operasyonları emniyetli bir şekilde yürütebilmesi için çok iyi eğitilmiş personelden oluşması gerekmektedir. İnsan hatasından kaynaklanan olayların ve kazaların önlenmesine yönelik tek bir yaklaşım bulunmamakla birlikte eğitim, emniyet, verimlilik gibi konuların birlikte ele alınması gerekmektedir. Havacılıkta insan faktörü çerçevesinde yapılan tüm incelemeler hatalar ve başarısızlıklar gibi olumsuz süreçler olarak değerlendirilmektedir. Her bir tehlikeli, emniyetsiz durumların ve olumsuz süreçlerin kontrol altına alınması ile hatalar minimize edilebileceği gibi insan faktörünün pozitif etkisinin uygulanması gereken bir unsur olduğu değerlendirilmektedir.

İnsan kaynağının etkin ve verimli bir şekilde yönetilmesinde uluslararası kurallar ve bu kurallara bağlılık, hizmetlerin çeşitliliği, hızlı teknolojik gelişmeler ve bu yaygın konuların başka eğitim kurumlarında yeterince yer almaması nedeniyle hizmet içi personel eğitimi kritik bir öneme sahip olup işletme faaliyetlerinin sürdürülebilirliğini olumlu yönde etkilemektedir. Havacılık sektöründe emniyetsiz durumların minimize edilmesi için bilgi ve tecrübe eksikliğinin giderilmesi ve pozitif insan faktörünü sağlayabilmek için eğitimlerin aktif bir şekilde sürdürülmesi gerekmektedir. Bu eğitimlerin gerçekleştirilmesi havaalanı faaliyetleri için hem yasal hem operasyonel açıdan gerekli bir durumu ortaya koymaktadır.

ARFF hizmetlerinde görevli personel acil durumlarda görevleri esnasında çok hızlı kararlar almak ve bu kararları uygulamak durumundadırlar. Ulusal ve uluslararası sivil havacılık kuralları da havacılık personelinin belli bilgi, eğitim ve beceri koşullarını sağlamasını zorunlu kılmaktadır.

Bu kapsamda, insan faktörü, operasyonel etkinlik ve standartlar birlikte değerlendirildiğinde; ARFF operasyonlarının başarıya ulaşabilmesi için ARFF personelinin yeterli yetkinliğe sahip olması, emniyetli, kontrollü ve gerçekçi bir ortamda eğitim almalarının sağlanması gerekmektedir.

Bunun için özellikle ARFF eğitimlerinde;

- Mümkün olduğu kadar gerçekçi olmasını sağlamak ve ARFF personelinin ısı ve dumanla kaplı bir ortama alışmasına yardımcı olması amacıyla ateşli yangın tatbikatı gerçekleştirilmesi,
- Simülatör sistemleri vasıtasıyla ARFF operasyonlarının farklı yönlerini yansıtan gerçekçi ortamlar sağlanması,
- Yanlış iletişimi önlemek üzere donanıma karşı personel veya personele karşı personel ilkesi benimsenerek ARFF eğitim programlarının bilgilerin doğru bir şekilde ve zamanında aktarılmasını sağlayacak bileşenler içermesi,

- Acil durumlara müdahale sırasında insan performansını arttırması için çeşitli hava aracı tiplerinin farklı modelleri de dahil olmak üzere detaylı içeriklere yer verilmesi önemlidir.

Bu amaçla, DHMİ Genel Müdürlüğü tarafından Havalimanlarında görevli Havalimanı personeli için Havacılık Akademisi Kurulmuş ve Havaalanı Emniyeti ve İşletimine ilişkin eğitimler düzenlenmekte ayrıca, ARFF ve diğer itfaiyecilerin eğitimini sağlamak üzere Erzincan Eğitim Tesisleri kurulmuştur.

Havacılık Akademisinde «Havaalanı İşletimi ve Emniyetine» yönelik eğitimler uzman eğitmen kadrosu ile Havalimanlarında yüz yüze ve saha incelemesi ile gerçekleştirilmektedir.

- Havaalanı Emniyeti ve İşletimi Temel Eğitimi
- Emniyet Yönetim Sistemleri
- Acil Durum Planı
- Havacılık Bilgi Yayınlarında Yayımlanması gereken Havalimanı Bilgileri
- Pist Emniyeti ve Pist İhlallerini Önleme Eğitimi
- PAT Sahası Kontrolleri
- Maniaların Kontrolü
- Görsel yardımcıları
- Yabani Hayvanlarla ve Kuşla Mücadele
- Pist Yüzey Şartları
- Kötü Hava Şartlarındaki Operasyonlar
- PAT Sahalarının Fiziki özellikleri
- PAT Sahalarında Araç Kullanma
- Apron Yönetimi ve Apron Emniyeti

#### **Erzincan Eğitim Tesisleri; (Yangınla Mücadele Eğitim Simülâtörü)**

Yaklaşık olarak 400 m<sup>2</sup> kapalı alan ayrıca, 120\*100 mt. uygulama alanına sahip olup, tesis içerisinde kontrol kulesi, Uçak - Araç Simülâtörleri ve Karla Mücadele Araç Simülâtörleri , su tankı ve yakıt tankları yer almaktadır. Tesis barındırdığı senaryolar itibariyle çok yönlü eğitim olanaklarına sahiptir. Söz konusu simülâtörde yurt içinden ve yurt dışından gelen eğitim talepleri de ICAO standartları esas alınarak karşılanabilmektedir. ARFF personelinin uygulamalı eğitimlerinin gerçek olaylara benzetilmiş koşullarda yürütülmesini sağlamak amacıyla; Boeing 737-800 tipindeki bir uçak bire bir ölçülerle simüle eden çelik sistemden imal edilmiş ana uçak gövdesi yapısından oluşmaktadır.

**Anahtar Kelimeler:** Eğitim, Uçak Kazaları, Emniyet Kavramı, İnsan Faktörleri, ARFF Memuru, Havalimanı İşletmeciliği

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# USING PHOTOGRAMMETRY FOR DIGITAL DOCUMENTATION OF HERITAGE SITES AND OBJECTS IN JORDAN.

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## **Abstract**

The study emphasizes the importance of using photogrammetry as a remote sensing technique for reliable two-dimensional documentation of heritage sites and archaeological objects, because documentation helps us preserve antiquities for the longest possible time, so that we have a database of antiquities in the event of their destruction. Our research data was collected from an archaeological site in the Jordanian desert, including (Al-Harranah) Palace. Images were taken at ideal locations and times to provide realistic colors and an accurate assessment of the building's facade characteristics. Data were processed and composite models were generated using dense image matching techniques. In addition to 3D modeling, orthogonal images of the facades were created. Photographs are to a uniform scale and depict all objects in their flat positions, providing reliable and realistic maps. The results will greatly assist in monitoring and planning preservation activities of historic buildings.

**Keywords:** Photogrammetry , Documentation, Close-range, Overlap , Forward overlap, lateral overlap , Agisoft .



## Introduction

Jordan's desert palaces are a beautiful reflection of the beginning of the era of Islamic architecture and arts. These palaces are still standing in place to tell their stories about that magnificent era that enriched the history of Jordan with its mosaic paintings, stone and plaster sculptures, and drawings. They are called palaces in reference to their majestic structure. In fact, these desert buildings were used for several purposes: they were caravan stations, centers of agriculture and trade, refuges, and military centers.

Because they are unique pieces, there must be a three-dimensional documentation system that documents the spatial information of each palace, to be used later in monitoring operations.

These systems feature high data acquisition rates, good accuracy and high spatial data density. Photogrammetry has been used as a tool for collecting three-dimensional (3D) information of cultural heritage. The 3D coordinates of points on an object surface are determined based on overlapping images with camera position and orientation information. There are two orientations in Photogrammetry: Interior and Exterior. The parameters of interior orientation that describe the principal point location and calibrated focal length of the camera have to be known. (Yastikli, 2007)

The exterior orientation can be determined if at least three control points are available in the overlapping image area.

\* This section provides a detailed description of one of the famous desert palaces documented in this research, Al-Harana palace, in terms of geographical location, functions, plan, History



### 3. Al-Harrana palace

Is one of the most important historical monuments in Jordan, and it is an Umayyad palace located in the Jordanian desert and 65 km east of Amman and rises 659 m above sea level. It was called the Palace of Harrana because it is located in Wadi Al-Harrana. (Aljdou)

It a variety of defense, recreational, agricultural and/or commercial purposes (Al-shawabkeh, 2008)

Figure (1) shows the palace's architectural plan, Figure (2) shows the map of access to the palace, while Figure (3) shows the exterior of Al-Harrana (Aerial photo from Sonia Halliday Photo Library)

### 3.1. Palace plan

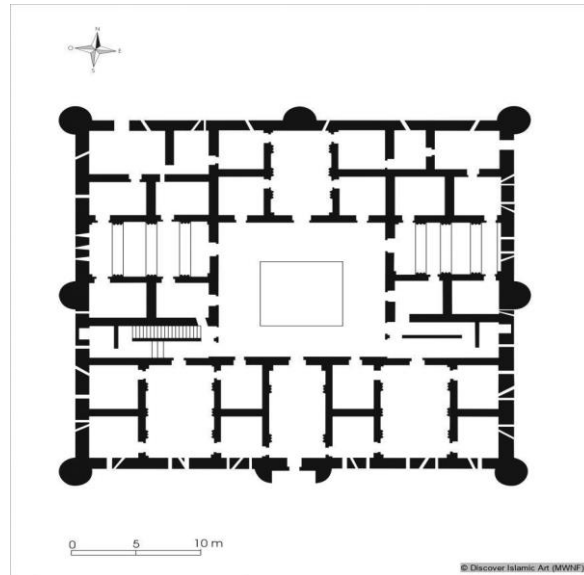
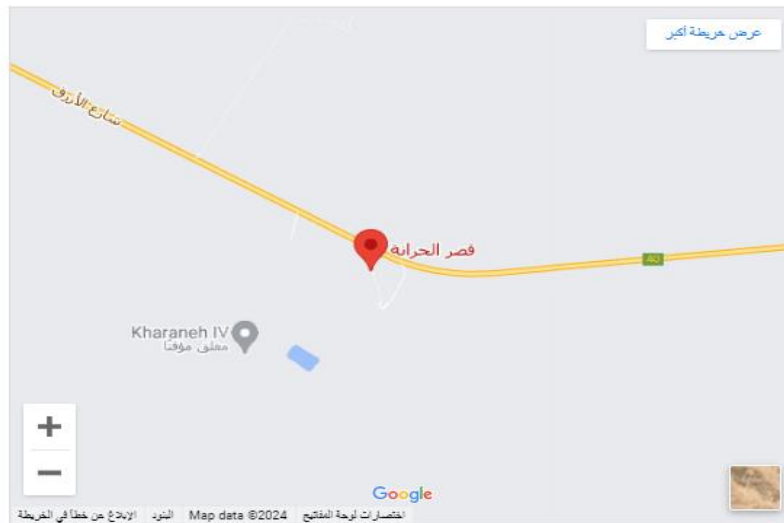


Figure (1): Al-Harran architectural plan (upper floor) (النجار, 2024)

### 3.2. Palace map:



[Google.html قصر الحارثية - خرائط](https://www.google.com/maps/@33.3333333,44.3333333,15z)

Figure (2): shows the map of access to the palace (goo)

### 3.3. The History of palace:

The palace was built during the reign of Al-Waleed bin Abdul Malik in 92 AH corresponding to 710 AD, Al-Harrana Palace is square in shape, each side is 35 meters long. All its sides are intact, except for the northern part, which is eroded

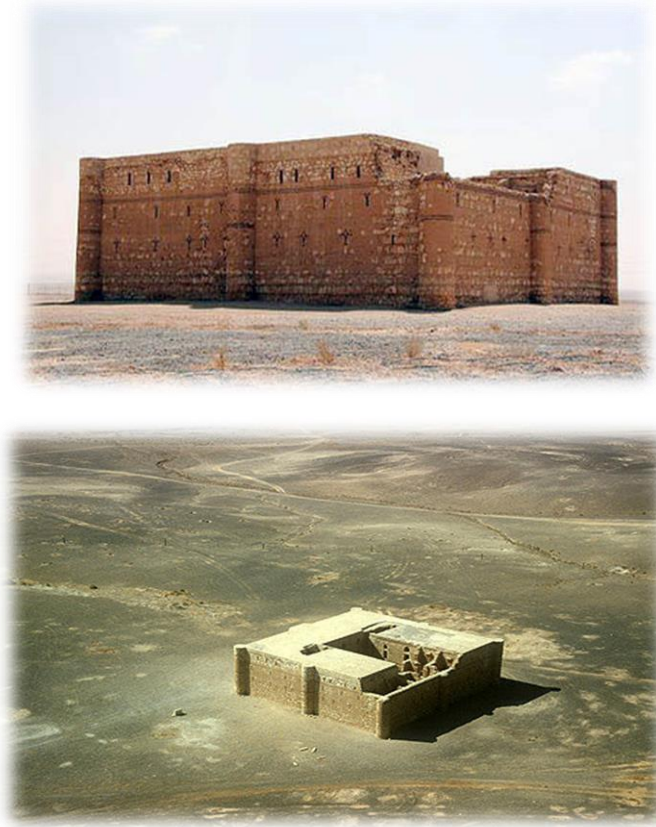
due to natural erosion factors, where the plaster fell on the outside and the original building material appeared .consisting of soft sandstone from local clay

\* The main reason it was built was for military reasons. (Aljdou)



South view

South east view



Northwest view

Aerial (Library)

Figure (3) shows the exterior of Al-Harrana

#### 4. Documentation

**4.1. Definition of documentation:** Description the context in which the material were found, their relationships in space and time to geological deposit and large architectural feature, monitoring of the remains of the past human activities, and risk assessments.

#### 4.2. An important rule in cultural documentation

Photographic and graphic documentation tools are merging in one process, in which the digital photographic technology is the main base.

#### 4.3. The importance of documentation:

Management of the cultural heritage.

Research.

Protection.

Interpretation.

Mitigation.

**4.4. There are several different ways to document heritage data, including:**

Remote sensing.

GPS.

GIS.

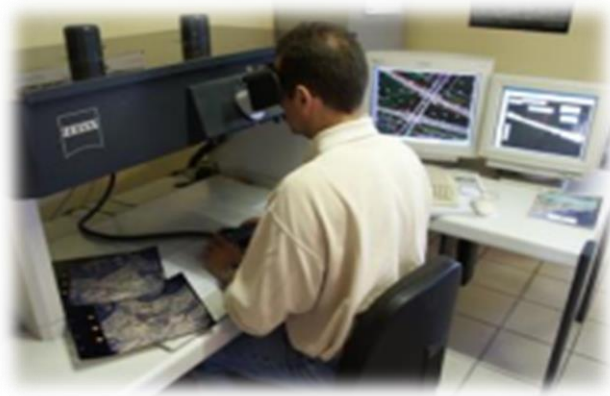
And Photogrammetry.

**5. Photogrammetry**

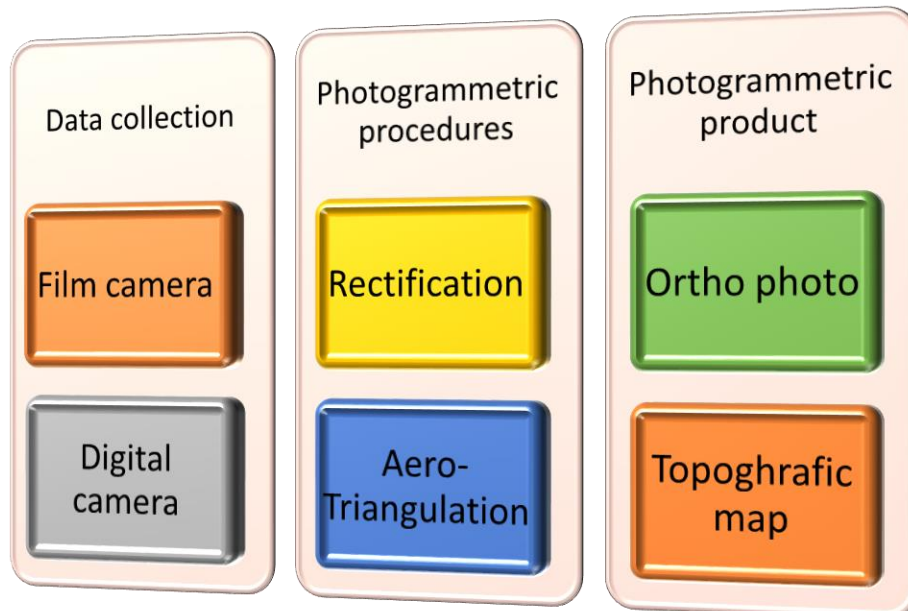
**5.1. Terminology:** is composed of three Greek roots:”photo’ Gram’ and ‘ metry”  
(alshawabkeh, 2023)

(The science of measuring from photograph)

5.2. Scientifically: is concerned with measurements of the size, shape and position of the objects from the measurements made to photographs. (Al-Ruzouq1, 2010)



**5.3. Photogrammetry workflow:** It consists of 3 main stages: 1) Data collection, 2) Photogrammetric procedures, 3) Photogrammetric product. (alshawabkeh, 2023)

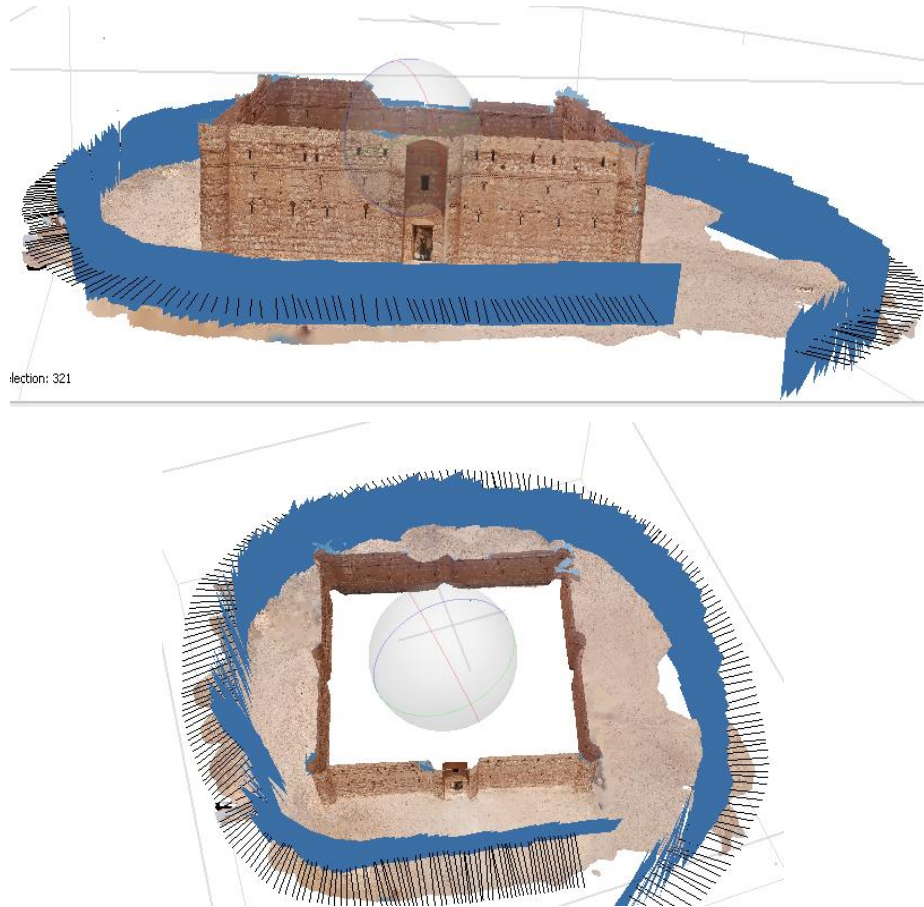




#### 5.4. There are two types of photogrammetry:

1) Aerial photogrammetry

2) Terrestrial (close range): Close Range was used to document Al-Harrana Palace, and it is based on the same theoretical basis as aerial photography, where pictures were taken from a very close distance to the palace from more than one station at the same focal length of the camera, around the entire palace. (alshawabkeh, 2023)



#### 5.5. Principles of photogrammetry:

Stereoscopic coverage

The Concept of Stereoscopy is one of the most important concepts, as it uses the principle of human vision to know the height of a object.

To know the heights, pictures must be taken from more than one perspective, which is called (overlap). (alshawabkeh, 2023)

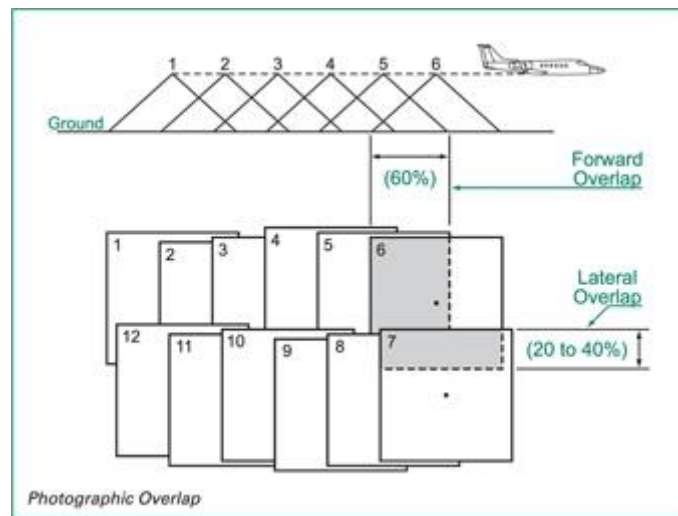
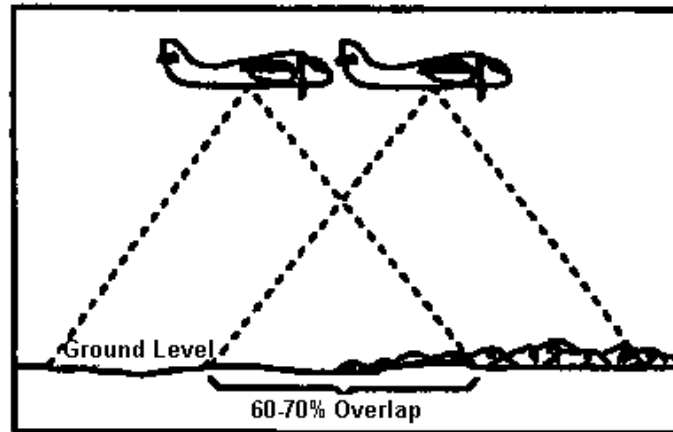
\*Planning of aerial photogrammetry includes Overlaps, Scale, Image Movement, Height accuracy, Camera. (pho)

\* Overlap includes: It ensures that each point on the ground is captured in multiple images from different vantage points, enhancing the detail and depth of the final map.

\* There are two types of overlap: (Walker)

Forward Overlap is 60% (on The Same Flight Path)

Lateral overlap is 30% (between images taken across adjacent flight paths.)



(bisenberger, 2013)

### 5.6. Working procedures:

A number of pictures of Al-Harrana Palace were taken from the site directly around the entire palace using a digital camera, then going to the laboratory and entering the images into the Agisoft program to be processed by the program (the images go through several stages during processing) so that a model of the palace appears in the end.

The analysis stages in the program are: ((1) Align photo, (2) Dense cloud, (3) Build Mesh, (4) Build Texture)

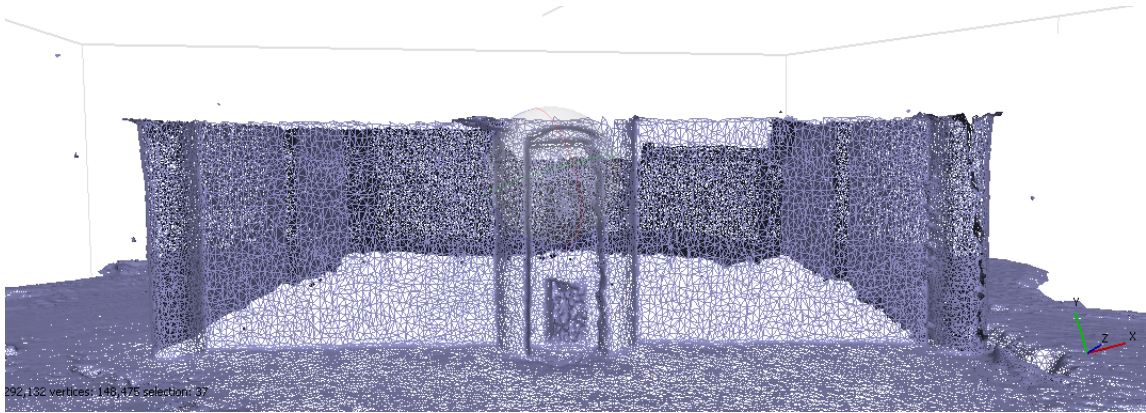


Figure (1): Align photo

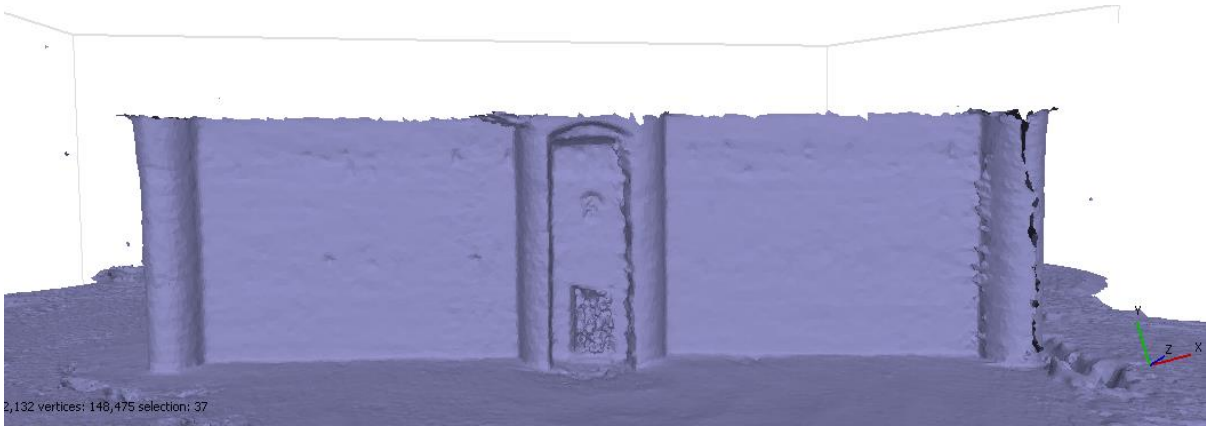


Figure (2) : Dens cloud



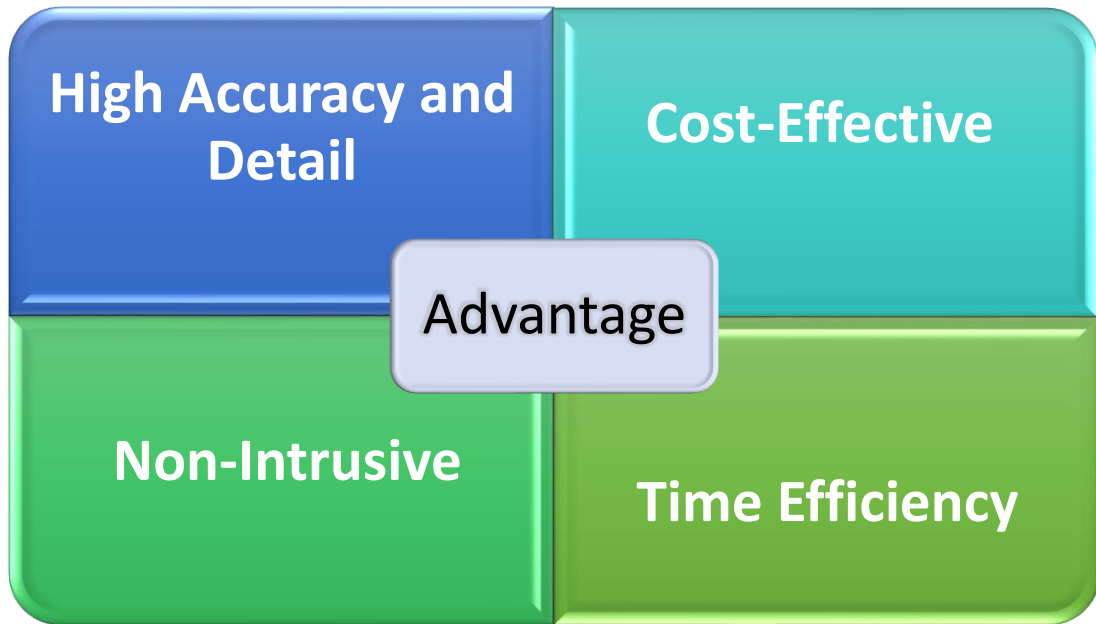
Figure (3): Build Mesh

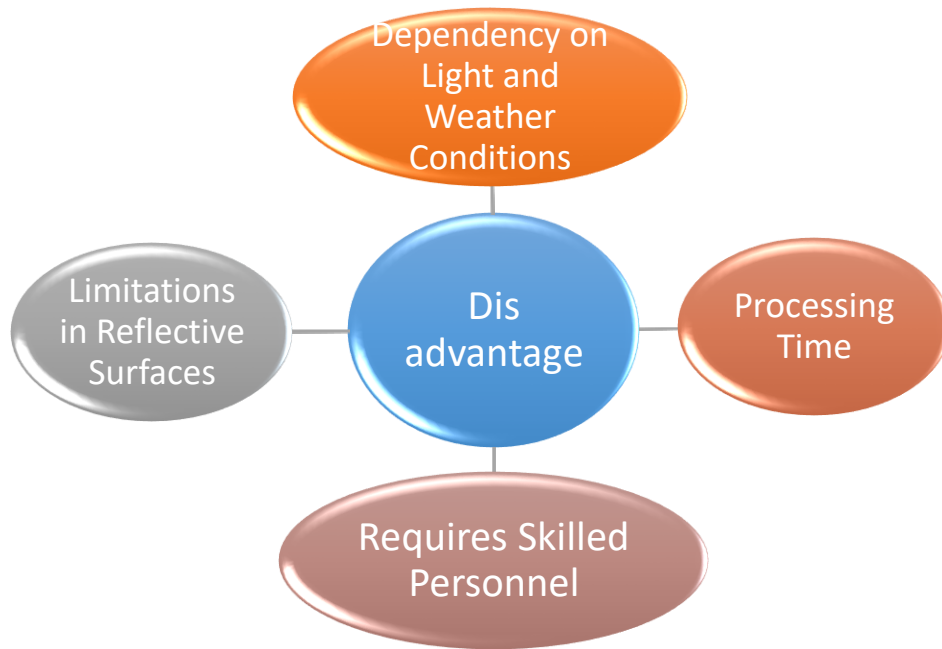




Figure (4):Build Texture

**5.7. Advantage & Dis advantage of Photogrammetry:** (Advantages and Disadvantages of Photogrammetry – Comprehensive Guide, 2024)





Methodological work (Almasri, 2020)

Although the 3D model produced by photogrammetry contains a large number of 3D data, representing the surface of the object, it is still difficult to recognize surface features such as cracks, deteriorated edges, and reliefs

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## **DESIGN AND DEVELOPMENT OF NOVEL APPROACH FOR FILE SHARING FOR SECURITY USING BLOCKCHAIN TECHNOLOGY : LITERATURE REVIEW**

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### **Abstract**

File sharing is a fundamental aspect of data management, and it is essential for collaboration, communication, and data exchange. However, file sharing systems are susceptible to security threats and data breaches, which can compromise data confidentiality, integrity, and availability. A novel approach for file sharing using blockchain technology is required which would ensure secure and decentralized file sharing. The novel approach for file sharing would use a hybrid consensus mechanism, combining proof-of-work and proof-of-stake algorithms, to ensure network security and prevent malicious attacks. It would use multi-layer encryption to enhance file security, where files are encrypted at the user level and the blockchain level. The proposed Novel approach would also incorporate smart contract technology for file access control, where users can set permissions for file sharing and access. The proposed approach was developed and tested using a prototype implementation, and the results show that the system is secure, efficient, and scalable. The system also provides a high level of data privacy and security, making it suitable for various applications, including healthcare, finance, and government.

**Keywords:** Novel Approach, File sharing; Security; Blockchain, Technology

## **1. Introduction**

In recent years, file sharing has become an integral part of our daily lives. It is widely used for sharing information, collaborating with colleagues, and transferring data between individuals and organizations. However, traditional file sharing systems are vulnerable to various security threats, such as data breaches, hacking, and unauthorized access. Blockchain technology offers a decentralized, secure, and tamper-proof environment for file sharing, making it an ideal solution to address the security challenges of traditional file sharing systems. This literature review provides an overview of the current state of research on blockchain-based file sharing systems, their architecture, security mechanisms, and performance.

### **Evolution of Blockchain Technology**

Blockchain technology was initially introduced as the underlying technology for the Bitcoin cryptocurrency. However, since its inception, blockchain technology has evolved significantly, and its application has expanded beyond cryptocurrency to various domains, including file sharing. Blockchain technology is a decentralized, distributed, and tamper-proof database that provides secure and transparent data sharing. The main characteristics of blockchain technology are its decentralized architecture, immutability, and consensus mechanism.

### **Architecture of Blockchain-Based File Sharing Systems**

Blockchain-based file sharing systems are designed to provide a secure and decentralized environment for file sharing. These systems are composed of three main components: the blockchain network, the user interface, and the file storage. The blockchain network is responsible for maintaining the integrity of the system, ensuring the validity of transactions, and preventing malicious attacks. The user interface provides users with an easy-to-use interface for uploading, downloading, and sharing files. The file storage component is responsible for storing and retrieving files securely.

### **Security Mechanisms of Blockchain-Based File Sharing Systems**

Security is a crucial aspect of blockchain-based file sharing systems. The security mechanisms of these systems are designed to provide data confidentiality, integrity, and availability. The security mechanisms of blockchain-based file sharing systems include network consensus, encryption, and smart contracts.

#### **Network Consensus**

Network consensus is the mechanism used by blockchain-based file sharing systems to validate transactions and ensure the integrity of the system. The most commonly used consensus algorithms are proof-of-work (PoW) and proof-of-stake (PoS). PoW is used in the Bitcoin network, and it requires miners to solve a cryptographic puzzle to validate transactions. PoS is used in the Ethereum network, and it requires validators to hold a certain amount of cryptocurrency to validate transactions.

#### **Encryption**

Encryption is the process of encoding data to ensure its confidentiality and integrity. Blockchain-based file sharing systems use encryption to protect files from unauthorized access and tampering. The most commonly used encryption algorithms in blockchain-based file sharing systems are AES and RSA. AES is a symmetric encryption algorithm that uses a shared secret key to encrypt and decrypt data. RSA is an asymmetric encryption algorithm that uses a public key to encrypt data and a private key to decrypt data.

## **Smart Contracts**

Smart contracts are self-executing contracts that are stored on the blockchain network. Smart contracts are used in blockchain-based file sharing systems to implement access control and automate file sharing. Smart contracts can be programmed to execute certain actions when specific conditions are met.

## **Performance of Block-chain-Based File Sharing Systems**

The performance of block-chain-based file sharing systems is affected by various factors, including transaction throughput, latency, and network scalability. The transaction throughput is the number of transactions that can be processed per second. Latency is the time taken to process a transaction. Network scalability is the ability of the network to handle an increasing number of users and transactions. The performance of block-chain-based file sharing systems can be improved by using efficient consensus algorithms, optimized file storage, and network optimizations.

## **II. Literature Review**

### **Muqaddas Naz et al (2019)**

Data sharing within a research community is crucial to maximizing the information gained from earlier work. Current data sharing solutions rely on a reliable third party. Such systems lack trust, transparency, security, and immutability because of the presence of TTP. This article proposes a blockchain-based secure data sharing platform to address these problems by using the advantages of the interplanetary file system. Owner uploads a meta data to an IPFS server, which is subsequently separated into  $n$  secret shares. By performing the access roles that the owner has defined in the smart contract, the suggested system ensures security and access control. Prior to submitting the desired amount as the fee of digital material, users must first confirm their identities using RSA signatures. The user is invited to provide feedback of the data after its successful delivery. The Watson analyzer is used to verify these reviews and weed out any bogus ones. Customers that submit truthful evaluations are rewarded. The greatest number of reviews is therefore submitted for each file. The Ethereum blockchain, decentralized storage, encryption, and an incentive system are all incorporated in this scenario. Solidity-written smart contracts are deployed on a local Ethereum test network to carry out the suggested scenario. Transparency, security, access control, owner authenticity, and data quality are all achieved by the suggested plan. In order to accurately assess the cost of implementing the implemented scenario in a real-world setting, a study of gas consumption and actual cost necessary in terms of USD is conducted in the simulation results. Also, the computational time for several encryption algorithms is plotted to show how well the implemented system, shamir secret sharing, performs.

### **Kanayo Kizito Uka et al (2020)**

The purpose of this study is to examine how a tertiary institution uses blockchain architecture to share and manage files. It is anticipated that this technology will enable an online system that could offer a decentralized architecture for multiple file transfers and sharing among participants, design a system that can ensure data integrity and security of files using IBM Blockchain technology, and provide a system that can support multiple users and multiple transactions at once. The research was spurred on by the security issues with the current system, which include slow file transfer and sharing, giving a single user a lot of power and responsibility in a centralized system, high risk of attack and file loss, sluggish file access/retrieval speeds, and a finite number of concurrent users. The programming language used was HTML, CSS, Java, and Node Js, and the methodology utilized was Object Oriented Analysis Design Process together with IBM Blockchain Technology and Unified Modeling

Language (UML). A decentralized cloud-based file sharing and management system that supports multiple-shared, replicated, and permissioned network transactions was the end outcome of the design process.

#### **Tuan-Vinh Le<sup>1</sup> and Chien-Lung Hsu (2021)**

With the advent of its first and most popular use, bitcoin, blockchain technology has gained recognition as a cryptocurrency platform. Blockchain helps to transform centralized transaction ledgers with low trust, maintained by a single entity, into decentralized ones with high trust, held by several verifying nodes. Blockchain has enormous potential for use in a variety of sectors outside of bitcoin because of its decentralized structure and security resilience. Blockchain transforms the conventional method of centrally storing data into a decentralized, trustless one. Blockchain's inherent security features open the door for large-scale applications that are coupled with cutting-edge technologies like mobile networks, edge computing, or IoT. They present and describe several blockchain security aspects in order to do this. There is a detailed taxonomy of blockchain applications in numerous areas. Also, they examine the security and performance issues with blockchains in their work and provide a number of remedies. The security features of blockchain should be acknowledged more, Work on safe energy and healthcare applications powered by blockchain should continue, and the environmental sustainability of blockchain has to be further addressed.

#### **Md. Nasim Uddin et al (2021)**

Humans rely on centralized systems with trusted third-party administration for sharing material, yet these platforms lack security, trust, immutability, and clarity. By combining the Interplanetary File System and Public Key Infrastructure technologies, this study has suggested a file-sharing environment based on Blockchain, which offers benefits for resolving these issues. The predetermined access-control list is enforced using a modified version of the IPFS software, and the smart contract is used to limit access rights.

In order to secure file sharing, an application framework on a secure decentralized file sharing system is described. It works with IPFS and PKI. Every file transaction is encrypted and decrypted using PKI using public and private keys, and identities are authenticated with Metamask to cryptographically identify account ownership in the Blockchain system. On the private Ethereum network, a gas consumption-based outcome analysis is conducted, and it achieves transparency, securely regulated access, and quality of data suggesting higher effectiveness of this job.

#### **Pabba Sumanth et al (2021)**

The market share of cloud computing, a relatively recent technical development, has consistently grown over the previous three years. In this article, we'll outline a novel approach to sharing files safely via the cloud that combines block chain for secure transactions and file viewing. The use of file-shredding software is widespread. Some individuals use these applications to earn money by selling the files that represent their work.

Chegg, Scribd, and other platforms offering a platform for academics, researchers, and independent contractors to publish their work are well known. Yet we need to be members in order to access these programs. Even if a user want access to the files, the application—not the author—must be paid a charge. We thus developed a novel strategy called as "Cloud-based file sharing utilizing Blockchain" in order to do away with middlemen. Users may simply transfer files utilizing the cloud-based file sharing approach by using our program.

As a consequence, this technology makes it easy and efficient for users to store and distribute information over cloud networks. We often lose control of our data when we upload it to the cloud, which increases the security threats to the integrity and confidentiality of our data. Hence, to prevent this, they will talk about an encrypted secure file sharing system for the cloud in this paper. In this study, we presented a novel file-sharing technique. A block chain is used to transfer the transaction from one user to another in order to see the files.

#### **Yogesh M Gajmal and R. Udayakumar (2021)**

A key element in improving data security in the cloud storage system is access control. The research community has a significant difficulty due to privacy data leaks and key abuse in the present data sharing and access control methods. As a result, the cloud storage system develops an efficient technique known as Blockchain-based access control and data sharing approach to improve data security. Single-point failure in the cloud system is successfully resolved by the suggested Blockchain-based access control and data sharing strategy. By boosting throughput and decreasing cost, it offers greater advantages. With their ID and password, the Data User submits a registration request to the Data Owner, who then processes it and verifies the Data User's identity. With the encrypted master key, the data owner's information is encoded and added to the transactional blockchain. The Data Owner completes the data encryption procedure, and the Interplanetary File System receives the encrypted files. The Data owner creates the ciphertext information and is included in the transactional blockchain based on the location of the encrypted file and the encrypted key. The suggested blockchain-based solution to data exchange and access control performed better according to the metrics, with a reduced response time of 25 seconds and a higher percentage of authentic user detection of 95%.

#### **Xiaowei Wang (2022)**

The expansion of numerous data sharing technologies has increasingly filtered into many industries thanks to the ongoing development of technology. In order to realize the value of the data, data exchange and security are essential. Yet, the original data sharing arrangement makes it difficult to keep an eye out for signs of electronic data usage. Another issue is the data suppliers' unwillingness to release their data. This study suggests a data sharing paradigm based on blockchain technology, providing safe access to data in order to overcome the security and control challenges of conventional centralized data sharing and administration. The model's usefulness and security are also evaluated in this research. The findings demonstrate the high degree of viability, security, controllability, and efficiency of the blockchain-based data sharing paradigm proposed in this study.

#### **Ajitesh Kumar et al (2022)**

The blockchain used in this study organizes network users into groups and maintains a single copy of the blockchain for each group. In contrast to the current bitcoin network and the lightweight blockchain architecture, the study offers a revolutionary blockchain method for safe healthcare sector data management. This mechanism lowers communicational and computing overhead costs. The article also explores how to use the suggested design to deal with the identified risks. The experimental findings demonstrate that the proposed design decreases network bandwidth by ten times and speeds up ledger updates by 63% as the number of nodes increases.

### **III. SUMMARY**

File sharing is a fundamental aspect of data management, and it is essential for collaboration, communication, and data exchange. However, file sharing systems are susceptible to security threats and data breaches, which can compromise data confidentiality, integrity, and



availability. A novel approach for file sharing using blockchain technology is required which would ensure secure and decentralized file sharing. The novel approach for file sharing would use a hybrid consensus mechanism, combining proof-of-work and proof-of-stake algorithms, to ensure network security and prevent malicious attacks.

It would use multi-layer encryption to enhance file security, where files are encrypted at the user level and the blockchain level. The proposed Novel approach would also incorporate smart contract technology for file access control, where users can set permissions for file sharing and access. The proposed approach was developed and tested using a prototype implementation, and the results show that the system is secure, efficient, and scalable. The system also provides a high level of data privacy and security, making it suitable for various applications, including healthcare, finance, and government.

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# THE COMBINATION OF FLEMISH AND COURTLY PAINTING AND THE FIVE SENSES OF PERCEPTION

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## **Abstract:**

This study explores the evolving representation of the senses, specifically 'touch' (Benninga, 2020) in 17th-century Flemish art, focusing on the influence of the cultural and courtly practices of the Spanish rulers of the Southern Netherlands, Archdukes Albert and Isabella. It centers on paintings by Jan, a series by Brueghel the Elder and Peter Paul Rubens from 1617-1618, and related artworks on the same theme. These artworks depict the senses as integral to the cultural identity of the artifacts present in the Archduke's court, drawing from both elite and traditional iconography. The article also delves into the continuity in the portrayal of the senses from 1600 onwards, examining the influence of various artists on the genre paintings of the courtly household and collector's cabinet. The merging of these artistic traditions leads to a reimagining of the courtly interpretation of the senses. This study utilizes scholarly articles and online sources to understand ancient philosophical phenomena comprehensively. The primary question addressed is the impact of Courtly art in the contemporary era.

**Keywords:** Flemish and Courtly Culture, Folklore, Arts and Craft, Liberal Arts, The Glimpses of Europe, Medieval Europe, The Delve of Enlightenment, Peter Paul Rubens, Flanders, 17th century, Five senses, Jan Brueghel the Elder, Spanish Monarchy, The Sense of Touch, Smell, Taste, Sight, Hearing, Personification of the Beauty, Monarchy, Spanish Netherlands, Symbolic Animals, Personification of Senses Visually, Symbolic Representation, Animal's Art, Folklore, Philology, Visualization, The Touch of Medieval Supernaturality Vs. Naturality, A Religious Entity from the Old and New Testament, The Land of Flanders.

**Introduction:** The study delves into the changing portrayal of the sense of 'touch'(Benninga, 2020, p103) <sup>10</sup>In 17th-century Flemish art. It centers on the influence of the cultural and courtly practices of the <sup>11</sup>Spanish rulers of the Southern Netherlands, Archdukes Albert and Isabella. The artworks depicting the <sup>12</sup>Senses play a crucial role in the cultural identity of the artifacts found in the Archduke's court. They draw from both. <sup>13</sup>Elite and traditional iconography led to a reinterpretation of the courtly understanding of the senses.

In the 17th century, the collaboration of <sup>14</sup>Jan Brueghel the Elder and <sup>15</sup>In the 17th century, the cooperation of Peter Paul Rubens in Flanders resulted in remarkable paintings that showcased the senses. These works, commissioned by the Archdukes of the Netherlands, Albert and Isabella, and featured the senses surrounded by lavish objects, symbolic animals, and exquisite artworks, stand as a testament to the significant role of the Archdukes' patronage in shaping the art of the time. This period was characterized by prosperity and political instability, significantly impacting the art and culture of Flanders. After a period of decline and Spanish rule, the Archdukes of Austria, Albert, Isabella, and Clara Eugenia, diligently rebuilt the region, promoting unity and prosperity. Their efforts were instrumental in restoring the region's cultural and economic vibrancy. The signing of the Twelve Years Truce in 1609 brought renewed hope for economic and cultural development during peacetime.

The paintings, a collaboration between Brueghel and Rubens and other artistic endeavours commissioned by the Archdukes, reflected the wealth and tranquillity of Flanders, celebrating the vibrancy and richness of the creative scene during recovery and renewal. These paintings' depictions of the senses offer insight into the evolving cultural and political landscape of 17th-century Flanders. They can be viewed as a commentary on the time's courtly culture and material wealth. The abundance of objects and intricate details in these paintings celebrated the material culture of the court while delving into broader philosophical inquiries about perception and reality.

**Literature Review:** The five paintings in the series are characterized by the fullness and variety of objects. <sup>16</sup>In 'Sense of Hearing' (Benninga, 2020), a nude female personification plays the lute and sings, accompanied by a putto and a stag. This painting, along with 'Sense of Smell' (Benninga, 2020), which depicts the female personification and a putto in a garden of beautiful flowers, is part of a series of five paintings that each represent one of the five senses. Various musical instruments and notes can be seen in the left foreground, while clocks are associated with hearing on the right due to their sounds. The left rear room shows men and women playing music. At the same time, the center opening reveals a landscape including the castles of

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<sup>10</sup> The Changing Perception of the Five Senses. Paragraph 1st. P103.

<sup>11</sup> The Changing Perception of the Five Senses. Paragraph 1st. P104.

<sup>12</sup> The Changing Perception of the Five Senses. Paragraph 2nd. P104.

<sup>13</sup> The Changing Perception of the Five Senses. Paragraph 2nd. P104.

<sup>14</sup> The Changing Perception of the Five Senses. Paragraph 3rd. P104.

<sup>15</sup> The Changing Perception of the Five Senses. Paragraph 3rd. P104.

<sup>16</sup>The Changing Perception of the Five Senses. Paragraph 6th. P105.

<sup>17</sup>Mariemont and the Archdukes.<sup>18</sup>"Sense of Smell" (Benninga, 2020) depicts the female personification and a putto in a garden of beautiful flowers.

In contrast, <sup>19</sup>"Sense of Taste" (Benninga, 2020) shows the personification at a laden table with a satyr pouring wine into her glass. <sup>20</sup>In "Sense of Touch" (Benninga, 2020), the personification kisses the putto, and the background illustrates armour creation. These paintings reflect the courtly life and values of Archdukes Albert and Isabella. The use of nude female figures to personify the senses and their accompaniment by <sup>21</sup>Symbolic animals originate from the prints of the German artist Georg Pencz. <sup>22</sup>Pencz's 16th-century prints departed from the medieval tradition of associating the senses with sin. They associated them with positive symbols, a concept further developed in the 16th century in Antwerp by artists who added noble characteristics to the female allegories and their attendants and scenery.

The representation of the five senses in 17th-century Flemish art, particularly in the works commissioned by Archdukes Albert and Isabella, has been a subject of admiration and criticism. While these paintings celebrated the luxury, prosperity, and cultural identity of the Southern Netherlands at the time, they have also faced criticism for their idealized and sometimes superficial portrayal of courtly life and the senses. One critique revolves around the generosity and material focus of these artworks. The sizing of opulent objects, symbolic animals, and exquisite art depicting the senses may have overshadowed deeper philosophical or social commentary. Critics suggest that the paintings, particularly those by Jan Brueghel the Elder and Peter Paul Rubens, contributed to a romanticized and somewhat disconnected view of the senses, distancing them from the everyday experiences of ordinary people. Another criticism involves the representation of the senses themselves, mainly through the use of nude female figures as personifications. While earlier artistic traditions and symbolisms influenced these depictions, some modern interpretations question the exclusivity and idealization of these representations, pointing out the lack of diversity and the potential reinforcement of traditional gender roles and power dynamics. Some critics argue that the focus on courtly culture and the patronage of the Archdukes may have restricted the artistic exploration of the senses within a broader societal context. The influence of the courtly and elite patrons on the artistic representations of the senses raises questions about the diversity of perspectives and experiences that could have been depicted in the works, considering the varied social strata and cultural currents present in 17th-century Flanders. Overall, while these paintings have been celebrated for their technical brilliance and historical significance, they have also faced criticism for potentially limiting the depth and inclusivity of the representation of the five senses within their time's cultural and social fabric.

**Methodology:** The research methodology employed documentary analysis to investigate the intersection of writing with literature. The study utilized a combination of scholarly articles and online sources to comprehensively understand the evolving representation of the senses in 17th-century Flemish art, specifically focusing on the influence of Archduke Albert and Isabella.

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<sup>17</sup>The Changing Perception of the Five Senses. Paragraph 6th. P105.

<sup>18</sup>The Changing Perception of the Five Senses. Paragraph 7th. P107.

<sup>19</sup>The Changing Perception of the Five Senses. Paragraph 7th. P107.

<sup>20</sup>The Changing Perception of the Five Senses. Paragraph 7th. P107.

<sup>21</sup>The Changing Perception of the Five Senses. Paragraph 8th. P108.

<sup>22</sup> The Changing Perception of the Five Senses. Paragraph 9th. P108.

The primary objective was to explore the impact of courtly art on the portrayal of the senses during that period. The methodology entailed a thorough examination of paintings by Jan, a series by Brueghel the Elder and Peter Paul Rubens from 1617-1618, and related artworks on the same theme. Additionally, it involved an analysis of the influence of various artists on the genre paintings of the courtly household and collector's cabinet from 1600 onwards. The study incorporated a literature review that focused on the range of objects characteristic of the paintings in the series. Each painting representing a different sense was meticulously examined, including the symbolism, arrangements of objects, and the historical context they represented. Overall, this methodology aimed to offer a comprehensive understanding of how the representation of the senses in 17th-century Flemish art was influenced by the cultural and courtly practices of the Spanish rulers and how it continues to impact contemporary interpretations of art. The content of medieval history is always joyful. Therefore, the methodological reflection is also dynamic in its presentation and provides insights for the audience to grasp the topic better. Paintings are central to the essay and are depicted through realized images. Therefore, painting and images are core elements of this article and are integral to the methodology.

**Discussion:** <sup>23</sup>The themes of the Five Senses first emerged in the Early Middle Ages (Nordenfalk, 1985). While scattered instances can be found in <sup>24</sup>Romanesque art (Nordenfalk, 1985), the <sup>25</sup>senses were depicted more frequently in the thirteenth century. There were two common ways of representing them. One approach was to <sup>26</sup>symbolize them with five different animals, based on the belief that certain animals have more developed senses than humans. Early Gothic encyclopedists first systematically laid down this idea, expressed in well-known verses quoted by <sup>27</sup>Thomas de Cantimpre in his *Liber de naturis rerum*. <sup>28</sup>An example of this imagery can be seen in the extraordinary Fuller brooch at the British Museum, dating from the ninth century, which is one of the few secular monuments featuring the Five Senses at this time.<sup>29</sup>"The Deepest Sense: A Cultural History of Touch" (Luhmann, 2014) argues that touch is a physical and cultural act. This idea has roots in <sup>30</sup>Marshall McLuhan's theory that spoken words and sound govern nonliterate societies, while literate societies are dominated by sight. While many anthropologists would disagree with this claim today, there is a growing willingness to argue that sensory perception is shaped as much by cultural training as biological capacity. <sup>31</sup>Researchers at the Max Planck Institute for Psycholinguistics and Radboud University in the Netherlands, led by Asifa Majid and Stephen C. Levinson (Luhmann, 2014),

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<sup>23</sup> The Five Senses in Late Medieval and Renaissance Art. Paragraph 1st.

<sup>24</sup> The Five Senses in Late Medieval and Renaissance Art. Paragraph 1st.

<sup>25</sup> The Five Senses in Late Medieval and Renaissance Art. Paragraph 1st.

<sup>26</sup> The Five Senses in Late Medieval and Renaissance Art. Paragraph 1st.

<sup>27</sup> The Five Senses in Late Medieval and Renaissance Art. Paragraph 1st.

<sup>28</sup> The Five Senses in Late Medieval and Renaissance Art. Paragraph 1st.

<sup>29</sup> Can't Place That Smell? It would be best if you Were American—Paragraph 2nd.

<sup>30</sup> Can't Place That Smell? It would be best if you Were American—Paragraph 2nd.

<sup>31</sup> Can't Place That Smell? It would be best if you Were American—Paragraph 3rd.

studied how language and culture influence sensory awareness. They developed a set of systematic stimuli for the <sup>32</sup>five traditional senses, such as colour chips and geometric forms for sight and pitch for hearing. <sup>33</sup>This research provided quantifiable evidence supporting the influence of language and culture on sensory perception. <sup>34</sup>Amplitude and rhythm variations; for smell, a set of scratch-and-sniff cards; and so forth. <sup>35</sup>They took these kits to over 20 cultural groups around the world. Their results upend some of our basic assumptions. <sup>36</sup>For example, in scientific literature, it's pretty standard to find the view that <sup>37</sup>"humans are astonishingly bad at odour identification and naming" (Luhmann, 2014), as a recent review of 30 years of experiments concluded. When people are presented with the smell of ordinary substances (coffee, peanut butter, chocolate), they correctly identify about half. That's why we think of scent as a trigger for personal memory that leads to the recall of something specific or uniquely our own. In the medieval world, sense is considered integral to the characteristics associated with the Courtly cultural sense and feelings. This encompasses a deep understanding of the sensory and emotional aspects valued and expressed within courtly life during that time. During the fifteenth century, <sup>38</sup>Flemish painters (Harbison, 1984) were renowned for their ability to depict the visible world in their artwork realistically. Contemporary observers, such as the <sup>39</sup>Italian Bartholomeo Fazio, praised Flemish paintings for their intricate details, the portrayal of precious objects, and the subtle play of light. While <sup>40</sup>Modern critics still appreciate these works' illusionistic qualities, they also seek to understand the historical and cultural context that allowed such impressive achievements (Harbison, 1984). <sup>41</sup>The term 'northern realism' was also used to describe the unique style of Flemish art and paintings during this period. In this context, a biblical scene existed during the era that was reflected in the Samaritan model of work and for the good of all. Therefore, Flemish art and paintings reflected those features as a reality and a symbol of society for building a future society based on betterment. The realism of early Flemish art represents religion, economy, social, political and historical issues through images as artwork. <sup>42</sup>According to Fazio and other observers, it is a descriptive realism of particulars (Harbison, 1984). Therefore, the portrayal of the individual objects is a particular set of relations among them.

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<sup>32</sup> Can't Place That Smell? It would be best if you Were American—Paragraph 3rd.

<sup>33</sup> Can't Place That Smell? It would be best if you Were American—Paragraph 3rd.

<sup>34</sup> Can't Place That Smell? It would be best if you Were American—Paragraph 3rd.

<sup>35</sup> Can't Place That Smell? It would be best if you Were American—Paragraph 3rd.

<sup>36</sup> Can't Place That Smell? It would be best if you Were American—Paragraph 4th.

<sup>37</sup> Can't Place That Smell? It would be best if you Were American—Paragraph 4th.

<sup>38</sup> Realism and Symbolism in Early Flemish Painting. Paragraph 1st.

<sup>39</sup> Realism and Symbolism in Early Flemish Painting. Paragraph 1st.

<sup>40</sup> Realism and Symbolism in Early Flemish Painting. Paragraph 1st.

<sup>41</sup> Realism and Symbolism in Early Flemish Painting. Paragraph 2nd.

<sup>42</sup> Realism and Symbolism in Early Flemish Painting. Paragraph 4th.

The paintings of the five senses are an outcome of this vision, visually expressing the prosperity of Flanders under a peaceful reign. What follows will be an analysis of the five senses' paintings concerning the subject's iconography, on the one hand, and regarding the arising genre themes, on the other. This analysis will highlight the changing approach towards the senses in 17th-century Flanders as an outcome of the Archdukes' cultural politics and courtly culture.

<sup>43</sup>The text describes a painting called "The Sense of Sight" (Benninga, 2020, p105), depicting a nude personification of sight in a collector's cabinet full of magnificent objects. The room is so full it is hard to account for everything in it, and through an arched doorway, a terrace and the Archduke's residence can be seen. <sup>44</sup>The painting is part of a series, including "Sense of Hearing" (Benninga, 2020, p105), portraying a nude female personification playing the lute and singing, accompanied by a putto and a stag (Benninga, 2020, p105). Various musical instruments and notes can be seen, and in the background, there is a scene of men and women playing music. <sup>45</sup>The Sense of Smell (1617–1618, Prado, Madrid) shows the female personification and her putto in a garden full of beautiful flowers. <sup>46</sup>The Sense of Taste (Benninga, 2020, p107) shows the dressed personification by a laden table. Satyr pours wine into her glass. <sup>47</sup>In the Sense of Touch (1618, Prado, Madrid), the personification kisses the putto beside her. The armour on the left and the paintings on the right allude to the collection of the Archdukes.

The forge in the left background shows the making of armour. These paintings are groundbreaking, associating the senses with the courtly life and values of Archduke Albert and Isabella. However, when examined closely with the visual history of the senses, it becomes clear that many elements have been adopted and developed from earlier iconography of the subject. The use of <sup>48</sup>nude female figures for the personification of the senses and their accompaniment by symbolic animals<sup>49</sup> stems from the first prints dedicated to the five senses by the German artist Georg Pencz<sup>50</sup>. The text describes <sup>51</sup>16th-century engravings by Pencz and Floris, which depict the senses as female personifications accompanied by symbolic animals. These engravings were a novelty at the time, as they portrayed the senses with positive symbols contrary to the long medieval tradition associating them with sin. Floris added noble characteristics to the female allegories and their symbolic attendants and scenery, associating the senses with abundance and prosperity. Floris's depiction of the sense of sight shows a noble lady peering into a mirror, with the blaring sun and an eagle in the background, symbolizing

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<sup>43</sup> The Changing Perception of the Five Senses. Paragraph 5th. P105.

<sup>44</sup> The Changing Perception of the Five Senses. Paragraph 6th. P105

<sup>45</sup> The Changing Perception of the Five Senses. Paragraph 7th. P107.

<sup>46</sup> The Changing Perception of the Five Senses. Paragraph 7th. P107.

<sup>47</sup> The Changing Perception of the Five Senses. Paragraph 7th. P107.

<sup>48</sup> The Changing Perception of the Five Senses. Paragraph 8th. P108.

<sup>49</sup> The Changing Perception of the Five Senses. Paragraph 8th. P108.

<sup>50</sup> The Changing Perception of the Five Senses. Paragraph 8th. P108.

<sup>51</sup> The Changing Perception of the Five Senses. Paragraph 8th. P108.



nobility. <sup>52</sup>Floris depicts the “sense of touch” (Benninga, 2020, p109) as a bird biting the personification's hand, relating touch to pain and suggesting sexual relations. Floris intricately weaves <sup>53</sup>the sensations of touch, pain, and love by incorporating various symbolic animals and actions in his designs. Contrastingly, Pencil's <sup>54</sup>symbolic representation is more simplistic, using only one animal and action. Floris enriches the symbolic meaning of his designs by incorporating multiple attributes, amplifying the depth of his work. Floris's depiction of the senses also showcases many objects and symbolic attributes. <sup>55</sup>For instance, compared to Pencil's portrayal, Floris's personification is surrounded by an impressive array of ten musical instruments. This attention to detail furthers the complexity and depth of the representation of the sense of hearing. Additionally, Floris consciously replaces symbolic animals and modifies the settings in his works, emphasizing his intention to elevate the depiction of the senses. In another context, the artwork <sup>56</sup>“Sense of Taste” by Flemish artist Maerten de Vos (Benninga, 2020, p110) presents a captivating scene rich with symbolism and allusions. <sup>57</sup>The personification of Taste is depicted alongside various elements such as fruit baskets, a wine jug, a wine cup, an apple tree, and even a nibbling monkey. These elements expand on previous designs and include references from <sup>58</sup>the Old and New Testaments, providing a rich and layered narrative. Artists like <sup>59</sup>Ghrel and Rubens also employ allegories of the senses, integrating objects, animals, landscapes, and biblical references. Their artworks not only prompt viewers to question the significance of what they see but also challenge them to contemplate whether each representation of the senses embodies positive or negative aspects. This artistic elaboration could respond to societal concerns about the influx of new knowledge and scientific advancements. In “Sense of Sight,” for example, the positive portrayal of sight, mainly through the image of Christ, reflects the value assigned to this sense in that particular context (Benninga, 2020, p112). These artworks not only serve as aesthetic expressions but also as thought-provoking reflections of societal attitudes and anxieties. <sup>60</sup>The composition features antique busts on the wall at the center, juxtaposed with a contemporary painting of Archduke Albert and Isabella on the left. This juxtaposition displays past and present portrayals of rulers. <sup>61</sup>In the right foreground, Rubens's painting “Bacchanal” (Benninga, 2020, p113) is positioned against Brueghel's portrait of the Madonna and Child in a garland of flowers. The comparison raises questions of precedence and influence, challenging viewers to ponder what they see.

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<sup>52</sup> The Changing Perception of the Five Senses. Paragraph 12th. P109.

<sup>53</sup> The Changing Perception of the Five Senses. Paragraph 12th. P109.

<sup>54</sup> The Changing Perception of the Five Senses. Paragraph 12th. P109.

<sup>55</sup> The Changing Perception of the Five Senses. Paragraph 12th. P110

<sup>56</sup> The Changing Perception of the Five Senses. Paragraph 13th. P111.

<sup>57</sup> The Changing Perception of the Five Senses. Paragraph 13th. P111.

<sup>58</sup> The Changing Perception of the Five Senses. Paragraph 13th. P112.

<sup>59</sup> The Changing Perception of the Five Senses. Paragraph 14th. P112.

<sup>60</sup> The Changing Perception of the Five Senses. Paragraph 14th. P113.

<sup>61</sup> The Changing Perception of the Five Senses. Paragraph 14th. P113.

<sup>62</sup>Brueghel's "Madonna and Child in a Garland of Flowers" (Benninga, 2020, p113) is juxtaposed with real flowers in a blue vase on the left, referring to the contest between art and nature, depicting art as the victor. A terrestrial globe in the mid-right ground is contrasted with an astrolabe showing the heavenly spheres, alluding to a vision of the earthly and divine. <sup>63</sup>The instruments for such vision are laid out at the personification's feet, denoting the varied and changing nature of "seeing." In <sup>64</sup>"The Sense of Taste," paintings in the background show <sup>65</sup>"The Wedding at Cana" on the right and <sup>66</sup>"The Fat Kitchen" on the left (Benninga,2020, p 113-114). In "The Wedding at Cana" (Benninga, 2020, p113), the personification of Taste is placed under the figure of Christ, visually associating courtly Taste with Christ's miracle.

"The Wedding at Cana"<sup>67</sup> is compared to the painting "Fruit Garland with Offering to Ceres" by Jan Brueghel the Elder and Hendrik van Balen. The painting symbolizes the fruit of the earth and alludes to taste through the Roman goddess Ceres. The photographs depict intricate details, comparing natural food sources and their artisanal preparation. They also represent still life in the painting genre of the time. They also evoke a sense of Taste, incorporating various cultural connotations. The sense of touch is depicted in armour, referencing the pains of war and conflict and adding new positive meanings to its portrayal, such as love relations. The series ultimately positions the senses as intertwined with a complex web of cultural artifacts, reflecting the elite experience of the time as portrayed in courtly companies and gallery cabinets in Flanders.

**Conclusion:** The text discusses depicting the Five Senses in art during the Early Middle Ages and how touch is perceived as a physical and cultural act. It also mentions the influence of language and culture on sensory perception, as demonstrated by research conducted by the Max Planck Institute for Psycholinguistics and Radboud University. Furthermore, the text touches on the importance of sensory and emotional aspects in courtly life during the medieval period, as well as the renowned ability of Flemish painters to realistically depict the visible world in their artwork during the fifteenth century. The courtly and Flemish paintings from the 17th century offer valuable insights into that time's cultural, political, and artistic landscape. These artworks provide a window into the influence of the Spanish rulers, Archdukes Albert and Isabella, on the representation of the senses, particularly 'touch' (Benninga, 2020) in Flemish art. They depict the integration of elite and traditional iconography, reflecting the courtly understanding of the senses and the cultural identity of the artifacts in the Archduke's court. The collaboration between artists such as Jan Brueghel the Elder and Peter Paul Rubens resulted in remarkable paintings that celebrated the senses, surrounded by lavish objects and symbolic animals. These works, commissioned by the Archdukes, stand as a testament to the significant role of their patronage in shaping the art of the time.

Furthermore, the paintings reflect Flanders' prosperity and political instability during that period and shed light on the region's recovery and renewal after a period of decline and Spanish rule. Studying these paintings allows the audience to understand the courtly culture, material wealth, and philosophical inquiries about perception and reality during that era. The representation of the senses in these artworks, characterized by the fullness and variety of objects, provides valuable insights into Archduke Albert and Isabella's courtly life and values.

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<sup>62</sup> The Changing Perception of the Five Senses. Paragraph 15th. P113.

<sup>63</sup> The Changing Perception of the Five Senses. Paragraph 16th. P113.

<sup>64</sup> The Changing Perception of the Five Senses. Paragraph 17th. P113.

<sup>65</sup> The Changing Perception of the Five Senses. Paragraph 17th. P113.

<sup>66</sup> The Changing Perception of the Five Senses. Paragraph 17th. P113.

<sup>67</sup> The Changing Perception of the Five Senses. Paragraph 18th. P113.

It's also worth noting the influence of German artist Georg Pencz's 16th-century prints on the representation of the senses, departing from the medieval tradition of associating the senses with sin and instead associating them with positive symbols. The article conveys a philosophical perspective on the flourishing Flemish and Courtly culture of the Medieval era, as evidenced by their paintings, images, and artistry. These glimpses of the Medieval world have endured over time and serve as a source of enlightenment and empowerment for future generations. The courtly interpretation of the senses as depicted in these paintings continues to inspire contemporary artists and scholars, shaping our understanding of the role of art in reflecting cultural identity and societal values. Overall, the courtly culture and the portrayal of the senses in 17th-century Flemish art continue to be a significant source of inspiration and influence in the contemporary era, shaping artistic expressions and contributing to the ongoing dialogue about perception and cultural identity.



Figure 1: Peter Paul Ruben and Jan Bruegel, the Elder- The Sense of Sight and Smell. [Rubens Brueghel Sight Smell.jpg \(1000×657\) \(pubhist.com\)](#)



Figure 2: Jan Bruegel, the Elder, The Senses of Hearing, Touch and Taste, 1618.[file-bruegel-d-jan-the-senses-of-hearing-touch-and-taste-1618-1.jpg!Large.jpg \(750×501\) \(wikiart.org\)](#)





1500-1550. The Sense of Sight.

[2017 NYR 14020 0098 005\(georg\\_pencz the seven deadly sins\).jpg \(1811×2717\) \(christies.com\)](#)



Figure 4: Frans Floris Touch. [\\_ccfO8rUGWCGJeM2cVw32mpUsuSep0nkp6FmJRbAb-R2\\_fc6TlzsNn0zu4VE \(512×387\) \(ggpht.com\)](#)



**Figure 5:** The five senses (series), Hearing, after Maerten de Vos, printed by Raphaël Sadeler (I), 1581

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# **CUTTING-EDGE TECHNOLOGY: AN APPRAISAL OF THE EFFICACY OF INTERNET SERVICES IN ACADEMIA AND ITS RELEVANCE IN EDUCATIONAL MANAGEMENT**

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## **Abstract**

The transformative impact of cutting-edge technology on education is immeasurable. The education sector was among the pioneers that embrace the use of internet services and has continued to explore the opportunities within its sphere. Today, the survival of academia without internet services is hardly imaginable as the various fields of education have found useful applications in online services, library catalogues, digital administrative systems and electronic learning systems. Thus, the internet has been a vital tool that is driving institutions of learning to greater heights in the journey of knowledge-based economy. This paper is a quantitative survey on the application of internet services in the education sector. The paper discussion provides an assessment of the relevance of internet utilization in learning fields. Some of the challenges associated with the use of internet in education were highlighted. In order to collect relevant data for the paper work, online Google form questionnaire instrument was used to gather vital information from respondents and subjected to reliability analysis. In conclusion, the paper affirmed that the internet is a major tool in the era of information and communication technology and it enhances the capability of students' studies and professional career. Finally, recommendations were made.

**Keywords:** Technology, Internet Services, Academics, Educational Management.



## INTRODUCTION



The incorporation of modern day technology into the various sector of human society is increasingly having transformative impact on all aspects of human endeavor including the education industry. Notably, among the pioneers to embrace the use of the internet is the education sector which has since continued to explore the services offered by the internet within its institutions of learning. The internet has essentially served as useful tool in various educational activities ranging from teaching to research. It has also been

used in different cognitive applications including online services, library catalogues, digital administrative systems and electronic learning systems. Higher institutions of learning are now investing on internet services because it is found to be helpful as medium of information sharing. Internet services encompass all of the facilities of the internet that assist in communication and collaboration; they include e-mail, Bulletin board, File Transfer Protocol (FTP), Discussion group, Usenet and Google Classrooms. Today, academia can hardly survive without internet services. Internet services are capable of providing researchers and scholars with enabling environment to overcome the barriers of communication and provide institutions of learning with the opportunity of presenting their research findings to others across the world. Internet services enable: lecturers to download free e-journals and e-books, prepare up-to-date lecture notes and send them to their students, use e-mail for collaboration with their colleagues and update their knowledge. Students can also use the internet services for other contemporary applications such as entertainment, eMarking and eDating.

## LITERATURE REVIEW

The internet is a worldwide network system that interconnects autonomous set of commercial, business, public, academic and government networks in order to enable global communication and access to information resources. Techopedia, (2020), sees the internet as a worldwide communication system that composes of both hardware (i.e., computer, mobile phone, etc. ) and infrastructure (i.e., protocol, mode of connectivity, etc. ). Yebowaah (2018), identified the internet as the major information and communication technology that has caused a global change in information quality. There are several services offered by the internet including World Wide Web. According to Ameyaw & Asante (2016), the availability of internet services is critical for the survival of all aspect of the society including education. Yebowaah (2018) explains that the internet helps to gather various types of data that college students and senior high school students use. Accessibility to internet resources and services is therefore crucial for learners (Akande & Bamise, 2017). Munangatire (2021) reveals that that the benefits of using online teaching and learning include flexibility, individualized learning and increased interaction between teachers and students. Blackwell, et al. (2014) outlines the devices that can be utilized as internet-based learning to include mobile phone, tablet, iPod, laptop and other computing gadgets. Among the platforms that can be used for "internet-based" learning include social media (Wolfson, et al., 2014), the web (Khatri, et al., 2016), blog (Noel, L.,2015) & blog videos (Shih, R., 2010)



## **Applications of Internet Services in Education**

The internet offers various opportunities. Such as:-

### 1. Information retrieval:

The key advantage of using the Internet is in the area of increased accessibility to reference materials and data for all categories of its users. The internet allows users with any software and hardware to retrieve the needed information from the network.

### 2. Individualized learning and teaching:

The importance of using internet services is in its prevalence of the “person-to-person” communication on using the Net. Internet application in education facilitates the practice of learners interacting directly with experts in the same or different fields.

### 3. Group learning and teaching:

Many learners are accessible to online presentations or lectures material that are partially or fully published on the Net using paradigms such as electronic mail discussion lists (Listservs) and electronic bulletin board (BBS) where students have access to “read-only” course notes.

### 4. Collaborative activities:

The Net is an environment essentially designed for collaborative work of group of learners or researchers from various remote territories of educational spheres. The Internet technology has given rooms for joint use of educational resources.

## **Challenges Associated with the Use of Internet in Education**

Internet-based learning is very helpful in achieving educational objectives but it is still experiencing many obstacles. These include:

### 1. Distraction:

This is a major challenge where students’ extreme desire to use the Internet causes renders them to unable to accomplish regular daily tasks. Studies have proven that students are susceptible with difficulties such as anxiety, impulsive control and mood disorders.

### 2. Spending Too Much Time Online:

In this situation, students are prone to ignoring their academics but rather spend more time online. Many students devote less time to their studies and instead waste their precious time talking with pals or watch movies over the Internet.

### 3. Privacy Issues:

The internet threatens students' data and privacy as hackers sometimes use the internet to break into students' mobile phones or computer in order to steal their personal information and also blackmail them.

### 4. Cyber bullying:

This is a common negative consequence of the use of the internet. Some mean students use the internet to oppress or harm other fellow students.

### 5. Health Concerns:

The excessive use of the internet sometimes create a number of health issues including back pain, neck discomfort and eye pain. Also, the rays emitted from smart devices are known to cause various eye disorders resulting to eye health disorder such as difficulty focusing and impaired vision.

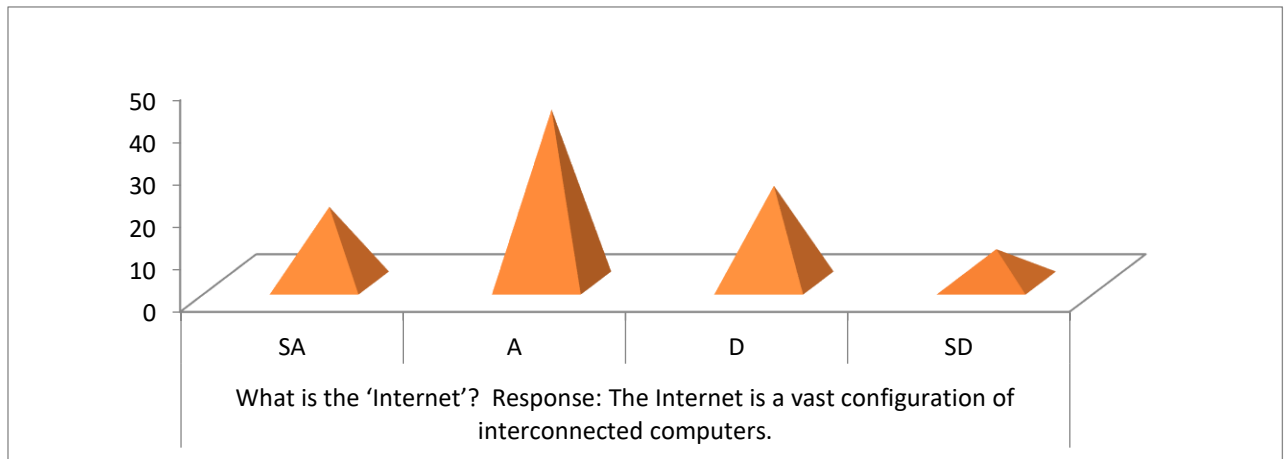
## **MATERIALS AND METHODS**

This paper adopts a quantitative survey approach on the relevance of internet services in learning fields. The researcher interviewed 100 respondents including students, teaching and non teaching staff from 10 selected schools from 5 different education zone in Lagos State, Nigeria. In order to gather useful data for the paper write-up, carefully drafted copies of questionnaires were administered the respondents using online Google form questionnaire instrument. The responses were gathered and subjected to Cronbach’s alpha reliability analysis.

The result of 0.86 gave a good reliability index of the instrument. The entire exercise took place within the space of 28 days before completion.

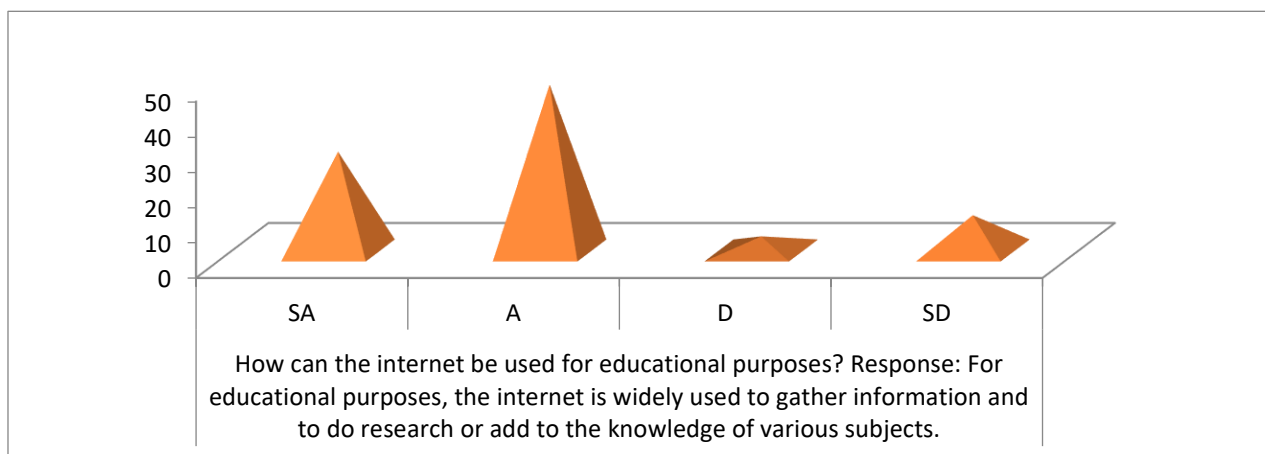
## RESULT AND DISCUSSION

**Fig.1: Chat Analysis**



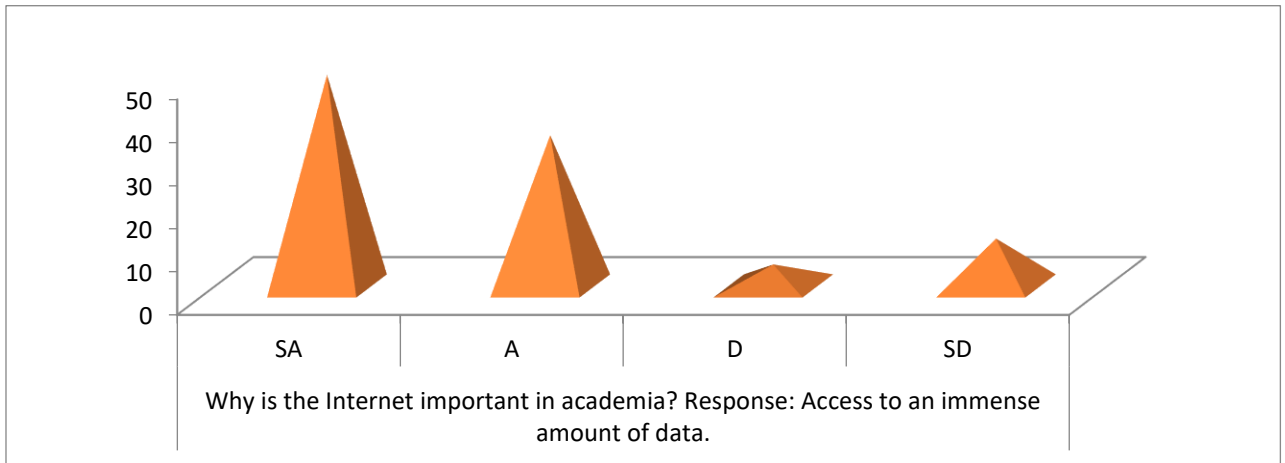
The graph plotted in figure 1 indicates that most of the respondents are technology inclined. The respondents are fully aware that the internet is a vast configuration of interconnected computers. According to the respondents, the internet consists of computer peripheral components, satellites, telephone lines and numerous assorted device infrastructures. The respondents further noted that the components of the internet encompasses of smaller domestic, business, academic and government networks that convey various data and services including file transfer, online chat, electronic mail, interlinked web pages and other web resources.

**Fig.2: Chat Analysis**



The graph plotted in figure 2 reveals that the internet applications cut across a variety of purposes including education. A higher number of the respondents inferred that the internet can essentially serve a number of educational purposes especially in gathering vital data or information and also for carryout research in various fields. Other uses of the internet include collaborative learning, individualized learning, language learning, virtual tours and evaluation purposes.

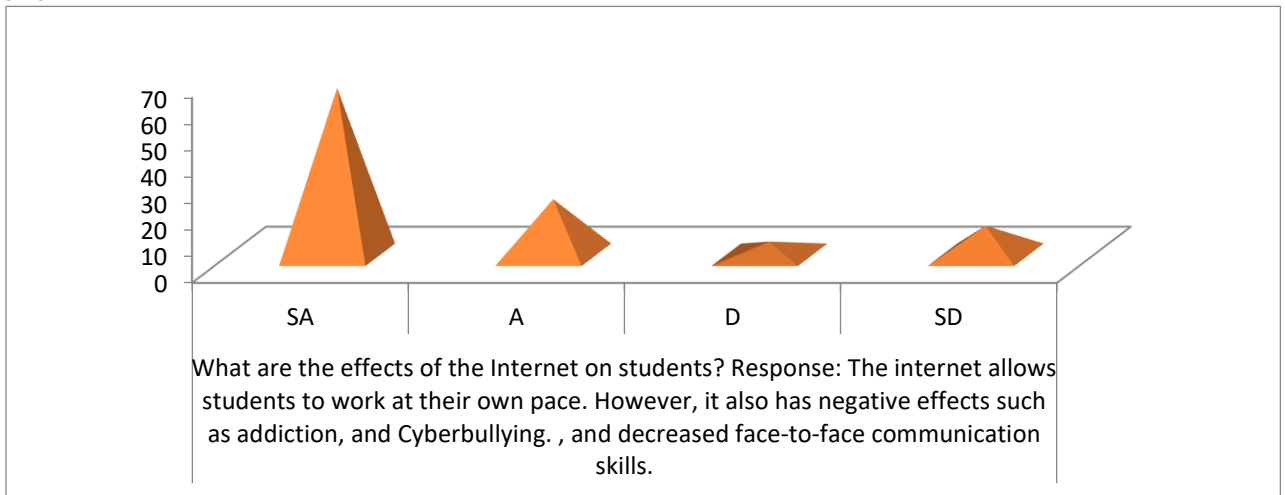
**Fig.3: Chat Analysis**



The graph plotted in figure 3 depicts that majority of the respondents actually supports that the internet is inferably important because gives not just tutor but learners the access to an immense amount of data. According to the respondents, there are times when educators or researchers need to acquire journals, books or other publications for academic purposes. The internet provides them with the opportunities to acquire these materials in digital format with just one

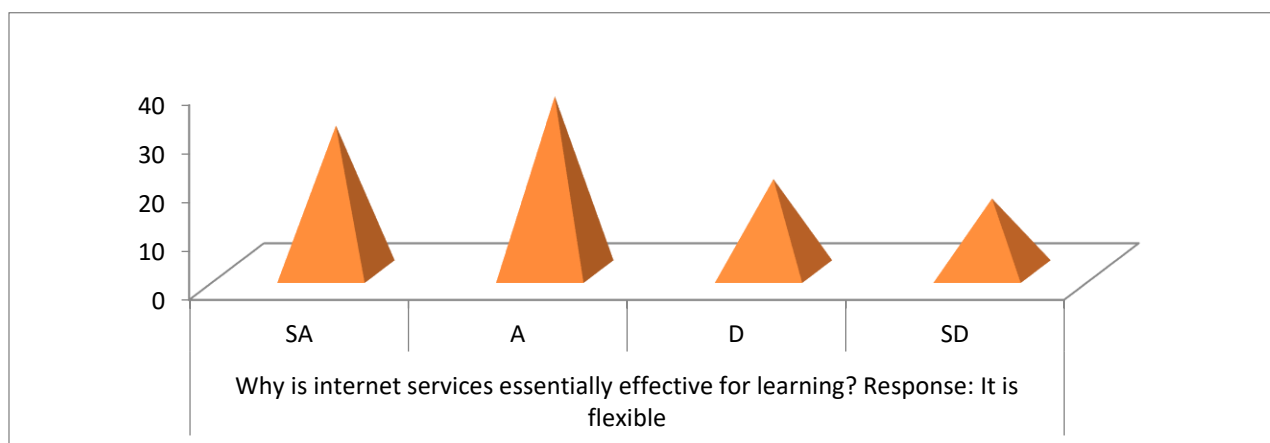
**Fig.4: Chat Analysis**

click



The graph plotted in figure 4 shows that a greater number of respondents agree with the statement that the internet allows students to work at their own pace. The respondents further added that the internet enables asynchronous communication which is most suitable for those who are anxious or may feel uncomfortable in conventional classrooms. In the cases of students who are having difficulty with their schoolwork, they will be able to find useful materials written by academicians and other professionals that may be of help. However, the respondents emphasized that the internet also has its negative effects on students such as online addiction and Cyberbullying.

**Fig.5: Chat Analysis**



The graph plotted in figure 5 signifies that a bigger amount of respondents asserted that the internet can significantly be effective for learning. The respondents inferred that the internet services are flexible. According to the respondents, using an online platform for educational purposes allow for better academic work. Viz, the internet allows students to take control of their own learning. More so, the internet provides access to a wide range of information thereby enriching learning process.

## **CONCLUSION**

The discussion on this paper provides a quantitative assessment of the services provided by the internet to the education industry. The paper asserted that the significance of internet services to academia cannot be over emphasized. This is achieved through the regular exposure of internet users to up-dated information in the various fields of learning. This paper evaluated the application of internet services and highlighted some of the challenges confronted using the internet including distraction, spending too much time online, privacy issues, cyber bullying and health concerns. Amidst these challenges, reduction in the cost of using the internet could go a very long way to enable its users have more access to relevant and updated academic materials.

## **RECOMMENDATION**

While this study, highlights the importance of the utilization of internet services in the education sector, the under listed recommendation are necessary for optimizing the use of the internet. Viz:-

1. Government should as a matter of necessity improve the state of power availability and stability in educational institutions.
2. The is need for extensive training at regular interval for students, teaching and non-teaching staff of learning institutions on how to leverage the use of internet services in academia.
3. Educational managers should acquire high speed internet connectivity with maximum bandwidth for academic use.
4. The charges for browsing should be minimized so that users access to the internet can increase.

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## **JAPANESE ETHICS: A KEY TO UNDERSTANDING AN ASIAN CULTURE**

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### **Abstract**

The purpose of this paper is to use knowledge of ethics in Japanese culture to better understand its mindset, which is so different from those of Western cultures. Ethics in Japanese culture coincides with the study of the human beings. For a human being to be ethical, what is needed is for them to be selfless, by negating their individuality and personal independence. These views are available from Watsuji Tetsuro's Rinrigaku, which refers to the principles standing at the basis of human beings' living together in a friendly community. Robert Carter and Yamamoto Seisaku have translated them and made them accessible to the Western public, allowing for them to understand the differences between their ethics and Asian ethics. We notice that individualism is practically negated by the Japanese ethics, which explains why their society is collectivistic, and why the individuals always consider their action in relation to the good of the community. Additionally, Japanese ethics considers human beings as innately good, and disturbed only by evil spirits, according to Shintoism, which is why rituals have the purpose of sending away the evil spirits, since evil comes from the outside, not from the inside. Western philosophy also believed in the inner good of man and his corruption by society. For the Japanese, society can be improved through collective action.

**Keywords:** collectivism, individualism, values

## Introduction

The concept of ethics, for any culture, refers to landmarks in moral values and principles which can guide a certain people's lifestyle, behaviour, and ways of thinking. Ethics can be seen as a set of rules, yet these rules are not simple sets of laws. They are, all of them, related to the way in which the human beings relate to themselves, as well as to the others, in their relationships to other persons, as well as to the entire community.

For the Japanese culture, its ethics overlaps with what is known as the study of human beings. Watsuji Tetsurão's *Rinrigaku* is the reference text to Japanese culture ethics (Carter, 2001), and, in its literal translation it means "the principles that allow us to love in friendly community" (Watsuji et al, 1996). The writing *Rinrigaku* by Watsuji Tetsurão, which is popularized for the Western culture reading audience by Yamamoto & Carter (1996), is considered to be "the definitive study of Japanese ethics" and has been considered so "for half a century" (Watsuji et al, 1996). Watsuji et al (1996) have translated the ethics of Japanese culture, and they offer the occasion for the Western audience to better understand the Japanese culture mindset. The Japanese cultural mindset is that of a collectivistic culture. When it comes to ethics, it resonates with the collectivist culture mindset since, in order to be considered ethical, selflessness of an individual is encouraged, to the point where they also negate their personal independence. Selflessness becomes, in this way, synonymous with "the true meaning of goodness" (Watsuji et al, 1996).

Such a view can make sense when we consider that ethics means considering, after all, any individual as being part of a community and as having relationships with the others. By interacting with the others, the individual acquires a certain sense of responsibility. Part of the individual's responsibility towards the others includes a correct, honest behaviour. It also includes treating them correctly. In addition, individual responsibility towards society can also be included here.

Being nice and kind to the others, as well as fair, and treating the others equally can be considered part of ethical behaviour of an individual. When we live in a community, we have both individual rights, as well as obligations and duties towards the others.

According to Japanese ethics, the human beings are innately good (Carter, 2012). They are only disturbed by evil spirits in their not so good actions. Thus, they are influenced to do wrong by external forces. Evil does not come from the inside. It has, instead, an external source. The native religion to Japan, Shintoism, includes rituals that have, as a purpose, sending evil spirits away. These evil spirits are the same that influence human beings to behave in wrong ways which are, after all, considered to be contrary to their inner good nature. Here we notice similarities with a belief in Western culture philosophy in the inner good of man, and the way that human beings are corrupted by society.

Therefore, we can expect Japanese ethics and Western culture ethics to be not only different, but also to share some common points. After all, ethics is about a sense of values. Values can be defined as the preference of a state of affairs over another state of affairs (Baciu, 2012), such as good vs bad, wrong vs right, beautiful vs ugly, and so on. Such values can have some universal components. Even the idea that human beings are, after all, both individuals with their own rights and having responsibilities towards the society they are part of, can be considered a universal state of affairs. In addition, in all our relationships, we can consider ourselves to be both independent, and to be able to consider our own needs within a relationship, as well as the needs of the other person. We consider the needs of the other person through our capacity for sympathy and empathy. We can try to put ourselves into someone else's shoes and see things from their point of view. We are never isolated from society and, therefore, we are never free from our responsibilities to the community we are part of.

However, the aspect of the individual as part of the community can be more pronounced in collectivistic cultures such as the Japanese culture.

## Materials and Methods

Compassion is the key element for Japanese ethics. We can consider it as a starting point for an ethical behaviour system, which in Japan starts from an honest feeling of genuinely considering the needs of the others, which is likely part of their mindset as a collectivistic culture. With a collectivistic culture (Hofstede, 2011), the individual always acts and thinks of him or herself as being part of a group, and not being independent from it, or separated from it. The others, any group, family, society, colleagues at work and at school, the other inhabitants of the city, all of them are considered and not considered to be set aside easily.

Carter (2019) mentions what looks like a definition of ethics for the Japanese, namely “a demand to show compassion (fellow-feeling or human-heartedness) in one’s dealings with others and with the world of nature.” Therefore, the human beings in Japanese culture, according to their mindset, are supposed to show compassion for, or, even more than that, to feel a strong connection with, not only with the other people, but also with their surrounding environment, and, more specifically, with nature. Ethics for the Japanese culture becomes a means of understanding each human being individually in a larger context of their life, with intertwining connections to the world around them symbolized by their relationships with other persons, as well as with the nature that is present around them. We notice how, for the Japanese culture members, ethics becomes synonymous, in the understanding of Western culture members, with a worldview, with psychology, with lifestyle, with dealing with relationships and thinking about the natural environment. The human being is integrated within a larger picture in the Japanese sense of ethics, and ethics becomes more than just a normative code of behaviour, meant to discipline and to educate. It is an honest, authentic belief that they apply in their life and ways of thinking.

Carter (2019) leads us to understand that the Japanese ethics are reflected in the traditions and rituals that make up the culture identity manifestations grid devised by Baciu (2012). Traditions and rituals present in what Carter (2019) calls the “Japanese arts,” of which he mentions “the ways of tea, flowers, calligraphy, landscape design, and the indigenous martial art called aikidō,” are understood as being part of the main core of the Japanese ethical system. The main core of the Japanese ethical system is compassion, or, according to the concept used by Carter (2019), “human-heartedness.” Human-heartedness, according to Carter (2019) is taught through the “Japanese arts” which were previously mentioned. Therefore, the Japanese arts work to reinforce what Baciu (2012) includes in the grid of culture identity manifestations, namely values, which make up the core of any culture and which are resistant in time. Values are what holds the members of a culture together, and the central point of the respective culture. For Japanese culture, human-heartedness, or compassion, is the central value. This value is further reinforced through practices and traditions such as the Japanese arts.

The dimension of honest connection with the other human beings and with the environment is highlighted by Carter (2019) through the mention that “human-heartedness should arise spontaneously and without calculation, as an effortless revelation of one’s true nature.” According to Carter (2019), the specific feature characterizing an ethical person is that of that person having “a passion for acting well, for not causing undue pain to others, and for nurturing and protecting the environment at large.” For the Japanese culture, the interconnection between the individuals and other people, as well as individuals and nature, come as part of the awareness that “we are all interconnected, that we are one with others and with nature” (Carter, 2019).

The strong connection of Japanese culture members and nature comes from Shintoism, which is the native religion of Japan. According to this religion, nature is tied to spiritual belief. Human beings are not above nature, but part of it, just like all other elements of nature. It is Shintoism that underlines that human beings should have a relationship of harmony with nature (Rayhan,



2023). Moreover, according to Shintoist belief, in nature, everywhere around us, we can find good spirits called kami. Every element in nature has a spirit (Rayhan, 2023).

Based on Shintoism, an ethical system of beliefs has been developed. According to BBC (2024), the Shintoist system of ethics does not consist in a “a set of commandments or laws that tell the faithful how to behave.” Instead, it has at its basis “following the will of the kami.” The importance of relationships with the others in Japanese culture is thus present in this system of beliefs as well. The way of the kami includes the individuals having a certain relationship with the kami, namely one of equality. This can be significant since otherwise the Japanese culture is, at least traditionally, based on a hierarchical system of relationships, and not on one of equality. Thus, power distance in Japan is, traditionally at least, high (Richardson & Smith, 2007; Oetzel et al, 2001; Yamamura et al, 2003). By being placed on an equal footing with the kami, the individuals can feel a closer emotional relationship and, therefore, be able to experience compassion and emotional connection easier.

Going on reading the material presented by BBC (2024), we notice that the ethical belief system of Shintoism is a human one, since not even the kami spirits are perfect. They can make mistakes. Western culture members recall how their religious faith includes a God that is perfect, yet the system of punishment, and guilt, is a severe one. Perhaps Shintoist ethics helps people to be more understanding to themselves and to others.

Moreover, according to BBC (2024), for Shintoist ethics, there are no absolute moral values. What is good and what is bad is judged as being so based on the context, by taking into consideration “circumstances, intention, purpose, time, location.” From this point of view, Shintoist ethics are closer to what Western culture members understand as philosophical ethics, and not religious ethics.

BBC (2024) mentions that harmony and purity are the goal of Shinto ethics, yet purity does not mean spiritual purity only, but that of an honest heart. This is what the Japanese understand by moral purity: complete honesty.

For Shinto belief, the following are considered bad: actions that disturb the kami, their worship, the world’s harmony, the natural world, the social order, as well as the group to which we as individuals belong to (BBC, 2024).

Knowledgeable Western culture members can consider the way in which natural setting is always surrounding their temples, and the way torii gates lead to sacred spaces in the forests and other natural settings. Nature is also part of Zen Buddhist meditation practice, and various seasonal elements are also present in the traditional Japanese cooking style. The strong connection with and awareness of the present moment in Japanese culture is tied to seasonal elements in meditation practices and other elements of lifestyle, including festivals, which are part of the Zen Buddhist mindset.

Having an ethical connection with nature can, thus, be considered natural, and is present all throughout the Japanese culture mindset and lifestyle.

According to Wargo (1990), there are several concepts on which traditional Japanese ethics is based on. Among these we can find: *on*, meaning “personal, often overarching obligation,” *giri*, meaning “social or status obligation,” *ninjo*, meaning “human feeling,” *gimu*, meaning “legalistic obligation.” From Wargo (1990) we also find out that the concept of compassion comes from Buddhist belief and that propriety and righteousness come from Confucianism. We also have, according to Wargo (1990), the concept of *amae*, meaning dependency. This concept refers to the relations between members of a family, especially, and couple relationships.

The present paper has not considered these concepts in detail, except for the value of compassion which has been clearly visible in various traditions and practices as well. Just as Wargo (1990) claims, Confucianism and Buddhism do not make up the Japanese mindset to the large extent to which they make up the cultural mindset of other countries such as China and

Thailand. China is a mainly Confucian culture, while Thailand is a mainly Buddhist one. Even the Western culture influence was not too large on Japan. Instead, as Wargo (1990) draws out attention, the Japanese culture's main mindset is Shintoist.

According to Rayhan (2023), We also notice a transformation of the value of honor for Japanese culture ethics, from the concept's use in samurai Bushido code to its use today, which has changed to the emphasis on "respect and harmony" (Rayhan, 2023). The concept of honour is tied to the individual's responsibility to the other persons in family, workplace, and community. It is present from personal relationships, to business relationships and it is also visible in the education system. Showing respect to those in higher positions is a sign of hierarchical structure of society and high power distance. Honor is strongly connected to another concept, that of shame, which is used to maintain social order and to prevent wrongdoings (Rayhan, 2023).

Japan is a special culture due to the way in which there is, according to Carter (2007), an intertwining among art, philosophy, and religion, which are otherwise separate in Western culture. There are no writings on ethics in Japanese culture standing by themselves, written by philosophers, in the sense we are accustomed in Western cultures, since, according to Carter (2007), ethics in Japanese culture are understood and "studied as an aspect of Buddhist or Confucian thought." In the meantime, according to Carter (2007), Shintoism was largely ignored in studying ethics since there are "no texts and no teachings to draw upon." This is due to the way Shintoism is practiced, namely it is "a religion that is 'caught' rather than 'taught,' its insights 'poerceived' before they are 'believed,' its basic concepts 'felt' rather than 'thought'" (Picken, 1994). Japanese culture thus, in ethical teachings, just as in other "basic concepts and attitudes," relies more on emulation than theorization (Carter, 2007).

Discussing Japanese ethics is significant since, throughout history, ethics has been an integral part of Japanese culture and society (Rayhan, 2023).

### **Findings and Discussion**

Western and Asian cultures are so radically different from one another, and the way the ethics system of Japan is can highlight not only differences, but also specific aspects of Japanese culture. In this way, we can reach a deeper understanding of the root of the way Japanese culture and society look today.

We have seen, throughout the present paper, how the ethics system of Japan relies on an approach where there is an overlapping between what is good and the way human beings are honestly practising these rules. To them they are not just abstract rules, or law-related rules, based on fear of punishment, based on mechanic obeying, on duty. When they practice them the Japanese are showing genuine convictions that this is the right thing to do. In fact, it is not just the right thing to do, but the natural way to do certain things. To them, it should come spontaneously, since, as Shintoism holds, human beings are inherently good and it is only the external world that makes them behave badly. The evil spirits are responsible for the human beings' evil actions. In addition, rules and laws in their ethical system are humanized, since compassion lies at the core of it all. Considering the context where an action is good or bad sounds more related to philosophy rather than religion and even law, since laws are quite clear in general.

We notice how the value central to Japanese ethics, compassion, is also reinforced through the practice of the arts, showing how it is part of several layers of life, and is not applied only in human relations and in the relationship between human beings and the natural environment.

We notice the aspect of cultures' creativity when it comes to practising and reinforcing, as well as naming and theorizing their ethical systems and values. While Japanese culture values and behaviour towards the others and nature could be argued to be universally valid, they are not named, presented, and practiced in the same way.

### **Conclusion and Recommendations**

Looking at the Japanese ethical system, we realize its elements and values are present everywhere in their ways of living, thinking, and doing. Theorizing these concepts, naming them, and practising them as parts of traditional arts work to reinforced them and to underline them for the members of its culture. They also serve to create a distinguishable, specific aspect of this culture which can be recognized by other cultures, from which it differs.

Cultural awareness and cultural empathy are values that are promoted in the world we are living it today. The Japanese ethical system is a means of showing how this culture makes attractive values, principles and ways of behaviour, which are otherwise universal and are, at least intuitively, as well as legally, understood to govern all societies. The specific way in which the Japanese ethical system looks makes it attractive to members of other cultures, which leads to their curiosity about understanding the Japanese culture's mindset. This can help Western culture members better connect with and communicate with Japanese culture members, which is a needed skill in an interconnected world, where business relations are established at international level more and more frequently.

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## ANIZIN HAYVANCILIKTAKİ ÖNEMİ, ANIZ YAKMANIN ZARARLARI VE ÇÖZÜM ÖNERİLERİ

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### Özet

Hasat sonrası toprak üzerinde kalan bitkilerin kök, sap, dal ve yaprak gibi artıklarına anız adı verilmektedir. Ekonomik olarak değerlendirilemeyen anızlar bazen toprak işleme esnasında toprağa karıştırılmaktadır. Ancak çoğu zaman yakılarak bertaraf edilmektedir. Buğday, arpa, çavdar, yulaf gibi tahıl hasadından sonra kalan sapların samanı yapılarak, başta geniş getirenler olmak üzere kışı ahırda geçiren hayvanlar tarafından tüketilmektedir. Sap samanı selüloz bakımından zengin ve besin değerleri bakımından düşük olmasına rağmen ülkemizde hala en çok tüketilen yem olma özelliğini korumaktadır. Sap samanı konsantre (ticari) yemler, arpa, kepek, küspe gibi yemlerle desteklenerek hayvanlara verilmektedir. Tüketim sonrası hayvanlardan artan kaba sap ve samanlar altlık olarak da kullanılabilir.

**Anahtar kelimeler:** Anız yakma, zararları, hayvancılıktaki önemi, çözüm önerileri.

## **THE IMPORTANCE OF STUBBLE IN LIVESTOCK, HARMS OF BURNING STUBBLE AND SOLUTION SUGGESTIONS**

### **Abstract**

The residues of plants such as roots, stems, branches and leaves that remain on the soil after harvest are called stubble. Stubbles that cannot be used economically are sometimes mixed into the soil during tillage. However, it is most often disposed of by burning. The stalks remaining after harvesting grains such as wheat, barley, rye and oats are made into straw and consumed by animals that spend the winter in barns, especially ruminants. Although straw is rich in cellulose and low in nutritional value, it still maintains its feature as the most consumed feed in our country. Straw is given to animals by supplementing it with concentrated (commercial) feeds, barley, bran and oil cake. The coarse stalks and straw left over from animals after consumption can also be used as bedding.

**Key words:** Stubble burning, its harms, its importance in animal husbandry, solution suggestions.

## Giriş

Anız, tarlalarda hasat ve harman işlemleri sonrasında kök, sap, yaprak, bitki parçası gibi toprak yüzeyinde kalan atıkların tümünün ortak adıdır. Buğday anızı ele alındığında; buğdayda tane dışındaki tüm bitki kısımları anız olarak bilinir. Anız biçilen kısım içerisinde sap, yaprak, kavuz, başak eksen ve kılçıklardan biçilmemiş kısımda ise biçim yüksekliğine bağlı olarak toprak yüzünde kalan saplardan ve toprak altı kısımlarından ibarettir. Buğdayda hasat ve harman sonrası biçilmiş olarak tarlada bırakılan anız artıkları oldukça fazladır. C/N katsayıları da yüksek olduğu için parçalanmaları da oldukça uzun zaman almaktadır. Bu özellikleri nedeniyle daha sonra tarlada yapılacak işleri de engellemektedir. Bunun için buğday anızının tarladan kaldırılması, bir şekilde uzaklaştırılması gereklidir (Geçit, 2014).

Anızın yakılması ile çıplaklaşan toprakta erozyonu hızlandırmakla birlikte toprağın nem ve sıcaklık dengesini de etkilemektedir. Anızlı topraklarda, toprak işleme yöntemlerinde toprak profilindeki ısı denge daha fazla korunmaktadır. Ancak, toprak profilindeki ısı dengenin sağlanamadığı durumlarda, toprak sıcaklığı ve su miktarı konuma ve zamana bağlı olarak daha fazla değişkenlik göstermektedir. Bu nedenle, toprak sıcaklığı ve topraktaki nem oranı gerek toprak işleme açısından gerekse bitki gelişimi açısından önemli parametrelerdir (Jury ve ark, 1991).

Hasattan sonra toprak yüzeyinde bırakılan anızın, hasat sonrası işlemlerde oluşturacağı bazı olumsuz etkilerinin yanı sıra, toprağın ve suyun korunması başta olmak üzere birçok olumlu etkileri de bulunmaktadır. Anızın yakılmaksızın sürümle toprağa verilmesi durumunda mikroorganizmaların sağladığı enzimler ile sapın önemli bir bölümünü (% 40-60) içeren selülozun parçalanarak C/N oranının düzeltildiği bilinmektedir. Bu arada, toprakta organik maddenin artışına bağlı olarak meydana gelen humin maddeleri, yağmur damlaları ve rüzgarın erozif etkilerini ve yüzeyde meydana gelen akışı azaltmakta, suyun toprak tarafından emilmesini sağlayacak toprak kanallarının oluşmasına yardımcı olmakta ve toprak zerrecilerinin arasında bağlayıcı rol oynamak sureti ile erozyonu azaltmaktadır. Ayrıca, topraktaki organik maddenin artması, kurak dönemde toprağın su tutma kapasitesini artırmakta ve dolayısıyla verimde artış sağlanmaktadır (Avşar ve Kamburoğlu, 1996; Mc Kenney, 1993; Sağlam, 1994; Shelton ve ark., 1997; Wysocki, 1988).

## Anız Neden Yakılmaktadır?

1- Özellikle kurak geçen bölgelerde tahıl hasadından sonra topraktaki nem yetersizliğine bağlı olarak mikroorganizma faaliyetleri yavaşlamaktadır. Dolayısıyla anız ve bitki artıklarının ayrışması ve çürümesi uzun zaman alır. Üreticiler ekime iyi bir tohum yatağı hazırlamak için anızları yakmaktadır.

2- Toprak işleme aletlerinin daha rahat çalışmasını sağlamak amacıyla anızlar yakılmaktadır.

3- Kendi gelen tahıl ve yabancı otların azaltılması amacıyla anızlar yakılmaktadır.

4- Zararlı böcek ve haşerelerin yok edilmesi veya azaltılması nedeniyle anızlar yakılmaktadır.

5- Çeşitli hastalıkların (sap ve kök çürüklüğü, yaprak lekesi, erken fide yanıklığı ve solgunluk gibi) azaltılması veya yok edilmesi amacıyla anızlar yakılmaktadır.

6- İkinci ürün yetiştirilen bölgelerde zaman tasarrufu sağlamak amacıyla anızlar yakılmaktadır.

7- Toprak işlemez tarımda mibzerle ekim problemlerinin en aza indirilmesi amacıyla anızlar yakılmaktadır.

8- Ekim esnasında mibzerin istenilen bir şekilde ekim yapmasını, anız sapsı ile mibzer gözeneklerinin tıkanmasını önlemek amacıyla anızlar yakılmaktadır.

9- Anızsız tarladan daha yüksek verim beklentilerinin olması nedeniyle anızlar yakılmaktadır.

## Anız Yakmanın Zararları

Anız yangınlarından dolayı gerek ormanlar gerekse komşu araziler zarar görmekte toprakta bulunan birçok canlı hayatını kaybetmektedir. Bunların dışında anızın yapısında bulunan fosfor, potasyum, kalsiyum, magnezyum, demir, mangan, çinko, bakır gibi diğer mikro elementler de bitkilerin kullanamayacağı form olan oksitlere dönüşmektedir. Bunlar toprağın fiziksel, kimyasal ve biyolojik özelliklerini bozmaktadır. Anız yakılması sonucunda toprağın bünyesindeki organik maddeler azalmakta, dolayısıyla toprağın su tutma kapasitesi olumsuz yönde etkilenmektedir. Anız yakılan topraklarda organik madde oranı % 1'in altındadır. Bu tür toprakların, organik madde oranı düşmekte, tarlalarda tohum yatağı hazırlığındaki toprakta rutubet yetersizliği problemlerinin yanında ekilen bitkilerin çıkışlarında büyük eksiklikler ortaya çıkmaktadır (Savcı ve Bağdatlı, 2016).

Anız yangınları sonucu oluşan dumanlar çevre ve atmosferin kirlenmesine, karayollarındaki görüşü engelleyerek trafik kazalarına neden olmaktadır. Ayrıca sıcak ve fırtınalı havalarda anız yangınlarıyla komşu tarlalardaki hasat edilmemiş ürünlerin de yanmasına, tarla sınırlarındaki canlı veya cansız çitlerinin, meyve bahçelerinin hatta ormanların ve telefon direklerinin yanmasına neden olmaktadır. Bunların yanı sıra arazide yaşayan pek çok yaban hayvanlarının (kuş, tavşan, tilki, çakal vs.) yuvalarını terk etmelerine veya ölmelerine neden olmaktadır. Bazı araştırmacılar (Cerit, 2001; Avşar ve Kamburoğlu, 1996) yanmanın çevresel boyutta başta orman yangınları olmak üzere, telefon ve enerji nakil hatlarının yanması, yoğun duman tabakasının beraberinde gelen gazlar ve kirlilik, hasat edilmemiş komşu tarlalarına ve yerleşim yerlerine yangının sıçraması sonucu canlı yaşamının tehdit edilmesi gibi riskler de ortaya çıktığını, ayrıca sis oluşumu ile trafik kazalarına sebep olunması, yakın köylerdeki hayvan barınaklarının yanması gibi bir çok çevresel riskleri de beraberinde getirdiğini ifade etmektedir.

Anız yakma özellikle kurak ve yarı kurak bölgelerde su ve rüzgar erozyonunu artırıcı rol oynamakta ve toprağı su ve rüzgar erozyonuna karşı daha hassas hale getirmektedir. Çıplaklaşan toprağın en değerli üst katmanları rüzgar ve su ile taşınarak yok olmaktadır.

Anız yakma esnasında 0-5 cm üst toprakta 330 °C derecelere ulaşan yüksek sıcaklıklarda toprağın canlılığını oluşturan yararlı organizmalar yok olmakta ve organik madde miktarı azalmakta, mikrobiyolojik aktivite gerilemektedir. Aynı zamanda sıcaklığın etkisiyle toprağın su tutma kapasitesi azalmakta, biyolojik denge bozulmakta ve zararlı bazı gazlar atmosfere salınmaktadır. Anızın yakılması ile mikrobiyal humus oluşumu için toprağa verilen organik madde miktarı azalmakta ve topraktaki humus miktarında azalma oluşmaktadır. Nitekim Jury ve ark, 1991 tarafından yapılan araştırmada anızın yakılması, toprakta sadece erozyonu artırıcı bir etkiye neden olmamakta, buna bağlı olarak toprağın nem ve sıcaklık dengesini de etkilediğini ifade etmektedir.

Yanmayla birlikte toprağın besleyiciliğı sadece elementer düzeyde değil, toprağın besleyebilme parametrelerinde de bir takım değişiklikler meydana gelir. Bu konuda temel parametrelerden biri olan toprak pH'ı yanmayla birlikte değişir. Bu konuda Nijerya'daki Uyo Üniversitesi Eğitim ve Araştırma Çiftliğinde metrekarede 30 kg, 90 kg, 120 kg anız örtüsü ile kaplı ve kontrol parselinde yakıldığında; yakılan topraklarda pH değeri artmış ve bu artışa neden olarak, yanma sonucu oluşan kül, yanmadan kaynaklanan asitleşme, bir de toprakların tampon kapasitesi neden olarak gösterilmiştir. Bu konuda bir çok araştırmacı benzer gözlemlerinde bu değişimin külün etkisiyle oluştuğunu gözlemlemişlerdir. Bitkisel kütlelerin yakımı sonucunda oluşan kül aynı zamanda yüksek katyon içeriğine de sahiptir (Edem ve ark., 2014). Üre 135 °C dereceden daha sıcak ortamda amonyum ve azot okside parçalanır ve buğday anızı yandığında toprak yüzeyinde sıcaklık 120 ila 330 °C derece arasında yanan anız miktarına bağlı olarak değişmektedir (Rasmussen ve ark., 1986).

Anız yangınları sonucunda havada partikül miktarı artmakta, karbon monoksit ve uçucu organik bileşikler atmosfere karışmaktadır. Ağırlaşan hava astım, amfizem, pnömani, bronşit,



kalp ve akciğer rahatsızlıkları ile alerjik reaksiyonları tetiklemekte ve burun boğaz ve göz tahrişlerine neden olmaktadır. Ayrıca anız yangınlarıyla beraber çok fazla miktarda CO<sub>2</sub> atmosfere karışmakta olup, küresel ısınmadan sorumlu en önemli gazların başında CO<sub>2</sub> yer almaktadır (Long ve ark., 1998).

Rasmussen ve Rohde (1988) tarafından yürütülen çalışmada, anız yakmanın yarı kurak bölgedeki kışlık buğdaylarda vejetasyonun gelişimini hızlandırması, hastalık ve yabancı ot rekabetini azaltması, azotun mikrobiyal bağlanarak hareketsiz hale gelmesini önlemesine rağmen anız yakmanın buğday verimi ve N alımı üzerine etkisinin olmadığı öne sürülmüştür. Diğer taraftan Christian ve arkadaşlarının (1999) dokuz yıl boyunca yaptıkları çalışmada da yanmış tarlalarda daha yüksek verim olduğu iddia edilmiştir.

Buğday hasadından sonra anız yakılmadan gölge tavında sürüm yapılmış parsellerde yıllık ortalama toprak kaybı 1160 kg/ha iken, hasattan sonra anızı yakılmış hemen sürülmüş parselde yıllık ortalama 2730 kg/ha toprak kaybı olduğu tespit edilmiştir (Avşar ve Kamburoğlu, 1996). Toprakların kaybettikleri bu değerleri tekrar kazanabilmeleri için daha fazla gübre kullanılması beraberinde başka bir çevresel tehdidi ortaya çıkarmaktadır (Dilber ve Güler, 2015).

### **Çözüm Önerileri**

Besleme değeri düşük olan ve kuru maddesinde en az %18 oranında ham selüloz bulunan sap samanı geniş getiren hayvanlar ve atlar için fiziki tokluk sağlamak amacıyla kullanılabilir. Böylece selüloz sayesinde sindirim olaylarının normal biçimde gerçekleşmesine yardımcı olur.

Sap samanı sığırlara günlük 3-6 kg, koyunlara 1-2 kg, atlara 3-4 kg'a kadar verilebilir. Ancak ileri derecede gebe hayvanlara fazla miktarda verildiği takdirde yavru atmalarına neden olabilir. Hayvanlara taze, doğal renkte, küf, mantar ve zararlı yabancı otları içermeyen sap samanı verilmelidir. Saman sığırlara verilmeden önce 2.5-3.5 cm, atlar ve koyunlar için de 1.5-2.5 cm uzunluğunda doğranırsa tüketim sırasında ortaya çıkacak kayıplar azaltılabileceği gibi çeşitli sindirim bozuklukları da önlenmiş olur. Öte yandan çok kısa parçalanmış samanlar tozma nedeniyle yem tüketiminin düşmesine, bazı solunum ve sindirim sistemi rahatsızlıklarına neden olurlar.

Geleneksel olarak, tahıl hasat edilir edilmez hayvanlar anız üzerinde otlamaya başlamakta ve tarla sürülünceye kadar otlatma devam etmektedir. Yılda bir ürün yetiştirmeye dayalı sistemlerde tahıl anızından daha uzun süre yararlanılabilmektedir. Sonbaharda toprak işlenmesi yapılmadığı takdirde anızlar üzerinde hayvanlar 5-6 ay süre ile otlayabilmektedir. Bu kaynakların hayvan beslemede maliyet tasarrufu sağladığı ortaya konmuştur (Yulafçı ve Pul, 2005).

Anız yakmak yerine, modern tarım teknikleri kullanılarak, daha iyi bir tohum yatağı hazırlama ve toprak işleme yapılmalıdır. Bunun yanında hasat sonrası parçalama ve çürümeyi kolaylaştırmak için sapları parçalayıcı bir alet kullanılarak anız toprağa karıştırılabilir. Yabancı ot ve canlıları yok etmek için anızın yakılması yerine ilaçlı mücadele yapılabilir. Hububat hasatları, başağın hemen altından biçildiğinde anız çok yüksekte kaldığı için mikroorganizmalar tarafından parçalanması çürüyerek organik maddeye dönüşmesi daha uzun sürede gerçekleşmektedir. Bu nedenle hububat hasatları toprak yüzeyine çok yakın yapılarak anız yakmanın önüne geçilebilir (Savcı ve Bağdatlı, 2016).

Hayvan beslemede sap samanları çoğunlukla; kaba yem açığının kapatılması, yüksek su içeriğine sahip olan maddelerin silolanmasında katkı maddesi olarak, içerdiği yüksek lignin ve selüloz ile hayvana tokluk hissi vermesi ve ergin ruminantlarda, kuru dönemdeki ineklerde, atların beslenmesinde yaşama payı düzeyinde kaba yem kaynağı amacıyla kullanılmaktadır (Gemalmaz ve Bilal, 2016; Özkan ve Demirbağ, 2016; Ak ve Akbay, 2018; Acikbas ve Ozyazici, 2019).

Samanların yem deęerini artırmak ve rasyonlardaki etkinlięini artırmak amacıyla farklı teknikler kullanılmaktadır. Bunlar; fiziksel (bitkilerin çeřitli kısımlarının ayrılması, buharla iřleme, öğütme, peletleme vb.), kimyasal (üre, sodyum hidroksit, potasyum hidroksit gibi alkaliler ve sulu veya susuz amonyak ile iřleme) ve biyolojik (bazı böcek, bakteri ve funguslarla mikrobiyal iřleme, sellüloz, hemisellüloz, pektinaz ve ksilanaz ile enzimatik iřleme, inokulant ilavesi) iřleme yöntemleridir (Eser, 2016).

Doęrudan anız üzerine ekimin yapıldığı yeni üretim modelinde tarladaki toprak nemi ve anızın organik madde içerięinden faydalanılmakta ve üretim doęrudan tarladaki anız üzerinde yapılmakta olup uygulama ülke sahtında giderek yaygınlařmaktadır (Dilber ve Güler, 2015).

Anız örtüsü, toprağı yağmur damlalarının direkt etkisinden korumakta, toprağın sıçratılmasına ve sürüklenmesine engel olmaktadır. Aynı zamanda yağışların yüzey akış hızını azaltır, kar ve yağmur sularının topraęa sızmasını sağlar. Böylece yağışların toprak tarafından emilmesi ile buharlaşma azalır, serin ve nemli bir toprak ortamı oluşur, humus artar ve sonuçta verim artmış olacaktır.

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## **THE ROLE OF ORIENTAL STUDIES IN ANALYZING THE PROPHET'S BIOGRAPHY**

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### **Abstract**

Orientalism dealt with the study of aspects of civilized life in the East in general, as it was particularly interested in aspects of the life and civilization of Islam and the Arabs in various fields such as language, religion, customs and traditions. There were several motives that led orientalists to this interest, including colonial and political motives that led to the conquest and colonization of the East, as well as economic and social motives. One of the points that arouses the reader's attention in orientalist studies related to the history of Arabs and Muslims is the apparent fanaticism in some of the ideas and opinions of orientalists. They dealt with aspects of Arab life in its various manifestations, and one of the most prominent topics targeted by orientalists was the biography of the Prophet Muhammad (peace be upon him) and his unique personality. Aspects of his personality (peace be upon him) have been treated unfairly, as some orientalists have united efforts to achieve this purpose. In this paper, I will show some aspects of the wrong approach followed by orientalists in their study of the biography of the Prophet Muhammad (peace be upon him), based on multiple examples. This is due to their failure to follow the approved scientific rules, their reliance on the writings of their predecessors, in addition to intolerance and hatred towards Islam and Muslims. I will also review examples of orientalists who tried to respond to the slanders of their colleagues. This research consists of an introduction, two axes and a conclusion: the introduction deals with the importance of the topic and the main axes of the research. The first axis provides an introductory overview of orientalism, its objectives and its origins, while the second axis focuses on the views of orientalists on the biography of the Prophet Muhammad (peace be upon him), including his childhood, his wives and the phenomenon of revelation. The study ends with a conclusion summarizing the main findings, followed by a list of sources and references used.

**Keywords:** Prophet Muhammad (may God bless him and grant him peace) - Orientalism - The phenomenon of revelation - The marriage of the Prophet

## **Introduction**

Orientalist studies are one of the most prominent areas that influenced the understanding of the Prophet's biography, as it provided multiple interpretations of aspects of the life of the Prophet Muhammad (peace be upon him). However, these studies raise questions about their accuracy and objectivity, especially in light of the existence of historical and cultural fanaticism that sometimes influence their analysis. The research problem lies in how colonial and political motives influence the reading of the Prophet's biography by orientalists, which may lead to a distorted or unbalanced picture of the Prophet's life and his teachings.

The importance of this research is to shed light on this phenomenon, as it helps to understand how historical and cultural contexts affect Islamic studies, and promotes readers' critical awareness about the sources on which they rely. The research also seeks to provide a balanced vision of the contributions of orientalists in the field of the Prophet's biography, with a focus on errors and deviations that may marred these studies.

The basic premise of this research is that Orientalist studies, despite their scientific value, often include biases that reflect political and cultural perspectives, negatively affecting the analysis of the Prophet's biography. A deep understanding of these analyses requires a critical approach that takes into account the motivations and theoretical frameworks on which they are based. As for the methodology, the research will follow the method of critical content analysis, where a selection of orientalist works related to the Prophet's biography will be studied, while evaluating their accuracy and objectivity. In addition, contemporary Islamic studies will be used to counter some of the fabrications and fallacies contained in these studies, promoting a comprehensive and objective approach to the subject.

### **The first topic: the definition of orientalism, its importance and motives**

**Orientalism came as a language of the word** derived from the word: East: It is said that the sun rises east and rises when it rises<sup>68</sup>, and Orientalism is done east of the shin, the raa and the qaf of one origin that indicates illumination and opening. From that the sun rises, if it<sup>69</sup> rises. The description of the region as the East means primarily the area where the sun of knowledge shone and not the sun in its well-known sensory sense<sup>70</sup>.

#### **A- Orientalism idiomatically:**

Terminology, on the other hand, it was defined by several definitions, including "the science of the East or the Eastern world".<sup>71</sup> Others define it as an expression that indicates the orientation towards the East, and it is called anyone who researches the affairs of the Easterners, their culture and history. This means the current of thought, which consists in conducting various studies on the Islamic East, which include its civilization, religions, literature, languages and culture. This trend has contributed to the formulation of Western perceptions of the East in

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Academy of<sup>68</sup>the Arabic Language, Intermediate Dictionary, Cairo, 1960, vol. 1, p. 482.

<sup>69</sup>Ibn Faris, Ahmed bin Faris bin Zakaria Al-Qazwini Al-Razi, Abu Al-Hussein (d.: 395 AH), Dictionary of Language Standards, Dar Al-Fikr for Printing and Publishing, 1979, vol. 3, p. 204.

<sup>70</sup>Al-Naim, Abdullah Muhammad Al-Amin, Orientalism in the Biography of the Prophet (A Historical Study of the Opinions of Watt-Brockelmann-Flehausen) compared to the Islamic Vision, Higher Institute of Islamic Thought Press, Balam, 1997, p. 16.

<sup>71</sup>Barthes, Rudy, Islamic and Arabic Studies in German Universities, written and translated by: Dr. Mustafa Maher, Cairo, 1967, p. 11

general and of the Islamic world in particular, expressing the intellectual background of the civilizational conflict between them.<sup>72</sup>As for Maxim Rodinson, Orientalism is defined as "a special system that has been devoted to the study of the sciences of the East, where it was not possible for those who specialized in the study of oriental sciences to establish associations or magazines that specialize in a particular country, so they were classified under the name (orientalists<sup>73</sup>)( ), and Dr. Edward Said defines it by saying: The easiest way to define orientalism is a kind of academic clarification of this term, and in fact this term is used in universities and academia for those who study oriental topics, or research about this Whether he is a specialist in human knowledge, sociology, historian, or linguistics in its general or private sense. He is an orientalist, and his work in this field is called "Orientalism",<sup>74</sup> and he also defines it: "Orientalism is a Western method of power, a kind of Western projection over the East and the will of the West to rule the East".<sup>75</sup>

We conclude from the above that Orientalism is an intellectual trend concerned with the study of the civilization of Eastern nations in general and the civilization of Islam and the Arabs in particular and was limited at the beginning of its emergence to the study of Islam and the Arabic language only and then expanded to include the study of the whole East in its languages, traditions and literature.

### **Objectives of Orientalism:**

Orientalists aim from Orientalism to achieve two main goals:

- Protecting the Western man from seeing the light of Islam and believing in it, and in return converting Muslims from their religion and dismembering their great human group and broadcasting it to discordant intersecting units, says Raja Jaroudi:( Orientalism was not an honest movement from the beginning, as it was aimed at implementing a project aimed at bringing Muslims to Christianity<sup>76</sup>.
- Knowing the East and studying its land, and its weather, and its scientists, and its people, and all its things, all to know how to reach it, the house of Islam remained feared and fearful and could not crusader with its brute hordes penetrate the lands of Islam at the beginning of the sixth century AH, but it has been managed, appreciated and trying to circumvent the lands of Islam when it eluded them to penetrate and Orientalism was its pioneer, who frequents her road, their goal here is their political, economic and scientific ambitions from the lands of Islam ().<sup>77</sup>

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<sup>72</sup>Al-Juhani, Mana'a, The Facilitated Encyclopedia of Contemporary Doctrines, Religions and Parties, 4th Edition, Dar Al-Nadwa Al-Alamia for Printing and Publishing, 1420, Part 2, p. 687, Al-Jabri, Abdul Mutaal Muhammad, Biography of the Prophet and the Illusions of Orientalists, Wahba Library, Egypt, Pla.T., p. 9.

<sup>73</sup>Arkoun<sup>73</sup>, Muhammad, Orientalism between its advocates and opponents, translated by: Hashem Saleh, 2nd Edition, Dar Al-Saqi, D.M., 2000, p. 161.

<sup>74</sup>Said, Edward, Orientalism Western Concepts of the East, translated by: Dr. Muhammad Anani, Vision for Printing, Pla.M., 2008, pp. 47-48.

<sup>75</sup>Orientalism, Western Concepts of the East, pp. 50-51.

See<sup>76</sup>: Al-Midani, Abd al-Rahman Hassan Habanka, The Three Wings of Cunning (Evangelization, Orientalism, Colonialism), Study, Analysis and Guidance, 8th Edition, Dar Al-Qalam, Damascus, 2000, p. 128; Al-Deeb, Abdul Azim, The Method of Orientalists, research published on the website of the Electronic Happiness Library, p. 339.

See<sup>77</sup>: Al-Deeb, Abdul Azim, Al-Manhaj according to orientalists, p. 339.

### **The Origin of Orientalism:**

Researchers differed in determining the year of the emergence of Orientalism, as some of them believe that the principle of Orientalism dates back to the French monk "Gerber Doi Ourik", who went to the Islamic country of Andalusia, and was apprenticed by its teachers in Seville and Cordoba, until he became the most knowledgeable scholar of his time<sup>78</sup>.

Others, including Ishaq Musa al-Husseini, assert<sup>79</sup> that "it was very difficult to determine the genesis of Orientalism in a particular year, but it is considered natural that Islam should have attracted the attention of Christian clergy since the emergence of its spread in the East and the Maghreb with surprising speed. Having referred to the opinion of Cardinal Köping, Archbishop of Austria, who praised his efforts and adoption in his writings, On the theology of Muslims, he added, and based on this text, the beginning of interest in Islam and its study dates back to about a hundred years after its appearance, and then Islam met Christianity in Andalusia. Christians began to study Islam and Arabic studies and literature with enthusiasm that attracted the attention of Christian clerics themselves because their followers had immersed themselves in reading Arabic poetry and stories, studying Muslim philosophy, and mastering and expressing Arabic.

Here we conclude that Orientalism was the result of friction between the Islamic East and the Christian West during the Islamic conquests of the West, and during the Western colonization of the Crusader to the East, and through embassies and trips, and the main motivation for the Orientalist movement was the Christian theological side in order to destroy Islam from within by intrigue and malice, and raise suspicions and doubts about its principles, values, laws and history.

Despite these differences about Orientalism and its origin, we cannot overlook the achievements of these orientalists, despite the ambiguity and widespread suspicion that surrounds the goals of orientalists, but we cannot deny that Orientalism had a great impact on preserving literary manuscripts from loss, publishing and printing; In everything related to it, considering its history as the basis for that, they studied Arabic literature by dating it and dividing it into different eras a new study imposed on it by the development of literary studies in the world, until orientalists followed the path of their Western historians in the study of their various literatures. Thus, they took a new direction in the study of Arabic literature as well, and orientalists did not only publish literary texts, but also went beyond it until orientalists translated hundreds of Arabic and Islamic books into all European languages. They have transferred to their languages a lot of poetry collections and commentators and books of history and religious sciences and in the examples of this we mention what the translation of the French orientalist Fatih "History of Ibn Makin" died (1292) AD has appended the history of the Arabs in Spain, and the books of logic and mental illness of Ibn Sina died (650) e, and lamentation for Tughrani died (515) e<sup>(80)</sup>, in addition to what was translated by Baron de Sacy of the work of Al-Maqrizi, including: "About contracts in matters of money" (1796), "The origin of pre-Islamic literature among the Arabs", "Kalila and Dimna" and "Maqamat al-Hariri" (1812) appended with an explanation in Arabic<sup>0.81</sup>

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<sup>78</sup>Al-Juhani, The Facilitated Encyclopedia of Contemporary Doctrines, Religions and Parties, vol. 2, p. 687.

<sup>79</sup>Murad, Dr. Yahya, Dictionary of Orientalist Names, Muhammad Ali Beydoun Publications, Dar Al-Kutub Al-Ilmiyya Beirut, Lebanon, Pla.T., p. 29.

<sup>80</sup>Khrewhish, Abdel Raouf, The Role of French Orientalists in Transmitting Arab Culture to the West, research published on a website, p. 407.

<sup>81</sup>Khrewhish, The Role of French Orientalists in Transmitting Arab Culture to the West, p. 409.





## **The second topic: the biography of the Prophet in oriental studies**

Orientalists differed from the vision of the Prophet's biography in general has represented the biography of the Prophet Muhammad peace be upon him and his family and his personality a wide field in the writings of orientalists and their writings vary around some of them tried hard to find outlets and loopholes through which to distort the biography of fragrant peace be upon him and his family by fabricating falsehoods and attributing them to him.

At the forefront of the things that aroused orientalists in the biography of the Prophet Muhammad (peace be upon him) is his childhood, as the orientalist Karl Brockelmann says: "We do not have reliable evidence about the Prophet's first life."<sup>82</sup> Rodinson says that "he has no confirmed information about it."<sup>83</sup> Among the other things raised by orientalists about his life (may God bless him and his machine) polygamy, as some orientalists attached to the Prophet the charge of sensuality and Montgomery Watt says: There is a European Christian accusation of Muhammad as lustful or, in seventeenth-century parlance, the rude "old fahash", but this accusation is dropped if we examine it in the light of the prevailing ideas of the time of Muhammad. Islamic thought in the early advent of Islam tended to exaggerate the personality of the Prophet and elevate it above the level of human beings, and there is a hadith that says: Muhammad was given the power of manhood to be able to divide his night among all his women). There is no doubt that we are here talking about a topic because the ordinary hadith says that Muhammad used to devote a night to each of his wives, and we can in any case judge from this the attitude of some of Muhammad's followers towards him. The first Muslims were unaware of singleness, and they opposed it on every occasion, even ascetics in Islam were usually married.<sup>84</sup>

The French orientalist researcher Etienne Diné discusses in his book: "Muhammad is the Messenger<sup>85</sup> of Allah" () who reproaches the Prophet (may Allah's peace and blessings be upon him) for loving women, by saying: ((Muhammad loved women, and many enemies reproached him for that. Indeed, Muhammad was a man in all the moral and material meanings of the word, and his manhood was characterized by chastity that does not contradict with the causes of innocent pleasure devoid of impurity, and like him the corps of Arabs, who are characterized to this day by chastity and modesty devoid of all cost and hypocrisy, not like the modesty of those who exaggerate in religion and their alleged artificial chastity. If Muhammad had contracted twenty-three wives, he had contact with only twelve of them. The others were married for purely political reasons, as all tribes wanted the honor of his marriage. It is narrated that Azza, the sister of Dahiya al-Kalbi, died of joy when she prophesied that the Prophet accepted her marriage, and the Prophet was kind to all women and tried on every occasion to do them justice. He forbade the first thing that was forbidden to infanticide girls, that ugly and cruel habit that we talked about earlier. He then put an end to polygamy, making the maximum number of them four, and furthermore advising the believers to think about the verse: } If you fear that you will not share in orphans, then marry as many women as you want, two, three, and

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History of<sup>82</sup>the Islamic Peoples, translated into Arabic: Nabih Fares and Munir Baalbaki, 9th Edition, Dar Al-Ilm Lil-Malayan, 1981, pp. 32-33.

<sup>83</sup>Al-Hajj, Sassi Salem, Points of Orientalist Discourse, Orientalist Phenomenon and its Impact on Islamic Studies, Dar Al-Madar, Beirut, 2002, vol. 2, p. 106.

<sup>84</sup>Watt , Montgomery, Muhammad in Medina, translated by: Shaaban Barakat, Al-Ghasriyeh Library Publications, Beirut, 1952, pp. 501-502.

<sup>85</sup>Suleiman ibn Ibrahim, translated by: Dr. Abdel Halim Mahmoud, Mohamed Abdel Halim Mahmoud, 3rd Edition, Dar Al-Maaref, Cairo, Pla.T., pp. 238-239.

four.<sup>{86}</sup>

For his part, Akkad discussed in his book "The Genius of Muhammad" the views of orientalists regarding the relationship of the Prophet with women, and refuted their claims about his flow behind his sexual desires and whims, the Prophet in his opinion is first establishes normal relations with women and secondly is natural love for women says : ( ( We do not see anything wrong with the great man to love women and feel their pleasure, this is both in instinct \_ there is no fault, and this normal soul we can understand clearly when we see that women did not It is distracted by what women occupy men who are excessive in women's knowledge of the tasks of matters and carrying out heavy burdens. . Whatever these people say, they will not be able to deny that Muhammad has achieved what no human being before or after him has achieved, nothing has distracted him from this, neither a woman nor a non-woman, if the greatness of a man has allowed him to give the call her right, and give the woman her right, then greatness is a preponderance and not a deficiency, and this proper fulfillment is perfection and not a defect.<sup>87</sup> Fair studies on the life of the Prophet showed that his marriage to his women was far from receiving sexual whims and indulging in pleasure, contrary to what went to orientalists biased says Akkad :( (Some orientalists told us that nine wives evidence of excessive sexual orientation, we said that you do not describe Jesus as a minor nationality because he never married. You should not describe Muhammad as excessive nationality because he combined nine women)) ().<sup>88</sup>

Hence, we find that the orientalist accusations attached to the Prophet of sensuality fall in front of criticism and fall in front of historical facts. Rather, the message of Islam was good for women as it made them the idol of men, the pillar of the family, gave legal and economic rights and strengthened their social status. . The universal message of Islam, which carried goodness, achieved justice and equality for the members of the same society, and brotherhood among different peoples, should be the bearer of goodness and justice for women, and worked to preserve their chastity.

And the other point that raised orientalists "the phenomenon of revelation" and as there are orientalists fair do not exceed the description of the Prophet peace be upon him and his family intelligence and genius that they see enabled him to solve the problems of the Arabs through a revolution reform general and radical, and also found these orientalists found others who compare what happens to the Prophet when the revelation descended on him of suffering and symptoms of mental illness where some of the orientalists describe that what affects the Prophet of symptoms while receiving revelation from the Emirates The external that appears on his face, eyes and forehead, from pallor or congestion or sweat, or the accompanying echoes or sounds as mentioned in Islamic narrations ().<sup>89</sup> He does not judge the validity of what he sees and says, as if he wants to say that what Muhammad (peace and blessings of Allaah be upon him) sees is nothing more than pathological fantasies<sup>90</sup>.

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<sup>86</sup>Surah An-Nisa, verse: 3.

<sup>87</sup> Al-Akkad, Abbas Mahmoud, The Genius of Muhammad, Publisher: Al-Asriya Library, Beirut, Pla.T., pp. 104-106.

<sup>88</sup> Al-Akkad, *ibid.*, p. 104.

<sup>89</sup>Al-Nasa'i, Ahmed bin Shuaib (d. 203 AH / 915 AD), Virtues of the Holy Qur'an, edited by: Farouk Hamada, 2nd Edition, Dar Revival of Science, Beirut, 1992, vol. 1, p. 59.

<sup>90</sup>Idris, Jaafar Sheikh, Montgomery Watt's Method in the Study of the Prophethood of Muhammad (peace and blessings of Allaah be upon him), within the book *Orientalist Curricula in Arab-Islamic Studies*, Arab Educational, Cultural and Scientific Organization, Arab Bureau of Education for the Gulf States, vol. 1, 1985, p. 211.

Some orientalists have sufficed us to respond to this wrong view, including the English orientalist William Moore, who said: "Portraying what appears to Muhammad in the hours of revelation in this scientifically wrong way is a big mistake. The epileptic seizure does not leave when infected with any mention of what he went through during it, but forgetfulness during this period of his life after he wakes up completely forgetful, and does not remember anything of what was done or solved during it, because the movement of feeling and thinking is completely disrupted by the holidays. These symptoms are as proven by science, and this was not what befell the Arab Prophet during the revelation, but his perceived senses were alerted in the meantime, an alert that people did not know, accurately reminding everything he received afterwards to his companions. Moreover, the revelation of revelation was not always associated with sensory coma with the presence of spiritual perception, but the revelation and the Prophet (peace and blessings of Allaah be upon him) often occur in his normal wakefulness."<sup>91</sup>

Another orientalist quotes that he changed another opinion on the revelation to the effect that he has over the days had a nervous state in his thinking ... Fasting and staying up late affected the health of Muhammad, who was accustomed to eating, movement and free life, so he saw strange visions during his light sleep that he remembered well when he woke up. In addition to this, Badli confirms Muhammad's message by saying: No Jew, Buddhist or Christian has seen his religion grow before his eyes so miraculously quickly, and no other religious leader has been rewarded as Muhammad was rewarded in his lifetime, and it seems as if God wills to confirm that Muhammad is the last of his messengers, and that Islam is the last of his religion. As for revelation, it is what is unique to the Prophet. Badli also says that Muhammad is unique in the history of religions that he was inspired by all What he was doing, and he was not a saint or a king, and what distinguished him in life from other Muslims, if we exclude his inimitable personality, he did not have a famous name or a counted money and he did not live a different life from other people until he says: I rarely think of him as the author of the Qur'an, that wonderful book of rulings, religion and systems ().<sup>92</sup>

Related to this point "revelation" to the Prophet is another point, which is the source from which the Prophet took his religion, and of course, this point also occurred in which there were many differences between orientalists in their opinions, some of them state that the religion brought by Muhammad is only a result of being influenced by previous religions, especially Judaism and Christianity, they say that Muhammad has taken his religious information from Jewish and Christian sources, and when they find a difference between the information of Islam and the information of the two previous religions, they return it to ignorance and lack of Accurate knowledge of the sciences of the People of the Book, and here they accuse the sources from which the Prophet was taken as unreliable sources. In addition to Jewish and Christian sources, orientalists stood at the pre-Islamic Arab sources from which the Prophet took some of his information and religious practices, according to their claims, and the most prominent of these is Karl Brockelmann, who claimed that the Prophet took many of his teachings from pre-Islamic Arab sources such as Friday prayers and Ashura fasting<sup>93</sup>.

One of the things that raised about orientalists doubts incident Isra and Mi'raj, which referred to in the Koran in Surat Isra .has been exposed to some to refer to Isra and Mi'raj and expressed them as a vision of the Prophet Muhammad (peace be upon him and machine), but the hadiths

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Emile<sup>91</sup> Dermengham , the life of mohammad,N.YDial press- 1930,pp14-29.

Quoted <sup>92</sup>from: Hamdan, Nazir, the Prophet (peace and blessings of Allaah be upon him) in the writings of orientalists, research published in the Journal of the Call of Truth, without M, Pla T, p. 48.

History <sup>93</sup>of the Islamic Peoples, translated into Arabic: Nabia Amin Fares, Munir Baalbaki, Dar Al-Ilm Lil-Malayan, Beirut, Pla.T., pp. 46-47.

correct frequent explicit in that they were not in the world of vision, but were in awake body and soul, and this was the subject of miracles, and this was denied by the Quraish ().<sup>94</sup> As is well known, Al-Isra is fixed in the Book of God Almighty, everyone who looked at his surahs and verses knows that, and that there is a surah bearing the name of this event in the Holy Qur'an, which is Surat Al-Isra issued by God Almighty by saying: }Glory be to him who was taken prisoner by his servant at night from the Grand Mosque to the Al-Aqsa Mosque, which blessed us around him to show him from our signs that he is the All-Hearing and Insightful.<sup>95</sup> The Holy Qur'an did not mention that the Isra was a dream vision, but showed that it is a real journey in wakefulness, in which the Messenger of God was captured in spirit and body to the Al-Aqsa Mosque in Palestine, and the Miraj has also been mentioned in the Holy Qur'an in the saying of the Almighty in Surat Al-Najm } and the star if he fell (1) What strayed your companion and what seduced (2) and what speaks of passion (3) If it is only a revelation inspired (4) His knowledge is very strong (5) Once upon a time Fastoi (6) It is the highest horizon (7) Then DNA drooped (8) He was around the corner (9) He inspired to his servant what he inspired (10) What lied the heart what he saw (11) Aftamaronh on what he sees (12) He saw another catarrh (13) At Sidra Al-Muntaha (14) Then the paradise of shelter (15) As the Sidra blurs what blurs (16) What Zag sight and what overwhelmed (17) He has seen from the great signs of his Lord {().<sup>96</sup>

Despite the foregoing, we do not deny the distinguished role of some orientalist who defended the Prophet Muhammad, may God bless him and grant him peace, led by Dr. Michael Hart, author of the book: "The First Hundred", which draws us to stand with him at his scientific view, which he put to classify the greats of history, within an ordinal ladder, chosen according to logical measures dictated first and foremost, the impact of this character in history in its stage, and in the formation of trends of the following stages and the permanence of this impact This was based on three points:

1. The first importance is for people who have always influenced history, whether it is the famous or obscure or evil character, humble or arrogant .
2. Relying in its previous classification on personalities that influenced at the global level and not taking into account the personalities that influenced at the local level.
3. In determining the status of a person, the researcher took into account the importance of the historical movement he contributed, although he realized that the necessity of the historical movement of evolution is not caused by the work of individuals (<sup>97</sup>).

According to these scientific criteria set by this researcher for those hundred who considered each of them to be truly pioneering figures in history, the Prophet was at the top of the ladder, and so it is not a heresy for us Arab Muslims, to see in his work a great gesture of fairness and an impartial scientific view, from a Western thinker, with which he was forced to provide justification and defend his choice because he presents his book to his fellow Westerners. The choice of Muhammad to be the first in the list of the most important men in history may have surprised many readers to the extent that it may raise some questions, but I believe that Muhammad (peace and blessings of Allaah be upon him and his family) was the only man in history who succeeded in a higher and prominent way at both the religious and worldly levels. These days, almost thirteen centuries after his death, his influence is still overwhelmingly

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<sup>94</sup>Hamdan, The Prophet (peace and blessings of Allaah be upon him) in the writings of orientalist, pp. 117-118.

Surah<sup>95</sup> Al-Isra'a, verse 1.

Verse<sup>96</sup> 1-18

(Hart<sup>97</sup>, Michael, The One Hundred Immortals, the greatest of whom is Muhammad the Messenger of Allah (peace and blessings of Allaah be upon him), translated by: Anis Mansour, Modern Egyptian Office, Cairo, Pla.T., pp. 9-10.

strong<sup>98</sup>.

Montgomery Watt concludes: "Whenever we think about the history of Muhammad and the history of early Islam, we are astonished by the greatness of such an act. There is no doubt that the conditions were favorable for Muhammad and provided him with opportunities for success that few men had, but the man was quite up to the circumstances. If he had not been a prophet, a statesman and an administrator, and if he had not placed his trust in God and was firmly convinced that God sent him, he would not have written an important chapter in the history of humanity. I hope that this study of Muhammad's life can help to arouse interest, once again, in a man who is the greatest of the men of the 'sons of Adam'<sup>99</sup>".

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<sup>98</sup>Hart, *ibid.*, pp. 13-19.

<sup>99</sup>Montgomery, *Muhammad in Medina*, p. 512.

## **The end**

We conclude from the above the following:

- The main motive of the Orientalist movement is to destroy Islam from within by intrigue and malice, and to raise suspicions and doubts about its principles, values, laws and history for fear of its spread in the West.
- Orientalists' interest in the Islamic East and its various sciences and Arab-Islamic studies since an early era, and among those things that they paid attention to the biography of the Holy Prophet Muhammad (may God bless him and his family and grant him peace), and these interests were represented by their study of the Prophet's biography, analysis of its events, discussion, investigation of its books, publication and translation into their different languages.
- Some of them were fair in the study of his personality (peace be upon him and his family) and others tried by all means to offend the Prophet, and recorded in their writings slanders on Islam, and his Prophet on him and the God of peace and blessings, intentionally and deliberately in order to distort the facts, abuse, and alienation Westerners from Islam, they took to deepen and tucked their abuses and slander on the Prophet in a few lines scattered between the pages of books.

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# MACRO ELEMENTS AND ENERGY VALUES OF HERBAGE OF DIFFERENT HUNGARIAN VETCH + TRITICALE MIXTURE RATIOS

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## **Abstract**

The aim of this study is to determine the macro elements and energy values of the hay of Hungarian vetch (HV) + Triticale (T) mixture ratios grown in Sivas ecological conditions. Seven mixture rates of Hungarian vetch + Triticale (100:0%, 80:20%, 60:40%, 50:50%, 40:60%, 20:80%, and 0:100%) were used as plant material in the experiment. The experiment was conducted at Sivas Science and Technology University, Faculty of Agricultural Sciences and Technology, Agricultural Ar&Ge Center trial area in the 2023-2024 growing season. According to the data obtained, the differences between the mixing ratios were found to be statistically very significant in terms of macro elements. Calcium (Ca), magnesium (Mg) phosphorus (P), and potassium (K), rates ranged between 0.46-2.01%, 0.177-0.397%, 0.325-0.393%, and 2.290-2.537%, respectively. In terms of total digestible nutrient rates, digestible and metabolic energy values of mixtures, differences were also significant. The values were 58.08-64.28% for total digestible nutrients (TDN) rates, 8.832-9.924 Mcal/kg for metabolic energy (ME) values, and 2.997-3.272 Mcal/kg for digestible energy (DE) values. Among the Hungarian vetch + Triticale mixture rates examined in the research, 100% Triticale and 20% Hungarian vetch + 20% Triticale mixture rates stand out in terms of high P rate, 80% Hungarian vetch + 20 Triticale, 50% Hungarian vetch + 50% Triticale, 40% Hungarian vetch + 60% Triticale and 20% Hungarian vetch + 80% Triticale mixtures in terms of high K rate, 100% Hungarian vetch in terms of high Ca, Mg and TDN rates, DE and ME values and it is suggested that these rates can be grown in Sivas and similar ecologies for hay purposes.

**Keywords:** Hungarian vetch, triticale, macro elements, digestible energy, metabolic energy

## 1. Introduction

Growing annual legume forage crops mixed with cereals has been widely used in the world for many years (Mariotti et al., 2009) and has become a planting method that is increasingly being adopted in our country (Seydoşoğlu et al., 2020). There are many advantages to planting mixed forage legumes and grasses. The most important of these advantages is that the yield in mixed planting is higher than when legume forage plants are planted alone (Ghanbari-Banjar and Lee, 2003).

It is not recommended to plant vetch (*Vicia*) species, which are quality forage plants, purely in forage production because they have a creeping feature. However, in order to eliminate this negative feature, many researchers recommend that they be grown as a mixture with upright-growing grasses (Açıköz, 1991; Cömert, 2014). In addition, annual legume forage crop species such as vetch, grass pea and forage pea, which have high nutritional value, lodge due to their creeping habitus, and as a result, rot occurs in the lower leaves. As a result, the quality and yield of the forage crop decreases. Although growing a single species purely has advantages such as ease of planting, ease of management, etc., growing forage crops as a mixture is more preferred (Kökten et al., 2003).

In order to use the soil more efficiently, planting a mixture of annual grasses and legumes in the Mediterranean countries has recently become more popular than planting these plants separately (Papastylianou, 2004). Planting in a mixture ensures better use of all layers of the soil, meets the needs of grass forage plants with the nitrogen that the legume forage plants in the mixture bind to the soil, and increases the organic matter and fertility of the soil. It has been reported that planting in a mixture also increases crude protein yield (Lithourgidis et al., 2006; Budaklı Çarpıcı and Çelik, 2014).

This study aimed to determine the macro elements and energy values of the herbage of different Hungarian vetch + Triticale mixture rates.

## 2. Materials and Methods

Seven different mixture rates of Hungarian vetch + Triticale (100:0%, 80:20%, 60:40%, 50:50%, 40:60%, 20:80% and 0:100%) were used as plant material in the experiment. Using a randomized block trial design with three replications, the experiment was set up in the 2023-2024 growing season at Sivas Science and Technology University, Faculty of Agricultural Sciences and Technology, Agricultural Ar&Ge Center trial area. The experiment's parcel area was designed to have four rows and a length of 5 meters. The experiment was planted in the first week of October, with the help of a hand marker, at 20 cm spacing. In pure plantings, 22 kg/da of Ümran Hanım triticale variety (Mirza, 2023) and 12 kg/da of Kansur Hungarian vetch variety (Gök, 2023) seeds were used. 10 kg of DAP fertilizer per decare was applied to the experiment (İptaş and Yılmaz, 1999).

**Table 1.** Total precipitation, and averages of temperature and relative humidity values of the period of the experiment

Months	Total Precipitation (mm)		Average Temperature (°C)		Average Relative Humidity (%)	
	2023-2024	Long Term	2023-2024	Long Term	2023-2024	Long Term
October	34.8	19.0	12.5	12.5	92.2	57.6
November	44.4	32.3	8.4	6.1	66.1	69.9
December	31.6	29.8	4.0	2.7	76.9	79.8
January	53.2	46.1	1.4	-2.0	77.3	74.0
February	10.8	35.4	3.5	0.6	65.8	71.2
March	44.4	44.2	5.0	2.5	69.7	64.7
April	11.2	23.2	13.9	11.1	52.9	50.0
May	60.0	18.9	13.1	13.9	63.7	53.8
June	11.6	77.7	20.9	18.6	49.5	55.2
Total/Aver.	302.0	326.6	9.2	7.3	68.2	64.0

The climate of the province of Sivas is continental, with hot, dry summers and cold, snowy winters. Key climatic variables for the study period, such as humidity, precipitation, and temperature, are shown in Table 1. The lowest average temperature was in January while the highest was in June. The total amount of precipitation during the vegetation period when the experiment was established was 302.0 mm, which was below the long-term average of 326.6 mm. The average relative humidity varied between 52.9% and 92.2% from month to month, and the average relative humidity of the vegetation period in which the experiment was established (68.2%) was above the long-term average of 64.0%.

**Table 2.** Physical and chemical properties of the soil of the trial site

Depth	Texture	pH	Lime (% CaCO <sub>3</sub> )	Salinity (%)	P <sub>2</sub> O <sub>5</sub> (kg/da)	K <sub>2</sub> O (kg/da)	Organic matter (%)
0-30 cm	Silty clay loam	7.28	19.6	0.33	3.40	93.59	1.7

The chemical and physical properties of the soils of the experimental area are listed in Table 2. The pH of the silty clay loam soil in the field is 7.28. Additionally, looking at Table 2, it is also seen that the soil has low organic matter (1.7%), high potassium (93.59 kg/da), low phosphorus (P<sub>2</sub>O<sub>5</sub>), low lime (19.6%) and low salt (0.33%) contents.

Hay samples of mixture rates of Hungarian vetch + Triticale were ground in a mill and passed through 1 mm for chemical analysis. In the research, the macro elements calcium (Ca), magnesium (Mg), phosphorus (P) and potassium (K) contents of mixture rates of Hungarian vetch + Triticale were determined. ICP-MS device (Inductively Coupled Plasma-Mass Spectroscopy) was used to determine the elemental contents of the hay samples (Başaran et al., 2021). Total digestible nutrients (TDN) rate, digestible energy (DE) value and metabolic energy (ME) value of hay samples of mixture rates of Hungarian vetch + Triticale were calculated according to the formulas. TDN % = 82.38 - (0.7515 x ADF %) (Moore and Undersander, 2002); DE (Mcal/kg) = 0.27 + 0.0428 \* DDM (Digestible Dry Matter) % (Fonnesbeck et al., 1984); ME = 0.821 \* DE (Khalil et al., 1986).

The analysis of the data obtained was made in the Jump-Pro13 statistical package program and the differences between the averages were compared according to the Tukey test.

### 3. Results and Discussion

Macro elements [Calcium (Ca), magnesium (Mg), phosphorus (P), and potassium (K)] rates and total digestible nutrients (TDN) rate, digestible energy (DE) and metabolic energy (ME) values, and determined in the dry herbage samples of mixture rates of Hungarian vetch + triticale were found to be statistically significant at the 1% level (Table 3).

The Ca and Mg levels of Hungarian vetch + triticale mixture rates vary between 0.46-2.21% and 0.177-0.397%, respectively. While the highest Ca and Mg rates were obtained from 100% HV parcels, the lowest Ca and Mg rates were found in the 100% T parcels. It has been reported that the Ca and Mg contents of dry hay should be between 0.1-1.0% and 0.1-0.4%, respectively (Motsara and Roy, 2008). While the Mg contents we obtained are in accordance with the values reported by these authors, it is seen that the values we obtained from other mixtures except 100% HV, 80% HV + 20% T and 60% HV + 40% T parcels are higher than the values reported by these authors.

While it was reported that Ca and Mg ratios of perennial ryegrass (*Lolium perenne* L.) varied between 0.231-0.485 mg/g and 0.152-0.511 mg/g, respectively (Li et al., 2021), it was reported that Ca and Mg ratios of Italian ryegrass varied between 0.56-0.76% (Öner et al., 2023). On the other hand, it was reported that Ca and Mg ratios of rangeland herbages varied between 0.97-1.30% and 0.24-0.35%, respectively (Kökten and Taşdemir, 2023), while it was reported that the Ca and Mg ratios of *Astragalus* species varied between 0.69-2.02% and 0.28-

0.47%, respectively (Çaçan et al., 2023). It was reported that the Ca and Mg ratios of buckwheat straw varied between 1.54-1.90% and 0.35-0.47%, respectively (Ekmekçi et al., 2022). Besides, it was reported that Ca and Mg ratios of Berseem clover + teff mixtures varied between 0.50-1.61% and 0.220-0.243%, respectively (Das and Kokten, 2024).

The P rates of the herbage of Hungarian vetch + triticale mixture rates vary between 0.325-0.393%. While the highest P rates were obtained from 100% T and 20% HV + 80% T parcels, the lowest P rates were found in the 80% HV + 20% T parcel. When we look at the K content of Hungarian vetch + triticale mixture rates, it varies between 2.290-2.537%. While the highest K rates were obtained from 80% HV + 20% T parcel, it was followed by the 50% HV + 50% T, 40% HV + 60% T and 20% HV + 80% T parcels, which are statistically in the same group. The lowest K rates were obtained from 100% HV parcel. It was reported by Motsara and Roy (2008) that the P and K contents of dry hay should be between 0.2-0.5% and 1.0-5.0%, respectively. The values we obtained are among the values reported by these authors.

While it was reported that P ratio of perennial ryegrass varied between 0.189-0.530 mg/g (Li et al., 2021), it was reported that K ratio of Italian ryegrass varied between 1.78-2.87% (Öner et al., 2023). It was reported that the P and K ratios of annual ryegrass varied between 0.39-0.54% and 1.15-2.09%, respectively (Sidhu et al., 2020). On the other hand, it was reported that P and K ratios of rangeland herbage varied between 0.30-0.41% and 2.18-3.19%, respectively (Kökten and Taşdemir, 2023), while it was reported that the P and K ratios of Astragalus species varied between 0.17-0.36% and 0.58-2.51%, respectively (Çaçan et al., 2023). It was reported that the P and K ratios of buckwheat straw varied between 0.14-0.21% and 0.54-0.82%, respectively (Ekmekçi et al., 2022). Besides, it was reported that P and K ratios of Berseem clover + teff mixtures varied between 0.277-0.380% and 2.190-2.470%, respectively (Das and Kokten, 2024).

**Table 3.** Averages of macro elements and energy values of the hays of Hungarian vetch + Triticale mixtures

Hay Mixtures	Ca (%)	Mg (%)	P (%)	K (%)	TDN (%)	ME (Mcal/kg)	DE (Mcal/kg)
100% HV	2.01a	0.397a	0.337bc	2.290d	64.28a	9.924a	3.272a
100% T	0.46f	0.177d	0.393a	2.237cd	58.08e	8.832e	2.997e
80% HV + 20% T	1.53b	0.309b	0.325c	2.537a	60.28b	9.219b	3.094b
60% HV + 40% T	1.16c	0.257c	0.348b	2.422bc	59.47bc	9.076bc	3.059bc
50% HV + 50% T	1.07cd	0.268c	0.341bc	2.534ab	59.14cd	9.017cd	3.044cd
40% HV + 60% T	0.95d	0.247c	0.353b	2.435abc	58.66cde	8.934cde	3.023cde
20% HV + 80% T	0.72e	0.209d	0.377a	2.423abc	58.32de	8.873de	3.007de
Average	1.13**	0.266**	0.353**	2.411**	59.75**	9.125**	3.071**

\*\* ; significant at the  $P \leq 0.01$  level. There is no statistical difference between the averages shown with the same letter. HV: Hungarian Vetch, T: Triticale

When we examine the TDN ratios, ME and DE values of Hungarian vetch + triticale mixture rates, it is seen that they vary between 58.08-64.28%, 8.832-9.924 Mcal/kg and 2.997-3.272 Mcal/kg, respectively. While the highest TDN rate, ME and DE values were obtained from 100% HV parcel, the lowest TDN rate, ME and DE values were obtained from 100% T parcel. It was reported that the DE and ME values of some grass pea genotypes varied between 2.34-2.79 Mcal/kg and 1.92-2.29 Mcal/kg, respectively (Özdemir et al., 2022), while it was reported that the ME values of sorghum herbage varied between 6.94-11.67 MJ/kg DM (Kaplan et al., 2017). On the other hand, it was reported that the ME values of potato haulms varied between 7.45-9.34 MJ/kg DM (Kaplan et al., 2018). It was also reported that the TDN rates, DE and ME values of Berseem clover + teff mixtures varied between 60.35-63.73%, 3.097-3.248 Mcal/kg and 9.231-9.827 Mcal/kg, respectively (Das and Kokten, 2024).

#### **4. Conclusions**

This study was conducted to provide information about determining to the macro elements and energy values of the hay of mixture rates of Hungarian vetch + Triticale grown in the Sivas ecological conditions. Mixture rates of Hungarian vetch (HV) + Triticale (T) showed significant differences in terms of the macro elements and energy values of the hays. This study depicted that (i) 100% Triticale and 20% Hungarian vetch + 20% Triticale mixture rates were the most favorable mixtures according to P rates, (ii) 80% Hungarian vetch + 20 Triticale, 50% Hungarian vetch + 50% Triticale, 40% Hungarian vetch + 60% Triticale and 20% Hungarian vetch + 80% Triticale mixtures was the best mixtures for the K rates, (iii) 100% Hungarian vetch was the most stable mixture according to Ca, Mg and TDN rates, DE and ME values.

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# **EFFECT OF ELECTROMAGNETIC RADIATION, TELECOMMUNICATION MAST ON *Clarias gariepinus***

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## **Abstract**

Telecommunication masts, also known as cell towers or base stations, are structures that emit electromagnetic radiation to facilitate wireless communication. These masts play a crucial role in modern telecommunications infrastructure, enabling the transmission and reception of signals for mobile phones, internet connectivity, and other wireless devices. This study is to evaluate the effects of Electromagnetic radiation on Behavior, growth and hematological indices of *Clarias gariepinus*. A total of 90 Juvenile *Clarias gariepinus* of approximately equal body weight of (6.66-6.96g) were purchased from a private hatchery in Birnin Kebbi and were transported in a gerry can to the research location, Gwangwaji village of Birnin Kebbi. A plastic tank of 50 liters were used. The fishes were divided into two groups of 15 with three (3) replicate fishes each, of which group one was made to be the control group and placed 800 meters away from the direct source of EMR (telecommunication mast). Group two was exposed to 18000 MHz EMR at about 50m away from telecommunication mast. The reactions of the fishes were observed daily for 90 days, after which the fishes were sacrificed. The data for this study were analyzed using the Statistical Package for Social Sciences (SPSS) version 20 for Windows. The Student's t-test was used to compare the differences between the test and control groups in which  $P < 0.05$  was considered as significant difference. The activeness of the Experimental fish was recorded to be very active on controlled group and active on exposed group. More so on growth parameters, the highest final weight ( $291.49 \pm 0.50$  g) while the least

(279.44±0.50 g) were observed in group A and B respectively. The highest mean weight (284.83±19.26 g), highest average daily growth (3.16±0.211 g), and highest survival rate (86.10±2.92 %) were obtained in control (Group). On the other hand, the least growth parameters were obtained in exposed (Group). The result on the highest PCV (27.10±0.50%), haemoglobin (8.70±0.50) and red blood cell (2.01±0.29) was observed in control group while the least PCV (25.77±0.29) haemoglobin (8.37±0.29), red blood cell (1.77±0.29) was in the exposed group. The high white blood cell (4.59±0.29) was observed in exposed group while least (2.84±0.29) was in the control group. The highest Granulocyte count (2.7%) was observed exposed (Group B) while the least Granulocyte (0.9%) was in the control (Group A). Conclusively, this study have shown that exposure to telecommunication mast (EMR) can induce toxicity in biological systems and it is therefore, recommended that the mass media, in their report of environmental and health matters, should also give adequate attention to issues of health and environmental risks associated with siting telecommunication masts close to people's residents.

**Keyword:** *Clarias gariepienus*, Birnin Kebbi, Telecommunication

## **Introduction**

Telecommunication masts, also known as cell towers or base stations, are structures that emit electromagnetic radiation to facilitate wireless communication. These masts play a crucial role in modern telecommunications infrastructure, enabling the transmission and reception of signals for mobile phones, internet connectivity, and other wireless devices. While there is ongoing research on the potential effects of telecommunication masts on various organisms, including fish, the current scientific consensus suggests that these structures have minimal direct impacts on aquatic life (Kavitha, 2016).

The length of the wavelength is inversely proportional to the amount of energy. Thus, short-wavelength radiations have more energy than long-wavelengths (Cleaver et al., 2010). As such, gamma rays, x-rays, and some ultraviolet waves with short wavelengths have a high amount of energy and frequency to knock out electrons from atoms and are termed ionizing EMR (Nagaraja, 2019). EMR such as radio waves, microwaves and heat waves have a long wavelength which results in low frequency and energy and are termed non-ionizing EMR (WHO, 2019). This study is to evaluate the effects of Electromagnetic radiation on hematological indices of *Clarias gariepinus*

## **Materials and Methods**

### **Study Area**

The research was conducted, at Gwawangwaji Village. Gwawangwaji is a locality in Birnin Kebbi, Kebbi State. With latitudes 12°27'51"N and longitude 4°15'36"S Minimum and maximum temperature ranges were 18-29°C and 30-42°C, respectively. The relative humidity ranged between 20 to 50% and speed ranged from 7 to 11. Kebbi State is bordered by Sokoto State in the north, Niger State in the south, Katsina and Zamfara State in the east as well as Niger and Benin Republic in the west. As of 2006, at least 3,256,541 people lived in the state (Population Council, 2007), mostly artisans and farmers. The natural vegetation of the state comprises a mixture of Sudan and Guinea Savannah. However, long-term anthropogenic activities have changed the natural vegetation of the state to mainly Sudan Savannah vegetation. The climate of the state is characterized by a long dry season and short wet season with an annual rainfall of about 787 mm (Yahaya et al., 2020).

### **Acquisition of the Experimental Fish**

A total of 90 Juvenile *Clarias gariepinus* of approximately equal body weight of (6.66-6.96g) were purchased from a private hatchery in Birnin Kebbi Local Government area. The juveniles were transported in a jerry can to the research location, Gwawangwaji village Birnin Kebbi. The fishes were acclimatized for 1 week during which they were fed with the vital feed with 2mm of 40% crude protein.

### **Measurement of EMR**

The EMR around the telecommunication mast was measured using a Trifield EMR meter (Yahaya et al. 2020).

### **Experimental Design**

A plastic tank of 50 liters were used. The fishes were divided into two groups of 15 with three (3) replicate fishes each, of which group one was made the control and placed 800 meters away from the direct source of EMR (telecommunication mast). Group two was exposed to 18000 MHz EMR at about 50m away from telecommunication mast (Aderoju et al., 2014). The reactions of the fishes were observed daily for 90 days, after which the fishes were sacrificed.

## Experimental Fish Management

Experimental fish in each plastic tank were fed with the commercial fish feed. The daily ration was split into two and fed twice daily; in the morning and evening. The ration was adjusted on weekly bases. Water levels were maintained and changed after every 3 days in the plastic tank.

## Growth Parameters

The body weight was recorded on weekly basis by weighing fishes in each experimental unit on a field weighing balance. The following growth performance indices were estimated using standard formulae (Jamabo and Ockiya, 2008) as follows;

**Mean Weight Gain (MWG) (g)** = Final Weight (g) –Initial Weight (g).

**Average Daily Growth (ADG)** = MWG (g)/length of feeding trial (t) (days).

**Specific Growth Rate (SGR, %/day)** =  $100(\ln W_2 - \ln W_1)/T_2 - T_1$

Where: W<sub>2</sub> = Weight at time T<sub>2</sub>; W<sub>1</sub> = Weight at time T<sub>1</sub>

**Survival rate (SR)** =  $100(\text{Number at end of feeding trial}/\text{Number at start of feeding trial})$

## Procedure for Blood Collection

Two milliliters (2ml) of blood was collected by direct cardiac puncture as described by Adebayo Tayo et al. (2008). The cardiac region was wiped with tissue paper to avoid contamination with mucus before puncture. The needle was inserted at right angle to the vertebral column of the fish, the needle was gently withdrawn and the blood was transferred in to EDTA containers.

## Data Analysis

Data obtained was analyzed using the Statistical Package for Social Sciences (SPSS) version 20 for Windows. The Student's t-test was used to compare the differences between the test and control groups in which P < 0.05 was considered as significant difference.

## Results and Discussion

Effects of EMR on Behavior and Growth of *C. Gariepinus*

Table 1 shows the result of EMR exposure resulted in behavioral changes, Swimming activities were reduced; Moreover, a reduction in appetite was also observed in exposed fish compared to the controlled.

**Table 1:** Behavioral Activities

Activities	Controlled group (A)	Exposed group (B)
Swimming	+++	+
Feeding	+++	+

The increase and decrease in the level of behavioral activities shown by (+++) or (+) signs. The (+++) indicate very active while (+) indicate active. Table 2 shows the growth parameters. The highest final weight gain (279.44±0.50g) was in observed in the control group, while the least (272.57±0.50g) was in the group exposed to EMR.

**Table 4.2.** Growth performance of experimental fish *clarias gariepinus*

Parameters	Control group (A)	Exposed group (B)
IW (g)	6.66±0.10 <sup>b</sup>	6.96±0.10 <sup>a</sup>
FW (g)	291.49±0.50 <sup>a</sup>	279.44±0.50 <sup>b</sup>
MWG (g)	284.83±19.26 <sup>a</sup>	272.34±35.49 <sup>b</sup>
ADG (g)	3.16±0.211 <sup>a</sup>	3.02±0.39 <sup>b</sup>
SGR (g)	4.21±0.23 <sup>a</sup>	4.08±0.22 <sup>b</sup>
SR (%)	86.10±2.92 <sup>a</sup>	84.44±0.50 <sup>b</sup>

n = 3. Values are expressed as Mean ± Standard deviation, Values on the same column with the different superscript are significantly different P<0.05

Keys:

Keys:

IW (g) = Initial weight

FW (g) = Final weight

MWG (g) = Mean weight gain

ADG (g) = Average daily growth

SGR (g) = Specific growth rate

SR (%) = Survival rate

### Hematological Analysis

The blood samples were immediately conveyed to Amma and Diagnosis Laboratory Birnin Kebbi, Kebbi State for analysis of haematological indices. Haemoglobin (Hb), packed cell volume (PCV), red blood cell count (RBC), white blood cell count (WBC), Mean corpuscular volume (MCV) and Mean corpuscular haemoglobin (MCH) were analyzed using Automated Mindry Haematological Machine Model: BC - 2800 (Soyinka and Boafo, 2015).

### Hematological Indices of Experimental Fish

Result from table 3: revealed the mean values for hematological indices of *C. gariepinus* in control group and exposed group are presented in Table 3: Result showed significant difference (P<0.05) for all the parameters measured, when compared to the control. There was decreased in values of some haematological parameters of *C. gariepinus* in the control group when compared with exposed group; these includes MCH (41.37±0.29), WBC (4.59±0.29), MCV (123.90±0.29) and MCHC (33.37±0.29). However, some parameters were found to be higher in the control group these include; PCV (27.10±0.50%), Hb (8.70±0.50 g/dL) and RBC (2.01±0.29). The result shows significant difference on haematological indices at P< 0.05 when the control group was compared with other groups.

**Table 4.3.** Blood Parameters of the *Clarias gariepinus* Exposed to Telecommunication Mast EMR

Parameters	Control group (A)	Exposed group (B)
PCV (%)	27.10±0.50 <sup>a</sup>	25.77±0.29 <sup>b</sup>
Hb (g/dL)	8.70±0.50 <sup>a</sup>	8.37±0.29 <sup>b</sup>
PLT(L)	8.00±0.50 <sup>a</sup>	8.00±0.50 <sup>a</sup>
MCH	39.10±0.50 <sup>b</sup>	41.37±0.29 <sup>a</sup>
WBC	2.84±0.29 <sup>b</sup>	4.59±0.29 <sup>a</sup>
RBC	2.01±0.29 <sup>a</sup>	1.77±0.29 <sup>b</sup>
MCV	117.40±0.50 <sup>b</sup>	123.90±0.29 <sup>a</sup>
MCHC	32.97±0.29 <sup>b</sup>	33.37±0.29 <sup>a</sup>

n = 3. Values are expressed as Mean ± Standard deviation, Values on the same column with the different superscript are significantly different P<0.05

Keys: PVC = packed cell volume; Hb = hemoglobin; WBC = white blood cells, RBC= red blood cell.

### Discussions

The behavioral activities of the fishes exposed to EMR were less active. This finding agrees with the works of Ricardo and Susana, (2020) who reported that a change in behavioral, physiological and the metabolic changes in juvenile/adult fish under short- and long-term

radiation exposure. Swimming activity was reduced; most of the fish tried to avoid exposure and showed a stationary behavior with slow caudal and dorsal fins movements or a slow displacement behavior. Moreover, a reduction in appetite, reflected by a remarkable increase in the time required to consume the food was reported in exposed fish compared to the control. The Loss of body weight observed in fish exposed to EMR; could be due to interactions between the EMR and the cell leading to toxicity. This is also in line with Ricardo and Susana, (2020), who observed growth reduction and loss in body condition of juvenile and adult fishes exposed to radiation. Earlier studies by Srivastava et al. (2017) also reported growth retardation among some rats exposed to 900 MHz EMR from mobile phones and Tajudeen et al. (2020) recorded no weight gain in rats exposed to EMR, which could have resulted in the loss of appetite and fewer feed intakes, culminating in iron deficiency. An increase in the level of WBC was observed in exposed fish which was significantly higher ( $P < 0.05$ ) than the control which suggested that the body is recruiting more immune cells to fight the EMR from the Mast. Adebayo et al. (2019) also observed elevated WBC levels in some rats exposed. The authors suggested that the increased WBC levels could be an indicator of a self-defense mechanism against exposure to foreign bodies. The level of PCV RBC, and Hb lymphocytes of exposed fish decreased. A lower count of PCV means a loss in RBC count due to several reasons, such as cell destruction, low bone marrow production and blood loss. The decreased blood is an indication that the fishes were anaemic. According to Tajudeen et al. (2020), EMR exposure may induce oxidative stress in animal systems, resulting in the reduction of blood parameters. Previous studies by Singh et al. (2013) and Aberumandet al. (2016) also found significant decreases in the levels of Hb, RBC, and blood platelets of some mice exposed to mobile phone EMR. However, Sani et al. (2018) reported an increase in the Hb and RBC levels of some rats exposed to EMR from mobile phones. The levels of the MCH and MCV of the fish there was a significant increase in the level of exposure ( $P < 0.05$ ).

### **Conclusion**

The results of this study have shown that exposure to telecommunication mast (EMR) can induce toxicity in biological systems. In particular, the EMR interfered with the functions of the selected health indices of the exposed fishes, resulting in reduced behavioral activities. The exposed fishes also weighed less than the control, indicating mitotic cell death or a loss of appetite consequent of the reduced activities with subsequent decreased in survival rates. Similarly, the blood parameters were altered, which add to the body of evidence that EMR from the telecommunication mast was strong enough to cause harmful effects. Collectively, the findings of the study showed that exposure to telecommunication mast EMR can induce toxicity to cells and hence affect their functions.

### **Recommendations**

1. The mass media, in their report of environmental and health matters, should also give adequate attention to issues of health and environmental risks associated with siting telecommunication masts close to Animal farms. Such reportage would serve as a form of advocacy for an appropriate response from the authorities as well as an enlightenment for the populace.
2. It is advisable to site telecommunication masts away from dwelling places.
3. Concerned administrative bodies, for example, the NCC and NESREA ought to guarantee the adequate and strict implementation of pertinent ecological guidelines with respect to the erection of media transmission poles. This is one way of addressing the health risks attendant on the spread of telecommunication installations around the country

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**PAKISTANI "FLOWER BOMB" – PASOORI AS "WEAPON" FOR PEACE AND UNITY. SENTIMENT AND CONTENT ANALYSIS OF THE AUDIENCE RESPONSE TOWARDS IT AND THE ELICITED ARTWORKS OVER THE CYBERSPACE**

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**Abstract**

The lands of Pakistan are host to some of the oldest known civilizations - a sign for rich cultural heritage. On other side Pakistan was created by the British elite trough a troublesome division of the British Raj that elicited many continuous wars, conflicts and tensions with millions deaths, casualties and shattered lives between and within the new countries. The Pakistani "flower-bomb" Pasoori was created in such harsh atmosphere and it resembles a song of troublesome love in troublesome land. However it is not the first time on the Indian subcontinent when the love and art instruments are used as "weapons" – let's just recollect about the famous simple Zafarnama poetic-prose letter by Guru Gobind Singh that finally defeated the mighty tyrant emperor Aurangzeb and became a driver for his positive transformation. Many charts and statistics show the Pakistani "flower-bomb" Pasoori really created mighty blast on the local and global scene, as it broke several local and global records for popularity and virality. In the current study the authors collected, investigated and analyzed with content based and NLP methods the audience response towards the Pakistani "flower-bomb" and some of the elicited by it artworks over one of the global cyber platforms for creative media content sharing as YouTube. The results from the analysis of the audience response revealed that the Pakistani "flower-bomb" elicited multiple sentiments and attitudes with domination of the positive ones. Thus the Pakistani "flower-bomb" Pasoori deserves to be named as "weapon" for peace and unity.

**Keywords:** Pasoori, peace, sentiment analysis, song cover, dance cover, social media, YouTube, Pakistan.

## INTRODUCTION

Love is Beauty and Beauty is Truth,  
and this is why in the beauty of a flower  
we can see the Truth of the Universe.  
(Gautama Buddha, 2011)

This short but eloquent aphorism accounted to the Indian prince/aristocrat - Siddhartha Gautama, later known as the Buddha - seems to be in remarkable resonance with the modern megahit "Pasoori" (Gautama Buddha, 2011; Keown, & Prebish, 2007). In it Buddha identifies the love with the beauty and the later one with truth, and the flower is presented as messenger, embodiment and vessel of them. Here according to some later scholars Buddha refers more of the universal form of Love that is beyond the erotic domain, as well as the Beauty (Cooper, 2017).

It seems the author of "Pasoori" Ali Sethi was sufficiently aware of these realities and dimensions of the Love, when he decided to use it as weapon in his masterpiece considered by him as "flower-bomb" (AFP, 2023; Images.Dawn, 2023). Love in its many forms and aspects was not for first time used as "weapon" in the history of the Indian subcontinent. The mighty tyrant emperor Aurangzeb was finally defeated and made deadly sick by the simple Zafarnama letter by Guru Gobind Singh, in which Love was key component for the destruction of his atrociousness and driver for his positive transformation (Nārā, & Singh, 1985).

To explore "Why we need "flower-bombs" in these days?" is beyond the scope of our study. But in order to comprehend some aspects of the research and analysis that will follow is worthwhile to mention in brief the participants, the reasoning and origin of some of the targeted by Pasoori "flower-bomb" battlefields. The establishment by the British and the control of their possession - the British Raj, was possible through continuous and deliberate implementation of the detrimental policies "divide and rule" and "Tertius gaudens" (third party that benefits from conflict between two other parties) (Xypolia, 2016). A fruitful soil for their implementation was the religious and ethnic abundance in the Raj. The results were many deliberately cultivated, provoked and stimulated conflicts and tensions between ethnic and societal groups within the Raj. Further the detrimental division of the Raj and granting of independence gave opportunity in the years to follow these artificially cultivated tensions further boosted on local levels by locals to become war conflicts, forceful migrations and genocides with death toll scoring millions and even more shattered human lives and destinies (Rahman et al., 2018; Xypolia, 2016; Beachler, 2007). According to R. Kumar the partition of India by the British was the most tragic ever human genocide artificially perpetrated in human history (Kumar, 2019).

So in such atmosphere of long lasting conflicts and tensions was created the remarkable song "Pasoori", which name can be translated as "Conflict" or "Difficulty" (Nanda, 2022). Pasoori's lyrics in a sense resembles and narrates about a conflict but not political one, but interpersonal and person-society. It elaborates on the universal theme of the troublesome love between two young people in society with significant control and regulations over the romantic relationships. According to its authors the song aimed to wipe out some of the societal stigmas and also the politically imposed tensions and discrepancies among the ethnically diverse population on the Indian subcontinent and adjacent areas (AFP, 2023; Images.Dawn, 2023).

According to some charts and statistics it probably eradicated a lot more divisions and united a lot more people in the Indian subcontinent and the nearby regions, than originally expected (Thecurrent.pk, 2022; Kabra, 2022; Bolnews, 2023; Baloch, 2022).

So in this study the authors aimed to explore and analyze the response of the professionals, enthusiasts and the general audience on global scale over one of the leading intercontinental cyber platforms for creative media content sharing – YouTube, in an atmosphere of ongoing geopolitical tensions and artists' hopes that even then art can bring positive changes.

## **Methods**

For the study were selected all of the videos that were filtrated by the search engine with the keywords "Pasoori" and "cover" or "remix" found over one of the most popular global platforms for free video sharing – YouTube, which met the fulfilment of the following criteria: 1/. the popularity to be above 200000 views, 2/. the video not to be part of competition, as the organizers often have rules for the artistic content and performance, 3/. the video not to be part of party or celebration, or other social event, or educational class, 4/. comedy, parody, animations, or when the performer is not visible, or mixes of several different performer's videos are excluded; 4/. the duration of the videos with the cover versions should be minimum 20% of the original song; 5/. the performers to be above 15 years (middle adolescence and above) since according to some studies on the subject it is assumed that below this threshold the emotional human relations and their complexity conveyed through the song lyrics and music are not experienced by the majority of the teenagers yet (Sumter, et al., 2013; Salerno, et al., 2015; Popatanasov et al., 2024).

For the search on the online platform YouTube was used the desktop version with Extended Support Release of the browser Mozilla Firefox (Mozilla Foundation (2023)). Care was taken to minimize the effects of subjectivity of YouTube search algorithms however there's no guarantee that some videos which may fulfill the criteria were not included in the presented results by the search engines.

The content analysis of the videos was done according to the theoretical framework and guidelines by Kassarian (Kassarian, 1977). Each video was evaluated by at least two trained observers and encoders.

Further for the analysis of the audience reactions and attitudes towards the creative content and its producers were used Python programming language and the YouTube Data API to extract the needed data and comments from the online platform YouTube (Pokharel & Bhatta, 2021). The collected comments were processed to remove the problematic symbols and punctuation marks. In order to analyze such large data set was used the neuro-linguistic programming and natural language processing (NLP) methodology (Cannon, et al., 2022; Pozzi, et al., 2016).

The processing and analysis of the data was done with the software packages as R and RStudio (RStudio Team, 2020; R Core Team, 2021) and Microsoft Excel (Microsoft Corporation, USA).

## **Research and Results**

As result from our search were selected 97 videos that fulfilled the selection criteria and over 86600 comments were collected as response to these videos. Majority of them were song covers or remixes and only 25 of them were dance covers, which will be analyzed separately. For the song covers were collected over 73000 comments and for the dance covers were collected nearly 14000 comments, while from the official video were gathered over 186000 comments.

### **Sentimental analysis of the audience response**

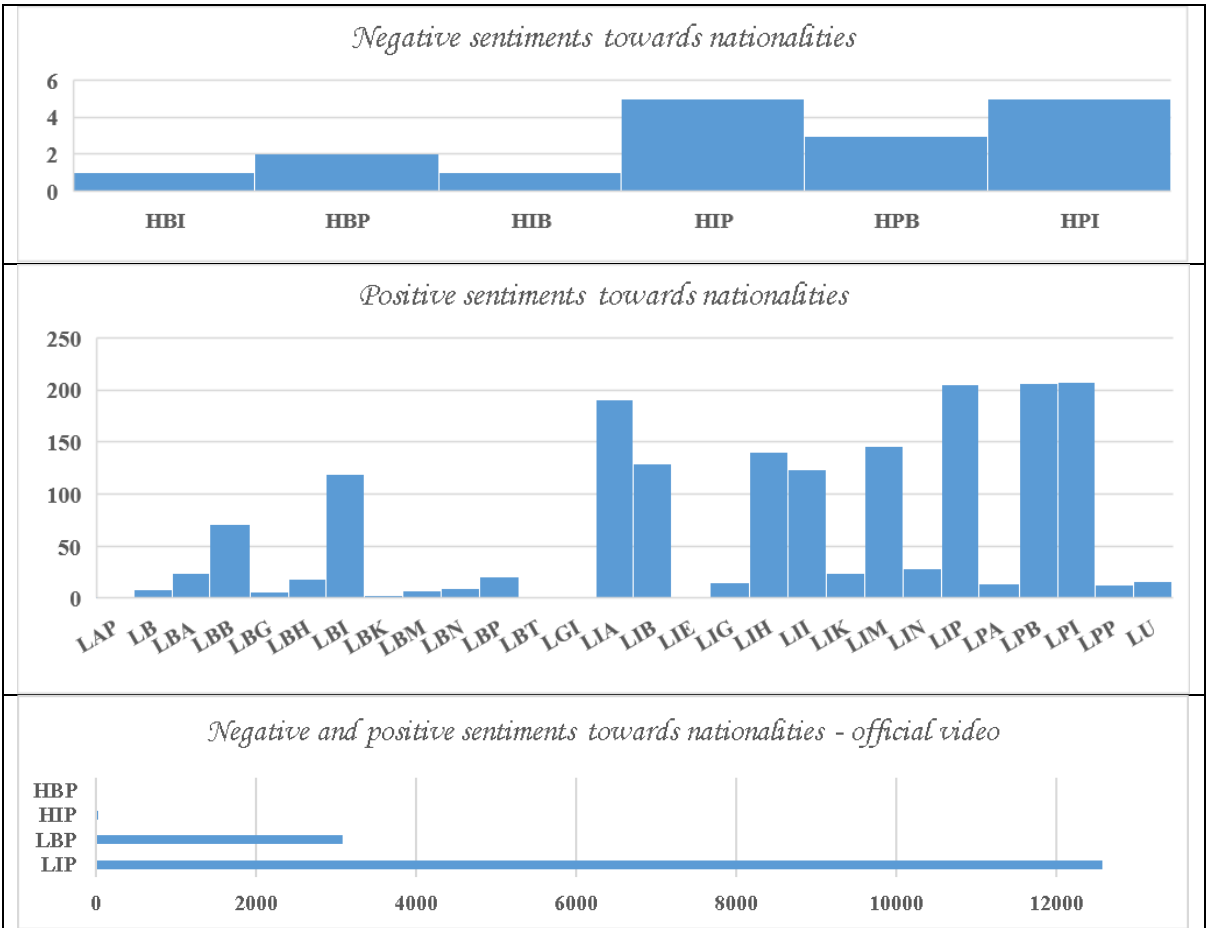
To evaluate the "success of the flower-bomb" by A. Sethi were analyzed the comments from the covers and from the official video in summary almost 3 lakh. The results showed that almost 10% of the audience response expressed highest level of verbal sentiments of positive appreciation and additionally over 80% of the comments were at different degrees of lower levels of positive appreciation and the rest were mostly neutral to occasional negative.

Specific sentiment analysis was done in regards to the sentimental comments expressing attitudes concerning nationalities and/or ethnicities elicited or provoked by the watched video and performer/s. Using custom scripts and algorithms was performed data mining over the 1 lakh covers' database, and were extracted nearly 1800 comments suitable for the purpose. Key points of the analysis were the national/ethnic origin of the commenter, the addressee/s and the type of sentiment expressed. The results revealed overwhelming prevalence of the positive sentiments over the negative ones with ratio approx. 104:1. The detailed analysis showed that

the level of negativism between Indians and Pakistani is similar on absolute scale, but by taking into account the population size differences Pakistani take over the Indians (Fig. 1) (United Nations, 2004). The next one is between Pakistani and Bangladeshi users and the former one prevail over the later.

The levels of positive sentiments invoked towards different nationalities are highest between Pakistani and Indians, followed by the Bangladeshis (Fig. 1). The positive sentiments are also quite pronounced between Indians and USA citizens, probably some of the later ones are part of the large diasporas from the Indian subcontinent. Between Indians and the Dutch is also present high level of positive sentiments. However for the other European countries – UK and Germany the response is relatively poor from the audience of the countries from the former British Raj probably related to the historical traumatism associated with them.

For the official video the nearly 2 lakh collected comments were processed in similar way. From them over 17% of the comments were suitable for the purpose. The analysis showed that the ratio of the positive sentiments over the negative ones is 630:1 which is over 6 times greater between Indians and Pakistani compared to the ratio from the covers and 617:1 for Bangladeshis (Fig. 1).



**Figure 1:** Frequency distributions of the sentiments towards nationalities. Legend: L-love/positive sentiments, H-hatred/negative sentiments, A-USA, B-Bangladesh, E-UAE, G-Germany, H-Holland, I-India, K-UK, M-Malesia, N-Nigeria, P-Pakistan.

Among the identifiable reasons for the negative sentiments are the inflicted traumas by the actions of people from the addressee country, as found from the detailed comments content: **@ram.ram.saryane8121:** "sorry , if you hurt but I hate Pakistan because my grandfather was in army and during patrolling in Kashmir and Pakistani funded terrorists shot him..."

**@taherajenz:** "Why on earth are our deluded people bugging up Pakistani songs...forgetting what Pakistan did to my motherland and my people back in 1971. I feel the younger generation are quick to forget the struggles of our people, the genocide, rape, murder, collateral damage to our infrastructure and economy... of Bangladesh..."

Among the identifiable reasons for the positive sentiments seem to be rooted in the universal feelings of love and oneness with other human beings as seen below:

**@felixabayomiakanbaiyaniwur4169:** "One world, one people devoid of hate, division, discrimination and segregation. United we are strong. Let's live together as brothers and sisters...see every human on earth as your brother human being. Blessings to everyone here..."

**@ameerali-qp3dt:** "Music is a best tool to eliminate hate and spread love among different nations!"

## **Discussion**

The results showed that the song cover videos are more popular and preferred type of cover of the Pasoori song video than their dance cover counterparts.

Overall it seems that the "Love-flower" which is obscured to grow and blossom in the troublesome land and environment that is embedded in the masterpiece "Pasoori" managed to touch emotionally close to 1 billion viewers on the cumulative scale. And although the song and the majority of the covers narrate anguish, sadness and melancholy, which are considered to be unpleasant affects that should elicit avoidance, paradoxically the audience responded in overwhelmingly positive manner. This howbeit seems to be in concordance with the psychological and neurobiological findings in recent studies, which find that sorrow and sadness elicited by artworks provoke in the perceiver similar affects, but also conjointly or afterwards activate affects and attitudes from the prosocial and altruistic spectrum as compassion, empathy, love, feeling of oneness etc. (Huron & Vuoskoski, 2020). And the "flower-bomb" Pasoori and its covers similarly seem to be able to evoke feelings of love, appreciation, oneness among diverse ethnic and societal groups (some of them being involved in ongoing or past conflicts).

On historical scale the "flower-bomb" Pasoori and its derivatives probably did not or may not produce such drastic effect as Zaframana letter in the human history (Фурцов, 2013; Nārā & Singh, 1985). But they definitely produced a mighty global "flower-blast", which not only beautified the audience lives from aesthetical perspective, but also from psychological one and they served the purpose foreseen by the talented author Ali Sethi and his team who actually love both geopolitical creations of the British elite – Pakistan and India and suffer from the political troubles between them (Jagota, 2023). So through their art creations Ali Sethi and the artists that he inspired were able to serve and bring harmony for the historically and culturally entwined countries. As they managed to transcend the politically imposed divisions and tensions and invoke feelings of oneness and appreciation among the diverse audience.

## **Conclusions**

The results from the analysis of the audience response revealed that the Pakistani "flower-bomb" elicited multiple sentiments and attitudes with domination of the positive ones. This holds true also for the nationality based sentiments and attitudes. Thus the Pakistani "flower-bomb" Pasoori deserves to be named as "weapon" for peace and unity.

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## **PITUITARY GLAND REGULATION BY THE HYPOTHALAMUS**

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### **Abstract**

The hypothalamus is essential for controlling the pituitary gland and coordinating the endocrine system's reaction to different physiological demands. The maintenance of homeostasis, regulation of metabolic activities, development, reproduction, and stress responses depend on the hypothalamic-pituitary axis. The hypothalamus produces hormones that release and inhibit pituitary output in response to neurological and hormonal signals from the pituitary. The structure, operation, and regulatory mechanisms of the pituitary gland's hypothalamic control will be examined in this review.

## **1. Introduction**

The neuroendocrine system's major hub, the hypothalamic-pituitary axis, connects the central nervous system to the peripheral endocrine glands. The hypothalamus, a little region near the base of the brain, regulates the pituitary, also known as the "master gland." Numerous hormones that control development, metabolism, reproduction, and stress are secreted by the pituitary. To maintain homeostasis and adapt to changes in the environment, the hypothalamus and pituitary must cooperate.

## **2. Anatomy of the Hypothalamus and Pituitary Gland**

### **2.1. Hypothalamus**

The hypothalamus, which is located beneath the thalamus, makes up the floor of the third ventricle. It is composed of several nuclei, each of which plays a distinct role in regulating the body's temperature, thirst, hunger, sleep cycles, and emotional activity. These nuclei emit neurohormones that influence pituitary gland activity.

### **2.2. Pituitary Gland**

The hypophysis, or pituitary gland, is a pea-sized gland with two separate parts: Adenohypophysis (the anterior pituitary): Growth hormone (GH), adrenocorticotrophic hormone (ACTH), thyroid-stimulating hormone (TSH), luteinizing hormone (LH), follicle-stimulating hormone (FSH), and prolactin are among the hormones that are produced by this epithelial tissue.

The posterior pituitary (neurohypophysis) is an extension of the hypothalamus that releases oxytocin and vasopressin (antidiuretic hormone, ADH) into the bloodstream.

## **3. Hypothalamic Control Mechanisms**

Through a combination of hormonal and neurological processes, the hypothalamus regulates the pituitary gland's activity directly and indirectly.

### **3.1. Hypothalamic Releasing and Inhibiting Hormones**

Hormones that release and inhibit are secreted by the hypothalamus into the hypothalamic-hypophyseal portal system, which is connected to the anterior pituitary directly. These hormones reach the anterior pituitary through the bloodstream, where they either promote or inhibit the release of hormones.

Thyrotropin-releasing hormone (TRH) encourages the production of thyroid hormones by stimulating the release of TSH.

Corticotropin-releasing hormone (CRH) initiates the release of ACTH, which controls the adrenal glands' output of cortisol.

Gonadotropin-releasing hormone (GnRH) hormone is essential for reproductive health as it stimulates the release of LH and FSH.

Growth hormone-releasing hormone (GHRH) facilitates the release of growth hormone (GH), which influences metabolism and growth.

Somatostatin: Prevents the production of TSH and GH.

Dopamine: Inhibits prolactin secretion.

The anterior pituitary's activity is altered by these hormones, allowing the hypothalamus to regulate several physiological processes.

### **3.2. Direct Neural Regulation of the Posterior Pituitary**

Via neural connections, the hypothalamus directly controls the posterior pituitary. Neurons in the paraventricular and supraoptic nuclei of the hypothalamus create vasopressin

and oxytocin, which are then sent via axons to the posterior pituitary. In reaction to a stimuli, these hormones are released into the bloodstream.

Oxytocin: necessary for a variety of processes, including social bonding, sexual reproduction, lactation, and pregnancy.

Vasopressin (ADH): Maintains blood pressure stability by decreasing urine production and enhancing water absorption through the kidneys. Water balance is regulated by this.

#### **4. Feedback Mechanisms and Homeostasis**

The hypothalamic-pituitary axis operates under a series of feedback loops, predominantly negative feedback, to maintain homeostasis. Hormones produced by peripheral endocrine glands (e.g., thyroid, adrenal glands, gonads) provide feedback to both the hypothalamus and pituitary gland to adjust their activity.

For instance:

- High levels of cortisol inhibit CRH and ACTH secretion, reducing cortisol production (negative feedback).
- Elevated thyroid hormone levels inhibit TRH and TSH production to prevent overproduction of thyroid hormones.

This feedback ensures that hormone levels remain within optimal ranges and that the body's physiological needs are met.

#### **5. Disorders of the Hypothalamic-Pituitary Axis**

Dysfunction in the hypothalamic-pituitary axis can lead to various endocrine disorders, depending on which part of the axis is affected.

- Hypopituitarism: A deficiency in one or more pituitary hormones, leading to conditions such as adrenal insufficiency, hypothyroidism, or infertility.
- Hyperpituitarism: Excess production of pituitary hormones, often due to pituitary tumors (adenomas). Examples include Cushing's disease (excess ACTH) and acromegaly (excess GH).
- Diabetes Insipidus: A condition caused by insufficient vasopressin, leading to excessive urination and thirst.
- Syndrome of Inappropriate Antidiuretic Hormone (SIADH): Excessive vasopressin leading to water retention and hyponatremia.

#### **6. Conclusion**

The hypothalamus is the master regulator of the endocrine system through its control of the pituitary gland. Its ability to integrate neural and hormonal signals enables the body to adapt to changing internal and external conditions. Understanding the mechanisms of hypothalamic control is critical for diagnosing and treating endocrine disorders that result from dysregulation of this axis.

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# **THE ROLE OF ENZYME ALLOSTERIC REGULATION IN METABOLIC PATHWAYS**

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## **Abstract**

An essential process in the regulation of metabolic pathways and enzyme activity is allostery. The fundamental ideas behind allosteric regulation, its effects on metabolic processes, and the most recent developments in our knowledge of this phenomena are all thoroughly reviewed in this article. We go over the several kinds of allosteric modulators, their structural underpinnings, and their implications for therapeutic interventions and drug development.

## Introduction

A key component of cellular biochemistry is allostery, which enables precise control over the activity of enzymes in response to signals from the environment and other cells. Allostery regulates an enzyme by binding effector molecules at locations other than the active site, which results in conformational changes that alter the activity of the enzyme. This is in contrast to classical enzyme regulation, which includes direct interaction with active sites. Coordinating intricate metabolic networks and preserving homeostasis depend on this type of regulation.

## Structural Basis of Allosteric Regulation

Enzymes are dynamic molecules with conformational changes that can control their activity. Different from the active site, allostery sites are essential for this control. Conformational alterations brought about by the binding of allosteric effectors have the ability to either increase or decrease the activity of an enzyme (positive allosteric modulators versus negative allosteric modulators). The Koshland-Némethy-Filmer (KNF) model and the Monod-Wyman-Changeux (MWC) model are two important theories that explain the molecular underpinnings of these conformational shifts.

## Model of Monod-Wyman-Changeux

The relaxed (R) state, which is catalytically active, and the tense (T) state, which is less active, are the two conformational states that enzymes are said to live in equilibrium between according to the MWC model, also referred to as the concerted model. By altering the balance between these states, allostery effectors can control the activity of certain enzymes.

**Model of Koshland-Némethy-Filmer.** According to the KNF model, also known as the sequential model, an allosteric effector's binding causes a single subunit to undergo a conformational change, which subsequently spreads to neighboring subunits. The sequential and cooperative nature of allosteric transitions is highlighted by this paradigm.

## Allosteric modulator types

Based on how they affect enzyme activity and how they bind, allosteric modulators are categorized.

**Positive Inhibitors of Allostery.** Positive modulators increase the activity of enzymes. By stabilizing the R state, they increase the enzyme's activity. As an illustration, consider fructose-2,6-bisphosphate, which functions as phosphofructokinase-1 (PFK-1), a crucial glycolysis regulating enzyme, positive allosteric effector.

**Allelosteric Negative Regulators.** Enzyme activity is inhibited by negative modulators. By stabilizing the T state, they lower the activity of the enzyme. For example, the negative allosteric modulator ATP inhibits PFK-1, which in turn prevents glycolysis when energy levels are high.

## The Regulation of Allostery in Metabolic Processes

To maintain cellular homeostasis, allosteric mechanisms tightly regulate metabolic processes. Allosteric control affects important enzymes involved in amino acid synthesis, the citric acid cycle, and glycolysis.

**Cycle of Citric Acid.** ADP allosterically activates isocitrate dehydrogenase, an essential enzyme in the citric acid cycle, while ATP and NADH inhibit it. This modulation aids in striking a balance between the needs of the cell and energy output.



**Drug Design Consequences.** Comprehending allosteric control creates opportunities for novel medication development. Compared to active site inhibitors, allosters can regulate enzyme activity more precisely and selectively. There may be benefits to medications that target allosteric sites, such as less adverse effects and increased specificity.

**Case Study: Gleevec (Imatinib).** One medication that demonstrates the potential of allosteric modulators is gleevec, a tyrosine kinase inhibitor used to treat chronic myeloid leukemia. It inhibits the activity of the enzyme by binding to an allosteric site on the BCR-ABL tyrosine kinase, stabilizing an inactive conformation.

### **Conclusion**

An essential method for regulating metabolic pathways and enzyme activity is allostery. Our understanding of this control has expanded thanks to developments in structural biology and biochemistry, which have also opened up new avenues for therapeutic intervention and provided insights into cellular metabolism. Further investigation in this field may lead to the creation of innovative clinically useful allosteric modulators.

## WHAT COOPERATION ADVICE WOULD SUBJECT TEACHERS GIVE TODAY'S PARENTS?

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### **Abstract**

The aim of this empirical research is to examine what advice about cooperation the subject teachers would give to today's parents. A total of 47 subject teachers who are employed in elementary schools in the Republic of Serbia participated. Some of the advice that subject teachers would give today's parents concerns communication, mutual trust, respect for teachers and the school their child attends, culture of behavior in interaction with teachers. Our results open many questions for a broader view of this relevant topic. The subject of future research could be to ask teachers who work with students of younger grades, psychologists, pedagogues, educators, as well as students who are preparing for this call about the advice they would give today's parents in the context of cooperation.

**Keywords:** cooperation, communication, interaction, modern school, students.

## Introduction

With our paper, we want to look at and contribute to the field of cooperation between parents and teachers, where we focus on the topic that examines what advice about cooperation teachers of the subject classes would give to today's parents with whom they interact in professional pedagogical work. „Cooperation and partnership are, if not a guarantee, then at least a good prognosis of the effectiveness of didactic and educational activities“ (Marzec, 2020: 139). It is necessary to point out that „developing mutual trust and complementary responsibilities are keys to partnerships“ (Moles, 1997: 5). The results of the empirical research show that teachers' perceptions are positive about family-school cooperation (Sidhu et al., 2019). The results of the research concerning the involvement of parents in their children's school duties show positive attitudes, as well as that despite the obstacles, parents are engaged and committed to learning with their children (Milanović, 2021). It is primary to note that „the school has the task of bringing parents closer to the school“ (Ilić, Nikolić & Jovanović, 2006: 364). According to all the above, with our empirical work we will try to present what advice about cooperation the subject teachers would give to today's parents.

## Methodology

The subject of this empirical research is what advice on cooperation would teachers of the subject give to today's parents. The aim of this empirical research is to examine what advice about cooperation the subject teachers would give to today's parents. A descriptive method and survey technique were used. Based on the literature that deals with cooperation and involvement of parents, we created a survey questionnaire.

A total of 47 subject teachers who are employed in elementary schools in the Republic of Serbia participated. In total, 93.6% of female teachers and 6.4% of male teachers participated. 74.5% of teachers are employed in a school located in a city and 25.5% of teachers are employed in a school located in a village. 80.9% of teachers are employed for an indefinite period of time and 19.1% of teachers are employed for a fixed period of time. 67.4% of teachers are class teachers and 32.6% of teachers are not class teachers in the school. 53.2% of teachers have been working at the school for more than 20 years, 19.1% of teachers have been working at the school for between 13 and 20 years, while 27.7% of teachers belong to the category of up to 12 years.

## Results and Discussion

In Table 1, we have presented the answers of the subject teachers.

**Table 1.** Advice on cooperation that subject teachers would give today's parents

Teacher1	„Parents should show enthusiasm“.
Teacher2	„To learn culture and good communication“
Teacher3	„To listen more carefully to what the teachers tell them“.
Teacher4	„That teachers want to help students and that everything they do is in their best interest“.
Teacher5	„To listen, monitor the development and behavior of their children and talk more with teachers“.
Teacher6	„To listen and trust the teacher“.
Teacher7	„ The advice is to inform the teachers about everything directly in communication“.
Teacher8	„I have no experience yet, but I think we should talk more“.
Teacher9	„I would advise parents that teachers are competent enough to work with students and that they can best assess students' knowledge“.
Teacher10	„That they come regularly for consultations, follow the diary, talk to the teacher about all doubts with the aim of solving the problem“.
Teacher11	„To understand that everything is for the benefit of the children“.
Teacher12	„Regularly coming to consultations and solving doubts as soon as they arise, is an excellent prevention of bad cooperation“.
Teacher13	„Being open to new knowledge and skills“.
Teacher14	„Greater trust in teachers for those parents who lack trust“.
Teacher15	„Listen to both sides“.
Teacher16	„That communication is very important, that good cooperation is the best way to solve all problems“.

Teacher17	„My advice is that they should be ready for cooperation, work and that we can always have a nice conversation, solve a problem and look forward to nice events”.
Teacher18	„I would advise them to come to the activities I invite them to, to be patient and to pay attention to the way they communicate in school”.
Teacher19	„To respect your children's teachers more”!
Teacher20	„That mutual trust is necessary”.
Teacher21	„Teachers do everything to pass on their knowledge to children and teach them to be good people”.
Teacher22	„To see teachers as someone who wants the best for their children”.
Teacher23	„To take more interest and talk with children and teachers”.
Teacher24	„Meeting deadlines and regular communication”.
Teacher25	„To listen to advice”.
Teacher26	„That by respecting and listening to the teacher's instructions, they are not doing the teacher a favor, everything they do is for the good of their children, if nothing else, at least they set a good example for their children and make good memories together”.
Teacher27	„To have more tolerance”.
Teacher28	„That we are on the same page and that as a team, we can be very useful in the child's upbringing”.
Teacher29	„That cooperation and communication with teachers is necessary and that the teacher knows their child best at school”.
Teacher30	„Because of the attitude that parents often take, thinking that we are on opposite sides, I would say that we are on the same side and that we are here to help”.
Teacher31	„That they try to be objective and realistic, that everything that is done is in the best interest of the children-students. That we are on the same side, that we are people and parents”.
Teacher32	„To have more trust in teachers and the school”.
Teacher33	„There is always a solution and an agreement”.
Teacher34	„More engagement, understanding and respect”.
Teacher35	„Just to be honest, to communicate with teachers. I believe that everything is solvable, we just need everyone to be calm and composed, to talk and solve the situation. Parents trust their children a lot, and this can lead to various situations that are not good for the teacher or the children”.
Teacher36	„To address the teacher directly and be honest in communication”.
Teacher37	„More communication”.
Teacher38	„She would advise them to come to school even when there is no problem, they should not come only when there is a problem”.
Teacher39	„To respect all teachers, to be pleasant and to take care of the vocabulary”.
Teacher40	„They should check the information with the teachers, not to react impulsively. If there are problems, they should call and come to the class teacher so that together we can solve what is needed”.
Teacher41	„Dear parents, listen to the advice and talk to us teachers”!
Teacher42	„Communicate openly”.
Teacher43	„That we want the best for children and that we were educated for our profession. They should trust us and our advice to them”.
Teacher44	„During my experience, I noticed that parents are scared when their children start the fifth grade, and that's when they become interested and come. As the grades progress, parents relax and come to school only when they have to”.
Teacher45	„That in addition to the parents' meeting, they also come to other activities, open doors, individual conversations... to be communicative”.
Teacher46	„They should come to school during the school year, take an interest in the child, talk to us teachers, and not only when the grades are concluded. At the end of the semester and at the end of the school year, most parents come and ask only about final grades”.
Teacher47	„They should not interfere with the assessment and evaluation of students' knowledge”.

Based on the obtained results and the answers presented by the teachers in Table 1, we can see that the advice that the teachers would give to parents concerns communication, mutual trust, respect for teachers and the school their child attends, culture of behavior in interaction with teachers, coming regularly to school and conversations, that they do not come to school only when there is a problem, but that they also come when there are no problems, that they do not interfere in the assessment and professional work of teachers, because they are experts in that calling. Most of the advice teachers would give to parents is about communication. „Especially communication between teachers and parents regarding students' performance in the class bears vital importance in better understanding students' problems, increasing parents' support in education, performing effective counselling and guidance, and ultimately increasing students' motivation and success“ (Ozmen et al., 2016: 28). This process must be worked on together.

According to the answers, we can see that the teachers state that more respect for the teachers and the school is needed from the parents. „Today's school crisis is directly related to the crisis of the teaching profession, because the changes primarily depend on the change in the position of teachers in it” (Radeka, 2007: 284), whereby „the social treatment of the teaching profession, i.e. its bearers, has not been adequately valued until now, because educational and pedagogical work, as well as the people who perform it, are not sufficiently appreciated in society” (Marković-Krstić, 2006: 204). According to the above, this problem is extremely current in modern society and it is necessary to systematically pay attention to the reputation and position of teachers in today's time when the value system is on the margins.

The teachers' answers are interesting that parents are often not aware that the teachers with them are a team that has a clear goal aimed at children and their positive development. We believe that parents can adopt these tips, but it is definitely necessary to engage the teachers themselves, especially teachers who are class teachers. It is clear that „family and school are two major, effective, and formative institutions in values education“ (Yaşaroğlu, 2016: 68). In this context, we are aware that we live in modern times, in times where behaviors, personal and social attention and interests are different, but it is schools and teachers who should lead and direct children, but also parents to positive behavior, constructive communication, to degree of trust through various meetings, activities, content, to constructively point out mistakes and consequences.

The results show that the advice given by teachers to parents also concerns parents' visits throughout the school year. Therefore, throughout the school year, parents should be interested, communicate with teachers, talk about what needs to be improved, what needs to be worked on together. In this way, effects and unique action can be monitored. Also, the teachers answer that parents should come to the school to talk with the teachers even when there are no problems, which is certainly an important element in building relationships and trust. The obtained results show that teachers state that parents should trust them, that teachers are competent, professional, that they do not interfere and that they are professionals in their field.

## **Conclusion**

There is a lot of advice about cooperation that subject teachers would give today's parents. The obtained results show that the advice that the teachers would give to parents concerns communication, mutual trust, respect for teachers and the school their child attends, culture of behavior in interaction with teachers, coming regularly to school and conversations, that they do not come to school only when there is a problem, but that they also come when there are no problems, that they do not interfere in the assessment and professional work of teachers, because they are experts in that calling. A suggestion for future research would be to include a larger number of subject teachers in the sample. Also, to see the connection between teachers' answers about the advice they would give to parents about cooperation and teachers' sociodemographic characteristics. It would be interesting research to examine teachers who work with students of younger grades, psychologists, pedagogues, educators, as well as university students who are preparing for this call about the advice they would give today's parents in the context of cooperation.

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# **EXPLORING INNOVATIVE APPROACHES FOR CARBON SEQUESTRATION: A COMPREHENSIVE REVIEW OF CURRENT STRATEGIES AND PROSPECTS**

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## **Abstract**

The primary cause of climate change, atmospheric carbon dioxide (CO<sub>2</sub>) concentrations, have significantly increased as a result of anthropogenic activity, especially the combustion of fossil fuels. Since CO<sub>2</sub> makes up around 60% of all greenhouse gases (GHGs), mitigation efforts are mostly focused on it. The natural process of soil carbon sequestration, which involves plants transferring CO<sub>2</sub> from the atmosphere into the soil, is becoming more recognized as an essential tactic in the global fight against climate change. This procedure is essential to Carbon Capture, Utilization, and Storage (CCUS) technologies, which are being investigated more and more as a means of lowering CO<sub>2</sub> levels in the atmosphere. In-depth analyses of the several forms of soil carbon sequestration, the variables affecting its efficiency, and the methods and technologies being researched today to improve it are all included in this study. Given that intensive agricultural practices have significantly degraded the soil and depleted SOC stocks in agroecosystems, special emphasis is paid to the soil organic carbon (SOC) pools therein. Soil health, agricultural output, and long-term climate resilience are all dependent on the preservation and enhancement of these stocks.

**Keywords:** soil, carbon, sequestration, soil organic carbon, SOC sequestration.

## **Introduction**

CO<sub>2</sub> in higher amounts traps sunlight, causing the Earth's temperature to increase which is called the greenhouse effect. Due to the increase in the emissions of greenhouse gases an utmost challenge in the twenty-first century arises to reduce the harmful effects of global atmosphere changes. Among the numerous greenhouse gases, CO<sub>2</sub> is the most important one marked for a total of 63 % of the emission, on the other hand nitrous oxide, methane and other trace gases account for 10, 24 and 3 % respectively (Ravindranath et al., 2006). Man is the chief contributor to an increased atmospheric CO<sub>2</sub> concentrations (Kuc et al., 2003). Prior to the Industrial Revolution, the amount of carbon dioxide in our atmosphere was roughly 280 ppm and in 2019 that amount is 412 ppm (Rotman, 2019), and it is anticipated that at the end of this century, it will reach 600-800 ppm (Knohl & Veldkamp, 2011).

The majority of climate experts claim that anthropogenic activities specifically the fossil fuel burning like coal, oil and gas are the cause of the current climate change. Global warming is being observed as a result of the atmospheric CO<sub>2</sub> rising from roughly 280 to over 380 parts per million (ppm) throughout the past 250 years that results in ocean acidification by dissolving in seawater (Gao et al., 2019).

The net extraction of carbon dioxide (CO<sub>2</sub>) from the atmosphere and deposited into long-lived carbon reservoirs in soil is known as soil carbon sequestration. In addition to eliminating atmospheric CO<sub>2</sub>, carbon sequestration enhances soil health, production, and environmental quality, making it a "win-win" tactic. One of the least expensive and least complicated technologies is soil carbon sequestration. It is described as a net uptake of atmospheric carbon dioxide (CO<sub>2</sub>) that increases the amount of organic carbon stored in the soil on the same unit where photosynthesis took place. Soil C sequestration is crucial to counter the issues associated with climate change by capturing CO<sub>2</sub> from the atmosphere. So, the existing ecosystem should be protected immediately by adopting the strategies of reforestation, and afforestation and by establishing artificial grasslands to encourage carbon sequestration (Panchal et al., 2022). Soil plays a critical role in the cycling of global carbon because it stores three times as much carbon as the atmosphere (Zhang et al., 2019).

The purpose of this study is to provide a comprehensive knowledge about carbon sequestration, factors that affect carbon sequestration, and the strategies that are used for carbon sequestration.

## **Material and methods**

### **Research strategy and Data source:**

In order to guarantee an exhaustive and objective selection of pertinent literature on carbon sequestration techniques, a systematic review was carried out in accordance with the PRISMA standards. The review's objective was to investigate carbon sequestration's future and existing tactics. Several databases, including Web of Science, Scopus, PubMed, and Google Scholar, were searched.

Study inclusion in the review was contingent upon the fulfilment of the subsequent eligibility requirements focused on soil carbon stocks and pools, sequestration mechanisms, and ways to improve soil carbon. Focused on carbon sequestration solutions between 2000 and 2024, publications were made conducted with an emphasis on soil carbon sequestration in a variety of settings, including terrestrial, marine, and geological contexts. Provided primary data, models, or evaluations of carbon sequestration strategies, including creative approaches, direct and indirect sequestration methods.



**Table 1.** The criteria for both inclusion and exclusion.

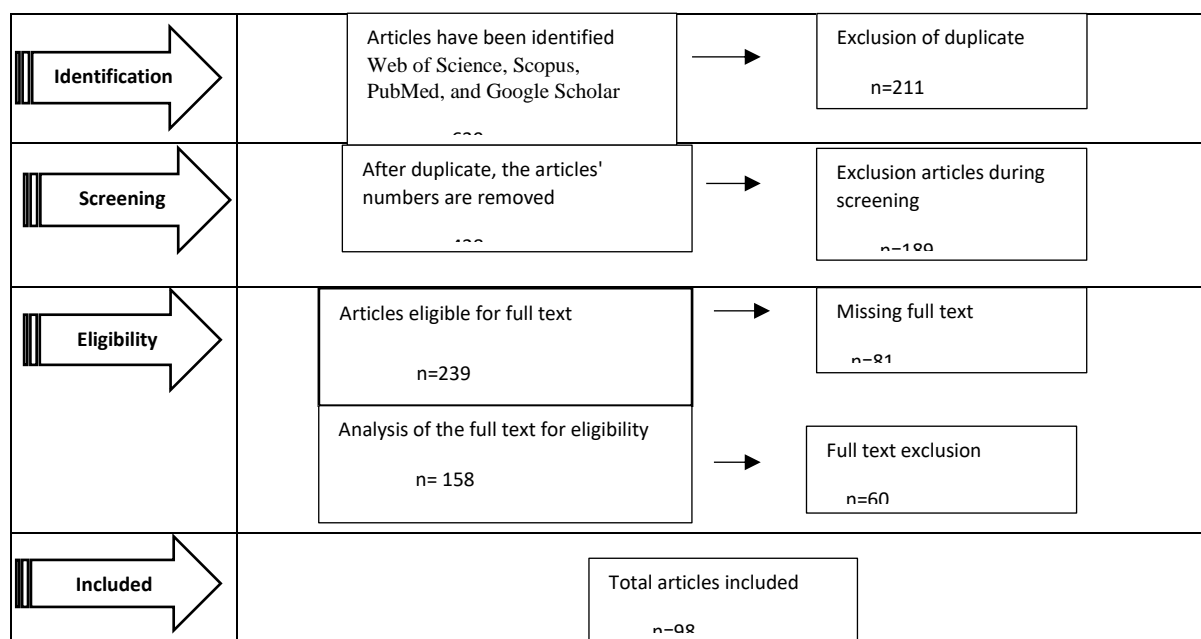
Criterion	Eligibility	Exclusion
Literature type	Research article journal, reports and review article, book or book chapter.	Conference or duplicate paper
Language	English	Non-English
Time line	2000 January-2024 August	<2000
Topic	Carbon ssequestration	All other

**Study selection and Data extraction:**

For reference management, every item that was pulled from the databases was loaded into EndNote X9. Identical research was eliminated. Two reviewers (Reviewer A and Reviewer B) separately examined the titles and abstracts of the remaining publications to find possibly relevant research. Then, the inclusion and exclusion criteria were applied to the complete texts of these publications. Disagreements were settled by discussion, and if necessary, a third reviewer (Reviewer C) was consulted.

The author(s), publication year, study location, study design, type of carbon sequestration strategy, key findings related to soil organic and inorganic carbon, direct and indirect sequestration methods, factors affecting sequestration, and reported benefits of carbon sequestration were all collected from the included studies using a standardized data extraction form. A second reviewer verified the retrieved data to ensure correctness and completeness.

To give the research selection procedure a visual depiction, a PRISMA flow diagram was created. The figure shows how many studies were found, vetted, evaluated for eligibility, and included in the review. It also shows the rationale behind each stage's exclusions.



**Figure 1.** The Preferred Reporting Materials for Systematic Review and Meta-Analysis (PRISMA) technique is used to generate relevant article inclusion and exclusion criteria.

**Data synthesis**

A narrative synthesis strategy was employed to synthesize data because the study designs, methods, and outcomes varied widely. A qualitative synopsis of the research was created, with an emphasis on the efficacy of various carbon sequestration techniques in several environmental contexts (soil, ocean, terrestrial, and geological). Because of the variations in research designs and outcome variables, a meta-analysis was not practical.

## **Result and discussion**

### **Soil Carbon Stocks and Pools**

#### **Soil Organic Carbon (SOC)**

By weight, 58 % of soil organic matter contains carbon. We refer to this carbon as soil organic carbon (SOC). Because it affects every aspect of soil fertility, soil organic carbon (SOC) is a good indication of mixed farms' health and performance. Increasing SOC can boost SOC levels and enhance productivity, stability, and resilience (Chan, 2010). Increasing soil organic matter and, consequently, soil carbon content may have additional benefits for soil health, such as improved water and nutrient storage and better resistance to erosion (Annabi et al., 2007). However, as soil organic carbon (SOC) makes up around half of soil organic matter (SOM) by mass, an increase in SOM of 1 % results in an increase in SOC of less than 1.0 % (Annabi et al., 2007).

#### **Soil Inorganic Carbon (SIC)**

In arid and semi-arid regions, soil inorganic carbon (SIC) is a potential carbon sink that supports landscape stability, soil development, sequestration of carbon (C), and global C dynamics (Batool et al., 2024). It is the greatest pool in the global carbon cycle at a depth of 100 cm (Ferdush & Paul, 2021). Approximately 50 % of terrestrial C stock is made up of soil inorganic carbon, and it is particularly essential in arid and semi-arid zones. SIC is vital for agriculture, lowering carbon dioxide (CO<sub>2</sub>) emissions and sequestration, and regulating climate (Sharififar et al., 2023).

### **Current Carbon Sequestration Processes and Strategies**

#### **Direct C sequestration**

Direct C sequestration takes place by the inorganic chemical reaction that transforms CO<sub>2</sub> into inorganic compounds of carbon like calcium and magnesium carbonates in soil (Chand, 2023).

#### **Indirect C sequestration**

Plant carbon sequestration takes place indirectly when plants photosynthesize CO<sub>2</sub> into the plant biomass; at a subsequent time a part of plant biomass is indirectly sequestered as SOC during the process of decomposition (Chand, 2023).

#### **Oceanic carbon sequestration**

At the moment, the oceans constitute the world's main long-term sink for CO<sub>2</sub> emissions created by humans, taking in a net 2 gigatons of carbon annually worldwide (Stavins & Richards, 2005). This uptake happens naturally as a result of chemical reactions between seawater and CO<sub>2</sub> in the atmosphere rather than as a result of intentional sequestration (Jangir et al., 2018). The development of carbonate skeletons and sediments, which are susceptible to breakdown in acidic conditions, is essential to the survival of several marine creatures and ecosystems. Measurements in the lab and in the field suggest that CO<sub>2</sub>-induced acidification in oceans may eventually lead to a situation in which carbonate dissolves more quickly than it forms in these ecosystems. It is not well known how intentional ocean fertilization and acidification affect marine and coastal food webs as well as other resources (Skog & Nicholson, 1998).

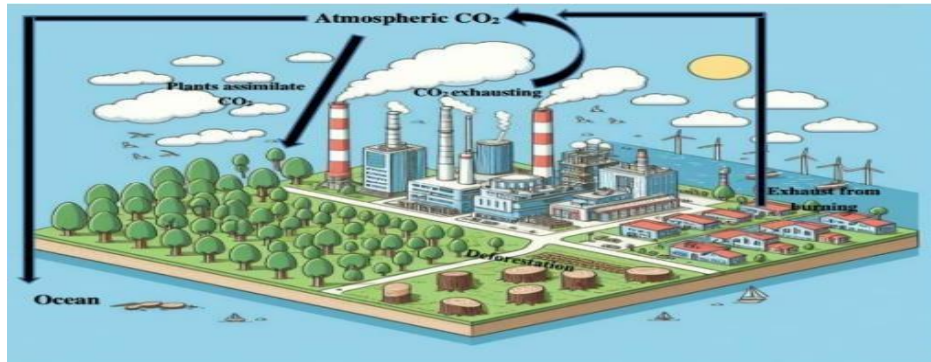
#### **Terrestrial carbon sequestration**

Terrestrial sequestration also referred to as biological sequestration, typically achieved through soil and forest conservation techniques that either decrease CO<sub>2</sub> emissions (by suppressing wildfires and reducing agricultural tillage) or improve the storage of carbon (by reforestation and creating new forests, wetlands, and grasslands). The management of the terrestrial ecosystem

provides affordable means to improve carbon sequestration, as it plays a significant part in the global C cycle.

### **Geologic carbon sequestration**

Capturing CO<sub>2</sub> from the exhaust of fossil fuel power plants and other significant sources is the first step in geologic sequestration. The efficiency of many CO<sub>2</sub> trapping methods determines how long geologic sequestration lasts. Once CO<sub>2</sub> has been injected underground, it will ascend buoyantly until it is caught under a seal or impermeable barrier. This physical method of trapping, which is the same as the natural geologic trapping of gas and oil, can hold onto CO<sub>2</sub> for millions of years.



**Figure 2.** Oceans and plants sequester carbon dioxide, which is released into the atmosphere by homes, industries, and deforestation.

### **Factors Affecting Carbon Sequestration**

Factors that affect carbon sequestration are:

#### **Land management**

Conservation tillage has a great impact on the sequestration of carbon which is more apparent when using tillage practices for long term as compared to short term (Deen & Kataki, 2003). Agriculture could be able to minimize GHG emissions and contribute to carbon sequestration in soil when the tillage practices are improved (Bhattacharyya et al., 2022). In rangelands, carbon sequestration is enhanced by compost amendment (Kutos et al., 2023), and soil organic carbon content is also increased by cover crops (Moukanni et al., 2022). Agroforestry systems have a greater potential for soil carbon sequestration and is important to combat climate change (Ghale et al., 2022).

#### **Climate**

Climate has an effect on microbial activity in soil. This demonstrates that even a small increase in temperature along with a change in precipitation patterns could result in a considerable decrease in soil functions including nitrogen cycling and organic matter decomposition (Sünnemann et al., 2021). Increasingly frequent and intense extreme climate events, such storms and droughts, have significantly disrupted the high-carbon sequestrations found in tropical montane forests and coastal mangroves (Yu & Gao, 2020).

#### **Soil Properties**

It is commonly recognized that soil texture is crucial for the SOC accumulation. SOC levels are much lower in sandy soils as compared to clayey soil because clayey soils have greater success at stabilizing C due to their finer texture (Feller & Beare, 1997; Zinn et al., 2007; Chivenge et al., 2011; Plante et al., 2006). Retention of soil organic carbon is increased after the addition of clay soil as compared with sandy soil alone (Tahir & Marschner 2017). Soil pH also has an impact on SOC storage, a negative effect on SOC storage is identified when soil pH is high (Chen et al., 2018).

A pool of soil organic carbon (SOC) comprising a depth of around 1 m of soil. However, because the chemical recalcitrance and turnover time of soil organic matter (SOM) enhances with depth, deeper soil horizons might possess a greater capacity to store a significant quantity of SOC. By adding more organic matter that is relatively stable to the deeper soil layers, it might be able to sequester sub soil carbon (C) (Lorenz & Lal, 2005).

### **Methods To Preserve Soil Organic Carbon (Soc)**

Several methods to protect SOC are:

#### **Conservation tillage**

Through the use of conservation tillage (CT), soil management techniques are employed to reduce disturbance of the soil's structure, composition, and natural biodiversity. This reduces erosion and degradation, manages yearly weed and seed bank growth, and also prevents water contamination (Karunakaran & Behera, 2015). Conservation tillage adoption can safeguard SOC from temporary losses (annual variation), and the extent of protection is associated with the kind of SOC fractions (Qi et al., 2019). Compared to conventional tillage, conservation tillage sequestered 3–7 kg/ha more C at a depth of 0–24 cm. Conservation agriculture has the potential to increase SOC between 0.16 and 1.01 t ha<sup>-1</sup> yr<sup>-1</sup> within an agro-tropical ecosystem, and it has numerous advantages such as; enhanced biodiversity, improved soil nutrition, and increased water retention (Du et al., 2017; Knapp & van der Heijden, 2018; Powlson et al., 2016).

#### **Soil erosion control**

Controlling soil erosion may increase SOC, and promote aggregate stability and microbial activities, which could be considered as the best option to use in areas with degraded lands (Feizi et al., 2019). The top layers (0–30 cm) of most farmland mineral soils have lost 30–50 % of their carbon content as a result of intense soil disturbance, decreased carbon input in conjunction with nutrient depletion and soil erosion (Paustian et al., 2019).

#### **Biochar amendment**

Biochar is a carbon-rich substance, produced when organic materials, such as agricultural and wood waste, decompose thermally in the absence of oxygen (Ghassemi-Golezani & FarhangiAbriz, 2021). Because it can be made from organically derived fuel, biochar application is an economical and environmentally friendly too (Alam et al., 2020). Biochar has a tremendous potential for increasing and stabilizing SOC (Gross et al., 2021). Biochar has a potential to increase SOC between 8-18 % at 60-90 t ha<sup>-1</sup> application rates. It has the advantages such as; 50 % initial carbon retention, and it acts as both a source and sink of soil carbon. Its disadvantages includes; data on the influence on soil quality vary, varying impacts on priming based on soil type, and varying impacts on SOC stocks according on the age and type of biochar (El-Naggar et al., 2015; Kammann et al., 2015; El-Naggar et al., 2018; Xu et al., 2018; Jiang et al., 2019; Wang et al., 2016; Han et al., 2022; Sun et al., 2020).

#### **Cover cropping**

Under many different names, cover crops are used to manage soils for a variety of purposes. Technically meaning "crops that cover the soil," one of the original purposes of cover crops in annual cropping systems was to lessen soil erosion during the fallow season. "Green manures," "catch crops," and "living mulch" are other names for cover crops (Kaspar & Singer, 2011). Including cover crops in cropping systems is a viable way to store carbon in agricultural soils. When it comes to increasing soil organic carbon (SOC), cover crops have an advantage over other management techniques that they don't reduce yields like extensification or cause carbon losses in other systems like applying organic manure may do (Poeplau & Don, 2015).

#### **Microbial inoculants**

The inoculation of a mixed microbial consortia (Streptomyces, Arthrobacter, and Lysinibacillus) accelerated the decomposition of added crop residues in vertisols and enhanced

soil biological activity. This process also boosts carbon mineralization and the formation of soil organic matter (Rao et al., 2019). A brief rise in SOC content and quality also brought about by microbial inoculation (Phukongchai et al., 2022).

### **Agroforestry**

In agroforestry systems (AFS), trees and crops are grown together in a single field. In these systems, soil organic carbon (SOC) reserves are often higher (Cardinael et al., 2016). In comparison to crop monocultures, agroforestry resulted in increases in soil pH of 2 %, SOC of 40 %, N storage of 13 %, available N of 46 %, and available P of 11 % (Muchane et al., 2020). One way to control net increases in the SOC pool is to choose agroforestry systems and soil management techniques that influence the quantity and quality of C inputs, particularly those produced below ground by tree and non-tree components (Ramachandran Nair, Mohan Kumar, & Nair, 2009). Up to 35 % of the lost forest carbon stock can be reclaimed by agroforestry (Sanchez, 2000). Agroforestry has the potential to increase SOC at a rate of 5.3 GtC y<sup>-1</sup> globally. It has some advantages such as; increase in above-ground biomass and increased soil carbon input. It also has disadvantages such as varying rates of SOC sequestration based on age, organic input type, management techniques, soil type, and climate (Zomer et al., 2016; Sanchez, 1999; Tschora & Cherubini, 2020; Shi et al., 2018).

### **Benefits Of Carbon Sequestration**

Soil C sequestration plays various roles: (i) restoration of degraded soils, (ii) enhancement of land productivity, (iii) functional diversity improvement, (iv) environmental protection, (v) reduces atmospheric CO<sub>2</sub> concentrations (Wang et al., 2010), (vi) In order to mitigate expected climate changes, carbon storage, and sequestration in soils are important methods of minimizing GHGs in the atmosphere (Goh, 2004), and (vii) Degraded soils are restored, biomass output is increased, surface and groundwater are purified, and the rate of atmospheric CO<sub>2</sub> enrichment is slowed down by offsetting emissions from fossil fuels (Lal, 2004).

### **Conclusion**

CO<sub>2</sub> levels are increasing in atmosphere day by day. CO<sub>2</sub> alone contributes 63 % of global warming issues. Soil carbon sequestration in this regard plays an important role by capturing CO<sub>2</sub> from the atmosphere and transferring it into the soil. Artificial grasslands, reforestation, and afforestation are the strategies that can help in carbon sequestration. Soil has organic and inorganic pools of carbon. World soils are the sources of GHGs and CO<sub>2</sub>. All terrestrial life relies on soil organic carbon, which is vital to conserve human well-being and the environment. Some physical, chemical, and biological methods are used to preserve soil organic carbon. Agroforestry systems can help in soil carbon sequestration and is essential to mitigate climate change. Afforestation is a vital approach to develop a sufficient C sink capacity. The SOC sequestration rates are higher in clayey soils than in sandy soils. On the other hand, cool and humid climate soils have higher SOC sequestration rates as compared to the soils of warm and dry conditions. SOC can be rapidly released by droughts, typhoons, tropical storms, strong hurricanes, and floods. SOC sequestration has many benefits. Some of these are increasing food security, improving water quality, enhancing biodiversity, environmental improvement, climate change mitigation, etc.

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**INHABITING THE FUTURE: CRAFTING ARCHITECTURE (in)THE BODY,  
(in)THE HOME, (in)THE CITY, (in)THE COSMOS**

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**Abstract**

This essay aims to frame and guide the critical, awareness, and operative processes, aiming at communicative action through the mastery of the image, the power of the word and the consistency of argumentation. Through the fundamental ethical-aesthetic-technical triad, our approach emerges from the intersection of two foundational planes: i) the "(E)DUCERE: complexes, implexes and reflexes" which, as a transdisciplinary epistemological territory, aims to strengthen the theoretical field of Architecture through dialogue with other knowledges, enhancing reflection and discernment on the constitutive and communicational dimensions of Knowledge, whose values, subjectivities and substances, between singularities and plurality, will be worked on in the territories Body, Home, City and Cosmos; and ii) "Maps and Dialogues in Contemporary Architecture" which, as a disciplinary (laboratorial) domain, explores the exemplarity of the competences inherent to production and research in Architecture, in whose perspective the recognition of valences, qualities and ambiguities, in a diversified and complex universe (contexts, objectives and intervention technologies), will be experienced in a broad spectrum from the Immaterial to the Sensible, passing through the Visual, the Visible, the Accessible, the Material and the Haptic. In an operative perspective of the human dwelling in the Future, three Study Fields will be experimented: o i) Body-Home, between the visible and the sensitive, passing through the accessible, the material and the haptic, which will address the domains of technology, functionality, materials and design of equipment and furniture in the living space -the challenges will be those of the composition of materials (resources, transformation, production, distribution and maintenance) and their ecological footprint, their ergonomic qualities, resistance and durability, among energies and waste; o ii) Home-City, between the visual and the haptic, going through the visible, the accessible and the material, which will address the domains of urban infrastructures, the public space, the association modes of housing units, isolated and/or grouped, their internal organizations, articulation and transition, taking into account the energy issues, collection and treatment of domestic and urban waste -the challenges will be the organization and compatibility of the various infrastructural, programmatic and functional networks, their modalities, extensions and impacts, in the urban space and in the territory and iii) City-Cosmos, between the immaterial and the material, going through the visual, the visible and the accessible, which will address environmental issues, resources and their optimization, particularly in the constitution and composition of the territory and the landscape.

**Keywords:** future, body, home, city, cosmos.

The pursuit of rethinking the modalities of inhabiting the future by referencing the past has always been among the main priorities of architects in various eras. This is evident as Le Corbusier, in his seminal book, *Towards a New Architecture*, argued that being modern is not a fashion but rather a state of mind that establishes the relationship of architecture to the past in its pursuit of a viable future<sup>100</sup>. In addition, Le Corbusier conceptualises architecture as a multifaceted discipline that operates on various levels, addressing not only the technical and aesthetic dimensions of space and form but also engaging with broader societal paradigms. This is clear in the case of housing, as he argued that "...The problem of the house is a problem of the era. Social equilibrium depends on it today. The first obligation of architecture, in an era of renewal, is to bring about a revision of values, a revision of the constitutive elements of the house."<sup>101</sup>

This is to argue that architecture operates at various levels at the same time in a parallel manner, from a minor scale of the relation of the body in the space, in the house to the major scale of the city and even the cosmos. Perhaps one could argue that it is due to this mediating nature of architecture that the renowned Finnish architect Juhani Pallasmaa suggests that "[architecture] is conceptually too "impure" or "messy" as a phenomenon and human activity to be logically structured within a single theory."<sup>102</sup>

Due to the nature of the ever-growing complexities of contemporary life, architecture should spontaneously consider various factors and respond on different scales. Contrary to Vitruvius, who argued that architecture should encompass three main questions of "Utilitas, Firmitas and Venustas"<sup>103</sup>, in the current days, architectural practice should operate beyond this triad. Consequently, the contemporary framework of architecture should not solely focus on aesthetic and technical proficiency but also should consider the ethical implications of design decisions. Ethical considerations often involve sustainability, community impact, and social equity, ensuring that architecture responds to people's and the environment's needs. Aesthetically, architects are concerned with creating spaces that evoke emotional responses, harmonise with their surroundings, and contribute to cultural expression. The technical dimension emphasises the materiality, structure, and engineering requirements to make these visions a reality. Hence, this triad intends to create a balance between form, function and ethics, enhancing the role of architecture in shaping human experience in a socially responsible manner<sup>104</sup>. The responsibility of architecture to society is clear, as Rasmussen, in his renowned work *Experiencing Architecture*, argued, "architecture is produced by ordinary people, for ordinary people; therefore it should be easily comprehensible to all"<sup>105</sup>.

One of the prominent architects of our era, whose oeuvres reflect the ethical aesthetic-technical triad, is the renowned Portuguese architect Álvaro Siza, who emphasises the interplay between human experience and technical innovation. Siza's architecture is grounded in spaces designed to be inhabited by humans, and hence, the needs of the inhabitants are prioritised. In an interview, the contemporary Portuguese architect Eduardo Souto de Moura specified this aspect

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<sup>100</sup> Le Corbusier, *Towards a New Architecture*, trans. Frederick Etchells (Dover Publications, Inc.,1986), 245.

<sup>101</sup> Le Corbusier, *Towards a New Architecture*, trans. Frederick Etchells (Dover Publications, Inc.,1986), 88.

<sup>102</sup> Juhani Pallasmaa, "Architecture as Experience," *Architectural Research in Finland*, vol.2,no.1 (2018): 9-17.

<sup>103</sup> Vitruvius. *The Ten Books on Architecture*, trans. Morris Hicky Morgan (Harvard University Press, 1914) Book I, Chapter III.

<sup>104</sup> Kenneth Frampton, *Modern Architecture: A Critical History* (Thames & Hudson, 1980), 34-39.

<sup>105</sup> Steen Elier Rasmussen, *Experiencing Architecture* (The MIT Press, 1959), 14.

of Siza's architecture by stating, "What's great about Siza is this!- It is either drawing, or intelligence, or his remarkable ability to link together various factors. It's a kind of alchemy."<sup>106</sup> This exemplary quality of Siza's architecture is clearly manifested in Santa Maria Church in Marco de Canaveses. The church is deeply embedded in a dialogue with the surrounding built environment; one can even define the elevations of the church as one of the main elements of the facade of the city, an urban element of the city's landscape. Connecting two different urban topographic points, Siza designs an urban square at the entrance of the church, which belongs as much to the church as it belongs to the city.

The form of the church is highly influenced by the typical and traditional Portuguese architecture found in many churches in the province of Minho, which are characterised by two white outstanding adjacent towers. The church, though belonging to the contemporary era, replicates some of the same architectural elements of the vernacular churches in Minho, like the ceramic tiles (Azulejo) and the wooden floor finishing<sup>107</sup>.

However, according to Souto de Moura, the modernity of his architectural work can be traced through references to several key pioneers of twentieth-century architecture. He dares inspiration from Adolf Loos's Villa Steiner. The use of high window openings designed to allow natural light to enter from above reflects the influence of Alvar Aalto's approach in the design of light in his churches. Similarly, the narrow, linear windows on the east side of the building echo the design of Le Corbusier's La Tourette, integrating both form and function. Additionally, the design of the cross can be linked to the work of Luis Barragan, whose architecture incorporates experience within a modernist framework<sup>108</sup>.

In other words, Siza's architecture integrates elements of both vernacular and Modernist traditions. This characteristic of Siza's architecture is manifested in his own words as he argues that "architects don't invent anything; they transform reality"<sup>109</sup>, hence creating spaces that are instilled in our era but not limited to it, resulting in an architecture that dwells both in time and space.

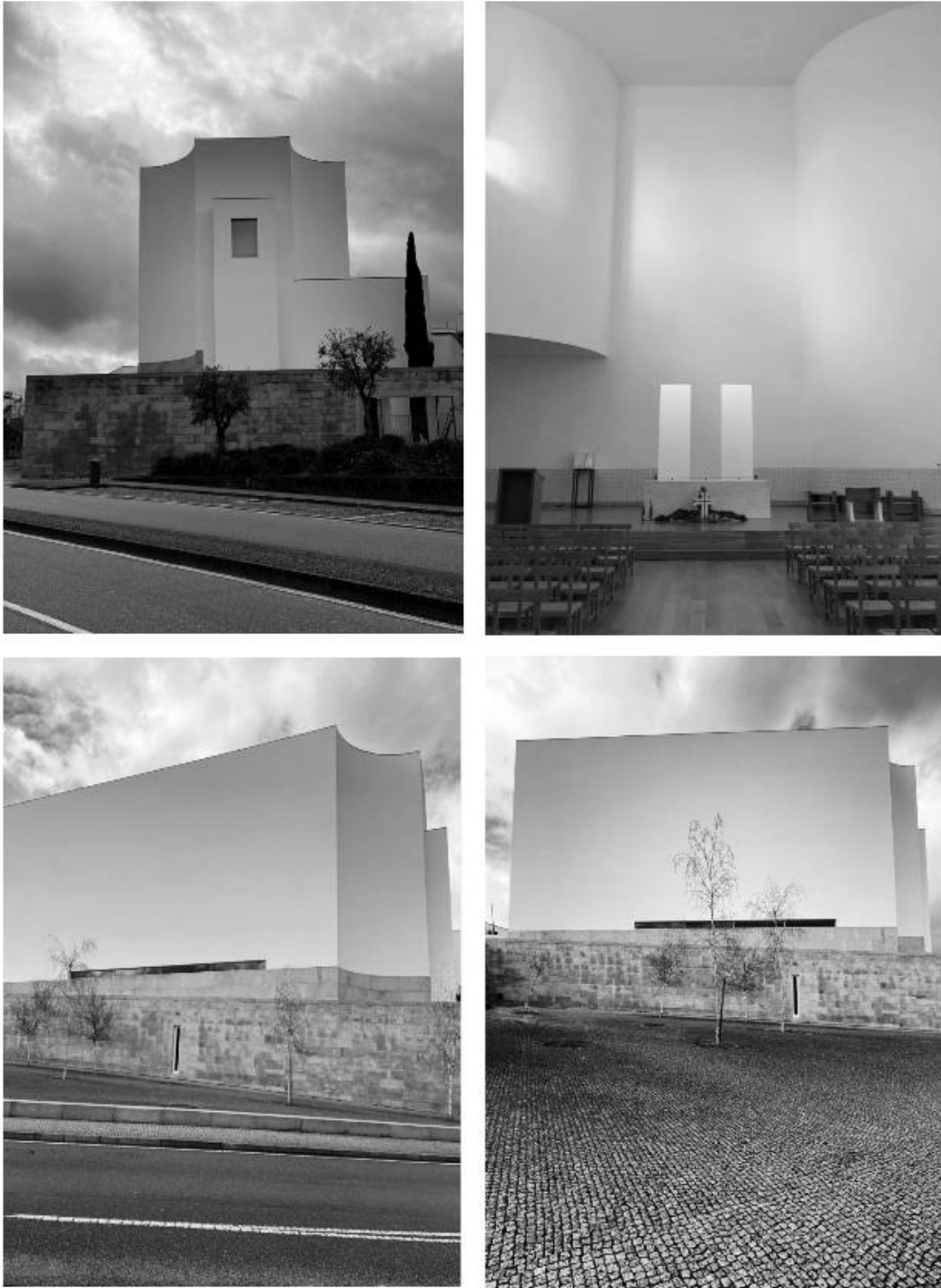
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<sup>106</sup> Eduardo Souto de Moura, "Exposição Siza (2019)", Serralves, Porto, April 2020, 5 min., 12sec., <https://www.youtube.com/watch?v=InmIyFzmi28&t=609s>.

<sup>107</sup> Ibid. 7 min.05,sec.

<sup>108</sup> Ibid. 8 min.57,sec.

<sup>109</sup> Alvaro Siza as quoted in Juhani Pallasmaa, "Dwelling in Time," *Forum Journal*, Vol.29, no.3. (2015): 17-24.



**Figure 1.** Various photos from the exterior and interior of Santa Maria Church in Marco de Canaveses. Photos Mahdi Alizadeh, May 2024.

Furthermore, the inherent task of architecture can be divided into four scales: the body, the home, the city and the cosmos, which will include a spectrum of immaterial to sensible experiences through the visual, visible, accessible, material and haptic.

## Body-Home

The body serves as the fundamental medium through which we engage with and understand the world, asserting our bodily experiences from the basis of knowledge. In this regard, Maurice Merleau-Ponty suggests that our understanding of the world around us is not merely from an intellectual contemplation but rather based on our lived experiences, emphasising the primacy of sensory perception in shaping our awareness of reality. He argues that "We know not through our intellect but through our experience"<sup>110</sup>. In an architectural context, this is to advocate for the perception of space that is not limited to visual sense and encompasses haptic and sensory inputs to our understanding of space.

In addition, by enhancing the sensory meaning of a home, the common definition of a home is sought to be reconsidered, the physical shelter in comparison to space for mental comfort. As the renowned French philosopher Gaston Bachelard in his renowned book, *The Poetics of Space* suggested, "I should say: the house shelters daydreaming, the house protects the dreamer, the house allows one to dream in peace"<sup>111</sup>, highlighting the relevance of an embodied experience of space over purely visual one is essential for understanding the complexities of spatial perception<sup>112</sup>. In other words, as Bachelard argues, "inhabited space transcends geometrical space"<sup>113</sup>, the traces of the same reasoning regarding the perception of home can be found in the works of Peter Zumthor as he refers to the notion of "carrying one's home"<sup>114</sup>. Similarly, Pallasmaa introduces the concept of the "mental home"<sup>115</sup>, which he views not as separate from the physical home but as a continuation of it bound in an existential sense of space.

## Home-City

In the Home-City section, the study explores the city not merely as a collection of individual structures but as a collective expression of cultural memory and identity. This view towards the city is also evident in the seminal work of Aldo Rossi, *The Architecture of the City*, where he contends that homes, while private and intimate, contribute to the larger urban fabric, each residence playing a role in the historical continuity of the city. In addition, he argues that the essence of a city emerges from the accumulation of individual experiences and memories associated with homes and buildings, which together form the city's identity; he argues, "One can say that the city itself is the collective memory of its people, and like memory, it is associated with objects and places. The city is the locus of the collective memory".<sup>116</sup> In addition, Rossi's view connects the human scale of home life to the larger context of urban planning, suggesting that the city's architecture is inseparable from the emotional and experiential dimensions of its inhabitants' daily lives<sup>117</sup>.

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<sup>110</sup> Maurice Merleau-Ponty, *Phenomenology of Perception*, trans. Donald A. Landes (Routledge, 2012), 298.

<sup>111</sup> Gaston Bachelard, *The Poetics of Space*, trans. Maria Jolas (Beacon Press, 1994), 48.

<sup>112</sup> Mahdi Alizadeh, *The Pursuit of Presence in Architecture: A Phenomenological Narrative of Naqsh-e Jahan Square of Ispahan* (University of Porto Master's Thesis, 2022). 09.

<sup>113</sup> Gaston Bachelard, *The Poetics of Space*, trans. Maria Jolas (Beacon Press, 1994), 8.

<sup>114</sup> Peter Zumthor in conversation with Juhani Pallasmaa, "Architecture Speaks", Aalto University, Helsinki, January 2018, 18 min., 10sec., <https://www.youtube.com/watch?v=ibwvGn3PkFg>.

<sup>115</sup> Ibid. 19 min., 05sec.

<sup>116</sup> Aldo Rossi, *The Architecture of the City*, trans. Diane Ghirardo and Joan Ockman (MIT Press, 1982), 130.

<sup>117</sup> Ibid. 112.

### **City-Cosmos**

The relationship between the city and the cosmos can be perceived through the lens of human interaction with the built and natural environment, especially how cities are designed to connect with larger ecological systems. This is apparent in the work of Jan Gehl, in his book, *Cities for People*, highlights the critical role of green infrastructure and sustainable urban design, arguing that the primary role of a city is to optimise accessibility to natural spaces and integrate environmental considerations into their development<sup>118</sup>. By enhancing the construction ecosystem through architecture, one can advocate for compact, walkable cities that reduce the inhabitants' dependency on cars, reduce energy consumption, and minimise ecological impact, ensuring that urban expansion respects the balance between the built environment and nature.

### **Conclusion**

This paper intends to explore the multifaceted role of architecture across varying scales, specifically rethinking and reinterpreting the relationships between body and home (Corpo-Casa), home and city (Casa-Cidade), and city and cosmos (Cidade-Cosmos). The paper suggests that spatial perception, at these different scales, is mediated through a continuum of experiences, ranging from the immaterial to the tangible. These experiences are shaped by a spectrum that includes visual, visible, accessible, material, and haptic dimensions, highlighting how architecture engages physical, sensory and experiential aspects of space. The paper is inspired by an optional course at the Faculty of Architecture of the University of Porto entitled "Dwelling the Future" (Habitar o Futuro), which is in the pursuit of engaging on the topic on both a theoretical and practical level.

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<sup>118</sup> Jan Gehl, *Cities for People* (Island Press, 2010), 105.

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# **THE POTENTIAL OF DIGITAL SOCIAL MEDIA PLATFORMS AS A TOOL FOR EFFECTIVE PROMOTION AND AWARENESS BUILDING OF ECO-ORIENTED BRANDS**

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## **Abstract**

As environmental sustainability becomes an increasingly important factor in consumer behaviour, it is crucial that eco-oriented brands use digital platforms to effectively promote their products and build awareness of sustainable values. This paper focuses on exploring the potential of social media as a tool for these purposes, with the main aim of identifying which digital platforms have the greatest potential to successfully communicate eco-friendly products. It also explores how these findings can support successful outreach to the current generation of millennials, who play a key role within the consumer segment. The paper analyses popular platforms such as Instagram, Facebook, YouTube and TikTok in terms of their ability to reach target audiences and disseminate content focused on green values. Social networks offer a unique opportunity not only to disseminate information, but also to create an interactive community of consumers who are increasingly committed to environmental sustainability. The paper is based on a secondary analysis of studies and statistical data related to the behaviour of millennials, who are considered to be a generation with a strong environmental awareness. These consumers prefer brands that embody green values and have a transparent approach to sustainable practices.

**Keywords:** Ecological Brands. Ecological Consumer. Marketing Communication. Social Media.

## **1. Introduction**

In recent years, digital and social media have emerged as potent instruments for brand promotion and brand awareness, particularly for eco-oriented brands striving to align themselves with the expanding environmental consciousness of consumers. The shift towards sustainable living has significantly influenced consumer behaviour, and as a result, brands that prioritise eco-friendliness must communicate their values effectively to a wider audience. Social media, with its interactive and far-reaching nature, provides a unique opportunity for green brands to connect with eco-conscious consumers, foster community building and promote sustainable practices.

The potential of these platforms lies not only in their capacity to reach a large and diverse audience, but also in their ability to facilitate meaningful dialogue between brands and their followers. The use of social media platforms such as Instagram, TikTok and Facebook allows eco-conscious brands to demonstrate their commitment to sustainability through the utilisation of storytelling, influencer partnerships and visual content that resonates with digital audiences. Furthermore, the data-driven targeting and personalised marketing strategies offered by these platforms can assist brands in connecting with niche markets, including those most likely to support eco-friendly products.

Despite the evident advantages, the utilisation of social media for eco-conscious brands is not without its challenges. One such challenge is the difficulty of conveying intricate sustainability initiatives in a concise digital format. This article examines the potential and constraints of digital social media platforms in advancing eco-oriented brands, and presents recommendations for efficacious brand awareness and long-term consumer engagement through social media communication.

## **2. Literature Overview**

A review of the databases reveals a substantial body of literature on the use of social media for marketing communication. Additionally, there is a growing corpus of research examining the role of social media in environmental marketing and the promotion of green products.

Kaplan and Haenlein (2010) offer a comprehensive analysis of the rapid growth and impact of social media on businesses and society. The article's primary objective is to define social media, categorise its various forms, and examine the challenges and opportunities that these platforms present to organisations. Furthermore, the authors emphasise the necessity for businesses to integrate social media into their strategic communications activities. They highlight that failing to do so may result in missed opportunities for brand engagement and customer loyalty. However, they also advise that companies must have a clear understanding of the distinctive dynamics of each platform to ensure they can optimise its potential. Their study remains an invaluable resource for understanding the strategic implications of social media in the business environment.

Hanna, Rohm and Crittenden (2011) examine the concept of the social media ecosystem and its potential as a powerful tool for businesses. The authors emphasise the evolving role of social media within broader marketing and communication strategies, underscoring the importance of understanding its interconnectedness and multifaceted nature. The study reaches the conclusion that social media is not an isolated marketing tool; rather, it is a dynamic and interconnected system. When used effectively, it has the potential to significantly increase brand visibility, consumer engagement and market influence. It is recommended that companies acknowledge the intricacies of the ecosystem and develop strategies that integrate all facets of social, owned and paid media to establish a comprehensive approach to digital marketing. Furthermore, their study underscores the significance of capitalising on the full potential of social media by acknowledging the interactivity of its ecosystem and the shift of power towards consumers.

Peattie and Crane (2005) undertake a critical examination of the evolution and impact of green marketing over time. The study investigates whether green marketing is fulfilling its initial promise or has become a misunderstood and underperforming concept. Furthermore, the authors consider the constraints and prospective of green marketing. They urge businesses and marketers to confront the systemic deficiencies and consumer scepticism that impede its efficacy. The authors contend that for green marketing to become a more efficacious force, companies must transition from concentrating solely on green products to integrating genuine sustainability into their operations and communications. Their article presents a fundamental critique of green marketing and offers invaluable insights into its evolution, challenges and prospective.

Schmuck, Matthes and Naderer (2018) examine the effects of greenwashing in environmental advertising and its impact on consumers. The term 'greenwashing' is used to describe the practice of making misleading claims by companies about the environmental benefits of their products or services. The study concentrates on the impact of greenwashing on consumers' perceptions, emotions and decision-making processes. Furthermore, the authors offer valuable insights into the psychological and emotional mechanisms underlying consumers' reactions to green advertising. Their findings indicate that greenwashing, while appealing to companies seeking immediate gains, can have significant long-term consequences for brand credibility, particularly among environmentally conscious consumers. Additionally, the research underscores the necessity for marketers to prioritize honesty in their environmental messaging to foster sustainable relationships with their audiences.

Kumar, Choi a Greene (2017) examine the dynamic interaction between social media and traditional marketing activities and their impact on brand sales over time. The authors offer significant insights into the evolving marketing landscape and demonstrate that the combination of social media and traditional marketing can yield greater returns for brands. Their study highlights the importance of considering the temporal dimension of marketing effectiveness and shows that the strategic integration of these channels can lead to more sustainable brand growth. This research is crucial for businesses looking to adapt their marketing strategies in a world where digital and traditional media coexist.

D'Souza, Taghian a Khosla (2007) examine the relationship between consumers' environmental beliefs and how these beliefs influence their purchasing decisions, with a particular focus on green products. In particular, the study examines the manner in which environmental awareness interacts with traditional factors, including price, quality, and demographic characteristics, when consumers make purchasing decisions. Additionally, the study elucidates the intricate interplay between environmental beliefs, price, and quality in the context of green purchasing behaviour. The research underscores the significance of comprehending consumer values when developing marketing strategies for green products. By targeting the appropriate demographic groups and prioritising sustainability over traditional factors such as price, businesses can effectively reach eco-conscious consumers.

### **3. Material and Methods**

The paper presents the findings of a secondary analysis of studies related to the behaviour of millennials, a generation widely regarded as environmentally conscious. Such consumers tend to favour brands that espouse green values and adopt a transparent approach to sustainable practices. The paper presents an analysis of the social media platforms that are most frequently utilised by the millennial demographic. Furthermore, the data from the social media platforms of the most popular ecological brands is subjected to analysis.

The following brands were subjected to analysis: The following brands were identified as being particularly noteworthy in terms of their alignment with the aforementioned criteria: Patagonia,

Tentree, Veja, Klean Kanteen, Blueland, Meliora and Who gives a crap. These are brands that are renowned for their commitment to sustainability and environmental protection.

The following assumptions were made:

A1: Ecological brands will utilise all social media platforms that are among the most frequently used by the millennial generation.

A2: Ecological brands are expected to have the highest number of followers on the social media platform Instagram.

A3: The highest engagement rates will be observed among the ecological brands on the social media platform TikTok.

#### **4. Results and Discussion**

The term 'Millennial' is used to describe individuals born between 1981 and 1996. This cohort has grown up in the digital age and, as Neufeld (2021) has observed, their relationship with social media is profound and influences their consumer behaviour, particularly in relation to organic brands. An understanding of these dynamics can assist businesses in developing marketing strategies that resonate with this demographic.

Millennials are prolific users of social media platforms, including Instagram, Facebook, Twitter and TikTok. Research indicates that they dedicate a considerable amount of time to these platforms, utilising them not only for social interaction but also for information gathering and shopping. A Pew Research Center report (2021) revealed that approximately 90% of millennials use social media, underscoring its significance as a domain for brand engagement.

The influence of social media on the purchasing decisions of millennials is becoming increasingly evident. A study conducted by Nielsen in 2015 revealed that millennials are more inclined to place trust in user-generated content and peer reviews than in traditional forms of advertising. In fact, 66% of millennials indicated that they prefer to engage with brands that demonstrate a robust social media presence. This preference also extends to organic brands, where authenticity and transparency are of paramount importance. Millennials frequently seek out brands that align with their values, particularly those that emphasise sustainability.

There is a notable proclivity among millennials to endorse eco-brands. A survey conducted by Cone Communications (2017) indicated that 87% of millennials would purchase a product from a company that advocates for an issue they care about, such as environmental sustainability. Additionally, a survey conducted by Accenture (2019) demonstrated that 43% of millennials have altered their purchasing habits to reduce their environmental impact, indicating a significant correlation between eco-awareness and consumer behavior.

For organic brands seeking to reach millennial consumers, social media represents an indispensable tool. Brands are employing storytelling and visual content in order to communicate their sustainability efforts, thereby fostering a sense of community and engagement. Campaigns that demonstrate an organisation's eco-friendly practices or collaborations with influencers have the potential to enhance brand visibility and foster trust. Furthermore, social media platforms such as Instagram and TikTok have emerged as the primary avenues through which millennials identify and learn about sustainable brands.

The results of the analysis of green brand communication on social media platforms yielded several noteworthy findings. Notwithstanding the considerable prevalence of social networking and social media across generations, the organic brands under examination do not utilise all of the most widely followed social media platforms for the purpose of communication. A single brand, Patagonia, employs all four social media platforms for communication purposes. It is noteworthy that while numerous brands have established accounts on each platform, they are not active on them. Table 1 provides an overview of the utilisation of social media platforms by brands.

**Table 1** Comparison of the use of social media platforms by the studied organic brands

	Facebook	Instagram	TikTok	YouTube
Patagonia	*	*	*	*
Tentree	N/A	*	*	*
Veja	x	*	*	*
Klean Kanteen	N/A	*	*	*
Blueland	*	*	*	x
Meliora	N/A	N/A	x	x
Who gives a crap	N/A	*	x	x

Source: Own processing, 2024.

Notes:

\* active

N/A no activity

x not using

Facebook is one of the largest social networks in the world, offering a wide range of possibilities for marketing communication. With more than 2.8 billion monthly active users, it is a unique space for customer interaction and brand building. Marketing on Facebook involves the use of various tools, including targeted ads, organic content and communities through groups or events. The platform's robust analytics and user segmentation capabilities have made it an essential tool for achieving specific marketing goals and improving customer relationships.

The results of the analysis of the communication of the studied organic brands on Facebook demonstrate that only one brand is actively utilising this social network. This may be attributed to a preference for and utilisation of alternative social media platforms. Further detailed results are presented in Table 2.

**Table 2** Overview of the number of followers, number of posts and interactions on Facebook

Facebook	Followers	Posts				Interactions		
		Videos	Photos	Links	Carousels	Likes	Shares	Comments
Patagonia	1 895 272	15	15	1	0	5 404	86	67
Tentree	578 603	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Veja	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Klean Kanteen	82 645	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Blueland	87 721	0	2	0	0	21	4	0
Meliora	197	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Who gives a crap	305 999	0	3	0	0	511	58	21

Source: Own processing, 2024.

Instagram can be described as a visually oriented platform. With over one billion monthly active users, Instagram has become a primary tool for marketing communication. Its emphasis on visual content allows brands to create authentic and aesthetically appealing posts that resonate with their target audience. Effective marketing on Instagram entails not only the creation of engaging posts and stories but also the strategic use of influencers, ad campaigns, and shopping features. The platform's high user engagement enables brands to not only boost visibility but also foster long-term customer relationships.

The results of the analysis of the communication of the studied eco-brands on the social network Instagram demonstrate that all of the brands under examination employ the platform actively. However, there are notable differences in the number of followers, posts and interactions. Further details can be found in Table 3.

**Table 3** Overview of the number of followers, posts and interactions on Instagram

Instagram	Followers	Posts			Interactions	
		Reels	Carousels	Images	Likes	Comments
Patagonia	5 444 564	15	12	4	216 830	836
Tentree	2 053 725	5	5	4	12 579	70
Veja	1 093 736	14	13	4	62 961	408
Klean Kanteen	142 126	2	1	0	507	18
Blueland	438 884	10	5	3	33 130	1 146
Meliora	1 712	N/A	N/A	N/A	N/A	N/A
Who gives a crap	334 336	14	7	3	7 922	1 163

Source: Own processing, 2024.

TikTok is a rapidly expanding social media platform that focuses on the dissemination of short video content, boasting over a billion monthly active users. The distinctive algorithms and capacity for viral dissemination afforded by the platform provide brands with the opportunity to reach a younger demographic and a highly engaged audience. The marketing of products or services on TikTok involves the production of creative and authentic video content, participation in challenges, the leveraging of trends and the formation of collaborations with influencers. This allows brands to gain both organic and paid visibility. The interactivity and playfulness of the social network make it an ideal platform for the rapid distribution of content and the creation of a strong emotional connection with customers.

The results of the analysis of the communication of the studied organic brands on TikTok demonstrate that, despite its rapid growth and popularity, not all of the brands under examination are utilising the platform actively. Among those that do engage with TikTok, there is considerable variation in the number of videos published and the number of 'likes' received. A more detailed presentation of these findings is provided in Table 4.

**Table 4** Overview of the number of followers, posts and interactions on TikTok

TikTok	Followers	Total likes	Total videos
Patagonia	184 042	1 451 221	412
Tentree	137 336	261 421	242
Veja	80 892	739 813	319
Klean Kanteen	3 294	7 850	241
Blueland	99 592	3 205 239	838
Meliora	N/A	N/A	N/A
Who gives a crap	N/A	N/A	N/A

Source: Own processing, 2024.

YouTube is the largest video-sharing platform, with more than two billion monthly active users. The platform allows brands to showcase products in detail, build relationships through educational content, and create entertaining and viral campaigns. YouTube marketing options include targeted video ads, collaborations with popular YouTubers (influencers), and the creation of an original brand channel that encourages long-term interaction with viewers.

The results of the analysis of the communication of the studied eco-brands on YouTube demonstrate a similar trend to that observed in the case of the social platform TikTok. It is notable that not all of the brands under examination utilise this platform, despite its long-standing popularity and high level of traffic. One potential explanation for this is the format of

the content, which may not align with the brand identity or resources of some organisations. Further detailed findings are presented in Table 5.

**Table 5** An overview of the number of followers, posts and interactions on YouTube

YouTube	Subscribers	Videos	Total views
Patagonia	468 000	1 705	154 547 173
Tentree	6 300	99	7 070 531
Veja	3 750	114	739 098
Klean Kanteen	3 410	57	1 620 023
Blueland	N/A	N/A	N/A
Meliora	N/A	N/A	N/A
Who gives a crap	N/A	N/A	N/A

Source: Own processing, 2024.

The engagement rate (ER) represents the level of audience engagement, which can be described as a key indicator of the success of content on social networks. It reflects the extent to which the audience interacts with the brand's posts. Expressed as a ratio between interactions (such as likes, comments and shares) and total reach or number of followers, it is an important tool for marketers as it not only quantifies audience interest but also helps evaluate the effectiveness of specific campaigns and strategies. High engagement rates typically indicate that content is relevant and resonating with followers, making it a valuable metric when optimising marketing communications.

The results of the ER analysis demonstrate that the highest engagement rates are achieved by the brands under examination on the TikTok and Instagram platforms. Nevertheless, it can be posited that TikTok is the social media platform with the highest audience engagement rate, which is a prerequisite for successful marketing communication. Further detailed results are presented in Table 6.

**Table 6** Engagement rate values of the studied brands on social media platforms Facebook, Instagram and TikTok

ER (%)	Facebook	Instagram	TikTok
Patagonia	0,29	3,99	6,19
Tentree	N/A	0,62	3,24
Veja	N/A	5,80	5,64
Klean Kanteen	N/A	0,37	4,14
Blueland	0	7,80	1,27
Meliora	N/A	N/A	N/A
Who gives a crap	0,19	2,70	N/A

Source: Own processing, 2024.

In light of the findings yielded by the conducted analyses, an evaluation of the individual assumptions can be undertaken.

It is therefore necessary to reject Assumption 1. The findings of the analysis indicate that the selected organic brands do not utilise all social media platforms. The most prevalent social media platform is Instagram, while YouTube is the least utilized.

We thus confirm assumption 2. The total number of followers of all brands under examination on Instagram is 4,064,519, in comparison to 2,644,438 followers on Facebook, 505,156 followers on TikTok and 481,460 subscribers on YouTube.

We therefore reject assumption 3. The highest total ER values were observed on Instagram (21.28%), in comparison to TikTok (20.48%) and Facebook (0.51%).

The analysis of organic brand communication on social media yielded several key conclusions. Firstly, although organic brands utilise a plethora of social media platforms, few are active on all of the major platforms. The largest number of brands are present on Instagram, which also offers the greatest number of followers and achieves the highest engagement rate (ER) values. Furthermore, brands that utilise TikTok have also demonstrated elevated audience engagement rates, thereby establishing this platform as a crucial instrument for marketing communications. Conversely, while YouTube and Facebook are both widely used platforms, not all brands utilise them to the same extent. This discrepancy may be attributed to factors such as the format of the content or the target audience.

The analysis indicates that brands on TikTok and Instagram are the most effective in engaging audiences. This suggests that the future of marketing communications, particularly for organic brands, will continue to depend on the effective use of visually oriented platforms with high interactivity, with an emphasis on authenticity and sustainability.

## **5. Conclusion**

An analysis of the communication of eco-brands on various social media platforms reveals several significant trends and findings that should be considered when developing marketing strategies. One of the most notable conclusions is the diversity of approaches to social media usage among different brands. While Instagram and TikTok emerged as the most effective platforms in terms of reach and engagement rate (ER), Facebook and YouTube, while still popular, were not utilized by all brands analyzed to the same extent.

The findings indicate that Instagram emerged as the primary platform for organic brands. As a visually oriented platform, it allows brands to showcase their products through attractive images and videos that have the ability to resonate strongly with millennials and Generation Z – groups known for their affinity for environmentally sustainable products and brands. This consumer group places a high value on aesthetics and authenticity, making Instagram an optimal venue for brands to convey their sustainability narratives.

The results of the analysis indicated that the majority of the brands under investigation had the highest number of followers on Instagram and the highest audience engagement rate (ER), which was 21.28%. This high ER indicates that Instagram is effective in facilitating interaction between brands and consumers, which in turn enhances credibility and brand loyalty. Furthermore, Instagram provides additional functionalities, such as the 'Instagram Stories' and 'Instagram Shopping' features, which enable direct engagement with consumers and streamline the purchasing process.

TikTok, which focuses on short videos, has emerged in recent years as a dynamic and rapidly growing social media platform that has gained significant traction among younger consumers. Its distinctive algorithms and capacity for viral dissemination of content offer organic brands the chance to reach a broad audience in a relatively short period at a minimal cost. In this analysis, TikTok was the second most successful platform, with an engagement rate of up to 20.48%.

While not all brands surveyed are currently utilising TikTok, there is a clear opportunity for those that are engaged on the platform. The use of short videos allows brands to demonstrate an authentic and creative approach to sustainability, which is highly valued by young consumers. Eco-friendly brands can effectively communicate their values through viral



challenges and collaborations with influencers on TikTok, which helps to strengthen the relationship with customers and increase visibility.

In contrast to Instagram and TikTok, Facebook has not been as actively utilised by organic brands. This discrepancy can be attributed to a number of factors. One such factor is the evolving demographic profile of Facebook users, with younger generations, particularly millennials, demonstrating a preference for newer platforms. Nevertheless, Facebook continues to offer robust tools for targeted advertising and is well-suited for community-building through groups and events.

As the largest video-sharing platform, YouTube provides brands with the opportunity to create longer and more detailed content. Despite the current popularity of videos, the survey revealed that not all brands use YouTube. This may be due to the higher production costs associated with videos compared to the faster and easier content on Instagram or TikTok. However, brands that choose to invest in YouTube content have the potential to establish a deeper relationship with consumers through educational videos and in-depth stories about their sustainability practices. The relatively high engagement rates on platforms such as Instagram and TikTok demonstrate that these platforms provide green brands with an opportunity to create content that consumers not only view but also interact with.

The analysis suggests that green brands that utilise visually oriented platforms are more likely to reach their target audiences and reinforce their sustainability message. Instagram and TikTok emerge as key channels for marketing communication, while platforms such as Facebook and YouTube can serve as complementary tools, depending on the type of content and the target group. Optimising social media presence and effectively using ER as an indicator of success can help green brands to better respond to consumer needs and adapt their strategies in line with current digital marketing trends.

### **Acknowledgement**

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# MULTIPATH ROUTING PROTOCOL BASED ON CROSS-LAYER APPROACH FOR MANET

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## **Abstract**

MANETs are networks that do not depend on any infrastructure during its working. They are considered as an infrastructure less network, so the cost of this type of networks is less in comparison to other traditional networks. The routing is one of the most important challenges in MANET systems. A Cross-layer design among Network, MAC and Physical layers based on Threshold Multipath Routing Protocol (CTMRP) is proposed. CTMRP is designed for decision maker based on threshold value of average paths signal for efficient transmission of the Text, image, audio and video. In an effort to improve the performance of MANET, there has been increased in protocols that rely on cross-layer interaction between different layers.

## 1. Introduction

Communications are divided into two basic types namely: wired and wireless communications and each one of them can be divided into different sub-types. Due to the different composition and work of the MANET, they face special challenges and obstacles stemming from the nature of the wireless nodes, which relies on self-configuration and play the role of the router and the client at the same time without having to rely on any infrastructure or base station<sup>6</sup>. In proposed a mechanism to provide load sharing to transfer data between the source and the destination, and by allowing transmission of packets through multi-path. The proposed idea in this paper is based on the measure of the signal strength of each path for comparing signal strength with the noise, however, in case the value of the signal strength is greater than the noise, then this path is considered one of the best available paths that will use to send the data. The results from the proposed study show an enhancement in the performance of the networks in terms of residual battery, average end to end delay, average jitter and throughput. The DSR was chosen because it offers the best performance in overall compared with the other routing protocols, especially in small to medium-sized networks and with nodes speed from slow to medium.

## 2. Mobile Ad Hoc Network

The fundamental objective of MANET is to permit a gathering of communication nodes to set up and keep up a network among themselves, without the backing of a base station or a focal controller. The absence of infrastructure in MANET requires the nodes to perform the network setup, administration, and control among themselves.

## 3. Routing Protocols

When designing a routing protocol that will work within the ad hoc network environment, it should be noted that the ad hoc network has to work within a limited bandwidth, in addition to limited resources in terms of node storage capacity, CPU capabilities, and energy resource since it depends mainly on batteries.

## 4. Dynamic Source Routing Protocol (Dsr):

The DSR protocol is classified as one of the reactive routing protocol used in multi hop wireless Ad-hoc networks. It consist two main stages one is route discovery, second is route maintenance. The route discovery stage begins when the source node want to send the data to a node not exists in its routing table. The route maintenance stage begins when one of the identified routes is broken or failed.

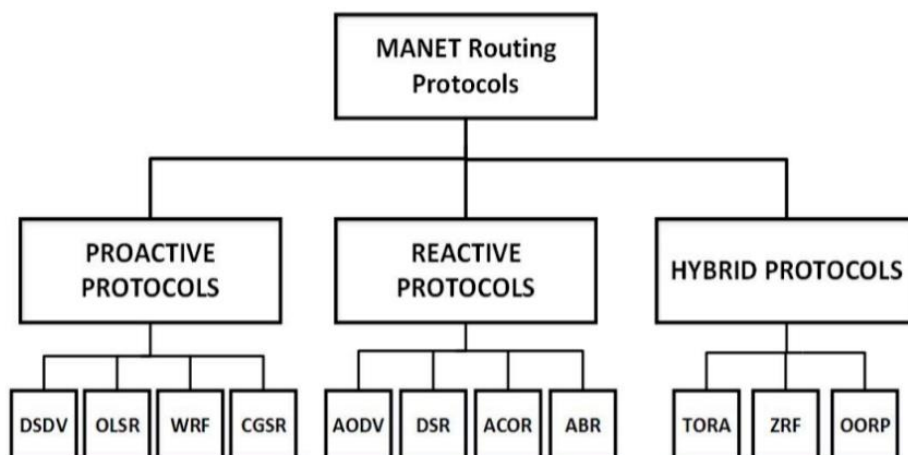


Fig. 1. MANETs routing protocols classifications

Function (PCF) is used in infrastructure networks, where an Access Point (AP) is used to coordinate access to the radio spectrum. The DCF provides the basic access methods of the 802.11 MAC protocol and is based on a Carrier Sense Multiple Access with Collision Avoidance (CSMA / CA) scheme. The PCF is implemented on top of the DCF and is based on a polling scheme. It uses a Point Coordinator that cyclically polls stations, giving them the opportunity to transmit.

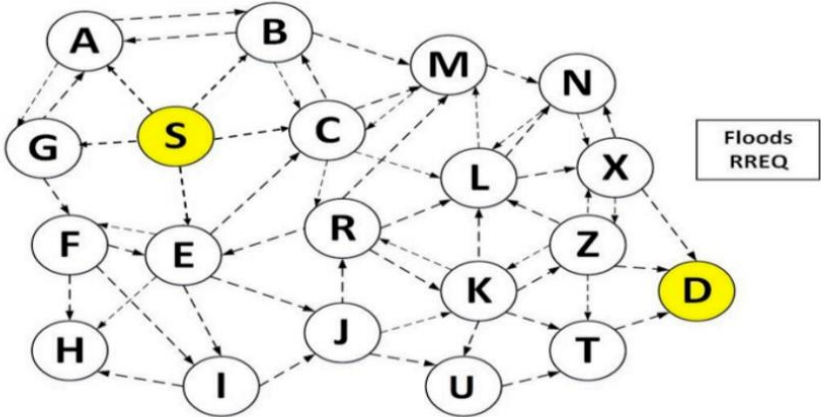


Fig. 2. Propagate RREQ for Intermediate nodes in DSR protocol

This figure shows the node S, initiating a route discovery by flooding RREQ message to all its neighbors' nodes. When the intermediate nodes receive the RREQ message and after each of them applied all the required checks, then each node rebroadcast the RREQ to all neighboring nodes in all directions. The process continued whereby other intermediate nodes perform the same process until the RREQ message reach to the destination node D.

**5. Proposed Method**

The Physical layer information can be used for signals values (Threshold), and scheduling information can be analyzed by MAC layer. Network layer can facilitate in best path selection based on information received from PHY and MAC layers. It allows the nodes to send data through multiple paths.

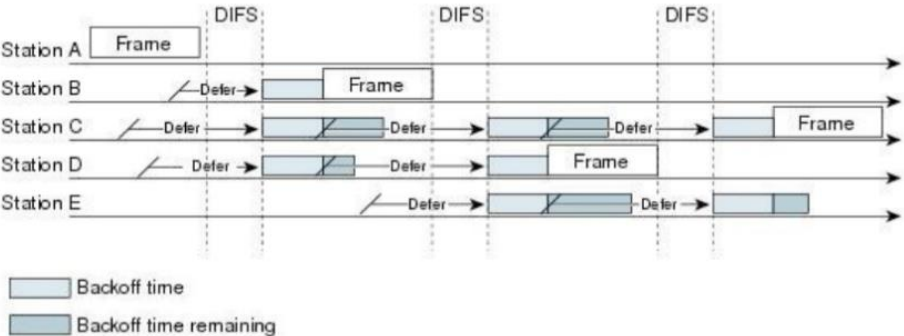


Fig. 3. Basic Access Mechanism

Several researchers have focused on study the effective path calculation based on their considered route selection metric (distance, number of hop, etc.) to find the most suitable path to forward packets. More optimized algorithms can be design by allowing Physical and MAC layers to provide information to Network layer.

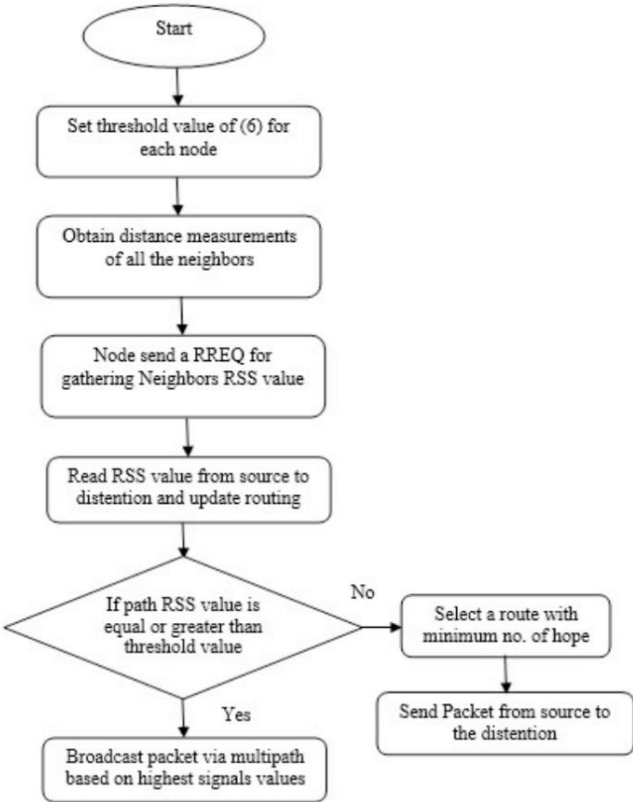


Fig. 4. Route Request messages

The Physical layer information can be used for signals values (Threshold), and scheduling information can be analyzed by MAC layer. Network layer can facilitate in best path selection based on information received from PHY and MAC layers. Figure 4, shows the overall proposed cross layer architecture with different parameters at different layers. When Route Reply receive, source node calculates average signal strength value for each path, if signal is equal to or greater than threshold value forward message via multipath, otherwise select route with minimum number of hope. The proposed method provides to perform adjustments in the mechanism of arrangement the routes in cache memory according to best signal strength (SS) of path, where the total SS of the path is the sum of SS of every node on the path. By using this new mechanism we can save more than one path, the source node S will choose the path with highest and ignoring the minimum number of hop count default factor. It allows the nodes to send data through multiple paths, as shown in Figure 5.

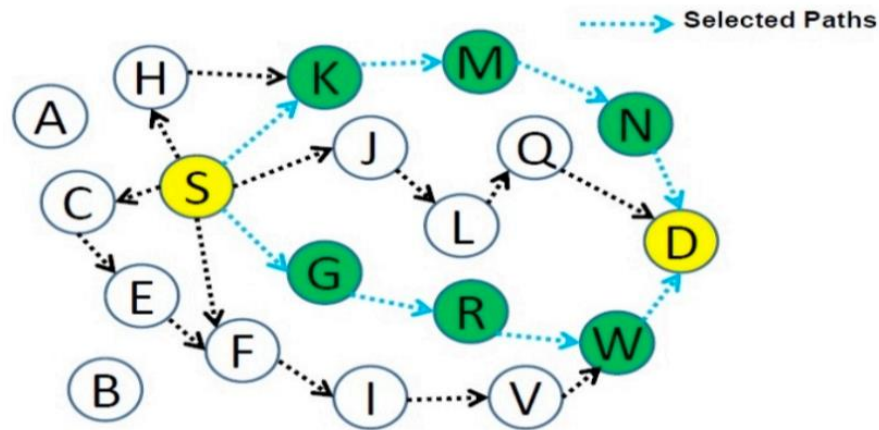


Fig. 5. The positive effects after apply the proposals

## 6. Implementation

According to what mentioned previously, it has been using the programming language of MATLAB in the design and implementation of simulation program to apply the proposed algorithms in addition to standard DSR protocol algorithms and then the comparison of the results.

## 7. The Simulation Scenarios

Whereas the second level relates to the size of the network, which is determined by the number of nodes in the network, where there is in this level three different sizes of the network of 5, 10, and 20 nodes. Finally, the third level determines the speed of movement of the nodes; 1 m/s, 5 m/s, and 10 m/s.

## 8. The Simulation Performance Metrics

The performance metrics is considered of the most important elements of any program to simulate the networks which they form indicators and evidence of the efficacy of the network and achieving its functions within the targets set. There are five performance metrics within this designed simulation that are related to the modified and proposed algorithms in this thesis, which they are:

- ✓ **Route Discovery Delay:** It is the delay time elapsed in route discovery process from the first moment which the source node initiates the route discovery process until it receives the responses from the destination node.
- ✓ **Number of RREQ Messages:** It is the total number of RREQ messages which distributed from all nodes in the network during route discovery process until reaching the destination node.
- ✓ **Number of RREP Messages:** It is the total number of RREP messages which sent from the destination node to the source node as a response to the RREQ messages during the route discovery process.
- ✓ **Packet Delivery Ratio (PDR):** It is the ratio of the traffic received to the traffic sent in the network.
- ✓ **Throughput:** It is a rate of successful data delivered to destination node over the communication channels in network.

## 9. Result and Discussion

According to what has been explained previously, DSR protocol depends on the blind broadcast in standard algorithm to all nodes in the process of route discovery, so it is natural increasing the number of RREQ messages when increasing the number of nodes in the network and this, of course, which will increase the delay of route discovery process also. Moreover, the increase in the number of nodes in the network will give further paths, which can be explored between the source and the destination nodes in the network, which explains the increasing number of RREP messages when increased the size of the network, which in turn contributes to increasing the value of the delay as well. On the other hand, has been canceled the dependence on the blind broadcast in the enhanced algorithm, and adopted instead on the filtering the transmission according to the signal strength of the nodes and prediction the position of the nodes. This is what leads to the reduction of the number of nodes that exchange RREQ messages, which gives the same effect of reducing the size of the network, which means that when applying the enhanced algorithm on the big network, the results will be better than applying the standard algorithm on the small network in general as shown in the obtained results. The calculation of the end-to-end delay value depends on three basic factors, where these factors are: the volume of data transmitted the rate of transmission, in addition to the number of nodes in the path. There are two main reasons which caused that the enhanced algorithm gives end-to-end delay value less than the standard algorithm:

- The number of nodes in the discovered paths between the source and destination are less than it is in the standard algorithm due to the adoption of the enhanced algorithm on filtering transmitter in route discovery process rather than the blind broadcast in the standard algorithm as explained previously.
- Naturally, the increasing the value of the end-to-end delay when increasing the size of the network, because it will lead to an increase the number of nodes in the path between the source and the destination especially the greater the distance between them.

The calculated value of the PDR mainly depends on the volume of data transmitted in addition to the value of data received, which will decrease when increased the number of nodes, due to increasing the probability of packet loss with collisions which will lead to decrease the data received in the destination. The PDR in enhanced DSR is greater than in standard DSR, due to the end-to-end delay is less in enhanced DSR in addition to sending data via multi paths which will increase the delivery ratio of the data with decreasing the probabilities of collisions and packet loss, all that increase the volume of data received in the destination node which in turn increase the PDR in enhanced DSR. Logically, the value of throughput will increase when increasing the size of the network, because that the load in network will increase when increasing number of nodes, and that in turn will increase the throughput, as well as, for the same reasons mentioned in PDR, the throughput in enhanced DSR is greater that in standard DSR. With regard to the extent of the effect of increasing the speed of the nodes on the performance metrics values, where this effect ranges from low to medium influence, where when increasing the speed of the nodes, will lead to change faster in the nodes' location in the network. This will cause a number of events, such as the connection loss between two nodes, which will lead to the failure of all the routes that rely on them, and also, some of the signal strength of the nodes may become a good signal after it was with the low signal strength and vice versa, leading to a continuous change in the process of route discovery and its results for both standard and enhanced algorithms.



## 10. Conclusion

The constant motion of the nodes is one of the key challenges faced by MANET networks. The negative effects of not dealing with this challenge, such as: High consumption of bandwidth, overhead, delay and latency. The proposed modified algorithm for DSR protocol providing for performing three adjustments, and are:

- ✓ Firstly, perform adjustments in the mechanism of re-send the intermediate nodes to RREQ broadcast messages to neighboring nodes according to the signal strength.
- ✓ Secondly, perform adjustments in the mechanism of arrangement the routes in cache memory, according to best signal strength (SS) of routes.
- ✓ Finally, allowed to the node to send the data through multi paths rather than single path. The simulation results show that the enhanced algorithm gives results better than the standard algorithm in terms of the routing traffic, delay.

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## **THE ORIGIN OF ROSES FROM THE ISLAM IN HUNGARY AND EUROPE, TOO: ROSE CULTURE AS TURKISH HERITAGE IN HUNGARY:**

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### **Abstract**

The author continues his earlier presentations in Cyprus about the Turkish Cultural Monuments of Hungary, which were read at the Cappadocia Congress in Tunceli, on 11 August 2024; and also, at the previous İZDAS Conference in Girne, Cyprus, on 06 July 2024. – There he demonstrated that the roses came to Hungary from the Turks, at the time when Hungary was a part of the Ottoman Turkish Empire. However, the question has been left open: why roses did not come to Hungary earlier, in the Middle Ages, although Christian legends talk about roses in the hagiography? The answer should be given considering the sources, and the “Little Ice Age” which took place in Europe in the 13-16 centuries. Then, considering all aspects of the topic, the full-paper will be given here. Gül Baba, father of the Roses, was a Bektashi dervish who arrived in Buda with the conquering Turkish army in 1541. Gül Baba, whose fame is still well known throughout the Muslim world, was born in Merzifun, Sivas province, Asia Minor. The turbe (türbesi), erected over the Tomb of Gül Baba, was built between 1543 and 1548 by Mehmed YahYapashazade, the 3<sup>rd</sup> Pasha of Buda. The Türbesi of Gül Baba has been a place of pilgrimage for Muslims ever since. According to legend, he was the first to plant roses in Budapest, the Rose Hill owes its name to this. Roses were built into the deep layers of Hungarian culture. The Hungarian simple people in the villages sing about roses in many folk songs. Roses are present in embroidery on clothes in a peculiar style of almost any folk landscape. A bouquet made of roses is still a symbol of love today, and we give it only to a woman we love or when it is necessary to express great social prestige. This is an element of the cultural heritage of Turkish origin, this Hungarian national symbol was given to us by the Turks. Therefore, the Ottoman Turks contributed much to the cultural heritage: we Hungarians eat potatoes, cultivate wonderful roses, and visit wellness bathes in five-hundred old Turkish buildings (such as in Budapest and Eger), that have remained for us as the valuable Turkish cultural heritage.

**Keywords:** Ottoman\_Empire, Hungary, Cultural\_Heritage, Roses, Gül\_Baba, Budapest.

## **Introduction: The Topic And Its Research**

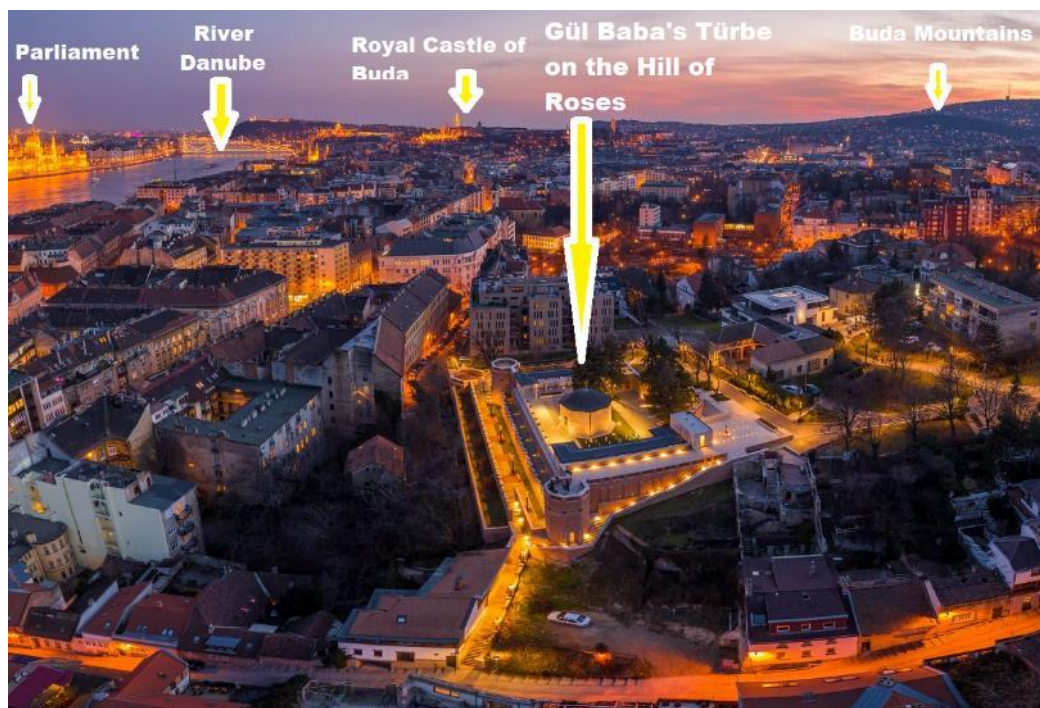
### **1.1. The Aim of This Paper in the Perspectives of Turkish Heritage in Hungary**

The author continues his earlier presentation in Cyprus about the Turkish Cultural Monuments of Hungary, which was read at the IArcSAS Symposium, on 31 May 2024. At that time, the author talked about the fact that the bath in Eger (Northern Hungary), which Evliya Çelebi had seen and described, is still operating today. Then he talked about the other operating Turkish baths in Budapest, the capital, at the next conference, the Friendship Bridge Social Sciences Congress June 07-09, 2024, Comrat, Moldova, Gagauzia country. He said that besides the baths, roses, and food are also Turkish cultural heritage in Hungary, and he will give a special lecture on these later, and at the Comrat Kongress the abstract was only published. Now he speaks about the Türbesi of Gül Baba and the Rose Garden where he is buried and a full text on this topic is given here.

Therefore, in the coherent line of our paper, we want to demonstrate here, that the Turkish cultural heritage became an organic part of the Hungarian culture, such as the baths at medical waters, the rose motifs in the folk-tales rose gardens around the houses, as well as potatoes in the Hungarian foods, and still other elements of the built and intellectual heritage. We aim to pay attention to the multiculturalism of the Hungarians and any nation and emphasize the Turkish contribution. We deal with a theoretic problem of cultural anthropology and nationalism studies, too, whether monolith or homogenous cultures and nations exist, and, certainly, our answer is the “not”, in any case. We strictly deny any kind of one-sided interpretation of the “heroic” past, but we argue for bilateral and multilateral kind of cultural interferences in any case of historical encounters between two or more peoples. History is a scene of wars, conquests, and fights for dominance or survival, but there is always more than one side to a coin, as an English proverb says. Thus, it is not our task to decide whether Gül Baba was a living person, nor can we deal with the historical sources. In this aspect, we rely on the literature in the field, mainly works of Balázs Sudár about Gül baba and the Bektashi Order (Sudár, 2008), as well as those of Gábor Ágoston about the historical background. (Ágoston, 1991)

### **1.2. Different Approaches to Gül Baba**

The name Gül Baba (Gül: “rose”, baba: “father” in Turkish) presupposes an old sage with a holy life nurturing a passionate passion for roses. But the Rose here plays an allegorical role and symbolizes the mystical ascent of the human soul to Allah. We imagine a holy man whose religious passion takes us to spiritual heights, we see in him the moral greatness and spiritual excellence, the divine gardener whom the Hungarians also respect, as Hungarian legends say about this, and most of all that the Sufi shrine has survived to this day, in the most beautiful area of Buda, the Rose Hill, is named after him. The “Rózsadomb” (‘Rose Hill’ in Hungarian) is located in the 2<sup>nd</sup> district of Budapest, in a picturesque point of the Buda Hills, being one of the most prestigious areas in the whole of Hungary. A lot of the wealthiest residents lived here. The area has easy access to the forests of the Buda Hills, while located near the downtown of the capital city. Nowadays it is mostly covered with exclusive villas; so old buildings from the heydays of the high bourgeoisie in the break of the 19<sup>th</sup> and 20<sup>th</sup> centuries, as newly built exclusive houses belonged to the party establishment in the communist era, and lately the newly ruling right-wing illiberal regime has already produced its well-to-do elite, too.



6. Figure Gül Baba's Tomb and its position in the city of Budapest

The roses and other motifs referring to Gül Baba were spread in folklore and became subjects of narratives in pious traditions and fairy tales. It must also be evaluated as a part of Hungarian and Turkish cultural heritage. (Saral & Saral, 2008) But it is not very certain that this saint ever had anything to do with roses. Some believe that since the members of the Dervish community he led, wore a so-called cap rose on the tip of their cap, the holy man was named the Father of Roses (leader of the rose cap community) after this attire. Moreover, it is possible that he only received this name after his death, in his lifetime he was called by the much more prosaic name Kel Baba, which means Father Bald (“Kel” in Turkish). This is what scholars think, much is explained only by poetic imagination, but it is part of cultural heritage, narratives, folklore, and literature, not the field of historiography.

It is also possible that in retrospect, already after his death, this name was glued to him, after the rose gardens surrounding his tomb became famous. Or vice versa, rose gardens were planted around the Turbe because the famous dead person was identified with this flower earlier. However, some authors think the legend seems to be less true that Gül Baba would have brought roses to Hungary first – he arrived more for conquest than for flower planting. (Boronkay, 2012) At the same time, the conquering Turks brought the rose to Hungary, this is a sound assumption that may hold its place. According to some theories, the Rose was considered a spiritual sign of rank among the dervishes, according to other sources, simply Gül Baba always carried a rose pinned to his turban. (Ágoston & Sudár, 2002; Sudár, 2022)

However, since our task is here to contribute to the question of heritage, we are not interested in the historical facts, as was said above, the Ottoman Turkish sources are consulted enough by Ágoston, who, with colleagues, lately completed a monograph on the activity and history of the Bektashi Dervish Order on Hungarian terrains (Ágoston & Sudár, 2002) , as well as Fodor, and Fekete, as well as others, and summarized and synthesized by Sudár (2022), in Hungarian, perhaps to be interpreted and soon published in Turkish, too. On the other hand, the lately appeared spread of secondary fiction literature, which seems to acquire more possible readers, must regarded as a kind of modern Orientalism, which may highlight the significance of the mystical hero Gül Baba in the fiction and discourses of amusing learned people over a cup of coffee, albeit it does not contribute anything to the cultural heritage of Turkish time in Hungary.

Weiner Sennyey T. (2012) Gül baba: elbeszélés 33 rózsamagban. [“Gül Baba: a Narrative in 33 Rose Seeds”, in Hungarian] Budapest. (Weiner Sennyey, 2012)

Already toward the secondary romanticism trekked at the beginning of the last century the operetta on the topic of Gül Baba, since the operetta itself aims to amuse the public and cannot depict any historical reality, even on the level of historical fiction, which was a popular genre in the romanticism. Still, the operetta genre uses its motifs with the purpose of light amusement. (Lamb, A. 2001) It was composed by Jenő / Eugen Huszka, the famous Hungarian operetta-composer, whose works also gained much success in Paris, London, and Vienna. His piece about Gül Baba debuted in 1905 in the “King Theater” in Budapest (named “the King”, not to confuse with the royal ones, it was independent and owned by a company; “Király Színház” in Hungarian). However, the motif of Gül Baba refers to the famous Turkish personality with roses: a young couple, falling in vain, hopeless love as well, dating in the Rose Garden of a Turkish Pasha, who is Gül Baba the same; this secondary romanticism links to the Rose Hill in Budapest, which was already an elegant quarter of the capital, inhabited by well-to-do people, and having rose gardens as well, next to the tomb of Gül Baba, which was renovated in 1885, with the support of the Ottoman government, therefore, the Turkish-Hungarian good relations and the restoration of the tomb was a significant topic of the discourses in the higher society in the time of the question, and those who belonged to that higher society visited the theatrical performances as well as the operetta.

### **1.3. The Türbesi (Thomb) of Gül Baba in Budapest**

The building itself was represented as a symbol of Turkish culture in the title of an essay by Gyula / Julius Germanus, Hajji Abdul Karim, the famous Orientalist of Hungarian Origin, who began his scholarly activity in the field of Turkish studies and then turned to the Arabic studies and the research on the Noble Quran. (Földvári, 2023) Germanus’s essay “Thoughts at the Grove of Gül Baba” in 1937 drew a marvelous vision of the cultural revival of the Islam, its opportunities, and skills to be included in the World Culture and enrich the World Culture. (Germanus, 1937) Germanus, who by 1937 was already a world-renowned scholar of Islam and a professor at the University of Santiniketan in India, when writing this essay, was enthusiastic and very optimistic, even at the dawn of World War II: “Gül-Baba, this Bektashi dervish, who sleeps in Buda forever, whose coffin was escorted to his grave by Sultan Suleiman The Magnificent, is an eternal admonition to the transience and change of earthly things. And who knows if the sowing will not yet flourish in the desolate steppes if proud cities will rise in the place of ruins, and if, in a great synthesis of Christian and Islamic culture, it will bring new strength and salvation to the man of the future? (Germanus, 1937:236)





2. Figure The restored Türbe of Gül Baba nowadays

Gül Baba's türbe is a Turkish tomb chapel that was built in the sixteenth century on Rose Hill in Budapest, the capital of Hungary, near the Buda bridgehead of the Margaret Bridge. Previously, it belonged to the Budapest History Museum of the capital. In 2016, the building was completely renovated along with its surroundings, and in 2018 the property complex was transferred to the property management of the Ministry of Foreign Affairs and Trade. The Gul Baba Cultural Center and exhibition space is operated by the Gul Baba Turbeje Heritage Foundation and is open to visitors in a renewed form from the autumn of 2018. (Ágoston, 1998.) Ottoman Turks conquered Hungary for one and a half of a century. Although the war destroyed inhabited places and humans, too, Turks enriched Hungary with buildings, food, flowers, and human blood, too. The Habsburgs expelled the Ottomans at the end of the 17th century but conquered Hungary themselves. In the 18th century, Turkish buildings, bathes, and living houses were ruined; however, Turks had built several hundred grandiose buildings, such as bathes to mineral waters (the land of Hungary is extremely rich in medical waters, albeit all the wellness culture was introduced by the Turks and a lot of Turkish baths have still been working nowadays as well), Jamis, medreses, minarets, or turbes where significant Turkish persons are buried. Two türbes remained to us, in good condition, and both operating as Muslim holy places of the pilgrimage. The first is the türbe of Gül Baba in Budapest, the capital, and the second is the türbe of Idris Baba, in the city of Pécs, South Hungary. Muslims visit both holy buildings to pray there to Allah (The Merciful) but NOT for the intercession of the holy persons buried there; because it is not permitted, it is a sin to pray to anyone else but Allah; thus Muslims express their respect to those lived very saint life close to Allah, and Muslims strengthen their faith and spirit in this way. Any pious visit to the tomb is called Ziyarah (in Turkish: Ziyaret) by Islam, thus the Hajj and the 'Umrah are also Ziyarah but still, there are more kinds of ziyarat, such as visiting the graves of well-respected faithful persons. (Enc. Islam, 1960: 524, 533–39) Arabic ziyāra(tun) زيارَة means "visitation" and refers to visits to sites associated with

Muhammed (Peace be Upon Him), his family members and descendants, important events in Islamic history, and other venerated figures in Islam, such as the famous and holy dervish persons. Therefore, ziyarat is a way to remember the dead and to show our respect for them. It is also a way to remind ourselves of our mortality and to prepare ourselves for the Hereafter. By visiting holy places, Muslims can also gain a deeper appreciation for the teachings and values of Islam. (Rowley, 1989).

Gül Baba, “Father of the Roses”, was a Bektashi dervish who arrived in Buda with the conquering Turkish army in 1541. Gül Baba, whose fame is still well known throughout the Muslim world, was born in Merzifun, Sivas province, Asia Minor. He died at the thanksgiving service at the Jami on the feast of the capture of the city in 1541. September 2. In his honor, an ornate funeral was held, which was attended by Sultan Suleiman I The Magnificent himself and even enlisted among the pallbearers. The turbe (türbesi), erected over the Tomb of Gül Baba, was built between 1543 and 1548 by Mehmed YahYapashazade, the 3rd Pasha of Buda. The Türbesi of Gül Baba has been a place of pilgrimage for Muslims ever since. According to legend, he was the first to plant roses in Budapest, the Rose Hill owes its name to this. The turbe was renovated in 2018 by the Hungarian and Turkish governments. The preservation of the memorial and the environment of the turbe of Gül Baba is also the strengthening of Hungarian-Turkish Cultural Relations. (Füredős, 2022)

## **2. Gül Baba and His Epoch**

The Skepticism appeared in the study of Gül Baba, too, thus a Hungarian Orientalist L. Fekete pointed out that his popular figure was fictitious and folkloric, and his alleged name “Gül Baba” was but the official title of the superior of a dervish order. (Fekete, 1954). Here we maintain he was a real person and summarise the knowledge about him. If all these were only legends, then the story would seem too coherent and too realistic, thus we summarize here what the sources and traditions preserved about him. Since our topic is the Turkish cultural heritage, it is not our task to criticize Fekete (1954), whose paper was published in the time of the sharp Stalinism, when all religious traditions were the subject of criticism and the trend in the scholarship was to prove that all pious traditions were false, and a new era came when the enlightened people did not believe anything was a subject of belief. Hence, we maintain the existence of Gül Baba is a subject of debate, and we summarize what can be said about him, regardless he was a real person or a hero of fiction. There were many other dervish Chiefs who bore the title “Father of Roses”, thus it is difficult to identify one of them. (Sarai 2004).

He was a famous dervish whose sermons (or a collection of sermons attributed to him) remained and circulated in the religious pious literature of the Turkish language Muslims, as a special kind of Muslim literature: he was the author of Meftahü'l-Ghayb. (Al-Baydawi, 1997) The first reference to Gül Baba came from Georgius Wernher (1551), whose work was published anonymously in Vienna about the medicinal mineral waters in Hungary. Thus, he wrote about the Turkish baths, which were built firm the 16<sup>th</sup> century in Hungary, at the springs of medicinal waters, and he refers to a Turkish saint buried near the thermal springs of Felhévíz and informs the readers that he was highly respected already in his life as well as afterwards. (Wernher 1551) Nevertheless, the Baktashi Order built several monasteries in Hungary in the 16<sup>th</sup> century, after the Turks conquered Buda, the then-capital of Hungary (Budapest has existed since the late 19<sup>th</sup> century, when two cities on the right and left bank of the Danube river, were united in 1873.) Did there live a real person Gül Baba there, or not, it does not matter, for the Bektashi order established ots new centers in Hungary, mainly in Buda, but also elsewhere in the country. (Sudár, 2008)

Thus, regardless he was a real person (which is probable, too) or an imaginary person in the folklore tradition, Gül Baba – the “Father of the Roses” in English – was a dervish of the Bektashi Order, who accompanied the Ottoman army already during Sultan Muhammad II’s



reign, in his military campaigns in Europe. The designation “rose” in his name is a kind of spiritual rank that indicates that he knew God in a profound, transcendent way. Gül Baba arrived in Buda in 1541, accompanied by Sultan Suleiman I The Magnificent, and the Turkish armies. According to legend, he died on Thanksgiving Day in honor of the capture of the city, in 1541. September 2. After his death, Gül Baba, the dervish well-respected among the Ottomans, was buried on a hill near “Baruthane mahallas” (in Türkish), a former gunpowder mill on the banks of the Danube in northern Buda, and his funeral was attended personally by Sultan Suleiman I. (Evliyā 2002:134, 153) His death in Buda in 1541 has been verified by a family tree (şecere) preserved at a monastery in Isparta. (Fekete 1954:9) Between 1543 and 1548 Yahyapashazade Mehmed, the beglerbeg of Buda, built a mausoleum, thus turbe, over his tomb. (Sudár, 2008:230-232)

During the Ottoman occupation, a monastery, in Türkish: tekke, inhabited by Bektashi dervishes, was built near the mausoleum, and it was typical for the Ottomans to bury themselves in the vicinity of the turbe. Thus, around the Tomb of Gül Baba in the hills of North Buda, a significant pilgrimage site was built by the Ottomans, and in the Ottoman era, the area was called Gül Baba's Hill, in Türkish: Gül Baba tepesi. About the person of Gül Baba already in the 16<sup>th</sup>-and 17<sup>th</sup> century. One of the best-known of these is the one that was recorded by the Turkish traveler Evlia Chelebi, who visited turbe in 1663. In Evlia's note, it is read that the dervish was born in Merziphon and died on 2 September 1541, during the first Friday prayer in the (formerly Christian) Church (formerly of the Assumption), which was converted into a mosque, and his funeral was attended by the Ottoman Sultan, thus Suleiman I The Magnificent. The Dervish became the spiritual patron, the symbolic guardian of the Borderland. (Evliyā 2002)

In 1686, during the second siege of Buda, the Habsburg army did not touch the Tomb. Later Jesuit priests converted it into a Catholic chapel, and it continued to exist as a Christian church in the Turbe, cross two centuries.

In 1885, the Ottoman government commissioned the Hungarian architect János Wagner to restore the turbe and its surrounding monuments. János Wagner built a retaining wall around the complex, which included his residence, too, and which differed very roughly from the style of the Turkish Tomb, imitating Christian castles in the West. After restoration, in 1914 the monument was declared a Hungarian National Monument.

To the person of Gül Baba in the 19<sup>th</sup> and 20<sup>th</sup> centuries, more legends were connected, known mainly from romantic literary and musical works. About the Dervish, it was at this time that the surroundings of the turbe were named Rose Hill, where Representative villas were first built by the establishment, and later a denser network of buildings developed. Around this time the neighbouring Niedermayer Gasse was also named Gül Baba Street.

As for the state of the building and place, in the twentieth century, the Türbe and the surrounding building complex underwent several renovations and reconstructions, but a significant renewal of its condition was not achieved. By the beginning of the twenty-first century, the complex needed extensive restoration, so the site was closed to visitors for several years. On 24 February 2015. In Budapest, the deputy prime ministers of Hungary and Turkey signed an agreement on heritage protection tasks and complex environmental management of turbe and its immediate surroundings, which works were completed in 2018. In the complex, not only the Ottoman historical building can be visited, but a complex cultural center has been created, with several spaces for permanent and temporary exhibitions, as well.



3. Figure Hungary's three parts in the 16/17 centuries: the Kingdom in the West, the Turkish Conquest in the Central part, and Transylvania in the East. (Magocsi, 1991 map No.14. - our great thanks to the author for permission)

### 3. The Rose Culture in The Hungarian Heritage

#### 3.1. Rose Is Symbolic Phenomenon of Hungarian Culture

Roses were built into the deep layers of Hungarian culture. The Hungarian simple people in the villages sing about roses in many folk songs. Roses, as decorative morphs, are present in embroidery on clothes in a peculiar style of almost any folk landscape. A simple Hungarian boy in the villages calls his love “my rose”. A bouquet made of roses is still a symbol of love today, and we give it only to a woman we love or when it is necessary to express great social prestige. An important and inalienable element of Hungarian folk culture is the Rose a typical Hungarian flower. This is an element of the heritage of Turkish culture, and the simple Hungarian does not know when he/she sings about the Rose that this Hungarian national symbol was given to us by the Turks. Nowadays, when Budapest, the capital of Hungary, renews its rose gardens, English-language newspaper articles inform the world that we become again similar to the Turkish time when roses were flourishing and decorated the town of Buda. (Füredős, 2022)



4. Figure Roses in Hungarian folk dresses, as an integrated part of the cultural heritage

### 3.2. Absence of Roses in the High Middle Ages in Hungary.

Some authors strove to evidence the presence of rose in Middle-Age Hungary, however, the attempts seemed to remain in vain. They referred to the hagiographic literature in the High Middle Ages, albeit it proves the sacral role of roses as symbols of the faith and interference of the Lord God, but no evidence has been given for cultivating rose gardens in the horticulture of the Middle Age Hungary. (Boronkay, 2012; Rapaics, 1932) In the Middle Ages, roses were plants cultivated in gardens for medicinal purposes, therefore, they were grown in the gardens of monasteries, for the monks dealt with the medical curation of people and monks cultivated gardens. (Géczi, 2020)

In Hungary, Benedictines appeared at the earliest times. In 996 Prince Geza settled monks from Bohemia on the “Holy Mountain of Pannonia”. St. Stephen I (1000-1038), the first Hungarian king, regularly visited the monastery in honor of St. Martin of Tours. (Somorjai, 1996) Soon in the Middle Ages, they still founded some other monasteries, too. (Hervay, 2001) Since they were Benedictines, they probably kept good contacts with the St. Gallen monastery in Switzerland. There, near Lake Constance, between the hills, the climate was not Mediterranean but cold to roses, even though, roses were grown in St. Gallen monastery, too, as medicinal herbs, and it was documented there. (Schedl, 2014) If there were any rose flowers in the Middle Ages in Hungary, then they had to be cultivated in the gardens of monasteries, and with the purpose of medical curation, therefore it might have been mentioned in the pious texts about favorite Christian persons. But there is no such evidence.

Still, it may be possible, that conservative Hungarian research has not considered gardening as a “worthy” subject of study, in contrast to the Western European scholarship, where the study of everyday life, the research of the way of life and circumstances of people are subject of the trendy research lately. On the contrary, a paper with monographic attempts, from the pen of Hungarian historian Kornél Szovák, focusing on the very beginnings and earliest history of Benedictines in the Hungarian Kingdom, deals with everything such as buildings, persons, royal diplomas, liturgy, and monastic administration – but nothing with the garden. Although the Benedictines on the “Holy Mountain of Pannonia” should have been doing gardening, since the earliest times, as their brothers in West Europe – there is not a single word about it. (Szovák, 2001) As for other papers on the activity of Benedictines in Hungary, there are even fewer

words about the garden; thus, there is no word, and in others even fewer. (Sólymos, 2001) The most solid and comprehensive study on the “Benedictine Life in Medieval Hungary” stated: “No precise information is available about the monks’ daily routine. They can be presumed to have taken part in household chores, maintenance of the buildings, and care of the orchard, vegetable garden, and livestock.” (Hervay, 2001:715) Therefore, it is more than probable, that no rose was cultivated in the Benedictine gardens in Hungary in the Middle Ages, but if roses still appeared in Hungary before the Early Modern Ages, then they disappeared due to the Mongol invasion.

### **3.3. Appearance of Roses in the Early Modern Ages (Just After the Turkish Conquest)**

Moreover, Hungary’s first horticultural work, the “Herbarium” of the Calvinist (thus Protestant) Bishop Peter Méliusz-Horhi [Juhász] (1532-1572) still treated the Rose as a medicinal plant in the late 16th century (Horhi Méliusz, 1578, according to Boronkay, 2012); therefore, it was a medicinal herb in the Middle Ages, too, if it had been cultivated in the gardens. Noteworthy, when Méliusz mentioned the rose as a medicinal herb, Hungary had already been conquered by the Ottoman Türks, moreover, a significant ratio of immigrants from the Balkans had already come earlier. (Szakály, 1990) Therefore, roses in Hungary by the late 16<sup>th</sup> century might have been spread due to the Turkish conquest of the Balkans first, then in Hungary. Even in the case of roses that had appeared in Hungary before the capture of Buda (1541), these flowers would have been brought by those inhabitants of the Balkans who moved to the Hungarian Kingdom. However, no doubt, the great Ottoman Turkish conquest in the middle of the 16<sup>th</sup> century resulted in the rose culture in Hungary, or, at least, the rise and heyday of cultivating roses. No doubt, the folk culture and rose motifs in dress codes of various ethnic groups among the Hungarian people, along various counties and landscapes, the embroideries on tablecloths, linens, and of course on clothes, all evolved as a result of the Turkish cultural impacts, considering the Balkan impacts, too, from Greeks and Serbians, who ran to Hungarian terrains from the Ottoman Turks. Still, the Turks made the lion’s share, of course. Turks established their administrative districts, vilayets, with heads of these districts, the Pasha’s (Paşalar), who built baths, mosques, minarets, and palaces here. (Hegyi, 1995) Surely, the rich and elegant members of the Ottoman Turkish establishment, those who were appointed to some strange country far from their home, sought to establish such comfort and cultural circumstances as they had at home. The Pasha of Buda had a gorgeous palace, with a luxurious harem and a brilliant garden, with roses, of course. (Fekete & Nagy, 1986)

### **3.4. Appearance of Roses in the High Middle Ages in the West.**

However, Benedictines knew well the roses as a medical flower and cultivated them in their gardens. The medicinal herb gardens were designed, among others, with ornamental plants such as roses. (Roth et al. 2009:49-75.) Albertus Magnus transferred various plants among them roses, too, to the medicinal herb garden in the St. Gallen monastery. (Schedl, 2014) Therefore, in Western Europe, the roses appeared in the gardens of Benedictine monasteries, as medical flowers. It seems more than probably, that these monks imported roses across Iberia, where the Arabic conquest resulted in the rose-gardens, too, and then roses remained the permanent elements of the peninsula, thus from there they were spread toward Europe, mainly to France, and Southern Germany, where the climate was more comfortable for roses than in the northern German lands and the rest of Europe.

The Rose culture should have declined due to climate change, too, in the High Middle Ages. It was not a true ice age but a relatively cool period that lasted from the 14<sup>th</sup> century until the 18<sup>th</sup> century. It occurred after the Medieval Warm Period when agriculture to the north from central territories of Europe was still richer in plant species than it was later. (Mann, 2002.) This climate change resulted in a terrible famine in North-Eastern Europe, for agriculture changed and many

plants had become impossible to grow. (Jordan, 1996) Certainly, this great change in the climate should have caused changes in horticulture, too; thus, the Benedictine monks could have roses until the 1300-ies but hardly later.

### **3.5. Roses in the Hagiographic Legends.**

The most famous Rose legend in Hungary originates from the thirteenth century, which is about Saint Elizabeth of Hungary (1207–1231). In the legend, the Rose is a symbol of Jesus rather than a secular ornamental plant. The story sounds as follows. The other day Elizabeth walked from Wartburg Castle to a village of their property. She was carrying food under her mantle with the purpose of donating it to the poor. Albeit she has taken it from the dining table of the royal family, against the prohibition by the royal family, who did not tolerate her pious behavior. On her way, she suddenly met her husband Duke Ludwig IV of Thuringia, who asked what she was carrying and opened her mantle, but to the surprise he found her carrying a bouquet of roses, and the story was emphasized in some versions with that it took place in cold winter. (Hohberg & Weigelt, 2006) Therefore, we can hardly agree with Boronkay (2012) said it would be evidence of roses appearing even being spread in the Hungarian Kingdom in the High Middle Ages.

First of all, Elizabeth was the daughter of the Hungarian King Andrew II, who was given to marry in Thuringia, Germany, thus she lived in Wartburg and died at a young age then became a saint there. (Maresch, 1931; Reber, 1982) Her legend was compiled by Franciscan monks in West Europe, on German terrains, and later spread to Hungary. (Reber, 1982) Second, any pious legend in the hagiographic literature, cannot refer to the presence of subjects of that legend in the everyday life in the country of the heroes of the story. This and other legends talk about miracles, but nothing about everyday life, such as, for instance, cultivating roses in the garden of Benedictine or Dominican Orders did not appear in legends, however, it would be very probable if the roses had already appeared in the High Middle ages in Hungary, but it can be found nothing such in the Middle Age legends. Similar miracles are described in various forms in hagiographies and legends. (Klaniczay, 2002)

Thus, although Elizabeth of Thuringia was of Hungarian origin, her life and legend hardly can prove anything about the rose culture in then-time Hungary. Her rose legend, actually, then was transmitted, as a narrative, to the legend of her great-niece, Saint Elizabeth of Portugal, too, as a narrative circulated in the hagiographic literature of the Middle Ages, too. The latter was married to King Denis of Portugal, and, like her great-aunt, showed much charitableity toward the poor, against the wishes of her husband (such as her great aunt). One day she was caught by her husband while carrying bread in her apron, but the food just turned into roses. (Butler & Walsh, 1991:205) Thus, the same narrative was circulated in Western terrains of Christianity, however, by no means demonstrating the presence of roses in Middle Age Hungary. (Klaniczay, 2002)

The next example proves a similar legend came into Hungary in the epoch of Angevin kings, but recorded much later, in the early 16<sup>th</sup> century. The Rose of “The Legend of Dorothea” (‘Dorottya in Hungarian’), preserved in the Hungarian language, is also symbolic. This was copied between 1514 and 1519 by the Dominican nun Lea Raskai of Margaret-Island (‘Margitsziget’ in Hungarian) and preserved in the Cornides Codex. (Uhrin, 2018) Some authors use this legend for evidence of the cultivating roses in the horticulture of Middle Age Hungary, albeit it seems to be a false argument. (Rapaics, 1932:44-72).

The legend sounds as follows. Saint Dorothy was a young virgin, who suffered martyrdom in Cappadocia ca. 311 CE. due to the intensive persecution of Christians by Emperor Diocletian. The pagan lawyer Theophilus said to her in mockery, if she sent him some fruits from her “bridegroom garden of Christ” since the virgin declared herself the “Bride of Christ”. Before she was executed and tortured, she sent him her headdress which was found to be filled with a



heavenly fragrance of roses and fruits. The pagan lawyer, sawn it, just converted to the Christian faith. (Meier, 1909) Christian legends about her life were spread from the early Middle Ages, however, only in the mid-fourteenth century did she become popular in various European regions, particularly in German-speaking territories. Noteworthy, where a century ago the legend of Saint Elizabeth with roses was produced; therefore, any Rose-legend, in German terrains, hardly proves anything about the presence of roses in Hungary in the High Middle Ages.

Hence no roses in Hungarian horticulture in the Middle Ages, since it has not been mentioned in the hagiographic texts of local saints but only miracles localized to saints who lived in the West.

### **Discussion and Conclusions**

In the mainstream of Hungarian historiography, the whole of Hungarian history is regarded as a heroic sad past, if only Hungarians had suffered during the history and other peoples had enjoyed their history, therefore, this heroization would make Hungarians a special nation, which suffered much, hence it deserves now much, according to the popular rhetoric of the popular leaders. (Lendvai, 2003). However, the Ottoman Turks contributed much to the cultural heritage: we Hungarians eat potatoes, cultivate wonderful roses, and visit wellness bathes in five-hundred old Turkish buildings (such as in Budapest and Eger), that have remained for us as the valuable Turkish cultural heritage. (Papp, 2018) The Hungarian archaeologist Győző Gerő excavated more than a hundred Turkish buildings in Hungary and restored some of them, which are still working as bathes or a small mosque as a türbe of Gül baba in Buda. He was awarded by the Turkish State in the last part of the 20<sup>th</sup> century for his great, lifelong work on the Turkish cultural heritage in Hungary. (Gerő, 1980) Nowadays, when Budapest, the capital of Hungary, renews its rose gardens, some English-language newspaper articles inform the world that we have now become like the Turkish time when roses were flourishing and decorated the town of Buda. (Füredős, 2022) The Turkish heritage was emphasized in a previous lecture of ours at the 2. Bilsel International Ahlat Scientific Research Congress on December 10 in Bitlis, Türkiye, albeit we sent only the abstract there but no full paper, thus the full text is this one, here. However, after the Turkish times, when the Habsburg Empire incorporated Hungary, under the umbrella of “deliberation”, all those towns, which earlier, in the epoch of the Ottoman conquest, were not built in a European way (but some significant Turkish buildings were made as well), now were rebuilt and extremely enlarged in the 18<sup>th</sup> century, in the style of the Baroque. Turkish buildings were destroyed, and more than half of the Turkish baths were ruined, although they made great contributions to wellness and health care, too, which is proved by the remained bathes which are still nowadays been working nowadays and attract many visitors, tourists, and those who need recreation in the hot medical mineral waters, with various illnesses. The significance of the Turkish conquest was underestimated by the traditional nationalist Hungarian historiography, which was impressed by the hot temp of building the Christian culture in Hungary, in the 18<sup>th</sup> century, and the increase of towns, which resulted in the architectural and intellectual development of those towns were ecclesiastical and cultural centers in the 18<sup>th</sup> century. Nevertheless, in the romantic historiography of the 19<sup>th</sup> century, when the Russian Empire crashed the Hungarian war for independence against the Habsburgs in 1849, but later Russia became a counterpart of the Habsburgs, moreover, enemy to Türkiye, then Hungarian historians also writers turned to the Turkish culture and the Turkish heritage in Hungary with some Romantic empathy — albeit it was a kind of Orientalism.

The Mongol invasion in Hungary in 1241-and 1242 destroyed the two third of the country, and no rose could remain in the monastery gardens if there were cultivated any. Soon after the Mongol invasion, in the 14<sup>th</sup> century, the Little Ice Age came, thus recovering horticulture could be done in the framework of pragmatic needs. Legends reported about roses in royal gardens in

the West, however, even in the legends, roses appeared as signs and symbols of some extraordinary phenomenon, in extraordinary circumstances, but not in ordinary events and places of everyday life of the Monks. Noteworthy, the case when Albertus Magnus took roses to the monastery of Saint Gallen, was an extraordinary one but not an everyday story, for Albertus Magnus was an exceptional person, and the report about his rose import should have been a record of an extraordinary event. It must be maintained that those roses came from Iberia, from the peninsula of the Mediterranean climate, which was under the rule of Islam from 756 to 1031, and the Arab University in Córdoba was the most famous cultural center in Europe, which acquired a lot of Christian students, too, who gained knowledge at that Muslim University much more than in poor Christian Europe in that time. It is logical, that the rose culture came from Islam to the warm-climate Iberian Peninsula, then from there it was spread toward the rest of Europe. (Catlos, 2018; Chejne, 1974; Glick, 2005 [1999])

Hence, it is not relevant, whether Gül Baba, the “Father of Roses”, brought roses into Hungary or not. The appearance of roses is linked to the time of the Ottoman Turkish conquest. Turks built their administrative districts and their traditionally cultivated things of the way of life, such as baths and gardens. Roses grew in Turkish gardens and generally, in the Islam culture. On the other hand, climate changed in the 16<sup>th</sup> when the Little Ice Age ended. Therefore, the climate in the Central zone of Europe, in Germany, North France, Poland as well as Hungary, became more comfortable for cultivating roses. Turkish pashas, merchants, military and social establishments, built their gardens to make their homes here more comfortable. Logical that roses were introduced into the Hungarian culture in Ottoman Turkish times, and then were spread to the folk, too. Roses were of Islamic origin in Europe, too, in general. Hagiographic legends do not contradict this opinion, because Christianity took its motifs from the Old Hebrew cultural heritage, therefore, Christian motifs all were of origin from the Middle East.

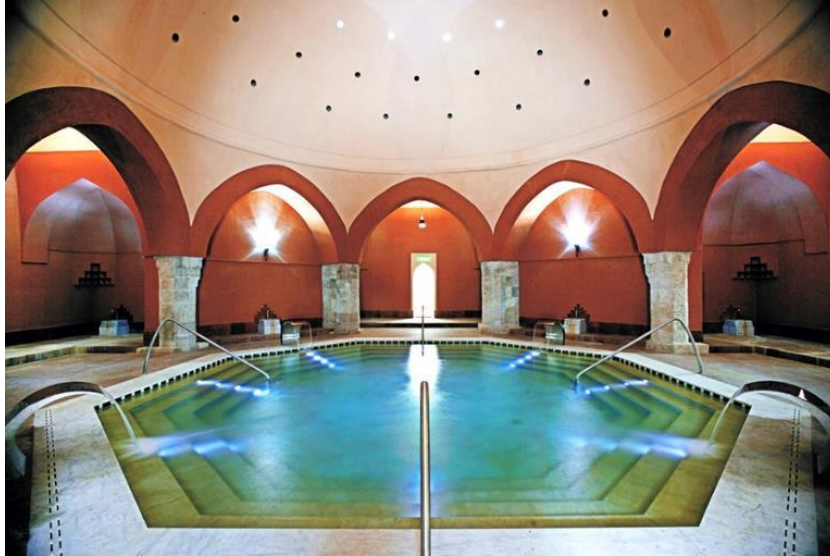


6. Figure Roses in Buda Castle nowadays

- Turkish heritage living in the center of the Capital of Hungary (source: Fördös, 2022)

In the mainstream of Hungarian historiography, the whole of Hungarian history is regarded as a heroic sad past, if only Hungarians had suffered during the history and other peoples had enjoyed their history, therefore, this heroization would make Hungarians a special nation, which suffered much, hence it deserves now much, according to the popular rhetoric of the popular leaders. (Lendvai, 2003). However, the Ottoman Turks contributed much to the cultural heritage: we Hungarians eat potatoes, cultivate wonderful roses, and visit wellness bathes in five-hundred old Turkish buildings (such as in Budapest and Eger), that have remained for us as the valuable Turkish cultural heritage. (Papp, 2018) The Hungarian archaeologist Győző

Gerő excavated more than a hundred Turkish buildings in Hungary and restored some of them, which are still working as bathes or a small mosque as a türbe of Gül baba in Buda. He was awarded by the Turkish State in the last part of the 20th century for his great, lifelong work on the Turkish cultural heritage in Hungary. (Gerő, 1980) Nowadays, when Budapest, the capital of Hungary, renews its rose gardens, some English-language newspaper articles inform the world that we have now become like the Turkish time when roses were flourishing and decorated the town of Buda. (Füüdős, 2022)



6. Figure The Turkish Bath of Veli Bej in Budapest, Hungary, the most wonderful Turkish bath in Hungary, still working and a lot of tourists visit it year by year – for five centuries it has still been working, together with a dozen other Turkish baths were built by the Ottoman Turks



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## PRIMING STUDIES IN MEDICINAL AND AROMATIC PLANTS

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### **Abstract**

Seed priming is an effective technique that improves germination and early growth, eliminates the effects of biotic and abiotic stress factors, increases plant resistance, and provides rapid and homogeneous emergence. Rapid and homogeneous emergence of plants in the field also increases yield and quality. In this review study, it is aimed to reveal the effects of different priming applications on germination and seedling development periods and field conditions in medicinal and aromatic plants, and their roles in reducing stress factors, with up-to-date and comprehensive literature reviews. As a result of the literature reviewed, it is shown that seed priming with certain chemical solutions at certain doses, certain temperatures and/or certain time intervals can improve some parameters related to germination, emergence and seedling growth of medicinal and aromatic plants. Priming application in medicinal and aromatic plants also has positive effects on secondary metabolites. This situation is of great importance in terms of increasing the production areas of medicinal plants.

**Keywords:** Medicinal and Aromatic Plants, Priming Techniques, Abiotic Stress, Germination

## 1. Introduction

Significant physiological and metabolic changes that negatively affect growth and development in plants, cause a decrease in product quality and quantity, and lead to the death of the plant or its organs are called "stress". Stress in plants is defined as morphological, physiological, biochemical and molecular changes that occur in plants due to drought, salinity, heavy metals, extreme temperature, biotic and abiotic environmental factors such as nutrient deficiency, weed infestation, diseases and harmful factors (Mahajan and Tuteja, 2005; Çakmakçı, 2009; Ceritoğlu et al., 2021). Abiotic stresses such as drought, salinity, extreme temperatures, chemical toxicity, and oxidative stress are serious threats that disrupt agricultural activities and degrade the environment. For example, abiotic stress is the primary cause of crop yield loss worldwide, reducing crop yields in most crop plants by more than 50% on average (Wang et al., 2004; Korkmaz and Durmaz, 2017). It is observed that stress factors in plants negatively affect plant productivity and product variety. Developing resistant varieties, water and nutrient management, use of plant growth-promoting bacteria (PGPB), pre-sowing seed priming, use of plant growth regulators, and organic inputs are the main methods used for stress management (Farooq et al., 2019; Ali et al., 2023; Solouki et al., 2023).

Internal structure of the seed and factors resulting from negative factors; Preliminary applications made to the seed before planting to reduce problems in germination, accelerate uniform seedling emergence, and make seedling development strong and tolerant to stress conditions are called "Priming" (Emiralioglu and Acar, 2022). Information from ancient times shows that studies on preparing seeds for planting by applying various applications date back to very old times (Nene, 2002). The principle of seed priming is to minimize emergence time and protect the seed from environmental stresses at the critical stage of seedling establishment, ensuring synchronization of emergence, leading to uniform establishment and improved yield. The priming technique is based on the principle of drying the seed again by keeping it in water or a solution with low osmotic potential for a certain period of time and temperature before sowing.

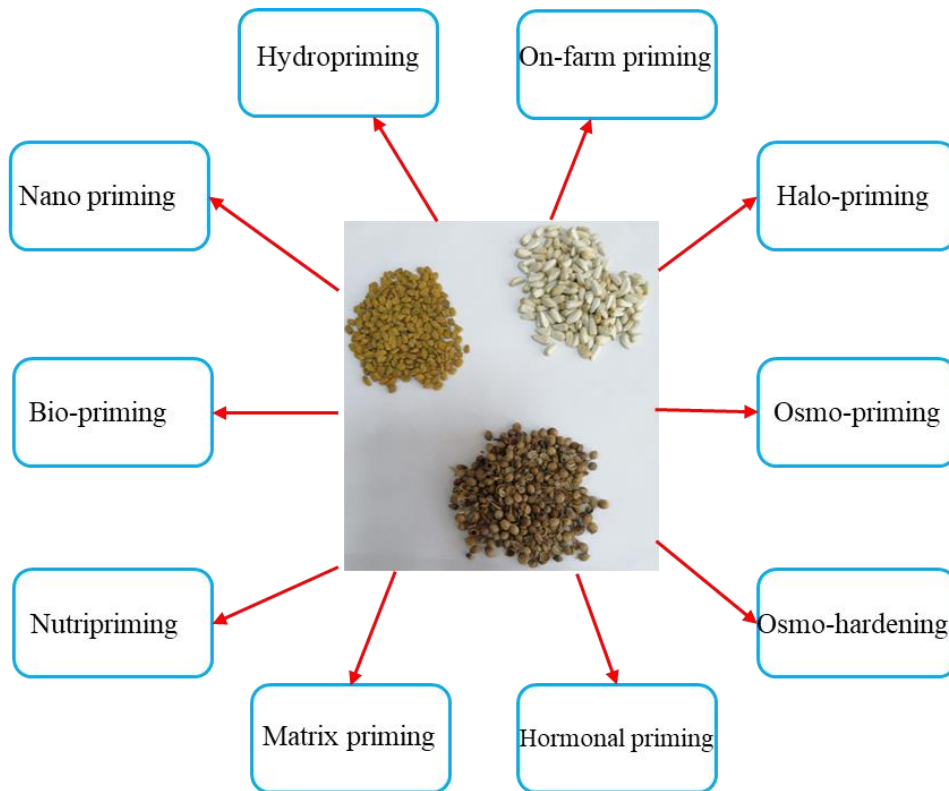
Priming applications are low cost, easy to apply, effective and efficient (Abdulkareem et al., 2024; Karalija ve ark., 2024). Because they are environmentally friendly and sustainable, they stand out among other stress management applications. Priming is done to break primary (internal) and secondary (external) dormancy, to increase germination speed, to ensure homogeneity of germination, to ensure strong seedling development, and to increase resistance to stress factors (Sher et al., 2019).

Seed aging reduces the biological value of the seed, reducing its resistance to stress conditions and germination rate. However, priming also alleviates these negative effects of aging on the seed. In fact, priming increases the respiratory activity of seeds (Halpin-Ingham and Sundstrom, 1992) and when priming is applied to old seeds, the activity of superoxide dismutase, catalase and glutathione reductase enzymes is improved (Bailly et al., 1997).

In this review study, it was aimed to reveal the effects of seed priming applications on germination and seedling development in medicinal and aromatic plants under laboratory and field conditions through literature reviews.

## 2. Priming Techniques

There are many seed pretreatment techniques, which are generally divided into traditional methods (hydropriming, osmopriming, nutripriming, on-farm priming etc.) and advanced methods (nanopriming and biopriming). When the studies were examined, priming techniques were divided into ten groups (Figure 1).



**Figure 1.** Priming techniques

### 2.1. Hydropriming

Hydropriming is the process of soaking seeds in water for a certain period of time before planting. This method is the simplest of the priming applications and is an old method used to increase the speed and rate of germination (Karakurt et al., 2010; İmriz et al., 2023; Erkul and Ülger, 2024). The purpose of this application is to create an osmotic pressure difference between the water inside the seed and the water outside or the solution in which the seed will be placed, and to ensure that enough water enters the seed to initiate germination. Thus, seed germination is stimulated and an increase in germination is achieved (Karakurt et al., 2010). Hydropriming is a simple priming method that has been used successfully in many plant species (Elkoca, 2006).

### 2.2. On-farm Priming

On-farm seed priming involves simply soaking the seed in water overnight, surface drying and sowing the same day. On-farm seed priming has been reported to improve emergence, crop retention and yield, as well as increasing economic benefits in dryland farming (Harris et al., 2002). The number of days to emergence, seed germination percentage, seedling uniformity and strength, number of days to maturity, stem and grain yields are significantly improved with the on farm priming technique (Sime and Aune, 2020).

### 2.3. Halo-priming

Halo-priming systems are resistant to the persistence of plants in inorganic salt solutions at different concentrations. Commonly used priming for this purpose can be listed as sodium chloride ( $\text{NaClO}_2$ ), calcium sulfate ( $\text{CaSO}_4$ ), potassium nitrate ( $\text{KNO}_3$ ), calcium chloride ( $\text{CaCl}_2$ ) and  $\text{NaCl}$  (Kumari et al., 2017; El-Sanatawy et al., 2021; Dhal et al., 2022). Inorganic salt reduces water potential of seeds similar to drought stress effects. Consequently, halo-priming can increase tolerance to other impending stresses and is also significantly beneficial for increasing grain yield (El-Sanatawy et al., 2021).

## **2.4. Osmo-priming**

Osmo-priming is based on the principle of keeping the seeds in a solution with low water potential that facilitates controlled water uptake. The materials frequently used in the osmo-priming technique are polyethylene glycol (PEG-6000/8000), sodium chloride (NaCl), calcium chloride (CaCl<sub>2</sub>), magnesium chloride (MgCl<sub>2</sub>), polyamine, magnesium sulfate (MnSO<sub>4</sub>), potassium sulfate (K<sub>3</sub>PO<sub>4</sub>), potassium nitrate (KNO<sub>3</sub>), sodium nitrate (NaNO<sub>3</sub>), sodium meta silicate (Na<sub>2</sub>SiO<sub>3</sub>) and mannitol. Polyethylene glycol is mostly used (Rehman et al., 2015; Pawar and Laware, 2018; Ceritoğlu et al., 2021). Polyethylene glycol 6000, which is inactive in nature and can maintain uniform water potential, can play a role in rapidly absorbing water, invigorating seed metabolism, increasing germination rate and reducing the inherent physiological heterogeneity in germination.

## **2.5. Osmo-hardening**

Osmo hardening involves soaking the seeds in tap water for 24 hours, drying the seeds again, and then hardening the seeds with CaCl<sub>2</sub> and KCl solutions (Pawar and Laware, 2018; Adhikary et al., 2021). This technique called osmotic hardening, in which both seed hardening and osmotic conditioning are successfully integrated, has been successfully applied in rice (Farooq et al., 2006).

## **2.6. Hormonal Priming**

In the hormonal priming technique, seeds are kept in solutions prepared with various concentrations of different hormones (auxin, gibberellin, cytokinin, salicylic acid, etc.) as a pre-application. Hormonal priming, as in other priming applications, initiates the germination process without root emergence and activates defense systems (Sytar et al., 2019). Growth regulators frequently used in hormopriming include abscisic acid, auxins, gibberellins, kinetin, ethylene, polyamines, jasmonic acid, and salicylic acid (Galhaut et al., 2014).

## **2.7. Matrix Priming**

It is a technique that involves mixing seeds with a solid carrier material and a small amount of water at a specified ratio. Seeds kept in an insoluble solid medium slowly take up water up to a certain level, which is very similar to the germination process in soil (Chakraborty and Dwivedi, 2021; İmriz et al., 2023; Erkul and Ülger, 2024). The solid material used for matrix priming should hold water well, not damage the seeds and be easily separated. The material that has these properties is vermiculite. With this technique, seeds of many plant species with small and large seeds germinate quickly and regularly and the plants grow strongly (Elkoca, 2006; Erkul and Ülger, 2024).

## **2.8. Nutri-priming**

It is a technique in which seeds are treated with solutions containing limited nutrients instead of pure water (İmriz et al., 2023). Nutri-priming, a low-risk, easy, cost effective and environmentally friendly practice, is a good alternative to ensure that the micronutrient requirements of plants are met. At this stage, internal conditions have a greater influence on plant development than external conditions. Adequate mineral nutrient reserves in the seed are necessary to ensure proper seedling growth until the root system becomes functional. However, these nutrients can support plant growth at later stages, thus contributing to increasing growth parameters and yield (Majda et al., 2019).

## **2.9. Bio-priming**

There are various seed priming methods such as hydro priming, osmo priming, solid matrix priming, hormo-priming, chemo-priming, nutri-priming and biopriming which are



useful for increasing seed germination and seedling survival and overcoming the adverse effects of abiotic stress. This priming technique uses microorganisms that protect plants from pathogens and improve their growth. Various fungal or bacterial bioactive substances such as *Azotobacter*, *Rhizobium*, *Arthrobacter*, *Agrobacterium*, *Azospirillum*, *Enterobacter*, *Streptomyces*, *Bacillus*, *Burkholderia*, *Klebsiella*, PSB, *Pseudomonas fluorescense*, *Trichoderma viride*, *Trichoderma harzianum* and *Vesicular Arbuscular Mycorrhiza* can be useful as biopriming agents, whether as biofertilizers or biopesticide (Desmukh et al., 2020). Biopriming applications have recently gained increasing attention due to their environmental friendliness (Imriz et al., 2023).

### **2.10. Nano-priming**

Nanopriming can be applied to seeds to improve and enhance the germination and seedling emergence process, which are the main determinants of successful plant establishment, especially under adverse conditions.

In addition to the direct use of nanoparticles for fertilization purposes, the use of nanoparticles as priming materials has led to the emergence of the nano-priming technique. Nanoparticles offer an effective approach in priming applications due to their small surface area and unique physicochemical structure (Dasgupta et al., 2017). Nano-priming increases the seed germination, seedling growth and development and vigor as well as seedling dry weight in most of the plants (Abbasi Khalaki et al., 2021). Recently, seed nanopriming has been found to regulate plant growth and development under abiotic and biotic stresses; therefore, it is very important for the sustainability of agriculture and increasing plant production.

## **3. Priming Studies on Medicinal Plants**

Most of the medicinal plants have some problems in seed germination in the field. Since germination and seedling establishment are critical stages in the plant life cycle, providing solutions for seed germination and proper emergence will help in better performance in the cultivation of medicinal plants. One of the simple techniques that can improve seedling vigor and establishment and hence field performance of plants is priming applications. This method is successfully applied in many small-seeded vegetables, forage crops and medicinal plants with great economic value that require rapid and uniform emergence.

### **3.1. Priming and Germination**

Farahani et al. (2011) conducted a study in Iran to determine the effect of different priming on the germination of basil seeds by applying different hydropriming times to the seeds, 4, 8 and 12 hours. The results showed that hydropriming had a significant effect on germination, and the highest seedling viability, germination percentage and seedling dry weight were obtained with hydropriming after 12 hours (7.08%, 89% and 0.08 g, respectively). Hydropriming increased the germination in basil, thus increasing the production of quality seedlings, and moreover, it improved both seedling viability and mean germination time. Ganji Arjenaki et al. (2011) investigated the effects of priming (control, PEG: polyethylene glycol 6000 at -3, -6 and -12 bar) on germination parameters of *Calendula officinalis* seeds and reported that the application significantly improved germination percentage, root and shoot length, seedling weight and germination rate when compared with the control, and that priming with PEG solution could be used as a simple method to improve germination of *C. officinalis* seeds.

Proper priming techniques are among the most important methods for enhancing seed germination and seedling growth. In the study where the effects of plant hormone (500 and 1000 mg/L gibberellic acid (GA)), magnetic field (3, 15, 30 milli Tesla (mT)) and laser irradiation at 650 nm (200 mW) were investigated on the germination and growth of *Salvia officinalis*, it was

determined that two concentrations of GA significantly increased seed germination and seedling growth, the magnetic field at 15 mT significantly increased the radical length, and laser irradiation also had significant effects on plumule length, fresh and dry weight, root fresh weight, germination percentage and rate and seed viability. Researchers emphasized that these priming practices can be used especially in arid and semi-arid areas, but more research is needed to determine the response of medicinal sage under stress conditions (Abdani Nasiri et al., 2018).

Benadjaoud et al. (2022) investigated whether KCl-osmopriming would improve the germination properties of *Lavandula stoechas* under salt and water stress by applying osmotic priming with different levels of KCl (1%, 2% and 4%) and germination under different NaCl (0, 50, 100, 150 mM) concentrations and drought (0, 0.25, 0.5, 0.75 and 1.0 MPa PEG) conditions. They found that as salinity and drought levels increased, germination decreased, and osmopriming significantly increased the germination percentage and rate at high salinity and low water potential levels, and was more pronounced under high stress conditions (i.e., higher salinity and lower water potential) than under low stress conditions. Accordingly, it suggests that KCl-osmopriming will facilitate the establishment of *L. stoechas* in arid and semiarid climates.

Bilinska et al. (2022) investigated the response of seeds of the species *Salvia przewalskii* Maxim. to priming and storage temperature, and stored them at 4 and 16 °C for 12 months after harvest and osmopriming was applied after storage. Seeds were primed in polyethylene glycol (PEG) water solution with an osmotic potential of -0.8 and -1.1 MPa. It was found that osmopriming application significantly reduced the germination time, and storing the seeds at both 4 and 16 °C for one year caused a statistically significant increase in the total number of germinated seeds, germination energy and capacity. The highest germination rate was detected in seeds stored at 16 °C and primed with -0.8 MPa PEG solution.

Özyazıcı (2022) conducted a study under laboratory conditions to investigate the effects of 6 different applications (control, hydropriming, 2 mM, 4 mM, 6 mM and 8 mM doses of silicon) on fennel (*Foeniculum vulgare* Mill.) genotypes (Kütahya and Tefenni), and addressed germination rate, average germination time, germination uniformity coefficient, germination energy and germination index parameters. Better results were obtained from the Kütahya genotype compared to the Tefenni genotype in terms of germination parameters, and it was determined that hydropriming and 4 mM silicon application improved the germination properties of fennel seeds.

In a study investigating the effect of boric acid applications on the germination of basil (*Ocimum basilicum* L.) plants, 5 different boric acids (0, 1, 2, 3 and 4 mM) were applied. The results of this study showed that boric acid applications positively affected the germination of basil seeds. Boric acid applications shortened the germination period, increased the germination uniformity coefficient and germination energy (Özyazıcı, 2023).

Nine hundred seeds of winter thyme (*Satureja montana* L.) from each of three natural populations (P1, P2 and P3) collected from the Adriatic coast were hydroprimed for 48 h and then the seeds were germinated under drought treatments with different concentrations of polyethylene glycol (PEG 6000) (-0, -0.2, -0.4, -0.8, -1.2, -1.6, -2, -2.5, -3.0 MPa). In the second stage of the study, P1 was used since it showed the best results on germination parameters and the effects of hormonal priming (100 and 400 ppm GA<sub>3</sub>, 48 h in the dark) and osmopriming (0.2 and 0.6 % w/v KNO<sub>3</sub>, 72 h in the dark) on seed germination and seedling morphological parameters under drought stress conditions (-0.8 and -2.5 MPa) were evaluated. Although thyme grows in dry conditions, it has been stated that extremely dry conditions (-3.0 and -2.5 MPa) negatively affect seed germination, but this effect can be alleviated by priming applications, especially hormonal priming (GA<sub>3</sub> 400 ppm) (Vidak et al., 2022).

Developments in the field of nanotechnology have offered important applications in plant sciences, contributing to plant performance and health under stress and non-stress

conditions. Among the applications, selenium (Se), chitosan and its conjugated forms as nanoparticles (Se-CS NPs) have emerged to have the potential to alleviate the deleterious effects of stress in various crops and subsequently increase growth and productivity. Sheikhalipour et al. (2023) studied the potential effects of Se and chitosan and their nanoparticles on growth, photosynthesis, nutrient concentration, antioxidant system and defense transcript levels in reversing or buffering the harmful effects of salt stress in bitter melon (*Momordica charantia* L.). It was stated that Se-CS NPs increased growth parameters, photosynthesis parameters (SPAD, Fv/Fm, Y(II)), antioxidant enzymatic activity (POD, SOD, CAT) and nutrient homeostasis ( $\text{Na}^+/\text{K}^+$ ,  $\text{Ca}^{2+}$  and  $\text{Cl}^-$ ) and induced gene expression in bitter melon plants under salt stress.

### 3.2. Priming and Field Performance

Hoseini et al. (2013) applied magnetic field application with similar strength (75 mT) but different duration (10 and 15 min); polyethylene glycol 6000; hydro-priming (24 and 72 h); and gibberellic acid priming at various concentrations (50, 500 and 1000 ppm) to lemon balm (*Melissa officinalis* L.), the effects of these applications on germination percentage and rate were significant. Plumule and radicle length were the highest in magnetic field compared to others. Considering physiological characters, the highest leaf area index and leaf area ratio were seen in magnetic field application. The effects of priming process on plant height, biomass dry weight and essential oil were significant. Different magnetic field durations had the most positive effect on essential oil.

Kanatas et al. (2020) evaluated the effects of seed pre-treatment (control, GA3 (400 and 800 ppm), potassium nitrate (2% and 4%), polyethylene glycol (12 and 24 h soaking) on the germination and growth of *Achillea millefolium* in their study conducted under laboratory and greenhouse conditions. The experiment in petri dishes revealed that GA3 at 400 ppm, potassium nitrate (2% and 4% concentrations) and PEG significantly increased the germination percentage of *A. millefolium* and the germination rate was also improved. The greenhouse experiment determined that GA3 at 400 ppm, both concentrations of potassium nitrate and PEG significantly increased seedling emergence compared to untreated seeds.

Mohammadi and Roshandel (2020) investigated the effect of seed pre-treatment with static magnetic field (SMF) (45, 90, 200 and 250 mT for 5 min) on drought tolerance and medicinal properties in 60-day-old hyssop (*Hyssopus officinalis*) plants irrigated every 8 days. In the research, total dry mass, membrane integrity, photosynthetic pigment concentrations, polyphenol content, antioxidant enzyme activities and antioxidant capacity were investigated. Compared to only water stress, magnetopriming especially at 200 mT significantly changed these parameters in grown plants and it was stated that total dry mass, total chlorophyll and polyphenol content levels increased by 94%, 2.5 and 7.7 fold, respectively. In addition, electrolyte leakage and malondialdehyde levels decreased by 35% and 33%. In general, this study showed the positive effect of magnetopriming (200 mT) in improving drought tolerance in *H. officinalis* by preserving cell membrane integrity, maintaining photosynthetic pigment content and changing antioxidant enzyme activities. As a result, it was stated that this application (200 mT) did not have a negative effect on the medicinal properties of *H. officinalis*, but also improved it by increasing its total phenolic content and antioxidant capacity.

Bayat and Aminifard (2021) conducted a pot experiment to determine the effect of selenium (Se) seed pretreatment (0 (control), 0.5, 1, 1.5, 2 and 4 mg L<sup>-1</sup>) on the growth, physiology and antioxidant activity of marigold (*Calendula officinalis* L.) grown under both well-watered and drought-stressed conditions. The results showed that lower concentrations of Se improved the growth parameters such as total leaf area, root length and total biomass of control and drought-stressed plants. In addition, the relative water content and chlorophyll content of drought-stressed plants increased with the application of lower concentrations of Se.

Treatment with Se alleviated the adverse effects of drought stress through enhancement of photosynthetic pigments, improvement of water relations, accumulation of soluble sugars and increased antioxidant activity. Seed priming with Se also increased the total phenols, flavonoids and free radical scavenging activity of marigold plants under both well-watered and water-stressed conditions. It was determined that Se application at lower concentrations (especially  $1.5 \text{ mg L}^{-1}$ ) could alleviate the negative effects of drought stress and improve the antioxidant activity of marigold plants.

Kahveci et al. (2021) aimed to alleviate the negative effects of salinity stress caused by NaCl on the growth and components of basil (*O. basilicum*) plants by using priming, and used salicylic acid, tryptophan and  $\beta$ -carotene for seed priming. They soaked basil seeds in 0.025 and 0.05 mM salicylic acid, 0.25 and 1 mM tryptophan and 0.1 and 0.2 mM  $\beta$ -carotene for 24 hours, and when the plants reached the 5-6 leaf stage after seed priming, they exposed the plants to salt stress (100 mM NaCl). The results showed that salinity reduced shoot and root length, root and leaf weight, leaf number, plant weight and photosynthetic pigments of plants. However, priming applications partially alleviated the negative effects of salinity on shoot and root length, root, leaf and plant weight, but did not have a significant effect on photosynthetic pigments in plants grown in saline conditions. Salinity decreased the percentage of linalool and eugenol from essential oil components, while increasing the percentage of methyl eugenol in plants without priming. However, priming increased the percentage of linalool and eugenol, and decreased the percentage of methyl eugenol in plants grown in saline conditions. As a result, it was observed that basil seedlings were negatively affected in terms of yield in 100 mM salt application, but especially 1 mM tryptophan priming application could protect plants from the toxic effect of salt and increase the amount of phenolics under stress.

In another study, Bahrasemani et al. (2024) reported that different salinity levels decreased the germination percentage, germination rate, germination speed coefficient, seed weight and vitality index of *Indigofera tinctoria* by 29%, 66%, 53% and 25%, respectively, while seedling fresh weight, seedling dry weight, root length and shoot length decreased by 37%, 14%, 72% and 61%, respectively, and priming with Putrescine (0.5 and 1.0 mM) was practical and economical in terms of reducing the negative effects of salinity.

#### **4. Conclusion**

Priming techniques activate enzymes and antioxidant defense systems that are effective in the germination process, thus showing positive effects from germination to maturity, and increasing tolerance to environmental stress factors. In addition to being an easy-to-apply, economical and effective method, the technique has the potential to contribute to the reduction of chemical inputs, indicating that it is an important alternative to achieve sustainable goals in agriculture. In particular, studies on biopriming and nanoprimering applications should be advanced and their use in sustainable agriculture should be increased.

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## ÇİNKOLU GÜBRELEMENİN TIBBİ BİTKİLERDE ÖNEMİ

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### Özet

Tıbbi bitkilerin hastalıkları tedavi etmek amacıyla geleneksel kullanımı çok eski çağlardan beri bilinmektedir. Tıbbi bitkilerin yetiştiriciliğinde makro besin maddelerinin yanında mikro elementlerin de büyük önemi bulunmaktadır. Bu anlamda tarım topraklarının önemli bir kısmında eksikliği görülen çinko (Zn), son yıllarda öne çıkan bir bitki besin maddesidir. Canlı organizmalar, düzenli metabolik aktiviteler için minimum düzeyde eser element olarak çinkoya ihtiyaç duymaktadır. Bitkilerde genel olarak Zn, protein sentezinde, enzim aktivasyonunda, oksidasyon ve karbonhidrat metabolizmasında önemli rol oynamaktadır. Çinkonun, tıbbi bitkilerde; bitki boyu, dal sayısı, metre karede bitki sayısı, çiçek sayısı, tohum verimi, taze ve kuru herba verimi ve uçucu yağ oranı ve bileşenleri gibi önemli tarımsal parametreler üzerine önemli ve olumlu etkileri vardır. Bu derleme çalışmasında, geniş araştırma aralıklarında farklı türlerle yapılan çok sayıdaki çalışmalar gözden geçirilerek, tıbbi bitkilerde Zn ve çinkolu gübrelemenin önemi vurgulanmıştır.

**Anahtar Kelimeler:** Çinko, sekonder metabolitler, drog herba verimi, karbonhidrat sentezi



## IMPORTANCE OF ZINC FERTILIZATION IN MEDICINAL PLANTS

### **Abstract**

The traditional use of medicinal plants to treat diseases has been known since ancient times. In addition to macronutrients, microelements also have great importance in the cultivation of medicinal plants. In this sense, zinc (Zn), which is deficient in a significant portion of agricultural soils, has become a prominent plant nutrient in recent years. Living organisms require zinc as a trace element at a minimum level for regular metabolic activities. In plants, Zn generally plays an important role in protein synthesis, enzyme activation, oxidation and carbohydrate metabolism. Zinc has important and positive effects on important agricultural parameters such as plant height, number of branches, number of plants per square meter, number of flowers, seed yield, fresh and dry herb yield and volatile oil ratio and components in medicinal plants. In this review, numerous studies conducted with different species in wide research ranges are reviewed and the importance of Zn and zinc fertilization in medicinal plants is emphasized.

**Keywords:** Zinc, secondary metabolites, drug herb yield, carbohydrate synthesis

## 1. Giriş

Diğer kültür bitkilerinde olduğu gibi tıbbi bitkilerde de topraktaki besin maddesi düzeyi üzerinde en çok araştırılan konularına başında gelmektedir. Tıbbi bitkilerin çoğu doğada kendiliğinden yetişmesine rağmen, bitkilerden yüksek verim ve kalitede ürün alabilmek için birçok bitki besin maddesinin toprakta elverişli formda olmasını ister. Bu anlamda, bitki besleme ve gübreleme ilişkisi kapsamında, azot (N), fosfor (P) ve potasyum (K) gübrelemesi önemli olduğu kadar, demir (Fe), bakır (Cu), çinko (Zn) ve mangan (Mn) gibi birçok mikro besin maddeleri de bitkilerde hem fonksiyonel hem de verim ve kalite açısından önem arz etmektedir.

Diğer yandan, toprağın fiziko-kimyasal özelliklerine bağlı olarak mikro besinlerin çözünürlüğü çok daha azdır. Bu durum bitkilerin mikro besin elementlerini alabilme yeteneğini azaltır; ve doğal olarak bitkilerin bu elementlere olan ihtiyacı artar. Nitekim Mousavi ve ark. (2012), mikro besin maddelerinin yeterli düzeyde olduğu topraklarda fosfatlı gübrelerin aşırı kullanımının bitkilerde mikro element eksikliğine neden olacağını bildirmektedirler. Buna bağlı olarak mikro besin maddesi konsantrasyonu kuru maddede ve ürün veriminde önemli düşümlere neden olabilmektedir (Khorgamy ve Farnia, 2009; Taheri ve ark., 2011). Bu nedenle bitki beslenmesinde mikro elementlerin önemi ihmal edilemez. Diğer makro besin maddelerine göre nispeten daha az oranda bitkilerin ihtiyacı olsa da, bitkilerin performansı açısından tüm elementlerin toprakta ve bitkide yeterli düzeyde olması kritik önem taşımaktadır. Bu yönüyle Zn bitkilerin ihtiyacı duyduğu önemli bir mikro elementtir. Çinko, insanlar, bitkiler ve hayvanlar için gerekli bir besin maddesi olup, özellikle az gelişmiş ülkelerde Zn eksikliği yaygın olarak görülmektedir.

Bitkisel üretim için gerekli olan temel besin maddelerinden biri olan Zn, bazı topraklarda yeterli miktarda bulunurken, tarım yapılan toprakların önemli bir kısmında da noksanlığı söz konusudur. Bu nedenle eksikliği görülen alanlarda çinkonun gübreler ile eklenmesi gerekir (Rehmm ve Schmitt, 1997; Mousavi, 2011; Yosefi ve ark., 2011). Günümüzde, tarım yapılan topraklarda Zn eksikliği ciddi bir küresel sorun haline gelmiş bulunmakta; bu durum, tıbbi bitkiler de dahil olmak üzere birçok üründe verim ve kalite kayıplarına neden olmaktadır. Bu çalışmada, çinkolu gübrelemenin tıbbi bitkilerin üretimi ve kalitesi üzerindeki rolü incelenmiştir.

## 2. Toprakta Çinko ve Bitkiler Tarafından Çinko Alımını Etkileyen Faktörler

Çinko, öncelikle çinko oksitler, sülfatlar, sülfidler, karbonatlar, silikatlar ve fosfatlar içeren minerallerden toprağa salınır. Diğer kaynaklar arasında; orman yangınları, volkanik aktivite gibi atmosferik süreçler, ayrışma, yaprak yüzeyinden yıkanma gibi biyotik süreçler ve son olarak antropojenik aktivite bulunmaktadır (Babula ve ark., 2008; Montalvo ve ark., 2016).

Tarım yapılan topraklarda Zn çoğunlukla eşit bir şekilde dağılmamıştır; toprakların Zn içeriği 10 ile 300 mg/kg arasında değişmektedir (Barber, 1995; Noulas ve ark., 2018). En düşük Zn içeriği kumlu topraklarda, en yüksek ise kireçli ve organik topraklarda bulunmuştur; bazı araştırmacılar ise dünya çapındaki topraklar için ortalama Zn içeriğinin 64 mg/kg olduğunu belirtmektedir (Kabata-Pendias ve Pendias, 2001). Tarım topraklarında Zn eksikliği, bitkisel üretimi sınırlayan en yaygın mikro element eksikliği kısıtlaması olarak kabul edilmekte iken (% 40'tan fazla verim kaybı), topraktaki fazlalığı ise jeolojik veya antropojenik kökenli olabilmektedir (Singh ve ark., 2005; Sadeghzadeh, 2013). Çinko eksiklikleri, makineli tarımın yapıldığı sürekli işlenen kireçli (yüksek pH) topraklarda meydana gelme eğilimindedir. Özellikle kireçli toprakların sürekli işlenmesi, mikro besinler açısından zengin üst toprağı ve organik maddeyi kaldırması nedeniyle kireçli topraklarda Zn eksikliğine neden olmaktadır (Noulas ve ark., 2018). Yine alkali topraktan organik maddenin uzaklaştırılması sonucunda Zn sorpsiyonunun arttığı bildirilmiştir (Azouzi ve ark., 2015). Gübre uygulaması ile ilave edilen çinkonun toprak bileşenleri ile olan reaksiyonlarında asit karakterli topraklarda oksit

minerallerinin, nötr karakterli topraklarda organik maddenin, alkali topraklarda ise kil ve kireç miktarının etkili olduğu bildirilmiştir (Kaya ve Uygur, 2019).

Bitkiler için çinkonun bulunabilirliğini etkileyen diğer faktörler; topraktaki kil bileşenin miktarı, organik bileşenlerin oranı, kalsiyum karbonat içeriği, rizosfer mikroorganizma aktivitesi, toprak nemi, diğer mikro elementlerin ve fosfor konsantrasyonları ile iklim koşulları sıralanabilir. İlk iki faktör, kil ve organik bileşiklerin değiştirilebilir formda Zn iyonlarını adsorbe etme yeteneği açısından önemlidir. Alkali bir bileşik olarak daha yüksek oranda kalsiyum karbonat, sırayla toprak pH'sını yükseltir. Mikroorganizmaların metabolitleri, kök eksüdatlarıyla birlikte ana kayanın parçalanmasına yardımcı olur ve böylece erişilebilir Zn formlarının toprak çözeltisine salınma sürecini hızlandırır (Hartmann ve ark., 2009). Diğer mikro elementler, sular altında kalan arazilerdeki daha yüksek Fe ve Mn konsantrasyonu, bitkilerin Zn iyonlarını emmesini önler (Loneragan ve Webb, 1993). Çinko formlarının bitki tarafından emilimi ve asimilasyonu üzerinde P olumsuz bir etkiye sahiptir. Toprakta fazla P varlığında, köklerin kolonizasyonu, toksik olmayan koşullar altında Zn iyonlarının emilimini destekleyen arbusküller mikoriza tarafından bastırılır (Watts-Williams ve ark., 2013). Dahası, bazı aşırı fosfatlı gübreleme nedeniyle toprak pH'sı artar ve çinko fosfatların çözünmeyen bileşikleri oluşmaya başlar (Özkutlu ve ark., 2019). Bu durum, toprakta Zn eksikliğine yol açtığı gibi, bitkiler tarafından alınabilir Zn miktarını da azaltır.

### 3. Bitkilerde Çinkonun Rolü

Bitkiler için önemli bir mikro element olan Zn birçok biyo-fizikokimyasal tepkilerinde yer alır (Noman ve ark., 2019; Zaheer ve ark., 2022). Karbonhidrat metabolizmasında rol oynayan enzimlerin çoğu Zn tarafından aktive edilir; bu nedenle Zn, karbonhidrat metabolizmasında rol oynayan en önemli elementlerden biridir. Ayrıca karbonik anhidraz, fruktoz-1, 6-bisfosfat ve aldolaz enzimleri Zn tarafından aktive edilir. Bu enzimler kloroplastlarda ve sitoplazmada aktiftir, altı karbonlu şeker molekülü fruktoz-1, 6-bisfosfat tarafından kloroplastlar ve sitoplazma arasında ayrılır ve fotosentezdeki üç karbonlu şeker molekülü aldolaz tarafından sitoplazmadan kloroplastlara taşınır. Bu enzimlerin aktivitesi Zn eksikliği durumunda azalır; bunun sonucunda, bitki yapraklarında karbonhidrat birikir (Marschner ve Çakmak, 1989, Mousavi, 2011; Taheri ve ark., 2011).

Çinko bitkilerde protein üretimi için de gerekli mikro besindir. Ayrıca Zn ribozomların ana bileşeni olup, gelişimleri için gereklidir. Bitki dokularında biriken amino asitler ve protein sentezi Zn eksikliğinde azalır. Protein sentezinin gerçekleştiği yerlerden biri polen tüpü olup, Zn polen tüpü oluşumunu etkileyerek tozlaşmaya katkıda bulunur (Marschner, 1995; Pandey ve ark., 2006).

Çinko eksikliği durumunda oksin (IAA) ve triptofan gibi bitki hormonlarının metabolizması azalır; bunun sonucunda, yaprak büyümesi durur. Aslında Zn, oksin oluşumunun ön koşulu olan triptofan sentezi için gereklidir (Marschner, 1995; Pedler ve ark., 2000). Bitkilerin Zn eksikliği yaşadığı bazı durumlarda protein sentezinin bozulması sonucunda yapraklarda triptofan artabilir. Çinko, membran fosfolipidlerine veya sülfidril bileşen gruplarına bağlanabilir veya sistein polipeptit zincirlerinin kalıntıları olan tetragonal bileşikler oluşturabilir ve böylece proteinler ve lipitler oksidasyon hasarına karşı korunur (Domingo ve ark., 1992; Marschner, 1995).

Çinko, metabolik ve fizyolojik süreçler, enzim aktivasyonu ve iyon dengesi gibi birçok önemli hücresel işlevde yer aldığı için bitkiler için önemli bir mikro besindir (Yang ve ark., 2020; Alsafran ve ark., 2022). Çinko aynı zamanda altı enzim sınıfının (liyazlar, transferazlar, hidrolazlar, izomerazlar, oksidoredüktazlar ve ligazlar) hepsinde 300'den fazla enzimin bir bileşeni olarak Zn önemli bir role sahip ve bu altı enzim sınıfının hepsinde bulunan tek elementtir. Çinko, temel veya katalitik bir enzim olarak çok sayıda proteinin aktivitesini, yapısal bütünlüğünü etkiler (Castillo-González ve ark., 2018; Zaheer ve ark., 2020).

Çinko, bazı enzimlerin ana yapı taşıdır ve bitki enzimlerinin oluşumu için gereklidir; ayrıca, Zn tarafından aktifleştirilen birçok enzimatik reaksiyon vardır (Vitosh ve ark., 1994; Pedler ve ark., 2000). Çinko, alkol dehidrogenaz, karbonik anhidraz ve süperoksit dismutaz çinko-bakır gibi enzimlerin çoğunda önemli bir rol oynar. Alkol dehidrogenaz enzimi, molekülünde iki Zn atomu vardır. Atomlardan biri katalitik, diğeri yapı rolü oynar. Alkol dehidrogenaz enzimi, asetaldehitin etanol rejenerasyonunda katalitik bir role sahiptir. Yüksek bitkilerde, etanol, aerobik koşullar altında kök ucu meristematik dokusunda üretilir, bitkilerde Zn eksikliğinde alkol dehidrogenaz enzimi azalır, bunun sonucunda kök gelişimi azalır (Marschner, 1995; Gokhan ve ark., 2003).

Karbonik anhidraz enzimi, karbondioksit (CO<sub>2</sub>) hidrasyonunu katalize eden bir Zn atomuna sahiptir. Enzim aktivitesinin yeri kloroplast ve sitoplazmadadır ve enzim aktivitesi bitkideki Zn değerine bağlıdır. Bu enzimin başlıca fonksiyonları; karbondioksitin susuzlaştırılması, yaprak alan birimi başına CO<sub>2</sub> emiliminin, fotosentez ve biyokütle üretiminin artırılmasıdır. Çinko eksikliği ile karşılaşan bitkilerde bu enzimin aktivitesi durur (Ohki, 1976; Dell ve Wilson, 1985).

Süperoksit dismutaz çinko-bakır enziminde, çinkonun katalitik, bakırın ise yapılandırıcı rol oynadığı düşünülmektedir. Süperoksit dismutaz aktivitesi Zn eksikliği koşullarında azalır ve bu durum aynı zamanda serbest radikallerin (süper oksit) artmasıyla ilişkilidir. Toksik bir madde olup, membranın lipid peroksidasyonu ve geçirgenliğinin artması nedeniyle bitki dokuları üzerinde zararlı bir etkiye sahiptir (Marschner, 1995).

Bitkiler tarafından Zn kökler vasıtasıyla toprak çözeltisinden, öncelikle Zn<sup>2+</sup> iyonları veya organik asit şelatlı kompleksler şeklinde alınır ve ksilem yoluyla bitkinin toprak üstü kısmına taşınır. Çinkonun topraktan köklere taşınması, çeltik (*Oryza sativa*), arpa (*Hordeum vulgare*) ve *Arabidopsis thaliana*'da tanımlanan ZIP ailesinden (Çinko Düzenleyici Taşıyıcı - Demir Düzenleyici Taşıyıcı Benzeri Protein) ağır metallerin protein taşıyıcıları tarafından gerçekleştirilir (Sturikova ve ark., 2018). Bu taşıyıcılar, merkezi silindirin hücrelerinde, plazma zarlarında ve vakuollerin tonoplastında bulunabilir. Çinkonun rizodermal ve korteks hücrelerinden ksileme taşınması, ağır metallerin özel protein taşıyıcıları tarafından aracılık edilir.

Bitkiler çinkoyu ayrıca yapraklar aracılığıyla alabilirler. Yapraklar aracılığıyla besin maddelerinin emilimi, mumsu koruyucu tabakanın kalınlığı, kütikülün kimyasal bileşimi ve yapısı, stoma ve trikomların yoğunluğu gibi yaprağın özelliklerinden etkilenir (Schonherr, 2006; Eichert ve Goldbach, 2008). Bitkinin sağlık durumu, nem, sıcaklık ve ışık gibi çevresel faktörler de aynı derecede önemlidir. Çinko uygulamasıyla bitkilerde verim artmakta, su noksanlığının zararlı etkileri azalmakta ve kuraklığa dayanıklılık artmaktadır (Yavaş ve ark., 2016). Ayrıca Zn bitkinin savunma mekanizmasını uyararak, bitkinin hastalıklara karşı dayanıklılığını arttırmaktadır. Nitekim Zn noksanlığında bitkilerin fungal ve bakteriyel hastalıklar daha kısa sürede yayılır (Küçükymuk ve Bayındır, 2023). Çinko gübrelemesinin yonca, buğday, mısır, arpa, asma, pamuk, patates ve yerfıstığı gibi birçok bitkinin büyümesi ve verimi üzerine etkisi çok sayıda araştırmada incelenmiş ve çinko uygulamasıyla verimde artış gözlenmiştir (Yağmur ve ark., 2002; Bukvić ve ark., 2003; Kinaci ve Kinaci, 2005; Shaheen ve ark., 2007; Mousavi ve ark., 2007; Erdem, 2011; Efe ve Yarpuz, 2011; Boydak ve ark., 2019).

#### **4. Tıbbi Bitkilerin Verim ve Kalitesine Çinkolu Gübrelerin Etkisi**

Çinko, bitkilerin önemli faaliyetlerinde rol oynayan, enzimlerin yapısında yer alan, bitkilerin büyümesini ve verimliliğini belirleyen bir mikro elementtir. Bitkiler ihtiyaç duydukları mikro besin elementlerini topraktan alırlar. Bu elementlerin biyoyararlılığı toprak özelliklerine bağlıdır. Özellikle çinkonun alımı, toprak özellikleri tarafından en fazla etkilenmektedir. Kireç içeriği, pH, metal oksitler, düşük organik madde, kil tipi ve miktarı

bitkilerin topraktan Zn alımını etkileyen faktörlerdir. Bundan dolayı, Zn seviyesinin düşük olduğu tarım topraklarında verimi artırmak ve sürdürülebilir tarım için çinkolu gübreler kullanılır. Çinko toprağa organik ve inorganik bileşikler olarak uygulanabilir. İnorganik çinko bileşikleri içerisinde suda çözünürlüğünün yüksek olması ve ucuz olması nedeniyle eksikliği görülen topraklarda en fazla çinko sülfat ( $ZnSO_4$ ) formu kullanılmaktadır.

Lamiaceae familyasından üç tıbbi bitkide (*Dracocephalum moldavica*, *Hyssopus officinalis* ve *Salvia officinalis*) yapılan Zn gübrelemesi sonucunda yaş herba, uçucu yağ ve flavanoidlerin arttığı gözlemlenmiştir (Hegazy ve ark., 2016). Sekonder metabolitlerin biyosentezinde genetik faktörler kadar aynı zamanda çevresel koşullarda güçlü bir şekilde etkilenir. Marschner (1995) çinkonun çeşitli enzimlerin metal bileşeni veya sakkarit metabolizması, fotosentez ve protein sentezi ile ilişkili işlevsel, yapısal veya düzenleyici bir yardımcı faktör olarak hareket eden temel bir mikro besin olduğunu bulmuştur. Karbondioksit ve glikoz, monoterpen biyosentezinin öncüleridir; sakkaritler ayrıca terpenoid sentezi için bir enerji ve indirgeyici güç kaynağıdır. Çinko, fotosentez ve sakkarit metabolizmasında yer aldığından,  $CO_2$  ve glikoz terpen biyosentezinde kullanılan en olası karbon kaynakları olduğundan, çinkonun uçucu yağ birikimini etkilemedeki rolü özellikle önemli görünmektedir.

Hindistan'ın tropikal ve subtropikal iklimlerinde çok çeşitli toprak tiplerinde, doğal mentol içeriği için yetiştirilen Japon nanesi (*Mentha arvensis* L.), uçucu yağ taşıyan aromatik bir bitkidir. Pande ve ark. (2007), yapılan çalışmaların birçoğunun Zn tepkisiyle ilgili olduğunu ancak nane (*Mentha* sp.) bitkisinin besin maddelerine olan gerçek gereksiniminin neredeyse hiç hesaplanmadığını bildirmişlerdir. Akut mikro besin eksikliği bulunan topraklarda yetiştirilen nane bitkisinde uçucu yağın verim ve kalitesinde Zn hayati bir rol oynayabilir. Mikro besin maddelerinin seviyesi, fotosentezde ve fotosentez ürünlerinin kullanımında olası rolleri nedeniyle uçucu yağ kalitesini etkiler; bu da muhtemelen monoterpenlerin sentezini, depolanmasını ve katabolizmasını kontrol eder (Loomis ve Croteau, 1980). Nitekim Farooqi ve ark. (1985) bir bitkinin tüm yağ içeriğinin yetiştirme ortamındaki mikro besin maddelerinin seviyesinden olumsuz etkilendiğini, ancak, bu seviyenin genotipe göre değişebileceğini rapor etmişlerdir.

Normal ve tuzlu topraklarda fesleğen (*Ocimum basilicum*) bitkisinin herba verimi ve uçucu yağ içeriği üzerine yapraklardan Zn uygulamasının etkisinin araştırıldığı çalışmada, taze ve kuru herba veriminin arttığı, ayrıca tuz stresi toleransını da arttırdığı belirlenmiştir (Said Al Ahl ve Mahmood, 2010). Çinko ve manganın (50 mg/L), tek başına ve kombine olarak uygulandığı çalışmada, kimyon (*Cuminum cyminum*) bitkilerinin büyümesi, uçucu yağ verimi ve bileşenleri üzerindeki etkileri incelenmiştir. Mikro besin uygulamalarının verim parametreleri ( $m^2$  de bitki sayısı,  $m^2$  de bitki ağırlığı, bitki başına dal sayısı, herba ve tohum verimi) ve uçucu yağın kimyasal bileşimi üzerinde olumlu etkileri olduğu ve kontrol konusuna göre artış gösterdiği gözlemlenmiştir (El-Sawi ve Mohamed, 2002).

Kuraklık stresinin, P ve Zn gübrelere Alman papatyasının (*Matricaria recutita* L.) fizyolojik özellikleri, verimi ve esansiyel yağ bileşenleri üzerindeki etkilerinin incelendiği çalışmada, kuraklık stresinin çalışılan tüm özellikler üzerinde, fosforlu gübre uygulamasının uçucu yağ yüzdesi, uçucu yağ verimi, kamazulen içeriği, b-farenzn, bisabolo oksit A ve bisabolo oksit B üzerinde ve Zn gübresinin uçucu yağ yüzdesi, uçucu yağ verimi ve kamazulen içeriği üzerinde önemli etkilerinin olduğu görülmüştür (Jeshni ve ark., 2017). Çinkonun kuraklık stresine karşı bitkinin korunmasında özel bir öneme sahip olduğu (Cakmak, 2009), N ve fosforun alım etkinliğini arttırdığı bilinmektedir.

Anason (*Pimpinella anisum* L.) üzerine yapılan bir çalışmada, yapraklardan Zn uygulamasının (0, % 0.1 ve % 0.2) uçucu yağ bileşenlerine ve kalitesine etkileri araştırılmıştır. Buna göre, anason meyvesi uçucu yağ bileşenlerinin kalitesinin ve miktarının düşük Zn seviyelerinin uygulanmasıyla önemli ölçüde değiştiği, anason meyvesinin polifenol içeriği ve

antioksidan aktivitesinin arttığı görülmüştür (Tavallali ve ark., 2017). Çinko gübresi, anason meyvesinin farmasötik ve gıda özelliklerini iyileştirmek için etkili bir yöntemdir.

Endemik bir tıbbi bitki olan *Satureja khuzistanica* Jamzad'ın verim, uçucu yağ oran ve kalitesinin iyileştirilmesi için bor ve çinkonun farklı konsantrasyonda yaprakтан uygulamalarının karşılaştırılması yapılmıştır. Yapraktan Zn uygulamalarında taze ve kuru ağırlıkları, tohum verimi, 1000 tohum ağırlığı ve tohum çimlenmesi kontrol bitkilerine kıyasla artış göstermiştir (Mumivand ve ark., 2021).

Çevresel stresler, özellikle tuzluluk, bitki büyümesini ve verimini azaltabilir. Ancak tuzun bitkilerdeki negatif etkilerini azaltmak için gübreleme iyi bir stratejidir. Nitekim Kavian ve ark (2022) yaptıkları çalışmada çinkonun bitki büyümesi ve tuz stresi koşullarında yetiştirilen *Aloe vera*'nın biyokimyasal tepkileri üzerindeki etkisini araştırmışlardır. Sodyum klorür seviyelerinin artmasıyla, yaprak taze ağırlığı, jel içeriği ve toplam klorofil içeriği önemli ölçüde azalmış; ancak, askorbat peroksidaz, peroksidaz, katalaz, süperoksit dismutaz ve prolin içeriği gibi antioksidan enzimlerin aktivitesi kontrolle kıyaslandığında artmıştır. Ancak, Zn gübresinin bitki büyümesini (yaprak taze ağırlığı ve % jel) ve bazı antioksidan enzim aktivitesini artırdığı gözlenmiştir. Tuzlu topraklarda yetiştirilen *Aloe vera*'da oksidatif stres hasarları Zn gübrelemesi ile azaltılabilir.

Azot ve Zn gübrelere birlikt kullanılması verimi yükseltirken, P ve Zn gübrelere birlikt kullanılması kimyasal özellikleri nedeniyle pratik olmadığını belirtmek gerekir. Çünkü hareketli Zn bileşikleri, topraktaki P bileşikleriyle reaksiyona girerek inaktif kompleksler oluşturur ve bu da çinkonun bitkiler tarafından kullanılabilirliğinin azalmasına neden olur. Maleki ve ark. (2014) kadife çiçeğine (*Calendula officinalis*) N ve çinkonun beraber uygulamalarının kuru madde, bitki başına çiçek sayısı, çiçek başına tane sayısı ve tane verimini önemli ölçüde artırdığını ifade etmişlerdir.

Safran (*Crocus sativus*) yetiştiriciliğinde bitki besin maddelerinin yönetimi önemli konulardan biridir. Çinko ve demirin tek başlarına ve beraber uygulandığı bir çalışmada, yalnız Zn yaprak uygulamasının çiçek sayısını (% 57.81), çiçeklerin taze ve kuru ağırlığını (sırasıyla, % 20.62 ve %80.97), stigmanın taze ve kuru ağırlığını (sırasıyla, % 44.22 ve % 65.27), krosini (% 6.88), pikrokrosini (% 11.39) ve safranalı (% 9.66) Fe ve Zn/Fe uygulamasına göre önemli derecede artırdığını saptamışlardır (Ayoubi ve ark., 2023). Safranda yapılan bir diğer çalışmada, ZnO formunda farklı boyut (normal ve nano gübre) ve oranlarda Zn uygulamalarının morfo-fizyolojik tepkilerini incelemişlerdir. Her iki ZnO türü de safran verimi ve çiçek sayısı üzerinde olumlu etkilere sahipken, normal ZnO gübresi nano ZnO'e göre safran verimi ve çiçek sayısını daha fazla artırmıştır (Rostami ve ark., 2019).

Çinko ile kişniş (*Coriandrum sativum* L.) bitkisinde yapılan bazı araştırmalarda, Zn dozlarının; bitki boyu ve dal sayısını (Tehlan ve ark., 2009; Mounika ve ark., 2017), bitki başına şemsiye sayısı, şemsiyecik sayısı, şemsiyede tohum sayısını, biyolojik verim, bin tane ağırlığı ve tohum verimini (Meena ve ark., 2017; Davara Monali ve ark., 2019; Özyazıcı, 2020) ve uçucu yağ oranını (Mounika ve ark., 2018; Bepari ve ark., 2020) arttırdığı rapor edilmiştir.

## 5. Sonuç

Çinko biyokimyasal süreçlerde aktif rol oynayan bir elementtir. Bitki metabolizmasında önemli işlevlere sahip olan Zn, tıbbi bitkilerde; taze ve kuru herba verimi ile tohum verimine, sekonder metabolit bileşimine, antioksidan aktivitelere önemli ve olumlu etkileri bulunmaktadır. Bu nedenle toprakta eksikliği görüldüğünde, temel gübrelemeye ek olarak çinkolu gübrelemenin de yapılması ve/veya toprakta yeterli miktarda Zn bulunmasına rağmen, toprağın diğer fraksiyonlarına bağlı olarak bitkiler tarafından alınmadığı durumlarda yaprak gübrelemesi yoluyla bitkilerin Zn eksikliğinin giderilmesi, tıbbi bitkilerde yüksek verim ve kalitede ürün elde edebilmek için büyük önem taşımaktadır.

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## ***PLANTAGO* sp.: YEM DEĞERİ ÜZERİNE KAPSAMLI BİR İNCELEME**

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### **Özet**

Hayvancılık işletmelerinin en önemli sorunlarından birisi, yetersiz yem miktarı ve düşük kalitede yem ile hayvan beslenmesidir. Bu sorun, doğal çayır mera alanlarındaki iklimsel ve antropolojik baskı nedeniyle daha da olumsuz yönde seyretmektedir. Bu anlamda, her türlü iklim ve toprak koşulları altında kendiliğinden yetişen *Plantago* türlerinin, yem kaynakları olarak değerlendirilebilme potansiyelleri bulunmaktadır. *Plantago* yaprakları otlayan hayvanlar için oldukça lezzetli olup, mineraller açısından zengin bir yem sağlar. Birçok bitki besin maddesi bakımından zengin olan *Plantago* türleri, düşük kaliteli otlara ve samanlara takviye olarak kullanılabilir. Dolayısıyla *Plantago* türleri geniş getiren hayvanların yem rasyonlarının önemli bir bileşeni olabilir. Bu derleme makalesi, *Plantago* türlerinin yem kalitesi kriterleri yönünden önemli parametrelerinin bir incelemesini sunmaktadır.

**Anahtar Kelimeler:** *Plantago lanceolata*, *Plantago major*, *Plantago ovata*, besin maddesi, ham protein

## ***PLANTAGO* sp.: A COMPREHENSIVE REVIEW ON FEED VALUE**

### **Abstract**

One of the most important problems of livestock enterprises is insufficient feed quantity and feeding animals with low quality feed. This problem is even more negative due to climatic and anthropological pressures in natural meadow and pasture areas. In this sense, *Plantago* species that grow spontaneously under all kinds of climate and soil conditions have the potential to be evaluated as feed sources. *Plantago* leaves are quite palatable for grazing animals and provide a feed rich in minerals. *Plantago* species, which are rich in many plant nutrients, can be used as a supplement to low quality grasses and straw. Therefore, *Plantago* species can be an important component of ruminant feed rations. This review article presents an examination of the important parameters of *Plantago* species in terms of feed quality criteria.

**Keywords:** *Plantago lanceolata*, *Plantago major*, *Plantago ovata*, nutrient, crude protein

## 1. Giriş

Günümüzde, gerek küresel iklim değişikliğine bağlı olarak gerekse yanlış kullanımlar sonucu çayır mera alanlarının verimliliklerinin azalması ve yem bitkileri tarımının yetersiz oluşu, hayvan beslenmesinde yem açığının artmasının başlıca sebepleri olarak gösterilmektedir. Sorunun çözüm yollarından biri de, yem kaynaklarının çeşitlendirilmesi ve/veya var olan kaynakların ortaya çıkarılmasıdır. Bu itibarla, yem açığının kapatılmasına yönelik olarak, alternatif kaba yem kaynaklarının araştırılması ve doğal vejetasyonda bulunan bazı yabancı bitkilerin hayvan beslenmesi amacıyla olası kullanımlarının ortaya konması ve bilinmesi önem taşımaktadır. Ilıman iklimlerdeki birçok doğal vejetasyonlarda iyi adaptasyon göstererek yaygın bir şekilde bulunan *Plantago* türleri, bu anlamda iyi bir aday bitkidir.

İnsan beslenmesinde de kullanılabileceği ileri sürülen *Plantago* türlerinin (Toussaint-Samat, 1991), tıbbi ve ekonomik kullanımları için de dünya genelinde yaygın olarak toplanmakta ve bu anlamda da birçok araştırmalara (Kartini ve ark., 2017; Eldesoky ve ark., 2018; Farcas ve ark., 2019) konu olmaktadır. *Plantago* türleri aynı zamanda, hayvanlar tarafından sevilerek tüketilen ve birçok mera alanlarının da önemli bitki gruplarını teşkil etmektedir. Bu derleme çalışmasında, *Plantago* türlerinin yem değeri olarak öneminin ortaya konması amaçlanmıştır.

## 2. *Plantago* Türlerinin Besleme Değeri

*Plantago* cinsi dünya genelinde, otlayan hayvanlar açısından yem olarak önemli bir rol oynayan yaklaşık 256 türden oluşmaktadır (Alghamdi, 2018). *Plantago* cinsi, Amerika, Asya, Afrika ve Avrupa dahil dünya çapında farklı vejetasyonlarda dağılıma sahip olan yıllık ve çok yıllık bitkilerden oluşmaktadır (Fons ve ark., 2008; Gonçalves ve ark., 2015). Bu cins içerisinde yer alan, örneğin *Plantago lanceolata* L., ılıman iklim çayırlarında geniş bir dağılıma sahip olan (Stewart, 1996), birçok merada doğal olarak bulunan ve Avrupa'da küçük bir yem bitkisi olarak uzun bir kullanım geçmişine sahip olan (Foster, 1988) bir türdür. *Plantago* cinsinin dünya genelinde bilinen ve tanınan diğer önemli üyelerini *Plantago major* L., *Plantago ovata* Forssk. ve *Plantago media* L. oluşturmaktadır.

Bir yem bitkisinin yem kalitesi denince onun besleme değeri akla gelir. Yem bitkilerinin besleme değerinin belirlenmesinde; ham protein (HP), ham yağ (HY), ham selülöz (HS), azotsuz öz maddeler, mineraller ve vitaminler gibi bitkilerin kimyasal kompozisyonları en önemli ölçütler içerisinde yer almaktadır. Birçok *Plantago* yaprakları otlayan hayvanlar için oldukça lezzetli olup, mineraller açısından da zengin bir yem sağlar.

*Plantago* türlerinin kimyasal yapısı üzerinde yapılan bir dizi çalışmada, örneğin; *P. major*'un C ve A vitamini içerikleri (Aliotta ve Pollio, 1981), yüksek miktardaki askorbik ve dehidroaskorbik asit kapsamı (Franke ve Kensbock, 1981), *P. major* ve *P. lanceolata* yapraklarının amino asit ve bazı mineral elementler yönünden durumu (Grandi ve ark., 1982) rapor edilmiştir. İspanya'nın güneydoğusundaki farklı yerlerden toplanan yabancı *P. major*, *P. lanceolata* ve *P. media* yapraklarının besin maddesi analizlerinde; 1.99 g (*P. media*) ile 2.81 g (*P. lanceolata*) (100 g taze ağırlık başına, 100 g f. wt.) arasında değişen düşük oranda kullanılabilir karbonhidrat, 33.5 mg (*P. media*) ile 88.2 mg (*P. lanceolata*) (100 g f. wt.) arasında değişen düşük miktarda oksalik asit (OA) tespit edilmiştir. Aynı çalışmada, *P. major*'un en yüksek C vitamini (45.1 mg/100g f. wt.) içeriğine sahip olduğu; türlerin sodyum (Na), potasyum (K), kalsiyum (Ca), magnezyum (Mg), fosfor (P), demir (Fe), bakır (Cu), çinko (Zn) ve mangan (Mn) içeriklerinin sırasıyla, 29.0-124, 318-440, 60-143, 49.3-95.3, 23.4-34.9, 1.54-2.62, 0.14-0.22, 0.41-0.97 ve 0.38-0.89 mg/100g f. wt. arasında değişkenlik gösterdiği; çoklu doymamış yağ asitlerinin [% 38.97 (*P. media*)-% 46.07 (*P. lanceolata*)] tüm türlerde yüksek bulunduğu; bazı minerallerin oranlarının (K/Na, Ca/P ve OA/Ca) genel olarak uygun düzeyde olduğu rapor edilmiştir (Guil-Guerrero, 2001). *Plantago major* ile yapılan başka bir çalışmada, Ca, Mg, K, Na ve kül içeriği sırasıyla; % 3.763, 0.484, 1.295, 0.099 ve 15.806 olarak

belirlenmiştir (Ştef ve ark., 2010). Bir diğer *Plantago* türü olan *P. ovata*'nın mineral analizlerinde Ca, Mg, P, K, Na ve kükürt (S) değerleri sırasıyla; 1500, 150, 140, 8500, 640 ve 23 µg/g olarak saptanmıştır (Guo ve ark., 2008). Qaisrani ve ark. (2014) tarafından aynı bitkide kül oranı % 3.85, HP oranı % 2.08, HY oranı % 0.09 ve HS oranı % 3.83 olarak rapor edilmiştir.

Suudi Arabistan'ın orta kuzeyindeki doğal floradan toplanan dört yerel *Plantago* türünün (*P. ciliata*, *P. lanceolata*, *P. ovata* ve *P. cylindrica*) besin değerinin incelendiği bir araştırmada, kuru ağırlığa göre; kül, HP, HY, ham lif ve karbonhidrat içeriklerinin sırasıyla %7.0-16.0, % 10.7-14.6, % 0.6-1.6, % 11.2-23.1 ve % 11.6-24.0 arasında değiştiği belirlenmiştir. Aynı çalışmada, asit deterjanda çözünmeyen lif (Acid Detergent Fiber, ADF) ve toplam sindirilebilir besin maddesi için kaydedilen değerlerin sırasıyla % 14.0-74.0 ve % 26.0-86.0; Ca ve P içeriklerinin sırasıyla 0.2-0.3 ve 0.1-0.2 mg/kg arasında değiştiği bildirilmiştir (Alghamdi, 2018).

Kuzeybatı Hindistan'da yetiştirilen *P. ovata* türünün dört farklı çeşidine ait tohumlarının besinsel analizlerinde; yağ oranı % 0.36-0.38, kül oranı % 4.29-5.00, protein oranı % 11.12-13.33, toplam karbonhidrat oranı % 74.75-77.88 ve ham lif içeriği % 26.21-29.37 arasında değişmiştir (Shah ve ark., 2020).

Kuru ve çorak arazilerde, yamaçlarda ve taşlı otlaklarda yetişen, Kuzey Afrika'nın güneyine doğru yarı çöl ortamlarına kadar dağılım gösteren *P. albicans* L. da yüksek yem değerine sahip bir bitkidir (Louhaichi ve ark., 2021). Güney Tunus'un kurak meralarında yaygın olarak bulunan *P. albicans* türünün mineral bileşimi, kuru maddede; 2106.4 mg/kg Fe, 21.5 mg/kg Zn, 10.8 mg/kg Cu, 54.8 mg/kg Mn, 0.8 g/kg Na, 28.6 g/kg Ca ve 4.3 g/kg Mg olarak karakterize edilmiştir (Louhaichi ve ark., 2021).

Çok yıllık çim ile karşılaştırıldığında *P. lanceolata*'nın daha düşük kuru madde, daha düşük yapısal lif ve daha yüksek yapısal olmayan lif, benzer HP içeriğine; ancak, daha az çözünür ve parçalanabilir azot (N) ve benzer sindirilebilirliğe sahip olduğu gösterilmiştir (Minnée ve ark., 2019).

Bazı *Plantago* türlerinin silaj bitkisi olarak da değerlendirilebilme potansiyeli bulunmaktadır. Bu amaca yönelik olarak *P. media*, *P. major* ve *P. lanceolata* türleri ile yapılan bir çalışmada; *P. lanceolata* ve *P. media* silajlarının yüksek kalitede silaj fermantasyonu sağladığı, silaj ortamında besin maddesi kompozisyonunun büyük oranda korunduğu, buna karşılık *P. major* silajının ise iyi bir silaj kalitesi sağlayamadığı belirlenmiştir (Kara ve ark., 2022).

*Plantago* türleri içerisinde yem olarak kullanılmak üzere *P. lanceolata* türüne ait iki çeşit geliştirilmiştir. Bunlar, Grasslands Lancelot (Anonymous, 1997) ve Ceres Tonic (Anonymous, 1996)'dir. Bu çeşitler, dik büyüme özelliği ve doğal olarak oluşan türlere göre daha büyük yaprakları ile ön plana çıkmıştır (Labreveux ve ark., 2006). Bu çeşitlerin yaprakları hayvanlar için son derece lezzetli olup, çok yıllık çim ve gazal boynuzu meralarıyla benzer bir sindirilebilirliğe sahiptirler (Fraser ve Rowarth, 1996; Stewart, 1996; Rumball ve ark., 1997). Lancelot çeşidinin kuru maddesindeki HP içeriği 144-216 g/kg iken, Tonic çeşidinin HP miktarı 131-219 g/kg olarak belirlenmiştir. Aynı çalışmada, çeşitlerin sırasıyla; nötral deterjanda çözünmeyen lif (Neutral Detergent Fiber, NDF) içeriği 284-406 ve 264-390 g/kg olarak saptanmış olup, Lancelot çeşidinde yaprağın gövde ağırlığına oranı Mayıs ayında 1.43-2.94, Ağustos ayında ise 10.0-11.1 olduğu tespit edilmiştir (Labreveux ve ark., 2006). Lancelot çeşidi ile mineral elementler yönünden yapılan analizlerinde, Lancelot yaprakları genel olarak, Na ve kobalt açısından İngiliz çimi ve ak üçgülünden daha yüksek; Ca, Cu ve Zn açısından üçgüle benzer, İngiliz çiminden daha yüksek; K ve Mn açısından ise her iki türden de biraz daha düşük olarak belirlenmiştir (Rumball ve ark., 1997).

*Plantago* türleri ile yapılan diğer bazı çalışmalarda da, örneğin; *P. ovata* tohumunun besin profili (Bukhsh ve ark., 2007; Sagar ve ark., 2020; Cowley ve ark., 2021) ve fiziko-kimyasal özellikleri (Shah ve ark., 2020), *P. maxima* Juss. ex Jacq., *P. major* ve *P. lanceolata*

türlerinin eser element içeriğinin karşılaştırmalı analizi (Tinkov ve ark., 2016) ortaya konmuştur.

### 3. *Plantago* Türlerinin Mera Bitkisi Olarak Önemi

*Plantago* türleri dünya genelinde çayır ve mera alanlarında ve yol kenarlarında yaygın olarak bulunmaktadır. Birçok *Plantago* türü; sert, geçirimsiz ve sığ topraklarda yetişebilmesi (Şekil 1), özellikle *P. lanceolata*'nın fosfor ve potasyum bakımından fakir topraklarda yaygın olması (Watson ve Nash, 1960; Kruijne ve ark., 1967) ve verimsiz ortamlara mükemmel adaptasyonu nedeniyle (Troelstra ve Brouwer, 1992) kıraç koşullara sahip doğal otlakların yaygın bir bileşenidir (Oloff ve Bakker, 1991). Otlatma şartları altında 2 ila 4 yıl boyunca varlığını sürdüren, kısa ömürlü ve çok yıllık bir bitki olarak kabul edilen *P. lanceolata* (Stewart ve Judson, 2019); mera alanlarında sık sık tohumlarını dökerek çoğalabilmesi (Derrick ve ark., 1993) nedeniyle, mera bitkisi olarak rekabet açısından da oldukça avantajlı bir bitki konumundadır.



Şekil 1. Doğal vejetasyonda *Plantago* türleri (Rize-Türkiye)

*Plantago* türleri birçok bitkilere göre lezzetliliği yüksektir. Bu nedenle, karışık meralarda sığır, koyun, geyik ve atlar tarafından çoğu baklagil ve buğdaygillerden önce seçici olarak otlanır (Archer, 1971; Clark ve Harris, 1985; Bhadresa, 1987). Özellikle çiçeklenmeden önceki gelişme devresinde yumuşak sap ve yaprak dokusuna sahip olması (Şekil 2) otlayan hayvanlar açısından lezzetliliği arttıran bir faktördür. Bu anlamda, birçok çiftçilik sisteminde mükemmel bir hayvan performansını destekleme kapasitesine sahiptir (Pinxterhuis ve ark., 2024). Çok yıllık çim ve ak üçgül meralarına kıyasla, *P. lanceolata* meralarının koyunlar için laktasyon dönemindeki faydaları arasında, artan süt üretimi (Kenyon ve ark., 2010) ve daha iyi kuzu canlı ağırlık kazanımları (Hutton ve ark., 2011; Kemp ve ark., 2013) yer alır.

Yeni Zelanda'da geliştirilen *P. lanceolata* çeşitleri (Grasslands Lancelot ve Ceres Tonic) (Stewart, 1996; Rumball ve ark., 1997), büyüme habitüslerine göre farklı otlatma sistemleri için düşünülmüş; daha yere yatık olarak büyüyen (yere kapanan) Lancelot çeşidi koyun otlatılan sistemleri için (Rumball ve ark., 1997), daha dik olan Ceres Tonic ise sığır sistemleri için (Pinxterhuis ve ark., 2024) uygun olduğu bildirilmiştir. *Plantago lanceolata*'nın vejetasyonda hızla yerleşmesi (Peri ve ark., 2000), yeminin mineral bakımından zengin olması, çeşitli sekonder metabolitleri içermesi, içerdiği bu biyolojik aktif bileşiklerin bazıları işkembe fonksiyonunu etkilemesi gibi (Stewart, 1996) değerli tarımsal özellikleri, bu türün Yeni Zelanda



ve Avustralya'nın birçok yerinde yaygın olarak kullanılan bir mera bitkisi haline gelmesini sağlamıştır (Moorhead ve ark., 2002). Yeni Zelanda'da uzun süredir ticari olarak kullanılan özellikle Tonic çeşidi besi hayvanları için başarılı bir yem bitkisi haline gelmiştir (Judson ve ark., 2018).



Şekil 2. Çiçeklenme öncesi *P. major* bitkisi (Rize-Türkiye)

Cranston ve ark. (2015), Yeni Zelanda'da hindiba (*Cichorium intybus*), *Plantago lanceolata*, çayır üçgülü (*Trifolium pratense*) ve ak üçgül (*T. repens*)'den oluşan bitki karışımlarının, hem koyun hem de sığır otlatmada yüksek kaliteli çok yıllık bir mera seçeneği olarak başarıyla kullanıldığını bildirmişlerdir. Bir başka çalışmada Moorhead ve ark. (2002), meralarda *P. lanceolata*'nın kuzularda yaz boyunca nispeten yüksek oranlarda canlı ağırlık artışını destekleyebildiğini ve karaciğerde Cu ve selenyum konsantrasyonlarını yükseltebildiğini ve bu nedenle kuzu otlatma sistemlerinde meralara önemli bir katkı sağlayabileceğini rapor etmişlerdir.

*Lolium perenne-Trifolium repens* meralarına % 17-28 oranında *P. lanceolata*'nın dahil edilmesi, süt ineklerinin süt üretimini koruduğu (Nguyen ve ark., 2024); *Lolium perenne* ile karşılaştırıldığında, üçgül (*T. repens*) ve bitki türlerini içeren yem karışımlarının (*Phleum pratense*, *Trifolium pratense*, *Cichorium intybus* ve *Plantago lanceolata*) otlatılması, sütün işlenebilirliğini olumsuz etkilemeden geç laktasyondaki süt ineklerinde süt verimini artırdığı ve süt yağ asidi profilini yararlı bir şekilde değiştirdiği (McCarthy ve ark., 2024) bildirilmiştir.

Bir başka çalışmada, *P. lanceolata*'nın kuzuların besi performansı ve işkembe fermantasyonu üzerine etkisinin İtalyan çimi (Gramineae familyası) ve korunga (Leguminosae familyası) yemleri ile benzer olduğu ve et kalitesi ve et raf ömrü kriterleri üzerine olumlu etkisi olduğu tespit edilmiştir. Aynı çalışmada kuzu eti üretimi için *P. lanceolata*'nın kuzu besi diyetine dahil edilebileceği rapor edilmiştir (Kara ve ark., 2024).

#### 4. Sonuç

*Plantago* türlerinin hayvanların beslenmesinde alternatif bir yem kaynağı olma potansiyeli bulunmaktadır. *Plantago* cinsine dahil bitkiler, önemli bazı buğdayil ve baklagil yem bitkilerine göre eşdeğer veya daha yüksek besin maddesi içeriğine sahiptir. Bu olgu, *Plantago* türlerini geniş getiren hayvanların yem rasyonlarının önemli bir bileşeni yapar. Bu nedenle *Plantago* türleri, birçok tarım sisteminde mükemmel bir şekilde hayvan performansını destekleyebilir. Bununla birlikte, *Plantago* türlerinin yem verimi ve yem kalitesini belirlemeye yönelik daha fazla çalışmaya ihtiyaç vardır.



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## FOSFORLU GÜBRELEMENİN BAKLAGİL YEM BİTKİLERİNDE ÖNEMİ

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### Özet

Tarla tarımı içerisinde yetiştirilen baklagil yem bitkileri hayvansal üretim faaliyetlerinde kaba yemin karşılandığı en önemli kaynakların başında gelmektedir. Çoğu baklagil yem bitkisi, proteinin en önemli kaynaklarından biri olup, bu yönüyle hayvan beslenmesinde yem rasyonlarının en önemli bileşenidir. Baklagil yem bitkileri aynı zamanda mineral ve vitaminlerce de zengin bir bitki grubudur. Bununla birlikte verim ve kimyasal kompozisyonları başta gübreleme olmak üzere uygulanan kültürel işlemlere göre önemli değişkenlikler gösterir. Bu anlamda fosforlu gübreler, baklagil yem bitkilerinin verim ve kalitesini arttıran en önemli besin maddesidir. Fosfor, baklagil yem bitkilerinde; birçok metabolik süreçte, biyolojik azot fiksasyonunda, yeterli sayıda ve büyüklükte nodül oluşumunda, abiyotik strese karşı toleransın gelişmesinde, çimlenmede, kök gelişimi ve nihayet yüksek verim ve kalitede ot eldesinde önemli rol oynamaktadır. Bu derleme çalışmasında, geniş araştırma aralıklarında farklı türlerle yapılan çok sayıda çalışmaları gözden geçirilerek, baklagil yem bitkilerinde fosforun ve fosforlu gübrelemenin önemi üzerine odaklanılmıştır.

**Anahtar Kelimeler:** Fosfor, biyolojik azot fiksasyonu, ham protein, asit deterjanda çözünmeyen lif, nötral deterjanda çözünmeyen lif

## IMPORTANCE OF PHOSPHORUS FERTILIZATION IN LEGUME FORAGE CROPS

### **Abstract**

Legume forage crops grown in field agriculture are among the most important sources of roughage in animal production activities. Most legume forage crops are one of the most important sources of protein and are the most important components of feed rations in animal nutrition. Legume forage crops are also a plant group rich in minerals and vitamins. However, their yield and chemical compositions show significant variations according to the applied cultural processes, especially fertilization. In this sense, phosphorus fertilizers are the most important nutrients that increase the yield and quality of legume forage crops. Phosphorus plays an important role in many metabolic processes, biological nitrogen fixation, formation of nodules in sufficient number and size, development of tolerance to abiotic stress, germination, root development and finally obtaining high yield and quality hay in legume forage crops. In this review study, numerous studies conducted with different species in wide research ranges are reviewed and the importance of phosphorus and phosphorus fertilization in legume forage crops is focused on.

**Keywords:** Phosphorus, biological nitrogen fixation, crude protein, acid detergent fiber, neutral detergent fiber

## 1. Giriş

Baklagil yem bitkileri, toprak verimliliğini ve sağlığını iyileştirme yetenekleri sayesinde sürdürülebilir tarımda önemli bir rol oynarlar. Sürdürülebilir tarımın önemli bileşeni olmalarında, baklagil yem bitkilerinin topraktaki bazı bakterilerle karşılıklı simbiyotik bir ilişki içinde olması ve bu sayede biyolojik azot (N) fiksasyonu yoluyla toprakların N miktarını arttırmaları veya iyileştirmeleri en büyük etkidir. Bununla birlikte, baklagillerin bu işlevleri en iyi bir şekilde yerine getirmek için, nodüllerde enerji dönüşümünde rol oynayan fosfor (P)'a ihtiyaç duyarlar (Mitran ve ark., 2018). Diğer yandan, yemlerin mineral ve besin bileşenlerinin içeriği, gübreleme rejimleri gibi çeşitli faktörlere bağlı olarak değişkenlik gösterir. Bu anlamda fosforlu gübreler baklagillerde öne çıkmaktadır. Fosfor, baklagil yem bitkilerinin; kök gelişimi ve biyokütle oluşumunun yanı sıra, besin alımı ve ot kalitesinde de önemli işlevlere sahiptir.

Bu derleme çalışması, hayvansal üretimde kaba yemin karşılanmasında rol oynayan ve sürdürülebilir tarımın önemli bir bileşeni olan baklagil yem bitkileri tarımında fosforun önemine vurgu yapmaktadır.

## 2. Tarımsal Üretimde Fosforun Önemi

Fosfor gıda güvenliği için önemli bir faktördür (Lott ve ark., 2011). Lott ve ark. (2011) fosforun dünya gıda güvenliği açısından önemini, bitki yaşamını sürdürmek için başka bir elementle değiştirilemeyen (Dessibourg, 2010) ve yenilenemeyen bir kaynak olan (Steen, 1998) önemli bir temel bitki besin maddesi olması ile açıklamaktadırlar. Dünyada her yıl kullanılan mineral fosforun çoğu gıda üretimi içindir; bu nedenle P gübresinin kullanımı, yüksek verimli gıda ürünleri için önemli bir uygulamadır (Lott ve ark., 2011). Ayrıca, dünya çapındaki toprakların önemli bir bölümünde P eksikliği bulunmaktadır; bu da, hem ürün verimliliğinde ciddi bir sınırlayıcı faktör hem de küresel gıda güvenliği için önemli bir risk teşkil etmektedir (Heuer ve ark., 2017).

Öte yandan, özellikle tarım topraklarında fosforlu gübrelerin -bilinçsiz kullanımına bağlı olarak- büyük oranda israf edilmesi ve bu nedenle özellikle çevresel boyutta zararlara sebep olması (Baker ve ark., 2015), ayrıca inorganik fosforlu gübrenin kaynağı olan kaya fosfat rezervlerinin sınırlı olması ve hızla tükenmesi (Cooper ve Carliell-Marquet, 2013), fosforun tarımsal alanda sürdürülebilir kullanımını gerektirmektedir (Baker ve ark., 2015). Mineral gübre üretmek için kullanılan fosfat kayası rezervlerinin tükenmesinin, aynı zamanda, gıda güvenliğini de tehdit ettiği ifade edilmiştir (Reijnders, 2014; Yu ve ark., 2022).

Bunun yanı sıra, düşük çözünürlüğü ve toprakta elverişli P miktarının düşük düzeyde bulunması (Amadou ve ark., 2021) da dikkate alındığında; fosfor, tarımsal ekosistemlerin verimliliği için sınırlayıcı bir besindir (Filippelli, 2008; Jarvie ve ark., 2019).

Diğer yandan, hayvansal üretimin en önemli girdisi ve bileşeni durumundaki kaba yemlerin, yüksek verimli ve kaliteli olması esastır. Bu da, birçok çevresel ve bitkisel faktörlerin yanında, kaba yemlerin üretimi sırasındaki uygulanan kültürel işlemlere de bağlıdır. Bu uygulamaların başında da gübreleme gelmektedir. Bu anlamda, özellikle baklagil yem bitkilerinin verim ve kalitesinde fosforlu gübreler önemli rol oynamaktadır.

Bu nedenlerle günümüzde, tarımsal ekosistemlerde sürdürülebilir P yönetimi her açıdan bir zorunluluktur.

## 3. Toprakta Fosfor ve Bitkiler Tarafından Fosfor Alımını Etkileyen Faktörler

Fosfor "küresel" elementlerden biri değildir; N gibi atmosfere girmez; asit yağmuruyla kükürt (S) gibi yayılmaz; suda çözünürlüğü düşüktür; toprakta P hareketsizdir; P içeren kirleticiler deşarj edildikçe fosforun sadece yavaş ve istikrarlı bir şekilde aşağı doğru hareketi söz konusudur (Tiessen, 2008). Normal bitki büyümesi ve metabolizması için önemli olmasına rağmen, P en az erişilebilir besinlerden biridir (Balemi ve Negisho, 2012). Fosfor, toprak parçacıkları tarafından güçlü bir şekilde emilmesi ve bitkiler için kullanılabilirliğini sınırlaması

nedeniyle hem doğal hem de tarımsal ekosistemlerde sınırlayıcı bir besindir (Fan ve ark., 2020; Hou ve ark., 2020). Bu nedenle, fosforun baklagil yem bitkilerindeki etkilerini anlamak için bitkiler tarafından fosforun alımını etkileyen temel faktörleri gözden geçirmek faydalıdır.

Fosfor, bitki kökleri tarafından toprak çözeltisinden esas olarak ortofosfat iyonları (primer ortofosfat,  $H_2PO_4^-$ ) ve daha az ölçüde  $HPO_4^{2-}$  (sekonder ortofosfat) olarak alınır (Edward Johnston ve ark., 2014). Bu iyonların absorpsiyon miktarında, bitki kök ortamındaki pH seviyesi etkilidir; genel olarak bitkiler, asit reaksiyonlu ortamda  $H_2PO_4^-$ , alkali ortamda ise  $HPO_4^{2-}$  iyonunu daha fazla alır (Kacar, 2012). Kök tüyünden ve kök ucundan geçerek kök içerisine giren inorganik fosfor bileşikleri ( $P_i$ ), köklerde depo edilir veya bitkinin üst organlarına taşınır. Bitki hücresindeki bu  $P_i$ , çeşitli metabolik olaylardan sonra enzimler, nükleik asitler ve proteinler gibi çeşitli organik bileşiklerin yapısında yer alarak bitkiler tarafından değerlendirilir (Kacar, 2012).

Toprakta, toplam P miktarı yüksek olabilir; burada önemli olan, bitkiler tarafından yararlanılan P yani toprağın alınabilir P kapsamıdır. Bir başka ifade ile alınabilir P miktarı, toprak çözeltisinde çözülmüş şekilde bulunan P miktarıdır; ve, bitki bu çözülmüş haldeki fosfordan yararlanır (Kacar, 2012).

Toprakta P, inorganik ( $P_i$ ) ve organik ( $P_o$ ) olmak üzere çeşitli kimyasal formlarda bulunur. İnorganik P genellikle topraktaki toplam fosforun % 35-70'ini oluşturur (Shen ve ark., 2011). Bitkiler tarafından kullanılan form olan  $P_i$ , çözünmez ve topraklarda yavaşça yayılır (Paz-Ares ve ark., 2022). Gübreleme yoluyla toprağa uygulandıktan sonra, toprak pH'sına bağlı olarak,  $P_i$  kolayca demir (Fe) ve alüminyum (Al) oksitleri ve hidroksitleri tarafından emilir veya kalsiyum (Ca) fosfatlar olarak çöker; böylece, toprak çözeltisinde düşük P konsantrasyonu ve dolayısıyla bitkilerde fosforun düşük absorpsiyon ve kullanım verimliliği ile sonuçlanır (Hinsinger, 2001; Johnston ve ark., 2014; Simpson ve ark., 2015). Bu durum, tarım arazilerinde ve ekosistemlerde P eksikliğine yol açar (Khan ve ark., 2023).

Organik fosfor ise, topraklardaki toplam P havuzunun önemli bir bölümünü temsil eder (Amadou ve ark., 2022). Toprakların ana bileşenleri olan, Fe ve Al oksihidroksitler gibi toprak mineralleri ve kil mineralleri (örneğin; kaolinit, montmorillonit) (Xu ve Arai, 2022), yüksek P adsorpsiyon kapasitelerine sahip olmaları (Bortoluzzi ve ark., 2015; Xu ve ark., 2021) nedeniyle topraklarda % 5-10 kadar düşük bir organik P kullanım verimliliğine neden olabilmektedir (He ve ark., 1994). Bu durum, tarımsal ekosistemlerde organik P kaynaklarını yetersiz kılmaktadır (Suliman ve Mühling, 2021).

Bitkiler için fosforun kullanılabilirliği, sorpsiyon/desorpsiyon, çökme/çözünme, immobilizasyon (bitkiler ve mikroorganizmalar tarafından alınması) ve mineralizasyon (kalıntıların ayrışması) gibi biyolojik süreçler de dâhil olmak üzere çeşitli fiziksel ve kimyasal reaksiyonlar tarafından kontrol edilir (Tiessen, 2008). Bu anlamda toprak-bitki interaksyonu önem taşımaktadır.

Fosfor, topraktaki en hareketsiz makro besin maddelerinden biridir; bitki beslenmesi için fosforun yararı, P kaynaklarının bitki köklerine ulaşılabilirlik derecesine bağlıdır (Mendoza ve ark., 2009). Fosforun bitki köklerine ulaşılabilirliğini kontrol eden en önemli faktörlerden biri, toprak çözeltisindeki P konsantrasyonu ve toprağın P tamponlama kapasitesidir (Edward Johnston ve ark., 2014).

Bitki gelişme ortamında, yeterli seviyede P bulunsa bile; kuraklık, nem ve sıcaklık gibi bazı stres faktörleri de P alımını etkiler. Genel olarak düşük sıcaklıkta bitkinin daha az P aldığı söylenebilir. Ayrıca, toprakta tarla kapasitesindeki su düzeyinde P alımı en fazla olmaktadır (Kacar, 2012).

Genel olarak tropikal ve yağışın bol olduğu topraklarda yüksek seviyelerde Fe ve Al oksitler bulunur; bu da, düşük toprak pH'ı ile birlikte topraktaki alınabilir fosforun miktarını düşürür (Novais ve Smyth, 1999). Bu topraklarda P, genellikle kimyasal çökme veya fiziksel adsorpsiyon yoluyla Fe ve Al oksit ve hidroksitlere bağlanır (Kochian ve ark., 2004).

Öte yandan, düşük P çözünürlüğü ve desorpsiyonu nedeniyle, optimum P gübrelenmesi altında bile bitki alımı için toprak çözeltisinde sadece küçük bir oranda fosfat iyonu bulunur; bu nedenle, P gübresi geri kazanımı diğer besin içeren gübrelere kıyasla daha düşüktür (Holford, 1997). Bu anlamda, bağlı P kaynaklarından fosforu açığa çıkarıp absorbe eden ve/veya absorbe edilen fosforu etkili bir şekilde kullanabilen iyileştirilmiş kök özelliklerine sahip genotiplerin/çeşitlerin kullanımı da, P gübrelenmesinin verimliliğini artırmak için son derece önemlidir (Balemi ve Negisho, 2012). Bir başka ifade ile fosfordan yararlanma bakımından, farklı bitki genotipleri arasında önemli değişkenlikler bulunmaktadır. Bu nedenle, yeterli düzeyde bitki besin maddesi içermeyen topraklarda uygun genotiplerin yetiştirilmesi kimyasal gübre kullanımının azaltılmasında önemli rol oynamaktadır (Kacar, 2012).

Özetle, fosforun bitkiler tarafından alınması; P ve diğer besin elementlerinin konsantrasyonları ve besin elementleri arasındaki etkileşim, pH, sıcaklık, ışık, toprak havalanması, toprağın nem içeriği, bitki köklerinin özelliği ve yapısı gibi faktörler etkili olmaktadır.

#### 4. Bitkilerde Fosforun Rolü

Fosfor, fosfolipitler, nükleotidler ve nükleik asitler, adenozin trifosfat (ATP) ve şeker fosfatlar gibi önemli biyomoleküllerin temel bir bileşenidir; ve, tüm yaşam formları için temel bir yapı taşı görevi görür (Aziz ve ark., 2014; He ve ark., 2020; Shi ve ark., 2022). Fosfor, besin alımı ve taşınmasında rol oynayan enzimlerin sentezi ve aktivasyonu için gereklidir; eksikliği, besin dengesizliklerine ve toksisite semptomlarına yol açabilir (Khan ve ark., 2023). Fosfor aynı zamanda, şekerin nişasta ve selüloza dönüştürülmesi gibi metabolik süreçlerde (El-Habbasha ve ark., 2007); yaprak fotosentez ürünlerinin taşınması gibi bitki büyüme ve gelişme sürecinde (Nasar ve ark., 2021); yaprakların fotosentetik verimliliği ve klorofil içeriğini iyileştirmede (Xia ve ark., 2023); enerji transferi, karbonhidrat kullanımı, kök sisteminin büyümesi, yaprak genişlemesi, yeterli nodülasyon ve etkili biyolojik N fiksasyonunda (Cihacek, 1993; Troicelli ve ark., 2006; Malhi ve Goerzen, 2010) önemli bir rol oynar. Açıkça fosfor, çok sayıda metabolik süreç için gereklidir.

Fosfor, rizobiyum bakterilerinin atmosferik azotu (N<sub>2</sub>) bitkiler tarafından kullanılabilen bir amonyum (NH<sub>4</sub>) formuna dönüştürmesi için gerekli bir bileşendir (Al-Kahtani ve ark., 2017). Baklagil yem bitkileri, biyolojik N fiksasyonunda yüksek enerjiye gereksinim duyarlar. Bu enerji, birer enerji taşıyan molekül olan ATP tarafından sağlanır. Bu nedenle baklagil bitkileri, genellikle ATP sentezi için yüksek P talebi gösterir (Broughton, 1983; Chen ve ark., 2023). Ayrıca P, bitkilerde enerji kaynağı olarak bu temel işlevleri aracılığıyla nodül gelişimini etkiler (Al-Kahtani ve ark., 2017). Dolayısıyla P, baklagil yem bitkilerinde toprak üstü ve toprak altı aksamalarının gelişmesini hızlandırarak biyolojik N fiksasyonunu artırır. Köklerde hem daha kısa sürede nodül oluşumunu sağlar hem de nodül sayısını ve büyüklüğünü artırır. Ayrıca, toprakta alınabilir P miktarının yeterli düzeyde olması, kök bölgesinde rizobiyum bakterilerinin yoğunluğunda da etkili olur (Kacar, 2012).

Fosfor, bitkilerde fizyolojik tepkileri düzenlemesinin yanı sıra; ısı, tuzluluk, kuraklık, su basması, yüksek karbondioksit (CO<sub>2</sub>) ve ağır metal toksisitesi gibi abiyotik stres toleransını artırmada da temel bir rol oynar (Lambers, 2022; Hawkesford ve ark., 2023).

Fosfor, bitki tohumlarının çimlenmesinde rol oynayan tohumdaki fitin maddesinin yapı taşıdır. Fitin, bitkilerde bulunan önemli bir fosforlu organik bileşiktir. Yeterli düzeyde fosforun bulunmaması durumunda tohum büyüklüğü, tohum sayısı ve çimlenme gücü olumsuz etkilenir (Kacar, 2012).

Fosfor bitkilerde kök gelişmesi üzerine olumlu etki yapar. Kök sistemi iyi gelişen bitkilerin, toprağın farklı katmanlarındaki bitki besin maddelerinden yararlanmaları ve aynı zamanda besin elementlerinin alımı da artar (Kacar, 2012). Yetersiz P, bitkiler tarafından N, potasyum (K) ve Ca gibi diğer besin maddelerinin alımını etkiler (Tariq ve ark., 2023).



Büyümenin ilk dönemlerinde P eksikliği yaprak çıkışını geciktirebilir, yaprak gelişimini azaltabilir; bu da, verimde düşümlere neden olabilir (Momen ve ark., 2020). Ayrıca, P gübrelemesinin farklı formları ve oranları, toprak pH'sını deęiřtirebilir; böylece, çeřitli elementlerin bulunabilirliğini ve bitkiye taşınmasını etkileyebilir (Osztoics ve ark., 2005).

Bitkilerde kök ve gövde gelişmesine olumlu etki yapmasının sonucu olarak P, bitki dokularının daha güçlü olmasını sağlar; bu da, bitkinin hastalık ve zararlılara karşı dayanıklılığını artırır ve dolayısıyla yüksek ve kaliteli ürün elde edilmesini sağlar (Kacar, 2012).

## **5. Baklagil Yem Bitkilerinin Ot Verimi ve Kalitesine Fosforlu Gübrelerin Etkisi**

Fosfor, bitkilerin büyümesini ve verimliliğini belirleyen temel bir elementtir. Tarım topraklarında P, gerek toprakların fiziksel, kimyasal ve biyolojik özelliklerine baęlı olarak bitkiler için elverişsiz formda olması gerekse kültür bitkileri tarafından vejetasyon periyodu veya gelişme dönemi boyunca topraktan kaldırılması sonucu, genel olarak az veya çok az düzeydedir. Bu nedenle, alınabilir P seviyesinin düşük veya yetersiz olduęu tarım topraklarında verimi korumak için kimyasal P gübreleri uygulanır.

Fosfor, özellikle baklagiller için önemli bir besin maddesidir (Fouda, 2017; Kumar ve ark., 2019). Baklagil yem bitkileri biyolojik N fiksasyonu sayesinde N ihtiyaçlarını karşılayabildiğinden fosforlu gübrelemeye iyi tepki verirler (Fayetörbay ve ark., 2014). Bir başka ifade ile baklagil yem bitkilerinde biyolojik N fiksasyonu nedeniyle N yönünden bitkilerin büyümesi kısıtlanmayabilir; buna karşılık P, düşük hareketliliği ve biyoyararlılığı nedeniyle bitki büyümesini dięer elementlerden daha fazla kısıtlar.

Yem bitkilerinde yüksek ot verimi olduęu kadar, aynı zamanda kaliteli kaba yemin elde edilmesi de önemlidir. Her iki parametre de gübreleme ile son derece önemli deęişkenlikler gösterir.

### **5.1. Yonca (*Medicago sativa* L.)'nın gelişimi üzerine fosforlu gübrelerin etkisi**

Yüksek verim potansiyeli, protein içeriği ve lezzetliliği nedeniyle dięer birçok baklagil yem bitkilerine göre tercih edilen (Mullen ve ark., 2000) ve toprak yapısını iyileştirmede, toprak verimliliğini artırmada ve hayvanlar için yüksek kaliteli yem sağlamada önemli rol oynayan (Xu ve ark., 2024) yonca (*Medicago sativa* L.); aynı zamanda, besin maddelerince zengin verimli toprakları sever. Besin maddelerinin sınırlı olduęu topraklarda yoncanın yem verimi ve kalitesi genellikle düşüktür. Yonca topraktan büyük miktarda besin maddesi uzaklaştırır (Al-Kahtani ve ark., 2017). Bu anlamda özellikle P, yonca tarımında önem taşıyan bir bitki besin elementidir. Nitekim yonca, 1 ton/ha biyokütle üretimi için topraktan 15 kg/ha P uzaklařtırmaktadır; bu nedenle yonca, yüksek P gereksinimine ihtiyacı olan bir bitkidir (Feng ve ark., 2014; Du ve ark., 2024). Makro besin maddesi olarak P, yoncanın büyümesini ve gelişimini etkiler (de Campos Bernardi ve de Oliveira, 2021); P eksikliği olan toprak, genellikle yonca ürün verimliliğini tehdit eder ve/veya azaltır (Berg ve ark., 2005; Hakl ve ark., 2016). Bu nedenle, yoncanın tesisi ve devamlılığı, uzun ömürlülüğü ve üretimi, düşük P seviyesine sahip topraklarda, fosfat gübrelemesine doğrudan baęlıdır (Sarmiento ve ark., 2001). Li ve ark. (1998), düşük düzeyde P konsantrasyonlarıyla yetişen yoncada genellikle yüksek kök niřastası ve kök proteini konsantrasyonlarının bulunduğunu; ancak, bitkiler biçildikten sonra bu organik rezervleri kullanamadığını ve hızla yeniden büyümediğini ifade etmişlerdir. Bunun yanı sıra yonca, düşük pH (Rechcięl ve ark., 1988) ve P mevcudiyetinde (Moir ve ark., 2016) yaygın olan Al ve manganez (Mn) (Toma ve ark., 1999) toksisitelerine karşı çok hassastır (Khu ve ark., 2012; Bouray ve ark., 2020). Bu nedenle yonca tarımında fosforlu gübreleme çok önemli bir kültürel işlemdir.

Yonca (*M. sativa*) ile yapılan bir arařtırmada, P dozlarına (0, 5, 10 ve 15 kg/da) göre kuru ot ve ham protein (HP) veriminin artış gösterdiği, buna karşılık HP oranı yönünden dozlar

arasındaki deęişkenlięin önemsiz olduęu bildirilmiřtir (Serin ve ark., 2005). Farklı ekolojide yapılan başka bir arařtırmada ise P dozları arttıka yoncada bitki boyu ve kuru ot veriminin yanı sıra, HP oranı ve HP veriminin de arttıęı rapor edilmiřtir (Türk ve ark., 2018). Yonca ile P yönünden fakir toprakta yapılan bir dięer arařtırmada ise, fosforlu gübre uygulamaları ile kuru madde (KM) verimi ve bitki sıklıęı önemli ölçüde artmış; bitki boyu ve ot kalite parametreleri [HP, asit deterjanda çözünmeyen lif (Acid Detergent Fiber, ADF) ve nötral deterjanda çözünmeyen lif (Neutral Detergent Fiber, NDF) oranları] ise yapılan uygulamadan etkilenmemiřtir (Kharazmi ve Tan, 2020). Yonca ile yapılan dięer birçok arařtırma raporlarında, fosforlu gübre uygulamalarının; köklerde kısa sürede nodül oluşumu sağladıęı (Armstrong, 1988), nodül kuru aęırlıęını ve nodül N içerięini (Armstrong, 1988), tohum verimini (Çelik, 1985; Al-Kahtani ve ark., 2017), toprak üstü kısmının KM üretimini, HP verimini ve makro element içerięini [P, K, Ca, magnezyum (Mg) ve S] (Carneiro ve ark., 2009), gövde ve yapraklarının taze ve kuru aęırlıęını (Madani ve ark., 2014), yeřil ve kuru ot verimi ile su kullanım etkinlięini (Gawad ve ark., 2018), besin maddelerinin absorpsiyon verimlilięini (Kong ve ark., 2020), verim ve bazı kalite parametrelerini (Erkovan ve ark., 2022; Li ve Liu, 2024; Massaliyev ve ark., 2024) önemli ölçüde etkiledięi ve/veya arttırdıęı bildirilmiřtir.

Fosforun, yonca bitkilerindeki dięer bazı işlevleri arasında; enerji depolama ve transferi (ADP ve ATP gibi), tohum oluşumu, Ca ve Mg fitat, kök büyümesi, hızlı ürün oluşumu, erken olgunlaşma ve daha hızlı iyileşme yer alır (Berg ve ark., 2005). Fosforlu gübreleme, enerji transferi için hayati önem taşımakta; kök gelişimini iyileřtirerek ve topraktaki temel besin maddelerinin alınabilirlięini artırarak yoncanın büyümesini ve verimlilięini önemli ölçüde iyileřtirebilmektedir.

## **5.2. Korunga (*Onobrychis sativa* L.)'nın gelişimi üzerine fosforlu gübrelerin etkisi**

Türkiye için önemli bir baklagil yem bitkisi olan korunga (*Onobrychis sativa* L.) yeminin besin içerięi, hayvan beslenmesinde önemli bir rol oynar (Turk ve ark., 2011). Yemin besin deęerini etkileyen faktörler içerisinde yer alan P gübrelemesi, korunga otunun kimyasal kompozisyonunda ve elde edilen ot miktarında rol oynayabilir. Korunga bitkisi ile sınırlı sayıda yapılan bazı çalışmalarda; *O. viciifolia* L.'da 3.9 kg/da P uygulamasının bitki boyunu, yeřil ve kuru ot verimini önemli ölçüde arttırdıęı (Tufenkci ve ark., 2006); *O. sativa*'da P uygulamalarının KM verimini, HP, N, P, Ca ve Mg içeriklerini artırırken, K, tetani [K/(Ca + Mg)], ADF ve NDF oranını azalttıęı (Turk ve ark., 2011) rapor edilmiřtir.

## **5.3. Üçgül (*Trifolium* L.) türlerinin gelişimi üzerine fosforlu gübrelerin etkisi**

Bir dięer baklagil yem bitkisi cinsini temsil eden üçgül (*Trifolium* L.) türleri için de P önemli bir makro besin maddesidir. Çayır üçgülü (*T. pratense* L.) ile yapılan çalışmalarda, fosforlu gübre uygulamaları; tohum verimini (Çomaklı, 1990; Manga ve ark., 1995), bin tane aęırlıęı ve tohumun çimlenme gücünü (Manga ve ark., 1995), sap verimini (Çomaklı, 1990), kuru ot ve HP verimi ile otun HP oranını (Özyazıcı ve Manga, 1996) önemli düzeyde arttırmıřtır. Buna karşılık Çomaklı (1990), ana saptaki kömeç sayısının, kömeçteki tohum sayısının ve tohumların bin tane aęırlıklarının P dozlarından etkilenmedięini bildirmiřtir. Acar ve ark. (1996), çayır üçgülünde P dozunun artışına paralel olarak çinko (Zn) dışında dięer mineral ve iz elementlerinde belirgin bir deęişimin görülmedięini, Zn miktarında azalmanın olduęunu rapor etmişlerdir. Çayır üçgülü ile yapılan dięer bazı çalışmalarda, fosforun; N fiksasyon parametreleri üzerinde (Hellsten ve Huss-Danell, 2000), bazı eser element konsantrasyonlarının deęişkenlięinde (Osztóics ve ark., 2005), bitkide molibden konsantrasyonlarının yeterli düzeyde olmasında (Ribera ve ark., 2010) ve izoflavon içerięinin yüksek olmasında (Du ve ark., 2013) önemli etkilere sahip olduęu bildirilmiřtir.

Hem ot üretimi amacıyla kullanılan hem de mera karışımlarının önemli bir türü olan ak üçgül (*T. repens* L.)'de P, ot veriminde ve kuru otun kalitesinde önemli rol oynamaktadır. Farklı

lokasyonlarda (Çarşamba ve Kavak-Samsun) yapılan bir çalışmada, P dozlarının ak üçgülün özellikle yaş ot veriminde önemli artışlar sağladığı, P dozlarının artışına paralel olarak kuru otun HP oranının arttığı rapor edilmiştir (Acar ve Önal Aşçı, 2006). Ayrıca, ak üçgülde fosforlu gübreleme; bitki tarafından selenyumun farklı şekilde alınmasında etkili olmakta (de la Luz Mora ve ark., 2008), tohumun çimlenme gücünü arttırmaktadır (Acar ve Önal Aşçı, 2011).

Hayvan besleme için mevcut en değerli yemlerden biri olan İskenderiye üçgülü (*T. alexandrinum* L.), daha iyi nodülasyon için yeterli miktarda serbest formda fosfora ihtiyaç duyar; bu da, bitki köklerinde daha fazla N fiksasyonu ile sonuçlanabilir (Kumawat ve Khinchi, 2017). *Trifolium* yetiştiriciliği için kullanılan tarım topraklarının çoğunda yeterli P bulunmadığını ve bu anlamda üçgül tarımında fosforlu gübrenin önemini vurgulayan Ansari ve Ghadimi (2015), fosforlu gübrelerin İskenderiye üçgülünün kuru ot verimi, HP oranı ve sindirilebilir protein içeriğini etkilemediğini; ancak, yeşil ot verimi, HP verimi ve ham lif içeriği üzerinde anlamlı etkilerinin söz konusu olduğunu rapor etmişlerdir. İskenderiye üçgülü (*T. alexandrinum*)'nde, yüksek P dozunda (12 kg/da); HP oranı, kuru madde alımı (KMA), kuru madde tüketimi (KMT), nispi yem değeri (NYD) ve laktasyon için net enerji değerlerinin en yüksek değerlere ulaştığı belirlenmiştir (Arif ve ark., 2022).

Çayır mera sistemlerine dahil edilerek (Howieson ve ark., 2000), hem ot miktarı hem de ot kalitesinde önemli iyileştirmeler sağlayan (Dear ve Virgona, 1996) tek yıllık bir baklagil yem bitkisi olan yer altı üçgülü (*T. subterraneum* L.)'nün harici P gereksinimi (yani, maksimum verime yakın verime ulaşmak için gereken P miktarı), yetiştirildiği ılıman iklim ot türlerine kıyasla nispeten yüksektir (Haling ve ark., 2016; Sandral ve ark., 2019). Yer altı üçgülü (*T. subterraneum* L.) ile yapılan çalışmada, fosforun; rizobiyal büyüme ya da nodül oluşumu ve fonksiyonu üzerindeki etkilerinden ziyade, konukçu bitki büyümesini uyararak bitkide N fiksasyonunu artırdığı sonucuna varılmıştır (Robson ve ark., 1981). Yeraltı üçgülünde yapılan bir başka çalışmada ise, fosforlu gübrelemenin kontrole göre, kök ve sürgün kuru maddesini arttırdığı belirlenmiştir (Jeffery ve ark., 2017). Stefanou ve ark. (2016), çiçeklenme ve meyve bağlama dönemlerindeki P kullanım verimliliği dikkate alındığında, *T. subterraneum*'da yem verimini artırmak için fosforlu gübrelemenin önemli olduğuna dikkat çekmektedir.

Dünyanın ılıman bölgelerinde yetiştirilen, N bağlayıcı özelliği nedeniyle hayvan yemi, toprak iyileştirme ve bozulmuş arazilerin ıslahı için büyük önem taşıyan İran üçgülü (*T. resupinatum* L.)'nde (Moradi-Ghahderijani ve ark., 2024) de fosforlu gübreleme etkili olan bir kültürel işlemdir. İran üçgülü (*T. resupinatum*) ile yapılan silajda, silaj KM verimi, pH, HP, ADF, NDF, P, Mg, sindirilebilir kuru madde (SKM), KMA, NYD, toplam sindirilebilir besin maddeleri (TSBM), net enerji kazancı ve Flieg puanı P dozlarından önemli ölçüde etkilenmiştir (Ates ve Tenikecier, 2022).

#### **5.4. Fiğ (*Vicia* L.) türlerinin gelişimi üzerine fosforlu gübrelerin etkisi**

Fiğ cinsinin en çok tanınan ve yetiştirilen türü olan yaygın fiğ (*Vicia sativa* L.) bitkisiyle Sürmen ve ark. (2011) tarafından yapılan çalışmada, P uygulamalarının (0, 3, 6, 9 ve 12 kg/da P<sub>2</sub>O<sub>5</sub>); TSBM, NYD, KM verimi, N ve P içeriğini artırdığı, buna karşılık K, ADF ve NDF değerlerini azalttığı bildirilmiştir. Yaygın fiğde benzer P dozları ile yapılan bir diğer çalışmada da, P dozlarının ot verimi ve kalitesini önemli düzeyde etkilediği, P dozları arttıkça KM veriminin, TSBM, NYD ve HP oranlarının arttığı, ADF ve NDF oranlarının ise azaldığı (Yıldız ve Türk, 2015); P oranlarının HP verimi, KMA, SKM, tohum verimi ve bin tohum ağırlığını arttırdığı (Türk ve Yıldız, 2016) belirlenmiştir. *Vicia sativa* ile yapılan diğer bazı çalışmalarda da P uygulamasıyla tane verimi ve bazı verim bileşenlerinin (Türk ve Tawaha, 2001), bitki boyu, yaprak uzunluğu, yaprak/sap oranının, yeşil ot, KM ve tohum veriminin (Gurmani ve ark., 2006), nodülasyon ve kök KM miktarının (Dzoma ve ark., 2019) önemli ölçüde arttığı rapor edilmiştir.

Macar fiği (*V. pannonica* Crantz.)'nde fosforlu gübre uygulamaları bakla sayısını, ana dal sayısını, baklada tane sayısını, bin tane ağırlığını ve tohum verimini önemli ölçüde arttırmaktadır (Fayetörbay ve ark., 2014). Aynı bitkide yapılan bir başka araştırma sonuçlarına göre ise tohum verimi ve verim ögeleri yönünden P dozlarına göre anlamlı değişkenlikler tespit edilmemiştir (Cebeci, 2017). Asit reaksiyonlu toprakta P uygulaması, Macar fiği otunun; P ve Mg içeriğini artırmış, K ve Fe içeriğini ise azaltmıştır (Aydın ve ark., 1997). Kaynar ve Kaynar (2016) Macar fiğinde fosforlu gübrelemenin biyokimyasal parametreleri olumlu etkilediğini bildirmişlerdir.

Özellikle kış soğukları ve kuraklık gibi ekstrem çevre koşullarında, yonca veya üçgül gibi diğer yem bitkilerinden daha iyi büyüme performansı gösteren kışlık tek yıllık bir yem bitkisi olan tüylü fiğ (*V. villosa* Roth.) (Jam ve ark., 2024) ile yapılan bir çalışmada ise P uygulamaları (0, 3, 6, 9 ve 12 kg/da) KM verimini, kuru otun N, P, Ca ve Mg içeriklerini arttırmış; K ve tetani oranı [ $K/(Ca + Mg)$ ] ile ADF ve NDF oranını azaltmış; buna karşılık P dozlarının Mn, bakır (Cu), Fe ve Zn gibi mineraller üzerinde hiçbir etkisi olmamıştır (Türk ve ark., 2009).

Tokat-Kazova koşullarında farklı dozlarda (0, 4, 8 ve 12 kg  $P_2O_5$ /da) fosforla gübrelenen *V. villosa*, *V. pannonica* ve *V. sativa* türlerinde, fosforla gübreleme bütün karakterler üzerine olumlu etki yaptı; fiğ türlerinde kök, gövde ve nodül gelişimini artırmak için toprakta alınabilir P miktarının çok az olduğu (1.14 kg  $P_2O_5$ /da) durumda dekara 12 kg  $P_2O_5$  uygulamasının önerilebileceği rapor edilmiştir (Karadağ ve Büyükburç, 2001).

Bir başka fiğ türü olan burçak (*V. ervilia* L.)'ta P uygulamalarının; bitki boyu, bitkide bakla sayısı, bitkide tohum sayısı, bin tane ağırlığı, HP oranı ve tohum verimi üzerine önemli etkileri tespit edilmiştir (Eken ve Türk, 2021).

Bir diğer önemli fiğ türü olan koca fiğ (*V. narbonensis* L.) bitkisinde, P dozları; bitki boyunu, ana sap kalınlığını, bin tane ağırlığını, hasat indeksini ve tane verimini kontrol grubuna göre önemli ölçüde arttırdığı tespit edilmiştir (Altıparmak, 2016). Fosforlu gübre uygulamaları koca fiğde bazı yem kalite bileşenlerini de önemli ölçüde etkilemektedir. Nitekim Türk ve ark. (2007), P uygulamalarının; KM veriminin yanı sıra, HP, N, P, Ca ve Mg içeriklerini artırdığı, K, Fe, ADF ve NDF oranlarını azalttığı ve Mn, Cu ve Zn üzerinde hiçbir etkisinin olmadığını saptamışlardır. Koca fiğ bitkisi ile yapılan diğer bazı çalışmalarda, örneğin; Türkiye'nin yarı kurak iklimine sahip Siirt ilinde yeşil ve kuru ot verimi, bitkide bakla sayısı ve tohum verimi üzerine (Özyazıcı ve Açıkbaş, 2019), Ürdün'ün kuzeyindeki yarı kurak bölgede tohum verimi ve tohum verimine etkili bileşenler üzerine (Türk ve ark., 2003) fosforlu gübre uygulamasının çok önemli etkiye sahip olduğu rapor edilmiştir.

Yem baklası (*V. faba* L.) ile yapılan bir çalışmada, P dozlarının artışına paralel olarak; bitki boyu, bitkide dal sayısı, bitki başına nodül sayısı, klorofil içeriği, bitkide bakla sayısı, baklada tohum sayısı, bin tane ağırlığı, bitki başına KM üretimi, tohum verimi, kes verimi, biyolojik verim, hasat indeksi ve tohum protein oranı gibi verim ve verim unsurları ile kalite parametrelerinin arttığı rapor edilmiştir (Yasmin ve ark., 2020). *Vicia faba*'da Negasa ve ark. (2019) tarafından yapılan çalışmada da P seviyesinin artmasıyla bitki boyunun, kuru biomas ve tohum veriminin arttığı belirlenmiştir. Yapılan diğer birçok araştırma sonuçlarında da *V. faba* yetiştiriciliğinde, fosforlu gübre uygulaması verim ve verime etkili bazı özellikleri arttırdığı veya iyileştirdiği bildirilmiştir (Weldua ve ark., 2012; Kubure ve ark., 2016; Woldekiros ve ark., 2018; Bartzialis ve ark., 2021; Chemedu ve ark., 2021; Tsige ve ark., 2022).

Baklagillerin kuraklık toleransını iyileştirmek, gübreleme gibi bazı tarımsal işlemlerin uygulanmasıyla sağlanabilir. Nitekim Abo-Alhassan ve ark. (2022) fosfor gübrelemesinin *V. faba* L. bitkisinin kuraklığa dayanıklılığını artırdığını bildirmişlerdir. Fosforlu gübrelerin bu etkisi, Oukaltouma ve ark. (2021) tarafından da ifade edildiği üzere, fosforun bitkide kök sisteminin uzamasına ve bunun sonucu olarak bitkilerin kuraklık stresini hafifletmesine katkıda bulunmasıyla açıklanabilir.

### 5.5. Yem bezelyesi (*Pisum sativum* ssp. *arvense* L. Poir)'nin gelişimi üzerine fosforlu gübrelerin etkisi

Yem bezelyesi (*Pisum sativum* ssp. *arvense* L. Poir) simbiyotik N fiksasyonu için daha yüksek P gereksinimine ihtiyaç duyan bir yem bitkisidir. Ayrıca, yem bezelyesinde ot ve tohum verimi ile verime etkili bazı tarımsal parametreler de fosforlu gübrelerden etkilenmektedir. Nitekim Yılmaz (2010), yem bezelyesi (*P. arvense*)'nde, P dozunun bitki boyu, bitkide bakla sayısı, baklada tohum sayısı, bin dane ağırlığı ve tohum verimi üzerine önemli etkisinin bulunduğunu rapor etmiştir. Yem bezelyesi ile yapılan bir başka çalışmada da, uygulanan P dozları (0, 3, 6, 9 ve 12 kg/da) arasında, KM verimi ve yem kalite özellikleri yönünden anlamlı farklılıkların olduğu; P uygulamaları KM verimi, HP oranı, HP verimi, TSBM ve nispi yem değerini arttırırken, ADF ve NDF oranlarını azalttığı tespit edilmiştir (Yüksel ve Turk, 2019). Bir diğer çalışmada da yem bezelyesi (*P. sativum* spp. *arvense*)'nde artan dozlarda fosforlu gübre uygulaması ile KM veriminde artış gözlenmiştir (Kaynar ve Çomaklı, 2023).

### 5.6. Mürdümük (*Lathyrus sativus* L.) bitkisinin gelişimi üzerine fosforlu gübrelerin etkisi

Mürdümük (*Lathyrus sativus* L.) eski çağlardan beri insan ve hayvan tüketimi için kullanılan bir baklagil bitkisidir (Hanbury ve ark., 2000). Yaygın mürdümük (*L. sativus*)'ün hayvan yemi olarak kullanılma potansiyeli, aynı zamanda diğer protein açısından zengin yem bileşenleriyle rekabet edebilecek verime ulaşmasına da bağlıdır (Montenegro ve Mera, 2009). Düşük verimliliğe ve zayıf yapıya sahip olan çok çeşitli topraklarda yetiştirilmesine rağmen (Siddique ve ark., 1996), yüksek ot ve tane verimi açısından diğer birçok ürünlerde olduğu gibi yaygın mürdümükte de P gübrelemesi belirleyici bir faktördür (Montenegro ve Mera, 2009). Yarı kurak iklim koşullarında yapılan bir çalışmada, yaygın mürdümük (*L. sativus*)'te P dozları (0, 4, 8, 12 ve 16 kg P<sub>2</sub>O<sub>5</sub>/da), doğal bitki boyu, yeşil ve kuru ot verimi çok önemli düzeyde etkilerken, ana sap uzunluğu ve ana sap kalınlığına P dozlarının etkisi önemsiz olmuştur (Özyazıcı ve ark., 2024). Mürdümükte P uygulamasının, özellikle düşük P içeriğine sahip topraklarda tane verimini arttırdığı (Montenegro ve Mera, 2009; Bahramnejad ve ark., 2021) rapor edilmiştir. Bir başka çalışmada da *L. sativus*'da P dozlarına (0, 2, 4 ve 6 kg/da) bağlı olarak bitkide nodül sayısının, nodül kuru ağırlığının, bitkide bakla sayısının, bakla uzunluğunun, baklada tohum sayısının, bin tane ağırlığının ve tohum veriminin arttığı belirlenmiştir (Sarkar ve ark., 2003).

### 5.7. Diğer bazı önemli baklagil yem bitkilerinin gelişimi üzerine fosforlu gübrelerin etkisi

Diğer bazı baklagil yem bitkileri ile yapılan sınırlı sayıdaki çalışmalarda, fosforlu gübreleme; yüksek protein içeriği ile yem rasyonlarında tanesinden istifade edilen çemen (*Trigonella foenum-graecum* L.)'in tohum verimi ve verim bileşenleri ile tohum protein içeriğini (Khiriya ve Singh, 2003; Tunçtürk, 2011; Singh ve ark., 2019; Özyazıcı, 2020) ve yem verimini (Basu ve ark., 2008), sarı taşyoncası (*Melilotus officinalis* L.)'nin tohum verimini (Luo ve ark., 2018) arttırdığı; tropik ve yarı tropik bölgelerde tarımı yapılan (Açıkgöz, 2021) Mısır börülcesi (*Lablab purpureus* L. Walp)'nin verim (Kharbamon ve ark., 2015; Surajo ve ark., 2023), tane verimi ve verim bileşenleri (Umar ve Zubairu, 2023), bitki büyümesi, çiçek sayısı ve HP içeriğinde (Kharbamon ve ark., 2015) etkili olduğu belirlenmiştir.

Diğer bazı araştırma sonuçlarına göre, örneğin; Güvercin bezelyesi [*Cajanus cajan* (L.) Millsp.]'nde bitkide fosforun fizyolojik verimliliği (Kumar ve Kushwaha, 2006), tane verimi ve ilişkili verim kompenetleri (Kumar ve ark., 2012; Singh ve Singh, 2012), saman verimi (Kumar ve ark., 2012); yem börülcesi [*Vigna unguiculata* (L.) Walp.]'nde otun HP oranı ve HP verimi (Ahmad ve ark., 2012), yeşil ot, KM ve HP verimi (Shekara ve ark., 2013), uygulanan P seviyesindeki artışla artmıştır. Yine yem börülcesi (*Vigna unguiculata*) ile yapılan bir diğer çalışmada, en yüksek P dozunda (8 kg/da); HP, ham lif, HP verimi, ham lif verimi,

ADF, NDF ve kül içeriği gibi kalite parametreleri açısından daha iyi performans alındığı rapor edilmiştir (Bhagat ve ark., 2018).

Yem ağacı [*Leucaena leucocephala* (Lam.) de Wit.]’nda fide gelişimi ve büyümenin iyileştirilmesinde (Yasin ve ark., 2012; Abdel Aziz ve Galal, 2014), nodül oluşumu ve gelişiminde, N ve K alımında (Abdel Aziz ve Galal, 2014); yem börülcesi [*Vigna unguiculata* (L.) Walp.]’nde yeşil ot ve KM verimi ile besin maddesi alımında (Kumar ve ark., 2016) fosforun önemine vurgu yapılmıştır.

## 6. Baklagil Yem Bitkilerinde Fosforlu Gübre Uygulaması ve Gübre Önerileri

Fosforun topraktaki hareketi ve miktarlarının anlaşılması, tarımsal faaliyetlerin en önemli girdisi konumundaki fosforlu gübrelerin etkili kullanımı, baklagil yem bitkilerinin biyolojik ve ekonomik üretkenliğinin sürdürülmesi için esastır. Diğer birçok kültür bitkilerinde olduğu gibi baklagil yem bitkilerinde de, toprakta P eksikliği görüldüğünde, P genel olarak kimyasal gübreleme yoluyla topraklara ilave edilir. Triple süperfosfat (TSP) veya di-amonyum fosfat (DAP) gibi suda çözünür bir fosforlu gübre toprağa uygulandığında, çözünmesinden hemen sonra çözültideki fosfat iyonları -toprak pH’sına bağlı olarak- toprak çözeltisinde bulunan Ca, Fe veya Al iyonlarıyla reaksiyona girer ve çözünmeyen bileşikler olarak çökelir veya kil parçacıklarının yüzeyine adsorbe olur (Prasad ve Power, 2000). Bu nedenle toprakta rahatlıkla fikse olabilen fosforun veya uygulanan gübre fosforunun alınabilirliğini artırmak, bir başka ifade ile topraktaki fosfordan bitkinin azami ölçüde faydalanmasını sağlamak için fosforlu gübrelerin ekimle birlikte mutlaka bitkinin etkili kök derinliğine banda uygulanması esastır. Fosforun nispeten hareketsiz olduğu topraklarda, gübrenin köklerin büyüyeceği tohumun yakınındaki toprakla iyice karıştırılması durumunda genç bitkiler tarafından P gübresinin en verimli kullanımı sağlanacaktır. Bu nedenle, ister serpmeye ekim isterse sıraya ekimlerde olsun, fosforlu gübreler kesinlikle toprak yüzeyine serpilmemeli veya atılmamalıdır.

Diğer yandan, gübreleme yapılmadan önce -ekim öncesinde- usulüne uygun olarak toprak örnekleri alınmalı ve alınan bu örneklerde mutlaka toprak analizleri yaptırılmalıdır. Bu analiz sonuçlarına göre tavsiye edilen miktarlar üzerinden gübreleme programı uygulanmalıdır. Bazı baklagil yem bitkilerinde farklı ekolojilerde yapılan çalışmalar sonucunda önerilen fosforlu gübre dozları Tablo 1’de verilmiştir.

## 7. Sonuç

Yapılan araştırmalar, fosforun baklagil yem bitkilerinde ot ve tohum verimi ile kalitesini önemli derecede etkilediğini, toprakta ve bitkide yeterli düzeyde fosforun bulunmaması durumunda verim ve kalitenin azaldığını göstermiştir. Bu anlamda, fosfor bitki metabolizmasında çok önemli işlevleri olan, baklagil yem bitkilerinde verim ve kaliteyi arttıran bir element olduğu söylenebilir. Bu nedenle fosfor, toprakta eksikliği görüldüğünde yüksek verim ve kalitede ürün elde etmek için mutlaka uygulanması gereken bir bitki besin maddesidir. Ancak, yeryüzünde fosfor kaynaklarının sınırlı olduğu dikkate alındığında; hayvansal üretimin ihtiyacı duyduğu kaba yemi karşılamak için yüksek ürün verimini sürdürmeye yönelik stratejiler ile birlikte, tarımsal ekosistemi olumsuz etkilemeden, tarımda fosfor kaynaklarının daha sürdürülebilir kullanımını sağlamak temel amaç olmalıdır.

**Tablo 1.** Bazı baklagil yem bitkileri için önerilen P dozları

Tür	Kullanım amacı	Lokasyon	Toprakta alınabilir P düzeyi	Önerilen doz (kg/da)	Kaynak
Ak üçgül	Ot üretimi	Samsun	Orta	4	Acar ve Önal Aşçı (2006)
Çayır üçgülü	Tohum	Erzurum	Orta	7.5	Çomaklı (1990)
Çayır üçgülü	Kuru ot	Samsun	Orta	7.5	Özyazıcı ve Manga (1996)
İran üçgülü	Silaj	Malkara-Tekirdağ	Çok fazla	3-9	Ates ve Tenikecier (2022)
Koca fiğ	Ot üretimi	Siirt	Çok az-az	8-8.5 (saf)	Özyazıcı ve Açıkbaş (2019)
Koca fiğ	Tohum	Ankara	Çok yüksek	8	Altıparmak (2016)
Koca fiğ	Tohum	Siirt	Çok az-az	9.7 (saf)	Özyazıcı ve Açıkbaş (2019)
Korunga	Ot üretimi	Isparta	Düşük	9	Türk ve ark. (2011)
Macar fiği	Tohum	Erzurum	Az-orta	10	Fayetörbay ve ark. (2014)
Yaygın fiğ	Ot üretimi	İslamabad/Pakistan	Düşük	4	Gurmani ve ark. (2006)
Yaygın mürdümük	Ot üretimi	Siirt	Az	12	Özyazıcı ve ark. (2024)
Yem baklası	Tohum	Bangladeş	---	4	Yasmin ve ark. (2020)
Yem baklası	Tohum	Güneydoğu Etiyopya	Çok düşük	2	Negasa ve ark. (2019)
Yem baklası	Tohum	Etiyopya	Çok düşük	4.6	Kubure ve ark. (2016)
Yem baklası	Tohum	Güney Etiyopya	Düşük	9.2	Tsige ve ark. (2022)
Yem bezelyesi	Tohum	İstanbul	Çok fazla	6	Yılmaz (2010)
Yem bezelyesi	Ot üretimi	Uşak	---	6	Yüksel ve Türk (2019)
Yem bezelyesi	Ot üretimi	Erzurum	Düşük/orta	10	Kaynar ve Çomaklı (2023)
Yonca	Ot üretimi	Erzurum	Fakir	10	Kharazmi ve Tan (2020)
Yonca	Ot üretimi	Isparta	Orta	12	Türk ve ark. (2018)
Yonca	Ot üretimi	Almaty-Kazakistan	Yeterli	12	Massaliyev ve ark. (2024)

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## EMPAGLİFLOZİN TEDAVİSİNİN TİP 2 DİYABETLİ HASTALARDA FİZYOLOJİK PARAMETRELERE ETKİSİ

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### ÖZET

**Amaç:** Bu çalışmada, diyabetes mellitus hastalarında sodyum glukoz ko-transporter-2 inhibitörü empagliflozinin hemogram, biyokimyasal parametreler ve kan basınçları üzerindeki etkisinin araştırılması amaçlanmaktadır.

**Gereç ve yöntem:** Çalışmaya diyabetes mellitus tanısı olan ve ilk defa empagliflozin başlanan 251 hasta dahil edildi. Tedavi öncesi ve tedaviye başlandıktan 6 ay sonrası tüm hastaların biyokimya, tam kan sayımı, HbA1c, kolesterol paneline bakıldı. Hastaların tedavi öncesi ve sonrası boy ve kiloları ölçülüp formülden vücut kitle indeksi hesaplandı. İstatiksel değerlendirme sonrası  $p < 0,05$  değerleri anlamlı kabul edildi.

**Bulgular:** 6 aylık empagliflozin tedavisi sonrasında kilo ve vücut kitle endeksinde anlamlı gerileme izlendi. Tedavi sonrasında glukoz, HbA1c, lipit panelinde kan basınçlarında istatistiksel açıdan anlamlı düşüşler, hematokrit seviyesinde ise anlamlı yükseklik saptandı.

**Sonuç:** Empagliflozin tedavisinin glisemik regülasyonu sağladığı gibi lipid parametrelerine, kilo kaybına ve kan basıncı üzerinede olumlu etkilerinin olduğunu gözlemledik.

**Anahtar Kelimeler:** Fizyoloji, tip 2 diyabet, empagliflozin, sodyum glukoz ko-transporter-2 inhibitörü

## Giriş

Diyabetes mellitus (DM), vücutta insülin hormonu eksikliğinde veya insülin hormonuna hücrelerin duyarlı olmasına bağlı olarak gelişen, hiperglisemi ile seyreden kronik, metabolik ve endokrin hastalıktır (1). DM durumunda insülin eksikliği ya da insülin etkisindeki bozukluklar nedeniyle dokularda karbonhidrat, yağ ve proteinlerin kullanımında eksiklikler izlenir. DM, yüksek prevalansla seyreden önemli bir halk sağlığı sorunudur (2). DM'li hastaların çoğunluğunda, zamanla çeşitli mikrovasküler ve makrovasküler komplikasyonlar gelişmektedir. Bu komplikasyonların ölüm oranları ve sekel bırakma üzerine belirgin etkileri mevcuttur. DM'nin, akut komplikasyon riskini azaltmak ve uzun dönemde gelişen kronik sekellerinden hastaları korumak için sürekli tıbbi bakım gerekmektedir (3)

Sodyum glikoz ko-transporter-2 (SGLT-2) inhibitörleri kan glikoz seviyesini düzenlemeye ek olarak kardiyovasküler sistem üzerine pozitif etkisi olan yeni nesil anti-diyabetik ilaçlardır. SGLT-2 inhibitörleri (canagliflozin, dapagliflozin ve empagliflozinin), glikoz geri emiliminin sağlandığı böbrek proksimal tübüllerinde glikoz reabsorbsiyonunu engelleyip glükozuri, diürez ve natriürez yaparak etki ederler (4). Empagliflozin bir SGLT-2 inhibitörü olup bu grup ilaçların glikoz üzerine olan etkilerine ek olarak hastalarda vücut kitle endeksi, kan basıncı, lipit profili ve hematolojik parametreler üzerinde pleiotropik etkilerinin olduğu düşünülmektedir.

DM kan glikoz seviyesindeki yüksekliğe ek olarak lipit ve hemogram parametrelerinde de anormallikler yapmaktadır. Bu anormallikler diyabetin mikro ve makrovasküler komplikasyonlarıyla yakından ilişkilidir. Diyabetin tedavisinde kullanılan ilaçların glikoz metabolizmasına olan etkilerine paralel olarak diğer biyokimyasal parametreler üzerine de olumlu etki gösterebilir (5).

## Araştırma ve Bulgular

“Empagliflozin Tedavisinin Tip 2 Diyabetli Hastalarda Fizyolojik Parametrelere Etkisi” adlı çalışmamız prospektif, iki merkezli ve gözlemsel bir çalışma olarak planlandı. Çalışmaya Dicle Üniversitesi Tıp Fakültesi ve Sağlık Bilimleri Üniversitesi Gazi Yaşargil Eğitim ve Araştırma Hastanesi İç hastalıkları bölümüne başvuran hastalar alınmıştır. Bu çalışmaya toplamda 251 T2DM tanısı olan ve ilk defa SGLT-2 inhibitörü empagliflozin başlanan hastalar alınmıştır.

Çalışmaya dahil edilme kriterleri:

- T2DM
- 18 yaş üstü ve 80 yaş altı hastalar
- Glomerüler Filtrasyon hızı (GFR)>60 ml/dk/1.7

Çalışmadan dışlama kriterleri:

- Karaciğer ve Böbrek yetmezliği
- Gebelik
- İlaç intoleransı

Çalışma kriterlerine uygun olan hastalar çalışmaya alındıktan sonra her hasta için 6. ay sonunda tekrar aynı değerlendirmeler yapıldı. T2DM tedavi altında olmasına rağmen HbA1c>6,5 olan hastalara empagliflozin 10 mg başlandı. Hastaların yaş, cinsiyet, komorbid hastalıklar ve medikal tedavileri kayıt altına alındı. Tedavi öncesi tüm hastalarda; geniş biyokimya, tam kan sayımı, HbA1c, lipit parametreleri bakıldı. Tüm hastaların boy, kilo, vücut kitle indeksi, kan basıncı, vücut yüzey alanları hesaplandı. Tedavi öncesi bakılan tüm parametreler 6. Ayda tekrar değerlendirildi.

## İstatiksel Analiz

İstatistiksel değerlendirme, IBM SPSS 24.0 (Statistical Program for Social Sciences 26) paket programı kullanılarak çözümlendi. Normal dağılıma uyan değişkenler ortalama  $\pm$  standart sapma şeklinde, normal dağılıma uymayan değişkenler ise medyan olarak (%25-%75) ve kategorik değişkenlere yüzde olarak belirtilmiştir.

Sürekli değişkenlerin karşılaştırılmasında normal dağılıma uyanlar için paired sample t testi ve normal dağılıma uymayanlar için Wilcoxon testi kullanıldı.  $p<0,05$  değerleri istatistiksel olarak anlamlı kabul edildi.

## Bulgular

Bu çalışmaya toplamda 251 adet T2DM tanısı olup SGLT-2 inhibitörü empagliflozin kullanan hastalar alınmıştır. Hastaların yaş ortalaması  $54.2 \pm 9.0$  yıl olarak saptanmıştır. Hastaların %53.8'i (135) kadın olup ortalama DM süresi  $9.2 \pm 4.5$  yıl olarak izlenmiştir. Eşlik eden hastalıklar açısından incelendiğinde hastaların 117'sinde (%46.6) hipertansiyon, 34'ünde (%13.5) koroner arter hastalığı, 80'inde (%32) hiperlipidemi ve 2'sinde (%0.8) serebrovasküler hastalık saptanmıştır. Oral antidiyabetik ilaç olarak metformin %91, Dipeptidil dipeptidaz-4 inhibitörleri %29, sülfanilüreler %9.6, tiazolidindionlar %4.8 ve GLP-1 agonistleri %2 sıklıkta kullanılmaktaydı. Hastaların %40'ında insülin kullanımı mevcuttu.

Hastaların tedavi sonrası vücut ağırlığı ve vücut kitle endeksi tedavi öncesine göre istatistiksel açıdan anlamlı olarak daha düşük bulunmuştur ( $p<0.001$ ,  $p:0.002$ ). Empagliflozin tedavisi sonrası hastaların sistolik ve diyastolik tansiyon değerleri daha düşük olarak izlenmiştir ( $p<0.001$ ,  $p<0.001$ ). Glukoz, HbA1c ve ürik asit değerleri tedavi sonrasında anlamlı olarak daha düşük bulunmuştur ( $p<0.001$ ,  $p<0.001$ ,  $p:0.02$ ).

Tedavi sonrası hematokrit ( $p<0.001$ ) değerleri tedavi öncesi değerlere göre istatistiksel açıdan anlamlı olarak daha yüksek saptanmıştır. Total kolesterol, LDL, HDL ve trigliserit seviyeleri tedavi sonrasında tedavi öncesine göre daha düşük izlenmiştir ( $p<0.001$ ,  $p<0.001$ ,  $p<0.001$ ,  $p<0.001$ ).

Hastaların potasyum, sodyum, kalsiyum, AST, ALT, total protein, albümin, Glomerüler filtrasyon hızı, Lökositler, ve trombosit değerlerinde tedavi öncesi ve sonrasında istatistiksel açıdan anlamlı değişiklikler saptanmamıştır. Hastaların klinik ve laboratuvar parametreleri tedavi öncesi ve sonrası incelenmiştir. Sonuçlar tablo 1'de gösterilmiştir.

**Tablo 1**

	Tedavi öncesi (n=251) Mean±SS	Tedavi sonrası (n=251) Mean±SS	p değeri
Vücut Ağırlığı, kg	85,3±15,6	80.6±16,3	<0.001
Vücut kitle indeksi, kg/m <sup>2</sup>	32,7±7,4	31,8±7,1	0.002
Sistolik kan basıncı, mm/Hg	125±13,4	121,2±11,6	<0.001
Diyastolik kan basıncı, mm/Hg	76,6±9	74,1±7,8	<0.001
Glukoz, mg/dL	166± 60.4	141±40.7	<0.001
HbA1c, %	8.3±2.1	7,0±1.4	<0.001
Potasyum, meq/L	4.3±0.9	4.2±0.8	0.137
Sodyum, meq/L	139±32.6	138±32.3	0.34
Ürik asit, mg/dL	6.8±1.9	5±1.5	<0.02
Kalsiyum, mg/dL	9.5±2.9	9.5±2.6	0.07
Total protein, g/dL	74±20.3	73±19.8	0.58
Albümin, g/dL	43±14.3	42±13.8	0.09
GFR, ml/dk	84±9.7	83±6.2	0.09
ALT, IU/L	23±4.8	20±4.4	0.09
AST, IU/L	25±4.6	20±4.1	0.225
Hematokrit	43±13.5	45±14.3	<0.001
Lökosit, 10 <sup>9</sup> /L	8.8±2.6	8.7±2.5	0.24
Trombosit, 10 <sup>9</sup> /L	270±64.4	274±65.3	0.14
Total kolesterol, mmol/L	197±54.3	180±49.3	<0.001
HDL, mmol/L	38±11.3	41±12.4	<0.001
LDL, mmol/L	127±32.5	114±31.3	<0.001
Trigliserit, mmol/L	154±37.4	141±35.3	<0.001

## **Sonuç**

DM prevalansı, tüm dünyada beslenme bozuklukları, yaşlı nüfus ve sedanter hayat tarzının artışına bağlı olarak yükseliş göstermektedir. Tedavilerde gelişmelere rağmen DM 'nin morbidite ve mortalitesinde istenen azalma sağlanamamıştır.

Çalışmamızda SGLT2 inhibitörü empagliflozinin metabolik ve laboratuvar parametreleri üzerindeki etkisini inceledik. Yaptığımız çalışma sonucunda 6 aylık empagliflozin tedavisinin glisemik regülasyonu sağladığı, lipit profile üzerine olumlu etkileri olduğu saptadık. Tedavi sonrasında kilo kaybı ve vücut kitle indeksi (VKİ) azalma, sistolik ve diyastolik kan basıncınları üzerinde olumlu etkileri olduğunu saptadık. Ayrıca tedavi sonrasında hematokrit seviyelerinde belirgin artış sağladığı görülmüştür.

Sonuç olarak, empagliflozin tedavisinin; glisemik regülasyon, lipit ve metabolik parametreler üzerinde olumlu etkilerinden dolayı uygun endikasyon durumlarında daha yaygın kullanılması sağlanmalıdır.

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# **AN ECONOMETRIC ANALYSIS OF FACTORS AFFECTING THE DEMAND FOR HIGHER EDUCATION IN ALBANIA**

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## **Abstract**

In this paper, the demand for higher education in Albania is analyzed and modeled. The analyzed factors on the demand for higher education are demographic and economic. By analyzing the enrollment rate of students in primary, secondary and higher cycles, government expenditure on education and using simple and multiple regression analysis, the direction of the influence of the factors will be found. The decrease in births in the country, demographic movements have a negative impact on the demand for higher education. R studio on secondary data is used to evaluate the models.

**Keywords:** Demand for higher education, Enrollment Secondary, forecasting

## **Introduction**

A good education offers individuals the opportunity to have a quality of life with higher standards and more interesting. At the social level, it creates opportunities for humanity to solve the immediate problems of individual and social life (Ritchie, H; Samborska, Veronika; Ahuja, Natasha; Ortiz-Ospina, Esteban; Roser, Max, 2023). The right to education in the Republic of Albania was provided for the first time by the constitution in 1946 and then in that of 1976, with the change that educational institutions should clearly express the ideological direction they had to follow (Gjevori & Xhepa, 2020). The political changes of the 90s found the educational system organized in the compulsory eight-year cycle, the four-year secondary cycle and higher education. This way of organization continued until 2010 where, after a reform, the mandatory cycle became a nine-year cycle, where the first five years of this cycle constitute primary education and the other four years constitute lower secondary education, then continuing with the education of upper secondary and finally higher education. In 2013-2014, another way of organizing compulsory basic education came to life, now the nine-year basic education was divided into six years of primary education and three years of lower secondary education. Since this year, there have been no more changes in the organization of the educational system in the Republic of Albania.

The focus of this study is the impact of economic and demographic factors on the demand for education in the Republic of Albania. Economic development and the quality of the education system are interrelated. In a country with a strong economy, the educational opportunities available to its citizens increase, and on the other hand, the stronger the education system, the more students and graduates are invested in contributing to its economic development (Bass, 2024). So the state through investment in education and education through the supply of qualified human resources in the economic sector constitute a strong pillar in the development and prosperity of a country.

## **Literature Review**

The demand for higher education is a phenomenon that is studied in both developed and developing countries. Education improves health and social well-being, reduces poverty, and raises living standards. An educated population is better able to make informed decisions and actively contribute to the sustainable development of society (Ch. Spiel, s. Schwartzman, M. Busemeyer, et al, 2018). Individuals with higher levels of education are more likely to have higher wages and be more productive in their jobs. This increases the purchasing power of the population and boosts consumption and investment in the economy. Furthermore, education helps develop critical thinking and innovation, creating a basis for technological development and scientific advances (F.Sairmaly, 2023). Governments and public policies should support access to education for all, including disadvantaged communities and minority groups, to ensure that every individual can benefit from education and contribute to the country's economic development (A. M. Hayes, 2017). Continued investment in education is necessary to ensure long-term socio-economic growth and development (Pal, 2023).



In the case of Albania (Johansson, 2014), he emphasized the need for improving the quality of education and matching the standards of higher education with international ones. (Johansson, 2014) has emphasized the importance of raising the capacities and improving the qualifications of academic staff, the qualification of teachers, the need for fairer and strategic allocation of financial resources, the need to improve curricula to better match the needs of the labor market and to ensure that graduates are better prepared for professional challenges. So, Albania should implement deep reforms and strategies for improving the higher education system, including adopting best practices from higher education systems in other countries (Johansson, 2014).

### Empirical Analysis

The data for this study were obtained from the World Bank, INSTAT. Government Expenditure on Education, Total (% of Government Expenditure), Enrollment in Primary, Secondary and Higher Schools (% Gross) for the years 2015-2022 are taken from the World Bank, while the number of births and the number of enrollments in each of the categories are received from INSTAT.

The variables used in this study are as follows:

**EXP:** Government expenditure on education, total (% of government expenditure), measures the percentage of the total government budget that goes to the education sector.

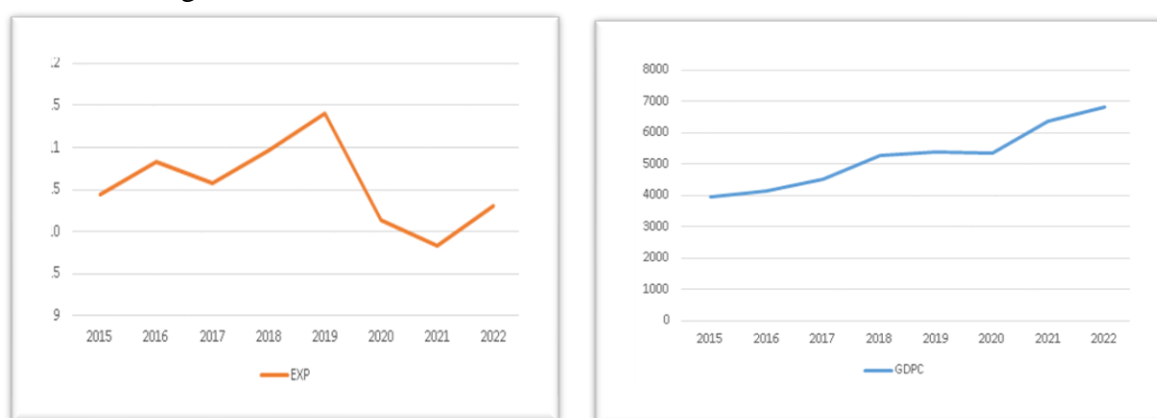
**GEP:** Enrollment in primary schools (% gross), shows the percentage of children enrolled in primary schools compared to the total number of children of suitable age for this level of education, and **primary1** and **primary2** the number of enrollments in primary and 9-year education, respectively.

**GES:** Enrollment in secondary schools (% gross), measures the percentage of students enrolled in secondary schools compared to the total number of young people of the appropriate age for this level of education, and **secondary** the number of enrollments.

**GET:** Enrollment in higher education (% gross), shows the percentage of young people enrolled in higher education institutions compared to the total number of young people of suitable age for this level of education, and the **tertiary** number of enrollments.

n.birth-number of births, shows the number of live births for each year.

CPI\_ED average index for education

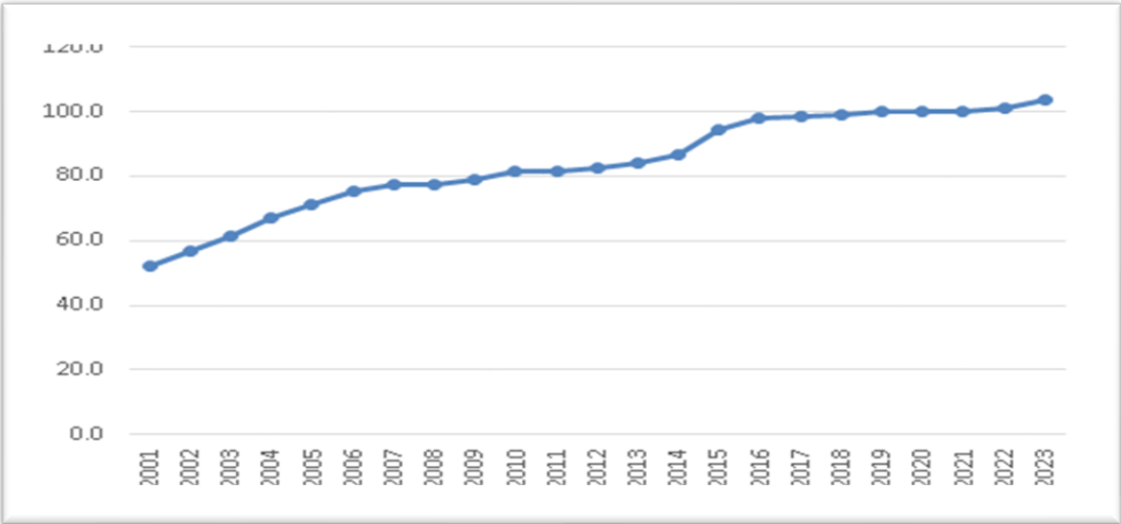


**Figure 7:** Trend of Government expenditure on education, total (% of government expenditure) and GDP per capita

**Source:** Authors' calculations

For the last few years, it can be seen that Government expenditure on education, total (% of government expenditure) has had continuous changes and has had a significant decrease compared to previous years in the years of the pandemic period and returning to average levels. in the following period. On the other hand, GDP per capita has had a positive trend except for the pandemic period.

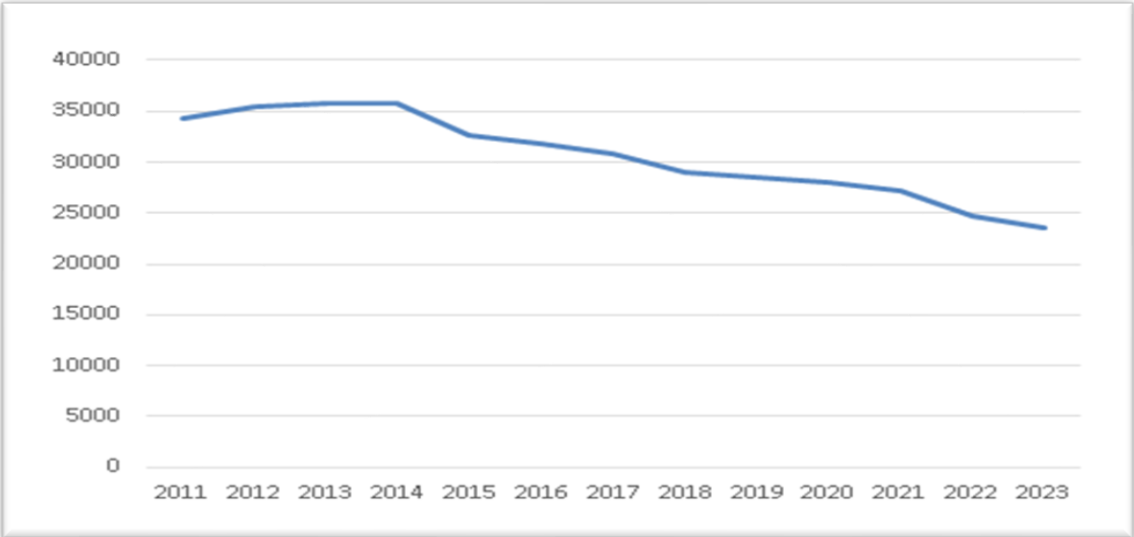
The graph below shows the average index of education expenditures in the country.



**Figure 8:** Trend of average index for education

Source: Authors' calculations

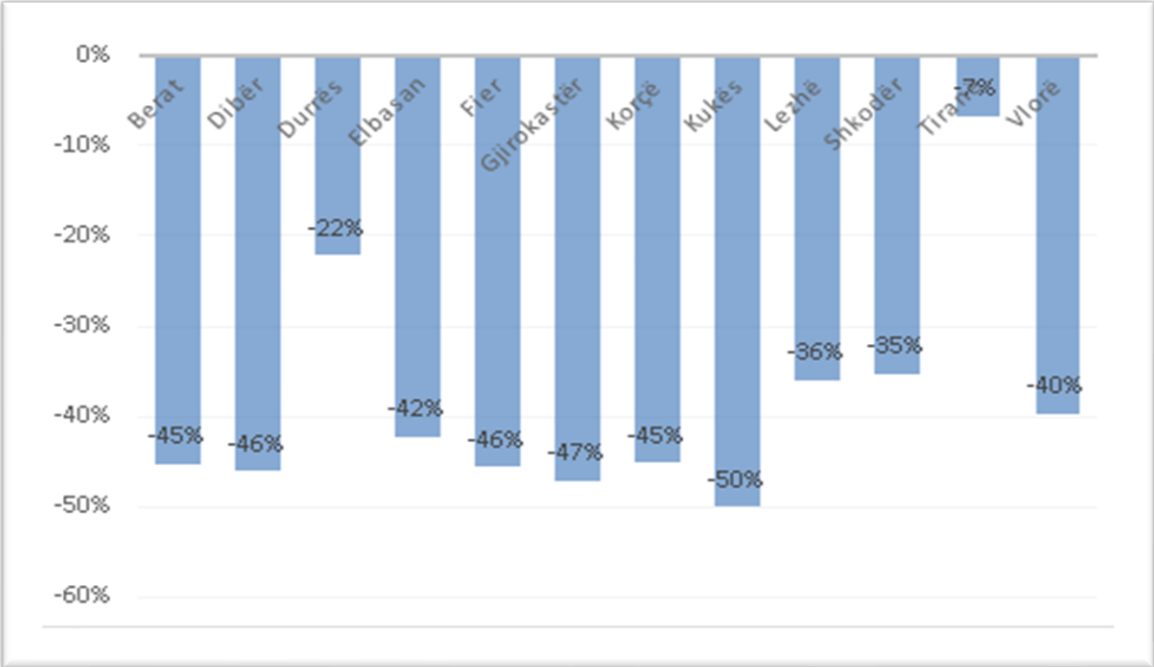
For Albanian families, the education of their children becomes more and more expensive, doubling in 2023 compared to 2001.



**Figure 9:** Trend of the number of births

Source: Authors' calculations

In the country, the number of births every year has only decreased throughout the country. In some counties, the decline is stronger and more moderate in Tirana, as there is a high demographic movement towards the capital. The chart below shows the change in births in 2023 compared to 2011.



**Figure 10:** The percentage change in the number of births according to the districts  
**Source:** Authors' calculations

In the district of Kukës, we have a decrease in births by 50%, and most districts have a high decrease. The district of Durrës has decreased by 22% and Tirana by only 7%.

The table below shows the percentage change in the number of births in the country for each year.

**Table 1:** The percentage of change in the number of births by year

Year	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
The percentage of change in the number of births	3.47%	0.78%	0.03%	-8.52%	-3.00%	-2.72%	-6.27%	-1.29%	-1.70%	-3.08%	-9.27%	-4.34%

**Source:** Authors' calculations

In the country, the largest decrease in births is in 2022 with 9.27% compared to 2021, while in 2013 there is a decrease of 4.34% compared to 2022. The fertility rate for Albania in 2023 is 1.545 births per woman, a 0.96% decline from 2022. The number of enrollments in both pre-

university and university education has declined in the country. The chart below shows enrollment trends as a percentage of the number of children in that age group.

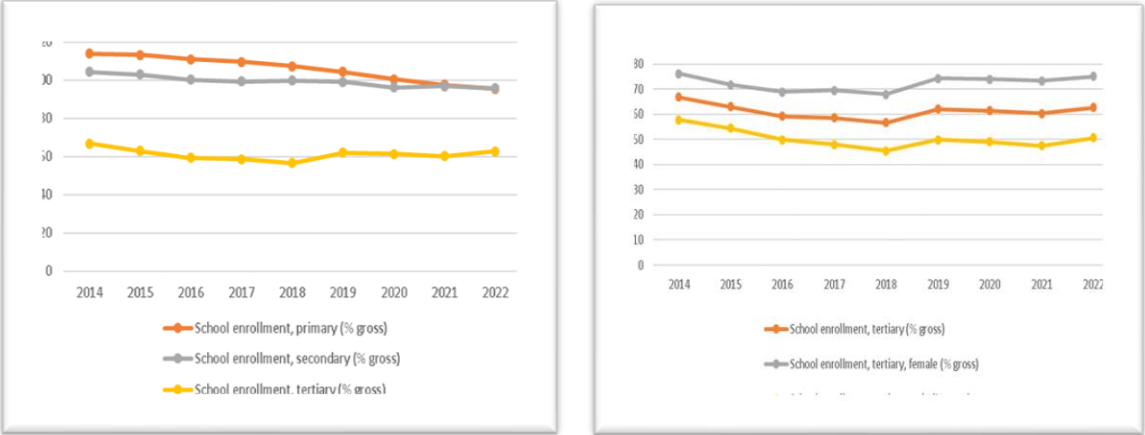


Figure 11: – School enrollment

Source: Authors' calculations

During the period under study, School enrollment for primary and secondary (% gross) has a downward trend, meanwhile School enrollment tertiary (% gross) has a decrease until 2018 and then the trend is light and positive. In Albania, the young generations tend to pursue higher education, in most cases they seek bachelor's studies, since the demand for education is a derived demand for employment opportunities with high salaries in the public and private sector (Todaro & Smith, 2011). However, recently the lack of qualified workforce has encouraged policymakers to promote vocational education from secondary school and then to higher vocational schools. The possibility of higher professional education in the country, in addition to private institutions, is also being offered by various state universities in the country. To increase the motivation of teachers and their professional development for a more attractive and technology-oriented teaching, some universities in the country have undertaken the training of pre-university system teachers. On the other hand, in higher education and why the number of registered women is greater than the number of men, as a percentage of the total, they follow the same trends.

**Evaluation of Models**

To evaluate the impact of each variable on the number of registrations in high school, several models were evaluated, where the independent variables are in turn all the factors taken into analysis.

In the first set of models, the dependent variable is enrollment in higher education (gross %) and as independent variables a set of factors. The evaluated models are summarized in the table below.

**Table 2:** The estimate model for scholl enrollment tertiary(%gross)

	Model 1	Model 2	Model 3	Model 4
(Intercept)	5.04 *	3.87 **	-75.91	4.54 ***
	(1.67)	(0.66)	(322.59)	(0.74)
log(NRL)	-0.09		16.56	
	(0.16)		(36.35)	
log(GDPC)		0.03		
		(0.08)		
GEP			-0.32	
			(0.51)	
log(EXP)				-0.19
				(0.31)
N	8	8	8	8
R2	0.05	0.02	0.12	0.06

\*\*\* p < 0.001; \*\* p < 0.01; \* p < 0.05.

Source: Authors' calculations

These models, despite the expected sign of the coefficients, have a low explainability.

In the second set of models, the dependent variable is the number of high school enrollments versus several factors. The estimated models are given in the table below.

**Table 3:** The estimate model for scholl enrollment

	Model 1	Model 2	Model 3	Model 4	Model 5
(Intercept)	5.30 **	4.50 *	1.82	5.90 **	27.05 ***
	(1.03)	(1.34)	(1.65)	(1.33)	(3.43)
log(secondary)	0.56 ***				
	(0.09)				
log(primary2)		0.62 **			
		(0.11)			
log(primary1)			0.83 ***		
			(0.14)		
log(n.birth)				0.57 **	
				(0.13)	
log(CPI_ED)					-3.32 **
					(0.75)
N	8	8	8	8	8
R2	0.87	0.83	0.86	0.76	0.77

\*\*\* p < 0.001; \*\* p < 0.01; \* p < 0.05.

Source: Authors' calculations

All models are statistically significant as the p-value is less than the 5% significance level in each case and the explanatory power for each factor ranges from 76% to 87%.

As expected, the impact of the factors is positive, except for the average index for education, which has a negative impact on the number of registrations. An increase in the costs of education will lead to a decrease in the demand for education (Li, 2013). A point which should be used by public HEIs to attract as many students as possible and why forecasts show that

public HEIs will attract more students in the coming years (Sinaj.V, Xhabafti.M, Shakaj.F, 2024). During the first round of registrations for the academic year 2024-2025, it was noticed that even the students with the highest average wanted to study in branches that have financial support from the relevant authorities, in contrast to other years.

### **Conclusions**

Policymakers should develop strategies to increase enrollment and quality in secondary and higher education as well. Improving access and inclusion in these educational levels will better prepare young people for the labor market and contribute to economic growth, aiming to eliminate curricular inconsistencies inherited from outdated teaching methods. Investments in the quality of education should be a priority for education policies. Governments should increase spending on education and ensure that these funds are used efficiently and aim to improve the quality of education. Investments in educational infrastructure, teacher training and improvement of teaching resources are essential to improve educational outcomes, especially in relation to early education.

At the end of this analysis, we can count these tangible conclusions.

- From 2015 to 2022 Government expenditure on education, total (% of government expenditure) have undergone continuous changes, specifically increasing until 2019 and then decreasing until 2022, a period that coincides with the Covid 19 pandemic.
- Expenditures of Albanian citizens for children's education have been increasing since 2001, doubling in 2023.
- The number of births in all districts of the republic has been decreasing from 2011 to 2023, marking the largest decrease in the district of Kuksi with 50% and the lowest decrease in the district of Tirana with 7%.
- Enrollment in higher education has been decreasing until 2018 and after this year with a slight increase until 2022.
- From the second set of evaluated models, it can be observed that the number of enrollments in higher education is significantly dependent on the factors described through the variables used in all models.

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## 5 NİSAN KARARLARI SONRASINDA TÜRKİYE'DE KAMU MALİYESİ

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### Özet

1990'lı yıllar ekonomik anlamda zorlu bir süreç olmuştur. Dünyada küreselleşmenin arttığı, iletişim teknolojisinin yeni bir boyut kazandığı bu yıllarda Türkiye de diğer ülkeler ile entegrasyon içerisinde. 24 Ocak 1980'de alınan kararlar ile birlikte liberal politikaların etkin olduğu yılların devamında Türkiye ekonomisi için olumsuz bir dönemden bahsetmek doğru olacaktır. Bu dönemde enflasyon ciddi manada artmış, Türk Lirası yabancı para birimlerine karşı değer kaybetmiştir. 1994 yılında belirli temel amaçlar doğrultusunda 5 Nisan Kararları alınmıştır. Kamu gelirlerinin artırılması, kamu harcamalarının azaltılması, enflasyon ile mücadele gibi temel belirli amaçların neticesinde uygulamaya konan kararların sonraki süreçte kamu maliyesini nasıl etkilediği araştırılmıştır. Kamu harcamalarında artışların olduğu özellikle faiz harcamalarının toplam harcamalar içerisinde payının sürekli arttığı görülmüştür. Kamu gelirlerinde 1994-2002 yılları arasında artışların olduğu fakat bütçe dengesinde negatif görünümün yıllar içerisinde değişmediği hatta giderek arttığı bilinmektedir. Bu sürecin ardından yaşanan 2001 krizine bakıldığında ise 5 Nisan kararlarından istenilen sonuçların alınmadığı ve belirlenen temel amaçlara ulaşamadığı sonucuna varılmaktadır. Yine yerel seçim dönemlerinden kaynaklı olarak kararların geç alındığı ve bu doğrultuda gecikmelerin yaşandığını da ifade etmek gerekmektedir.

**Anahtar Kelimeler:** Kamu maliyesi, 5 Nisan 1994, Kamu Harcamaları, Kamu Gelirleri



## PUBLIC FINANCE IN TURKEY AFTER THE APRIL 5 DECISIONS

### **Abstract**

The 1990s were a difficult period in economic terms. In these years when globalization increased in the world and communication technology gained a new dimension, Turkey was also in integration with other countries. It would be right to talk about a negative period for the Turkish economy in the years following the decisions taken on January 24, 1980 and the years when liberal policies were effective. Inflation increased significantly during this period and the Turkish Lira lost value against foreign currencies. In 1994, the April 5 decisions were taken in line with certain basic objectives. It was investigated how the decisions implemented as a result of basic specific objectives such as increasing public revenues, reducing public expenditures and combating inflation affected public finance in the following period. It was observed that there were increases in public expenditures and especially the share of interest expenditures in total expenditures was constantly increasing. It is known that there were increases in public revenues between 1994 and 2002, but the negative outlook in the budget balance did not change over the years and even increased. When we look at the 2001 crisis that occurred after this process, it is concluded that the desired results were not obtained from the April 5 decisions and the determined basic objectives could not be achieved. It should also be noted that decisions were made late due to local election periods and delays occurred accordingly.

**Keywords:** Public Finance, April 5 1994, Public Expenditures, Public Revenues

## 1. Giriş

İkinci Dünya Savaşı'nın ardından dünya ekonomisinde yeniden yapılanma süreci başlamıştır. Bu süreç hem savaşa girip direkt etkilenen ülkelerde olduğu gibi Türkiye gibi savaşa katılmamasına rağmen savaş ekonomisinden etkilenen ülkelerde de yaşanmıştır. Bu süreç hem sosyal hem de ekonomik anlamda etkilerini uzun yıllar boyunca hissettirmiştir. Amerika Birleşik Devletleri'nin ilk dünya savaşının ardından yapmış olduğu diğer ülkeler ile etkileşim politikası İkinci Dünya Savaşı'nın ardından değişmiştir. Bir diğer önemli güç olan Sovyetler Birliği'nin alanlarını daraltmak ve rüştünü ispat etmek için yapılan bu uygulamalar 1989 yılında Sovyetler Birliği'nin yıkılmasının ardından farklı bir boyut kazanmıştır. 1980'li yıllarda liberalizm etkisinde olan Türkiye, 1990'lı yıllarda teknolojinin gelişimi, ekonomide güncel uygulamaların hız kazanması, ülke içerisinde siyasal istikrarsızlığın bulunması neticesinde yeni bir dönem yaşamıştır. Bu dönem içerisinde enflasyon, döviz kuru ve dış ticaret açıkları başta olmak üzere bir takım makroekonomik göstergelerde yaşanan negatif durumlar 1994 yılında 5 Nisan Kararları'nın alınmasına neden olmuştur. Türk Lirasının devalüe edilmesi, yeni kur belirleme yöntemleri ve IMF ile stand by anlaşmalarının yapılmasının hem kısa dönemde hem de uzun dönemde kamu maliyesine etkileri olmuştur. Bu etkiler kamu gelirlerini etkilemiş olmakla birlikte kamu harcamalarının ve kamu borçlarının da değişmesine neden olmuştur.

## 2. 1990'lı yıllarda ekonominin genel durumu

1990'lı yıllar hem küresel hem de Türkiye özelinde önemli değişimlerin olduğu yıllar olmuştur. Küreselleşmenin tam olarak kendini gösterdiği bu yıllarda iletişim teknolojisinin hızla artması özellikle internetin gelişimi, elektronik bankacılık ile yeni gelişmelerin olması sermaye hareketlerine yeni bir boyut kazandırmıştır (Toruk, 2005: 494). Bir önceki süreç olan 1986-1989 yılları arasına bakıldığında mali sistemde yapısal değişikliklerin yapıldığı görülmüştür. Burada geniş anlam para arzının milli gelirin içerisindeki payında önemli değişikliğin olmadığı görülmektedir. Bununla birlikte toplam kredilerin milli gelir içerisindeki payının 1988 yılında önemli miktarda düştüğü, bir sonraki yıl ise yine 1988 seviyelerine yakın olduğu bilinmektedir. Söz konusu yıllarda para piyasalarında ve menkul kıymetlerdeki gelişmelerin bankacılık sektörünün hakim olduğu mali kesime kaynakların kullanılabilmesi durumunu beraberinde getirmiştir (Saracoğlu, 1989: 7). 1980'li yıllarda kurulan bazı ekonomi temelli kurumların 90'larda gelişme gösterdiği bilinmektedir. Buna rağmen yüksek enflasyon ve dengesiz büyümenin olduğu da bilinmektedir. Bu sebepler kamu maliyesinde olumsuzlukları da beraberinde getirmiştir. Önceki dönemde sürdürülebilir olan bu durum sonraları içinden çıkılmaz bir hâl almıştır (Gaytancıoğlu, 2010: 142). 1990'lı yıllarda uygulanan finansal serbestleşme politikaları Türkiye ekonomisi için hem fırsatları hem de tehditleri içerisinde barındırmıştır. Bu zaman içerisinde kamu finansman açığı ile cari işlemler açığı başta olmak üzere kurda, enflasyonda faizde ve dış ticarete sorunlar belirli aralıklarla meydana gelmiştir (Oktar, Dalyancı, 2010:12).

## 3. 5 Nisan Kararlarının Amaçları ve Akabindeki Göstergeler

5 Nisan kararlarında öncelikli bazı hedefler bulunmaktaydı. Bu amaçlardan biri mali piyasalarda istikrarın sağlanmasıydı. Bununla birlikte Türk Lirası'ndan kaçışın engellenmesiydi. Bir diğer önemli amaç ise kamu gelir ve gider dengesini sağlayarak borçlanma ihtiyacının azaltılması durumuydu. Yine enflasyonu azaltmak, ödemeler dengesini yeniden kurmak 5 Nisan Kararlarının önemli makroekonomik amaçları arasında yer almaktadır (Köse, 2000: 99). Belirlenen amaçlar doğrultusunda 5 Nisan Kararları 1994 tarihinde bazı kararlar

alınmıştır. Bu kararlar genel itibariyle Türk Lirasının %39 oranında devalüe edilmesi, döviz kurlarında serbestliğe müsaade edilmesi, 10 yıllık bir zaman diliminin ardından IMF ile stand-by anlaşmasına gidilmesi, Kamu İktisadi Teşebbüsü ve Tekel ürünlerinin fiyatlarının arttırılması, konsolide bütçe açığının ve kamu kesimi borçlanma gereğinin düşürülmesi şeklindedir (Susam, 2009:191). Bunlarla birlikte kamu gelirlerinin arttırılması ve kamu giderlerinin azaltılması yönünde bazı tedbirlerinde alındığı görülmektedir. Kamu gelirlerinin arttırılması ile ilgili; ek vergiler, devlete ait olan lojmanların sosyal tesislerin ve on yaşından büyük araçların satılması ile birlikte akaryakıt tüketim vergisi özelinde bazı değişiklikler yapılmıştır. Giderlerin azaltılması ile ilgili olarak memur ve işçi alımının durdurulması, beklenen enflasyon oranında kamu çalışanlarına zam verilmesi gibi kararlar alınmıştır (Köse, 2000: 99,100).

5 Nisan Kararlarının alındığı 1994 ve sonraki sekiz yıllık döneme ait bir takım veriler incelendiğinde ise özellikle kamu maliyesi kapsamında alınan kararların istenilen sonuçları doğurmadığı görülmektedir.

**Tablo 1: 1994-2002 Harcama Verileri**

Yıl	Faiz Harcamaları	Faiz Dışı Harcamalar	Toplam Harcamalar
1994	298.284	604.170	902.454
1995	576.116	1.148.078	1.724.194
1996	1.497.401	2.463.907	3.961.308
1997	2.277.917	5.772.335	8.050.252
1998	6.176.595	9.437.846	15.614.441
1999	10.720.840	17.363.845	28.084.685
2000	20.439.862	26.265.166	46.705.028
2001	41.062.226	39.516.839	80.579.065
2002	51.870.659	63.811.691	115.682.350

**Kaynak: Hazine ve Maliye Bakanlığı**

Tablo 1’de 1994-2002 yılları arasında konsolide bütçe kapsamında harcama verilerine yer verilmiştir. Toplam harcamalar; faiz harcamaları ve faiz dışı harcamalar olarak iki ayrı grupta gösterilmiştir. Faiz harcamalarının her sene giderek arttığı görülmektedir. Toplam harcamalar içerisinde faiz harcamalarının payı konusunda da benzer durum görülmektedir. Faiz dışı harcamaların da aynı periyot içerisinde gittikçe arttığı ve 2002 yılında 63.811.691’e ulaştığı görülmektedir.

**Tablo 2: 1994-2002 yılları arasında Gelir Verileri**

Yıl	Vergi Gelirleri	Diğer Gelirler	Toplam Gelirler
1994	587.760	163.855	751.615
1995	1.084.350	324.900	1.409.250
1996	2.244.094	483.864	2.727.958
1997	4.745.484	1.069.615	5.815.099
1998	9.228.596	2.582.469	11.811.065
1999	14.802.280	4.130.785	18.933.065
2000	26.503.698	6.936.445	33.440.143
2001	39.735.928	11.807.042	51.542.970
2002	59.631.868	15.960.456	75.592.324

**Kaynak: Hazine ve Maliye Bakanlığı**

Tablo 2’de 1994-2002 yılları arasında toplam gelirler; vergi gelirleri ve diğer gelirler olmak üzere iki ayrı kategoride ele alınmıştır. Burada vergi gelirlerinin her sene arttığı görülmektedir. Aynı durum diğer gelirler içinde geçerlidir. 2002 yılına gelindiğinde 75.592.324 olan toplam gelirlerin yaklaşık 60 milyarlık kısmının vergi gelirlerinden meydana geldiği görülmektedir.

**Tablo 3: 1994-2002 yılları arasında Denge Durumu**

Yıl	Bütçe Dengesi	Faiz Dışı Denge
1994	-150.839	147.445
1995	-314.944	261.172
1996	-1.233.350	264.051
1997	-2.235.153	42.764
1998	-3.803.376	2.273.219
1999	-9.151.620	1.569.220
2000	-13.264.885	7.174.977
2001	-29.036.095	12.026.131
2002	-40.090.026	11.780.633

**Kaynak: Hazine ve Maliye Bakanlığı**

Tablo 3, 1994-2002 yılları arasında hem bütçe dengesini hem de faiz dışı dengeyi göstermektedir. Faiz dışı dengede istikrarsız pozitif bir durum söz konusu olmakla birlikte bütçe dengesinde negatiflik göze çarpmaktadır. Bununla birlikte negatif durumun her sene giderek arttığı da görülmektedir.

1990’lı yılların ekonomik konjonktürü kapsamında alınan kararlardan olan 5 Nisan kararlarının etkileri ve etkilediği ekonomik göstergeler hemen ortaya çıkmamıştır. Sonraki zaman dilimi içerisinde de ekonominin direkt olarak etkilendiği pek çok durum mevcuttur. 2002 yılında yapılan genel seçim sonuçları da bu süreç ile bağlantılıdır.

1998 yılında IMF ile olan ilişkiler için yeni bir dönüm noktası olan Yakın İzleme Anlaşması aracılığı ile yeni bir sürece girilmiştir. Bu önem 24 Ocak 1980 tarihinde alınan kararlar gibi yeni bir liberal iktisat geçişi biçiminde ülke ekonomisi adına son derece önemlidir (Kolsuz, Yeldan, 2014: 52). Enflasyonla mücadele kapsamında IMF ile yapılan anlaşmanın neticesi 2001 yılında yaşanan ekonomik krizin sebepleri arasında yer almaktadır. Ardından yapılan reformlar ile birlikte ekonomide yüksek büyüme oranları yakalanmış fakat bu yüksek cari açığı da beraberinde getirmiştir. Aynı dönemde kaynak ihtiyacı yabancı sermaye ile sağlanmıştır. 2009 küresel krizinin ardından ise kişi başına düşen gelirden azalmanın olduğu bilinmektedir (Göcen, 2017:62).

#### 4. Sonuç

1990'lı yıllar hem ekonomik hem de siyasi sorunların yaşandığı bir dönem olmuştur. Ülkedeki ekonomik tablonun giderek kötüleşmesinin neticesinde bazı önlemler alınmak istenmiş ve bunlar belirli amaçlar doğrultusunda yapılmıştır. Amaçlar genel itibariyle kamu gelirlerini arttırmak, harcamaları azaltmak ve enflasyon, döviz kuru, ödemeler dengesi gibi önemli makroekonomik göstergeleri daha olumlu hale getirmektir. 5 Nisan kararlarının uygulamaya konulmasının ardından gelirlerin arttığı görülmekte olup istenilen ölçüde arttırılmadığı tespit edilmiştir. Özellikle bütçe dengesinde giderek artan negatif durumun devam ettiği görülmektedir. Bu durumun neticesinde 2001 krizinden kaçınılamamış ve Türkiye'nin ekonomik anlamda yıprandığı günler geçirilmiştir. Kamu maliyesi kapsamında özellikle harcama verilerinde faiz harcamalarının büyüklüğü ve toplam harcamalar içerisindeki payı bir diğer önemli husus olarak göze çarpmaktadır.

5 Nisan Kararları kapsamında ortaya çıkan bir diğer sonuç büyümenin durdurulmasıdır. Bu durum çok fazla sayıda insanın işsiz kalmasına, üretimin azalmasına, kapasite kullanımının çok ciddi azalmasına sebep olmuştur. Ardından pek çok iflas meydana gelmiştir (Sayılğan, 1994: 216)

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# SİVAS EKOLOJİK KOŞULLARINDA YETİŞTİRİLEN BAZI SOYA GENOTİP VE ÇEŞİTLERİNİN ANTIOKSİDAN KAPASİTESİ BAKIMINDAN DEĞERLENDİRİLMESİ

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## Özet

Oldukça yüksek protein değerine sahip bir bitki olan soya fasulyesi, kolesterol ve doymuş yağlar içermeyen yapısı, yüksek kaliteli protein içeriği ile çok yönlü bir bitkidir. Hayvan ve insan beslenmesinde büyük oranda kullanılmaktadır. Soya ekstrüzyon işleminden geçirilmekte, yağ ve küspe olarak ayrılarak değerlendirilmektedir. Soya fasulyesi küspesi, özellikle kanatlı yem ve büyükbaş hayvan yemi üretiminde yoğun olarak kullanılmaktadır. Çiftlik hayvanlarının rasyonlarını dengelemek, amino asit açıklarını tamamlamak amacıyla kullanılan soya küspesi, yüksek derecede sindirim derecesine sahip bir üründür. Tüm dünyada yem endüstrisinin temel bir protein kaynağı olduğu için, yılın her günü stratejik olarak ticarete konu olan bir yem ham maddesidir. Bu çalışmanın materyalini bazı soya genotip ve çeşitleri (yemsoy, yeşilsoy, PNR-8) oluşturmaktadır. Çalışma kapsamında DPPH ve ABTS yöntemi ile antioksidan kapasite tayini yapılmıştır. ABTS yöntemi ile VD1-10 genotipinin (11,02 µmol TE/g örnek), DPPH yöntemi ile de VD1-3 genotipinin (4,11 µmol TE/g örnek) en yüksek antioksidan kapasiteye sahip olduğu belirlenmiştir. Örnekler arasında ortalama nem oranı %10,75 ve ortalama kül miktarı % 3,54 olarak tespit edilmiştir. Kaliteli soya üretimi, hayvancılık sektöründe yem kalitesini artırarak hayvan beslenmesinde olumlu katkılar sağlayacaktır.

**Anahtar Kelimeler:** antioksidan, yem, soya

## EVALUATION OF SOME SOYBEAN GENOTYPES AND VARIETIES GROWN IN SİVAS ECOLOGICAL CONDITIONS IN TERMS OF ANTIOXIDANT CAPACITY

### **Abstract**

Soybean, a plant with a very high protein value, is a versatile plant with its cholesterol and saturated fat-free structure and high-quality protein content. It is widely used in animal and human nutrition. Soybean is extruded and evaluated by separating it into oil and meal. Soybean meal is used intensively, especially in the production of poultry feed and cattle feed. Soybean meal, which is used to balance the rations of farm animals and complete amino acid deficiencies, is a product with a high degree of digestibility. Since it is a basic protein source of the feed industry all over the world, it is a feed raw material that is strategically traded every day of the year. The material of this study consists of some soybean genotypes and varieties (yemsoy, yeşilsoy, PNR-8). Antioxidant capacity determination was made with DPPH and ABTS methods within the scope of the study. It was determined that the VD1-10 genotype (11.02  $\mu\text{mol TE/g}$  sample) had the highest antioxidant capacity with the ABTS method and the VD1-3 genotype (4.11  $\mu\text{mol TE/g}$  sample) with the DPPH method. The average moisture content among the samples was determined as 10.75% and the average ash content as 3.54%. Quality soybean production will provide positive contributions to animal nutrition by increasing feed quality in the livestock sector.

**Keywords:** antioxidant, feed, soybean



## Giriş

Soya, özellikle Çin, Kore gibi birçok ülkede yaşayan insanların en önemli geçim kaynağıdır. Protein ve yağ içeriği bakımından oldukça zengindir. Soya, dünya çapında yağ bitkileri sınıfında oldukça önemli bir yere sahiptir. Bunun sebebi, soyanın çok yönlü kullanım alanlarının olması ve hızlı nüfus artışı nedeniyle bitkisel yağ tüketiminin sürekli artmasıdır. Soyada verim ve kalite üzerine genotip, çevre ve genotip x çevre interaksyonu çok önemli etkilere sahiptir (Arioğlu ve ark., 1992).

Dünya toplam yağlı tohum üretimi 2010 yılında 832 milyon ton iken 2019 yılında 1.102 milyon tona yükselmiştir. Geniş kullanım alanına sahip olmasından dolayı dünyada yağlı tohum üretiminde üretim miktarı bakımından ilk sırada palm, ikinci sırada soya yer almaktadır (3.409 milyon ton). Soya, dünya çapında yağlı tohum ekim alanları bakımından ilk sırada (11.525 milyon da), üretim miktarı bakımından ikinci sırada yer almaktadır (3.047 milyon ton). 2019 yılı verilerine göre dünya genelinde yağlı tohumlu bitkilerin toplam ekiliş alanlarının (29.803 milyon da) %37,37'sinin soyaya (1205 milyon da) ait olduğu görülmektedir FAO (2021). Dünya genelinde olduğu gibi ülkemizde de son 10 yıl içerisinde yağlı tohum üretim miktarı artış göstermiştir. 2009-2019 yılları arasında yağlı tohum üretimi 2.4 milyon tondan 4 milyon tona çıkarak %66.3 oranında artmıştır. Buna paralel olarak aynı yıllar arasında toplam yağlı tohum ekim alanı 8 milyon dekardan 13.9 milyon dekara ulaşmıştır. Bu 10 yıllık süreç içerisinde yağlı tohumlu bitkiler içerisinde en fazla üretim artışı soyada gerçekleşmiştir. 2009 yılında 38 bin ton olan soya üretim miktarı 2019 yılında 150 bin tona çıkmıştır TÜİK (2020).

Türkiye'de yürütülen soya ıslah çalışmalarının eksik yönlerinden biri, soya yağının kalitesi ile ilgili olarak yapılan çalışma sayısının az olmasıdır. Türkiye'ye yem amacı ile ithal edilen soylar GDO'lu olması sebebi ile gıda sanayisinde kullanılamamaktadır. Bu sebeple, yerli ıslah çalışmalarıyla yeni çeşitlerin geliştirilmesi ve bu çeşitlerin kalite parametreleri bakımından incelenmesi gerekmektedir (Gölükçü ve ark., 2019). Soya fasulyesi, hayvan yemi olarak yaygın bir şekilde kullanılır. Özellikle tavuk, domuz ve balık yetiştiriciliğinde önemli bir yem kaynağıdır. Soya yağı, gıda sanayisinde yaygın olarak kullanılır ve margarin, mayonez, salata sosları gibi ürünlerin yapımında temel bir bileşendir. Kaliteli soya üretimi, hayvancılık sektöründe yem kalitesini artırarak hayvan beslenmesinde olumlu katkılar sağlamaktadır. Soya fasulyesine uygulanan ekstrüzyon işlemi ile soyanın besleyiciliği yükselmekte ve soya yağından faydalanılması artmaktadır. Ekstrüzyon işleminden sonra soya tanelerinden çıkarılan yağın ardından kalan soya fasulyesi küspesi kanatlı yem ve büyükbaş hayvan yemi üretiminde kullanılmaktadır (Civelek, 2006; Arslan, 2007; Arslanoğlu ve Aytaç, 2010).

Bu çalışmada bazı soya genotip ve çeşitlerinin antioksidan kapasite, nem ve kül parametreleri bakımından değerlendirilmesi amaçlanmıştır.

## Materyal ve Metod

### Materyal

Araştırma, soya yetiştirme sezonunda bir yıl (2023) süreyle yürütülmüştür. Araştırmada, on bir soya genotipi ve 3 adet soya (yemsoy, yeşilsoy, PNR-8) çeşidi materyal olarak kullanılmıştır (Tablo 1). Çalışmanın tarla denemesi 2022-2023 yetiştirme sezonunda Sivas Bilim ve Teknoloji Üniversitesi Tarım Bilimleri ve Teknoloji Fakültesi tarımsal AR-GE merkezi deneme alanında tesadüf blokları deneme desenine göre 3 tekerrürlü olarak yürütülmüştür. Denemede her genotip 6 sıra, sıra arası 70 cm ve sıra üzeri 10 cm olacak şekilde 5 metrelik parsellere ekimi yapılmıştır. Denemede ekimle birlikte 6 kg/da N ve 6 kg/da P<sub>2</sub>O<sub>5</sub> uygulaması yapılmıştır. Yetiştirme sezonunda ekim işlemi bölgenin iklim koşulları dikkate alınarak gerçekleştirilmiştir.

**Tablo 1.** Denemede materyal olarak kullanılan genotip ve çeşitler

No	Genotip
1	VD1-1
2	VD1-2
3	VD1-3
4	VD1-4
5	VD1-5
6	VD1-6
7	VD1-7
8	VD1-8
9	VD1-9
10	VD1-10
11	VD2-11
<b>Çeşitler</b>	
12	PNR-8
13	Yemsoy
14	Yeşilsoy

## Metot

**Kül Analizi:** Ham kül analizi AOAC (1990) metoduna göre yapılmıştır. Kurutup öğütülen numuneler porselen krozeler içinde 1 g hassas terazide tartılıp 550 °C'ye ayarlı yakma fırınına yerleştirilerek 3 ila 5 saat (gümüş gri bir renk almaya kadar) yakılmıştır. Süre sonunda numuneler desikatöre alınıp soğutulduktan sonra hassas terazide tartımı yapılmıştır. Kaydedilen tartımlardan aşağıdaki formüle göre % kül miktarı hesaplanmıştır.

$$\%Kül\ miktarı = \frac{(Son\ ağırlık - Dara) \times 100}{(Dara + Numune) - Dara}$$

**Nem Analizi:** Gardner (1986) metoduna göre yapılmıştır. 3 g tartılan örnekler rutubet kabına konulmuştur. Örnekler 130°C'de önceden ısıtılmış etüve yerleştirilmiştir. 2 saat boyunca etüvde bekletilmiştir. Etüvden çıkarılan örnekler tartılmıştır. Nem hesaplama formülü kullanılarak nem miktarı belirlenmiştir.

$$W_{H_2O} = \frac{m_1 - m_2}{m_2 - m_0} * 100$$

Eşitlikte;

mo: Boş kabın kapağı ile birlikte kütlesi, g

m1: Nemli örneği bulduran kabın kütlesi, g

m2: 105°C de kurutulmuş toprak örneğin kapla birlikte kütlesi, g

### Antioksidan Analizi:

**DPPH Yöntemi:** 2,2-difenil-1-pikrilhidrazil (DPPH) protokolü uygulanmıştır (Aghraz ve ark., 2018). Bunun için 2 ml DPPH solüsyonuna (0,025 g/L) 0,1 ml numune eklenmiştir. Elde edilen karışım 30 dk karanlıkta inkübe edilmiştir. Absorbanslar 517 nm'de kaydedilmiş ve bulgular kurutulmuş Morchella gramı başına mmol 6-hidroksi-2,5,7,8-tetrametilkroman-2-karboksilik asit (trolloks) eşdeğeri (TE) olarak belirtilmiştir.

**ABTS Yöntemi:** Re ve ark. (1999) tarafından geliştirilen spektrofotometrik yöntem kullanılmıştır. 2,2'-azino-bis (3- ethylbenzothiazoline-6-sulphonic acid (7 mM) ve potasyum peroksidisülfat çözeltisi (2.45 mM) sırasıyla 50 ml ve 50 mL saf suda çözülmüştür. Stok çözeltiyi hazırlamak için hazırlanan ABTS çözeltisinden 10 ml alınmış, 10 ml K2O8S2 (potasyum persülfat) çözeltisinden ilave edilmiştir. ABTS radikal çözeltisinin hazırlanması için

karişım oda sıcaklığında 16 saat karanlık ortamda bekletilmiştir. Çalışma çözeltisi; stok çözeltisinin 734 nm’de 0.700±0.02 absorbans değeri verecek şekilde seyreltilmesi ile hazırlanıp ve böylece başlangıç absorbans değeri belirlenmiştir. Daha sonra 100 µL ekstrakt üzerine 3 ml çalışma çözeltisi (ABTS+peroksidisülfat) standart ya da örnek ilave edilip karıştırıldıktan sonra reaksiyonun gerçekleşmesi için oda sıcaklığında karanlık bir ortamda 10 dakika beklenip ve 734 nm’de absorbans değerleri okunmuştur.

## Bulgular ve Tartışma

Çalışmada kullanılan soya genotiplerinin antioksidan kapasite, nem ve kül değerleri Tablo 2’de verilmiştir.

**Tablo 2.** Çalışmada kullanılan yemlik soyaların antioksidan kapasite, nem ve kül değerleri

	ABTS (µmol TE/g örnek)	DPPH (µmol TE/g örnek)	Nem (%)	Kül (%)
VD1-1	8,28 a-c	3,13 a	10,75	3,08
VD1-2	8,68 a-d	2,31 c	10,4	3,19
VD1-3	7,91 d-f	4,11 a-b	9,79	3,64
VD1-4	10,13 a-b	3,37 a	9,67	3,98
VD1-5	10,30 a-b	3,47 a	9,67	3,56
VD1-6	8,86 a-d	3,15 a	10,81	3,14
VD1-7	8,94 a-c	3,17 a	11,59	3,77
VD1-8	8,71 a-d	3,52 a-c	11,22	3,90
VD1-9	8,43 a-d	3,50 a-c	11,66	3,21
VD1-10	11,02 a-b	2,85 b-c	10,4	3,59
VD2-11	9,28 a-b	4,00 a	11,11	3,22
PNR-8	9,09 a-b	4,09 a	11,58	4,05
Yemsoy	8,90 a-d	3,59 a-c	10,85	3,72
Yeşilsoy	9,39 a-b	3,36 a	11,06	3,52
Ortalama	9,14	3,40	10,75	3,54

Tablo 2 incelendiğinde genotip ve çeşitler arasında antioksidan içerikleri ABTS yönteminde 7,91-11,02 µmol TE/g örnek arasında değişim göstermiş olup DPPH yönteminde ise 2,31-4,11 µmol TE/g örnek arasında değişim göstermiştir. Ortalama nem değeri %10,75 ve ortalama kül değeri %3,54 olarak saptanmıştır. Çalışmada materyal olarak kullanılan genotip ve çeşitler arasında incelenen özellikler bakımından farklılık gözlenmiştir fakat anlamlı bulunmamıştır. Soedarjo ve ark. (2020), bazı soya fasulyesi çeşitlerinin toplam fenolik içeriğini ve antioksidan aktivitesini değerlendirmek için yaptıkları çalışmada; ABTS ve DPPH ile ölçülen toplam fenolik içeriğin ve antioksidan aktivitenin test edilen soya fasulyesi tohumları arasında değiştiğini saptamıştır. Toplam fenolik içerik ve antioksidan aktivitenin değişkenliğinin farklı tohum boyutlarından değil, tohum boyutundan farklı fenotipleri kodlayan farklı genetik arka plandan kaynaklandığını ve antioksidan aktivite ile toplam fenolik içerik arasında pozitif ilişki olduğunu bildirmişlerdir (Soedarjo ve ark., 2020). Antioksidanlar, vücudumuzda serbest radikallerin zararlı etkilerini azaltan veya ortadan kaldıran bileşiklerdir. Diyetle alınan doğal antioksidanlar, antioksidan savunma sistemini güçlendiren en önemli unsurların başında gelmektedir. Ülkemizde ve dünya genelinde büyük oranda tüketilen soyanın antioksidan içeriği gıda kalitesi açısından önem arz etmektedir. Kullanışlılık düzeyi yüksek bir yöntem olarak kabul edilen DPPH ve ABTS testi antioksidanların aktivitesini değerlendirmektedir (Seeram ve ark., 2006; Yu ve ark., 2006).

## **Sonuç**

Yerli üretimi artırabilmek için İç Anadolu Bölgesi gibi soyanın rahatlıkla yetiştirilebileceği yerlerde, soyanın ekim nöbeti içine dahil edilmesi ve bu bölgelere uygun yüksek verimli ve kaliteli yeni çeşitlerin geliştirilmesi gerekmektedir. Çalışmalarımız sonucunda; VD1-10 ve VD1-3 genotipinin en yüksek antioksidan kapasiteye sahip olduğu belirlenmiştir. Ülkemizde ve dünya genelinde büyük oranda tüketilen soyanın antioksidan içeriği gıda kalitesi açısından önem arz etmektedir. Bu nedenle kalite değeri yüksek yeni çeşitler geliştirme çalışmalarında VD1-10 ve VD1-3 genotiplerinin değerlendirilebileceğini öngörmekteyiz.

## **Açıklama**

Bu çalışma Sivas Bilim ve Teknoloji Üniversitesi “bazı soya genotip ve çeşitlerinin agromorfolojik özellikler ve kalite parametreleri bakımından Sivas ekolojik koşullarında değerlendirilmesi” başlıklı yüksek lisans tezinden üretilmiştir.

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