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# Usage of Sludge in Agricultural Applications

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**Abstract**

The aim of this study was to evaluate the use of waste sludge from treatment plants and to use them in agricultural applications. With the increasing population, the amount of waste sludge from the treatment plants is increasing in proportion to the same amount. However, one of the important problems in the facilities is the storage problem, so there is an alternative solution for what to do with the excess sludge. The disposal method that has been on the agenda in recent years is the application of the sludge after the treatment to agricultural land. The content of the sludge is also an important factor. Substances that should not be on agricultural land should not be applied to the land. In case of necessary conditions, it has great advantages both in terms of agricultural land and increase plant.

**Keywords:** Agriculture, Environment, Treatment Sludge

**Review article**

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## INTRODUCTION

Today, the amount of water used in increasing population is increasing. Considering that this situation will cause further problems, Wastewater Treatment Plants are being constructed. During the day, houses, workplaces, common areas etc. The waters we use come to these facilities as waste water and they are rendered harmless to the environment by providing them. Treatment sludge is formed as a result of the increase of domestic and industrial water. Depending on the components in which the sludge is used. Mud to be used in agricultural areas should not contain heavy metal and toxic compounds. For this reason, it is more convenient to use sludge in the treatment of domestic wastewater.

It is an effective recycling method in terms of evaluation of agriculture, prevention of environmental pollution and protection of natural resources. This method is the cheapest waste removal method compared to other evaluation methods. The sewage sludge supports the reduction of fertilization costs as a source of organic fertilizers with the nutrients it contains. In addition, the improvement effect of some properties of soil in the treatment sludge is another important advantage that supports its use (Akat et al., 2015).

The increase in the number of wastewater treatment plants in our country every day raises the issue of how to evaluate the treatment sludge. However, it cannot be said that there is sufficient knowledge and research findings about the use of treatment sludges. The current practice is that wastewater sludges should be disposed of as waste by landfills or unconsciously in agricultural production by farmers near the plant. Environmental pollution will be prevented by the use of treatment sludge, which is a great source of organic matter, in the field (Bilgin et al., 2002).

### Treatment Sludge

Treatment sludges are wastes generated by the process in domestic and industrial wastewater treatment plants. Treatment sludge is a product of the wastewater treatment and the sludge disposal has become a more vital need as the amount of sludge that is accumulated every day and thus the amount of storage for the sludge is increased (Aslan 2018).

In all pathogenic organisms, pollutants and wastewater treatment plants in the wastewater, the chemicals used in the processes are converted into sludge in order to reach the discharge limits of the water. For this reason, sludge contains harmful substances. These muds, which are of great harm to human health and the environment, are not evaluable for any process but have good calorific value. For this reason, these sludges can be recovered as energy by being disposed of in appropriate thermal processes (Anonymous 2018).

### Sewage Sludge Sources

Generally the mud originates from 3 main categories. These;

- Purification sludge from drinking water treatment plants
- Refining sludge from waste water treatment plants
- Industrial wastewater is the treatment sludge from the treatment plant.

Depending on the type and purpose of treatment, the types of treatment sludge vary.

- Pre-sedimentation sludge formed by collapsible solids
- Chemical sludge from chemical treatment and coagulation

- Biological sludge from biological treatment
- Advanced Treatment Sludge (Yıldız et. al., 2009)

**Composition of Treatment Sludges**

Sewage sludge, according to the type of industrial organization in which it occurs; organic compounds, acids, alkalis, metal salts, phenols, oxidants, dyes, sulfates, hydrocarbons, oils, Fe, Cu, Al, Hg, Cd, As, Co, Pb, Cr, organic phosphorus and nitrogen can contain substances such as (Taşatar, 1997).

In order to be able to use the slurries in the agricultural areas, attention should be paid to the nutrients, pH level, salinity and presence of heavy metals.

**The Effects of Nutrients in the Sludge on Plants:**

Plants need many nutrients to grow and grow from seed. These nutrients;

*Macro Nutrients:*

*Carbon* is an element that is received from the air by air (atmosphere) in the form of $CO_2$. It is the basic molecular component of carbohydrates, proteins, fats and nucleic acids. It is the plant nutrient element that is used in the photosynthesis process of plants (Jones ve Jacobsen, 2001; Fageria et al., 2011).

*Hydrogen* is an element taken from water by the plants in $H_2O$ form. It is a plant nutrient that plays a central role in plant metabolism. It is important to provide ion balance due to being the main reducing agent. It also has a key role in the energy relations between cells. Responsible for many biochemical reactions in the plant (Jones ve Jacobsen, 2001; Fageria et al., 2011).

It takes *oxygen* from plant water and air in $O_2$ and $H_2O$ forms. It is a nutrient that is very similar to carbon in terms of its functions in the plant. Therefore, all organic compounds of living organisms are actually present. The oxygen element that forms the structure of carbohydrates is also required for respiration (Jones ve Jacobsen, 2001; Fageria et al., 2011).

*Nitrogen*, together with water, is the most frequent nutrient. That's why we see more plant growth control as a nutrient element (Çepel, 1996; Gardiner ve Miller, 2008; Fageria, 2009). Because there is no nitrogen compound in the inorganic parent material from the bedrock and the bedrock. The source of nitrogen in nature is the atmosphere. There is also a significant amount of nitrogen in the hydrosphere and living things. The main depot of nitrogen in the soil is organic matter. Plants can be used in nitrogen as a result of the decomposition of organic matter over time (Çepel, 1996; Kantarcı, 2000; Boşgelmez et al., 2001).

*Potassium* plays a major role in multiple events taking place in plants. It is used by plants in the activation of numerous enzymes and coenzymes, photosynthesis, protein formation, starch formation and sugar transfer. It increases the water balance of the plant with the cell sap and thus increases the resistance against drought. It has a positive effect on summer drought and frost resistance (Brady, 1990; Kantarcı, 2000; McCauley et al., 2009).

*Calcium* is the third most used plant nutrient. The plant is an integral part of the cell wall and is therefore known as the plant nutrient element that regulates the cell wall structure (Plaster, 1992; McCauley et al., 2009).

The source of *phosphorus* in the soil is apatite mineral. Apatite mineral is present in flour apatite or hydroxyapatite compositions. Generally, while crystalline schists such as quartzites, phyllites and micaschists contain a small amount of phosphorus, the amount of phosphorus in basalt and similar basic magmatic rocks is higher. It can be used by phosphorus plants which are released by fragmentation of rocks and minerals. There are also organic phosphorus compounds in the soil because of the presence of phosphorus in the structure of organic matter (Çepel, 1996; Aktaş & Ateş, 1998; Kantarcı, 2000).

The source of *magnesium* is biotite, augite, hornblende, olivine, serpentine, chlorite, dolomite. Magnesium in the soil is found in various forms according to the mineralogical composition of the main rock (Çepel, 1996; Kantarcı 2000; Kacar & Katkat 2010). Minerals such as biotite, dolomite, chlorite, serpentine and olivine contain magnesium. The magnesium in the soil can be water-soluble, changeable and non-volatile. These three forms of magnesium are in a dynamic equilibrium with each other (Boşgelmez et al., 2001).

*Sulfur* is an essential nutrient for plants, animals and human. Primary eruptive stones are found as pyrite ($Fe_2S$) and copper, nickel sulphides. Sedimentary stones or materials include anhydrite ($CaSO_4$) or gypsum ($CaSO_4.2H_2O$). In salt soils, what is the alkali and magnesium sulfate compound. The soil reaches some amount of sulfur from the atmosphere. $SO_2$ gas in the air goes down in the rain (Kantarcı, 2000; Boşgelmez et al., 2001; Özbek et al., 2001; Gardiner & Miller, 2008).

*Micro Nutrients:*

*Iron* is an essential element for plants, animals and humans. A small amount is needed by all living things (Özbek et al., 2001). Most of the iron in the soil is found as the building element in the crystal lattices of various minerals. Ferrous silicate minerals such as olivine, augite, hornblende and biotite are primary minerals containing iron. Iron in some parts of the clay minerals, in the form of oxide, hydroxide, carbonate and phosphate in many soils (Kantarcı, 2000; Boşgelmez et al., 2001; Güzel et al., 2004).

*Chlorine* sources are NaCl, KCl and MgCl2 minerals which are formed by apatite $Ca_5$ (F, Cl) $(PO_4)_3$ and sodalite (Na4Al3Si3O12Cl) minerals. It is a plant nutrient that is not found in nature freely. It is mostly found in the form of mineral chlorides with sodium chloride (NaCl). Magnesium chloride and potassium chloride are found in seawater and in some beds (Kantarcı, 2000; Boşgelmez et al., 2001).

*Copper* chlorophyll production is a plant nutrient required by the plant for respiratory and protein synthesis. Activation of various oxidase enzymes and the transfer of a large number of electrons are carried out by copper. It is effective in protein and carbohydrate metabolism. It has a role in fixation of symbiotic nitrogen (Boşgelmez et al., 2001; Gardiner ve Miller, 2008; McCauley et al., 2009).

*Manganese* is in the structure of various primary and secondary minerals. Primary source is silicate minerals. Olivine gabbros and micaschists and serpentines are more common. In the soil, manganese has 3 and 4 valent manganese oxides with power dissolving. The solubility of manganese in soil varies according to soil reaction, microorganism activities and soil water characteristics (Kantarcı, 2000; Boşgelmez et al., 2001).

*Zinc* silicate minerals in the soil, as oxides; It is contained in clay minerals or in organic matter. In magmatites, metamorphics and mineral deposits as zinc sulphide (ZnS, sphalerite) and with some other heavy metals, they are present as sulphides. The zinc in the soil is transformed into insoluble compounds over time. Insoluble binding of zinc increases at high pH. In contrast, the solubility of zinc compounds increases as the soil simplifies (Kantarcı, 2000; Özbek et al., 2001).

*Molybdenum* is particularly present in primary minerals. Molybdenum, wulfenite, powellite and ferromolybdenum are among these. Olivine and biotite minerals are also rich in molybdenum. Keeping in the soil is similar to the retention of phosphate anions. Iron and aluminum oxides also retained by. (Kantarcı, 2000; Özbek et al., 2001; Kacar & Katkat, 2010).

*Boron* is the only nonmetal element between the micro elements. Borax, kernite, colemanite, ulexite, ludvigit and katoit are other important boron minerals found in soils. Boron silicate minerals are mostly found in limestones and dolomites. On the other hand, the amount of boron in marine sediments is very high. The boron element is present in the soil as borates of (Foth, 1984; Kantarcı, 2000; Güzel et al., 2004; Gardiner & Miller, 2008; Kacar & Katkat, 2010).

It was revealed that the *nickel* element was a nutrient needed for the growth and development of the plant (Brown et al., 1987; Brown et al., 1990; Fageria, 2009). In general, the amount of nickel in the soil is very low. However, high amounts of serpentines are present in soils. The nickel leaking from the soil goes away from the soil with leaking water. In the arid regions, nickel in the soil cannot be washed and accumulates (Kantarcı, 2000).

**The Effect of pH Level on the Plants in Waste Sludge:**

- Acid Soils Calcium and Magnesium elements which are essential for plants are not sufficient. Therefore, plants growing in acid soils cannot get enough calcium and magnesium. Yield and Quality ability of these plants showing unhealthy structure is decreasing.

- Plants in acid soils give the battle of life. Acid Soils are unsuitable habitats for many plants. In this land, there is a war between plant and acidity. However, in this war, soil acidity prevails by damaging the plants, especially the capillary root system. As a result, the yield and quality of the crop decrease significantly. Strong acidity, especially in summer plants where dry farming is done, for example in sunflower plants, even the plant can prevent the exit. Despite the acidity, the plants on the soil to survive on the battle of life to enter into a significant loss of their ability to lose.

- Nitrogen, Phosphorus and Potassium are the macro nutrients and plants need to take these foods at the rates specified in Soil Analysis Reports. However, if the soil is acid, all of these foods contained in fertilizers cannot be taken by plants. Depending on the degree of acidity, they bind to the soil in significant amounts.

- The water-holding capabilities of the beach-based acid soils are low. If the soil is low in water retention, yield and quality will decrease. (Küçükaslan 2012).

**The Effect of Salinity on the Plants:**

The salty soils are soils that are commonly present in arid regions and contain soluble salts in an amount that will prevent plant growth. Soluble salts can easily be taken up by plants. It is harmful to the plant when it exceeds a certain concentration according to the type and amount of salt compounds entering the plant. The salt concentration in salinity or soil is determined by the electrical conductivity of the saturated solution (extract, solution). The electrical conductivity of a solution is proportionally dependent on its salt content (Karaman et al., 2007).

Salt stress in plants;

- Stunting in,
- Decrease in root growth
- Reduction of bud formation,
- Leaves and fruits remain small
- Fertilization disorders
- Causes the formation of yellow spots (necrosis) on the roots, buds, leaf edges and growth ends as a result of dying of cells (Yang et al., 1990).

**The Effect of Heavy Metal Presence on the Plants in Waste Sludge:**

*Lead* contains a variety of lead in various plants. Natural lead levels in plants are below 5 ppm. Natural lead time may increase according to the soil and the atmosphere in which the plant is grown. Most of the lead taken by the plant accumulates in the roots of the plant. Lead is not found in parts of the soil above the plant. The fact that the plant is taking or assimilating the lead is at a level of 0.05-5ppm of soluble lead in the soil rather than the total lead in the soil. Very soluble lead compounds are converted into lead compounds which cannot be dissolved in soil (Özkan, 2009).

The effect of *copper* on plants and living things depends on the chemical form and the size of the organism. It is a basic building component for large living beings while it is a poisonous property for small and simple living creatures. Therefore, copper and its compounds are widely used as fungicides, biocides, antibacterial agents and insect pests against agricultural pests and molluscs. Copper deficiency is observed in mineral soils, especially in sandy and pebbly soils. Copper is found in many foods and mostly in organ meat, shellfish, nuts and seeds. Wheat bran and whole grain products are also a good source of copper (Seven, 2018).

Total *zinc* in the soil is generally between 10-300 mg / kg and 30-50 mg / kg on average. Some acidic soils with high levels of washing contain zinc at levels as low as 10-30 mg / kg. Zinc is only toxic at high concentrations (Kaçağıl, 2013). Zinc-soluble forms of zinc are suitable for plants and the uptake of zinc increases as the concentration of the substance in the soil increases. Zinc intake depends on the type of plant as well as the environment. In particular, the amount of calcium in the environment affects zinc uptake. Zinc is usually found in plant roots (Okcu et al., 2009).

*Cadmium* is the element with the highest solubility in heavy metals. For this reason, it differs rapidly in nature and is not necessary for human life. Due to its water soluble properties, it is taken into the biological systems by plant and sea creatures as $Cd^{2+}$ and has the property of being present. Cadmium fertilizers and pesticides are also easily found in the soil. Liver, mushrooms, shellfish, mussels, cocoa powder and seaweed (Özkan, 2009).

Plants are absorbed by *nickel* absorbing, ecological cycle of vegetables and fruits from the body of living creatures nickel intake is high. Nickel when exposed to contaminated soil or water (Özkan 2009).

The solubility in the form of *mercury* phosphate, carbonate and sulfate is immobilized in the soil to form low forms. Immobilized and water-insoluble mercury compounds are inaccessible to plants. However, these compounds can be reduced again to metallic mercury. The evaporation and environmental movement of the mercury may thus be possible (Okcu et. al., 2009).

*Iron* counts among the minor elements, but ranks fourth among the most common elements in the earth's crust. Plants are taken by small amount. Iron is necessary for the formation of chlorophyll. In the case of iron deficiency, chlorophyll does not form well and chlorosis is seen in plants. In case of iron deficiency, the leaves of the plants become light yellow. This situation is especially more pronounced in young leaves. The leaf veins are dark colored, but the veins are light. Iron chlorosis can be prevented by giving ferrisulfate ($Fe_2SO_4$) to leaves or directly to soil. In calcareous soils it is useless to give iron sulphate to soil. Sprayed into the leaves of plants (Özkan, 2009).

The permissible total Cr level in *chromium* agricultural soils is 100 mg / kg and the extractable Cr level is around 1 mg / kg. Soils composed of serpentine are rich in Cr. The increase in Cr content in plants is not seen much. In most soils, Cr has not been found to have a harmful effect even in the case of the use of Cr salts with high water solubility due to the immobility of Cr. The movement of chromium within the plant is also very limited. In contrast, Cr, which is applied at very high levels, can have toxic effects on plants. Plant roots in chrome poisoning is small, leaves are narrow and brown red color. Leaves are composed of small burn spots (Karaçağıl 2013).

**Use of Treatment Sludges in Agricultural Areas**

Waste sludge from sewage treatment plants contain high amounts of nutrients, so their use in agriculture minimizes the use of fertilizers. It is important that there is no toxic material in the waste sludge. Because it does not benefit the land by pouring the substances not found in the environment into agricultural land, damage to the soil structure can be given.

The periods in which the sludge will be deposited to the soil vary according to the climatic conditions of the region, the plant production program and the permissible load. The most important factor in the calculation of the load that can be given to the soil is the maximum amount of mud that the soil can absorb without causing floods and ponding. İkinci önemli faktör, azot ve fosfor gibi besin maddeleridir (Nisanoğlu, 1998).

It is necessary to pay attention to the amount of nitrogen in the waste sludge given to the land. Excessive application rate may cause damage to crops as it prevents seed germination and growth. Ammonia in waste sludge, preventing seed germination. Bunu engellemek için tohum atılmadan birkaç gün önce çamur toprağa püskürtülmelidir ya da arıtma çamuru havalandırılmalıdır (Filibeli, 1996).

The ability of the soil to use mud depends on the physical and chemical properties of the soil. Soil must be capable of filtering, buffering and absorbing sludge as well as product growth. Generally, the soil be treated with mud should be medium permable (1,5-15 cm/ha), good drainage, neutral or alkaline to control the solubility of heavy metal, must have fine to provide high moisture and nütrient capacity (Filibeli,1996).

## RESULTS

It is known that the amount of wastewater increases with the increase of population. Used wastewater must be treated in treatment plants in order not to harm the nature and to be reused in certain conditions. At the end of the treatment process, the amount of waste sludge from the plant is increasing. In order to use the waste sludge in agriculture, investigations should be done in detail. Waste sludge from industrial water treatment is not preferred in agricultural land because it can contain heavy metal heavy metals. Stabilized sludge from domestic wastewater is more suitable for farmland. These sludges are used for breeding in agricultural areas as a result of investigations, if they are suitable for salinity, nutrients, heavy metal and pH. The use of stabilized slurries also reduces the use of fertilizers. The fact that fertilizer is rich in ammonia can cause problems during the sprouting of plants. Stabilized mud is also suitable for plants because it is rich in nutrients.

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# Uses of Natural additives in seafood

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**Abstracts**

Due to the health challenge in association with chemical additives in food, this has led to its rejection as preservation by the consumer, demand for Natural processed seafood with good nutritional properties and sensory quality increased, Fish and shell-fish spoils faster immediately after harvesting and the quality together with the nutrients are lost during processing and preservation period, because of their high level of polyunsaturated fatty acids (PUFAs,) the high moisture contents, free amino acids and the presence of autolytic enzymes, bacteria contamination and loss of protein functionality. To retain these qualities, Natural additives have been widely employed in the seafood industry in order to maintain the seafood quality Natural antimicrobial systems found in plants, animals and microorganisms can be used with developing technology. natural antimicrobials that reinforce food safety and preservation by inhibiting bacteria, fungi, and viruses are being deeply evaluated and studied. Foods such as celery, thyme, oregano, clove, bay, almond, coffee, and cranberry contain natural antimicrobials with the ability to inhibit the growth of several microorganisms Natural additives frequently applied Include lysozome, Lactoperoxidase system, Lactoferrin, Chitosan, Spices and their essential oils, Olives, Nisin and bacteriocins .In this review, we will examine the natural antimicrobial, antioxidant, and antibacterial effects on preservation of shelf life of seafood products.

**Keywords**: Natural antimicrobials, antioxidant, antibacterial, seafood quality and seafood shelf-life.

**Review article**

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## INTRODUCTION

Fish and shellfish are highly perishable as a result of non-protein nitrogen substances they contained such as Lipid content, ph level and high moisture content which makes them be easily prone to microbial growth (Miraglia et al., 2016). Also, Seafood contains a high concentration of lipid as a result of high percentage of Polyunsaturated fatty acids (PUFAs) especially eicosapentaenoic acid, (EPA) and docosahexanoic acid (DHA) which caused off-flavor formation, alteration of color, texture and nutritional level (Secci & Parisi, 2016). Microbial spoilage agents microorganism type, number, harvesting area, type, capture method and handling operations are effective. Typical fish odor comes from TMA. The TMA microbial activity results from trimethylamine oxide (TMA-O). TMA-O is specific to fish meat, other meat is either absent or very small in quantity. Therefore, other meats do not smell like fish. Some additives could be incorporated intentionally to preserve and/or enhance food characteristics, an example would be antimicrobial agents (Wang et al., 2011).Many foods contain natural compounds with antimicrobial activity; these compounds may play a significant role in prolonging food shelf-life. Many of them have been studied for their potential as direct antimicrobials added to food. Their usage has been gaining popularity throughout the globe, natural antimicrobials that reinforce food safety and preservation by inhibiting bacteria, fungi, and viruses are being deeply evaluated and studied. Foods such as celery, thyme, oregano, clove, bay, almond, coffee, and cranberry contain natural antimicrobials with the ability to inhibit the growth of several microorganisms (Sono-chilaca et al., 2016).Antimicrobials are chemical compounds that are naturally present in or added to foods, food packaging, food contact surfaces, or food processing environments to inhibit microbial growth or kill microorganisms (Davidson et al., 2003).

Preservatives are added to food in order to control the growth of microorganisms (bacteria and fungi). Although the most utilized are synthetic preservatives, there are a number of natural products obtained from plants that can be used as food preservatives. Food antimicrobials remain among the most important food additives, they can be synthetic compounds (intentionally added to foods) or from natural origin (Vigil et al., 2005). Phenolics antioxidant in food as well as being important in terms of microbial safety. Natural antimicrobial systems present in plants, animals, or microorganisms are gaining popularity for their potential usage in minimally processed foods. Natural antimicrobial systems can be classified by origin (Soto-chilaca, 2016).

### Animal source

Animal is one of the major source of antimicrobial agent that can be consumed safely, chitosan have been applied broadly in the food processing industry (Sharif et al., 2017). Chitosan are low acetyl replaced forms of chitin, it’s identified as resourceful biopolymers widely use in food industry (Shahidi et al., 1999). Chitosan can also be applied for the preparation of several polyelectrolytes complex products with natural polyanions like alginate (Alishali et al., 2012). Chitosan can be extracted from exoskeleton of chitin (arthropods) like crabs, shrimps, and lobsters.it is rich in metal binding capacity with metal iron like chromium, zinc, lead, and iron . (Peng et al.,1998). Now a days, chitosan and its derivatives has showed positive effects as antimicrobial agents, against several microorganisms like bacterial, fungi, yeast (Cao et al., 2009) reported that 5 g/L of chitosan prolong the shelf –life of oyster (*Crassosttrea gigas*) from 8 to 9 days to 14 to 15 days. They further explained that *pseudomonas* and *shewanella* reproduce faster than other in production of toxins and microbial growth. Ye et al., (2008) also reported that chitosan possesses an antibacterial activity that effectively showed in aqueos system, wherefore, its antibacterial characteristics against *L. monocytogenes* in cold-smoked salmon was insignificant. When chitosan is applied in Insoluble film, the growth of *L. monocytogenes* in salmon samples covered with chitosan-coated film and plain film showed similar result (Alishali et al., 2012).

Antioxidant activity of chitosan on different level of viscousities (360.57 and 14cp) having molecular weight of 1800,960 and 660.was applied on commuinuted flesh of herring (*Clupea harengus*) was studied by (Kamil et al ., 2002). The oxidative stability of fish flesh applied with chitosan (50, 100 and 200 pmm) was compared with synthethic antioxidant such as butylated hydroxyanisole added with butylated hydroxytoluene (BHA+BHT, 200ppm) were stored at 4 degree celcius, the best result was from the 14cp chitosan, it inhibit lipid oxidation and TBARS formation in herring sample with 200ppm of 14cp chitosan was slowed down for 8 days of storage period by 52% when in comparism with the other treatment. Lopez-caballero et al. (2005a, b) applied chitosan as a base material to produce a chitosan-gelatin coating for cod patties, the result showed that chitosan applied as powdered or coating do not have any positive effects on the product at the end of the study, but rather, it led to an increase in the yellow color of the product, the elasticity of the patty was also increased. The coating with chitosan inhibit the spoilage of cod patties which was seen in the reduction in Total basic volatile Nitrogen(TVBN).there was no serious effects seen on bacterial spoilage, an excellent sensory properties was observed. (Rong et al., 2010) reported that chitosan coating could significantly increase the shelf-life of pacific oyster with high level of perishability *C. gigas*.

Lactoferrin belongs to the family of iron-binding glycoprotein which closely resemble the plasma iron-transport, it aids in the movement of protein into the body and its made up of a single chain peptides having a molecular weight of 87KDa (Weinberg, 2003). Lactoferrin is a natural origin antimicrobial agent, available in human secretion like milk, tears and saliva. It has potential to reduce the number of Iron available in the environment, as a result of this its very strong potential to retard the activity of microorganisms like Esterichia coli and L. monocytogenes (Sharif et al., 2017). The functionality of lactoferrin as an antimicrobial is as a result of its protein structural conformation (Roller et al., 2003). Its Iron-binding potential and polycatonic nature makes it to be against broad range of bacteria which include food-borne pathogens such as *carnobacterium, Listeria monocytogenes, Esterichia coli, Klebsiella* and *viruses* (Gyawali & Ibrahim, 2014). Lactoferrin functions also depend on its Isolation from the milk source without destruction of the protein conformation of the molecule present in it, Lactoferrin is applied widely in commercial industries for food packaging as antimicrobial edible coating with combination of polypeptides like lactoferrin, lysosome and peroxides(Juneja, et al., 2012).The edible coating from polyptides could help to prolong shelf-life of food and render them safe for human being consumption (Fransen & Krochta, 2003). Lactoferrin was carried out in an In vitro study by Del Olmo et al. (2011) to test its bacterial efficacy with the use of amidated and pepsin-digested derivateives an their contents, it was reported that lactoferrin have potential to be used as antimicrobial against *Esterichia coli* 0157:H7. In another study by (Rollini et al., 2016) salmon fillets was coverered with different packagings film and was also treated with combination of lysosome and lactoferrin (LZ/LF), the result showed that LZ/LF coated PET film lowered the population of mesophiles and psycotrophs bacteria down to 4.5 and 3.8 log/CFU/g, It was observed that sample treated with LZ/LF coated with PET inhibit the growth of $H_2S$- producing bacterial to 2.7 of 4.7 log CFU/g which was seen in control sample.

**Lactoperoxidase system**

Due to the fact that the use of chemical preservatives in food protection is not required by the consumer, attention has been directed towards natural antimicrobial systems and the lactoperoxidase system (LP), which is one of these systems, has started to gain importance for this purpose (Yıldız, 2008). Lactoperoxidase (LP) system; lactoperoxidase, thiocyanate ion ($SCN^-$) and hydrogen peroxide ($H_2O_2$) consists of three components (Nicholette, 1999; Seifu, 2005). Lactoperoxidase (LP), one of these components, is a member of the peroxidase family which is a natural enzyme group (Yıldız, 2008). LP is an oxidoreductase found in milk and has an important role in protecting the newborn baby's gut systems and mammary glands against pathogenic microorganisms (Seifu, 2005). LP contains a single polypeptide chain containing 608 amino acid residues and has a molecular weight of 78 KDa (Boots, 2006). The antimicrobial properties of LP against microorganisms, as well as the cleavage of different carcinogens and the protection of animal cells against peroxidative effects, indicate its biological importance (Yıldız, 2008). It has also been reported that the LP system plays an antioxidant role and therefore protects mammalian cells (Seifu, 2005). As a result, LP system can be used as a preservative in both food and pharmacological applications and it is very important for it to exhibit synergistic effect with other preservatives.

**Lysozyme**

Lysozyme, also known as muramidase or N-acetylated glycan hydrolase, is an antimicrobial enzyme produced by animals that form part of the natural immune system. Lysozyme is a glycoside hydrolase which catalyzes the hydrolysis of the 1.4-beta-bonds between the N-acetyl-methamic acid and the N-acetyl-D-glucosamine residues in the peptidoglycan, the major component of the gram-positive bacterial cell wall (Manchenko, 1994). This hydrolysis compromises the integrity of the bacterial cell walls that cause bacterial breakdown. Lysozyme is abundant in secretions such as tears, saliva, breast milk and mucus. It is also found in cytoplasmic granules of macrophages and polymorphonuclear neutrophils (PMNs). In humans, the lysozyme enzyme is encoded by the LYZ gene (Yoshimura, 1989; Peters, 1989). These polypeptides inhibit the development of food spoilage and foodborne disease-causing bacteria and are of great importance in the food industry due to these properties (Akkoç et al., 2009). In addition, the increasing interest in bio-preservation methods, especially in the food industry, in which natural antimicrobial components are used, increases the potential of bacteriocin (nisin) and natural enzymes (lysozyme) in foods (Davidson & Harrison, 2002). Lysozyme is known as the only antimicrobial enzyme that has a commercial use. Especially in Gram-positive bacteria, it causes the structural integrity of the cell membrane to hydrolyze the P-1, 4-glucosidic linkages in the peptidoglycan layer, the most important structure of the cell membrane (Gill & Holley, 2000). As a result, Lysozyme is one of the most important bio-protective agents used in the food industry against food pathogens.

**Microbial source**

**Bacteriocins**

Bacteriocins are group of Gram- negative and Gram-positive bacteria developed from proteins or polypeptides with resourceful antimicrobial properties (Zacharof & lovith, 2012). Bacteriocins are generally known as primary metabolites produced in the ribosome during the primary process of lower growth of bacteria and the bacteria possesses a slim antimicrobial spectrum. The production of bacteriocins in lactic acid bacteria (LAB) fermentation process are produced in large quantities (Bali et al., 2011). Its production Involves enzymatic process to change the inert substance into active bacteriocins and this process is referred to as Bacteriocin maturation (Rilley &Wertz, 2002). Bacteriocins have strong potential to destroy bacteria bound to the inner membrane of the cell (Garcia-Bayona et al., 2017). The antimicrobial effects of bacteriocins showed positive effects against several strains of pathogen and spoilage microorganism through different level of class and type of bacteriocins (Perez et al., 2015). Application of bacteriocins with other preservatives has extended the shelf-life of fish products. Bacteriocins produced from *Bacillus sp.* extracted from curd possess excellent bactericidal potency against *salmonella sp* and *vibrio sp*. Salt water fish infected with *parastromateus niger* and squid *loligo duvauceli* (Ashwitha et al., 2017).The reduction of bacteriocin in the total count is of the infected fish in storage at -4 and -20 shows to be significantly different.

Nisin

Nisin is a bacteriocin produced by Lactococcus lactic from lactic acid bacteria, called antibiotics and included in first class bacteriocins. Nisin was first discovered in 1928 by Rogers. The investigator has discovered that several species of Streptococcus produce metabolites that inhibit other lactic acid bacteria (Hampikyan, 2007). In 1944, nisin name was used for this substance and it was started commercially in 1950s. Nisin (E234) was first accepted as a food additive in the UK 30 years ago, and was later used in 50 countries in Europe, America and China (Koponen, 2004). Since then, nisin has taken its place among the protective food additives that are used safely in the food Industry (Luck, 1995; Wessels, 1998). It has been adopted by the United Nations Food and Drug Administration as a “GRAS ler (Generally Safe Acceptable Product) and also World Health (WHO) is the only bacteriocin approved as a food additive (Bouttefroy, 2000; Nel, 2004). As a result, important food such as *Bacillus cereus*, *E.coli*, *Salmonella spp., Listeria monocytogenes* and *Clostridium perfringens,* which seriously threaten consumer and public health. To eliminate pathogens, various antimicrobial agents are currently used. In the Investigation of (Gogus et al., 2006). In Comparative effects combination of lactic acid, nisin, coating some postmortem quality criteria of refrigerated *Sardina pilchardus*. The author reported significant difference in the reduction of Mesophilic aerobic bacteria, the growth of MAB was inhibited to 1.54 log/CFU/g. Also another study by (Lakshmanan et al., 2002) Reported 1 log/CFU of Mesophilic aerobic bacteria, Nisin with other treatment reduced the bacterial load of fish.

## Plant origin

Olive is an agri-food originally owned by the Spanish and a symbol of rich cuisine (Millan et al., 2002).There is increased attention in the application of polyphenols obtained from Agricultural food products from by-products (Servili et al., 2015). Olive mill wastewater obtained from the mechanical compression of olives during the oil extraction process. The oil is reported to have a higher level of polyphenols, polyphenols from several studies are confirmed to be high in antioxidant properties (Servili et al., 2011, Benedetto et al., 2006). Application of bioactive compound in food Industry led to retardation growth of bacterial strains (Fasolato et al.,2015)Especially, oleuropein, hydroxytyrosel and aliphatic aldehydes which can be found in olive products showed to retard the growth rate of several bacteria and microfungi (Furneri et al.,2002). In a study by (Miraglia et al ., 2016)applied extract of olive water on salmon streaks, they reported that salmon sample with highest percentage olive water extract has lowest value of TVC than the second treatment with a reduced percentage, they stated that the amount of extract absorbed by the salmon was low and the author suggested this may be caused by the high hydrophilic nature of the compound that caused reduced adsorption of the salmon streaks treated with olive water extract, alteration in the color of the salmon was also observed, the author suggested it could be as a result of oxidation of the polyphenols which occurred in the muscle enzymatic activity that altered the yellow color of the sample, Erikson & Misimi (2008) also reported an increased in the level of yellow and redness of the salmon fillet during storage.

**Spices and their essential oils**

Plant essential oils have been used for many purposes for many years, especially in scientific and commercial fields (Ebru, 2007). Cosmetics, pharmaceuticals, food industry, aromatherapy and phytotherapy are among the top uses (Hammer, 1999). Since the essential oils have a wide range of use, many scientists have recently attracted the attention of many scientists and the biological activities of these essential oils have been investigated. As a result of these researches, the properties of natural products were put into practice (Mouhssen, 2004). Nowadays, obtaining and evaluating pure and especially main active substances of medicinal plants and essential oils of these plants is very important both scientifically and economically (Kırbağ, 2000). The results show that the essential oils of these plants have antimicrobial activity (Ebru, 2007). It is stated that the pharmacological properties of essential oil and its components can be examined and it can be useful to be used in medicine, cosmetics and industrial fields (Kırbağ, 2000). Essential oils can be found in certain organs of the plant, such as petals, leaves, fruit, bark, fruit stalk, woody texture, or in all organs of the plant, and sometimes also in specific tissues of an organ (Ebru, 2007). These oils are found in secretory hairs, secretory pockets, secretory channels or secretory cells according to the families where the plants are connected (Ceylan, 1987). To date, it has been shown that more than 2000 chemical components are present in essential oils, the most important of which are terpenes, phenylpropanoids, and the like. Because of their physiological effects, these substances are sometimes used individually or sometimes as a mixture therapy (Ceylan, 1987). As is known, volatile oils have special properties such as volatility, hydrophobicity and having special odors acting on the respiratory system. These last characteristics reveal that they can be biologically active (Ebru, 2007). The most frequently reported features are that they are antimicrobial and the tests in which these properties are revealed do not depend on a certain standardization and can be performed in appropriate laboratories (Anssen, 1987

**Antimicrobial Properties of Plant Essential Oils**

Antimicrobial effects of plant essential oils have been extensively studied to date (Leal, 1999) Nostro et al, in their study of some plant extracts used as test microorganism Gram (+), Gram (-) bacteria and yeast showed that inhibitory effect against the strain (Nostro, 2000). In another study using disk diffusion method, it was observed that antimicrobial activity was more effective against Gram (+) bacteria and yeast strains than Gram (-) bacteria (Dağcı, 2002).

**Spices**

Spices are used for flavor, color, perfume and preserving food and beverages. Spices are extracted from many parts of the plant: skin, buds, flowers, fruits, leaves, rhizomes, roots, seeds, vegetables and styles, or whole plants. The term 'herb' is used as a subset of spice and refers to plants with aromatic leaves. Spices are often dried and used in a processed but complete state. Another option is to prepare extracts such as essential oils by distilling the raw spice material (wet or dry), or to use solvents to extract oleoresins and other standardized products (Weiss, 1997; Anon, 1999; Weiss, 2002; De Silva, 1995).In a study by (Cai et al., 2015) three different spices were investigated for their essential oil , clove, cumin, and spearmints was evaluated for their essential oil efficacy in Inhibiting quality degradation and extending of shelf-life of drum (*Scianops ocellatus*) fillets during 20days of storage at 4 degree celcius, The authour reported that spearmint significantly reduced biogenic amines and microflora counts was reduced to lowest level.

## CONCLUSION

Recently, several techniques have been employed in the food processing industry in other to preserve food, Fish and seafood products as the demand for healthy food is on the increase, based on this quest, the techniques to be selected for seafood preservation must have some important characteristics such as maintaining seafood freshness, preserve the quality and give good sensory properties, Natural preservatives have been found to possess these characteristics , so, it can be applied as alternatives to synthethic additives, natural additives have promising functions and potential quality, such as chitosan, lysosome, bacteriocins, spices and herbs, all these have been studied and positive effects have been observed , they can be incorporated successfully as food additive to function as antimicrobial, antibacterial and antioxidant.

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# Edible films in seafood

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## Abstract

Fish and seafood products are highly perishable in nature they lossess their freshness shortly after death which occurred through several biochemical reactions such as such as changes in the quality of fish protein ,lipids level and development of biogenic amines, hypoxanthine and microbial spoilage. The changes in fish and seafood muscles lead to decay in the quality (e.g in sensory quality and nutritional content of nutritional value of fish. Seafood and fish quality maintainance is crucial to hinder the loss of this nutritionally quality of fish. Therefore, seafood and fish-processing industry are currently in search of alternative techniques of preservation that can prolong the shelf-life of fresh fish. Various preservation techniques have been developed in order to prevent spoilage in food and to maintain quality and extend shelf life. Edible film and coating are famous in the food industry, because they are economically low, abundantly available. Coating and film are produced from several carborhydrate and protein origin and these coating and film are safely applied for enhancement of seafood quality and to prolong their shelflife. Edible film and coating have several advantages because they function in so many ways as following: they are safe to be consumed and biodegradable; are additives to the nutritional value of seafood products; enhancement of organoleptic characteristics of food, like appearance, smell, and flavor; lower packaging volume, weight and waste; contain antimicrobial agents and antioxidants; prolong shelf-life and quality enhancement of non-packaged items; guide over inter-component movement of moisture, gases, lipids, and solutes. Food additives have been integrated successfully into edible film and coating, these additives have anti-browning agents, antimicrobials, flavors, colorants, and several functional substances. Techniques of application include Immersion, spraying and dripping. This article reviews the types of edible film, their importance and application techniques and their effects on the different materials in seafood.

**Key words:** Edible films, Seafood quality, Seafood shelf-life

**Review article**

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## INTRODUCTION

Fisheries and aquaculture are great source of economic and social benefits (Watterson et., 2008).Biochemical Composition of fish consists Moisture contents 65-80%, Protein 15-20%, Fat 5-20%, Ash 0.5-2% (Sauvant, 2004). It also contains antioxidants such as proteins, vitamins, carotenoids and tocopherols, Fish is very rich in nutrients and its of great benefit to humans health. Its so rich in long-chain omega-3 polyunsaturated fatty acids (PUFA) which are required for growth and development. Among these long-chain fatty acids, especially eicosapentaenoic (EPA, C20: 5n-3) and docosahexaenoic acid (DHA, C22: 6n-3) are widely used in human health, such as reducing the risk of cardiovascular diseases and some types of cancer, contributing to nervous system functions and body development, this function has been accepted as responsible for the beneficial effect (Shahidi, 2015). The rapid increase in the world population, the tendency to raise people's living standards and the rapid growth of food, increased the demand for ready-made foodstuffs and as a result, the production of foodstuffs became an industry branch. Thus, the number of food additives and preservation methods used in the production and production of processed foods is increased rapidly (Gennadios, 1997). However, losses of seafood and cultured fish occured due to post-harvest handling, processing and storage methods (Gustavsson et al., 2015). Post-harvest losses could be in various forms such as nutritional losses, spoilage of seafood products due to poor processing, economical and physical losses (Hall, 2011).In the world, fish losses that occurred through spoilage is around 10%(10 to 12million tons per year) recorded for both aquaculture and seafoods (Socaciu, et al., 2018). Fish is highly perishable in nature compare to poultry and meats, its losses the fresness shortly after death which occurred through severals biochemical reactions such as such as changes in the quality of fish protein,lipids level and development of biogenic amines, hypoxanthine and microbial spoilage (Matak et al., 2015). The changes in fish and seafoods muscles leads to decay in the quality (e.g in sensory quality and nutritional content of nutritional value of fish. Seafood and fish quality maintainance is crucial to hinder the loss of this nutritionally quality of fish (Mohan et al., 2012).Therefore, seafood and fish-process industry are currently in search of alternative techniques of preservation that will prolong the shelf-life of fresh fish (Ashie et al., 1996). Various preservation techniques have been developed in order to prevent spoilage in food and to maintain quality and extend shelf life. Recently, edible and recycled films and coatings prepared with proteins, polysaccharides and lipids have become increasingly important in food storage. Edible films and coatings is a thin – layer food that is formed from natural food material to preserve foods and extend their shelf life (Dursun & Erkan 2009). Edible films gives physical protection (Min et al., 2005) to preserve food products from mechanical deterioration, physical, chemical and microbiological spoilage. These products can be consumed, biocompatible, nontoxic, and function as a barrier and a carrier of food additives e.g (antioxidants and antimicrobials).

Types of Edible film and coating

Edible films and coatings are the thin layer of food that is formed on the surface of foods and can be consumed with food and obtained from natural sources. They extend the shelf life of foods, improve their organoleptic properties, nutritional value and quality (Ayana, 2010). The use of edible films in active packaging is a new approach in food safety. The necessity of simple production technology, being cheap, being obtained from natural compounds, the diversity of functional properties and the biodegradability packaging materials. Control the transfer of moisture, oxygen, carbon dioxide, lipid, flavor and aroma by serving as food transfer between food components or between the atmosphere surrounding the food (Alper, 1998). Additive materials such as preservatives and antioxidants can be added to edible films and coatings, the number of microorganisms on the surface of food can be controlled (Ayana, 2010). In addition, the environmental damage caused by the residual materials used in packaging makes alternative packaging applications attractive, With the increasing demand of consumers for reliable, high quality and long shelf life products, the use of edible films and coatings is also increasing (Janjarasskul & Krochta, 2010).

Polysaccharides films

Polysaccharides – based films and coatings are applied generally with several gums and chitosan (Sánchez-Ortega et al., 2014). The gums are allowed to dissolve in water through the hydrogen bonds that exist between solvent and polymer, In solution the polymer molecules can reorganize into different the structure is known as a micelle, which holds or strengthened with the aid of intermolecular hydrogen bonds (Dehghani, et al., 2018).The mechanical properties of the polysaccharide and the gas barrier are very good. Although they are effective against fats, their resistance to water migration is low due to their hydro-specific properties. The most important feature of the polysaccharide films is that they are structurally stable and reduce the oxygen delivery rate. These films have very low resistance to water passage (Robert, 2013). As edible polysaccharide film and coating material; cellulose ethers, starch, chitosan, pectins, algae extracts and gums are used (Gennadios, 1997; Janjarasskul & Krochta, 2010). Starch is available and the cost is very low. It is a reliable polymer for an edible film because of its thermoplastic properties (Jimenez et al., 2012). It is colorless and tasteless material derived from starchy tubers through the process of water extraction. (Nadia et al., 2014).The Incorporation of starch-based films in food packaging is favorable due to the characteristics it possess such as they are environmental appealing, low cost, flexibility, and transparency (Bilbao-Sáinz et al., 2010). Starch-based edible films are tasteless, odorless and transparent, therefore, prevent the food taste, flavor and appearance from alteration (Chiumareli & Hubinger, 2012). The major advantages of starch films are possession of good barrier properties to oxygen and carbon dioxide. contrarily, it possesses a weak barrier property to the water as a result of high hydrophilicity (Šuput et al., 2013) Starch-based films added with chitosan and lauric acid proved distinct effect to retard Bacillus subtilis and Escherichia coli showed that the film contains strong antimicrobial effect (Salleh et al., 2007).

Lipid films

Lipid compounds, The fatty acids commonly applied for this goal are waxes, nonhydrogeneted vegetable oils, fatty alcohols and fatty acids that possess carbon atom number which changes from 14 to 18 such as natural and synthetic waxes and glycerides, are used as coating material due to low polarity and good moisture barriers. In general, wax coatings are more resistant to moisture than other lipid and non-lipid coatings. Oil- based candles and films; Thickness and slippery surfaces; Application can cause problems due to wax and bitter taste (Robertson, 2013). Direct application of any lipid to a hydraulic or wet surface results in poor absorbent power between the food and film interface. So the double layer coating Barrier properties will heal (Pavlath, 2009). In the film production of lipids and lipid-based films, solvent and high temperature show poor mechanical properties. Lipids in the liquid phase show less resistance to gas and vapor passage than solids. (Dursun, 2009) Lipids are normally Incorporate along with other film-forming materials, like proteins or polysaccharides, functioning as emulsion particles or multilayer coatings in order to expand the resistance to water penetration (Mehyar et al., 2012).

Chitosan-lipid based film

Chitosan-lipid based films performed better efficiency to moisture movement when the lipid is uniformly integrated in the matrix.It also reveals the importance of the morphological organisation of the lipid within the chitosan matrix, [Wong, et al., 1992].Packaging film is assumed to possess characteristics of resisting breakage conditions that are worst, also the plastic quality of the packaging film should be able to adapt to possible malformation (Velickova, etal., 2013).

Waxes

Waxes are composed of esters of long-chain aliphatic acids with long-chain aliphatic alcohols, resulting from the low level of polargroups and elevated level of long-chain fatty alcohols and alkanes,they are strongly resistant to water movement than almost all other edible film substances (Cordeiro de Azeredo, 2012). Mono-, di- and triglycerides also possess the characteristics to be used as coating substances. The chemical structure can remarkably influence the functional properties, mostly water vapor permeability. Short-chain triglycerides are partly soluble in liquid soluble, while long-chain molecules are insoluble in water. (Dehghani, et al., 2018).

Edible films applied with cinnamon oil

Edible films applied with cinnamon oil was used to serve as an antioxidant and antibacterial coating for snakehead fish fillets (Lu et al., 2010). Cinnamon is highly consisted of cinnamaldehyde as well as b-caryophyllene, linalool and several terpenes (Wong et al., 2014). In another research by (Anvari & Rezaei, 2011) shows that a gelatin coating improved with cinnamon oil has the potential to prolong the shelf-life of fresh rainbow trout fillets whereas enhancing an acceptable quality during storage. Gelatin coatings with the inclusion of cinnamon drastically lowered total bacteria growth during 15 days of cold storage (Anvari & Rezaei, 2011). Study was also carried out on effect of chitosan-based edible coatings enhanced with garlic (*Allium sativum*) oil at 0.5, 1.0 and 1.5% on shrimp (*Parapenaeus longirostris*) quality was evaluated during refrigerated storage by (Asik & Candoğan 2014) concentration of garlic oil was reduced (0.5%) in the coating with containing chitosan, it shows to be adequate to maintain and extend the shelf-life (Asik & Candoğan, 2014).

Protein films

Proteins used for the film are polymers comprises more than 100 amino acid remnants (Hanani et al., 2014) and this protein must be modified by heat, acid, alkali and/or solvent in order to create the more enlarge structures which are needed for film formation (Bourtoom, 2008). The mechanical properties and barrier properties of the protein obtained are better than those obtained from polysaccharides and lipids. The diversity of proteins from other structural components is that various functional properties, particularly intermolecular binding potentials, are high. Protein films limit the use of low water vapor resistant areas (Campos et al., 2011). Proteins are better than polysaccharides in their potential to create films with greater mechanical and barrier effects they possess (Cuq et al., 1998).

Proteins are great substance for film formation which possess excellent gas and lipid barrier properties (Popović et al., 2012), especially at lower relative humidity. Edible protein, herbal origin proteins (eg, corn zeini, wheat gluten, soy protein, pea protein, sunflower protein, peanut protein, rice protein and cottonseed protein) and proteins of animal origin (keratin, collagen, gelatin, fish myofibrillar protein, egg flux protein, casein and whey protein) (Dursun & Erkan, 2009).

Lin et al. (2009) applied three antioxidants consisting butylated hydroxyanisole, butylated hydroxytoluene, and n-propyl gallate to produce antioxidant zein coatings. Zein coatings consisting n-propyl gallate proved the most improved quality of preservation whereas all three antioxidants caused retardation of quality degradation. Several proteins possess antimicrobial effects and have been applied with films and coating products. Proteins from lactic acid bacteria which destroy other related and unrelated microorganisms are reffered to as bacteriocins. Heat-stability, observable hypoallergenicity and simple deterioration by proteolytic enzymes in the human intestinal tract are mostly common features of bacteriocins (Sánchez-Ortega et al., 2014).

Chitosan is obtained from chitin by deacetylation with the use of alkali. Chitin and chitosan have been used several times in differents researcher in the food industry to serve as wrapper for the food because of ability of film forming they possess. Chitosan films are tough, durable, flexible and not easily pull apart with average water vapour permeability level and it could function to prolong the storage life of fresh produce and foodstuffs with higher water levels (Phadke et al., 2011). The use of chitosan in coating offers a great advantage in preventing microbial surface growth on foods. It will cause the retardation of Listeria monocytogenes growth whereas being a biopackaging (Coma et al., 2002). Chitosan was applied on glazing skinless pink salmon (*Onchorhynchus gorbuscha*) fillets. Fillets glazed incorporated with chitosan solution shows high yield than lactic acid glazed and distilled water glazed fillets and retardation of lipid oxidation after eight months frozen storage was observed (Sathivel et al., 2007).

Composites film

Edible films are diverse in nature, combining the mix of polysaccharides, protein, and or lipids. This perspective allows the utilization of definite functional characteristics of an individual class of film. currently, many scientists have broadly explored the expansion of composite films incorporated with methyl cellulose and lipid, methyl cellulose and fatty acid, corn zein, whey isolate and lipids, casein and lipids, corn zein and corn starch, gelatin and fatty acid, soy protein isolate and gelatin (Phadke et al., 2011).

Usually films made from a raw material have a good deterrent or good mechanical resistance, but they cannot show two good properties at the same time. While protein and polysaccharide films are resistant to oxygen permeability, they are hydrophilic and therefore resistant to water vapor permeability. Lipid-based films form a good moisture barrier, but the surface of these films may have pores and cracks, such as holes and pores, not homogeneous, and may produce a candle-like taste in the product. Mixtures of different materials are used to eliminate these negatives and to produce the desired film (Gennadios, 1997). Two basic methods are used in the production of composite films. One of the emulsion methods is that the two-layer films are produced by laminating the lipids onto the edible film and adding oil to the solution of the film (Robertson, 2013; Gennadios, 1997).

Active compound applied in Edible film and coating

Food additives can be integrated into edible films and coatings, these additives include anti-browning agents, antimicrobials, flavors, colorants, and several functional substances. The active properties of films and coatings should release these compounds slowly such as antimicrobials and autoxidation agents which cause retardation of food deterioration and leads to absorption of undesirable compounds (e.g., free radicals) these free radicals can speed up the rate of food degradation. The edible coating is an excellent process to incorporates the additives lowly to the seafood which results in interaction between the coating and external compounds before it gets to the surface of the fisheries products. (Dehghani et al., 2018). There are different classifications of active compounds that can be incorporated into edible films and coating which includes organic acids (e.g., benzoic, propionic, lactic, sorbic and acetic), fatty acid esters, polypeptides and bacteriocins (e.g., peroxidase and nisin); plant essential oils (e.g., cinnamon, oregano, and lemongrass) also, probiotic bacteria are commonly applied in films and coating (Dehghani et al.,2018).

The antimicrobial effect of organic acids

The antimicrobial effect of organic acids occur through concentration of the un-segregated form, which can invade the bacterial cell membrane, dissociation can occur within the cell and this results to interaction with membrane permeability (Sánchez-Ortegaet al., 2014). In a study with shrimp with the effectiveness of catfish skin gelatin-based antibacterial edible coatings which content level of 2% PS, 2% sodium tripolyphosphateora combined solution including the base solution plus 2% PS and 2% sodium tripolyphosphate on extending the shelf-life and quality changes of fresh shrimp with ice storage were studied. The results proved that the antimicrobial coating has the potential to slow down microbial growth and improve the shelf-life for up to 10 days (Jiang et al., 2011). Another study also proved that citric acid has the potential to improve enhance the preservation role of chitosan significantly through retardation of lipid oxidation and restricting microbial growth with the application of thiobarbituric acid reactive substances and total plate count, accordingly (Qiu et al., 2014).

**Application Methods of Edible Packaging**

The selection of the raw materials and other additives, the techniques applied and the thickness of the coating are effective on the final properties of the edible coating. Coating technique should be selected in such a way that the end product cannot be damaged (Işık et al., 2013).

**Immersion Method**

In this method, the products are immersed in liquid coating materials and the excess material is removed from the product for drying and solidification. After immersion, the products may be allowed to dry by standing in room conditions or by moving the solvent to a desiccant (Işık et al., 2013).

**Spray method**

The spraying method is applied by spraying to the edible coating product if a certain portion of the product is to be coated or if a uniform layer is to be obtained. This method is particularly high pressure spray applicators or air blower with the development of systems, fruit and vegetable coating is a method used (Işık et al., 2013).

**Dripping Method**

It is determined that chitosan reduces the moisture loss in prepared meatballs (Wu et al., 2001). In general, carbohydrate-based edible films and coatings are often used to improve the quality and stability of meat throughout storage and sale. Also, using edible films with low oil permeability, oil absorption of products to be fried in oil can be prevented and in this way, better nutrients and sensory properties can be obtained. In addition, some edible films have been developed which better control the ripening by reducing the oxygen penetration in the fruits and reducing the carbon dioxide and ethylene evaporation (Debeaufort et al., 1998).

## CONCLUSION

The application of non-biodegradable packaging materials in fish and seafoods industries to increase the product quality and shelf-life results to a huge environmental threat on human health and wellbeing. Biodegradable coating and films are produced from several carbohydrate and protein origin and these coating and film are safely applied for enhancement of seafood quality and to prolong their shelf life. The active packaging of fish presents a low cost alternative to conventional preservation technologies (vacuum and modified atmosphere packaging) as a result of lack of huge capital for investments, biodegradable, edible films and coatings help in the enhancement of microbiological stability of fish and drastically lower the waste; also, delay lipid oxidation. Fish is among the most-traded part of the world food sector. Wherefore, there is urgent demand for the packaging of this good in Industrial and commercial based antimicrobial production is needed.

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# Determination of the Relationships between Plant Distribution and Salinity in Water Source of Kırşehir Province, Turkey

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**Abstract**
Knowing the quality and content of the irrigation water used in agriculture irrigation management is very important in terms of the impact on soil-plant and the environment. All surface and underground water used in irrigation also contain salts dissolved in their plant bodies. Salts transmitted to the soil by irrigation water, affect the physical and chemical properties of the soil and as a result, they decrease in yield and quality. This study was carried out to investigate the salt contents of irrigation water in irrigated agricultural areas in Kırşehir province in the Middle Kızılırmak region and to determine the relationship between the amount of salinity in irrigation water and the distribution of plant. In the study, 120 irrigation water samples were taken from 40 different irrigation points, and the analysis of the mentioned samples was carried out at Chemistry Laboratory of Ahi Evran University Mucur Vocational High School. As a result, it has been observed that related to the contents of the water and the plants grown. The amount of salinity varied from 201 µS/cm to 1878 µS/cm. Grain plants such as barley, wheat and triticale are at the foreground in areas where salinity is high, while plants such as walnut, grape, bean and lentil are grown in places where salinity is low. In the studied areas, very high salinity was observed in 23 areas, while low salt concentration in 38 areas was observed. The remaining 59 regions were found to have moderate salinity.

**Key words:** Salinity, production pattern, irrigation water, Kırşehir, Middle Kızılırmak

**Research article**
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## INTRODUCTION

Salinity is an important environmental factor that can severely inhibit plant growth and agricultural productivity (Lidia Vysotskaya et al., 2010). Salinity in irrigation water and in soils is one of the major abiotic constraints on agriculture worldwide, and the situation has worsened over the last 20 years due to the increase in irrigation requirements in arid and semi-arid regions such as those found in the Mediterranean area (Colla et al., 2010, Cirillo et al., 2016).

As a result of the drought and improper watering that is experienced throughout the world, soils have been exposed to serious wasteland and salinity. The increased salt density in the soil limits their activities by affecting the root regions of the plants (Karadavut, 1997). Above the limit value, it can make toxic effects on the plants and cause death of the plants which are very sensitive especially during the germination and early development periods (Lauter et al., 1981). Plants vary greatly in their tolerance to saline water. The extent of yield loss when plants are irrigated with saline water depends on several factors including soil type, drainage and the frequency, method and time of irrigation.

As plants grow, salt tolerance increases. However, it should be noted that the increase is a limit and that the amount of salt remains at the limit values (Levitt, 1980). When the limit values are exceeded, salt first disrupts the energy balance in the plant and slows down plant growth (Çulha and Çakırlar, 2011). While vegetative growth is reduced in plants, gas exchange decreases and yield decreases (Parida and Das, 2005).

All the physiological events such as diffusion, osmosis, plasmolysis and substance transport, which are necessary for the survival of the plants, can be done with the help of water and the properties of the water (Lauter and Munns, 1986). Therefore, water usage should be considered especially in irrigation studies and applications. In particular, the content of water is becoming more important. Unconscious and excessive irrigation practices in water use can lead to salinity problems (Karadavut, 1995). Sairam and Tyagi (2004), in their study, increased the salinity of the water in the plant with Ca $2^{+}$ is released and in order to create tolerance to the plant to limit the growth or inhibition of plant growth. Munns and Tester, (2008), the increase in salt amount of stomata and water transmission in the stomata are closed. It is suggested that in such environments salt-resistant or tolerant plants should be cultivated. It is stated that grain tolerance is better, but edible legumes and garden plants are weaker (Bernstren, 1974; Bewley and Black, 1981; Maaş, 1985). It is stated that the amount of salt has an effect on the cultivated plant pattern and it can change the botanical composition (Bernstein et. al., 1974; Karadavut, 1997; Yurtseven ve ark., 2001; Kanber et al., 2005)

Water used for irrigation always contains measurable quantities of dissolved substances which as a general collective term are called salts. These include relatively small but important amounts of dissolved solids originating from dissolution or weathering of the rocks and soil and dissolving of lime, gypsum and other salt sources as water passes over or percolates through them.

Knowing the quality and content of irrigation water used in agricultural areas in irrigation management is very important in terms of its impact on soil-plant and environment. All surface and underground water used in irrigation also contain salts dissolved in their plant bodies. Salts transmitted to the soil by irrigation water, affect the physical and chemical properties of the soil and as a result, they decrease in yield and quality. This study was carried out to investigate the salt contents of irrigation water in irrigated agricultural areas in Kırşehir province in the Middle Kızılırmak region and to determine the relationship between the amount of salinity in irrigation water and the distribution of plant.

## MATERIALS AND METHOD

This study was carried out in areas where irrigation was carried out throughout the central district of Kırşehir.

In the study, water samples were taken from 40 wells, which were determined by simple random sampling, and water samples were sampled in three replicates with 120 samples. The study area is shown in Figure 1. Water samples were taken from the well as the point where the water out. Salinity values of water samples taken during the irrigation period between May and September were investigated. The analyzes of water were carried out in the chemical laboratories of the Mucur Vocational High School at Kırşehir Ahi Evran University. According to the salinity values of the irrigation water, plant species and varieties distribution in settlements were determined and the differences among salinity, plant species and varieties were determined.

The suitability of a water for irrigation will be determined by the amount and kind of salts present. With poor water quality, various soil and cropping problems can be expected to develop. Special management practices may be required to maintain full crop productivity. With good quality water there should be very infrequent or no problems affecting productivity. 0-250 µS / cm, water is the best quality waters. 251 to 750 µS / cm moderately saline water, from 751 to 2250 µS / cm highly saline waters and waters above 2250 µS / cm are evaluated in waters having very high water salinity problem (Baştuğ, 2018; Temizel, 2018). In addition, the correlation coefficient was used for the relationship between the variables. Correlation coefficient is said to be significant correlation between the significant variables. The data were analysed by using SPSS 21 V statistical package programme.

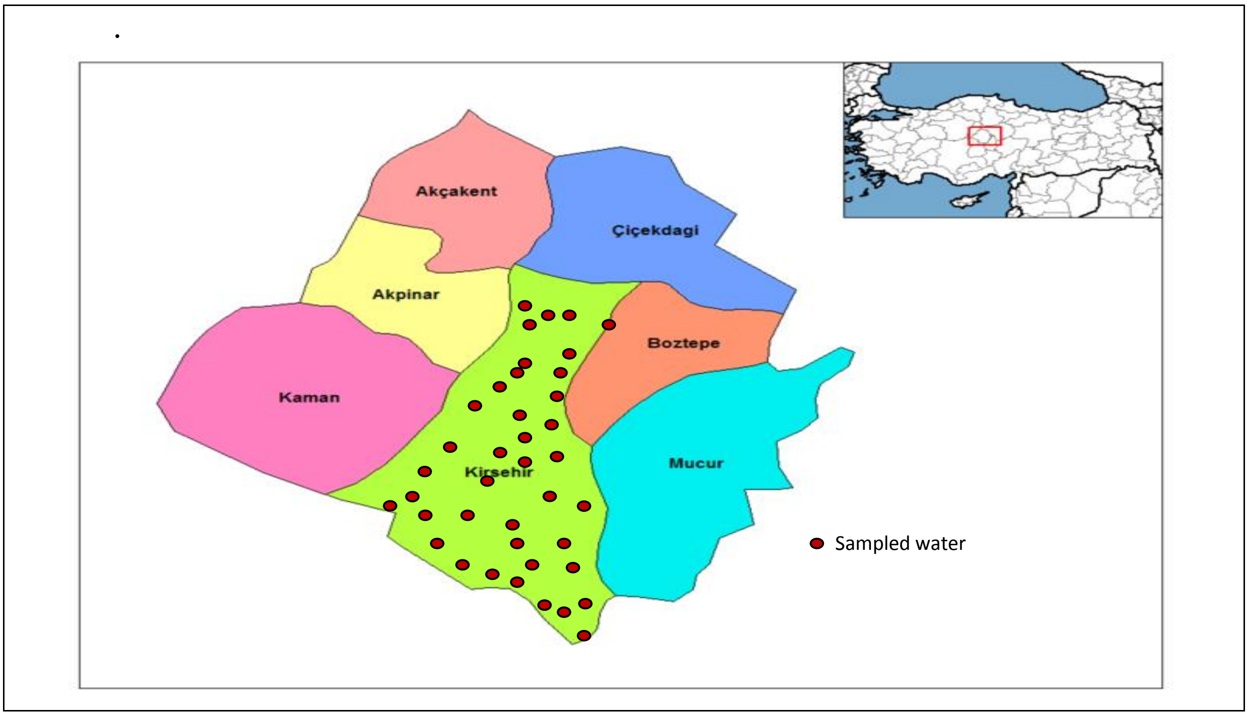


**Figure 1.** Location of water samples

## RESULTS AND DISCUSSION

The data obtained in the study is given in Table 1. When the Table 1 is examined, it is seen that there is generally medium and high salinity in the study area. A high degree of salinity was detected in 14 irrigation centers, while the remaining 26 irrigation centers had moderate salinity. It is observed that wheat and barley plants are the main plant where high salinity is detected, and oat and rye plants are observed.

However, although rye plants have a high tolerance to salinity, the lower amount of cultivation in comparison with other plants is due to the fact that this plant has very high competition with other plants and suppresses the growth of other plants. It is observed that these plants are also grown in places that are moderately salty. It should be noted here that these four plants are ecologically grown as a necessity. Because of the arid and semi-arid climate of Kırşehir province, there is not much change in plant species and diversity (Karadavut, 1997).

**Table 1. Salinity in terms of settlements and growing plants**

| *Vilages/ Grown products* | ***Water salinity*** | | *walnut* | Wheat | Barley | Sugar beet | Grape | Maize | Oat | Rye | Trifolium | Lentil | Chickpea | Vetches | Apple | Sunflower | Potato | Cumin | Almond | Triticale | Tomato | Bean | Kiona | Safflower | Kavaklık |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Karaboğaz Vilage* | 787.0 µs/cm | High | | **X** | **X** | **X** | **X** | | | | | | | | | | **X** | | | | | | | | |
| *Rahmalar Vilage* | 588.7 µs/cm | Moderate | **X** | **X** | **X** | | **X** | | | | | **X** | **X** | | | | | | | | | **X** | | | |
| *Saraycık Vilage* | 500.3 µs/cm | Moderate | **X** | **X** | **X** | **X** | **X** | | | | | | | | | | | | | | | | | | |
| *Ecikağıl Vilage* | 753.7 µs/cm | High | | **X** | **X** | | **X** | | | | | | **X** | | | | | **X** | | | | | | | |
| *Değirmenkaşı Vilage* | 1343.0 µs/cm | High | | **X** | **X** | **X** | **X** | **X** | **X** | | **X** | | **X** | **X** | | | | | | | | **X** | | | |
| *Kocabey Vilage* | 1548.0 µs/cm | High | | **X** | **X** | **X** | | **X** | | | **X** | | | **X** | | | | | | | | | | | |
| *Akçaağıl Vilage* | 691.7 µs/cm | Moderate | **X** | **X** | **X** | | **X** | **X** | **X** | | | | | | | | | | | | | | | | |
| *Güzler Vilage* | 618.7 µs/cm | Moderate | **X** | **X** | **X** | | | | **X** | | **X** | | | | **X** | | | | | | **X** | | | | |
| *Tepesidelik Vilage* | 1253.3 µs/cm | High | | **X** | **X** | | **X** | **X** | | **X** | | | **X** | | | | | | | | | | | | |
| *Yukarı Homurlu Vilage* | 587.0 µs/cm | Moderate | **X** | **X** | **X** | | **X** | | **X** | | | | | **X** | | **X** | | | | | | | | | |
| *Dulkadirlikaraisa Vilage* | 566.3 µs/cm | Moderate | **X** | **X** | **X** | | **X** | | | | | **X** | **X** | | | | | | | **X** | | | | | |
| *Dulkadirliyarımkale Vilage* | 747.0 µs/cm | Moderate | | **X** | **X** | | | **X** | **X** | | **X** | | **X** | **X** | | **X** | | | | **X** | | | | | |
| *Tosunburnu Vilage* | 312.3 µs/cm | Moderate | | **X** | **X** | | | | **X** | | | | **X** | **X** | | **X** | | **X** | **X** | | | | | | |
| *Taburoğlu Vilage* | 517.3 µs/cm | Moderat | | **X** | **X** | | | **X** | **X** | | **X** | **X** | | **X** | | **X** | | | | | | | | | |

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| *Homurlu Üçler Vilage* | 521.0 µs/cm | Moderat e | | **X** | **X** | | | | **X** | | **X** | | **X** | | | **X** | | | | | | | | | |
| *Çuğun Vilage* | 692.3 µs/cm | Moderat e | | **X** | **X** | | **X** | **X** | **X** | | **X** | | **X** | **X** | | **X** | | | | | | | | | **X** |
| *Körpınar Vilage* | 417.3 µs/cm | Moderat e | **X** | **X** | **X** | | | | **X** | | | | | **X** | | | | | | **X** | | | | | |
| *Homurlu Beşler Vilage* | 814.7 µs/cm | High | | **X** | **X** | | **X** | | **X** | | | | | | | | | | | | | | | | |
| *Hashöyük Vilage* | 866.3 µs/cm | High | | **X** | **X** | | | | **X** | | **X** | | **X** | **X** | | **X** | | | | | | | | | |
| *Kartalkaya Vilage* | 683.7 µs/cm | Moderat e | | **X** | **X** | | | | **X** | **X** | | | | | | | | | | | | | | | |
| *Kırkpınar Vilage* | 487.3 µs/cm | Moderat e | | **X** | **X** | | | | **X** | **X** | | | | | | | | | | | | | | | |
| *Yeşiloba Vilage* | 434.3 µs/cm | Moderat e | | **X** | **X** | | | | **X** | | | | **X** | | | | | | | **X** | | | | | |
| *Tatarilyas Yayla Vilage* | 325.0 µs/cm | Moderat e | **X** | **X** | **X** | | **X** | | **X** | | | | **X** | | | | | | | | | | | | |
| *Tatarilyas Kışla Vilage* | 375.0 µs/cm | Moderat e | | **X** | **X** | | **X** | | **X** | | | | **X** | | | | | | | | | | | | |
| *Karıncalı Vilage* | 423.7 µs/cm | Moderat e | **X** | **X** | **X** | | **X** | | **X** | | | **X** | **X** | **X** | | | | | | | | | | | |
| *Sıdıklı Ortaoba Vilage* | 980.7 µs/cm | High | | **X** | **X** | **X** | **X** | | | | | | **X** | | | | | | | | | | | | |
| *Sıdıklı Büyükoba Vilage* | 1858.0 µs/cm | High | **X** | **X** | **X** | **X** | **X** | | **X** | | **X** | | | | | | | | | | **X** | **X** | **X** | | |
| *Sıdıklı Darboğaz Vilage* | 1519.3 µs/cm | High | | **X** | **X** | **X** | | | | | | | | | | | | | | | | | | | |
| *Kortullu Vilage* | 1096.0 µs/cm | High | | **X** | **X** | **X** | **X** | | | | **X** | **X** | | | **X** | | | | | | | | | | |
| *Yağmurlu Kale Vilage* | 273.3 µs/cm | Moderat e | | **X** | **X** | | | | | | | | | | | | | | | | | | | | |

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| *Kesikköprü Vilage* | 1578.7 µs/cm | High | | **X** | **X** | | **X** | | | **X** | | | **X** | | | | | | | | | | | | |
| *Kalankaldı Vilage* | 393.0 µs/cm | Moderate | **X** | **X** | **X** | | **X** | | **X** | | | | **X** | | | | | | | | | | | | |
| *Sıdıklı Küçükoba Vilage* | 665.0 µs/cm | Moderate | **X** | **X** | **X** | | **X** | | **X** | | **X** | | | | | | | | | | | | | | |
| *Karalar Vilage* | 784.3 µs/cm | Moderate | **X** | **X** | **X** | | **X** | | **X** | | | | | | | | | | | | | | | | |
| *Sevdiğin Vilage* | 463.7 µs/cm | Moderate | | **X** | **X** | | | **X** | | | | **X** | **X** | | | | | | | | | | | | |
| *Yağmurlu Armutlu Vilage* | 687.7 µs/cm | Moderate | | | **X** | | | | | | | | | | | | | | | | | | | | |
| *Dedeli Vilage* | 426.0 µs/cm | Moderate | | **X** | **X** | | **X** | | | | **X** | | | **X** | **X** | **X** | | | | | | | | **X** | |
| *Kuruağıl Vilage* | 1768.3 µs/cm | High | | **X** | **X** | **X** | **X** | | | **X** | **X** | **X** | **X** | | | | | | | | | | | | |
| *Yeşilli Vilage* | 504.0 µs/cm | Moderate | **X** | **X** | **X** | | **X** | | | | | **X** | **X** | | | | | | | | | **X** | | | |
| *Yağmurlu Büyükoba Vilage* | 485.0 µs/cm | Moderate | **X** | **X** | **X** | | **X** | | **X** | | | | **X** | | **X** | **X** | | | | | | | | | |

Apart from basic plants, it is possible to grow some other plants in small areas. Salinity is washed out in arid and semi-arid areas, and the soluble salts that go down to the ground go to the soil surface together with the ground water and increase the salinity by evaporation (Ergene, 1982; Kara, 2002). Due to this, there are differences in plant species and diversity (Kwiatowsky, 1998). The high tolerance of salt to the plants seen as the basic plant may be the result of this selectivity. Because, graminea are resistant more than legumes to soil salinity (Ashraf, 1994; Maas,1985)

It is seen that walnut plant is grown in medium salty areas in general and it is not cultivated in high salty areas. In the villages of Karalar and Sıdıklı Büyükoba, the situation is slightly different. However, it was seen that water are taken from wells for walnuts grown was not taken from irrigation wells. Sugar beet plants, which have a very important place among the cultivated plants, are generally grown in high salt areas. It is thought that the beet growing in these areas eliminates as metabolically and allows for great difficulties in terms of growth and development. However, the lower sugar content than the beet grown in neighboring provinces suggests that the source of irrigation may be irrigation water. Because of the salinity effects of plants as well as the reduction in the amount of fresh weight can be seen. (Yurtsever et al., 2001). High salt concentrations in the irrigation water effect on reducing of plant growth , limiting leaf expansion and changing the relationship between the aerial and root parts (Tattini et al., 1995; Cramer, 2002, Munns and Tester 2008).

In addition, biomass production is significantly reduced (Güngör et al., 1993). The effect of salinity may become more pronounced in growth and development stages. It has been observed that edible seed legume crops such as chickpeas and lentils, which are one of the important plants of the region, have the opportunity to cultivate in medium and high salinity values. In particular, the chickpea plant is highly resistant to salt in parallel with the belief that there is a high salt in places where chickpea farming is seen. In studies conducted, it is stated that salinity has positive contribution to the physiological structures of legume plants (Geren et al., 2011).

Plants increase their performance with physiological self-preservation instinct and show positive improvements beyond expectations (Mahdavi and Sanav, 2007). When the results are taken into consideration, the tolerance of salinity indicated for chickpea plant may be caused by the well-developed development of the plant as a result of the efforts of the plant. Lentil plants are less tolerant than chickpeas and can be affected faster and negatively more than salt stress. It is stated that the saltiness and salt water effect is higher in the arid and semi-arid areas where monocultures are made (Sivritepe ve Eriş, 1998; Sonneveld, 2001). On the other hand, when the irrigation culture is not sufficiently established and the wrong fertilization is added, the negative effect increases. (Sevgican, 2002; Hale and Orcutt, 1987).

Most of the salty soils are suitable for cultivation of crops, provided that they do not exceed a certain percentage (Ünlükara et al., 2006). In the case of very high salinity, the plants have low yields and the higher salinity starts with death. The harmful effect of salinity can vary depending on climatic conditions, light intensity, irrigation methods, plant species, plant cultivar or soil conditions (Tang et al., 2015).

It is stated that even if the growth and development is completed smoothly or with very few problems, the plants are very weak in terms of vitamins and minerals and may lose their nutritional value (Elçi, 2005). Since no specific study was carried out for the nutritional values of the grown products, it was not determined whether or not there was a change. However, it is understood that needs to be done. These deficiencies in the soils of such plants grown will create deficiencies in humans and animals which benefit from such plants, it is clear that the nutritional supplement should be taken. This problem is clearly stated in the studies on the subject. It is stated that barley plant produces very high energy value in saline soils and nutritional value decreases (El Shaer, 2010).

The results of the correlation analysis to determine whether there is a relationship between the salinity values in the waters and the plant species grown are given in Table 2. It was determined that the cultivation of barley, rye and triticale plants under high salt water was highly correlated. Sugar beet and chickpea plants can be grown in medium and high salt waters. Barley, rye and triticale plants are known as plants that like saline soils and can be grown successfully. However, the fact that sugar beet has such a relationship could not be explained. Walnut is a very important plant for the province of Kırşehir. In the study, it was understood that it can grow with success under moderate salty waters. Similarly, oats, vetch and safflower plants could be successfully grown in medium salt waters. In the other plants it has not been detected in any relationship. Accordingly, we can say that other plants can grow in suitable conditions for themselves.

**Table 2.** Plant species-salinity relationship

| Plant Varieties | Water-Salinity Plant Species "r" value | Significance |
|---|---|---|
| Walnut | r=0,514** | Moderate salinity |
| Wheat | r=0,307 | not significant |
| Barley | r=0,635** | High salinity |
| Sugar beet | r=0,494**<br>r=0,466* | Moderate and High salinity |
| Grape | r=0,155 | not significant |
| Maize | r=0,263 | not significant |
| Oat | r=0,571* | Moderate salinity |
| Rye | r=0,648* | High salinity |
| Trifolium | r=0,096 | not significant |
| Lentil | r=0,309 | not significant |
| Chickpea | r=0,551*<br>r=0,493** | Moderate and High salinity |
| Vetches | r=0,459* | Moderate salinity |
| Apple | r=0,168 | not significant |
| Sunflower | r=0,197 | not significant |
| Potato | r=0,226 | not significant |
| Cumin | r=0,198 | not significant |
| Almond | r=0,207 | not significant |
| Triticale | r=0,530** | High salinity |
| Tomato | r=0,119 | not significant |
| Bean | r=0,263 | not significant |
| Kinoa | r=0,248 | not significant |
| Safflower | r=0,528* | Moderate salinity |
| Podlar | r=0,384 | not significant |

## CONCLUSIONS

In the study area, surface irrigation method is applied as irrigation systems (free, pans etc.). Excessive irrigation is carried out by farmers, due to the lack of adequate irrigation culture during surface irrigation. As a result, soil salinity due to salinity in the water increases. Fort this reason, changing of irrigation methods will give better salt control as change cultural practices. The harmful effect of the salt in the soil varies depending on the irrigation method, plant species and varieties, soil characteristics and ecological characteristics. Considering the ecological characteristics of the region, it was thought that it would be more appropriate to make drip irrigation water because of the fact that both the amount of water consumed in free irrigation methods and the effect of increasing the salinity in the soil. Because, drip irrigation permits the use of water with a higher salt content than other delivery methods, since evaporation losses are minimal. The drip irrigation method also allows to continuously maintaining moist soil around the plant roots. It can also reduce the effects of salinity by continuously draining the salt to the edge of the wetted region.

As can be seen in the study, important relationships were determined between plant species and species and salinity. Therefore, it is advisable to select salt-resistant or tolerant plant species and varieties in high salinity areas. From this point of view, it can be recommended to grow cereals such as wheat, barley and rye, and edible legume plants such as chickpeas. It is also thought that the vetch plant, which is a legume fodder plant, can be successfully cultivated. As a result, this study is important because it is the first in the region. After that, it can be a guide for the studies related to the subject.

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# Biogas Production from Wastewater Treatment Plant

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## ABSTRACT

The increasing world population has the damage and the damages caused by the environment. Biogas refers to the production of usable gas from organic waste. The conversion of organic matter to carbon dioxide and methane in an oxygen-free medium is another expression. The activated sludge is burned to the agricultural land before it is burned as a fertilizer and it is converted to biogas energy in Wastewater Treatment Plants. The disposal and use of the wastes from the treatment plants makes a great contribution to the environment. Growing biogas production and use is of great importance in the world. The fields of use such as direct heating and heating, the use of motor fuel as a fuel, the use of turbine fuel and the production of electricity are gradually developing. This production is environmentally friendly and provides an economic contribution.

**Key Words:** Treatment Sludge, Biogas production

**Review article**

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## INTRODUCTION

The rapidly developing technology and population growth in the globalizing world bring about various environmental problems. The accumulation, collection, transportation and disposal of all kinds of treatment sludge resulting from the purification of drinking water, human and industrial wastewaters, which are the indispensable source of life of living things, is a big problem. To eliminate or minimize this problem, the waste sludge from the treatment plants is converted to biogas. Some aerobic bacteria carry out the degradation in air and other anaerobic bacteria in the airless environment. Anaerobic decomposition is a complex biochemical process involving different microorganism groups, especially acid bacteria and methane bacteria. Animal and plant organic waste / residues are often either burned directly or are fed into agricultural soils. It is more common to use such wastes, especially by burning them in heat production. In this way, heat can not be produced in the desired feature, it is not possible to use the wastes as fertilizer after heat production. Biogas technology makes it possible to extract both energy and waste from organic waste or residues to the soil. It is an environmentally friendly energy and fertilizer source by assisting recycling of waste (Anonymous, 2018a).

### Waste Sludge

The solids that can be collapsed or floated as a result of the application of physical, chemical and biological treatment processes to potable water and wastewater can be defined as mud. Water and wastewater treatment, due to the properties they carry, they should also be treated separately, they can be damaged in the environment when they are given to the environment without purification, solid and liquid mixture consists of substances. They must be treated with high amounts of organic matter, nutrients, pathogenic microorganisms and large amounts of water.

### Waste Sludge Treatment

The presence of significant amounts of odor in the untreated wastewater, the sludge that must be removed and removed in the biological treatment, in a structure different from the organic materials in the raw wastewater, the tendency to decay and smell, only a small part of the sludge is composed of solids and a large part of the water, so large volumes of occupation and also because of the pathogenic microorganism must be treated before being removed (Yıldız et al., 2009). Biogas; refers to the production of gas that can be used from organic wastes. In other words, under the influence of microbiological flora in the oxygen-free environment, the conversion of organic matter into carbon dioxide and methane gas (Anonymous, 2007).

### Biogas

It is a cheap, environmentally friendly energy and fertilizer source. Provides waste recovery. As a result of biogas production, weed seeds that can be found in animal manure lose their germination feature. As a result of biogas production, the smell of animal manure disappears to a great extent. Causes the loss of effectiveness of disease factors that threaten human health and groundwater caused by animal fertilizers. After biogas production, wastes are not destroyed and they are transformed into a more valuable organic fertilizer (Gizlenci et al., 2008).

Since the acquisition of biogas is mainly based on the decomposition of organic substances, vegetable waste or animal fertilizers can be used as the main ingredient. Used as the basic material in the world due to the fact that the used animal fertilizers become more useful as fermentation during the biogas conversion (Anonymous, 2018b). The materials used for biogas production can be examined under three headings: animal fertilizers, organic wastes and industrial wastes.

**Herbal Waste**

Garden waste, Food waste, Industrial wastes; Agricultural wastes, wastes from forest industry, wastes from leather and textile industry, wastes from paper industry, food industry wastes, waste from vegetable, cereal, fruit and oil industry, sugar industry wastes, domestic solid wastes.

**Energy**

An indispensable need of human beings as an indicator of economic and social development. It is vital to increase the quality of energy and is vital for technological production and development. Finding and sustaining new and renewable energy resources has become a necessity today. One of the most important reasons for this is that the intensive consumption of fossil fuels is the source of greenhouse gas generation, causing global climate changes and many environmental pollution (Kılıç et al., 2007).

Today, a very large proportion of primary energy production is derived from fossil fuels. In 2006, the share of fossil resources in the world's primary energy production is about 79%, the share of renewable energy resources is 18% and the share of nuclear energy is 3% (Demirbaş, 2009).

## CONCLUSION AND SUGGESTIONS

The energy potential that can be recovered from organic wastes in our country is quite high. Particularly in a country like Turkey potential of organic substances is too high, organic domestic waste and other organic waste with significant energy recovery facility can be provided that achieves the establishment of biogas (Öztürk et al., 2006).

Biogas energy is a very advantageous type of energy and is a renewable energy source with almost no disadvantage. Because when the biogas plant is installed, it does not cause any harm or discomfort to the environment and people. In order to increase the usage area of biogas, the ratio of methane ($CH_4$), which is the main source of energy in biogas, should be increased. By increasing the biogas plants, organic materials can be evaluated and energy can be produced (Ilkılıç & Deviren 2011).

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