БИОЛОГИЧЕСКИЕ НАУКИ И НАУКИ ПО ТЕХНОЛОГИИ ПРОИЗВОДСТВА,ВЕТЕРИНАРНО-САНИТАРНОЙ ЭКСПЕРТИЗЫ И ПЕРЕРАБОТКИ ПРОДУКЦИИ СЕЛЬСКОХОЗЯЙСТВЕННОГО ПРОИЗВОДСТВА

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INDUSTRIAL WATER DISCHARGE INTO THE IZMIR BAY: ENVIRONMENTAL THREATS TO THE LOCAL ECOSYSTEMS

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Abstract. The region of Izmir is a particular coastal part of western Turkey: it has unique landscapes with variety of vegetation types, diverse relief and natural reserve areas. At the same time, Izmir Bay is one of the most contaminated estuaries in the Mediterranean Sea. Polluted by chemical from agricultural activities and other sources, the region gradually change its natural local landscape structure and biodiversity level. The paper gives a review of current emerging ecological problems of the study area.

Аннотация. Район г.Измир является уникальным прибрежным регионом Турции с ландшафтами природоохранного значения. В то же время, измирский залив является одним из самых загрязненных лиманов в Средиземном море. Естественная структура ландшафта и биоразнообразие региона, загрязненного химикатами, поступающими со сточными водами от аграрной деятельности и других источников, постепенно меняется. Доклад посвящен текущим экологическим проблемам прибрежной зоны Измира.

Actuality and Introduction. The richness of the geography of Izmir is well illustrated by the variety of natural features: aesthetic landscapes, geothermal waters, hills and mountain chains, mountain pasture landscapes, coastal islands, mountain lakes, waterfalls, caves, forests, unique vegetation and endemic Mediterranean plants, meadows, rare wild animals and scenic landscapes. The cultural attractiveness of this regions well illustrated by archaeological places of ancient cities, rock tombs and ruins of castles, local manufactory products, typical local villages. The vegetation within the Aegean region has a very complex character, since local species are mixed with other the ones from phytogeographical areas: Euro-Siberian, Irano-Turanian, Mediterranean. This explains the variety, biogeographical diversity and richness of the region [5]. Typical species are coniferous forests (pine), junipers, oaks etc. Detailed study of the local plant types is presented by [9]. However, being a third large metropolis of Turkey, Izmir is an industrial city with high anthropogenic pressure on the nature. The city has high importance for the country: a key seaport harbor, strategic hub of transport network within the Aegean, Marmara and the Mediterranean Seas. Izmir is also known as an important business and fair trade center, where meetings, exhibitions, conferences and fairs take place. Therefore, it has intensive anthropogenic activities: intensive transport network, shipping and maritime construction, industrial factories, plants, densely populated districts, agricultural activities. All this triggers strong human pressure on the environment. Comparing to other regions, western Turkey has much more human pressure on the environment.

Objectives. Research objective is to assess environmental threats to the coastal ecosystems of the Izmir Bay consisting in the chemical pollution of waters and other human induced sources. There are about 100 main sewage outlets near the periphery of Inner Izmir Bay, which actively discharge 500,000-900,000 m3/day of waste waters into the bay. Main source of pollution has anthropogenic origin. Thus, industrial wastewater and domestic wastewater together consist about 50% of total pollutants. They include sewage collection and canalization from buildings discharged into Izmir Bay through sewage system used by of about 4 M local population of the metropolitan municipality.

Material and Methods. The materials include statistical data and information of the on

chemical pollution of coastal waters. The method consists in assessment of available materials, preparing and visualizing graph. During the last decades a large number of studies have been reported on the environmental, physical, chemical and biological properties of Izmir Bay [17], [12], [2]. Recently, many advances have been made in the past decades for the environmental assessment of Turkey. Earth observation satellites, such as Aster and Landsat are used for monitoring ecological problems from space [18], [10]. Various research have been reported proving recent changes in Turkish landscapes. Example is recent environmental monitoring of western Turkey for assessment of settlement suitability in response to geomorphic hazards and risks [1]. Another example, a detailed study of Candarli Bay in Izmir surroundings proves the increase in urban areas and the reduction in semi-natural and agricultural areas, which well illustrates ongoing processes of urbanization in west Turkey [9]. Besides natural population increase, there is a tendency of local population migration coming from eastern regions westwards (for education and employment). Such migration leads to the congested, overpopulated quarters in large western metropolises with dense construction of multistoried buildings. Even small coastal Turkish towns nowadays become more urbanized and gradually enlarge in size. As a consequence, this leads to the loss of natural and agricultural lands, landscape changes and increased human pressure [4].

Results. Water pollution from streets and roads brings 15% of contamination. Important pollutant sources include agricultural activities (10%) on fields, fertilizers (both synthetic and natural ones), acidic rains, as well as other agricultural chemicals entering Izmir Bay through the surface and drainage systems, as well as streams (also 10%) [6]. Certain role in contamination plays the soil erosion (8%). Other contamination sources include wastewaters from the harbor, gas emissions from local industries, buildings and vehicles (Figure 1).

Marine transportation and traffic necessarily brings pollution (4%) (discharge of ballast water, wastewater and black water from ships, freight ships, tankers and passenger vessels). In Inner Izmir Bay surface sediments are seriously polluted and contain significant concentration of heavy metals in Ag, As, Cd, Cr, Cu, Hg, Mo, Pb, Sb, Sn, V, and Zn, well above their preindustrial background levels, as well as notable quantities of PCDD, PCDF and PAH. For example, the traces of mercury originating from Gediz River and inactive mining sites in Karaburun Peninsula are discharged into adjacent shelf waters [13]. The content of mercury detected in selected plankton organisms exceeds the acceptable standard level [11]. The oceanological characteristics of the Izmir bay and biological cleanness of waters is not reaching the standards of clean shelf waters, as demonstrated by the Institute of Marine Science and Technology, Dokuz Eylul University and [6] (Table 1). As assessed by various oceanological parameters, the waters of Izmir Bay are polluted critically in the inner part, significantly in its central part, while only more or less satisfactorily in the outer part of the bay [3].

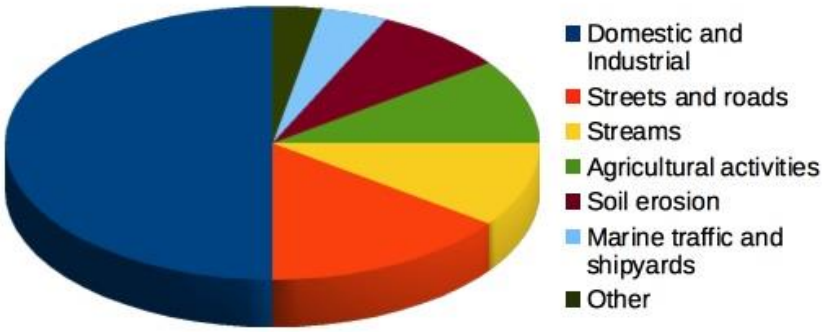

Figure 1 – Contribution of pollutants in Izmir Bay. Diagram based on [6]

This proves Izmir Bay to be one of the most polluted estuaries in the Mediterranean Sea. Since hydro- and oceanological characteristics are vital parts of the ecosystem, highly polluted shelf waters illustrate environmental and ecological threats in the region (Table 1). Water shortage and deterioration may lead to deforestation of precious forest communities, desertification, soil erosion and land degradation on the Karuburun Peninsula, an important part of Izmir ecosystems, well known as one of the major undisturbed sites in Turkey with precious biodiversity structure, aesthetic landscapes and unique environment.

The region of Izmir and surroundings is a highly dynamic and rapidly developing region of western Turkey with impressive urbanization rates, increasing from 18.5% in 1950 to 62% in 2000. The urban areas located on the coastal area of the Aegean Sea with ca 4 M people have impact on the environment through enormous demographic, cultural and economic pressure. This human influence is reflected on the physical landscape patterns, e.g. land use types or spatial heterogeneity of the landscapes. Apart from the industrial anthropogenic activities, Izmir region is being intensively visited by tourists, due to the touristic attractiveness of the Izmir region, its natural settings, favorable climate conditions and scenic landscapes, geothermal water springs. This definitely has positive influence on the local economics and tourism development. However, the uncontrolled anthropogenic pressure also has potential negative consequences. Example of negative effects of tourism on the environment is the threat for seal population (*Monachus Monachus*) which comes from the tourism and local uncontrolled fishery and leads to the dramatic increase of human pressure on the Mediterranean seal [16]. As a result of multiple factors, this region is recently being under pressure from both climate changes and from anthropogenic activities. As a result, local landscapes are affected by industrialization, uncontrolled urbanization and high anthropogenic pressure (e.g. overgrazing) leading to landscape changes. The urbanization triggers gradual decrease of fertile landscapes and agricultural areas along the Aegean coasts [14]. As a result, natural and semi-natural landscapes disappeared drastically in the course of XX c., a period of the most intensive urbanization.

Table 1 – Pollution loads of Izmir sewage and streams. Source: [6]

Parameter	Sewage	Streams	Total	Sewage, %	Streams, %
Flow rate (10^6 m^3/year)	188	732	920	20.4	79.6
COD (ton/year)	110,000	280,000	390,000	28.2	71.8
BOD (ton/year)	29,000	122,000	151,000	19.2	80.0
Suspended solid matter (ton/y)	20,000	87,000	107,000	18.7	81.3
NH_3^+ -N (ton/year)	6,800	16,700	23,500	28.9	71.1
NO_2^- -N (ton/year)	51	136	188	27.1	72.9
NO_3^- -N (ton/year)	381	1,052	1,433	26.6	73.4
Total N (ton/year)	7,232	17,888	25,121	28.7	71.3
Total P (ton/year)	488	820	1,308	37.3	62.7
Cadmium (ton/year)	0.699	0.218	0.917	76.2	23.8
Copper (ton/year)	3.420	23.860	27.280	12.5	87.5
Lead (ton/year)	8.060	4.985	13.045	61.8	38.2

Discussion. The multifold anthropogenic factors impact the environment of Izmir area causing destruction and loss of landscape elements. Environmental landscape changes have been recorded and detected recently in Izmir including vulnerable coastal areas. It is therefore necessary to increase measures on nature protection and environmental monitoring of the Aegean Sea area. Certain efforts are taken to protect the environment and landscapes from degradation, and to create effective ecological monitoring system [7]. Creation of protected areas aims to

protect rare marine species from the extinction, and to maintain natural landscapes from negative environmental changes. The protecting measures taken by the UNEP in Turkey include creation of biosphere reserves zoning schemes, establishment of the responsible use of natural resources, coordination of land use purposes and functions in special nature zones, and special complex landscape zoning [15]. It implies creation of ecological corridors, identification of endangered species, conservation, protection, landscapes evaluation, assessment of environmental resilience, analysis of habitats.

Conclusions. The coastal landscapes of Izmir have unique value for the environment of Turkey and the Mediterranean Sea. Together with other coastal regions, they form natural heritage of the Earth. Coastal areas have unique environmental value, since they include habitats of nesting and living places for strictly protected marine species: sea turtles (*Caretta Caretta*) and Mediterranean Monk Sea (*Monachus Monachus*). The protection status of these areas is established by the Special Environmental Protection Agency. At the same time, this area is intensely used for industrial activities, agriculture and tourism. Main environmental problems of the region include chemical contamination of waters of Izmir Bay, industrial threats on the surrounding landscapes caused by chemical and organic pollutants and water pollution. Monitoring environment of coastal and marine areas is necessary for maintaining environmental sustainability of the whole region. Reporting actual environmental situation, performing geospatial analysis and regular environmental reviews are necessary tools for this goal.

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КЛОНИРОВАНИЕ И ЭКСПРЕССИЯ ГЕНА БЫЧЬЕГО ПРЕПРОХИМОЗИНА В КЛЕТКАХ МИКРООРГАНИЗМОВ

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Осуществлена сборка полноразмерного гена телячьего препрохимозина В *in silico*. Ген телячьего препрохимозина В *preprochymB* был клонирован в бактериальном векторе, в составе pET-28c(+). Получены штаммы, Rosetta(DE3)/preprochymB и ArcticExpress(DE3)/preprochymB, обеспечивающие внутриклеточное накопление рекомбинантных телячьего препрохимозина В.

Толық өлшемді бұзау В препрохимозині генінің *in silico* құрастырылуы жүргізілді. Бұзау В препрохимозинің гені, *preprochymB*, бактериялық pET-28c(+) векторында клондалды. Рекомбинантты бұзау В препрохимозині жасушаішілік жинақталуын қамтамасыз ететін Rosetta(DE3)/preprochymB және ArcticExpress(DE3)/preprochymB штаммдары алынды.

Full length bovine preprochymosine B gene was assembled *in silico*. Constructed bovine preprochymosine B *preprochymB* gene was cloned in a bacterial pET-28c(+) vector. The expression strains, Rosetta(DE3)/preprochymB and ArcticExpress(DE3)/preprochymB, providing the intracellular accumulation of recombinant bovine preprochymosine B was obtained.

Актуальность. Сычужный фермент представляет собой смесь двух эндопептидаз: пепсина и химозина известного также как ренин. Сычужный ренин на 90% состоит из химозина [1]. Препарат, в котором превалирует или содержится только химозин, представляет собой наибольшую ценность в сыроварении, так как его состав сильно влияет на органолептические и вкусовые качества сыра. Бычий химозин является особым членом группы аспарагиновых протеаз, синтезируемых в четвертом желудке новорожденных телят. Этот фермент (323 аминокислот, 35,6 кДа) секретируется клетками слизистой оболочки желудка в виде зимогена, известный как препрохимозин (381 аминокислот, 42,1 кДа). Лидерная "пре" последовательность состоит из 16 гидрофобных аминокислот [2], которая представляет собой сигнальный пептид, участвующий в секреции химозина через мембраны секреторных клеток желудка, где и происходит его отщепление. В кислой среде просвета желудка, фермент-предшественник (прохимозин)