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RESEARCH ARTICLE

Heavy Metal Levels In Octopos Caught From Iskenderun Bay

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ABSTRACT

In recent years, in parallel with increasing industrialization and unregulated urbanization, there has been an increase in air, soil and water pollution. Iskenderun Bay and industrial establishments around it, pollution resulting from agricultural activities, domestic waste, industrial waste, waste gases released into the atmosphere from residences and vehicles cause the Gulf to be polluted. The port and maritime transportation in the Gulf of Iskenderun also contribute to this pollution and increase the accumulation of chemicals in marine organisms. This study aimed to determine heavy metal pollution in Iskenderun Bay and, accordingly, to evaluate the risks of octopus consumption on consumer health. In this context, 40 octopuses caught from Iskenderun Bay were used in the research. arsenic (As), mercury (Hg), cadmium (Cd), lead (Pb), nickel (Ni), copper (Cu), zinc (Zn), aluminum (Al), iron (Fe) and heavy metal levels such as manganese (Mn) were determined by ICP-OES (Inductively coupled plasma – Optical emission spectrophotometer) device. As a result of the study, metal levels in the edible parts of the octopus were found to be within acceptable limits. No accumulation of Hg or Pb was found in any of the octopus samples analyzed. Metal levels in the edible tissues of octopuses were determined in accordance with the Turkish Food Codex and European Food standards. As a result of the study, it was determined that heavy metal accumulation in octopus tissues obtained from Iskenderun Bay is not dangerous for human health and ecosystem.

Keywords: Heavy Metal, Iskenderun Bay, Octopus Octopus

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İskenderun Körfezi'nden Yakalanan Ahtapotlarda Ağır Metal Düzeyleri

ÖZ

Son yıllarda artan sanayileşme ve düzensiz kentleşmeye paralel olarak hava, toprak ve su kirliliğinde de artış görülmektedir. İskenderun Körfezi, çevresinde bulunan sanayi kuruluşları, tarımsal faaliyetlerden kaynaklanan kirlilik, evsel atıklar, endüstriyel atıklar, konutlar ve araçlardan atmosfere salınan atık gazlar Körfezi'nin kirlenmesine neden olmaktadır. İskenderun Körfezi'ndeki liman ve deniz ulaşımı da bu kirliliğe katkıda bulunmakta ve deniz canlılarındaki kimyasal madde birikimini artırmaktadır. Bu çalışmada, İskenderun Körfezi'ndeki ağır metal kirliliğinin belirlenmesi ve buna bağlı olarak ahtapot tüketiminin tüketici sağlığı üzerine risklerinin değerlendirilmesini amaçlanmıştır. Bu kapsamda, araştırmada İskenderun Körfezi'nden yakalanan 40 adet ahtapot kullanılmıştır. Ahtapotların kas ve mantle dokularında Arsenik (As), Cıva (Hg), Kadmiyum (Cd), Kurşun (Pb), Nikel (Ni), Bakır (Cu), Çinko (Zn), Alüminyum (Al), Demir (Fe) ve Manganez (Mn) gibi ağır metal seviyeleri ICP-OES (Endüktif olarak birleştirilmiş plazma – Optik emisyon spektrofotometresi) cihazı ile belirlenmiştir. Çalışma sonucunda ahtapotun yenilebilir kısımlarındaki metal seviyeleri kabul edilebilir sınırlar içerisinde bulunmuştur. Analiz edilen ahtapot numunelerinin hiçbirinde Hg ve Pb birikimine rastlanmamıştır. Ahtapotların yenilebilir dokularındaki metal seviyeleri Türk Gıda Kodeksine ve Avrupa Gıda standartlarına uygun olarak tespit edilmiştir. Çalışma sonucunda İskenderun Körfezi'nden elde edilen ahtapot dokularındaki ağır metal birikiminin insan sağlığı ve ekosistem için tehlikeli olmadığı tespit edilmiştir.

Anahtar Kelimeler: Ahtapot, Ağır Metal, İskenderun Körfezi

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INTRODUCTION

Heavy metals are elements that can have toxic effects even at low concentrations. Heavy metals are examined in two groups, essential and non-essential, according to their degree of impact on biological events. Metals such as nickel (Ni), zinc (Zn), copper (Cu), iron (Fe), selenium (Se), which generally serve as co-factors in enzymatic reactions and must be present in a certain concentration in the organism structure, are classified as essential. Levels of these metals greater than 1-10 ppm may cause toxic effects.

Metals such as mercury (Hg), cadmium (Cd) and lead (Pb) are non-essential heavy metals that are not necessary for the organism and can cause toxic effects even at concentrations of 0.001-0.1 ppm. Heavy metal toxicity causes a decrease in energy level and deterioration in the functioning of the lungs, brain, liver, kidney, blood composition and other important organs. Long-term exposure to heavy metals can lead to gradually progressive physical and neurological degenerative damage that mimics diseases such as Multiple sclerosis, Parkinson's disease, Alzheimer's disease and muscular dystrophy. Long-term exposure to some metals and their compounds can also cause cancer. (Jarup 2003; Türk et al. 2020).

Heavy metals have been found naturally in the earth's crust since the formation of the planet. Due to the increase in the use of heavy metals, metallic substances have increased in both the terrestrial and aquatic environments (Gautam et al. 2016). Heavy metal pollution has arisen as a result of anthropogenic activity, which is the primary cause of pollution, primarily due to the leaching of metals from different sources such as metal mining, smelting, foundries and other metal-based industries, and landfills. Automobiles, road works, the use of heavy metals in agriculture, use of pesticides, insecticides and fertilizers have become secondary sources of heavy metal pollution. Natural causes are also other sources of heavy metal pollution such as volcanic activity, metal corrosion, metal evaporation from soil and water and resuspension of sediment, soil erosion, geological weathering (Shallari 1998; Herawati et al. 2000; He et al. 2005).

Water pollution increases with the discharge of industrial and domestic wastes into aquatic environments without treatment. Air and soil pollution are other factors that pollute water resources. Water pollution means a decrease in the quality of water that prevents its use. The effect of a radioactive, organic, inorganic or biological substance on water indicates that the water is polluted. Deterioration of water resources negatively affects living life. As a result of wastewater not being treated and being discharged into water resources in an uncontrolled manner; highly polluted bays, rivers and seas emerge (Anonymous 2004).

Octopus lives in 0-200 m depths of the sea, mostly on stony hard surfaces and bottom. It is mostly found in tropical seas around the world and in temperate regions such as the Marmara Sea, the Aegean Sea and mostly the Mediterranean coasts in Turkey. It is economically important that its consumption is high in these regions (Roper 1984; Katağan and Benli 1990; Katağan and Kocataş 1990; Salman et al. 1997). The nutritional importance of octopuses, a subclass of cephalopods, is due to their fat content, like many other marine creatures; It consists of unsaturated fatty acids omega-3 and omega-6 and glycerol. The presence of unsaturated fatty acids is important for many systems in the human body (Güner et al. 1998).

Iskenderun Bay is a region where industrial establishments, agricultural activities, population and maritime transportation are dense. As a result of these activities, environmental pollution increases. Many living creatures in the sea are used as bioindicators to determine pollution. Since octopuses have nutritional value, the pollution they accumulate is important for human health, which is the top link of the food chain (Sönmezateş and Türk 2023). This study aimed to determine the level of heavy metals in the edible tissues of octopuses caught from Iskenderun Bay, which is polluted with domestic, agricultural and industrial waste.

MATERIAL and METHOD

The samples used in the study were obtained from octopuses (Octopus vulgaris) caught in İskenderun Bay, Hatay province (Longitude: 36* 12' 16" E, Latitude: 36* 39' 54" N). The captured octopus samples were transported under cold chain to the Namık Kemal University Central laboratory, where analyzes were carried out. The samples were stored at -20 °C until analysis. This project was carried out with the approval of Hatay Mustafa Kemal University Animal Experiments Local Ethics Committee, decision numbered 2019/04-2 dated 25/04/2019.

Preparation of Samples

Before starting the heavy metal analysis, octopus samples frozen at -20 °C were thawed in the refrigerator at +4 °C for 12 hours. 25 grams of muscle and mantle tissue of octopuses were weighed and homogenized with a homogenizer, and 1 gram of it was placed in glass tubes. 3 ml of the solution prepared from HCl and HNO_3 in a 1:1 ratio was added to the glass tubes and left at room temperature for 1 hour. The volume of the mixture was completed to 5 ml with HNO_3 and kept in an oven at 95 ˚C for 2 hours. After being removed from the oven, the tubes were kept until they reached room temperature. After 2 ml of ultrapure water was added to the cooled tube, 3 ml of H_2O_2 was added and it was kept in the oven at 95 ˚C for two hours. After the tubes were removed from the oven and reached room temperature, 2 ml of ultrapure water was added and filtered with Watman filter paper. The filtrate taken into Falkon tubes was centrifuged at 3000 rpm for 12 minutes. After centrifugation, the liquid remaining in the upper part was transferred to falcon tubes and 1% Triton X 100 mixture was added to the tube volume to 10 ml. The mixtures in falcon tubes with a final volume of 10 ml were prepared to be measured in ICP-OES (Alam et al. 2002; EPA Method 3052, 1996).

Preparation of blank solutions and calibration (standards)

Blank solution was used to adjust the optical settings of ICP-OES. Distilled water used to dilute the samples in the study was used blindly. Multi-element calibration standard solutions containing elements at different concentrations were prepared for metal analyses. 5 different calibration standards were prepared for the elements As, Hg, Cd, Pb, Ni, Cu, Zn, Al, Fe and Mn in the range of 25, 50, 250, 500 and 1000 μg $kg^{-1.}$

Measuring Samples

Residue levels of As, Hg, Cd, Pb, Ni, Cu, Zn, Al, Fe and Mn metals in the prepared samples were measured by Inductively Coupled Plasma Atomic Emission Spectroscopy (ICP-OES, Inductively Coupled Plasma Optical Emission Spectrometer). The plasma temperature varied between 6000-8000 °C. The samples were aerosolized with a nebulizer and given to plasma. The measurement was determined by repeating 3 times for each sample. These operations were carried out automatically by the device, and the results were interpreted by the computer system connected to the device and software specific to this system (EPA Method 3052, 1996).

Statistical analysis

SPSS package program (IBM SPSS Statistics 23, USA) was used for statistical analysis. Heavy metal levels in octopus samples were presented as arithmetic mean±standard error and minimum and maximum values.

RESULTS

Method Validation Findings

Calibration standards prepared for heavy metals Hg, Cd, Pb, Ni, Cu, Zn, Al, Fe and Mn in the range of 25, 50, 250, 500 and 1000 μg kg^{-1} were linear ($R^2 \geq 0.99$). The lowest detectable limit (LOD) values for the heavy metals Hg, Cd, Pb, Ni, Cu, Zn, Al, Fe and Mn are 3.51, 0.73, 17, 4.01, 2.01, 1.57, 0.48, 1.06 and 0.52 μg kg^{-1}, respectively. The lowest calculable limit (LOQ) values were determined as 25 μg kg^{-1} for all elements. Recovery values for Hg, Cd, Pb, Ni, Cu, Zn, Al, Fe and Mn elements are 90.40%, 109.21%, 104.10%, 106.60%, 100.66%, 110.18%, 115.20%, 107.16% and 105.70%, respectively. Intraday and interday coefficients of variation were found to be <1.45% and <7.33%.

Result in Octopus Samples

Heavy metal results obtained from 40 octopus samples caught from Iskenderun Bay, Hatay province, are presented in Table 1, and mean ± standard error in Table 2. While Cd, Cu, Zn, Al, Fe and Mn heavy metals were detected in all 40 samples analyzed, Ni element was detected in 11 of them. Hg and Pb could not be detected in any sample. Of these heavy metals, maximum residue limits are specified only for Hg, Cd and Pb. The maximum residue limits specified for Hg, Cd and Pb are 0.5, 1 and 1 mg kg^{-1}, respectively, according to the Turkish Food Codex, and 0.3, 1 and 0.3 mg kg^{-1}, respectively, according to the European Union. When these results were evaluated, it was determined that Hg, Cd and Pb levels in octopuses were below the maximum residue limits (TGK, 2011; EU, 2023)

Table 1. Heavy metal levels obtained from octopus samples

Number of samples	As µg kg-1	Hg mg kg-1	Cd µg kg-1	Ni mg kg-1	Pb mg kg-1	Cu mg kg-1	Zn mg kg-1	Al µg kg-1	Fe mg kg-1	Mn mg kg-1
1	37,68	0,00	1,97	0,00	0,00	10,27	221,23	11,79	8,67	1,14
2	61,34	0,00	7,20	0,00	0,00	21,08	94,10	8,70	2,72	0,81
3	105,70	0,00	2,02	0,00	0,00	10,30	75,94	6,72	2,71	0,77
4	118,64	0,00	1,10	0,00	0,00	11,69	70,55	8,46	2,76	1,07
5	32,45	0,00	1,31	0,00	0,00	7,52	77,39	9,02	45,95	0,77
6	56,49	0,00	1,65	0,00	0,00	9,24	128,22	6,97	3,56	0,73
7	50,13	0,00	2,32	0,00	0,00	13,76	90,54	9,13	2,39	1,02
8	45,64	0,00	1,25	0,00	0,00	10,44	77,89	8,16	7,64	1,17
9	46,25	0,00	4,74	0,00	0,00	7,26	77,38	10,22	3,28	0,65
10	48,51	0,00	9,26	0,00	0,00	14,12	291,80	14,35	7,16	0,79
11	42,28	0,00	2,08	0,00	0,00	10,23	87,33	9,34	2,55	0,87
12	20,09	0,00	1,03	0,00	0,00	4,32	68,04	7,99	1,53	0,45
13	44,59	0,00	1,24	0,00	0,00	7,01	87,24	8,62	2,30	0,63
14	43,69	0,00	1,78	0,00	0,00	18,53	88,75	10,30	4,16	0,90
15	32,62	0,00	1,53	0,00	0,00	6,59	81,26	8,74	1,65	0,84
16	35,51	0,00	43,96	1,37	0,00	39,33	70,29	8,74	15,62	1,91
17	28,21	0,00	2,07	0,00	0,00	9,83	103,82	9,68	4,37	0,73
18	37,65	0,00	74,25	0,75	0,00	0,09	182,57	8,76	13,92	1,33
19	26,60	0,00	8,83	0,38	0,00	10,73	103,38	8,50	4,41	1,18
20	37,94	0,00	2,45	0,00	0,00	8,07	81,97	8,90	3,57	0,85
21	44,79	0,00	1,68	0,00	0,00	6,92	82,64	3,01	1,75	0,75
22	43,22	0,00	1,79	0,43	0,00	7,51	81,33	2,27	1,53	0,77
23	24,74	0,00	21,47	0,37	0,00	15,65	107,00	2,21	9,97	0,91
24	48,38	0,00	1,98	0,00	0,00	5,56	80,12	5,31	3,91	0,64
25	43,36	0,00	22,82	1,61	0,00	37,41	360,57	2,83	8,88	2,58
26	29,71	0,00	62,11	0,80	0,00	37,66	156,60	2,18	13,73	1,37
27	45,72	0,00	15,77	0,00	0,00	21,64	90,70	2,75	5,70	0,98
28	40,45	0,00	3,22	0,00	0,00	16,19	100,38	1,84	2,67	1,05
29	55,81	0,00	1,34	0,00	0,00	6,61	83,83	2,86	0,50	0,66
30	48,73	0,00	4,26	0,00	0,00	8,78	72,31	3,12	0,50	0,72
31	37,55	0,00	22,21	0,74	0,00	36,13	87,56	11,39	10,25	3,95
32	37,51	0,00	9,61	0,00	0,00	10,71	96,75	2,54	6,43	0,67
33	50,49	0,00	3,61	0,00	0,00	13,93	82,17	3,78	2,39	0,87
34	23,68	0,00	24,25	0,89	0,00	27,71	80,81	4,27	8,78	2,05
35	44,85	0,00	1,41	0,00	0,00	11,27	89,95	2,75	1,54	0,77
36	30,55	0,00	174,62	1,86	0,00	74,76	186,51	6,53	37,34	2,26
37	70,75	0,00	1,30	0,00	0,00	11,65	101,70	1,91	0,61	0,78
38	49,10	0,00	4,82	0,00	0,00	7,72	97,54	1,73	0,73	0,70
39	172,47	0,00	0,11	0,43	0,00	14,16	86,64	340,61	48,88	2,32
40	270,50	0,00	0,14	0,00	0,00	11,99	69,79	23,54	3,18	1,25

Arsenic (As), Mercury (Hg), Cadmium (Cd), Lead (Pb), Nickel (Ni), Copper (Cu), Zinc (Zn), Aluminum (Al), Iron(Fe) and Manganese (Mn).

Table 2. Mean (±SE) heavy metal levels obtained from octopus samples

Parameter	N	Mean	Minimum	Maximum
As (μg kg^{-1})	40	49,75±7,05	20,09	270,50
Hg (mg kg^{-1})	40	ND	0,00	0,00
Cd (μg kg^{-1})	40	12,56±4,87	0,11	174,62
Ni (mg kg^{-1})	40	0,24±0,08	0,00	1,86
Pb (mg kg^{-1})	40	ND	0,00	0,00
Cu (mg kg^{-1})	40	15,36±2,14	0,09	74,76
Zn (mg kg^{-1})	40	108,87±9,64	68,04	360,57
Al (μg kg-^{1})	40	15,26±8,37	1,73	340,61
Fe (mg kg^{-1})	40	7,76±1,78	0,50	48,88
Mn (mg kg^{-1})	40	1,12±0,11	0,45	3,95

Arsenic (As), Mercury (Hg), Cadmium (Cd), Lead (Pb), Nickel (Ni), Copper (Cu), Zinc (Zn), Aluminum (Al), Iron (Fe) and Manganese (Mn). ND: not detected.

DISCUSSION

Many industrial establishments (such as iron-steel, fertilizer, profile, sheet metal, pipe factories) located on the coast of Iskenderun Bay, pollution resulting from agricultural activities around the bay, domestic waste, industrial waste, waste gases released into the atmosphere from residences and vehicles increasingly cause the bay to be polluted. In addition, the port and maritime transportation in the bay also contribute to this pollution in the bay. As a result, all these reasons increase chemical accumulation in marine organisms.

This study examined the metal levels of Arsenic 49.75±7.05 μg.kg^{-1}, Cadmium 12.56±4.87 μg kg^{-1}, Nickel 0.24±0.08 mg kg^{-1}, Copper 15.36±2.14 mg kg^{-1}, Zinc 108.87±9.64 mg kg^{-1}, Aluminum 15.26±8 .37 μg kg^{-1}, Iron 7.76±1.78 mg kg^{-1} and Manganese 1.12±0.1 mg kg^{-1} in 40 octopuses caught from Iskenderun Bay. Hg and Pb were not found in any of the analyzed samples. Metal levels in the edible tissues of octopuses were determined to be below the residue limits determined by the Turkish Food Codex Contaminants Regulation and the European Union Regulation.

In the study conducted by Kosker (2020), Pb levels measured in the muscle and mantle tissues of 24 octopuses caught from Mersin Bay were above the limit level of 1 mg · kg^{-1} determined by the European Union (EC, 2023) and the Turkish Food Codex (TGK, 2011). It was reported that the Cd level was below the limit level. In our current study, Pb could not be detected in all samples. In our study, Cd values were determined below the maximum limits, consistent with the current study.

Raimundo et al. (2015) on 24 octopuses caught off the Portuguese coast, the average Fe, Cu, Zn and Cd values measured in muscle and mantle tissues were reported as 21.25, 23.4, 77.5, 0.67 mg kg^{-1}, respectively. Ariano et al. (2019), Cd and Hg levels in 38 octopuses caught from the southern Tyrrhenian Sea of Italy were found below the legal limits for human consumption. Fe, Cu, Zn, Cd and Hg levels in our current study were found to be compatible with these studies.

Ahdy et al. (2007) determined Ca, K, Cu, Fe, Se, Sr, Zn, Cr, Cd, Hg and Pb levels in the muscles of octopuses caught off the coast of Egypt. In this study, the values of essential metals such as Ca, K, Cu, Fe, Se, Sr, Zn and Cr were found to be 815, 133, 11.7, 97.9, 1.8, 12.4, 69 and 2.7 mg kg^{-1}, respectively. The values of non-essential substances such as Cd, Hg and Pb were determined as 1.7, 0.053 and 1.3 mg kg^{-1}. The values obtained in this study were higher than the values obtained in our current study. When these results are evaluated, it is understood that the accumulation of heavy metals and the potential environmental stress caused by octopuses caught from Iskenderun Bay are less than the octopuses from the compared regions.

Mok. et al. (2014), the levels of essential and non-essential metals in octopus tissues caught from the Korean coast were 71.72 mg kg^{-1} for Zn, 24.148 mg kg^{-1} for Cu, 1.568 mg kg^{-1} for Cd, 0.303 mg kg^{-1} for Ni. 1, 0.125 mg kg^{-1} for Ag, 0.045 mg kg^{-1} for Cr, 0.032 mg kg^{-1} for Pb and 0.029 mg kg^{-1} for Hg. In this study, Cd content was found to be above the legal limits set by Korea and the European Union. The main way of Cd uptake in octopuses is through food, and the digestive gland is the main retention organ. The probable cause of the high Cd level in the above study is octopuses; They feed on a wide variety of other marine animals, including crustaceans, molluscs, fish and other cephalopod species, and may result from bioaccumulation of pollutants through the food chain. Compared to our current study, essential metals were consistent with our study, while non-essential metals were higher.

Neto et al. (2014), As, Se and Zn levels in 117 octopuses obtained from sales points in Brazil were determined as 5.67, 1.40 and 14.2 mg kg^{-1}, respectively. According to Brazilian authorities, the Maximum Tolerance Limit for arsenic in fish and fish products is 1.0 mg kg^{-1}, and in solid foods it is determined as 0.30 mg kg^{-1} for Se and 50.0 mg kg^{-1} for Zn. As and Se were above the specified legal limits. When we compare it with our current study, high Zn results were found to be similar.

Karim et al. (2016) in the muscle tissues of octopuses collected in Morocco, the Cd, Zn, Cu, Fe and Co values were 0.58, 8.95, 280.68, 171.12, 229.35 and 2.73 mg kg^{-1} in the summer months, and 0.24, 298.6, 133.04, 40.551.17 mg kg^{-1} in the winter months. and was determined. Compared to the maximum residue limit allowed by WHO, the concentrations of the studied metallic elements were generally detected within the permissible limits for human consumption. When we compare the results of octopuses caught in Iskenderun Bay, it can be said that non-essential elements are high and essential elements are similar.

Cd 0.68-9.51, Cu 5.97-324.1, Cr 0.48-8.75, Fe 7.23-131.35, Mn 0.52-52.46, Pb 1.49-3.10, Zn 9.13-85.19 mg kg^{-1} were determined between in 60 squid tissues caught from İskenderun Bay by Duysak and Dural (2015). In this study, Cd and Pb limit values were above the residue limits determined by the Turkish Food Codex Contaminants Regulation and the European Commission Regulation. In our current study in the same region, all values were found to be below acceptable levels.

Baş and Altındağ (2019) investigated heavy metal accumulations such as Pb, Cd, Fe, Ni, Cu, Zn, Cr, As, Al, and Mn in sardine (Sardina pilchardus) and horse mackerel (Trachurus trachurus) samples obtained from İskenderun Bay. It has been determined that iron is the most accumulated heavy metal and the highest accumulation is in the gill tissues. Metal values in all tissues were found to be in accordance with the Turkish Food Codex and European Union norms. The results were found to be compatible with our current study conducted in the same region.

In their study, Kaya and Türkoğlu (2017) conducted heavy metal levels in the muscle tissues of fish and shrimps caught from the bay of İskenderun: 0.103-4.988 mg kg^{-1} for Mn, 0.134-0.336 for Cr, 0.005-0.008 for Cd, 0.091-0.110 for Ni, It was determined between 0.026-0.228 for Hg, 1.741-29.254 for As, 0.087-0.110 for Pb, and <0.00050-0.027 mg kg^{-1} for Co. In this study, it was determined that the total arsenic level in shrimp muscle was at high concentrations and it was concluded that shrimp may pose a health risk because it exceeds the legal limits for both total arsenic and estimated inorganic arsenic amounts. When compared to our octopus study conducted in the same region, the values were found to be similar except for arsenic.

CONCLUSION

Industrialization and unregulated urbanization play a major role in deteriorating the ecological balance. In parallel with the increase in industrialization, water, soil and air pollution has also been gradually increasing. The environmental balance, which has been functioning spontaneously for centuries, has begun to deteriorate in a way that it can no longer fulfill this function. The important thing is that chemicals pass through the food chain to plant and animal bodies, and from there to humans, the last link of the food chain. Factory wastes, untreated material discharge, agricultural wastes, domestic wastes and maritime transportation cause an increase in chemical pollution in Iskenderun Bay. Heavy metal pollution, one of the chemical pollutions, has negative effects on marine creatures.

Heavy metal pollution, one of the chemical pollutions, has negative effects on marine organisms.

In the measurements made, the highest heavy metal level in octopus tissues was determined for Zn, and Hg and Pb could not be detected in any sample. It has been determined that the heavy metal levels in their edible tissues comply with the European Union norms and the values published in the Turkish Food Codex. As a result of the study, it was understood that the heavy metal accumulation detected in octopus tissues was not dangerous for human health and ecosystem.

It has been observed that the heavy metal levels found in the research conducted in the bay of Iskenderun increase every year, and in recent years, the levels of some heavy metals have exceeded the maximum residue amount specified in the Turkish Food Codex Contaminants Regulation. Future plans and programs should be made to reduce and prevent chemical pollution in Iskenderun Bay.

Conflict of interest: The authors have no conflicts of interest to report.

Authors' Contributions: E.T. contributed to the project idea, design and execution of the study. E.T and A.C contributed to the acquisition of data. E.T and A.C analysed the data. E.Tand A.C. drafted and wrote the manuscript. E.T, and A.C reviewed the manuscript critically. All authors have read and approved the finalized manuscript.

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Explanation: We have presented as a abstract at the International Congress on Biological and Healtlh Sciences (ıcbh) (2021).

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