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Determination of the Content of Mercury and Cadmium in Fish of Rivers (Chakvistskali, Bartskhana, Chorokhi, Ajaristskali and Kubistskali)

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Abstract
The major problem of our time is the contamination of reservoirs with heavy metals, which is mainly a result of anthropogenic impact. One of the particularly toxic metals is cadmium, which, as a result of sorption on suspended particles, forms complex compounds with organic substances and moves in this form. They pollute the water. They are characterized by special toxicity for hydrobionts and humans and have a significant negative impact on freshwater ecosystems, as they may transform into more dangerous forms in the environment. They can poison and/or reduce the number of aquatic organisms, pollute natural landscapes, disrupt and reduce the biodiversity of aquatic ecosystems (Mchedluri, T. 2020).
Based on the above, we considered it urgent to study the Cd pollution of the rivers of the Black Sea Basin (the Chakvistskali, the Chorokhi, the Bartskhana, the Adjaristskali, the Kubistskal) and its contents in the body of fishes.
Based on the results of our research, it was found that it is possible that the water taken from a specific point is not contaminated with Cd, but a certain amount of cadmium is accumulated in the body of fish taken from the same river. During the fall season of 2019-2020, the concentrations of cadmium in the bodies of fish taken from the rivers as research objects were small, but still recorded. The results of the analysis show that the highest content was found in the fish of the rivers Chorokhi and the Adjariskali. In our opinion, this is due to the fact that fish easily absorb cadmium from the water and it accumulates in the body. It is important to note that their concentration is much lower than MAC.
Thus, the ecosystems of the mentioned river are not polluted by cadmium. Consequently, it is almost impossible to pollute rivers, water ecosystems, fish, hydrobionts and their populations, reservoir biocenoses with the mentioned heavy metals

Keywords: The Black Sea, heavy metals, cadmium, mercury.

INTRODUCTION

Among heavy metals, Hg and Cd are dangerous contaminants of water reservoirs. They can accumulate and migrate. Have a negative effect on the flora and fauna of water reservoirs. It is almost unexplored how they spread in the biota, their transformation in time and space, toxicity to organisms, as well as biochemical-pathological reactions, etc. Therefore, the introduction of these pollutants into aquatic ecosystems poses a potential threat to aquatic flora and fauna, as well as to human health. [Wren C. D., et al 1983].

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There is practically no self-cleaning mechanism for heavy metals because they only move from one water reservoir to another, affect different categories of living organisms, and usually cause undesirable, sometimes disastrous consequences. (Ghoghoberidze, M. 1992).

According to some researchers, heavy metals, in particular, Hg, when they get into a reservoir, they settle to its bottom and become practically harmless. Studies showed that they are broken down by bacteria, as a result of which they get into fish food along with bacteria, after which they get in fish and finally in the human body. Mercury enters water bodies mainly from industries. The total mercury content in freshwater plankton and benthos is much higher than in similar organisms in seawater. Hg gets into water reservoirs mainly from the industry. The total content of Hg in freshwater plankton and benthos is much higher than in similar organisms of seawater. (Mchedluri T., et al 2018)

It took specialists fifteen years to determine It took specialists fifteen years to determine what caused the terrible disease that spread through the population of Minamata in 1956-60. Dozens of people died as a result of an unknown disease at that time. The cause of the illness was mercury compounds introduced into the ocean by the wastewater of one of the chemical plants. For years, mentally and physically imperfect, paralyzed children with a damaged central nervous system were born in Minamata. This disease was called "industrial Hiroshima", that is, "Minamata disease", and in medicine this term refers to human poisoning by industrial waste (David Lennett., et al 2018) .

Due to the pH values in natural waters, cadmium entered t reservoir undergoes hydrolysis. Cd^{2+} is adsorbed on suspended particles, forms complex compounds of organic substances, and moves in this form. The processes of cadmium sorption and desorption in bottom sediments of water bodies are very fast, and humic acids are the dominant factor in these processes.

The total content of cadmium in freshwater vegetation is 1 kg. Dry weight can vary from 0.15 to 342 mg. Low water temperature reduces cadmium absorption. Cadmium in fish accumulates primarily in the tissues of internal organs. There are a few reported cases of cadmium poisoning in humans by consuming fish or using water.

The most well-known example of cadmium poisoning is the so-called “Itai-Itai” disease, which was found in the residents of one of the districts of Japan in 1940-60. Here, contaminated waters from deposits were discharged into small rivers without treatment, which affected the quality of drinking water **(**Alan D. Woolf. 2022) .

The same was used to irrigate rice crops. When people are poisoned by cadmium, softening of bones, calcification and pyelonephritis of the kidneys followed by bone deformation and kidney dysfunction take place. The half-life of cadmium accumulated in the body is 10-30 years, moreover - there is a direct correlation between cadmium exposure and cancer. (*Mchedluri T., 2021)*

Research Object and Methods:

Determination of cadmium concentration in the analyzed product, fish, was done by atomic absorption method (30178-96). Determination of heavy metals in water by axial induction plasma (ICP-OES) spectrometer; GOST 26927-86 “Raw materials and food products. Mercury determination methods

Results and Discussion:

The results of the analysis of Cd and Hg in the water of the rivers studied by us showed that the water of some rivers is much smaller than MAC. Mercury and cadmium have the ability to biomagnify and bioaccumulate. In the environment, they may transform into more dangerous forms, which is why they are characterized by special toxicity for hydrobionts and humans. They can poison and/or reduce the number of aquatic organisms, pollute natural landscapes, disrupt and reduce the biodiversity of aquatic ecosystems (Mchedluri, T. *et al 2017)*

Based on the mentioned problem, we considered it topical to determine the content of mercury and cadmium in the bodies of fish common in the rivers (Chakvistskali, Bartskhana, Chorokhi, Ajaristskali and Kubastskali) taken by us as research objects, to see how easily Hg and Cd could penetrate into the body of fish through the fatty coating, absorption and accumulation.

We conducted research in September 2019-2020. The obtained results are presented in tables No. 1,2,3,4

Table 1 Hg contamination in the fish tissue samples from the rivers

№	Place sample was taken	Time sample was taken	Finding Hg mg/kg	MAC mg/kg	Comment
1	Theriver Chakvistskali	September, 2019	0.0030	0.5	Weight of taken samples – 350 gr
2	The river Bartskhana		0.0035		
3	The river Chorokhi		0.0055		
4	The river Ajaristskali		-		
5	The river Kubistskali		-		

Table 2 Cd contamination in the fish tissue samples from rivers

№	Place sample was taken	Time sample was taken	Finding Cd mg/kg	MAC mg/kg	Comment
1	The river Chakvistskali	September, 2019	0.0112	0.05	Weight of taken samples – 350 gr
2	The river Bartskhana		—		
3	The river Chorokhi		0.0119		
4	The river Ajaristskali		0,0111		
5	The river Kubistskali		0.0100		

Table 3 Hg contamination in the fish tissue samples from the rivers

№	Place sample was taken	Time sample was taken	Finding Hg mg/kg	MAC mg/kg	Comment
1	The river Chakvistskali	September, 2020	0.0030	0.5	Weight of taken samples – 350 gr
2	The river Bartskhana		0.0032		
3	The river Chorokhi		_		
4	The river Ajaristskali		_		
5	The river Kubistskali		-		

Table 4 Cd contamination in the fish tissue samples from the rivers

№	Place sample was taken	Time sample was taken	Finding Cd mg/kg	MAC mg/kg	Comment
1	The river Chakvistskali	September, 2020	0.010	0.05	Weight of taken samples – 350 gr
2	The river Bartskhana		—		
3	The river Chorokhi		0,012		
4	The river Ajaristskali		0.011		
5	The river Kubistskali		0.010		

The results of the 2019-2020 research showed that even though the concentrations of Hg and Cd in the research rivers are quite small and in some points were not even detected, the concentrations of mercury and cadmium in the fish samples taken from different points were found to be very low concentrations and the difference between the obtained results is also small.

Based on the data of 2019, the lowest concentration of mercury was recorded in the fish taken from Chakvistskal (0.0030 mg/kg), and the highest - in the fish of Chorokhi River (0.0055 mg/kg). The concentration of cadmium is also very low. For instance, it was the lowest in Kubastskali fish (0.01 mg/kg), the highest - in chorokhi fish (0.0119 mg/kg). It was not observed in the fish of Ajaristskali and Kubitskali.

According to the data of 2020, mercury was recorded in the fish of Bartskhana River (0.0032 mg/kg) and Chakvistskali (0.003 mg/kg). No mercury content was recorded in the fish taken from Chorokhi, Kubistskali and Ajaristskali. Cd content is very low only in Chakvistskali (0.01 mg/kg) and Kubistskali fish (0.01). No cadmium was detected in the fish taken from Chorokhi, Bartskhana and Adjaristskali.

Conclusion:

The obtained results of 2019-2020 show that even though the rivers (Chakvistskali, Bartskhana, Chorokhi, Adjaristskali and Kubastskali) suffer from anthropogenic pollution, quite small concentrations of mercury and cadmium were found even in the points most loaded with anthropogenic factors. Both mercury and cadmium contents are very low in the analytical fish taken from the rivers (in some of them their concentration was not observed).

In our opinion, this is because there are no such enterprises in Georgia that result in the pollution of water bodies' ecosystems with mercury and cadmium. Therefore, it is impossible to poison hydrobionts, fish and their populations with the mentioned heavy metals. It is important to note that mercury is characterized by a short stay in water. It rapidly transforms into compounds in sediments.

Thus, for the first time, we have determined Hg and Cd contents in fish of Western Georgian rivers (Chakvistskali, Bartskhana, Chorokhi, Adjaristskail and Kubastskali). The obtained results show that it is possible that Hg and Cd are absent in water taken from a particular point or there is a very low concentration in it, but in the tissues of fish taken from the same point, these elements are accumulated in certain amounts. It should be noted that the processes of contamination in fish with these elements can take place quite easily and quickly. Nevertheless, the concentrations of Cd and Hg in the body of fish are very low and in no case can they even approach MAC values.

It is noticeable that many European countries carry out monitoring of the content of heavy metals in hydrobionts and fish of open water reservoirs, even though the mentioned rivers are not polluted by heavy metals.

Unfortunately, such monitoring of hydrobionts and fish is not carried out in Georgia. Therefore, we can say that our research on fish is topical and important. The results are worthy for specialists and interested parties.

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