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The Effects of Heavy Metals on Living Organisms

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Shafa Karimova*

Candidate of Biological Sciences, Nakhchivan State University, University Campus, Nakhchivan, AZ7012, Azerbaijan

***Corresponding Author:** Shafa Karimova, Candidate of Biological Sciences, Nakhchivan State University, University Campus, Nakhchivan, AZ7012, Azerbaijan.

Abstract

The study was conducted on fish. My research on fish: their current state, the role of environmental factors in their development, and the study of negative factors affecting their development were given priority.

In the early stages of toxicosis, the body color may be lighter than normal due to the disappearance of black pigment. The most severe signs of toxicosis are shrunken scales or the appearance of ulcers on the body. It is known that all changes in body color are clearly related to the amount of heavy metals in the fish's body. It should be noted that when water is polluted, the skin, gills, and digestive system of the fish are damaged first; then, through the blood, toxicants spread to the muscles, skeleton, liver, kidneys, and gonads. The organs for the main "extraction" of toxic substances from the body are the liver and kidneys, that is, the most harmful substances accumulate in them and morphological anomalies are more noticeable.

Keywords: Heavy metals; fish; Nakhchivan fauna; pathology

Such studies are of great importance, since fish are bioindicators of water pollution and are an important link in the food chain of the toxic element entering the human body.

Currently, the diagnosis of toxicosis and the prognosis of its outcome provide for a comprehensive assessment of the condition of fish, taking into account the severity of the pathological process, including the assessment of the state of the germinal system and its ability to reproduce.

It should also be noted here that fish is one of the main food products for humans, and when assessing its condition, it is necessary to take into account the requirements of veterinary and sanitary expertise [1, p.280]. Ideas about the stability of hydrobionts, the ability of organisms to resist the effects of pollutants entering the reservoir, have not yet been fully formed. Studies conducted in recent years have shown that many organisms living in water bodies survive in areas of economic activity, maintaining a fairly high population size [1, p.255]. Survival in this case means not only the ability to save one's own life, but also the continuation of generations. It has been proven that data on the pathology of the gonads [3, p.123-126] indicate their significant weakening under the influence of pollutants. It has been established that pathologies of the female gonads are the most diverse and most common in spawning grounds. The loss of females leads to a decrease in the total number without affecting the qualitative characteristics of the population, while the disappearance of some males does not affect the number of the population, but can change the quality of the offspring, which helps to adapt to new conditions, which in turn leads to the evolution of the species.

Fish is a bioindicator of pollution of water bodies and an important link in the entry of toxic elements into the human body through the food chain. In the composition of the human diet, fish products are in fourth place after meat, milk, bread and bakery products. Therefore, they became the basis for studying the fish fauna widespread in the republic. The description of clinical and pathoanatomical signs of fish intoxication was carried out within the first hour after the fish was caught. Heavy metals (HM), including mercury, entering water bodies, combine with the buffer system of water, then pass into poorly soluble hydroxides, carbonates, sulfides and phosphates, and also form organometallic complexes that are adsorbed by bottom sediments and accumulate in fish [3, p. 250-280]. The absorption of HM by the body, their transport, interaction with intracellular biostructures and excretion from the body is a complex active process closely related to the general metabolism. Therefore, the amount of absorbed metal is a determining factor in the state of the organism as a whole, affecting the biochemical processes and physiological functions of aquatic organisms [3, p. 285-286]. As can be seen from this, fish populations there are represented by a small number of age groups of fish and a minimum number of spawning generations. Shortening of life span, predominance of fish in young age groups, decrease in growth rate and decrease in average size, early maturity, starting at very small sizes for species or inhibition of growth processes with growth, there is a long period of sexual maturity. When exposed to heavy metals in chronic subtoxic conditions, there is a change in the life cycle strategy of fish.

Since the end of 1990, a steady decrease in the total fishing of the autonomous republic has been observed. In recent years, as a result of heavy pollution by Armenia, major changes have occurred in the ichthyofauna of the reservoir. The discharge of many heavy metals, phenol and other toxicants into it has led to an increase in the MPC for them and has had a serious impact on the stocks of many fish species. These factors have led to sharp changes in the ecosystem, which has been seriously damaged.

All this has led to the degradation of spawning rivers and feeding grounds for small fish in the near future. This pollution makes the normal course of embryogenesis and the development of young impossible.

Normally, the fins have smooth contours and a number of rays characteristic of the species. In mild toxicosis, bent and broken rays were observed in the fins of all studied fish species, sometimes the bending involved several rays at once, which changed the shape of the fin. Particular attention was paid to cases where the number of rays in the fin went beyond the usual limits of fluctuations characteristic of the species. Partial or complete shortening of the rays in the fins, uneven edge of the fins ("fin melting") were considered as a consequence of more severe toxicosis . Anomalies in the number of vertebrae were rarely observed (2-5%). In the early stages of toxicosis, a slight bending of the spinal column to the side was observed, probably due to a decrease in muscle turgor. It was found in dissected fish when examining the spinal column from the abdominal side. With the development of myopathy, this curvature was already manifested in the form of a curvature of the spine, which was clearly visible when counting the number of ribs in the longitudinal section of the fish. In addition, anomalies were found in the spines: a change in shape, shortening and fusion of several of them, the destruction of individual vertebrae. As a rule, all these anomalies are associated with a shortening of the body of the fish and the presence of fixed curvatures of the body without visible signs of trauma. Fusion and destruction of individual vertebrae are most likely associated with exposure to toxicants during the embryonic stages of development.

Samples taken from the lakes where the study was conducted were cleaned with water in the area of capture and sorted by size. The fish were brought to the laboratory unharmed and placed in neat, closed containers with ice. Fish with a total length of more than 15 cm were prevented from decay by injecting 40% formaldehyde into the abdominal cavity. The fish were laid on their sides and shaped as neatly as possible, and a 4% formaldehyde solution was added to cover the samples and allowed to harden for 2-3 days. To neutralize the acidic properties of formaldehyde, which causes discoloration over time, one tablespoon of boron solution ($Na_2[B_4O_5(OH)_4]\cdot 8H_2O$) was added to every 5 liters of 4% formaldehyde solution. Labels indicating the place and date of capture of the samples were affixed to the containers in which the fish were stored. Photographs of the species were taken before they were packaged. The fins were fixed with the help of insect needles while taking the photographs. The color, pattern, etc. of the samples when they were fresh were noted.

After the samples brought to the laboratory were identified and hardened, they were washed with water to remove formaldehyde, and an evaluation was conducted based on the metric characteristics used in fish systematics.

Heavy metals with an atomic weight of more than 40 should be under constant control of environmental organizations. These metals, depending on their physicochemical properties, affect the activities of humans and other living organisms to varying degrees. In the aquatic environment, the ions of these metals are hydrated and allow the formation of various hydrocomplexes. If there are any anions or molecules of organic compounds in the solution, then the ions of the metals can form complexes with very different structures. They later enter and poison organisms, continuing to act as substances. Although the intake of some heavy metals is necessary for the life of living organisms, some of these heavy metals naturally pass into water resources with anthropogenic environmental waste and create problems for living organisms. Of these, elements belonging to the "xenobiotic" group have a negative impact on human life. When this group of elements enters the composition of living organisms, they cause poisoning and even death. These include cadmium, arsenic, mercury, lead, zinc and chromium. Among them, lead and cadmium are mainly toxic, while arsenic is very toxic [5, p. 6-8].

The toxic loads (heavy metals) on fish exposed to unfavorable conditions caused premature mortality of young and old groups, inhibited growth rates, and caused changes in metabolism, including a shift to a shorter life and reproduction period. However, this also led to poor development of the fish and an often prolonged spawning season.

Control test points	***Metals***			
	Accepted norm mg/l			
	0.5(mg/l)	***(0,1mg/l)***	***1.0(mg/l)***	***1.0(mg/l)***
	Iron	***Chrome***	***Aluminum***	***Copper***
1.	2,00	0,50	0,19	0,50
2.	1,80	0,65	0,22	0,20
3.	2,50	0,55	0,18	0,10
4.	1,50	0,60	0,16	0,60
5.	2,00	0,65	0,18	0,20
6.	1,50	0,55	0,22	0,18
7.	2,00	0,70	0,25	0,11
8.	2,20	0,75	0,24	0,22
9.	2,00	0,55	0,75	0,10
10.	2,50	0,60	0,50	0,10
11.	2,80	0,95	0,95	0,40
12.	1,50	0,50	0,75	0,50
13.	1,00	0,25	0,50	0,14
14.	0,50	0,25	0,70	0,15
15.	1,00	0,75	0,82	0,86
16.	0,80	0,50	0,95	0,60
17.	1,50	0,25	0,70	0,75
18.	2,00	0,90	0,89	0,90
19.	1,00	0,40	0,75	0,40
20.	0,50	0,50	0,70	0,50
21.	0,55	0,30	0,50	0,30

Table 1: The content of some metals in water samples taken from different parts of the Araz watershed.

Figure 1: Assessment of the impact of heavy metals on fish organisms.

Figure 2

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