Journal of Stress Physiology & Biochemistry, Vol. 19, No. 3, 2023, pp. 72-78 ISSN 1997-0838

ORIGINAL ARTICLE

Quantitative Properties of Chemical Elements in the Body of Bivalves

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Received February 27, 2023

Biogeochemical processes have a great influence on the presence and distribution of hydrobionts. Although the morphophysiological properties of hydrobionts, especially mollusks, in the region of the Middle Zarafshan are well studied, the amount of chemical elements in its composition has not yet been studied. The purpose of our study is to study the composition of chemical elements in the body of bivalves.

The study of the composition of mollusks by biogeochemical parts is important in determining the need of organisms for chemical elements. Because the lack or excess of elements in the environment can lead not only to quantitative changes in the internal environment of organisms, but also to changes in the external environment. Therefore, various diseases arise due to a lack or excess of elements in the body. The study of the amount of elements in mollusks, which play an important role in the bioindication of water quality, is of great scientific and practical importance today.

Key words: Bivalve mollusks, Zarafshan river, hydrobiont, trace elements, shell, pearl shell, gills

Bivalve mollusks belong to the group of benthic invertebrates that live in various freshwater bodies of water. One of the main threats that bivalves currently face is chemical pollution of water bodies. Although bivalves are highly variable in their environment, they are very sensitive to environmental changes. Mollusks, like other organisms, have the ability to adapt to the geochemical influences of their environment.

The relative constancy of the habitat is of great importance for the normal functioning of organisms. In addition to ensuring the stability of the internal environment of this organism, it is also involved in ensuring the homeostasis of biocenoses and the biosphere as a whole (Kovalsky, 1982).

Elements are involved in the biogeochemical cycles of organisms and play an important role in maintaining the dynamic stability of the habitat (Ermakov, 2017).

One of the environmental components that have a significant impact on the biocenosis is the chemical elements present in organisms. They affect organisms in different ways in terms of their biological functions. Essential (vital) Cu, Zn, Mn, Co, Cr, Mo, Se, J, B; useful - As, Br, F, Li, Ni, Si, V; passive - Al, Ba, Bi, Cd, Pb, Ta, Hg and so on (Kovalsky, 2009). In addition, the most important of these elements are Fe, Cu, Zn, Mn, Co, Cr, Mo, Se, J and conditionally important - As, Br, Li, Ni, V, Cd, Pb (Bgatov, 1999).

Chemical elements are widely distributed in the natural environment and are necessary for the normal functioning of living organisms in the required quantities. The predominance of substances in the components of biogeocenoses plays an important role not only in the geochemistry of the environment, but also in the assimilation of substances by living organisms. Thus, it biologically improves living organisms and involves them in the trophic cycle (Vernadsky, 1987).

During the evolution of the biosphere, stable levels of chemical elements have formed in the abiotic and biotic components of the environment, to which living organisms are well adapted. The evolution of living organisms is also due to their adaptation to the geochemical factors of the environment, which allows organisms to choose from the environment that set of substances (elements) that make up the structural and dynamic basis of life. The need to study the composition of mollusks in biogeochemical regions is important in determining the body's need for elements. After all, with a lack or excess of surrounding elements, not only quantitative changes in the intermediate exchange can occur, but also deep, qualitative disorders, expressed in the dysfunction of metabolic processes. However, the cause of endemic diseases is also a deficiency or excess of elements in hydrobionts (Ermakov, 2017).

Knowledge of the geochemical ecological balance of animals makes it possible to reconstruct the local biogeochemical cycles of chemical elements.

MATERIALS AND METHODS

Samples were taken from the body of a bivalve mollusk (Boymurodov & Khasanov, 2021) and from a reservoir on December 12, 2022. The samples were taken in the basin of the middle part of the Zarafshan River (Jumabozor village) in winter (December).

To separate the substances in the pool water, 1.5 L of water was first evaporated at 60° C. for 6 hours and heated until a dry mass was formed. The result was a 3-gram dry weight. This dry mass in powder form was placed in a glass jar.

Organs such as bivalve shells, shell layer, jaw, and walking legs were used as material for research. The samples were dried in an oven at 80° C. for 4 hours until a dry mass was formed. Each of the samples was weighed to 3 grams, placed in a glass container and all samples were delivered to the laboratory.

The analysis was performed in a modern way using gamma spectrometers. The peculiarity of this is that it allows the detection of all samples in the form of a dry powder with a very high sensitivity of more than 30 elements at the same time.

Analysis of the mollusk organs and the water content in dry matter revealed the following elements important for the body: Co, Cr, Mn, Mo, Se, Zn.

The results of the study were statistically processed using the Microsoft Excel 2013 software package and analyzed based on the requirements of the criteria (Plokhinsky, 1982).

Laboratory analyzes were performed at the Research Institute of Nuclear Physics of the Academy of Sciences of the Republic of Uzbekistan.

RESULTS AND DISCUSSION

The elements of the reservoir of the Zaravshan river basin (the village of Dzhumabozor), where bivalve mollusks were collected, were analyzed.

During the transition of mollusks from the period of winter dormancy to spring, an activation of metabolism is observed. Enzyme systems are activated in which metals such as zinc participate as coenzymes in the body. By spring, stocks accumulated in autumn are depleted, animals start feeding, and the breeding season begins. All this is reflected in the change in the micronutrient spectrum of the body. The transition of bivalve mollusks to the spring life cycle leads to a number of changes in the microelement composition of organs and tissues. Therefore, the amount of trace elements in the tissues of the mollusk in winter is somewhat different than in spring.

The results of the analysis were expressed in mg dry weight. Data on the number of elements in various organs of bivalve mollusks are given in Table 1.

As in all organisms, in bivalve mollusks, the amount of 6 elements necessary for metabolism in the body was analyzed: zinc, selenium, manganese, chromium, cobalt, molybdenum in various organs of the mollusk, such as gills, shell, pearl layer, legs. The analyzes were carried out in winter. As a result, it was found that Zinc: in the leg of the mollusk - 8.8, in the pearl layer - 0,32, in the gills - 24,4, in the shell - 0,141, Selenium: in the leg - 0,285, in the pearl layer - 0,0281, in the gills - 0,847, in the shell -0,0158, Molybdenum: in the leg - 0,231, in the pearl layer -0,172, Manganese: in the leg - 21,8, in the pearl layer - 33,5, in the gills - 605, in the shell - 50,9, Chroma: in the gills - 0,84, in the leg - 0,0644, in the shell - 0,0493, in the pearl layer - 0,157, Cobalt: in leg - 0,0311, in the pearl layer - 0,0298, in the gills - 0,215, in the shell - 0,0128.

Zinc.

Zinc diffuses into water and is a natural product of the destruction and smelting of natural rocks and minerals (sphalerite, zincite, goslarite, smithsonite, calamine), as well as wastewater from mining and processing plants and electro-paint shops, parchment paper, mineral dyes, viscose fiber, and etc. In water, it is found mainly in the form of ions or in the form of its mineral and organic complexes. Sometimes found in insoluble forms: hydroxide, carbonate, sulfide and others. The concentration of zinc in river water is usually from 3 to 120 µg/l, in sea water - from 1.5 to 10 µg/l. The content can be significant in ore and especially in mineral waters with low pH (Moore, Ramamurthy, 2012). Zinc is one of the active elements that affect the growth and normal development of organisms. However, many zinc compounds are toxic, especially sulfate and chloride compounds. The high content of alcohol in the organisms of hydrobionts adversely affects the physiological processes of the body.

Selenium.

Selenium is very rare in nature. Normally, the minerals formed by this element are added to surface and ground water during flushing. In addition, a large concentration of it enters natural water sources with wastewater from various enterprises.

Selenium is a biologically active element, as well as an antioxidant. For example, it neutralizes the toxic effect of these elements, participating in the body's defense against compounds of mercury, cadmium, arsenic, tellurium, lead, copper (Kurskov, Rastegaev 2013).

The accumulation of selenium in the body of hydrobionts occurs mainly due to the food chain (Janz, 2012), its concentration in water is very low. Selenium is found in all organs of the mollusk, and its amount in the gills is much higher than in other organs.

Manganese.

Manganese compounds are one of the most common pollutants of water bodies (Martynova, 2012).

They can disrupt the integrity of physiological and biochemical processes in hydrobionts, leading to significant changes in metabolic reactions (Shilova et al., 2012). Manganese, on the one hand, makes it possible to assess the overall resistance of body cells, on the other hand, it is involved in ensuring their viability (Vladimirova, Semenenko, 1962). Although present in very small amounts, manganese is required by almost all living things and is essential for enzyme activity.

Table 1. The concentration of dry matter elements in various organs of aquatic and bivalve mollusks in the Zeravshan River basin (on the territory of the Urgut region), mg/kg.

	Pool water			Clam shell			Clam gills			Pearl layer			Clam legs		
Co	1,96	±	0,196	0,0128	±	0,00128	0,215	±	0,0215	0,0298	±	0,00298	0,0311	±	0,00279
Cr	2,54	±	0,204	0,0493	±	0,00542	0,84	±	0,0756	0,157	±	0,0157	0,0644	±	0,00644
Mn	12,1	±	1,09	50,9	±	3,56	605	±	42,4	33,5	±	2,34	21,8	±	1,53
Mo	1,77	±	0,159	0		0	0		0	0,172		0	0,231		0
Se	0,195	±	0,0156	0,0158	±	0,00253	0,847	±	0,0677	0,0281	±	0,00281	0,285	±	0,0228
Zn	8,7	±	0,6	0,141	±	0,0239	24,4	±	1,71	0,32	±	0,0224	8,8	±	0,528

According to the degree of decrease in the content of elements in water bodies of river basins and mollusks, the elements are arranged as follows.

Water: Mn >Zn > Cr > Co > Mo > Se
Shell: Mn > Zn >Cr> Se>Co
Gills: Mn >Zn>Se>Cr>Co
Pearl layer: Mn>Zn> Mo>Cr >Co>Se
Legs: Mn >Zn > Se > Mo> Cr >Co

At the metabolic level, water samples were taken, in which bivalve mollusks settled during the winter, and the elemental composition was studied. The results of the analysis are presented in table 2.

Table 2. Concentrations of elements in the water of the Zarafshan river basin (on the territory of the Urgut region) in various organs of bivalve mollusks, mg/kg.

sample type	**Chemical elements**					
	Zn	**Se**	**Mo**	**Mn**	**Cr**	**Co**
Pool water	8,7	0,195	1,77	12,1	2,54	1,96
Clam shell	0,141	0,0158	-	50,9	0,0493	0,0128
Gills	24,4	0,847	-	605	0,84	0,215
Pearl layer	0,32	0,0281	0,172	33,5	0,157	0,0298
Legs	8,8	0,285	0,231	21,8	0,0644	0,0311

The decrease in the concentration of elements of the reservoir and in the bodies of the mollusk occurs as follows:

Zinc: gills, legs, pearl layer, shell
Selenium: gills, legs, pearl layer, shell
Molybdenum: legs, pearl layer
Manganese: gills, shell, pearl layer, legs
Chrome:gills, pearl layer, legs, shell
Cobalt: gills, legs, pearl layer, shell

Chrome.

The toxicological significance of chromium and chromium compounds is due to the fact that they are poisonous substances and the widespread use of chromium preservatives in the national economy.

The toxic effect of chromium salts on the body depends on the valency of the chromium cation. Hexavalent chromium compounds are more toxic than trivalent chromium compounds. Poisoning with chromium compounds occurs mainly in hydrobionts in connection with nutrition.

The amount of chromium in unpolluted and slightly polluted river waters ranges from tenths of a microgram per liter to several micrograms, and in polluted water bodies from a few tens and hundreds of micrograms per liter. The average concentration in sea water is 0.05 $\mu g/dm^3$, in groundwater - usually within n.10 - n.102 $\mu g/dm^3$.

Chromium and its compounds are harmful substances that pollute water bodies and enter water bodies along with acid rain, chemicals and radionuclides.

Among the group of heavy metals, chromium and its compounds, which are widely used in industrial production, play an important role in nature. J.W. Moore and S. Ramamoorthy (2012) classified chromium as one of the most dangerous pollutants in the aquatic environment. Environmental pollution with chromium compounds is extremely dangerous for biological species. The amount of chromium compounds in the environment is constantly increasing, leading to dangerous levels for the life of these organisms.

Cobalt.

Mixtures of cobalt and its compounds enter water bodies as a result of metal processing processes, their discharge from chemical and metallurgical enterprises, and ores. A certain amount of it in the water is formed as a result of washing the soil.

In surface waters, mainly its following compounds are found CoF_2, CoF_3, $CoCl_2$, $CoBr_2$, CoI_2, so that $CoCO_3$, $Co(NO_3)_2 \cdot 6H_2O$ и $CoSO_4 \cdot 7H_2O$ (Moiseenko et al., 2005; Moiseenko et al., 2006; Moiseenko & Gashkina, 2007; Moiseenko et al., 2008).

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Cobalt is an essential element for all organisms. In animals, cobalt ionizes iron and activates substances, affects the formation of erythrocytes, activates protein synthesis, and promotes their accumulation in organs and tissues (Simonsen et al., 2012).

As a result of cobalt deficiency in water, its uptake by molluscs decreases (Veltman et al., 2008). The cobalt exchange cycle is very important in the body of cobalt hydrobionts. For example, 5.61 mg of cobalt corresponds to 1 kg of dry weight of fish (Türkmen et al., 2005). In the tissues of invertebrates, its content is much higher than in water, and oligochaetes and larvae have the ability to accumulate the element cobalt in their bodies (Golovanova, 2008; Sharma, Behera, 2021).

Molybdenum.

Molybdenum and its compounds enter surface waters as a result of leaching of exogenous minerals, as well as with wastewater from processing plants and non-ferrous metallurgy plants (Eisler, 1989).

Small amounts of molybdenum are important for the normal development of hydrobiont organisms, and its large concentrations are harmful to the organism.

The element molybdenum is important for the normal development of the organism of aquatic organisms and belongs to the category of essential microelements, but its role and significance in the accumulation and metabolism in the body have not been sufficiently studied.

CONCLUSION

The results of such studies show that various chemical elements accumulate in the organisms of aquatic organisms along with water bodies as a result of environmental pollution. These chemical elements are involved in the activity of enzymes in the body and affect its physiological development.

CONFLICTS OF INTEREST

The author declare that he has no potential conflicts of interest.

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