

INFLUENCE OF HEAVY METALS ON THE CONCENTRATION OF BIOGENIC ELEMENTS IN ORGANS OF COMMON CARP (*CYPRINUS CARPIO*)

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Abstract

The influence of heavy metals (copper, zinc) on the concentration of calcium, phosphorus and magnesium in the tissues (vertebra, gills, muscles and eye) of fish was studied. The investigation has revealed that concentrations of these elements before and after experiment are different. Due to the influence of heavy metals the level of calcium decreased by 5 and 11.5 times, in gills and muscles respectively. and increased 2 times in eyes. The concentration of magnesium decreased by 4.25 times in vertebra and by 2 times in eye, and increased in gills by 2 times. The level of phosphorus varies less than of the rest two elements.

Key words: heavy metals, biogenic elements, *Cyprinus carpio*

Introduction

Contamination of aquatic ecosystems (e.g. lakes, rivers, streams, etc.) with metals has been receiving increased worldwide attention [Vinodhini & Narayanan, 2008; Vutukuru, 2005; Mansour & Sidky, 2002; Dirilgen, 2001]. Usually, many toxic compounds affect organisms in nature at the same time, each of them having a specific effect on physical and chemical processes that influence an organism's condition and reactions. Therefore, in order to maintain the quality of food it is important to regularly monitor and evaluate the pollution levels in fish as well as in water reservoirs [Staniskiene et al., 2006]. Heavy metal contamination may have devastating effects on the ecological balance of the recipient environment and a diversity of aquatic organisms [Farombi et al., 2007; Vosyliene & Jankaite, 2006; Ashraj, 2005]. Among animal species, fishes are the inhabitants that cannot escape from the detrimental effects of these pollutants [Olaifa et al., 2004]. Fish are widely used to evaluate the health of aquatic ecosystems because pollutants build up in the food chain and are responsible for adverse effects and death in the aquatic systems [Farkas et al., 2002]. The studies carried out on various fishes have shown that heavy metals may alter the physiological activities and biochemical parameters both in tissues and in blood [Canli, 1995].

Almost the entire store of calcium (99 %) and most of the phosphorus (80 %) in the fish's body are present in bones, teeth and scales. The one percent extra-skeletal calcium is widely distributed throughout the organs and tissues. In the muscle activity and osmoregulation, ionized calcium actively participates in the extra cellular fluids and in the circulatory system. Large amounts of extra-skeletal phosphorus are present mostly in combinations with proteins, lipids,

sugars, nucleic acids and other organic compounds. These phosphor compounds are vital exchange currencies in life processes and are distributed throughout the organs and tissues of the fish. The bulk of magnesium in fish (60 % in the carp) is stored in the skeleton. The remaining 40 % of the body's magnesium is distributed throughout the organs and muscle tissues (where it plays vital role as enzyme co-factors, and as an important structural component of cell membranes) and in extra cellular fluids [Chow & Schell, 1980].

The aim of the investigation was to determine heavy metals influence on the calcium, magnesium and phosphorus concentration in fish tissues: vertebra, gills, muscles and eyes. We chose these three elements for their importance for fish body. Common carp (*Cyprinus carpio*) was selected due to its adoption in polluted aquatic environment.

Materials and Methods

Common carp (*Cyprinus carpio*), 62 individuals (15-30 cm length, 130-150 g weight), for the research were collected from the river Mtkvari (Gardabani region). The experiment was carried out in Lab of Hydrobiology and Ichthyology, Institute of Zoology. At the first stage of the experiment all collected fish were placed into 50 liter volume aquarium, filled by trap water, at 21°C temperature during 2 hours, aerated by the compressor. This stage was lethal for some part of experimental fish.

Survived fish were divided into 3 groups, by 12-12 samples (36 fish), first group served as control and other groups as experimental, second group of fish was placed in 0.5 mg/l ZnSO₄ solution and third group – in 1.0 mg/l CuSO₄ solution. These concentrations were chosen by their lethal influence on fish. Organs from fish were removed after 24, 48, 72 hours. The vertebra, gills, muscles and eyes were removed from each fish and were analyzed separately [Dybem, 1983]. Afterwards P was assayed using spectrophotometer method and Ca, Mg - by titration method [Alekin, 1970].

Results and Discussion

At the first stage 42% (26 individuals) of fish die. In all water samples before adding solution of heavy metals concentration of phosphorus, calcium and magnesium was lower. Afterwards concentration of P increased by 7-8 times, Ca - 1.5-2 times and Mg - 1.5 times. The concentration of these elements in most selected fish organs decreased respectively (Fig.1-3). Changes of biogenic elements in both parts of experimental groups were similar. Due to the influence of heavy metals the level of calcium decreased by 5 and 11.5 times, in gills and muscles respectively, and increased 2 times in eyes, concentration of Ca in vertebra changed insignificantly (Fig. 1).

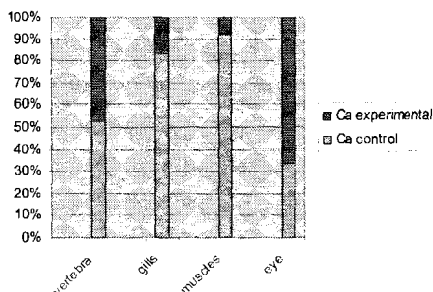


Fig.1. Concentration of Ca in fish organs in experimental and control samples.

The concentration of magnesium decreased by 4.25 times in vertebra and by 2 times in eye, and increased in gills by 2 times. In muscles changes of the level of Mg was not vital (Fig. 2).

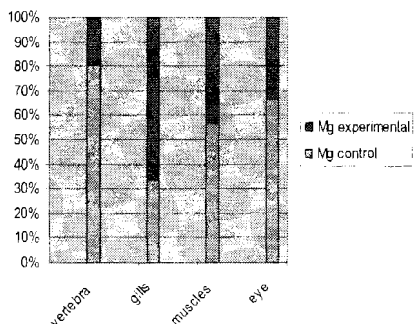


Fig.2. Concentration of Mg in fish organs in experimental and control samples.

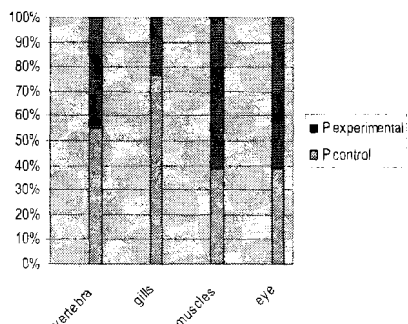


Fig 3. Concentration of P in fish organs in experimental and control samples.

Change of the concentration of phosphorus in gills was most significant – increased by 3 times, in other organs of fish changes were insignificant.

At the beginning of intoxication the oxygen demand increased, respiration was more frequent, afterwards breathe became labored, these symptoms were followed by arrhythmia and anoxic death. Skin and gills were covered by mucous.

It has revealed that influence of zinc sulfate mainly provoke decrease of calcium concentration in fish muscles than in gills. Concentration of magnesium decreased in vertebrae and concentration of phosphorus in – gills. In the eye quantity of calcium and phosphorus increased insignificantly and magnesium - decreased. 2-4 days after 80% of experimental fish die. In survived individuals concentration of biogenic elements vary insignificantly. The copper was adsorbed on the scales of fish which were placed in copper sulfate and in the all individuals provoked necrosis of hepatic cells.

The result indicates that the heavy metal contamination definitely affects the aquatic life of the fresh water fish.

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**მძიმე მეტალების გავლენა კობრის (*Cyprinus carpio*) ორბანოებში
ბიოგენური ელემენტების შემცველობაზე**

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რეზიუმე

შესწავლილია მძიმე მეტალების (სპიდენდი, თუთია) გავლენა კობრის ორბანოებში (ხერხემალი, ღაჯუნები, კუნთები და თვალი), კალციუმის, ფოსფორისა და მაგნიუმის შემცველობაზე. დადგენილია, რომ ამ ელემენტების კონცენტრაციები ექსპერიმენტამდე და ექსპერიმენტის შემდეგ განსხვავებულია. მძიმე მეტალების ზეგავლენის შედეგად კალციუმის კონცენტრაცია მკვეთრად მცირდება ღაჯუნებში და კუნთებში, 5 და 11.5-ჯერ შესაბამისად, ხოლო თვალში იზარდება 2-ჯერ. მაგნიუმის შემცველობა ხერხემლაში შემცირდა 4.25-ჯერ, თვალში 2-ჯერ, ხოლო ღაჯუნებში გაიზარდა 2-ჯერ. ფოსფორის რაოდენობა დანარჩენ ელემენტებთან შედარებით ნაკლებად იცვლება.