THE INCIDENCE OF HEAVY METALS IN THE ONE POND AREA AROUND OF BUCHAREST AND IN FISHES THAT POPULATED THESE WATERS

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SUMMARY

The study aimed at determining the concentration of two heavy metals, in the water of a pool from Ilfov County, by the atomic absorption spectroscopy.

The Pb content in the assays of water varied in the limits between 3.43 and 6.21 μg/l, and the content in Cd in the assays of water varied in the limits between 0.02 and 0.25 μg/l. The analysis of muscular tissue taken from the fish living in this pool relieved content in Pb which varied between 0.04 and 0.81 ppm and content in Cd between 0.05 ppm and absent.

The diversity of values registered due to some factors does not show a correlation between the concentration of metals in water and in the muscular tissue of fish but the cumulative effect of these represents a risk for the human population.

Keywords: lead, cadmium, fishes, pond area

INTRODUCTION

Water is an important natural resource for men, both directly and indirectly, by means of the fish resources. In comparison with the other species of animals, fish use as sources of nutritive substances, both food and water from the environment where they live. Both nutritive substances and pollutant substances enter the fish body through the gills and through the hundreds of capillaries existing at this level. The sources of water can be constantly polluted with a series of metals (as well as with other pollutants) which can be sources of intoxications for men, depending on the dose of metal that exists in water. Metals have both benefits for the human body, when they act as mineral substances and also toxic effects when they reach a certain concentration. Cadmium (Cd) is considered to be a toxic metal for fish, its absorption at the level of the gastro-intestinal tract increases the incidence of the hepatic necrosis and mortality (NRC, 1993). Lead (Pb) affects pituitary function, gonadosomatic index, oocyte growth, neurological disorders, and scoliosis [3].

Carp (*Cyprinus carpio*) is an omnivorous species and in its natural environment it feeds on: shrimps, mud worms, the larva of some insects but also the seeds of the plants living under the water, plants ramie or different parts of plants in different stages of putrefaction (Laszlo).

The correlation between heavy metals and the content of organic sediments in heavy metals, the source of food at this species, is well known (*Van-Hattum* and col., 1993). Fish is known for

the bioaccumulation of the heavy metals in its body, thus it is an important biomonitor of their presence in water.

In the rural areas, fish is an important source of food for the human population and its procurement is not always controlled, therefore there is more than often a risk for those people to consume contaminated fish.

MATERIAL AND METHODS

The study focused on the analysis of the concentration of two heavy metals – Lead (Pb) and Cadmium (Cd) in 10 assays of water taken from the mere of Branita village, Ilfov County, close to Bucharest. The assays were taken from different depths, both from the surface of the lake and from the bottom of water. The analysis of the concentration in Cd and Pb from the water was made by means of the atomic absorption spectroscopy, adjusting the wave length at 228.8 nm for Cd and 283.3 nm for Pb.

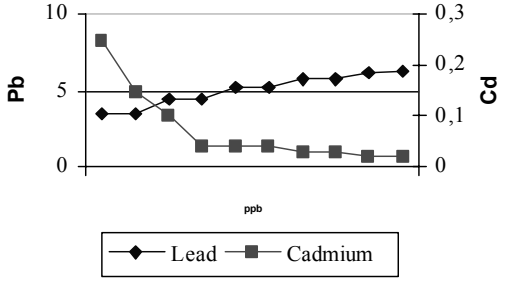
At the same time, 10 exemplars of fish from the species of *Cyprinus carpio* were fished in order to investigate the concentration in Pb and Cd. After the fish assays were processed, the concentration in the two metals was performed by means of the atomic absorption spectroscopy, adjusting the wave length at 328.1 nm for Cd and 217 nm for Pb.

RESULTS AND DISCUSSION

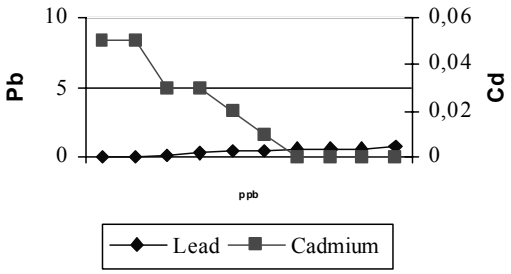
After the analysis of the 10 assays of water which were taken from a mere from Ilfov, the following results were registered (Graphic no. 1): the content in Pb of the assays of water varied between 3.43 and 6.21 µg/l, the maximum allowed limits were between 1–5 µg/l; the content in Cd in the assays of water which were analyzed varied in the limits of 0.02–0.25 µg/l, the maximum allowed limits were between 0.1–0.5 µg/l (Chart no. 1).

Table 1. The content in lead and cadmium in the analyzed water assays

No. assays	Pb µg/l	Level of pollution	Quality class	Cd µg/l	Level of pollution	Quality class
1	3.43	+	IV	0.02	–	I
2	3.50	+	IV	0.02	–	I
3	4.41	+	IV	0.03	–	I
4	4.43	+	IV	0.03	–	I
5	5.20	+	V	0.04	–	I
6	5.25	+	V	0.04	–	I
7	5.78	++	V	0.04	–	I
8	5.80	++	V	0.10	+	II
9	6.10	+++	V	0.15	+	II
10	6.21	+++	V	0.25	++	III



Graphic 1. The Pb and Cd content in the assays of water



Graphic 2. The Pb and Cd in the assays of muscular tissue

According to the Directive 76/464/CEE regarding the pollution caused by certain dangerous substances from the aquatic environment, the classification of the water quality is made in quality classes, classes II – V for Pb representing concentrations between 1 and > 5 μg/l and for Cd, concentrations between 0,1 and > 0,5 μg/l.

After the analysis of the 10 assays of muscular tissue coming from the sweet water fish (C*yprinus carpio),* the following results were registered (Graphic no. 3): the content in Pb varied between 0.04–0.81 ppm, the allowed limits were between 0.2–0.4 ppm; the content in Cd of the fish assays was between 0.05 ppm and absent, the maximum allowed limits are 0.05 ppm (Chart no. 2).

Table 2. The content in lead and cadmium in the assays of muscular tissue coming from the sweet water fish (*Cyprinus carpio)*

No. assays	Pb (ppm)	Level of pollution	Cd (ppm)	Level of pollution
1	0,04	–	absent	–
2	0,05	–	absent	–
3	0,10	–	absent	–
4	0,25	+	absent	–
5	0,50	++	0,01	–
6	0,51	++	0,02	–
7	0,53	++	0,03	–
8	0,60	+++	0,03	–
9	0,62	+++	0.05	+
10	0,81	++++	0,05	+

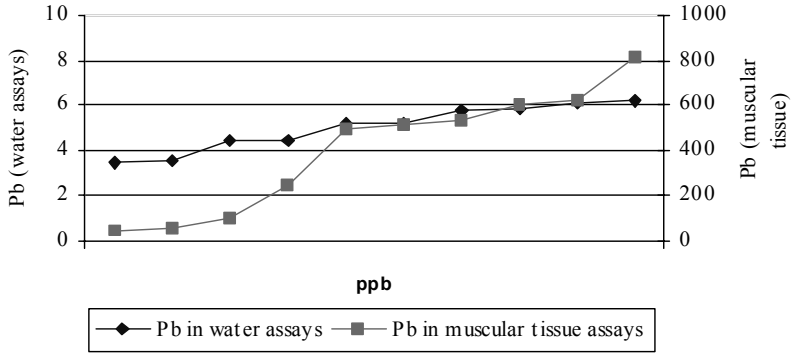
Lead is one of the heavy metals, regarding which there are many discussions and according to the Decision of the International Organization for Health Protection, Pb is given to the first indices of evaluation of the environment pollution.

Pb is one of the four metals which have the most destructive effect on human health. It can enter the human body by means of food (65%), water 20% and air (15%). The contamination of man with Pb is most often made by ingestion after the consumption of fish. The minimum allowed concentrations of Pb in the alimentary products vary between 0.005 mg/kg in the diary products and 1.0 mg/kg in fish. Fish meat may contain Pb especially if the environment in which those fish live, is extremely contaminated. The accumulation is more frequent at the rapacious

fish, especially due to the cumulative effect and to the contamination "in pyramid" (they consume other potentially contaminated fish). Lead is deposited especially in liver and muscles, the older the fish are, and the more important the deposits are.

The toxicity of Pb through fish consumption depends on the chemical form in which Pb is, thus when it is in its inorganic form, Pb from fish is absorbed by man in proportion of 10%, while in its organic form of tetrametil of Pb, it will be absorbed in proportion of 100% (*Allan Johnson*, 1996).

In Graphic no. 3 there is a comparative presentation of the Pb concentrations in water and in the muscular tissue of the fish which were taken from that water.

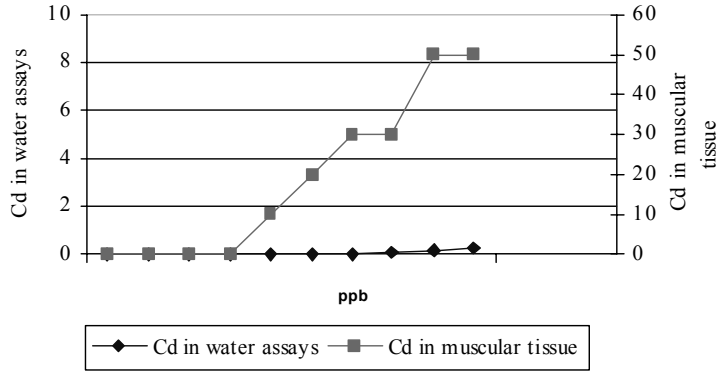


Graphic 3. The content in Pb in the assays of water and muscular tissue

Cadmium represents a chemical composite without an essential biological function, since it is known the fact that cadmium can be considered one of the most toxic heavy metals. Cadmium is fast stored in the fish body, but its metabolism and elimination happen slowly. Cadmium enters the fish body through the gills because it has a negative load, fact which induces a great affinity for the ions of the metals that have a positive load.

The concentration of Cd in fish is of about 20μg/kg wet weight, the exposure of fish to the artificial intoxication with Cd, shows that the main effects of the intoxication are the lack of movement at fish, while the response to light and sounds is obviously weaker. The election organ for the deposits made by cadmium in fish is the kidney (0.402 μg/g), followed by the digestive tract, skin, etc [1]. The accumulation period for the cadmium is of 4–7 days, after that its elimination starts. In the case in which the concentrations in fish are much higher than the admitted limits, there is a second period of redistribution in the organs of the cadmium ions (14 – 30 days) and then a new period of elimination starts [2].

In the Graphic no.4 there is a comparative presentation of the Cd concentrations in water and in the muscular tissue of the fish taken from that water.



Graphic 4. The content in Cd in water assays and muscular tissue

Since Cd is accumulated in the organs and it has quite a long period of semi-elimination (10 – 30 years), the use of insignificant quantities of fish containing Cd during a long period of time, can lead to some intoxication forms. The regulating standards limit the use of fish with cadmium content Cd > 0.5 mg/kg dry weight. This also draws the attention that liver and other organs from fish are not good for consumption.

The chronic toxicity tests performed on fish, showed that 1.7 μg/kg represents the lowest value at which the chronic intoxication of fish occurs. According to standard regarding certain contaminants from the food of animal and non animal origin, the maximum allowed level in fish fillet is for Pb of 0.2 mg/kg and for Cd of 0.05 mg/kg.

CONCLUSIONS

Both cadmium and lead, due to their capacity of accumulation in the environment and in the organisms living in that environment and due to the harmful effects that they have upon the health of the aquatic animals are considered to be two of the heavy metals with a high degree of toxicity.

The Pb content in the assays of water taken from different areas varied in the limits between 3.43 and 6.21 mg/dm^3 and the content in Cd in the same water assays varied in the limits between 0.02 and 0.25 mg/dm^3.

The analysis of 10 assays of muscular tissue taken from the fish living in this pool relieved content in Pb which varied between 0.04 and 0.81 ppm and content in Cd between 0.05 ppm and absent.

The results that were obtained confirm for water an average pollution with Pb, 6 of the 10 assays had over 5 μg/l (class V of quality) and almost the lack of pollution for Cd, 7 from the 10 assays had under 0.1 μg/l (class II of quality).

The concentration of metals in fish was higher for Pb, only 3 assays of 10 had under the limit of 0.2 ppm and even more reduced for Cd, 8 assays of 10 had under 0.05 ppm.

Due to its anatomic and physiological particularities, fish is one of the species with a high contamination risk with heavy metals and at the same time, it is a potential toxin factor for the human population.

The diversity of value registered due to some factors (the fish exemplars, the pool area, the aquatic flora) does not show a correlation between the concentration of metals in water and in the

muscular tissue of fish but the cumulative effect of these represents a risk for the human population.

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