Research Article

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HEAVY METALS CONCENTRATIONS IN CERTAIN TISSUES OF *OSTEOBRAMA VIGORSII* (SYKES) FROM NIRA RIVER. BHOR DISTRICT (MAHARASHTRA). INDIA

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Abstract: *Osteobrama vigorsii* an endemic species from Western Ghats of Maharashtra is been widely consumed by the local population in fresh form as well as dried form. A study was undertaken in the month of January, 2013 to find out the distribution heavy metals in gills, liver, kidney and muscles. Five heavy metals (Fe, Zn, Cd, Ni, Pb) were detected. Atomic Absorption spectophometer technique was implemented in the study. Iron and zinc were most abundant in all fish tissues under investigation. Iron, zinc and copper recorded highest concentration levels in liver while cadmium, and lead recorded their highest values in muscles. The level sequence of the elements studied was Fe > Zn > Cd > Ni> Pb. The observed heavy metals concentrations in these organisms were below the recommended limits for human consumption.

Keywords: *Osetobrama_vigorsii,* Heavy metals, Atomic Absorption Spectro-photometer, tissues.

INTRODUCTION

Fresh water bodies throughout the globe are deteriorating in their physio-chemical status. This is due to the influx of sewage, industrial effluents, and agricultural discharge along with pharmaceutical waste which find their way towards these water bodies. Fresh water bodies harbor different species of organisms, which eventually are on the verge of extinction because of the deteriorating status of water bodies. Pollutants which may include heavy metals are toxic to aquatic organisms and cause their lethal or sub-lethal effect on the physiological processes of the organism. Among the myriad of organic and inorganic substances released into aquatic ecosystems, heavy metals have received considerable attention due to their different toxicity and potential bioaccumulation in different aquatic species (8, 4, 19). Metal ions are essential for biological processes are a well-known proved fact. The list includes Na, K, Mg, Ca, Mn, Fe, Co, Cu, Zn and Mo. Along with these essential metal ions there are certain metal ions which acts as a catalyst in carrying out physiological process, and are thus required in a small quantities namely B, Si, V, Cr, As, Se, Ni, Nb, Rb, Sr and Ti and were found essential for living organisms (23, 24). Essential heavy metals are absolutely required by an organism to grow and complete its life cycle, become toxic when its concentration levels exceed those required for correct nutritional response by factors varying between 40 and 2001folds (21). Meanwhile, some other metals Such as Pb, Hg and Cd are toxic at quite low concentrations (15, 16). Human beings may be contaminated by organic and inorganic pollutants associated with aquatic systems by consumption of contaminated fish and other aquatic foods from this environment (12). This fact is due to the capacity of some aquatic organisms to concentrate heavy metals up to 105 times the concentration present in the water (2) many of these metals tend to remain in the ecosystem and eventually move from one trophic level to the next within the food chain. This leads to Bioaccumulation and bio magnification leading to toxic level of these metals in fish, even when the exposure is low. Thus the presence of heavy metal in fresh water brings about a drastic change in the physio-chemical properties of the aquatic ecosystem. Fishes are notorious for their ability to concentrate heavy metals in their muscles and since they play important role in human nutrition, they need to be carefully screened to ensure that high levels of some toxic trace metals are not being transferred to man through fish consumption (17). The main objective of this study was to evaluate the concentrations of heavy metals (Cd, Fe, Ni, Pb and Zn) in certain tissues (gills, liver, kidney and muscle) and to compare the maximum acceptable standards for human health as prescribed by ICMR, CPCB and WHO.(22)

MATERIALS AND METHODS

Sampling and sample preparation:

Osteobrama vigorsii an endemic species from Western Ghats of Maharashtra is been widely consumed by the local population. Freshly collected 50 fishes from Nira River (Bhor District, Maharashtra), were stored in prewashed polyethylene bags in ice and brought to laboratory on the same day of capture. In

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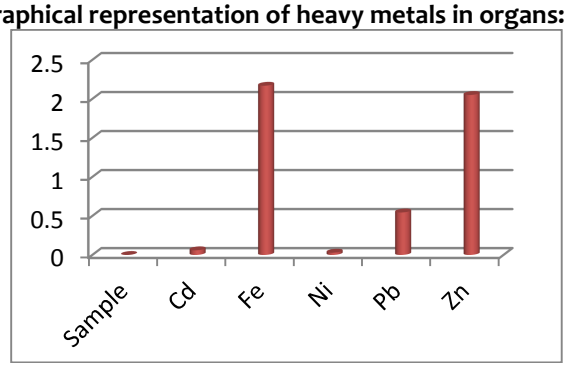
the laboratory, a composite sample for each organ (gill, liver and muscle) from each fish was dissected, using clean equipment and put separately in pre weighed labeled petri-dishes. The samples were washed thoroughly with double distilled water and air dried for about 6 h after which they were transferred to a well-ventilated oven set at 60°C for 48 h. drying continued till the wet tissues reached to a constant weight. Pulverization and homogenization were achieved by grinding the tissue samples according to UNEP/FAO/IAEA/IOC (1984) (20). When the samples were confirmed dry; they were pulverized whole to fine powder and stored in air tight crew-capped plastic containers. Dry tissue samples weighing 0.5 g were digested with 6 ml of concentrated nitric acid and 1 ml of 30% hydrogen peroxide. The digestion was carried out in a microwave digester using the microwave digestion. The completely digested samples were filtered through whattman paper and diluted to 25 ml in volumetric flasks with distilled water. The resulting solutions were analyzed for metals using Flame Atomic Absorption Spectrophotometer (Perkin-Elmer, Model 2380).

RESULTS

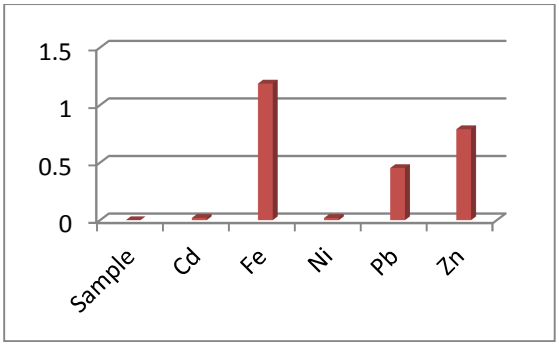
TABLE.1: Concentrations of heavy metals are in mg/kg.

FAO/WHO Recommended standard list	Cd (0.05-0.20) mg/kg	Fe (1.00-4.50) mg/kg	Ni (0.10-0.90) mg/kg	Pb (0.05-0.20) mg/kg	Zn (2.06-4.75) mg/kg
Sample	Cd	Fe	Ni	Pb	Zn
Liver	0.06	2.1687	0.0294	0.5446	2.05
Muscle	0.02	1.1872	0.0194	0.4531	0.7906
Gills	ND	1.4219	0.0742	0.5881	1.7371

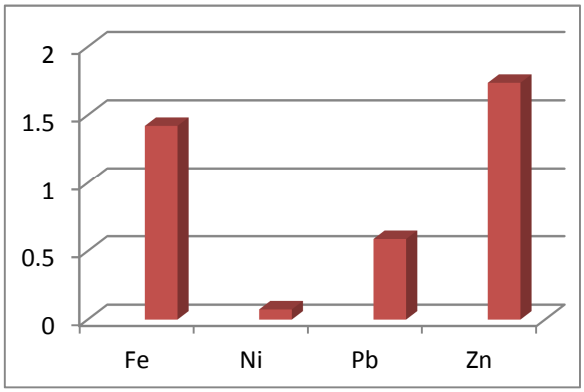
Graphical representation of heavy metals in organs:



Accumulation of metals in liver



Accumulation of metals in muscles



Accumulation of metals in gills

Measured concentrations of the five tested metals in liver, gills, and muscles of *Ostobrama vigorsii* are tabulated in table.1. Iron, zinc and copper were most abundant in all the examined organs.

The concentration of Fe in the liver had accumulated the highest level while the muscle had the lowest concentration. Similar results were also reported by many investigators (13, 18).

CADMIUM:

The distribution pattern of Cd in the present study was in the decreasing order of liver >Gills > Muscle. Thus, liver seemed to be the organ which accumulates the highest value of Cd. This is in agreement with WHO-IPCS-Environmental Health Criteria of Cd (1987) (22) which reported that Cd is stored in the body in various tissues, but the main site of accumulation in aquatic organisms is in the kidney and liver, beside other tissues, notably the gills and exoskeleton (6). The concentration of Cd in gills recorded a comparable value with that in the liver which indicated that the uptake of Cd could occur through gills as well as the food chain. There was no considerable difference between the concentrations of Cd in muscles of all collected fishes.

IRON:

The level of Iron in the present studies shows the level of Iron in tissues ranges from liver >gills>muscles. Iron is widely used by molecular structures in redox systems form of heme proteins and non heme enzymes. Moreover, Fe has been reported to play an important role as an essential element in all the living system, i.e., from invertebrates to humans and hence, they tend to accumulate high levels of Fe from the surrounding environment (9). The highest concentration of Fe was recorded in fish liver. As previously reported by some authors (11,10), the concentration of iron in liver recorded its highest value due to their feeding habits as they inhabit in the bottom where sediments were rich in organic matter which contains high iron content.

LEAD:

Lead concentration is seen more in Gills compared to liver n muscles. This is due to the fact that Pb and Ca are similar in deposition in and mobilization from bone as previously reported by (19, 7). The high content of lead in gills was reported by NRCC (1973) and attributed to the possibility of adsorption of particulate or organic Pb to fish gills. Lower pH at the gills surface (due to respired CO_2) may dissolve Pb to a soluble form, which could diffuse into the gill tissues(1).The relatively low rate of binding lead with the SH group explained the lowest concentration of the Pb in muscle.

NICKEL:

The concentration of Nickel recorded its highest in kidney, gills and liver and its lowest concentration in muscle. This is in agreement with (19) who reported that the levels of Ni in the kidney of carnivorous fishes were substantially higher than those of omnivorous fishes.

ZINC:

The concentration of Zinc in liver showed highest value, depending on its feeding on green, red and brown algae as well as the detritus. This is in agreement with (18) who reported that Zn content of digestive tract of (detrivorous) is higher than (omnivorous). The concentration of zinc in gills is higher, indicating it depends on the concentration of zinc in surrounding water and food habits.

The emersion of Ganesh Idol during Ganesh festival would be the main cause of zinc in the water bodies because the artificial colors that are used for painting the idol are rich in zinc.

DISCUSSION

The concentration levels of Cd, Fe, Pb, Ni and Zn in muscles of studied fishes were lower than the permissible limits as shown in Table 1. These interactions perhaps indicate that mineral balance in the body is regulated by important homeostatic mechanisms in which toxic elements contend with the essential metals, even at low levels of metal exposure. The knowledge of these correlations may be essential to appreciate the kinetic interactions of metals and their implications in the trace metal metabolism (3).

The results very clearly indicates that metal concentrations were lowest in muscle and highest in gill and liver tissues due to their physiological roles in fish metabolism where target tissues of heavy metals are the metabolically active ones. Therefore, metal accumulation in these tissues is higher compared to muscles where metabolic activity is relatively lower and so there is substantially lesser risk yet for human consumption of flesh of these fishes. The pollution status of the fish immediate environment can accentuate its metal accumulation. The effect of these heavy metals leads to toxic effect on human's health.

Cadmium is known to be one of most harmful heavy metals and is capable of inducing renal, hepatic and testicular injury. Long term exposure to chromium can cause kidney, liver and nerve tissue damage, many chromium compounds are carcinogenic .High iron content leads to primary heamochromatisis (genetic effect) or secondary hemochromatisis in severe cases and thalassaemia. Prospective lead studies of child development from 1980 to date show associations between low blood lead concentration and poor neurobehavioral development. Zinc toxicity results in vomiting and diarrhea. Pb is considered as one of the major environmental pollutants and it is also cancer-causing and affects the liver and thyroid functions (5).

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