Effect of Heavy Metal Pollution on Fresh Water Fishes

V. S. Ranbhare[1], and R. V. Bakare[2]
[1]S.G.M. College, Karad, Dist. Satara, Maharashtra
[2]K.V. Mahavidyalaya, Wai, Dist. Satara, Maharashtra

Abstract

This investigation was aimed to estimate the heavy metal pollution in fresh water and their acute toxicity and its toxicological effects on widely consumed fresh water fishes of Krishna River at Karad. Two bioindicators, fresh water species (*Cyprinus carpio* and *Labeo rohita*) were collected to study. Water samples from four stations collected to analyze the essential and non essential metals and muscles of fish were sampled. Total lipids, proteins, amino acids and glycogen were estimated by Spectrophotometery, whereas Atomic Absorption Spectrophotometer was used for metals detection. High concentrations of contaminants were found in tissues of fishes collected from fresh water.

Introduction:

Untreated wastes of industrial, technological and agricultural origin containing various metallic compounds often contaminate natural waters. Heavy metals due to their bio-accumulative and non-biodegradable properties constitute a major group of aquatic pollutants. These metals particulates enter the aquatic medium through effluents discharged from tanneries, textiles, metal finishing, mining, dyeing and printing industries, ceramic and pharmaceutical industries etc. (Azmat and Talat, 2006). They concentrate in the tissues of aquatic biota and are known to produce deleterious effects (Cosson, 1994). Heavy metals concentration in the tissues of fish enter into human beings through food chain and causes potential health hazards sometimes even lethal (El-Shehawi *et al*., 2007). Heavy metals concentration in the tissues of fish enter into human beings through food chain and causes potential health hazards sometimes even lethal (El-Shehawi *et al*., 2007). In this context, an attempt was made to investigate bioaccumulation of heavy metals in fresh water fishes and their acute effects on the aquatic food chain.

Material and Methods :

Two species of fesh water fishes, *Cyprinus carpio* and *Labeo rohita* from Krishna River at Karad Were collected and selected for monitoring the effect of water born metal pollution. Water sample from above site were also collected for determination of heavy metal pollution in present aquatic resources. Collection of water was made during fishing by fisher man in the depth of 5 to 7 feet in aquatic resources. Ten sample of each fish were analyzed for essential and non-essential metal and their biochemical profile were estimated for nutritional quality. Metal Analysis was done after collection of fishes by dry ashing. Equal weight of two fishes was put into crucibles. The crucibles were placed in the oven for 2 h at 200°C. After that the samples were mineralized for 24 h then 2 ml of nitric acid was added and sample was dehydrated at 200 °C. To each sample 10 ml of hydrochloric acid was added and then make up to 50 ml with distilled water. Water sample were digested in the same manner for the detection of pollutant toxic metals. Macronutrient elements were determined by Spectrophotometry in laboratory and reported in mg kg^{-1}. The content of heavy metals were determined by atomic absorption Spectrophotometry (AAS) along with standards (As a reference), supplied by the Agilent Technologies and results were given in ìg kg^{-1}

Glycogen content was measured and estimated. Total lipids contents were extracted from tissues. Protein and amino acids were estimate. Analysis of metals in water samples from fresh water resources under study showed that there is a significant difference in concentration of pollutants. (Table 1, 2). In addition it is an important step to detect the level of toxicants and their effects in the organism. Such effects might lead to effects on metabolic functions such as behavioral, growth, reproduction, protein folding and survival. This can result in changes in fish health and reproduction that may alter fish population.

Results and discussion :

Analysis of metals in water samples from fresh water resources under study showed that there is a significant difference in concentration of pollutants. (Table 1, 2). In addition it is an important step to detect the level of toxicants and their effects in the organism. Such effects might lead to effects on metabolic functions such as behavioral, growth, reproduction and survival. This can result in changes in fish health and reproduction that may alter fish population. (Table 3) showed the concentration of macronutrients in fresh water fish of Karad region. The values of macronutrients compared with literature. An increase in concentration of K, Na or Mg contents in water (Table 1) may alter the functional changes in fishes.

Table 4 showed bioaccumulation potential of heavy toxic metals in two species under investigation and compared with international literature. *Cyprinus carpio* (0.6 ìg kg^{-1}) and *Labeo rohita* (5.8 ìg kg^{-1}) showed significant difference. Hg concentration in muscle of two fresh water species was higher. Cadmium (Cd) as an ion affects on respiration and binders in exchange of gases (Gulfaraz and Ahmed, 2001). In fresh water fish *Cyprinus carpio* the highest level of protein was reported (2.36 wet wt. and 3.36 dry wt.) as compared to other fish , *Cyprinus carpio* was more tolerant to heavy metal stress. Table 5 showed that nutritional composition of fresh water fish under studied which may be related with water body condition. Results obtained from biochemical analysis of these common edible fish. Increment in free amino acids level may be the results of breakdown of protein for energy requirement. Glycogen content in muscle was investigated as a biological monitoring tool for assessment of effect of heavy metals present in water. Table 5 showed that the value of glycogen content in species. Lipid content in muscles were inversely related level of As, Hg and Pb. *Labeo rohita* (22.86). Investigation showed that appreciable decline in the biochemical profiles such as total glycogen, total lipids and total protein contents of the fish in presence of toxins, results in decrease productivity of fish population. This study reflects the extent of the toxic effects of toxic metals at various functional levels in the widely consumed freshwater fish. The toxicity of heavy metal caused the glucose level to decrease with increase of pollutants concentration. Statistical data analysis showed significant difference in macro elements of fresh water. Whereas biochemical parameters of fish belongs to different aquatic resources showed variation in proteins, amino acids, glycogen and lipids.

Aquatic resources	Macronutrients(mg Kg-1)			
	Na	K	Mg	Ca
Krishna River Water	65±14	39±10.2	23±9.0	25±7.5

Table 1: Macronutrients metal analysis of aquatic resources of Krisna River at Karad

Aquatic resources	Trace Metals (µg Kg-1)				
	Ag	Pb	Cd	Hg	Zn
Krishna River Water	23±5.6	12±2.3	5±1.2	2±0.5	13±2.8
Current National Recomnded Water	1.50	9	0.25	0.77	120

Table 2:Trace metal analysis of aquatic resources of Krishna River at Karad

Treatment	Na	K	Ca	Mg
Cyprinus carpio	61±1.50	38. ±0.70	27±1.70	19±1.06
Labeo Rohita	50±1.20	39±1.41	23±1.50	16±1.24
Corelation	0.996	0.0	0.605	-0.83
Paired difference	34.78	-0.632	3.25	3.523

Table 3: Analysis of macronutrients of four bioindicators of Krishna River at Karad (mg kg^{-1})

Krishna River Water Fish	Ag	Hg	Pb	Cd	Zn
Cyprinus carpio	3±0.015	4.4±0.31	6±0.08	3.0±0.22	11±0.22
Labeo rohita	5±0.25	5.0±0.36	5.8±0.13	4.2±0.10	8±0.01
Paired Correlation	0.484	0.272	0.939	0.041	0.957
Paired Difference	-9.76	-1.2	2.16	-4.66	13.91

Table 4 :Heavy metals level in two bioindicators of Krishna River at Karad (µg kg^{-1})

Treatment	Protein Wet Wt.	Protein Dry Wt.	Amino Acid	Glycogen	**Total Lipids**
Cyprinus carpio	1.36±0.015	2.36±0.012	14.17±0.86	0.077±0.003	**19.20±1.36**
Labeo rohita	1.78±0.015	3.25±0.05	30.172±2.10	0.052±0.002	**22.86±2.06**
Paired Correlation	-0.622	-0.035	0.990	-0.134	**0.913**
Paired Difference	21.08	-14.80	12.890	4.47	**-3.34**

Table 5: Biochemical analysis of two bioindicators of Karad (g g^{-1})

Conclusion :

On the basis of above investigation it may be concluded that concentration of heavy metals in fish of Karad region is a matter of serious fact because ultimately its accumulate in human body and can cause damages in human body. Therefore, heavy metals in the tissues of aquatic animals should occasionally monitored. Therefore it is suggested that River Water metal management required assessing the potential toxicity of metals-contaminated effluent at its point of discharge to avoid the determining effects of toxic metals in high quality food. Otherwise changes in fish health due to pollution may decline in fish population.

References :

Alquezar A., Marrkish S J and Booth D J., (2006), Effects of metals on condition and reproductive output of the smooth toadfish in Sydney estuaries South Eastern Australia. J. Environ. Pollut., Vol. 142, 116-122.

Badawi H K., (1972), Sodium and potassium in the edible portions of thirty fish species, Mar. Biol., Vol. 12, 151-153.

Canli M., Ay O and Kalay M., (1998), Levels of heavy metals (Cd, Pb, Cu, Cr and Ni) in tissues of *Cyprinus carpio*, barbus capito and chondrostoma region from the seyhan river Turkey, Tr. J. Zool., Vol. 22, 149-157.

Carroll N V., Longley R.W and Roe J H., (1956), The determination of glycogen in liver and muscle by use anthron reagent, J. Biol. Chem., Vol. 220, 583-593.

Cosson R., (1994), Heavy metals intercellular balance and relationship with liver of crap after contamination by silver, cadmium and mercury following or not pretreatment by Zinc. Biol. Merals., Vol 7, 9-19.

De la Torre F F., Saliian A. and Ferrari L., (2000), Biomarker assessments in Juvenile *Cyprinus carpio* exposed to water born cadmium, Environ. Pollut., Vol. 109, 277-282.

DrastichovÃ J E., ŠvestkovÃ V L and SvobodovÃ Z., (2005), Cytochemical study of carp neutrophil granulocytes after acute exposure to cadmium, J. Applied Ichthyol., Vol. 21, 215-219.

El-Demeerdash and Elgamy E L., (1999), Biological effect in *Tilopia nitotica* fish as an indicator of pollution by cadmium and mercury, Int. J. Environ. Health Res., Vol.9, 173-186.

El-Shehawi A M., Ali F K and Seehy M A., (2007), Estimation of water pollution by genetic biomakers in tilopia and cat fish species shows species site interaction, Afr. J. Biotech., Vol. 6, 840-846.

Funk A E., Day F A and Brady F O., (1987), Displacement of Zn and Cu induced metallothionine by Cd and by Hg: *In vivo* and *ex vivo* studies, Comp. Biochem. Physiol. C Pharmacol. Toxicol., Vol. 86, 1-6.

Garg A N and Ramakrishna V V S., (2006), Fish as an indicator of aquatic environment: Multielemental neutron activation analysis of nutrient and pollutant elements in fish from Indian coastal areas, Toxicol. Environ. Chem., Vol. 88, 125-140.

Gulfaraz M and Ahmad T., (2001), Concentration level of heavy and trace metals in the fish and relevant water from Rawal and Mangal Lakes. Pak. J. Biol. Sci., Vol. 5, 414-416.

Iliana G.V., (2006), Zinc content in the organs and tissues of freshwater fish from the Kardjali and Studen Kladenets dam lakes in Bulgaria. Turk. J. Zool., Vol. 30: 1-7.

Khaniki G.R., Inteaz J A., Nowroozi E and. Nabizadeh R., 2005. Mercury contamination in fish and public health aspects: A reviw. Pak. J. Nutr., 4: 276-281

Michael L F.,Pennypacker K.R,. Drummond K.A and. Blem C.R, 1986. Concentration and location of metabolic substrates in fast toadfish sonic muscle. Copeia, 4: 910-915.

Mohammady N.G.E.D., Chen Y.C., Mahdy A.E.R.A.E and Mohammad R F., (2005), Physiological responses of the eustigmatophycean *Nannochloropsis salina* to aqueous diesel fuel pollution. Oceanologia, Vol. 47, 75-92.

Oilvereau M J., Oilverwau M C and Aimar C., (1981), Specific effect of calcium ions on the calcium sensitive cells of the pars intermedia in the goldfish, Cell Tissue Res., Vol. 214, 23-31.