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EFFECT OF HEAVY METAL POLLUTION ON THREE DIFFERENT FRESH WATER FISHES IN RIVER CAUVERY

Mahalakshmi. R and Maruthanayagam.C
Dept .of Zoology. Aringar anna govt. College
Musiri. 621211

ABSTRACT

The present investigation was aimed to estimate the heavy metal toxicity and accumulation in widely consumed fresh water fishes of river Cauvery at Mayanur check dam (Tamil Nadu). Three bioindicators species (Tilapia mossambicus, Catala catala and Labeo rohita) were used for this study. The tissue samples were collected to analyze the metals concentration in muscle, gill and liver of fishes. Atomic Absorption Spectrophotometer was used for metals detection. High concentrations of contaminants were found in tissues of fishes collected from study area, total accumulated metals in muscle of Tilapia mossambicus was in order of Cr> Fe>Zn> Cu> Co> Cd> Pb> Mg and Ni, in liver, Cr> Zn> Fe> Cu> Mg> Pb, Co, and NI, and in gills Cr> Zn> Fe> Cu> Mg> Pb> Cd> Co and Ni. Nearly same trends was observed in Catla catla and Lebeo rohitathis finding results were discussed here.

Keywords: Heavy metals, Freshwater fishes, Gill, Liver, Muscle

Introduction

Fish constitutes an important and cheap source of animal protein to human beings and a large number of people depend on fish and fishing activities for their livelihood. Increasing human influences through heavy metal pollution have however led to the depletion of our fish resources and substantial reduction in the nutritive values (Srivastava and Srivastava, 2008). As a

result of these heavy metals pollution several endemic fish species have become threatened. The environmental pollution is caused by a variety of pollutants in water, air and soil. One of the major concerned pollutants of living environment is "Hazardous Metals" also termed as "Trace Elements". This term is used in geochemical and biochemical literature to refer to a group of otherwise unrelated chemical elements which are found in nature at very low concentrations. These concentrations in different natural environments vary widely. A wide variety of pollutants-physical, chemical, biological and radiological have been identified in the environment consequent to urbanization, industrialization and new technological developments. Heavy metals, though naturally occurring, can be present in some areas in sufficient concentrations and in physico-chemical forms that might create pollution problems. 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). Major sources of aquatic pollution by trace metals viz. Hg, Pb, Cd, As, Cr, Zn, Cu, Mn and Fe are industrial operations, fossil fuel burning, domestic sewage discharges and land run-off. These elements exhibit varying environmental behavior and toxicity to aquatic organism and man. The background levels of some of the trace metals vary widely depending upon the location. Several fold increase in the concentration of Zn, Cd, Hg etc., have been observed in some riversand ground waters in the country. For evaluation of impact of heavy metal in aquatic environment, further investigations are needed. In this context, an attempt was made to investigate bioaccumulation of heavy metals in three different fresh water fishes *Catla catla, Labeo rohita and Tilapia mossambicus* and their acute effects on the aquatic food chain.

Materials and Methods

Fresh fish samples were collected by using long line or nets from the selected sites during the period from August 2016 to July 2017, muscles, liver and gills were transported in liquid nitrogen container to the laboratory for chemical analysis. Each tissue was put in a separate petri dish and dried in an oven at 110^{o}c for 48h until constant weight was reached. 0.5g of each dry tissue was weight and put in a separate test tube. The nitric acid (HNO_3) and perchloric acid ($HCLO_4$) in 2:1 ratio were added to each sample and left over night at room temperature. Sample were digested in a water bath set to 100^{o}c water boiling temperature and the content was boiled

for about 2h until all the tissues dissolved. The digest was allowed to cool and 5 ml of distilled water was added. The solution transferred to 25ml volumetric flask and made up to mark with 1% HNO_3(FAO,1984). The digest ware kept in plastic bottles and accumulated heavy metals concentration in mg/g dry weight ware determined using atomic absorption spectrophotometer (Shah and Altindag, 2005).

Results and discussion

The concentration of heavy metal in fishes parts, the results of three fishes in table 1. Shows that metal concentration in fish organ (*Tilapia mossambicus*) Cr was highly accumulated in muscles (0.07±.09) followed by gill (0.46±0.10) and liver (0.42±0.01). Similarly *Cattla cattla* chromium concentration high in gills (0.76±0.84) fallowed by muscles (0.51±0.12) and liver (0.45±0.09), but the fish *Labeo rohita* have high accumulation Fe in muscles (0.61±0.84) followed by chromium in gills (0.49±.0.10), muscles (0.43±0.10) and liver (0.43±0.08). Adebayo (2017) stated that Fe (3.09± 1.09) Cr (0.15 ±0.07) were at the toxicity threshold in the muscles of the fish in line with WHO standard in food. This may be attributed to the abundance of these metals in the environmental and the tropic level of the fish. (EPA 2010). Adebayo (2017) and (Fernades *et al* 2008) observed that a remarkable relationship between heavy metal concentrations in water and fish. According to (Shivakumar *et al* 2014) accumulation of heavy metals in tissues is mainly dependent up on water concentration of metals and its exposure period. High levels of heavy metals were found in gills of all the three fish's very high level of Cr, accumulation in *Catla catla* followed by *Labeo rohita* and *Tilapia mossambicus*. However fish gills are mainly filter at respiratory organ, it usually accumulated more heavy metal and must represent good bio monitor of metals present in the surrounding environment. The obtained results are in agreed with previews observations made by (Deb and Fukshima 1999). That metal may be high concentrations in the gills, intestine and digestive glands. There organ have relative high related for metal accumulation. The results indicate the differences in sensitively to metals among the three fish species. The fish concentration of Cr, Cu, Fe and Zn, in tissues of species could be related to the essentials of three metals in the cellular metabolic process. These metals concentration in fish organs ware much higher than those of non-essentials. Metal Cd and Pb low content of Zn, Co, and Ni was detected in fish species because, Zinc metals is for respiratory and enzymatic of fishes.

The examine all the three fishes the concentration of metal in gills was significantly higher ($p<0.05$) when compared with other organs. The gills tissue play an important role in iron regulation, gas exchange, acid base balance nitrogenous wastes and excretion which signifies the key role it plays of the interface with the environment. (Karthikeyan *et al*, 2007, and Shivakumar *et al.,* 2014) Hence gill is an important site for the entry of heavy metal at in high concentration provokes lesion and gills damage. The results of the levels of concentration of the heavy metal in the fish sample are presented in table 1. in *Tilapia mossambicus* show the accumulation of different heavy metals in organs. Cr, accumulation was fishes in muscles, liver and gills, the concentration of Cr in different organs ranged from 0.42-.047 and it was in muscle.0.47±0.09 and liver 0.42±0.07 was in liver. The of accumulation order was muscles > gills> liver. The table 1 shows the mean and SD values of the tested heavy metal in three different fresh water fish organs such as muscles, liver and gills. The knowledge of heavy metal concentration in fish is impotent and human actively / human conception of fish. But at wish concentration it can affect and heart system of fish body. Even though but lower term accumulation of this metal can cause damage to nerve, blood and respiratory system (Shivakumar *et al.,* 2014) and (Filipovic and Respor 2003).

Concentration of heavy metals in difference parts of *Catla catla, Labeo rohita and Tilapia mossambicus* adult fishes collected from river Cauvery with special reference to Mayanur check dam. Accumulated concentration of heavy metals (Zn,Cu,Fe,Mg,Cr,Pb,Cd,Ni,Co and Hg) were analyzed in gills, liver and muscles of above mentioned fresh water fishes. The results showed high levelsof Cr, (0.47± .10) in muscles,(0.76 ±0.84) in gills, (0.49±0.10) in liver of *Tilapia mossambicus* whereas similar trends was observed in *Catla catla and Labeo rohita*. The heavy metal mercury was not deducted in all the three species indicatively their low concentration in these fishes, several studies have indicated that metal accumulation in fish depends on numerous factors such as food habit of the fish. (Tuzen.2003) heavy rain fall and industries wastes eliminated to environments.

According to (Kalay and Canli 2000) reported that metal accumulation in the tissues of fishes varied according to the rate of uptake, dissolved mater, storage and elimination. The high level of Cr, Fe and Zn accumulation in the study could attributed to their high demands as essential elements in blood hemoglobin and an a dietary essential trace metals (Kambole 2002).

Chromium and zinc exceeded the toxicity threshold in the muscle and gills of these fishes in line with who stranded in food.

Different organism has different metabolic rates and different food requirements. The requirements of essential metal such as copper , zinc and iron for the growth of organism depends on its physiological condition and also Sivakumar *et al*.,(2014) stated that the different organism absorb metal depending up on its requirement for metabolic function. The difference in heavy metal accumulation in different organs is due to the different in physiological and biochemical functions. Thus the result indicate that the gills and liver of these fishes (*Catla catla, Labeo rohita* and *Tilapia mossambicus*) have high Cr content while the least were recorded in the muscle of those fishes.

Table 1 accumulation of Cr, and Fe metals are high in *Catla catla*, followed by *Tilapia mossambicus* and *Labeo rohita*. It may be the fishes received the metal containing food with high food intake also tends to accumulate more metals (Ademoroti 1996, Ghedira, *et al*2010).Chromium is an essential nutrient metal, necessary for metabolism of carbohydrates (Farag *et al*., 2006) Chromium enter the aquatic ecosystem through effluents discharged from leather tanneries, textiles, electroplating, metal finishing, mining, dyeing and printing industries, ceramic, photographic and pharmaceutical industries etc.(Arunkumar,2005) Very Poor treatment of these toxic effluents can be lead to the available of Cr (VI) in the surrounding water bodies, where it is commonly found at potentially harmful levels to fish and other aquatic organism(Li Zh, and Li P, Randak 2011). (Palaniappan and Karthikeyan 2009) reported that the kidney is a target organ for chromium accumulation, which implies that it is also the “critical” organ for toxic symptoms. On chronic exposures, hexavalent chromium severely affected the renal tubules causing hypertrophy of epithelial cells, reduction of tubular lumen, contraction of glomeruli and epithelial and glomerular necrosis(Mishra and Mohanty 2009).Necrosis and fibrosis of tubular lumen was reported in chronic chromium-exposed Chinook salmon (Farag *et al* 2006).

Conclusion

On the basis of in the present investigation it may be concluded that concentration of heavy metals in fish of Cauvery (Mayanur) region is a matter of serious fact because ultimately its accumulate in food chin to human body and can cause damages in human health and hygiene. Therefore, heavy metals in the tissues of aquatic animals should occasionally

monitored. Otherwise changes in fish health due to pollution may decline in aquatic organism and also economic value.

Table1. Accumulation of, Zn, Cu, Fe, Mg……Hg.(mg/l) in different organs of three different fish species collected from river Cauvery mayanur.

Fish tissue Sample Mayanur Mean ± Std Division											
Mayanur		2016-2017									
		Zn	Cu	Fe	Mg	Cr	Pb	Cd	Ni	Co	Hg
Tilapia mossambicus	Muscle	0.25 ± 0.03	0.08 ± 0.06	0.38 ± 0.08	0.40 ± 0.39	0.47 ± 0.99	0.04 ± 0.04	0.39 ± 0.60	0.02 ± 0.02	0.02 ± 0.02	BDL
	Liver	0.26 ± 0.05	0.22 ± 0.79	0.37 ± 0.03	0.15 ± 0.02	0.49 ± 0.04	0.05 ± 0.66	0.07 ± 0.09	0.04 ± 0.04	0.03 ± 0.02	BDL
	Gill	0.28 ± 0.04	0.24 ± 0.08	0.25 ± 0.05	0.19 ± 0.06	0.76 ± 0.11	0.10 ± 0.16	0.09 ± 0.08	0.05 ± 0.03	0.05 ± 0.02	BDL
Catla catla	Muscle	0.28 ± 0.05	0.14 ± 0.09	0.42 ± 0.12	0.08 0.04	0.50 ± 0.11	0.08 ± 0.06	0.08 ± 0.06	0.05 ± 0.03	0.06 ± 0.03	BDL
	Liver	0.31 ± 0.06	0.23 ± 0.06	0.37 ± 0.10	0.18 ± 0.05	0.49 ± 0.08	0.07 ± 0.05	0.10 ± 0.03	0.05 ± 0.03	0.07 ± 0.04	BDL
	Gill	0.20 ± 0.07	0.30 ± 0.10	0.28 ± 0.08	0.29 ± 0.17	0.50 ± 0.16	0.17 ± 0.18	0.15 ± 0.18	0.07 ± 0.06	0.10 ± 0.06	BDL
Labeo rohita	Muscle	0.27 ± 0.03	0.13 ± 006	0.38 ± 0.09	0.07 ± 0.02	0.48 ± 0.12	0.05 ± 0.03	0.05 ± 0.02	0.05 ± 0.02	0.10 ± 0.18	BDL
	Liver	0.29 ± 0.07	0.21 ± 0.04	0.38 ± 0.05	0.14 ± 0.04	0.49 ± 0.10	0.07 ± 0.03	0.09 ± 0.07	0.05 ± 0.02	0.06 ± 0.41	BDL
	Gill	0.29 ± 0.05	0.27 ± 0.09	0.24 ± 0.06	0.22 ± 0.07	0.47 ± 0.12	0.17 ± 0.18	0.15 ± 0.09	0.04 ± 0.03	0.10 ± 0.05	BDL

BDL **: Below detectable level**

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