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UPTAKE OF HEAVY METALS BY *Oreochromis mossambicus* FROM SEWAGE FED BUDHA SAGAR POND OF RAJNANDGAON, CHHATTISGARH

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ABSTRACT

Heavy metals have a tendency to accumulate in living system. Investigations on the bioaccumulation of heavy metals (Fe, Pb, Cr, Cd and Hg) are observed in Muscles, Gills and Liver of fish "*Oreochromis mossambicus*". The results revealed that heavy metals tend to accumulate in different tissues of fish. The accumulation is observed in tissues such as gills, liver and muscle. All the tissues investigated shows accumulation of Fe and Cr. Only one sample of gills from all tissues investigated shows presence of Hg. Their pattern of accumulation in investigated tissues was Fe > Cr > Hg > Cd. Pb did not found in any sample. Fe shows maximum tendency of accumulation. Fe accumulation is found in order of Liver > Gill >Muscle. Cr is second most abundant metal. It shows maximum tendency to accumulate in muscle than gills and after that in liver. Although Fe is found in higher concentration but except Cr other metals are found in limit prescribed by FSSAI/ FAO/ WHO.

KEYWORDS: Heavy Metals, Bioaccumulation

The pollution of the aquatic environment with heavy metals has become a worldwide concern during recent times because they are persistent and bioaccumulative in nature and have toxic effects on organisms (MacFarlane and Burchett, 2000).

Metals are omnipresent in nature and with increasing industrialization the threat of metal poisoning is increasing rapidly. A metal in trace amount less than 0.01 percent is vital and in the absence of that metal an organism is unable to sustain however the same trace metals may prove to be toxic when the concentration level exceeds the threshold limit required for proper functioning by increase in forty to two hundred times. (Venugopal and Luckey, 1975). Metals are broadly categorized as essential and non essential as far as human health is concerned. Some metals are essential for functioning biological activity of body. Heavy metals enter fish through routes like food particles, gills, water and skin, flows into the blood and are carried to either a storage point in body or to the liver for its transformation or storage.

Amid environmental pollutants, heavy metals are of particular concern, due to their possible noxious effect and ability to bioaccumulate in aquatic ecosystems (Censi *et al.,* 2006). Heavy metals in aquatic organisms, along with bioaccumulation have been extensively studied in diverse places around the globe (Amaranemi 2006; Dural 2007; Teodorovic *et al.* 2000; Yilmaz *et al.* 2007; Hamilton, 2008).

Heavy metals are present in the aquatic environment where they bio accumulate in the food chain. Accumulation occurs in the tissues of aquatic animals and may become toxic for fishes and also for people depending on them when it reaches a certain high level. An example of an environmental tragedy due to heavy metal occurred in 1952 in the vicinity of the Japanese coast of Minimata. A previously unknown Minimata disease erupted and spread rapidly and became epidemic. It was caused due to mercury compounds (Vandecasteele & Block, 1991). It was well known case where fishermen and natives from vicinity of Minimata Bay and Jintsu River died or suffered from mercury and cadmium poisoning, respectively. From this point of time understanding of heavy metals in aquatic living being particularly fishes became important for human health. (Ravera, 1979; Cid *et al.* 2001).

According to Teodorovic *et al.* (2000) and Abdullah (2008) heavy metals studies in aquatic living system give an idea that heavy metals in aquatic living system could be more reliable water quality indicator than chemical analysis of any other indicator. Fishes can be considered as one of the ideal organism in freshwater systems for the estimation of metal pollution level (Rashed, 2001). Fish is significant indicators in freshwater systems for the estimation of heavy metal pollution level because it is an important food source for human and it is organisms of high trophic level in the aquatic food chain (Abdel Baki *et al.,* 2011; Agah *et al.,* 2009; Blasco *et al.,* 1998 and Rashed 2001)

MATERIALS AND METHODS

Fish *Oreochromis mossambicus*, Mean weight 100 gm, were collected from the sewage fed pond. Procured fishes were directly kept in pre-cleaned polythene bags, sealed and stored in an ice box for further examination. The present study was conducted to investigate the accumulation of heavy metals (Fe, Cd, Hg, Cr, and Pb) in various tissues (gills, liver,and

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muscle). The separated organs were put in petridishes to dry at 120^{o} C until reaching a constant weight. The separated organs were placed into digestion flasks and ultrapure Conc. HNO_3 and H_2O_2 (1:1 v/v) was added. The digestion flasks were heated to 130^{o} C until dissolution, diluted with water and analyzed for heavy metal concentration using atomic absorption Spectrometer. Heavy metals testing process was conducted at NABL recognized testing lab (Abida Begum *et al*. 2008)

RESULTS AND DISCUSSION

The aquatic environment of the sewage fed pond is subjected to many stressful factors, heavy metals are one of the pollutants that reach the aquatic habitat and also a matter of concern. For this reason, this work is projected to examine the hazardous effects of heavy metal on one of the most common fish species *Oreochromis mossambicus* in the sewage fed pond budha sagar of Rajnangaon (C.G.) In this study level of heavy metals in different tissues of *Oreochromis mossambicus* was examined.

Results of present study indicate that in general Liver was the most affected organ where maximum accumulation of heavy metals takes place followed by Gill & Muscles, amongst the heavy metals Fe accumulated in higher concentration in all tissues. Malik *et al.* (2010) evaluated heavy metal in tissues of *L. rohita* and observed accumulation of heavy metals was in the sequence liver > gills > muscles.

Chatterjee *et al.* (2006) studied *Oreochromis* spp. at East Calcutta Wetlands and observed maximum concentration of heavy metals in Liver and least accumulation in muscles. Giripunje *et al*. (2014) studied heavy metal pollution status in *Oreochromis mossambicus* of Futala, Gandhisagar and Ambazari lakes of Nagpur city and found higher level of Pb, Cd, Fe in muscles of fish.

In this study Fe was the most plentiful heavy metal in all tissues of *Oreochromis mossambicus*, its highest value was observed in liver followed by gill than muscle. (Table 1)

Shrivastava *et al.* (2003) investigated shahpura lake of Bhopal and found higher level of Fe in fish tissues. Different researchers concluded that metal concentrations were always lowest in the muscle and highest in the liver and gill. This may be due to their physiological function in fish metabolism. It has been shown that target tissues of heavy metals are metabolically active ones, like the liver and gill. Therefore, metal accumulation in these tissues occur higher level compared to other tissues like the muscle, where metabolic activity is relatively low (Heath, 1987; Langston, 1990; Roesijadi and Robinson, 1994; Canli *et al.,* 1998).

Cr was the most abundant metal after Fe. Gill shows higher concentration than Liver and least in muscle but if we see individual season wise higher concentration it was high in muscle in post monsoon season. As far as higher concentration of Cr is concerned it is comparatively higher in relation to FSSAI, food safety and standards regulation given for refined sugar (20 ppb) and gelatin (10 ppb). Sample of post monsoon season of gill shows presence of Hg and sample of post monsoon season of liver shows presence of Cd except this these two metals are not found in any sample. Pb was not found in any sample. Nandi *et al.* (2012) studied accumulation of Cd & Pb in *labeo rohita* and *catla catla* of east Kolkata wetland and found higher level in liver and muscle of both fishes. Arain *et al.* (2008) studied *Oreochromis mossambicus* of polluted Manchar Lake and found higher concentration of Fe, Cr, Pb in muscles of fish. Trace amount of Cd and Hg in two samples indicate that these metals are entering in food chain. Although Cd and Hg are in trace amount and below the permissible limit but in future they may increase in concentration(Table 2& Figure 1-4).

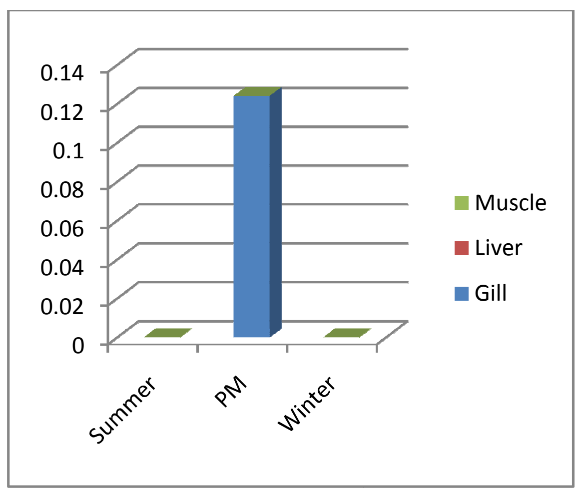

Figure 1: Hg in different Season (Con. In mg/kg)

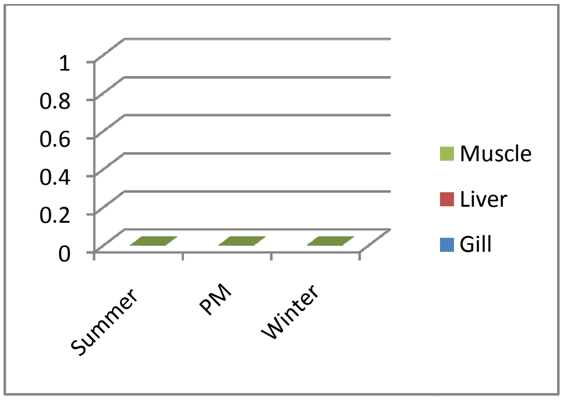

Figure 2: Pb in different Season (Con. In mg/kg)

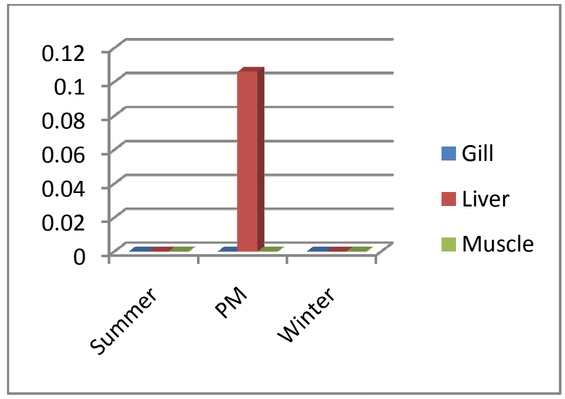

Figure 4: Cd in different Season (Con. In mg/kg)

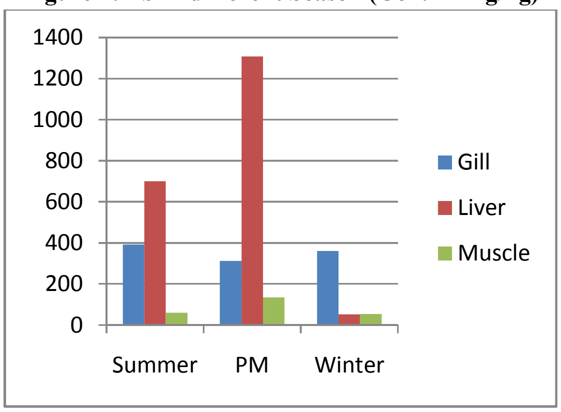

Figure 3: Fe in different Season (Con. In mg/kg)

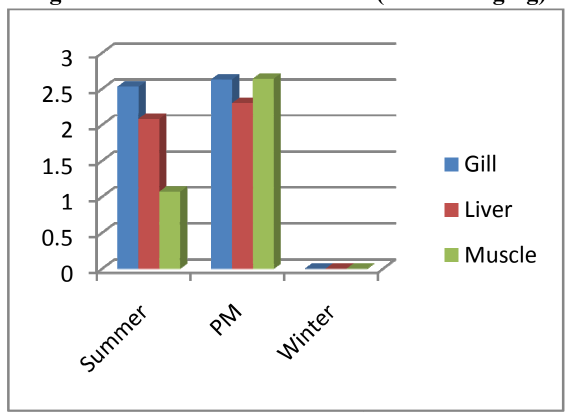

Figure 5: Cr in different Season (Con. In mg/kg)

Table 1: Heavy metal concentration in different Tissues

Metal	Gill			Liver			Muscle		
	Summer	Post Monsoon	Winter	Summer	Post Monsoon	Winter	Summer	Post Monsoon	Winter
Mercury (Hg)	BDL	0.124	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Lead (Pb)	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL	BDL
Iron (Fe)	391	312	360	700	1308	51.8	60.6	135	53.8
Cadmium (Cd)	BDL	BDL	BDL	BDL	0.106	BDL	BDL	BDL	BDL
Chromium (Cr)	2.53	2.63	BDL	2.08	2.30	BDL	1.07	2.64	BDL

Values expressed in mg/kg=ppm, d.w, BDL- Below Detection Limit.

Table 2: Mean concentration of heavy metals in different tissues

Metal	FSSAI	Codex FAO/WHO	BIS 10500 for Water Mg/l	EU	Gill	Liver	Muscle
Pb	2.5	0.3	0.01	0.30	0 ±0	0 ±0	0 ±0
Cd	1.5	2 (bivalve)	0.003	0.050	0±0	0.035±0.061	0 ±0
Hg	1.0	0.5	0.001	0.50	0.0413±0.071	0 ±0	0 ±0
Cr	10 ppb (Gelatin)	-	0.05	-	1.72 ±1.49	1.46±1.26	1.23±1.32
Fe	-	-	0.3	-	3.54E2±3.981	6.86E2±6.28E2	8.33E1±4.48 E1

Values expressed as Mean±SD,d.w., Unit mg/kg=ppm.

CONCLUSION

This study was carried out to find out presence of heavy metal concentrations in *Oreochromis mossambicus* from sewage fed pond, and its potential health risk for local population due to their consumption. The majority of heavy metal concentrations in the fish samples analyzed were within the permitted limits set by various authorities except Fe and Cr which are found in higher concentration and may pose health risks for the local population due to high consumption of fish.

Budha sagar pond is domestic sewage fed pond it has no connection of industrial or agriculture waste water but surprisingly, amount of non essential heavy metal Hg and Cd is seen in trace amount. Budhasagar is now shrinking in area due to encroachments and land filling. It is also polluted by sewage water so this is need of the hour to make effort to save this historical urban wetland.

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