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BIOACCUMULATION OF HEAVY METALS IN FRESHWATER FISHES OF RIVER GODAVARI AT SARAPAKA VILLAGE IN BHADRADRIKOTTAGUDEM DISTRICT OF TELANGANA STATE

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ABSTRACT

This study was conducted during season of March to May to determine the metal pollution in water and Bioaccumulation into freshwater fishes of Catla catla, Labeo rohita ,Notopterus notopterus and Clarius batracus were collected from the two different places within the river Godavari. The gill and muscle tissues of fish were analyzed for Cd, Cr, Cu, Pb, Ni and Zn using Atomic Absorption Spectrophotometer (AAS- Model AA500 PG Instruments, UK). The levels of heavy metals in the freshwater were found to be higher than the WHO recommendations. The fish samples were also high levels of heavy metals than the WHO recommendations. The fish tissues of gills were observed highest level of heavy metals than the muscle tissue. The metals were accumulated in descending order as follow: Zn>Cu>Pb>Ni>Cr>Cd.The present study shows that the high-level bioaccumulation of metal in fish and water that could be unsafe for human consumption.

KEY WORDS

River Godavari, Heavy metals, Bioaccumulation, Freshwater Fishes.

INTRODUCTION

River Godavari originates from Brahmagiri Mountain (at 19.56000N, 73.20000E) having 920 m elevation located at Triambakeswar in the Nasik District of Maharashtra. In the Western Ghats and travelled about 1,530 Km eastwards across the peninsular India and drains to the Bay of Bengal between the latitudes 160 .15' to 160 .45' N and longitudes 810.45' to 820.25' E, discharging large quantities of fresh water during southwest monsoon season and joins the Bay of Bengal near Yanam and Antarvedi in East Godavari district of Andhra Pradesh. It enters into Telanagana at Kandhakurthi in Nizamabad district. Water is one of the gifts from nature and also basic needs to survival on the earth. The 90% of water can recycle and used for daily purposes. The formation of water is a hydrological cycle process. The sources of water are surface and ground water. Basically, the water is pure condition but due to mixing of many particles quality of water has been changed. The water is important for any type of industries. The 50% wastes from industries are directly released into rivers and seas.

The term pollution can be defined as a situation in which the atmosphere contains a variety of compounds that causing harmful effects and the agents causing pollution are called "pollutants". Pollutants include chemical are biological product capable of altering the natural environment of a man and other living organisms. Often pollutions are the residue which we use and throw away (Renukumar, 1989; Sinha et al., 1989). Gross pollution of water has its origin mainly in urbanization, industrialization, agriculture and increase in human population being observed (Calhoun, 2005; Goel, 2009).

Metal pollution is a global issue and its impact felt in the industrial belt of the country as well as in the remote areas due to the contaminants being carried away to far off places by streams and rivers. The main routes of heavy metal entry into the aquatic system are direct discharge via industrial, urban effluents, surface runoff and direct entry from the fallout. The other sources are from seed dressing agents which are widely applied in agriculture Heavy metals or trace elements are among the most harmful of the elemental pollutants. Heavy metals are persistent and easily enter the food chain and accumulate until they reach toxic levels (Abah et al. 2013).). However, the primary sources of metal toxicity in surface water have been thought to be the natural occurrence and subsequent degradation of the environment (Jessica et al. 2011).

MATERIAL

The freshwater fish samples (Labeo rohita (Rohu) Catla catla(Bocche),Clarius batracus(Marpoo) and Notopterus notopterus(Vollenka) were collected at the different places in and around 1km radius of River Godavari near Sarapaka village at Burgampahad mandal, Bhadradri kottha gudem District in Telangana State. The fish samples were collected in three different seasons as pre-monsoon, monsoon and post-monsoon seasons. The collected samples were maintained at -4¬0C and shifted to laboratory for the further investigation. Water samples were also collected from the same sites for analysis.

METHODS

The samples were collected and analyzed according to the method of Mohinuddin Shaik et al 2014. The collected water samples were acidified immediately after collection by adding 5 ml nitric acid to minimize adsorption of heavy metals onto the walls of the bottles [APHA ;2004]. Fish samples were dissected to remove muscles and gills. These organs were weighed. These dissected organs were washed with distilled water for removing the unwanted materials. These organs were put into petri dishes to dry at 120^{0}C. The dried tissue was homogenized with mortar and pestle.1.0grm of each tissue was placed into digestion flasks and ultrapure Con. Nitric acid and hydrogen peroxide (1:1 v/v) was added. The digestion flasks were then heated to 130^{0}C until all the materials were dissolved. Digest was diluted with double distilled water appropriately.

Statistical analysis

The significant differences ($p < 0.05$) of individual heavy metal among tissues and species were determined by one-way analysis of variance (ANOVA). Statistical analysis was carried out through SPSS-Software (SPSS v.13.0 for Windows), applied to substitute for the non-detected value of corresponding heavy metal in statistical analysis.

Table 1 Length and weight of four fish species

SL.NO.	Species	Length (cm.)	Weight(g)
1.	*Catla catla*	20.6±0.5	371.6±20.2
2.	*Labeo rohita*	22.0±1.0	370.0±43.5
3.	*Notopterus notopterus*	20.3±1.3	228.3±20.2
4.	*Clarius batracus*	19.3±1.2	220.0±20.0

Table 2: Metal concentration (Mean and Standard deviation) of the analyzed heavy metals in gill & muscle tissues of the fishes and water samples.

Name of the Fish	Tissue	Cd Mean ± SD	Cr Mean ± SD	Cu Mean ± SD	Pb Mean ± SD	Ni Mean ± SD	Zn Mean ± SD
Catla Catla	Gills	0.006 ± 0.003[c]	0.240±0.002[c]	1.395±0.003[a]	0.361±0.003[c]	0.155±0.003[c]	5.044±0.004[a]
	Muscle	0.004 ± 0.002[c]	0.253±0.003[b]	0.290±0.002[c]	0.317±0.003[d]	0.107±0.001[d]	3.820±0.005[c]
Labeorohita	Gills	0.025 ± 0.004[a]	0.317±0.002[a]	0.930±0.003[b]	0.677±0.003[a]	0.367±0.001[a]	3.886±0.003[b]
	Muscle	0.170 ± 0.002[b]	0.166±0.003[d]	0.227±0.003[d]	0.631±0.002[b]	0.337±0.002[b]	3.721±0.002[d]
Notopterus notopterus	Gills	0.176 ± 0.002[a]	0.329±0.003[b]	2.528±0.002[a]	0.679±0.005[a]	0.277±0.002[a]	11.550±0.005[b]
	Muscle	0.015 ± 0.003[c]	0.207±0.002[c]	0.164±0.004[c]	0.672±0.002[a]	0.197±0.002[c]	2.315±0.003[c]
Clariusbatracus	Gills	0.025±0.003[c]	0.776±0.002[a]	0.658±0.002[b]	0.454±0.004[b]	0.231±0.003[b]	12.381±0.002[a]
	Muscle	0.007±0.002[c]	0.530±0.002[c]	0.284±0.004[b]	0.447±0.002[c]	0.107±0.001[c]	1.864±0.003[b]
Water Sample site -I		0.016±0.002[b]	0.816±0.002[b]	0.275±0.003[c]	0.675±0.001[b]	0.355±0.005[b]	1.193±0.003[c]
Water Sample site -II		0.030±0.003[a]	0.897±0.001[a]	2.527±0.001[a]	0.724±0.005[a]	0.397±0.002[a]	28.120±0.005[a]
Who Standards According to Geneva: 2010		0.003	0.05	2.00	0.01	0.02	3.00

Different letters in the columns indicate significant differences at $p<0.05$

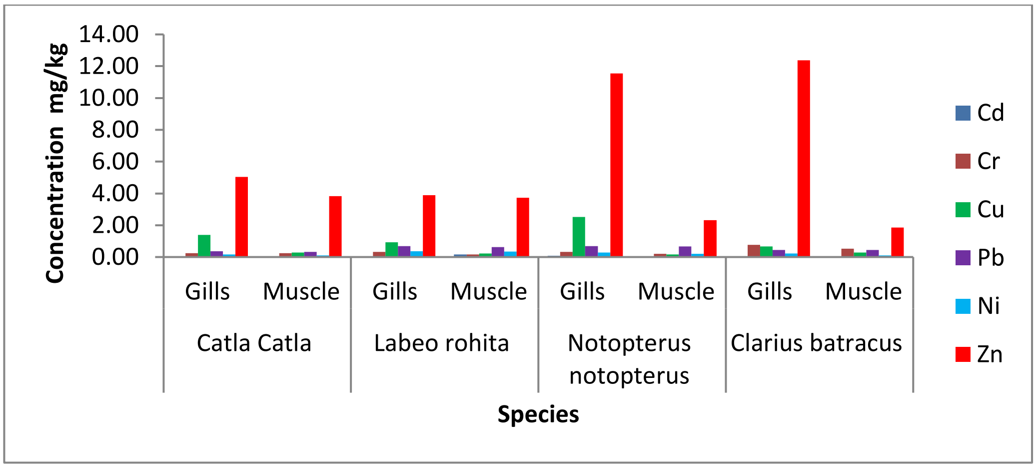


FIGURE-1 Concentration of Heavy Metals in Fish Samples Mg/Kg in Pre-Monsoon Season

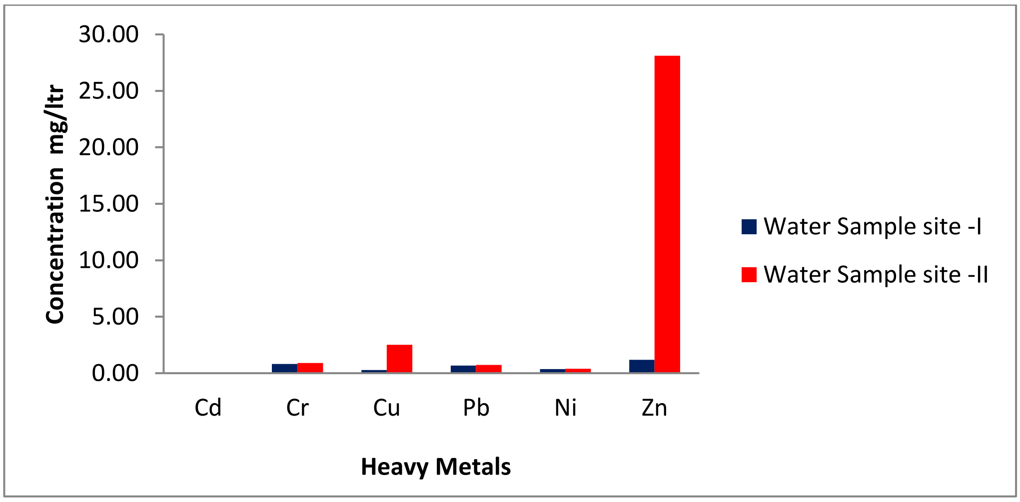


FIGURE-2Concentration of heavy metals in water samples mg/l. In pre-monsoon season

RESULTS AND DISCUSSION

The process whereby an organism concentrates metals in its body from the surrounding medium or food, either by absorption or ingestion is known as bioaccumulation [Forstner, 1981]. According to Heath [Heath, A.G., 1991], fish can regulate metal concentration to a certain limit after which bioaccumulation occurs. The concentration of metals in an organism's body vary from organ to organ and is the product of an equilibrium between the concentration of the metal in an organism's environment and its rate of ingestion and excretion [Oronsaye, J.A.O., 1987, Gerhardt, A., 1992, Adeyeye, E.I. et, al, 1996].

Heavy metal concentrations in fish tissues

The mean concentration (±standard deviation) of heavy metals (Cd, Cr, Cu, Ni, Pb, and Zn) in the muscle, and gill tissues of four fish species collected from Godavari River at Burgampahad Mandal in Bhadradri Kottagudem in Telangana State were summarized in Table 2. And also, comparative statement of heavy metals shows in Figure 1 and Figure 2.

Cadmium

Cadmium is not a part of natural biochemical processes and is extremely hazardous due to its organ toxicity and carcinogenicity to human beings (Robards and Worsfold 1991). Significant variations ($p < 0.05$) of Cd concentrations were observed in gill and muscle tissues of *Catla catla, Labeo rohita, Notopterus notopterus and Clarius batracus* were examined by ANOVA (Table 2). The Cd contamination in fish tissues might be derived from anthropogenic sources such as mining and smelting activities. The Cd concentrations in these four fishes were high in gills and low in muscles.

Chromium:

Chromiumdoes not normally accumulate in fish and hence low concentrations were reported even from the industrialized part of the world. The rate of uptake was higher in young fish, but the body burden of Cr was declined with age due to rapid elimination (Dara,1995) Significant variations ($p < 0.05$) of Cd concentrations were observed in gill and muscle tissues of *Catla catla, Labeo rohita*, *Notopterus notopterus and Clarius batracus* were examined by ANOVA (Table 2). Cr concentration in these four fishes were high in gills and low in muscles.

Copper

Copper is an essential part of several enzymes and is necessary for the synthesis of hemoglobin (Sivaperumal, Sankar, & Nair, 2007). However, high intake of Cu has been recognized to cause adverse health problem (Gorell et al., 1997).) Significant variations ($p < 0.05$) of Cu concentrations were observed in gill and muscle tissues of *Catla catla,Labeo rohita ,Notopterus notopterus and Clarius batracus* were examined by ANOVA (Table 2). Cr concentrations in these four fishes were high in gills and low in muscles.

Lead

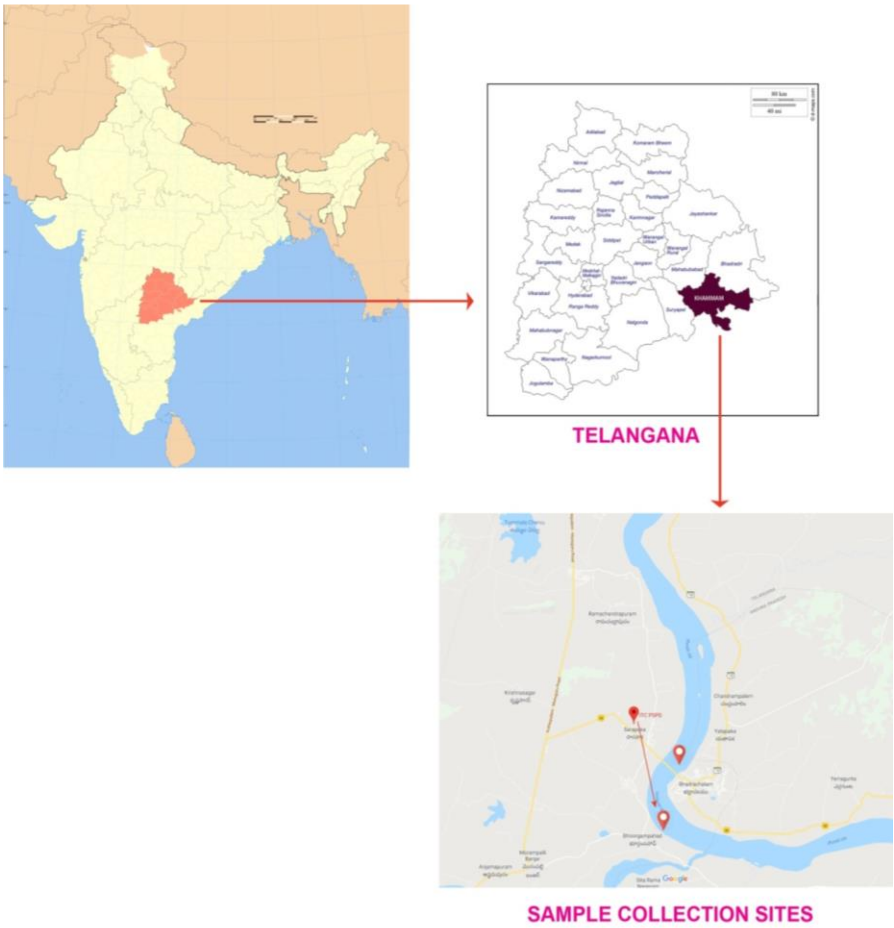
Lead is a non-essential element which can cause serious damage to human health at trace level (García-Lestón et al. 2010). The significant variations ($p < 0.05$) were only observed between the muscle and gill, of *Catla catla,Labeo rohita , Notopterus notopterus and Clarius batracus* were examined by ANOVA (Table 2). The accumulation pattern of Pb in fish tissues was high in the gills than the muscle tissue. The gill is the target organ for accumulation of heavy metals from water. It was demonstrated that the gills could accumulate Pb rapidly when exposed to Pb-contaminated water (Grosell et, al. 2006).

Nickel

Nickel normally occurs at very low levels in the environment and it can cause variety of pulmonary adverse health effects, such as lung inflammation, fibrosis, emphysema and tumors (Forti et al., 2011). The significant variations ($p < 0.05$) were only observed between the muscle and gill of *Catla catla, Labeo rohita, Notopterus notopterus and Clarius batracus* were examined by ANOVA (Table 2). The accumulation patterns of Ni in fish tissues were high in the gills than the muscle tissue.

Zinc

Zinc is an essential micronutrient for both animals and humans due to its biological role in transcription factors. Deficiency of Zn can lead to various chronic diseases such as malabsorption, growth retardation, immunological abnormalities, chronic liver and renal diseases, etc. The significant variations ($p < 0.05$) were only observed between the muscle and gill, of *Catla catla, Labeo rohita , Notopterus notopterus and Clarius batracus* were examined by ANOVA (Table 2). Zinc being a heavy metal, has a tendency to get bio-accumulated in the fatty tissues of aquatic organisms, including fish and is known to affect reproductive physiology in fish (Ghosh, Mukhopandhyay, & Bagchi, 1985). The accumulation patterns of Zn in fish tissues were high in the gills than the muscle tissue from other tissues. It means the Zn preferred to be accumulated in the gill, rather than in the muscle of fish in these four fishes the accumulation pattern of Cd,Cr,Cu,Pb,Ni and Zn were in descending order Zn>Cu>Pb>Ni>Cr>Cd. The heavy metal accumulation in water samples were high in site 2 and low in site 1, that is why because the water at that site any industrial effluents were not released but the at the site 2 the ITC paper mill effluents were directly released without any treatment.



CONCLUTION

Samples collected at different time interval and at the different sites. Among these site 2 samples were more amount of metal ions concentration, while compared with site 1 of site 2 samples. Collected samples were cut into gill, muscle most of these metallic ions were present already the people by near the river Godavari are affecting different diseases like liver damage and kidney problems. It is one of the evidence that the high amount of metallic ions than the WHO standards leads adverse effects in this area. While compared other site of these organs were high metallic ions will inject to the fish (or) food web through bioaccumulation. These anaromous amount of metallic ions which are more than required according to (WHO) Standards, causes adverse effects in fishes and human beings.

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