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Studies on bioaccumulation of heavy metals in gills and muscles of freshwater edible fish species *Clarias batrachus* and *Labeo rohita* of Bara Talab, Bundu, Jharkhand

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Abstract- Agricultural, domestic wastes and industrial discharges have contributed as source of inorganic pollutants in freshwater bodies, that are also a home for many species of edible freshwater fishes. Heavy metals Zinc and Copper are common inorganic components bioaccumulating gradually in different body parts of the fishes, particularly gills and muscles. Consumption of these fishes by people of nearby areas lead to bioaccumulation of toxic heavy metals in the body. In the present study freshwater pond Bara Talab, Bundu, Jharkhand was selected, and bioaccumulation of toxic heavy metals in gills and muscles of two freshwater edible fish *Clarias batrachus* and *Labeo rohita* were studied. Concentration of Zinc in gills of *Clarias batrachus* and *Labeo rohita* was found to be 2.69±0.8 µg/g and 1.8 ±0.6 µg/g respectively, whereas, concentration of Copper was found to be 1.28 ±0.15 µg/g and 0.48 ±0.09 µg/g respectively. Concentration of Zinc in muscles of *C. batrachus* and *L. rohita* was 1.4 ±0.5 µg/g and 0.8 ±0.04 µg/g respectively. Gills showed higher bioaccumulation of both Cu and Zn heavy metal. This result showed that due to deposition of agricultural and domestic waste in Bara Talab, Bundu, freshwater edible fishes are facing the degradation of health as a result of bioaccumulation of toxic heavy metals Zn and Cu.

Key words: Bioaccumulation, *Clarias batrachus, Labeo rohita,* Whatman's filter paper, ANOVA

INTRODUCTION

The term bioaccumulation is defined as uptake, storage, and accumulation of organic and inorganic contaminants by organisms from their environment.[1] Bioaccumulation therefore results from complex interactions between various routes of uptake, excretion, passive release, and metabolization.

For fish, the bioaccumulation process includes two routes of uptake: aqueous uptake of water-borne chemicals and dietary uptake by ingestion of contaminated food particles. Many inorganic pollutants involving toxic metals and different types of salts cause bioaccumulation, that are sourced by agriculture and domestic wastes and industrial discharges. A heavy metal can be defined as a naturally occurring element that has a high atomic weight and high density which is five times greater than that of water.[2] Due to their toxic nature and nature to accumulate in the environment, heavy metals have received a paramount attention among all the pollutants. Usually heavy metals are present in trace amounts in natural waters but many of them are toxic even at very low concentrations.[2] Heavy metals contamination may have devastating effects on the ecological balance of the recipient environment and a diversity of aquatic

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organisms. Due to their toxicity and potential bioaccumulation in many aquatic species heavy metals have gained considerable attention in the past decades. High metal concentration in gills reflects high metal concentration in dissolved phase. Zn, although is important for synthesis of important enzymes formation and stabilization of large amount of proteins, it becomes toxic when present in high concentration. Cu also causes Mense disease, Wilson disease, and kidney damage when present in high quantity.

In the present study, bioaccumulation of two heavy metals Zn and Cu in gills and muscles of two important edible freshwater fish species *Clarias batrachus* and *Labeo rohita* found in Bara Talab, Bundu, Jharkhand, was quantitatively studied.

MATERIALS & METHOD

Selection of study area-

In this project Bundu lake, was selected for study because it is widely spread out with abundant flora and fauna. It is a huge lake where freshwater fishes like *Labeo rohita* and *Clarias batrachus* inhabit, other species like *Catla catla* is also found. This was selected for the study mainly because fishes of this lake are brought to the city of Ranchi and are widely sold out. This lake is highly polluted and is vastly covered with water hyacinth. Water hyacinth degrades the water quality and is known to reduce oxygen levels in water bodies.

Fig. 1- partially decomposed plastic pollutants thrown in Bara Talab, Bundu

Fig. 2- Discharge from drains into Bara Talab, Bundu

Fish and tissue collection –

10 specimen of *Clarias batrachus* and *Labeo rohita* each were purchased from the fishermen directly from the site and were transferred to ice box and taken to the laboratory for further assessment. After complete cleaning and removal of scales, fishes were dissected to obtain their gills, accessory respiratory organs and muscles to study the bioaccumulation of heavy metals.

Digestion of tissues-

The tissues were digested following the protocol of Chindah *et al.* (2009)[3]. The tissues were dried in incubator to obtain a constant dry weight 10 ml of concentrated HCl and 1 ml of concentrated HNO_3 was taken in a beaker, 4 g of dry tissue was weighed, ground and added to the beaker gradually. 50 ml of deionized water was added. The mixture was heated in a steam bath to obtain a thick yellow liquid and allowed to cool. The mixture was then filtered using Whatman's filter paper and filtrate obtained was made upto 100 ml using distilled water. Filtrate was stored in plastic bottles and analyzed using atomic absorption spectrophotometer.

Statistical analysis-

All values were expressed as mean of 10 fishes. The difference obtained in the analysis of concentration of metals between two different species were analysed by ANOVA. The difference obtained in the metal concentration in different organs of two different species were statistically analysed by Student's t test to test the significance.

RESULT & DISCUSSION

Table 1- Comparison of concentration of Zinc in gills and muscles of *Clarias batrachus* and *Labeo rohita*

Fish species	Concentration of Zn in Gills (µg/g)	Concentration of Zn in Muscles (µg/g)
Clarias batrachus	2.69±0.8	1.4±0.5*
Labeo rohita	1.8±0.6	0.8±0.04

*=significant at 5% level

Table 2- Comparison of concentration of Copper in gills and muscles of *Clarias batrachus* and *Labeo rohita*

Fish species	Concentration of Cu in Gills (µg/g)	Concentration of Cu in Muscles (µg/g)
Clarias batrachus	1.28±0.15***	0.2±0.08*
Labeo rohita	0.48±0.09	0.08±0.008

*=significant at 5% level

In the present study (Table 1) showed the bioaccumulation of Zinc in gills and muscles of *Clarias batrachus* as 2.69 ± 0.8 µg/g and 1.4± 0.5 µg/g respectively. *Labeo rohita* showed lesser bioaccumulation of Zn in gills and muscles as 1.8±0.6 µg/g and 0.8±0.04 µg/g respectively. Zn concentration in muscles of *C. batrachus* was significantly higher than that of *L. rohita* at 5% significance level. This was in accordance with Yousafzai *et al*. (2017)[4] where they obtained higher concentration for Zn was found in gills as compared to muscles .

Table 2 showed higher bioaccumulation of Copper in *Clarias batrachus* as compared to *Labeo rohita*. Cu was found to be higher in gills of *C. batrachus* as 1.28 ±0.15 µg/g and muscles as 0.2 ±0.08 µg/g. Gills and muscles of *Labeo rohita* showed comparative lesser bioaccumulation of copper as 0.48±0.09 µg/g and 0.08±0.008 µg/g respectively. Statistical analysis showed that bioaccumulation of Cu in gills of *C. batrachus* was significantly higher than that of *L. rohita* at 0.1 % level. Also, bioaccumulation of Cu in Muscles of *C.batrachu*s was significantly higher than that of *L. rohita* at 5% significance level. This is different from the findings of Pandey *et al.* (2014)[5] where the high accumulation of Cu was detected in the muscles. From the data, the storage of Cu was highest in the liver in the studied species which is in congruency with Oldewage and Marx (2000)[6] who used *Clarias gariepinus* for their study and obtained that liver had the highest Cu concentration.

According to Forstner and Prosi (1979)[7] the harmful effects of heavy metals as pollutants results from incomplete biological degradation[8]. The water bodies are contaminated by industrial discharge and agricultural wastewater discharge, possible sources of heavy metals, which are absorbed by the suspended sediments which gets precipitated to be a part of the surface sediment, which in case of certain disturbances gets released into the water column and serve as the potential secondary source of contaminants which can be a potential threat to ecosystems.[9]

Fishes are integral component of human diet,[10] because it's a good source of high-quality protein, amino acid (lysine, sulphur containing amino acids etc), iodine, calcium, trace elements (Mn, Fe, Cu, Zn, Se etc), vitamins and omega-3-polyunsaturated fatty acid.[11] Fish are the organisms that absorb dissolved or available metals[12] from the surrounding environment and therefore are considered as an excellent biomarker of metal pollution in an aquatic ecosystem. In an aquatic ecosystem fishes occupy higher tropic levels this is another reason for considering it as a biomarker of metal pollution. Since fishes are among the top consumers in an aquatic environment, the tropic transfer which is also referred to trophodynamics of elements along a food chain can result in an increase (biomagnification) or decrease (bio-dilution) or even no change in the element concentrations from lower to upper components of the food web.[13] Therefore, since they play an important role in human nutrition, fish need to be screened to ensure that unnecessarily high levels of the toxic heavy metals are not being transferred to man through them.

CONCLUSION

Both Zinc and Copper heavy metals were found to be heavily bioaccumulated in the gills and muscles of the two commonly consumed freshwater fishes of Bara Talab i.e., *Clarias batrachus* and *Labeo rohita*.

Such extent of bioaccumulation in both fish species is suspected to be because of the pollutants in the Bara Talab in response to anthropogenic activities taking place in and around it.

Acknowledging it as one of the rice source of edible fish supply in Jharkhand, the Government of Jharkhand should take major steps to protect this fresh water body from any kind of pollution, so as to better the health condition of fishes present there and thereby providing a healthier source of protein to the markets.

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