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International Journal of Current Research
Vol. 9, Issue, 10, pp.58442-58445, October, 2017

INTERNATIONAL JOURNAL
OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

IMPACT OF HEAVY METALS ON THREAD FIN CAT FISH (*Ariusarius*) IN THE MOUTH OF HALDI RIVER OF WEST BENGAL, INDIA

RiyankaMaity, *Basudev Mandal and Ashis Gupta

Department of Aquaculture Management and Technology Vidyasagar University, Midnapore-721102, West Bengal, India

ARTICLE INFO

Article History:
Received 14th July, 2017
Received in revised form
23rd August, 2017
Accepted 17th September, 2017
Published online 17th October, 2017

Key words:

Heavy metals,
Threadfin cat fish,
Haldi River

ABSTRACT

The concentration of heavy metals such as zinc (Zn), copper (Cu), lead (Pb) and cadmium (Cd) in water sample and different body parts of thread fin cat fish such as muscle, gill and liver were analyzed. There was considerable increase of metal concentration in sample water collected from mouth of Haldi River. The descending order of heavy metal concentrations in sample water was Pb>Cu>Zn>Cd. The concentration of lead was4.172µg/L followed by copper 3.102µg/L, zinc 1.079µg/L and that of cadmium was 0.050µg/L. The accumulation of heavy metals in different body parts of thread fin cat fish is i) Muscle: lead- 6.39µg/g, copper- 3.81µg/g, zinc- 10.19µg/g and cadmium- 0.54µg/g ii) Gill: lead- 8.09µg/g, copper- 1.56µg/g, zinc -22.48µg/g and cadmium- 0.50µg/g iii) Liver: lead- 5.22µg/g, copper- 1.01µg/g, zinc- 4.63µg/g and cadmium- 0.61µg/g. In the gills, zinc concentration was found maximum but cadmium was minimum. In the muscles, the maximum values of zinc was observed as compared to the values of cadmium. The concentration of lead in liver was higher as compared to cadmium. The concentration of heavy metals in gills and muscles was found in the order of Zn >Pd> Cu > Cdand in the livers was Pb> Cu > Zn> Cd. In this study, gills and body muscles shows highest tendency to accumulate both zinc and copper, while accumulation of metals is less in livers. As the fish thread fin cat fish largely consumed by local people, it is essential to make awareness about water pollution and effects of heavy metals on human beings.

Citation: RiyankaMaity, Basudev Mandal and Ashis Gupta, 2017. "Impact of heavy metals on thread fin cat fish (*Ariusarius*) in the mouth of Haldi river of west Bengal, India", *International Journal of Current Research*, 9, (10), 58442-58445.

INTRODUCTION

Heavy metals are arises from rapid industrialization, urbanization and anthropogenic sources that threatened environment and human health (Nriagu 1979; Schalcsha and Ahumada 1998; Krishniani *et al.*, 2003). Heavy metals are stable and persists environmental contaminants of aquatic environments. They occur in the environment both as a result of natural processes and as pollutants from human activities (Garcia- Monelongo *et al.*, 1994; Jordao *et al.*, 2002). Some metals like Zn and Cu, which are required for metabolic activity in organisms, lie in the narrow "window" between their essentiality and toxicity. Other heavy metals like Cd and Pb, mayexhibit extreme toxicity even at low levels under certain conditions, thus necessitating regular monitoring of sensitive aquatic environments (Cohen *et al.*, 2001; Fergusson 1990; Peerzada *et al.*, 1990). The coastal zone receives a large amount of metal pollution from agricultural and industrial activity (Usero *et al.*, 2005).

****Corresponding author:*** **Basudev Mandal**
Department of Aquaculture Management and Technology Vidyasagar University, Midnapore-721102, West Bengal, India.

Adverse anthropogenic effects on the coastal environment include eutrophication, heavy metals, organic and microbial pollution, and oil spills (Boudouresque and Verlaque, 2002). Fish may absorb heavy metals from surrounding water and food, which may accumulate in various tissues in significant amounts and are eliciting toxicological effects at critical targets. Also, fish may accumulate significant concentrations of metals even in waters in which those metals are below the limit of detection in routine water samples. Therefore, fish might prove a better material for detecting metals contaminating the freshwater ecosystems. Intensive studies were conducted on the levels of heavy metals in different water bodies (Samanta *et al.*, 2005; Toufeek 2005; Authman and Abbas, 2007). The Gangetic delta, at the apex of Bay of Bengalis recognized as one of the most diversified and productive ecosystems of the Tropics. However, due to intense industrial activities in the upstream zone, and several anthropogenic factors, the western part of the deltaic complex is exposed to pollution from domestic sewage and industrial effluents leading to serious impacts on biota (Mitra and Choudhury, 1992). The presence of Haldia port-cum-industrial complex in the downstream (mouth of haldi river) region of the

River Ganga (also known as the Hooghly River) has accelerated the pollution problem with a much greater dimension (Mitra 1998). Haldia, a newly group up industrial town in the district of purbamedinipur west Bengal processes a good number of industries like petroleum refineries, fertilizers, pesticides, battery, detergent etc. A number of industries are located in close proximity of the confluence of the two estuaries, viz. Hooghly and Haldi, which are subjected to severe impact of pollutants discharge. Various studies have already been undertaken worldwide on the contamination of different fish species to determine their heavy metal concentration (Carvalho *et al.*, 2005; Sivaperumal *et al.*, 2007; Raja *et al.*, 2009; Yilmaz 2009; Ahmed and Nain 2008; Nawal 2008; Nath and Banerjee 2012) butlittle information is available pertaining to the accumulation of heavy metals in coastal biota especiallycoastal fishes collected earlier from the North Eastern Bay of Bengal, India (Mitra 2000; Bhattacharya *et al.*, 2001 & 2006). The present research work aimed to analyze the accumulation of heavy metals (Zinc, Lead, Copper, and Cadmium) in water as well as organs of thread fin cat fish (*Arius* sp.) in the mouth of Haldi River.

MATERIALS AND METHODS

Water samples and fish samples (*Arius* sp.) were collected from mouth of Haldi River in the month of June 2016. Sampling sites was selected downstream lower Gangetic delta (mouth of Haldi River) West Bengal at the apex of the Bay of Bengal.

Table 1. Sampling stations with coordinates and salient features

Station	Coordinates	Salient Features
Mouth of Haldi River	22° 01´ 18.3" N 88° 03´ 11.4" E	It is located in the Hooghly estuary in the western sector of the lower Gangetic delta and is the industrial HUB of the maritime state of West Bengal in India

Water samples were collected in the middle of the river at 50 cm below the surface, using 1L polythene bottles with screw caps. The bottle had been washed and soaked in 5% nitric acid and rinsed with deionizer's water before use. The 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, 2012). Water samples were analyzed in Atomic Absorption Spectrophotometer for detection of heavy metals. Samples of five fish (*Arius* sp.) of nearly equal size and weight were dissected to remove muscles, gills and liver. The separated organs were put into petridishes to dry at 120ºC. The organs were placed into digestion flasks and ultrapure concentrate Nitric acid and hydrogen peroxide (1:1 v/v) was added. The digestion flasks were then heated to 130ºC until all the materials were dissolved. Digest was diluted with double distilled water appropriately. The heavy metals Pb, Zn, Cu, and Cd were assayed using Atomic Absorption Spectrophotometer and the results were given as µg/g dry weight. Data obtained from the experiments were analyzed and the results were expressed as mean of all five. Values of $P<0.05$ were considered statistically significant.

RESULTS AND DISCUSSION

Average heavy metal concentration in the sample water collected from mouth of Haldi River is tabulated in Table 2. The trace of heavy metals in water was found to decrease in the sequence of Pb> Cu > Zn > Cd at that site. Maximum amount of metal found in sample water was lead (Pb). The values of lead observed 4.175µg/L.

Figure 1. Sampling places of Haldi River

The value of cadmium (Cd) was minimum and the values of 0.033µg/L. The higher level of lead, copper and zinc in the river water may be due to excessive use of industrial effluents, pesticides and fertilizers in the agriculture fields along this river. The analysis of heavy metals in different body parts of Arius sp. is shown in Table 3. All the three organs muscle, gills and liver shows different values of accumulation of heavy metals. Gills show higher levels of metals succeeded by muscle and liver. In the gills, the sequence of trace metals is Zn >Pb> Cu > Cd. It is observed that the sequence of trace metals is Zn >Pb> Cu > Cd in muscles and Pb> Zn > Cu > Cd in liver. The concentration of copper and cadmium shows fluctuations in all the three body parts. The maximum amount of heavy metals found in fish tissue is zinc, which accumulating in the gills and it shows values 22.48 µg/g dry weights. The values and sequence of heavy metals found in different organs are correlated with the results found by Abida Begum *et al.*, 2009. Accumulation of bioactive metals like cadmium, chromium, lead, nickel and zinc was actively controlled by fish through different metabolic processes and the level of accumulations usually depend on ambient concentrations. In the literature, heavy metal concentration in the tissues of freshwater fish vary considerably among different studies (Chattopadhyay *et al.*, 2002; Papagiannis *et al.,* 2004), possibly due to chemical characteristics of water, ecological needs, metabolism andfeeding patterns of fish. It could be concluded that the concentrations of metals in the studied fish tissues is dependent upon the target organ as well as the type of metal. This is in agreement with that reported by (Abdel - Baky 2001 and Mohamed and Aboul-Ezz 2006). Heavy metal contamination of the environment has been occurring for centuries, but its extent has increased markedly in the last 50 years due to technological developments and increased consumer use of materials containing these metals (Gualin *et al*., 2006). Pollution by heavy metals isa serious problem due to their toxicity and ability to accumulate in the biota (Islam and Tanaka 2004).

Table 2. Heavy metal concentrations (µg/L) inHaldi River water

Date of month	Lead (Pb) µg/L	Copper (Cu) µg/L	Zinc (Zn) µg/L	Cadmium (Cd) µg/L
1.06.2017	3.973±1.21	3.102±0.56	1.060±0.50	0.051±0.01
8.06.2017	4.015±0.87	3.005±0.06	1.079±0.88	0.033±0.02
15.06.2017	4.175±1.11	2.895±1.10	0.713±1.00	0.050±0.00
22.06.2017	3.628±1.58	2.156±1.25	0.958±0.59	0.019±0.05
29.06.2017	4.121±1.03	3.221±0.29	1.023±0.21	0.050±0.02

Each data is the mean of 5 separate determinations and their Standard Deviation (SD)

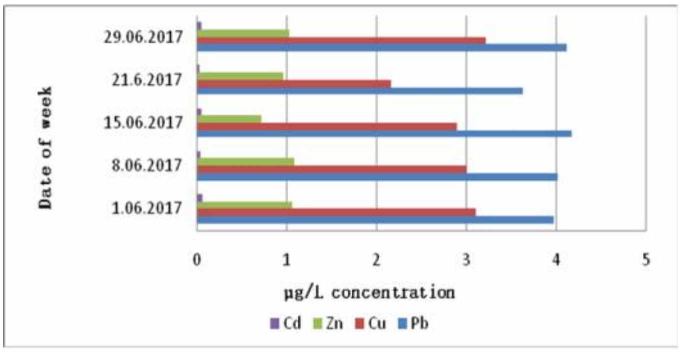

Figure 2. Variation of Heavy metal concentration in water

Table 3. Average heavy metal concentrations (µg/g dry weight) in different partsof fish *Arius* sp. Collected from mouth of Haldi River

Organ	Pb (µg/g)	Cu (µg/g)	Zn (µg/g)	Cd (µg/g)
Muscle	6.39 ±1.03	3.81±0.40	10.19±2.27	0.54±0.20
Gills	8.09±0.80	1.56±0.10	22.48±1.10	0.50±0.13
Liver	5.22±0.30	1.01±0.07	4.63±0.12	0.61±0.11

Each data is the mean of 5 separate determinations and their Standard Deviation (SD)

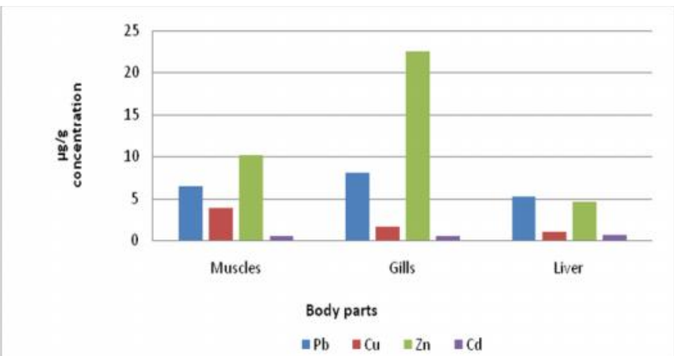

Figure 3. Variation of Heavy metal concentration in fish body parts

There is still a general concern about the impact of metals in the aquatic environment (Grosell and Brix 2005). Howrah, and the newly emerging Haldia complex in the maritime state of West Bengal has caused considerable ecological imbalance in the adjacent coastal zone (Mitra and Choudhury 1992; Mitra 1998). The concentration of other metals measured in the muscle, gill, and liver of the species studied generally lower than the levels issued by WHO/ FAO (WHO, 1989; FAO 1983).

Conclusion

The results of this study revealed that consuming fish from the mouth of Haldi River may not have harmful effects because levels of heavy metals concentrations are below the permissible limits. Moreover, comparisons with Canadian food standards (Cu: 100 µg $g^{-1,}$ Zn: 100 µg g^{-1}), Hungarian standards (Cu: 60 µg $g^{-1,}$ Zn: 80 µg g^{-1}), and Australian acceptable limits (Cu: 10 µg $g^{-1,}$ Zn: 150 µg g^{-1}) demonstrate that the content of these metals in the muscle tissue of the examined fishes is lower than the guidelines mentioned before. As the fish *Arius* sp. is one of the part of aquatic food, it should be noticed by the consumers and awareness must be done.

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