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Level of heavy metals Cu, Cr, Pb and Zn in alien fish species, *Cyprinus carpio* from the Gomti river at Sultanpur, India

ASHISH TIWARI[1], AMITABH CHANDRA DWIVEDI[2] **AND** D.N. SHUKLA[1]

[1]Bharghava Laboratory, Department of Botany, University of Allahabad, ALLAHABAD (U.P.) INDIA
[2]Regional Centre, Central Inland Fisheries Research Institute, ICAR, ALLAHABAD (U.P.) INDIA
Email : ashishtiwari.aubot@gmail.com

Now-a-days, bioaccumulation of toxic metals in aquatic animals causes serious threats to the human health when they are consumed. This study was carried out to assess the concentration of various heavy metals and their distribution in organ of *Cyprinus carpio* from the Gomti river at Sultanpur, Uttar Pradesh during 2011-2012. The heavy metals copper (Cu), chromium (Cr), lead (Pb) and zinc (Zn) were determined in liver, gill and muscle using atomic absorption spectrophotometer. The analysis of heavy metals was measured with order, in liver Pb > Cr > Cu > Zn, in gill Pb >Cr> Zn > Cu and in muscle Zn > Cr > Pb> Cu. Maximum level of heavy metals were observed in liver compared to gill and muscle. The presence of heavy metal in our environment has been of great concern because of their toxicity when their concentrations are more than the permissible level.

Key words : Metal accumulation, *Cyprinus carpio*, Gomti river, Muscle, Gill, Liver

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INTRODUCTION

Knowledge of heavy meatl concentration in fish is important for both human consumtion and nature managment. Rapid urbanization and industrial development during last decade have provoked some serious concerns for the environment. Metals are non-biodegradable and considered as major environment pollutants causing cytotoxic mutagenic and carcinogenic effect in animals (More *et al.*, 2003). Heavy metals contamination in river is one of the major quality issues in many fast growing cities, because maintenance of water quality and sanitation infrastructure did not increased along with population and urbanization growth especially for the developing countries (Akoto *et al.*, 2008; Ahmad *et al.*, 2010). Heavy metals are known to distort the structural or biological functions of bio-molecules. Since metals act as endocrine disruptors, they can interfere with metabolism, synthesis and transport of hormones or receptors (Manjappa and Puttaioh, 2005; Riddell *et al.*, 2005). The bioaccumulation of trace elements in living organisms and biomagnifications in them describes the processes and pathways of these (possible) pollutants from one tropic level to another, exhibiting the higher bioaccumulation ability in the organisms concerned. Increasing concentration through the food chain caused higher retention time of toxic substances than that of the other normal food components. Therefore, various fish species are ideally used as bio-indicators of metal contamination (Svobodova *et al.*, 2004).

Fishes are major part of the human diet due to rich protein content, low saturated fats. *C. carpio* is alien fish species for India. It is commercially exploited with (14.20%) in the Ganga river at Allahabad (Pathak *et al.*, 2013). The objective of the present study was to determine the levels of certain heavy metals (Cu, Cr, Pb and Zn) in *Cyprinus carpio* in tissues of liver, gill and muscle from the Gomti river at Sultanpur.

RESEARCH METHODOLOGY

Sampling procedures :

Preparation of samples for analysis of heavy metals in fish species, Cyprinus carpio :

The tissues were homogenized and approximately 10 g

of the homogenate then digested as follows, 1.0 g of the powdered samples (liver, muscle and gill) were placed in a 100 ml round bottom flask with ground glass joint and mineralized under reflux using a mixture of 6 ml HNO_3, 2.0 ml HClO and 4 ml H_2O_2. The digestion was done with help of water bath .The digestion procedure lasted for about 6 h to obtain a clear solution. The digests were prepared in triplicate and carefully transferred with their respective washing into a 25 ml volumetric flask and diluted to volume. The digests were then analyzed for Cu, Cr, Pb and Zn, using an atomic absorption spectrophotometer (MODEL No. SL 173, ELICKO, India) with aqueous calibration standards prepared from the stock standard solutions of the respective elements as was reported by Aweke and Taddese (2004).

RESEARCH FINDINGS AND ANALYSIS

The experimental findings obtained from the present study have been discussed in following heads:

Level of heavy metals (Cu, Cr, Pb and Zn) in *C. Carpio* from the Gomti river :

The data were obtained from the present study revealed that the higher metal accumulation occurs in liver compared to gill and muscle. In the present study muscle accumulated the least metals burdens as compared to the other organs. Considerable variations in the heavy metals were observed in all the samples, with minimum accumulation during monsoon season and maximum in summer season in all fish samples and organs (muscle, gill, liver). The order of heavy metals accumulation were found to be in muscle Zn > Cr > Pb > Cu (Table 1), in gill Pb > Zn > Cr > Cu (Table 2) and in liver Pb > Cr > Cu > Zn (Table 3). The seasonal variations of heavy metals accumulation into muscle of *C. carpio* have been shown in Table 1. In case of muscle, Cu, Cr, Pb and Zn were varied from 0.19 to 0.59 µg/g, 0.57 to 1.38 µg/g, 0.39 to 0.72 µg/g and 1.72 to 3.03 µg/g, respectively. In case of gill, heavy metal level were ranged from Cu (0.42-0.76 µg/g), Cr (0.62-1.23 µg/g), Pb (1.51-3.43 µg/g) and Zn (0.62-1.37 µg/g) (Table 2). In case of liver Cu (4.72-7.65 µg/g), Cr (6.42-12.21 µg/g), Pb (7.68- 13.41 µg/g) and Zn (1.55- 4.32 µg/g,) were observed (Table 3). The liver accumulates relatively higher amount of metals. The higher accumulation in liver may alter the levels of various biochemical parameters in liver. Edem *et al*. (2008) stated that the heavy metal pollution is less visible but its effects on the ecosystem and humans are intensive and very extensive.

Cu metal distribution pattern was different from muscle, gill and liver. Cu level was observed maximum in liver with 7.65 µg/g in summer season and minimum for muscle with 0.19 µg/g in monsoon season. Average concentration of Cu was measured 0.39±0.20 µg/g in muscle, 0.56±0.17µg/g in gill and 6.39±1.51µg/g in liver. Cu maximum accumulate in liver as compared to gill and muscles. According to WHO guidelines (1989) and Indian standard for food (Awasthi, 2000) permissible limit of Cu concentration in flesh is 30 µg/g standard. Present

Table 1: Concentration of heavy metals accumulation in muscle of cyprinus carpio of the river Gomti at Sultanpur

Heavy metals	Year 2011-2012					
	Summer	monsoon	winter	Avg± Sd	WHO guideline	ISFF
Cu (µg/g)	0.59	0.19	0.38	0.38± 0.20	30	30
Cr (µg/g)	1.38	0.57	0.78	0.91± 0.42	0.05	20
Pb (µg/g)	0.72	0.39	0.54	0.55± 0.16	0.5	2.5
Zn (µg/g)	3.03	1.72	2.01	2.25 ± 0.68	40	50

Table 2: Concentration of heavy metals accumulation in gill of cyprinus carpio of the river Gomti at Sultanpur

Heavy metals	Year 2011-2012			
	Summer	monsoon	winter	Avg± Sd
Cu (µg/g)	0.76	0.42	0.51	0.56± 0.176
Cr (µg/g)	1.23	0.62	0.85	0.90± 0.31
Pb (µg/g)	3.43	1.51	2.12	2.30± 0.98
Zn (µg/g)	1.37	0.62	0.78	0.92± 0.39

Table 3: Concentration of heavy metals accumulation in liver of cyprinus carpio of the river Gomti at Sultanpur

Heavy metals	Year 2011-2012			
	Summer	monsoon	winter	Avg± Sd
Cu (µg/g)	7.65	4.72	6.82	6.39 ± 1.51
Cr (µg/g)	12.21	6.42	8.71	9.11± 2.9
Pb (µg/g)	13.41	7.68	8.42	9.83± 3.1
Zn (µg/g)	4.32	1.55	2.31	2.72± 1.4

finding is less than WHO guidelines (1989) and Awasthi, (2000). Yousafzai *et al*., (2012) reported that Cu in muscle (255 ± 303 µg/g), in gill (159± 44µg/g) and in liver (390±13.5µg/g) of *C. carpio*. Celechouska *et al.* (2007) reported Cu median 0.217, mean 0.237.

Cr level was observed highest 12.21 µg/g in liver in summer season and lowest for muscle 0.57 µg/g in monsoon season. Average concentration of Cr was recorded 0.91 ±0.42 µg/g in muscle, 0.90±0.31 µg/g in gill and 9.11±2.9 µg/g in liver. According to WHO (1989) guidelines permissible limit of Cr in flesh is (0.05µg/g) and while Indian standard for food (Awasthi, 2000) permissible limit is 20 µg/g in muscle. Sreedhara Nayaka *et al.* (2009) reported that Cr ranged in muscle (0.004 to 2 µg/g) *C. Carpio* from the tank at Tumar (India). Begum *et al.* (2009), reported that Cr average concentration 1.02µg/kg in muscle 4.56µg/kg in gill and 2.45µg/kg in liver.

The highest level of Pb was recorded 13.41µg/g in liver in summer season and lowest 0.39 µg/g in muscle in monsoon season. Average concentration of Pb was observed 0.55±0.16 µg/g in muscle, 2.30±0.98 µg/g in gill and 9.83±3.10 µg/g in liver of *C. carpio*. The statistical analysis of Pb in gill and liver showed higher mean values above the detection limits. Pb maximum accumulate in liver as compared to gill and muscles. According to FAO/WHO (1989) guidelines permissible limit of Pb in flesh is (0.5 µg/g) and according to Indian standard for food (fish) (Awasthi, 2000) permissible limit is 2.5 µg/g in muscles, gills and livers. Begum *et al.* (2009) reported that Pb (Avg 2.45µg/kg) in muscle and (4.30µg/kg) in gill, (9.05µg/kg) in liver of *C. carpio*. Yousafzai *et al*. (2012) reported that Pb in muscle (226.3 ± 222.2 µg/g), in gill (125.7 ± 64.8 µg/g) and in liver (261.3 ± 72.7µg/g).

The maximum level of Zn was observed 4.32 µg/g in liver in summer season and minimum for gill 0.62 µg/g in monsoon season. The result of present study was found that average concentration of Zn (2.25±0.68 µg/g) in muscle, (0.92±0.39 µg/g) in gill, (2.72±1.40 µg/g) in liver. Zn accumulation was observed maximum in liver as compared to muscle and gill. The results of our present study show that there is no threat of any hazard at present except Pb, because it crosses WHO permissible limit. However, their increasing accumulating tendency in water, muscles, gill and liver of the fish species indicates that a constant monitoring of this river is needed before the level cross its threshold and become toxic to the aquatic animals and their predators including humans.

According to WHO (1989) guideline and Indian standard for food (Awasthi, 2000) permissible limit of Zn in flesh is (40µg/g) and (50µg/g), respectively. Yousafzai *et al.* (2012) reported that the Zn 826.3 ± 166.6 µg/g wet weights in muscle, 1489 ± 504.6 µg/g wet weight in gill and 3319.0 ± 376.8µg/g wet weight in liver. Al-Weher, (2008) reported that Zn in muscle (30.31 ± 4.16 mg/g) and in Gill (27.85 ± 3.93 mg/k). High concentration of Pb and Cr in the fish tissue such as liver, muscles and gills of common carp (*Cyprinus carpio*) has been reported specially in area close to industries (Thompson *et al.*, 2000; Vinodhini and Narayana, 2008). The increase in concentration of metals in fish could be mainly due to metals contaminated diet which comes from discharge of effluents into rivers from different industries and other sources in the form of particulate and solution (Mount and Stephon, 1969). The heavy metals accumulated predominantly in gill, liver, intestine and kidney (Brown *et al*., 1986; Thomas *et al*., 1985).

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