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Determination of heavy metals in cyprinidae fishes in Bolan River Balochistan Pakistan

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Abstract

The Bolan River is one of the major rivers in Balochistan province, Pakistan, it flows in District Bolan. It is main source of fishing and agriculture in the region. In this study we carried out research on cyprinid fishes of Bolan River in the District Bolan. This study includes water and fish chemistry to assess heavy metals concentration in water and various organs of fish from four cyprinid fishes of Bolan River, i.e. (*Cirinus mirigla, Labeo rohuta, Cyprinus carpio,* and Catla *catla*). The water and fish samples were evaluated for the identification of four heavy metals Fe, Pb, Cd, and Cr by atomic absorption spectroscopy. The metal concentration varied as well similar over four stations of Bolan River, about to water and fishes metals concentration followed the order : Fe > Cr > Pb > Cd. In all fish species Gills and liver showed comparatively highest heavy metals concentration organs in fish's metals concentration followed the order: Fe > Cr > Pb > cd. Subsequently, all cyprinid fishes showed statistically important variations in each organ. Except for Fe, the concentration of heavy metal in all fish organ was below the threshold value of World Health Organization (WHO). The access amount of metal effects fish may cause health issue to humans, such as effect of lungs kidney protein, formation of RBCs, and cause of cancer.

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Introduction

The family Cyprinidae is most multifarious family of freshwater fishes around the globe. Almost 3,000 species (living and extinct) of these fishes have been reported but only 1,270 remain extant (Froese *et al.,* 2015). Their body is enclosed with cycloid scales and teeth are absent in their jaws.They are cosmopolitan in their distribution, but are not found in Australia, South America and Antarctica (Mayden *et al.,* 2009). These fishes have a great economic value because of large quantity of proteins present in their body (Zheng *et al*., 2010).

Heavy metals is a collective term referring to a catego ry of atomic density metals and metalloids that reach 4 g / cm3 or 5 times or more than water (Hutton and symon, 1986; Nriagu, 1989. Garbarino *et al*., 1995; Lenntech, 2004). The word heavy metal applies to any metallic components which are toxic and lethal even in small concentrations (Battarbee *et al*., 1988). The absorption of heavy metals in fishes depends upon physiological behavior and found different in tissues of various fishes (Zhang, 2006; Has-schön *et al.,* 2008). Geographically Bolan Districtcovers 7499 square kilometers approximately (Census, 2017).

The rivers of Bolan District ; i.e. Bibi nani, Kirtha,Pir ghaib and Gokurth.These rivers are big source of food (fishes) for native population, and it is compulsory to study the metals concentration in fishes. However, in this study we describe heavy metals concentration in fish and it implications on human and animal health.

Materials and methods

Study area

For the purpose of heavy metals concentration fish sample of cyprinid fishes from March 2018 to December of Bolan District including *Labeo rohita, Cirrhinus mrigala, Cyprinus carpio,* and *Catla Catla*.

Identification of fish species

The selected species of fishes were recognized and confirmed by using keys and illustrations which was given (Talwar and Jhingaran, 1991; Jayaram, 1999). Water samples in 50 ml plastic bottles were collected in triplicate from four stations (Kirta, Gokurt, Bibi Nani and pir ghaib) of Bolan River. About 10% $HNO_3$was added in all sampling bottle. For metal detection these water samples were brought to Zoology Laboratory of University of Balochistan, Quetta. Sample of Fish were collected from selected area of District Bolan and recognized. Four fishes of family Cyprinidae i.e. (*Labeo rohita, Cirrhinus Mirigla, Cyprinus carpio and Catla catla*) were selected for dissection to expose their different organs (gills, muscles, heart and liver) for downstream Observation of heavy metals in different tissues of each fish.

The dissected organs were oven dried at 105°C for hours. Later on the Samples were kept for 30 hours at room temperature and were prevented from sun light and moisture.

The dried samples were grinded separately with the help of Morter and Pestel. The heavy metal analysis was carried out for each of 10 samples According to a reported method of (Iqbal *et al*., 2016), with little modifications. Briefly for digestion, 01 g of each powdered Samples of fish organs were collected in a flask, 2.5 ml of concentrated H_2SO_4 and 4.0 mL of concentrated HNO_3 were added. The mixtures ware then heated slightly on a hot plate while adding four to five drops of H_2O_2. These step were performed several times for clarification of solution. Later, the mixture was heated at 150°C for an additional 20 minutes and allow it to cool at room temperature. Moreover, the metal solutions were filtered into volumetric flask of 50 ml and diluted up to the mark with deionized water. A solar atomic absorption spectrophotometer model 3100 was used to measure heavy metal concentrations in fish and water samples.

Statistical analysis

Using ANOVA, important differences were reported at a meaning levelof 0.05. All statistical comparisons were made using the post-hoc various compression test of SPSS 15.00 packaged software and variance analysis was used to determine statistical differences between various parameters Steel *et al.* (1996).

Results and discussion

Concentration of heavy metals in water samples

The present study was conductedin March to December 2018 for concentrations the of heavy metals detection. The metal concentration in freshwater and fish samples varied as well similar in different stations over four water sample station i.e. (Bibi Nani, pir Ghaib Gokurth kirtha). Table. 1 show the average metal concentrations; the Fe ranged between 0.227 to 0.45, Pb 0016 to 0183, Cd 006 to 0066 Cr 0.02 to 0166**.** Fe accumulation recorded was highest and that Cd concentration was lowest in freshwater samples. Metal concentration followed the order: Fe>Cr>Pb>Cd, whereas it varies from heavy metal orders observed in Indus river: Zn> Cu> Pb> Cr Jabeen and Chaudhry (2010). Metal concentrations show slightly lowest in two stations as compare to other two, due to the impact of dilution. Different herbs are discovered to be the largest accumulation compared to the smallest region.

On the other side, owing to huge and deep mud fields, water flow is lower in the largest region. Water slow movement encourages metals to accumulate in water all metals studied were accumulated below WHO limits. Fe showed significant difference and other listed heavy metals of water not showed significant difference with each other (Table 1).

Table 1. Heavy metal concentration in water stations of Bolan River.

Main station	Sub station	Fe Conc.	Pb Conc.	Cd Conc.	Cr Conc.
Bibi nani	Average	0.227	.0016	.0066	0.166
Pir ghaib	Average	0.249	.0066	.0066	0.02
Gokurth	Average	0.381	..0183	.006	.0166
Kirtha	Average	0.45	.0016	.0066	.118
WHO Limit (ppm)		1	1.5	0.2	0.5

Metal accumulation in several organs of fish species

The mean concentrations of four heavy metals in several cyprinid fish tissues, *Labeo rohita*(rahu), *Cirrhinus mrigala*(mori), *Cyprinus carpio*(Gulfam) and *Catla catla* (thaila) are presentedin (Tables 2-5). The mean concentration of Fe in *Labeo rohita* (µgg–1) ranged from 1.3 to 4.12. While that of pb was 0.12-0.32, Cd 0.01-0.04, Cr 0.145-0.192. Heavy metals concentration followed the order: Fe > cr > pb > cd in all investigated fishes.

All metals concentration in organs of all investigated Species had statistically significant. In all tissues of all commercially important listed fishes, the concentration of Fe were greater than in those Cr, than in Pb and Cd.

Table 2. Concentrations (µg/g) of heavy metals in organs of *Labeo rohita* from Bolan River.

Organ	Stations	Fe Conc.	Pb Conc.	Cd Conc.	Cr Conc.
Gills	Average	4.12	0.32	0.04	.155
Muscle	Average	1.3	0.12	0.01	0.192
Liver	Average	2.205	0.21	0.03	.155
Heart	Average	2.115	0.12	0.01	0.145
WHO Limit (ppm)		1	1	1.5	0.2

The association of heavy metals among organs gills showed highest metal concentration then liver, muscle and heart was listed in least concentration organ in the fishes of *Labeo rohita* of Bolan River. The work of Gurganari *et al.*, (2020) showing similarity with present work.However, it wassupported by different researcher that the tissue of liver is highly vigorous in the storage and uptake of heavy metals. It is ratified that the metallothionein induction occurs largely in the tissue of fish liver (Heath, 1987; Hodson, 1988; Langston, 1990).

Table 3. Heavy Metals concentrations (µg/g) in *Cirrhinus* Mirigla from Bolan River. Organs of

organ	Stations	Fe Conc.	Pb Conc.	Cd Conc.	Cr Conc.
Gills	Average	13.97	0.26	0.055	0.2
Muscle	Average	0.9	0.033	0.040	0.2
Liver	Average	8.16	.043	0.03	.122
Heart	Average	0.512	.155	0.03	0.095
WHO Limit (ppm)		1	1	1.5	0.2

From Table 3, in present study, the average of Fe concentration gills of *Cirrhinus mrigala* followed the range of 0.055 -13.97, muscle 0.033-0.9, liver 0.03-8.16, and heart 0.03-0.512. Metal accumulation is usually the highest in liver and gills, current study supported by various researcher that gills and liver accumulate higher concentration. On the other hand, gonad and muscle accumulation are lowest in all species, this was the case in many fish species, although there were interspecies variations in the accumulation of distinct metals in these tissues (Gey, 1983; Kargin, 1996; Usero *et al.,* 2003; Yilmaz, 2003; Malik, 2017). Except Fe all heavy metals were below the prescribed list of WHO. The absorption of each heavy metals in the organ of *Cirrhinus mirigla* showed significant difference.

From Table 4, he average metal concentration of *Cyprinus carpio* gills followed the order, 0.07-.345, muscle 0.126- 8.0, liver 0.065-0.41 and heart 0.0875- 0.45. Fe and cr showed highest then the ratio of who Pb and cd were the prescribed limit of WHO. The concentration of each heavy metals in the organ of *Cyprinus carpio* showed statically significant difference. Which was agreement with work of current study supported by researchers that fish gills and muscles were found the storing organs of heavy metal (Malik *et al.,* 2017; Gurganari *et al.*, 2020).

Table 4. Heavy metals concentrations (µg/g) in organs of *Cyprinus carpio* from Bolan River.

organ	Stations	Fe Conc.	Pb Conc.	Cd Conc.	Cr Conc.
Gills	Average	1.4	.21	0.07	.345
Muscle	Average	8.62	0.28	.077	.126
Liver	Average	1.26	0.41	0.065	.212
Heart	Average	0.225	.0875	0.45	0.205
WHO Limit (ppm)		1	1	1.5	0.2

From Table 5 in present study, the average concentration of *Catla catla* the order followed in gills 0.0725- 5.27, muscle 0.0725-1.96, liver 0.08 -1.90, and heart 0.075 -1.95. Fe and cr showed highest then the ratio of WHO Pb and cd were the prescribed limit of WHO. Cadmium is commonly recognized to be an extremely toxic non-essential heavy metal and has no part to play in living organisms in biological processes. Cadmium could therefore be damaging to living organisms even at its low concentration. TSUI M. T. K and WANG W. V. (2004).

Table 5. Heavy metals concentrations (µg/g) in organs of *Catla catla* from Bolan River.

Organ	Stations	Fe Conc.	Pb Conc.	Cd Conc.	Cr Conc.
Gills	Average	5.27	.185	.0725	.532
Muscle	Average	1.965	.0725	.0525	.272
Liver	Average	1.90	0.332	0.08	0.28
Heart	Average	1.95	0.33	0.075	0.285
WHO Limit (ppm)		1	1	1.5	0.2

It show the similarity with the research, that Fe was found in a highest quantity in the heart and its value was above the prescribed list (Malik *et al.,* 2017; Gurganari *et al.*, 2020). The concentration of each heavy metals in the organ of Catla *catla* showed statically significant difference. Bolan River but the accumulation of Fe in heart is above the documented list of Who.

The largest mean levels of all studied metals were discovered in kirtha during the current research, and the smallest levels of metals were discovered in Bibi Nani. Followed order kirtha> Gokurth>pir Ghaib> Bibi Nani while on the basis of Metal concentration in fishes followed order fishes, *Cirrhinus mrigala*>*Cyprinus carpio*>*Labeo rohita* >*Catla catla,* Physiological operations have been discussed affecting the metal bioavailability level of aquatic settings in distinct seasons (Tekin-Ozan and Kir, I1986). With respect to toxicity the exposure of Lower levels are mainly of concern of the kidney (Satarug, Haswell-Elkins, & Moore, 2000). Subsequently, it could be suggested that the water eco system is not contaminated owing to absence of human operations that promote environmental contamination such as industrial activities, washing car, throwing plastic bags in water channels owing to less populous region. Fish consumption is save from health hazards among consumers.

Conclusion

This study discuss the concentrations of several heavy metals in rive of bolan and different tissues of *Labeo rohita ,Cirrhinus mrigala*, *Cyprinus carpio* and *Catla catla* collected from four stations (Bibi Nani,Pir Ghaib, Kirta, And Gokurt) of Bolan River.

The mean concentration of Fe was highest inall fishes. Cr showed second highest accumulation then Pb and then Cd. Similar order of metal concentration were studied in both testing samples water and fishes. Fe which is above WHO threshold limit that can pose health risk to native population. Other all metals were below the threshold limit, in future might they crossed the prescribed limit due to human activities.

Therefore, compared to the iron levels slightly above the appropriate food standards recognized, largest accumulation of Cr in the muscle was in *Labeo rohita*. Pb was not found in *Cyprinus carpio* and *Cirrhinus mrigala*. Moreover, the effected fish may create health problems, such as effect of lungs kidney protein, formation of RBCs, and major cause of cancer. However, it is suggested that the levels of above metals should be monitored in a higher level.

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