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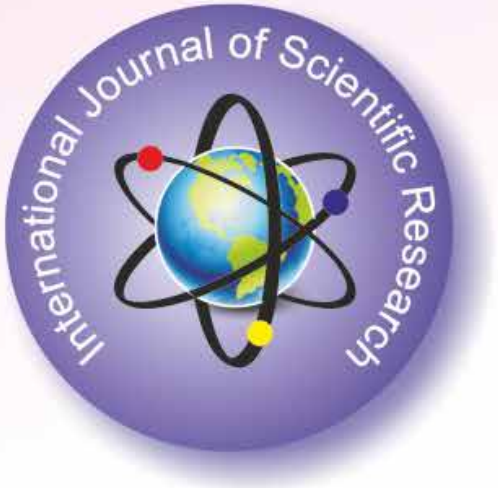

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Research Paper

Bioaccumlation Of Heavy Metal In Labeo Rohita From River Panchgang.

Engineering

KEYWORDS :Heavy Metals , Labeo rohita, Bioaccumulation, Fish tissue, River Panchganga .

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ABSTRACT

Osteogenesis Imperfecta is a rare bone disease which affects all the bones in the body including the middle ear ossicles making them fragile. This condition is characterized primarily by frequent bone fractures and complications like respiratory, cardiac, neurological complications, and hearing loss. Hearing loss is usually believed to occur and progress in the middle ages. For audiologists, thus it is important to understand the Audiological profile observed in this population for providing effective ways of management. Current case report is an evidence of a 5 year old child with Osteogenesis Imperfecta having initial stages of hearing impairment and its management. This report is aimed at improving the existing literature and to highlight the fact that hearing loss could appear early in life in the reported population.

1. Introduction :

Industrial development in the developing and developed countries has resulted in heavy metal contamination of local waters. It resulted from many sources, e.g. accidental spillage of chemical Wastes, discharge of industrial or sewerage effluents, agricultural drainage, domestic wastewater and gasoline from fishery boots [4,18].

Metals are non-biodegradable and are considered as major environmental pollutants causing cytotoxic, mutagenic and carcinogenic effects in animals [19]. Fish species were recently suggested as environmental biomarkers [21,25,26,27]. Heavy metals like copper, iron and zinc are essential for fish metabolism, while some others such as mercury, cadmium and lead have no known role in biological systems. For normal metabolism the essential metals must be taken up from water or food, but excessive intake of the essential metals can produce toxic effects [31]. Liver and gills as main organs for metabolism and respiration are target organs for contaminants accumulation as reported by many authors concerning structural damage to organs and tissues related to the exposure of fish to heavy metal, [3,11,17]. The gills [22], liver [16] and kidney [10] are commonly the primary target organs for pollution .Heavy metals after accumulation by the body of aquatic organisms enter into food chain and extremely consumed by human [1]. Reactions of these element depends on the concentration, physiochemical properties, chemical bonds and their solution on the absorption, accumulation, distribution in body and physiological effects on metals [1,9].

The present study was aimed to study the heavy metal (Cu, Zn, Fe, Cr) accumulation in water and in the gills , Liver, Intestine and Brain tissues of the Labeo rohita collected from two different sites along the course of the Panchganga River.

2. Materials and Methods

2.1. Study Area

Kolhapur city is located at 16° 42' N and 74° 14' E, having mean sea level of 570 m, stands on rising ground on the south bank of the river Panchaganga [28]. For present study along the stretch of Panchganga river two sites were selected .Site I is near Mahadev temple (Shivaji pool naka) . This site receives agricultural Waste, domestic sewage, disposal of religious material. The Site II is Bhogawati 20 km away from site I. This site receives effluents sugar factory, agriculture waste.The program of monitoring had been planned and implemented to know the quality of water and the influence of the pollutant on its aquatic life. The study was carried out at Kolhapur region situated along Panchganga River, Maharashtra state, India, during the period of June 2011 to May 2012.

2.2 Fish and water sample collection:

The species used for the study was Labeo rohita. Each fish species were caught at Panchganga River using drag net, which were usually left over night in the river by local fishermen. The netted fish were recovered each morning in a picnic box with some quantity of water to the laboratory. It was then drained under folds of filter, weighed, wrapped in aluminum foil and then frozen at –10 0C prior to analysis. Fish, specimen of uniform size were collected in order to avoid the possible error due to size differences[20].

2.3 Water and fish sample analysis:

For preparation of water sample 5 mL of concentrated hydrochloric acid was added to 250 mL of water sample and evaporated to 25 mL. The concentrate was transferred to a 50 mL flask and diluted to mark with distilled water, [20].

For analysis the fish samples were defrosted for two hours. The different organs (bone, liver, stomach, gills and Kidney) were carefully dissected after rinsing with double distilled water and oven dried at 110 OC. The heavy metal concentrations in the dried samples were estimated after acid digestion following standard methods as laid down in APHA[2], using Atomic Absorption spectrophotometer. The results were expressed in µg/ g metal per dry weight.

3. Result and discussion:

3.1 Water analysis:

The result of means and SD of water sample collected from two sites are given in table. Heavy metals enter in river from a variety of sources. The copper concentration was within the permissible limit in the water of both stations fluctuated between 0.422±0.001 to 1.214±0.02 ppm (Table 1 & 2). Zn exhibited wide range of variation between 0.892±0.001 and 3.176±0.003 ppm (Table 1 & 2). The highest value was recorded at station 2 was 3.176±0.003 ppm which was above permissible limit according to WHO. The Iron level was higher than the permissible

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limits at station 1 from Jan - May exhibited wide ranges from 1.004±0.002 to 1.027±0.046 ppm (Table 1 & 2). At station 2 Iron value was within permissible limit ranges from 0.487±0.002 to 0.602±0.001 ppm.

Cr values were fluctuated within a narrow range from 0.029±0.002 to 0.036±0.001 ppm (Table 1&2) and it was very low at station 2 ranging from 0.017±0.003 to 0.029±0.002 (Table 1&2).

Table 1: Mean and SD of the concentrations of the selected heavy metals of the water samples collected from station 1 along course of the Panchganga river from June 2011 to May 2012 .

Station 1	Cu	Zn	Fe	Cr
June	0.624±0.002	0.996±0.002	0.911±0.003	0.03±0.002
July	0.525±0.002	0.993±0.002	0.903±0.002	0.03±0.002
Aug	0.522±0.001	0.903±0.002	0.904±0.011	0.029±0.002
Sept	0.474±0.002	0.895±0.002	0.895±0.009	0.036±0.003
Oct	0.422±0.001	0.892±0.001	0.897±0.003	0.035±0.001
Nov	0.43±0.08	0.893±0.002	0.896±0.002	0.035±0.001
Dec	0.427±0.002	0.894±0.003	0.903±0.002	0.036±0.001
Jan	0.489±0.001	0.895±0.003	1.005±0.008	0.032±0.002
Feb	0.532±0.002	1.106±0.002	1.027±0.046	0.033±0.003
March	0.657±0.002	1.214±0.002	1.04±0.04	0.03±0.002
April	0.651±0.001	1.014±0.001	1.004±0.002	0.03±0.002
May	0.644±0.002	1.013±0.002	1.013±0.002	0.029±0.002

Table 2: Mean and SD of the concentrations of the selected heavy metals of the water samples collected from station 2 along course of the Panchganga River from June 2011 to May 2012.

Station 2	Cu	Zn	Fe	Cr
June	0.996±0.002	3.174±0.001	0.582±0.001	0.029±0.002
July	0.993±0.001	2.196±0.004	0.572±0.001	0.026±0.001
Aug	0.907±0.002	2.105±0.002	0.513±0.001	0.026±0.001
Sept	0.895±0.003	2.073±0.002	0.487±0.002	0.028±0.001
Oct	0.893±0.001	2.072±0.001	0.49±0.001	0.021±0.002
Nov	0.894±0.002	2.071±0.002	0.53±0.001	0.021±0.001
Dec	0.895±0.002	2.069±0.002	0.563±0.002	0.019±0.001
Jan	0.896±0.002	2.073±0.002	0.563±0.002	0.018±0.001
Feb	1.105±0.001	2.077±0.002	0.568±0.002	0.017±0.003
March	1.214±0.002	3.175±0.003	0.596±0.003	0.026±0.01
April	1.017±0.002	3.176±0.003	0.602±0.001	0.02
May	1.019±0.002	3.176±0.002	0.583±0.002	0.02±0.002

3.2 Tissue analysis :

Table shows the mean and SD values of the tested heavy metals in Labeo rohita organs. In the river, fish are often at the top of the food chain and have the tendency to concentrate heavy metals from water [17]. Therefore, bioaccumulation of metals in fish can be considered as an index of metal pollution in the aquatic bodies [14,23] that could be a useful tool to study the biological role of metals present at higher concentrations in fish [7].

Copper is an essential part of several enzymes and is necessary for the synthesis of haemoglobin [31], but very high intake of Cu can cause adverse health problems. The concentration of the copper exhibited a wide range. Among the organs of Labeo rohita maximum concentration of Cu analyzed in Gills was 0.628±0.003 µg/g at station 2 and minimum concentration in Brain 0.001±0.001 µg/g (Table 3 & 4) The trend of mean Cu concentration in different organs of Labeo rohita was: gills > liver > Intestine> Brain. Copper toxicity in fish is taken up directly from the water via gills [29]. The present study showed similar accumulation of copper in the gills[21]. Effects of high concentrations of copper on fish are not well established; however, there is evidence that high concentrations in fish can experience toxicity [30].

Zinc is an essential element and is a common pollutant as well. Zinc was detected in all the fish samples, and the highest concentration was analyzed in the liver of fish recorded was 3.007±0.02 µg/g collected at station 2 which was above permissible limit according to WHO limit in food fish and minimum concentration in Brain 0.001±0.0001 µg/g (Table 5& 6). The increase of zinc accumulation in fish liver in this study may be related to the increase of total dissolved Zinc in Panchganga River and consequently increase the free metal zinc concentration and thereby lead to an increase in metal uptake by different organs [24]. Such results were previously reported by [6]. Consequently, the water and fish from the Panchganga River is not safer for human consumption in relation to the zinc levels The trend of Zn concentration in different organs of Labeo rohita was: liver > gills > Intestine> Brain. Iron is an abundant and important element, unsurpassed by any other heavy metals in the earth's crust [8].

In contrast to earlier reports showing Iron (Fe) to be normally highest in gills [22] . The present study shows maximum concentration of Fe analyzed in Liver was 0.786±0.004 µg/g at station 1 and minimum concentration in Brain 0.002±0.001 µg/g (Table 7 & 8).The concentration of Iron in liver of fish collected from both site was higher than permissible limit in food fish throughout study .The trend of Fe concentration in different organs of Labio rohita was: liver > gills > Intestine> Brain.

The highest level of Chromium was detected in the liver 0.017±0.002 µg/g of fish and the lowest concentration was recorded in the Brain 0.001±0.0005 µg/g (Table 9 & 10) .The distribution of Cr in different organs of Labeo rohita was: liver > gill > Intestine> Brain. The Cr levels in fish caught from both stations were within the safe limits according to WHO limit in food fish. Trace metals accumulations in fish at both sites detected in following order: Zn > Fe > Cu > Cr. Intestine and Brain were found to accumulate small amounts of most heavy metals and might have received it through circulation. Heavy metal concentrations in the tissue of freshwater fish vary considerably among

Different studies possibly due to differences in metal concentrations and chemical characteristics of water

From which fish were sampled, ecological needs, metabolism and feeding patterns of fish and also the season

In which studies were carried out , [7,15,17].

Table 3 : Mean and SD of the concentration of copper in different tissues of the Labio rohita s collected from station 1 along the Panchganga river .

Station 1	Gill	Liver	Intestine	Brain
June	0.326±0.004	0.107±0.004	0.073±0.005	0.005±0.001
July	0.218±0.005	0.092±0.01	0.024±0.002	0.003±0.002
Aug	0.205±0.004	0.076±0.003	0.019±0.003	0.002±0.001
Sept	0.215±0.005	0.17±0.003	0.045±0.001	0.002±0.001
Oct	0.153±0.002	0.022±0.001	0.002±0.001	0.001±0.001
Nov	0.217±0.008	0.058±0.002	0.008±0.005	0.002±0.001
Dec	0.228±0.007	0.175±0.002	0.104±0.002	0.001±0.0001
Jan	0.235±0.003	0.215±0.003	0.097±0.003	0.019±0.003
Feb	0.311±0.004	0.218±0.001	0.078±0.003	0.003±0.002
March	0.416±0.001	0.283±0.004	0.119±0.004	0.007±0.002
April	0.318±0.001	0.185±0.001	0.123±0.002	0.021±0.002
May	0.327±0.004	0.167±0.002	0.097±0.002	0.016±0.002

Table 4 : Mean and SD of the concentration of Copper in different tissues of the Labio rohita s collected from station 2 along

the Panchganga river .

Station 2 , Cu	Gill	Liver	Intestine	Brain
June	0.523±0.002	0.183±0.002	0.093±0.002	0.016±0.002
July	0.615±0.001	0.133±0.002	0.053±0.001	0.009±0.003
Aug	0.556±0.002	0.236±0.005	0.028±0.002	0.002±0.001
Sept	0.538±0.003	0.263±0.002	0.019±0.003	0.002±0.001
Oct	0.593±0.002	0.169±0.005	0.085±0.004	0.006±0.002
Nov	0.523±0.003	0.297±0.001	0.137±0.002	0.027±0.002
Dec	0.605±0.004	0.166±0.006	0.108±0.002	0.008±0.002
Jan	0.583±0.003	0.145±0.001	0.018±0.003	0.001±0.001
Feb	0.589±0.005	0.283±0.002	0.149±0.002	0.008±0.004
March	0.628±0.001	0.296±0.001	0.138±0.002	0.022±0.004
April	0.593±0.003	0.359±0.002	0.197±0.002	0.001±0.001
May	0.628±0.003	0.369±0.001	0.152±0.002	0.018±0.004

Table 5 : Mean and SD of the concentration of Zinc in different tissues of the Labio rohita s collected from station 1 along the Panchganga river .

Station 1 , Zn	Gill	Liver	Intestine	Brain
June	0.928±0.001	0.936±0.001	0.166±0.002	0.013±0.006
July	0.834±0.004	0.919±0.002	0.128±0.001	0.008±0.001
Aug	0.854±0.001	0.903±0.001	0.159±0.003	0.005±0.002
Sept	0.736±0.002	0.868±0.001	0.228±0.001	0.003±0.001
Oct	0.833±0.002	0.719±0.003	0.137±0.002	0.007±0.002
Nov	0.828±0.002	0.985±0.002	0.296±0.002	0.002±0.001
Dec	0.727±0.003	0.527±0.001	0.139±0.003	0.002±0.001
Jan	0.628±0.001	0.903±0.002	0.233±0.004	0.004±0.001
Feb	0.829±0.003	1.327±0.002	0.184±0.003	0.017±0.002
March	0.932±0.001	1.366±0.002	0.383±0.002	0.006±0.001
April	0.865±0.001	1.415±0.003	0.126±0.002	0.003±0.002
May	0.756±0.002	1.317±0.002	0.316±0.002	0.007±0.003

Table 6 : Mean and SD of the concentration of Zinc in different tissues of the Labio rohita s collected from station 2 along the Panchganga river .

Station 2,Zn	Gill	Liver	Intestine	Brain
June	0.523±0.003	0.927±0.002	0.266±0.009	0.082±0.002
July	0.536±0.001	0.957±0.002	0.169±0.004	0.027±0.002
Aug	0.797±0.002	0.807±0.002	0.137±0.003	0.003±0.002
Sept	0.568±0.003	0.684±0.004	0.145±0.002	0.003±0.002
Oct	0.431±0.003	0.855±0.001	0.142±0.004	0.03±0.002
Nov	0.835±0.003	0.988±0.003	0.196±0.002	0.013±0.002
Dec	0.896±0.005	0.658±0.001	0.155±0.002	0.029±0.003
Jan	1.237±0.013	2.197±0.002	0.429±0.002	0.057±0.002
Feb	1.234±0.005	2.567±0.002	0.583±0.001	0.007±0.002
March	1.864±0.002	2.169±0.002	0.133±0.001	0.036±0.002
April	1.167±0.003	2.457±0.002	0.136±0.003	0.053±0.002
May	1.197±0.002	3.007±0.002	0.151±0.003	0.043±0.002

Table 7 : Mean and SD of the concentration of Iron in different tissues of the Labio rohita s collected from station 1 along the Panchganga river .

Station 1 ,Fe	Gill	Liver	Intestine	Brain
June	0.219±0.04	0.621±0.002	0.103±0.001	0.022±0.002
July	0.128±0.001	0.619±0.003	0.098±0.005	0.013±0.001
Aug	0.326±0.02	0.621±0.002	0.073±0.005	0.002±0.002
Sept	0.127±0.02	0.623±0.004	0.056±0.001	0.009±0.002
Oct	0.256±0.02	0.624±0.002	0.101±0.002	0.03±0.003
Nov	0.149±0.01	0.629±0.001	0.092±0.001	0.004±0.001
Dec	0.175±0.01	0.623±0.005	0.095±0.001	0.002±0.001
Jan	0.165±0.01	0.628±0.003	0.083±0.012	0.003±0.001
Feb	0.178±0.02	0.633±0.002	0.084±0.001	0.006±0.001
March	0.165±0.01	0.658±0.002	0.078±0.001	0.005±0.002
April	0.103±0.03	0.786±0.004	0.054±0.004	0.008±0.001
May	0.124±0.01	0.729±0.004	0.083±0.01	0.005±0.001

Table 8 : Mean and SD of the concentration of Iron in different tissues of the Labio rohita s collected from station 2 along the Panchganga river .

Station 2, Fe	Gill	Liver	Intestine	Brain
June	0.186±0.002	0.329±0.006	0.019±0.002	0.009±0.002
July	0.105±0.003	0.331±0.002	0.083±0.002	0.016±0.003
Aug	0.068±0.001	0.358±0.001	0.083±0.002	0.003±0.001
Sept	0.132±0.002	0.285±0.004	0.027±0.002	0.009±0.003
Oct	0.286±0.003	0.313±0.002	0.039±0.002	0.006±0.004
Nov	0.036±0.003	0.253±0.002	0.008±0.002	0.002±0.001
Dec	0.183±0.003	0.285±0.004	0.078±0.001	0.006±0.002
Jan	0.095±0.001	0.239±0.002	0.005±0.001	0.002±0.001
Feb	0.185±0.004	0.318±0.003	0.197±0.002	0.012±0.003
March	0.129±0.002	0.264±0.003	0.114±0.002	0.002±0.001
April	0.168±0.003	0.399±0.002	0.066±0.003	0.002±0.001
May	0.194±0.003	0.354±0.003	0.123±0.001	0.004±0.002

Table 9 : Mean and SD of the concentration of Chromium in different tissues of the Labio rohita s collected from station 1 along the Panchganga river .

Station 1 Cr	Gill	Liver	Intestine	Brain
June	0.003±0.001	0.009±0.003	0.001±0.001	ND
July	0.009±0.002	0.011±0.004	0.002±0.001	ND
Aug	0.006±0.002	0.012±0.001	0.005±0.001	0.001
Sept	0.009±0.001	0.013±0.006	0.003±0.001	0.003±0.001
Oct	0.009±0.003	0.014±0.002	0.003±0.001	0.001±0.001
Nov	0.008±0.001	0.012±0.001	0.001±0.001	0.001±0.001
Dec	0.007±0.001	0.014±0.002	0.002±0.002	0.001
Jan	0.005±0.001	0.011±0.002	0.008±0.005	0.001±0.001
Feb	0.007±0.001	0.013±0.002	0.013±0.006	0.001
March	0.006±0.002	0.015±0.001	0.002±0.001	0.001
April	0.009±0.003	0.016±0.004	0.004±0.001	0.002±0.001
May	0.007±0.002	0.017±0.002	0.002±0.001	ND

Table 10: Mean and SD of the concentration of Chromium in different tissues of the Labio rohita s collected from station 2 along the Panchganga river.

Station 2, Cr	**Gill**	**Liver**	**Intestine**	**Brain**
June	0.005±0.003	0.006±0.002	0.001±0.001	ND
July	0.003±0.001	0.005±0.003	0.001±0.001	ND
Aug	0.003±0.001	0.005±0.002	0.003±0.001	0.001
Sept	0.003±0.002	0.006±0.003	0.002±0.001	0.001
Oct	0.002±0.001	0.006±0.002	0.001±0.001	ND
Nov	0.003	0.007±0.003	0.001±0.001	ND

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Dec	0.005±0.003	0.005±0.003	0.003±0.002	0.001±0.0005
Jan	0.002	0.004±0.003	0.001±0.001	ND
Feb	0.002±0.001	0.006±0.003	0.002±0.001	ND
March	0.002±0.001	0.007	0.002±0.001	ND
April	0.008±0.001	0.009	0.004	0.001±0.0005
May	0.008±0.003	0.009±0.001	0.005±0.001	0.002

4. Conclusion:

The heavy metal residues in the tissues of Labeo rohita exhibited different patterns of accumulation and distribution among the selected tissues and localities. In fish, gills are considered to be the dominant site for contaminant uptake because of their anatomical and/or physiological properties that maximizes absorption efficiency from water [12]. However, it was evident from our study that, liver was the site of maximum accumulation for the elements. Whereas Brain was the overall site of least metal accumulation. The higher levels of trace elements in liver relative to other tissues may be attributed to the affinity or strong coordination of metallothionein protein with these elements[13]Kalubia Governorates," African Journal of Biology Science, Vol. 3, 2007, pp. 9-21.

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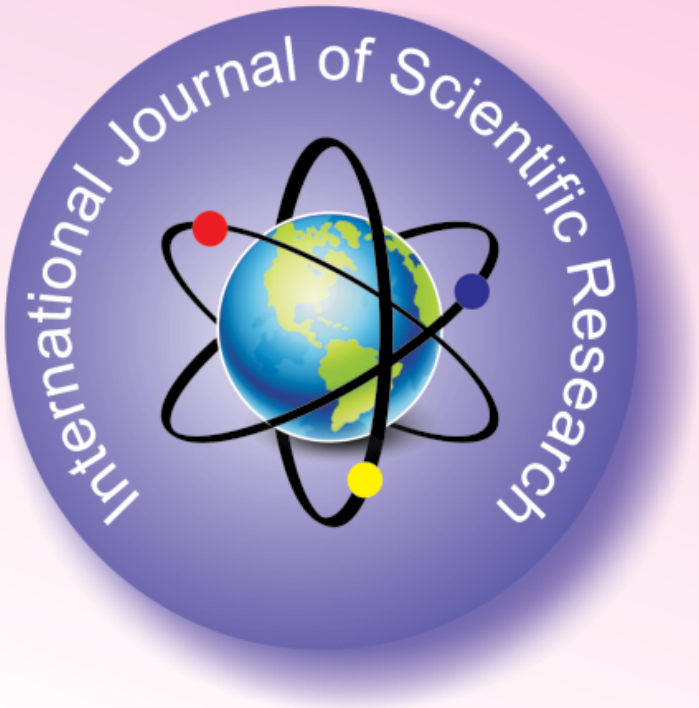

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