Bioaccumulation of Heavy Metals in Tissues of *Labeo Rohita* from Nathsagar Dam, Near Aurangabad, Maharashtra

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Abstract--- The present study was conducted to determine the bioaccumulation of heavy metals (Cadmium and Chromium) in tissues (Gills and Liver) of the fish *Labeo rohita* from Nathsagar Dam, near Aurangabad in Maharashtra. The concentration of cadmium in sample water collected from site I was maximum 0.0078 mg/l, which is more than permissible limits for drinking water. The concentration of chromium in sample water is however less and the mean was 0.062 mg/l. The accumulation of cadmium in liver was found more (2.17 mg/kg) compared to gills (1.73 mg/kg). The maximum bioaccumulation factor (BAF) of cadmium was 314.49 in the liver and maximum BAF of cadmium was 240.28 in the gills. The concentration of chromium was found more (3.28 mg/kg) in liver compared to gills (2.81 mg/kg). The BAF of chromium was found maximum 57.59 in liver and 52.04 in gills. However, the accumulation of cadmium in gills of *Labeo rohita* was less than permissible limits, but its concentration in liver was slightly above the limits. Similarly, the accumulation of chromium in gills is less and in liver it is above the permissible limits. The result indicates that the bioaccumulation of heavy metals definitely affects the aquatic life of freshwater fish *Labeo rohita* and scientific method detoxification is essential to improve the life of these fishes.

Keywords— Bioaccumulation factor, Cadmium, Chromium, Labeo rohita, Nathsagar dam.

I. Introduction

IN aquatic ecosystem, heavy metals are considered as the most important pollutants, since they are present throughout the ecosystem and are detectable in critical amounts. Heavy metals are non-biodegradable and once discharged into water bodies, they can either be adsorbed on sediment particles or accumulated in aquatic organisms. Fish may absorb dissolved elements and heavy metals from surrounding water and food, which may accumulate in various tissues in significant amounts and shows toxicological effects at critical targets [1].

Edible fish are often contaminated with heavy metals as a result of agricultural technology, industrial pollution, sewage drainage and other sources, which could affect human health and cause chronic diseases [2]. The heavy metals, being conservative in nature have the maximum probability of biomagnifications, when they are transferred to the human beings through the various members of different tropic levels in the food chain. Human beings are affected negatively as a result of their accumulation.

The bioaccumulation of heavy metals in different fish tissues has been studied by several investigators [3],[4]. Fish is often at the top of aquatic food chain and may concentrate large amounts of some metals from the water. Metal bioaccumulation is largely attributed to differences in uptake and depuration period of various metals in different fish species. Multiple factors including season, physical and chemical properties of water can play a significant role in metal accumulation in different fish tissues. The gills are directly in contact with water. Therefore, the concentration of metals in gills reflects their concentration in water where the fish lives, whereas the concentration in liver represents storage of metals in water [5].

In the Nathsagar Dam, Maharashtra, India there is ample of fish *Labeo rohita* (Rohu) and commonly used as aquatic food by the people. This study aims to find out the bioaccumulation of heavy metals (Cadmium and Chromium) in different tissues (gills and liver) of the fish *Labeo rohita* collected from three different sites of Nathsagar Dam.

II. Materials And Methods

Water samples and fish samples (*Labeo rohita*) were collected from three different sites of Nathsagar Dam, near Aurangabad in January 2013. Site I was near the wall of Dam and sites II and III were 500 meters distance away respectively from site I. Water samples were collected at 50 cm below the surface, using 1 liter polythene bottle with screw caps. The bottle had been washed and soaked in 5% nitric acid and rinsed with deionised 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 [6]. Water samples were analyzed in Atomic Absorption Spectrophotometer for detection of heavy metals.

Samples of three fish (*Labeo rohita*) of nearly equal size and weight were dissected to remove muscles, gills and liver. The separated organs were put into petri dishes to dry at 120^0C. The organs were placed into digestion flasks and ultrapure Con. Nitric acid and hydrogen peroxide (1:1 v/v) was added. The digestion flasks were then heated to 130^0C until all the materials were dissolved. Digest was diluted with

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double distilled water appropriately. The heavy metals Cadmium (Cd) and Chromium (Cr) were assayed using Atomic Absorption Spectrophotometer and the results were given as mg/kg dry weight. Data obtained from the experiments were analyzed and the results were expressed as mean of all three. Values of $P<0.05$ were considered statistically significant.

Bioaccumulation factor (BAF) is the ratio between the accumulated concentration of a given pollutant in any organ and its dissolved concentration in water. It is calculated by dividing concentration of heavy metals in fish organs by heavy metals found in water.

III. Results And Discussion

Heavy metal concentrations in the sample water collected from three different sites of Nathsagar Dam is given in Table – 1. There is fluctuation in the concentration of Cadmium (Cd) as well as Chromium (Cr). Maximum amount of Cd found is 0.0078 mg/l at site I, near the Dam. The regional mean of Cd was observed to be 0.0073 mg/l which is far above the permissible limit of [7] for drinking water. The concentration of Cr found maximum is 0.068 mg/l at site I. The regional mean of Cr dissolved in sample water was 0.062 mg/l, which is more than permissible limit (0.05 mg/l) of [7] for drinking water.

The concentration of Cd in gills and liver of fish *Labeo rohita* is given in Table-II. The accumulation of Cd is more in liver tissues than gills. The liver shows maximum (2.17 mg/kg dw) amount of Cd, where as gills show 1.73 mg/kg as the maximum concentration. The regional mean of Cd found in gills is 1.66 mg/kg where as that of liver is 2.09 mg/kg. The values of Cd found in gills is lower than permissible limits of [7], but the concentration of Cd in liver is slightly above the permissible limits.

The concentration of Cr in gills and liver of fish *Labeo rohita* is given in Table-III. The accumulation of Cr is more in liver tissues than gills. The liver shows maximum 3.28 mg/kg of Cr, where as gills show 2.81 as the maximum concentration. The regional mean of Cr found in gills is 2.74 where as that found in liver is 3.21. The values of Cr observed in gills and liver exceeds the permissible limits of [7]. Similar results are observed by [8] in the organs of fish *Cyprinus carpio* from Tamilnadu and by [9] working on River Yamuna in Delhi.

It was found that the concentration of Cd and Cr in both the tissues of fish were several times higher than their concentrations in water. The bioaccumulation factors (BAF) are given in Table-II and Table-III. Cadmium shows highest BAF (314.49) in the liver and lowest (214.10) in gills. Comparatively, bioaccumulation of Chromium is lower than Cadmium. However, the lowest values of BAF were recorded in gills. Bioaccumulation factor gives an indication about the accumulation efficiency for any particular pollutant in any fish organs. Similar results were observed by [10] in the fish *Tilapia nilotica*. The results suggested the loss of homeostatic capacity of fish under chronic metal exposure leading to bioaccumulation.

TABLE I
HEAVY METAL CONCENTRATION (MG/L) IN THE WATER OF NATHSAGAR DAM

Sites	Cd	Cr
I	0.0082	0.065
II	0.0074	0.059
III	0.0076	0.068
Regional mean	0.0077	0.064
WHO limit for Drinking water	0.005	0.05

TABLE II
CONCENTRATION OF CADMIUM (MG/KG DRY WEIGHT) AND THE BIOACCUMULATION FACTOR (BAF) IN DIFFERENT TISSUES OF LABEO ROHITA FROM NATHSAGAR DAM

Sites	Gills	Liver
I	1.43 (174.39)	1.86 (226.83)
II	1.37 (185.14)	1.97 (266.21)
III	1.29 (169.73)	1.94 (255.26)
Regional mean	1.36	1.92
WHO limit for fish tissues	2.0	2.0

Values in brackets are bioaccumulation factors (BAF)

TABLE III
CONCENTRATION OF CHROMIUM (MG/KG DRY WEIGHT) AND THE BIOACCUMULATION FACTOR (BAF) IN DIFFERENT TISSUES OF LABEO ROHITA FROM NATHSAGAR DAM

Sites	Gills	Liver
I	2.93 (45.07)	3.23 (49.69)
II	2.87 (48.64)	3.17 (53.73)
III	2.74 (40.29)	3.09 (45.44)
Regional mean	2.84	3.16
WHO limit for fish tissues	2.8	2.8

Values in brackets are bioaccumulation factors (BAF)

IV. Conclusions

The results showed that the accumulation levels in fish tissues exceeded the levels of the metals in water and indicated bioaccumulation in the fish *Labeo rohita* of the river Godavari, at Nathsagar Dam. Fish liver exhibited highest tendency to accumulate both cadmium and chromium. The bioaccumulation of chromium in gills and liver is beyond the standard limits. The result indicates that the heavy metal contamination definitely affects the aquatic life of the fresh water fish. Hence, a scientific method detoxification and close monitoring of metal pollution of the river is essential to improve the life of these economically important fishes in any stressed environmental conditions.

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REFERENCES

[1] Calta,M. and O.Canpolat, "The comparison of three cyprinid species in terms of heavy metal accumulation in some tissues". *Water Environmental Research*, 2006, 78 : 548 – 551.
http://dx.doi.org/10.2175/106143006X99849

[2] Zyadah, M.A. and Abdel-Baky, T.E., "Toxicity and bioaccumulation of copper, zinc and cadmium in some aquatic organisms". Bull. Environ. Contamin. Toxicol.2000, 64 (5) : 740 – 747
http://dx.doi.org/10.1007/s001280000066

[3] Fatma A.S. Mohamed, "Bioaccumulation of selected metals and histopathological alterations in tissues of *Oreochromis niloticus* and *Lates niloticus* from lake Nasser, Egypt". *Global Veterinaria*, 2008, 2 (4) : 205 – 218.

[4] Javed M. and Usmani N., "Accumulation of heavy metals in fishes : A human health concern". *International Journal of Environmental Sciences*, 2011, 2 (2) : 659 – 668.

[5] A.Rauf, M.Javed and M.Ubaidullah, "Heavy metal levels in three major carps (*Catla catla, Labeo rohita* and *Cirrhina mrigala*) from the river Ravi, Pakistan". *Pakistan Vet. J*., 2009, 29(1): 24-26.

[6] APHA – AWWA, "Standard methods for examination of water and waste water". 21st Edition, Washington DC., USA, 2004.

[7] WHO, List of maximum levels recommended for contaminants by the Joint FAO/WHO Codex Alimentarius Commission, 2004.

[8] Vinodhini, R. and Narayanan, M., "Bioaccumulation of heavy metals in organs of fresh water fish *Cyprinus carpio* (Common carp)". *Int. J. Environ. Sci. Tech*., 2008, 5(2) : 179-182.
http://dx.doi.org/10.1007/BF03326011

[9] V.S.Shrivastava, Ajay Shandil and Indrajit Sen, "Study of determination of heavy metals in fish species of the River Yamuna (Delhi) by Inductively Coupled Plasma Optical Emission Spectroscopy". *Adv. Appl. Sci. Res*., 2011, 2 (2) : 161 – 166.

[10] Rashed, M.N., "Cadmium and lead levels in fish (*Tilapia nilotica*) tissues as biological indicator for lake water pollution". *Environmental Monitoring and Assessment*, 2001, 68 : 75-89.
http://dx.doi.org/10.1023/A:1010739023662

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