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BIOACCUMULATION OF HEAVY METALS IN ORGANS OF FRESH WATER FISH *CLARIAS BATRACHUS* (MANGUR)

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ABSTRACT

The present study is to determine the bioaccumulation of heavy metals in various organs of the fresh water fish *Clarias batrachus* exposed to heavy metal contaminated water system. The experimental fish were exposed to Cr, Ni, Cd and Pb concentrations for periods of 48 days.the heavy metals Cd, Pb, Ni & Cr were assayed using atomic absorption spectrophotometery and the result were given as μg/g dry Wt. The accumulation of heavy metals gradually increases in liver during the heavy metals exposure period. The heavy metal accumulation in the gills was in the order of Pb>Cd>Ni>Cr, the heavy metal accumulation in the liver was in the order of Pb>Cd>Ni>Cr. The bioaccumulation in kidney and flesh tissues was in the order of Pb>Cd>Cr>Ni and Cr>Pb>Cd>Ni.

Keywords: *Clarias batrachus*, toxicity, pollutants, gills, liver, kidney, flesh

INTRODUCTION

Amongst the pollutants contaminating water bodies, metals play an important role (Witeska et al., 1995). Metals are elements found naturally in aquatic ecosystems due to various processes such as weathering and erosion (Viljoen,1999).Some of these metals are essential to living organisms in trace amongst (for example copper & zinc). Essential trace elements have a narrow optimal concentration range for growth & reproduction and both excess and shortage can be detrimental to organisms (Pelgrom et al., 1994), with unusually high concentrations becoming toxic to aquatic organisms (Wepener, et al., 2001). Other metals (for example cadmium and lead) have no known biological function (Seymore, 1994). Certain of these non- essential trace metals, for example cadmium, are major contaminants of aquatic environments (Munger et al., 1999) that are toxic towards aquatic organisms (Witeska et al., 1995) even at concentration found in natural waters (Pelgrom et al., 1994). The most important heavy metals in water pollution are zinc, copper, lead, cadmium, mercury, nickel and chromium (Abel, 1989; Seymore, 1994; Viljoen, 1999). Metal uptake by aquatic organisms is a two-phased process, firstly involving rapid adsorption or surface binding, followed by slower transport into the cell interior. The studies carried out on various fishes in different regions have shown that heavy metals may alter the physiological activities and biochemical parameters both in tissue and in blood (Basa and Rani, 2003; Canli, 1995; Tort and Torres, 1988). In the present study, *Clarias batrachus* (Mangur) was selected due to highly consumed fish in Gangetic plains. The purpose of study is to quantify the accumulation of heavy metals in various organs in *Clarias batrachus* (Mangur).

MATERIALS AND METHODS

The fresh water fish *Clarias batrachus* (Mangur) were collected from the ponds of Western U.P. belt, India, having a length of 15-20

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Research Experience : Almost 14 Years of Research Experience. **Conferences/Workshop : Attended -16**
Research Guidance : AWARDED: 2.
Membership of Scientific and : Research Bodies
1. Member Research Board of advisors of 'American Biographical **Research Publications :** 10 research papers published in various Journals (List Enclosed in Appendix-1) **Honours & Awards :** Won 2nd **Young Scientist Award** in National Convention on Recent Advances on Environmental Management for Vector Borne Diseases Control in Feb. 10-12, 1994 held at Dehradun. **Current Responsibility :** Working as **Reader** at Department of Zoology, Meerut College , Meerut.

cm. and weight 55-60 gm. The specimens collected were acclimated to laboratory conditions for a week. Thirty to thirty five individuals were used for the experimental work and 12 hour (h) photo period was maintained throughout the experimental work. During acclimation they were fed with minced goat liver every day (d), for 3 h. Water of aquaria was renewed 24 h, leaving no faecal matter and debris. Analytical graded cadmium chloride, lead nitrate, potassium chromate and nickel sulphate was used as metal toxicants in the experiments. The fish were divided equally into five groups, the first group served as controlled and rests were served as experimental groups. The experimental groups of fish were administered with a sub lethal concentration of 5 ppm of combined metal solution (1/10th of LC_{50}/48 h) daily for 1, 8, 16, 32 and 48 days. Fish from experimental groups and the controlled were dissected to separate the organs (liver, gill, kidney, and flesh) according to the FAO methods (Dybem, 1983) for the analysis of heavy metals. The separated organs were put in petri dishes to dry at 120 ^{0}C until reaching a constant wt., after it the organs were placed in digestion flasks and ultrapure con. nitric acid and hydrogen peroxide (1:1 v/v) were added. To dissolve the material, the digestion flasks were heated to 130 ^{0}C until the material dissolved and then it was diluted with double distilled water. The heavy metals Cd, Pb, Ni and Cr were analyzed using Shimadzu AA 6200 atomic absorption spectrophotometer. Palladium-magnesium nitrate matrix modifier was employed for cadmium and lead analysis. The

Table 1: Heavy metal analysis in different organs of control fish Clarias batrachus (Mangur) (µg/g. dw)

Heavy metals	Gills	Liver	Kidney	Flesh
Cr	0.876±0.026	1.012±0.015	1.324±0.021	1.622±0.021
Ni	1.756±0.021	1.349±0.021	0.967±0.010	0.672±0.015
Cd	1.832±0.028	1.672±0.015	1.332±0.015	0.512±0.025
Pb	1.872±0.020	2.492±0.017	1.982±0.020	1.765±0.034

Table 2: Heavy metal analysis in gills of fish Clarias batrachus (Mangur) after exposure to the combination of heavy metal solution (µg/g. dw)

Heavy metals	Exposure days				
	1	8	16	32	48
Cr	2.342±0.015	2.423±0.017	2.576±0.021	2.697±0.010	2.803±0.017
Ni	3.252±0.021	3.467±0.020	3.595±0.017	3.926±0.017	4.114±0.021
Cd	6.342±0.017	6.437±0.021	6.671±0.010	6.732±0.026	6.913±0.021
Pb	6.953±0.015	7.132±0.020	7.351±0.021	7.469±0.021	7.621±0.017

Table 3: Heavy metal analysis in liver of fish Clarias batrachus (Mangur) after exposure to the combination of heavy metal solution (µg/g. dw)

Heavy metals	Exposure days				
	1	8	16	32	48
Cr	2.532±0.021	3.683±0.020	3.967±0.021	4.263±0.015	5.672±0.015
Ni	3.579±0.021	3.861±0.021	4.142±0.026	4.486±0.017	4.982±0.021
Cd	4.674±0.017	4.712±0.026	4.928±0.015	5.216±0.021	5.474±0.021
Pb	7.754±0.015	7.812±0.015	8.128±0.021	8.247±0.015	8.417±0.017

Table 4: Heavy metal analysis in kidney of fish Clarias batrachus (Mangur) after exposure to the combination of heavy metal solution (µg/g. dw)

Heavy metals	Exposure days				
	1	8	16	32	48
Cr	3.131 ±0.015	3.213±0.017	3.258±0.021	3.469±0.010	3.657±0.017
Ni	1.832±0.020	1.957±0.020	2.065±0.017	2.213±0.017	2.416±0.021
Cd	4.241±0.015	4.312±0.021	4.512±0.017	5.016±0.026	5.325±0.015
Pb	6.769±0.015	6.821±0.015	6.911±0.021	7.018±0.017	7.231±0.017

Table 5: Heavy metal analysis in flesh of fish Clarias batrachus (Mangur) after exposure to the combination of heavy metal solution (µg/g. dw)

Heavy metals	Exposure days				
	1	8	16	32	48
Cr	3.162±0.020	3.645±0.015	3.656±0.020	3.824±0.010	3.981±0.017
Ni	0.231±0.015	1.326±0.017	1.557±0.017	1.776±0.021	1.928±0.021
Cd	1.153±0.021	1.342±0.020	1.549±0.017	1.668±0.021	1.842±0.017
Pb	2.274±0.017	2.853±0.020	3.162±0.021	3.359±0.010	3.423±0.015

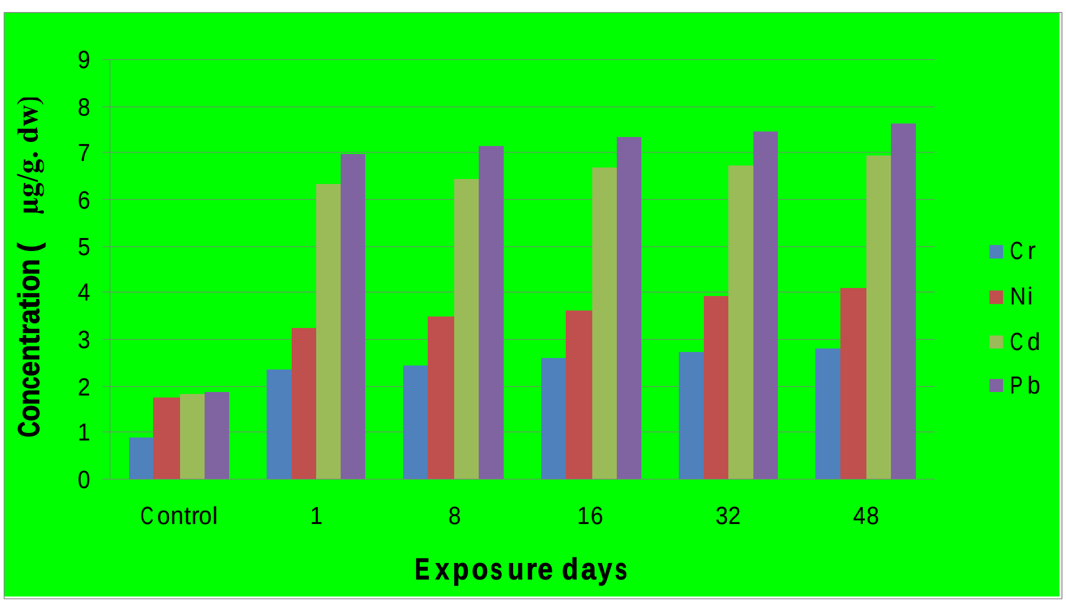

Fig. 1: Accumulation of heavy metals in gills

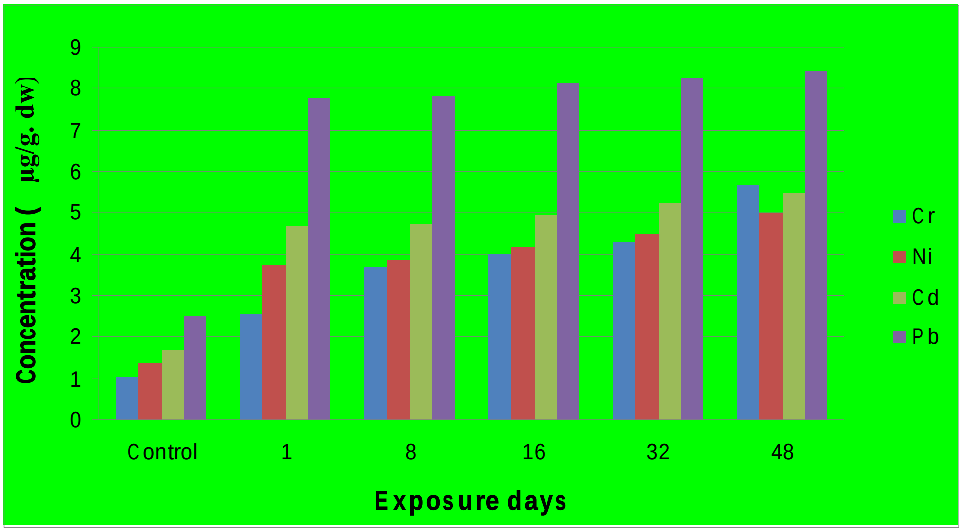

Fig. 2: Accumulation of heavy metals in liver

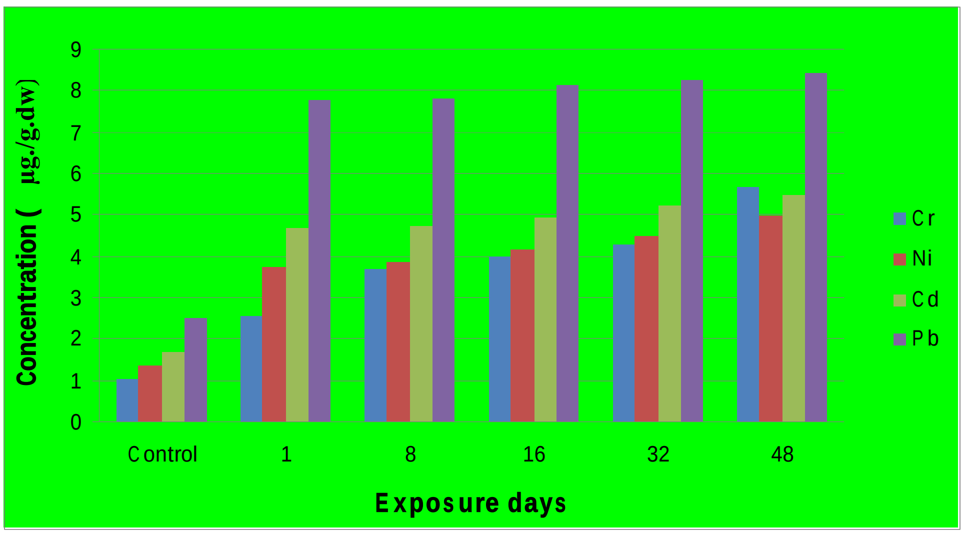

Fig. 3: Accumulation of heavy metals in kidney

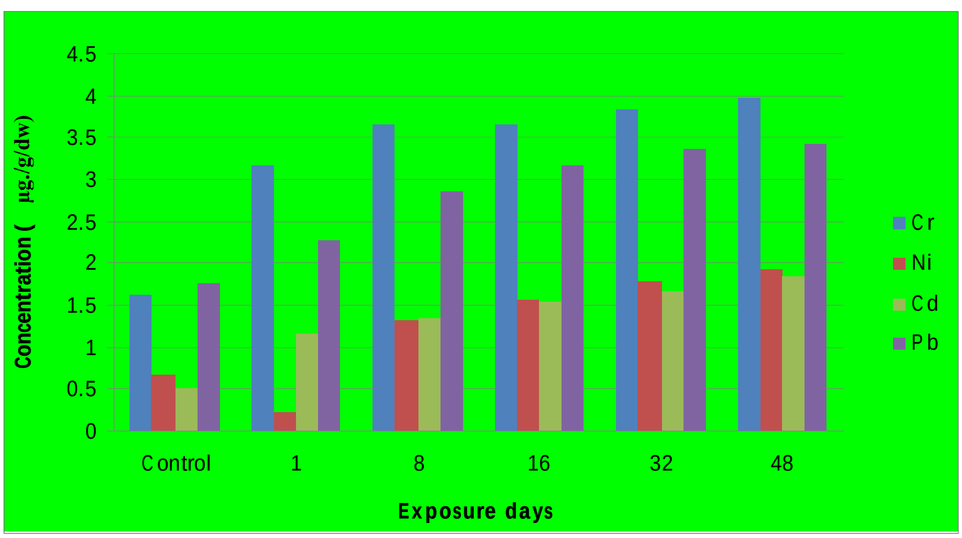

Fig. 4: Accumulation of heavy metals in flesh

experimental data was analyzed and results were expressed as mean± S.D. The results were evaluated using Student' s t-test. The values of $p<0.001$ were considered statistically significant.

RESULTS AND DISCUSSION

The heavy metals such as chromium (Cr), nickel (Ni), cadmium (Cd), and lead (Pb) were analyzed in different organs of control fish. The accumulation of heavy metals in fish species were analyzed at the end of experimental period and compared with experimental fish, which were exposed to selected heavy metals (Table 1). The gill is an important site for the entry of heavy metals in the fish body, the range of Cr was 2.342±0.015 - 5.672±0.015, the range of Ni was 0.231±0.015 - 4.982±0.021, the range of Cd was 1.153±0.021 - 6.913±0.021 and the range of Pb was 2.274±0.017 - 8.417±0.017 µg/g.dw, during initial to 48 days of exposure. The results indicate that the accumulation of Cr, Ni, Pb and Cd gradually increases during the exposure period in gills, liver , kidney and tissue, in gills the range of Cr was 2.342±0.015 - 2.803±0.017, Ni was 3.252±0.021 - 4.114±0.021, Cd was 6.342±0.017 - 6.913±0.021 and Pb was 6.953±0.015 - 7.621±0.017 µg/g.dw (Fig. 1), in liver the range of Cr was 2.532±0.021 - 5.672±0.015, Ni was 3.579±0.021 - 4.982±0.021, Cd was 4.674±0.017 - 5.474±0.021 and Pb was 7.754±0.015 - 8.417±0.017 µg/g.dw (Fig. 2), in kidney the range of Cr was 3.131 ±0.015 - 3.657±0.017, Ni was 1.832±0.020 - 2.416±0.021, Cd was 4.241±0.015 - 5.325±0.015 and Pb was 6.769±0.015 - 7.231±0.017 µg/g.dw (Fig. 3), in flesh the range of Cr was 3.162±0.020 - 3.981±0.017, Ni was 0.231±0.015 - 1.928±0.021, Cd was 1.153±0.021 - 1.842±0.017 and Pb was 2.274±0.017 - 3.423±0.015 µg/g.dw (Fig. 4). The results are clearly showing that the heavy metal accumulation gradually increases during the exposure period. Accumulation of heavy metals in liver may cause severe liver damage (Fergusun, 1989; Mayers and Hendricks, 1984). The results also indicate that lead and cadmium strongly accumulate rather than chromium and nickel in kidney, the heavy metals were uniformly distributed over the body muscles. The study clearly shows that the order of heavy metal accumulation in gills was Pb>Cd>Ni>Cr, order in liver was Pb>Cd>Ni>Cr, order in kidney was Pb>Cd>Cr>Ni and the order in flesh was Cr>Pb>Cd>Ni. Heavy metal contamination definitely affects the aquatic life, hence some scientific methods are essential to improve the quality of life.

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