ISSN: 0975-8585

Research Journal of Pharmaceutical, Biological and Chemical Sciences

Bioaccumulation of hexavalent chromium in the organs of fresh water teleost, C*yprinus carpio* (common carp).

K Parvathi[1], P Sivakumar[2], C Sarasu[3]

[1] Department of Advanced Zoology and Biotechnology, Erode Arts and Science College, Erode-9, Tamil Nadu.
[2] J K K Nataraja College of Pharmacy, Komarapalayam. Tamil Nadu.
[3] J K K Nataraja College of Arts and Science, Komarapalayam. Tamil Nadu.

ABSTRACT

The aim of the present study was to quantify the bioaccumulation of hexavalent chromium in various organs of the freshwater fish, *Cyprinus carpio* exposed to sub lethal concentrations ($1/_{10}$ of LC_{50} 96 h) for 32 days. After the stipulated time (8, 16, 24 and 32 days), various organs (gill, liver and kidney) were assayed for hexavalent chromium using Shimadzu AA 6200 atomic absorption spectrophotometer. The maximum accumulation was found in liver and the minimum accumulation was found in Kidney of the exposed fish.

Keywords: *Cyprinus carpio*, hexavalent chromium, exposure period, accumulation.

Corresponding author
E-Mail: parsi95@yahoo.com

ISSN: 0975-8585

INTRODUCTION

The contamination of fresh water ecosystem with a wide range of pollutants has become a serious matter of concern over few decades [1-4]. Heavy metals constitute a core group of aquatic pollutants and additional concentrations of these metals accumulate in the aquatic ecosystems as a result of land based activities [5]. Metals are non-biodegradable and are considered as major environmental pollutants causing cytotoxicity, mutagenic and carcinogenic effects in animals [6]. Fish are often at the top of aquatic food chain and may concentrate large amounts of some metals from the water [7]. Among the heavy metals, hexavalent Chromium is being important pollutants from the industrial effluents and agricultural wastes in aquatic environment, cause effect on non-target aquatic organisms resulting imbalance in ecosystem [8]. Chromium VI compounds found to be mutagenic and carcinogenic. Information on the acute toxic effects of hexavalent chromium on accumulation is limited in Indian context. Knowledge of acute toxicity of xenobiotics often can be very helpful in predicting and preventing acute damage to aquatic life in receiving waters as well as in regulating toxic waste discharges [9]. In the present study, *Cyprinus carpio* was selected due to its adaptation in polluted aquatic environment. The aim of the present research is to quantify the accumulation of hexavalent chromium in various organs (gill, liver and kidney) of *Cyprinus carpio*.

MATERIALS AND METHODS

The Common carp, *Cyprinus carpio* (22gm) were procured from Tamilnadu Fisheries Development Corporation Ltd., (Fish Farm, Mettur, Tamil Nadu) and were acclimated to laboratory conditions (24.20^{0C}) for one month. Fish were fed *ad-libitum* with commercial feed once a day. A major portion of the water was changed daily.

For sub lethal toxicity studies, 2 Tubs of 125 L capacity were disinfected with potassium permanganate, sun dried and filled with clean water. The tubs were labeled with 'C' and 'T' represented control and treatment respectively. Sublethal concentration of hexavalent chromium (potassium dichromate) ($1/_{10}$ of $LC_{50\ 96}$ h) was taken according to [10]. After filling the tub 'T' with 100 L of water sub lethal concentration of toxicant ($1/_{10}$ of LC_{50} 96 h) was added and mixed well. Then 100 fish were randomly selected from the stock and introduced into tub-'T'. Five similar replicates were maintained. Separate control of 100 fish was maintained in tub 'C' for 32 days exposure time. During sub lethal studies, fishes were fed *ad-libitum.* The exposure medium was changed to maintain the desired concentration of chromium salt and in order to reduce any accumulation of excretory waste and unused feed. After the stipulated time (8, 16, 24 and 32 days), 20 fish were randomly selected from control and experiment and sacrificed without being anesthetized for analysis. After drawing blood, fish were washed with double distilled water and blotted dry with absorbent paper. Then the fish was cut open and gill, liver and kidney were removed according to the method of [11] and stored in respective plastic vials for accumulation studies. The separated organs were put in Petri dishes to dry at 120^{0C} until reaching a constant weight. The separated organs were placed

ISSN: 0975-8585

into digestion flasks and ultrapure concentrated Nitric acid and Hydrogen peroxide (1:1v/v-SD-fine chemicals) was added. The digestion flasks were then heated to 130.C until all the materials were dissolved. Digest was diluted with double distilled water appropriately. The hexavalent chromium was assayed using Shimadzu AA 6200 atomic absorption spectrophotometer and the results were given as mg/g.dw. The standard error for the sample mean was calculated and given in appropriate tables. Using student's-t test the significance of sample mean between control and experiment fish was tested.

RESULTS

Variations occurred in the pattern of accumulation in different tissues (liver, gill and kidney) of *Cyprinus carpio* exposed to sublethal concentration of hexavalent chromium. Maximum accumulation was found in liver of exposed fish in all exposure periods (8, 16, 24 and 32 days) showed the percent increase of 254.09%, 260.10%, 266.93% and 271.61%. Minimum accumulation was observed in the kidney of treated fish to the percent of 214.29%, 224.08%, 227.61% and 234.33%.The accumulation in gill was found to be 231.29%, 233.78%, 253.38 and 260 .32% throughout all the exposure periods (Table-1).

Table-1.Accumulation of chromium in gill, liver and kidney of *Cyprinus carpio* exposed to varying periods of sublethal concentrations.

Parameter	Treatment	Exposure period (days)			
		8	16	24	32
Gill(mg/dry wt)	C	0.147 ± 0.026	0.148±0.026	0.148±0.026	0.1482±0.012
	T	0.487± 0.087* (+231.29)	0.494± 0.088* (+233.78)	0.523± 0.094* (+253.38)	0.534 ±0.043* (+260.32)
Liver(mg/dry wt)	C	0.154± 0.027	0.154± 0.028	0.1548± 0.028	0.155± 0.028
	T	0.546± 0.097* (+254.09)	0.556± 0.099* (+260.10)	0.568± 0.10 * (+266.93)	0.576± 0.103* (+271.61)
Kidney(mg/dry wt)	C	0.133±0.023	0.1333±0.024	0.134±0.024	0.134 ± 0.024
	T	0.418± 0.075* (+214.29)	0.432 ±0.077* (+224.08)	0.439 ±0.078* (+227.61)	0.448 ±0.08* (+234.33)

Values are Mean standard error of five individual observations.
* Significant difference (P<0.05).

DISCUSSION

Liver accumulates relatively higher amount of hexavalent chromium when the common carp exposed to sublethal concentrations of hexavalent chromium toxicity. The accumulation

was found to be higher in liver of treated fish over that of the control throughout all the exposure periods. The increased level of accumulation was directly proportional to the exposure periods of toxicant. The present investigation was supported by the findings of [12-14]. Higher accumulation in liver may alter the levels of various biochemical parameters in the liver. This may also cause severe liver damage [15, 16]. Since the liver is a major producer of metal binding proteins, such as metallothionein can be closely related to heavy metal exposure and this metal taken up from the environment is possibly detoxified by their binding on to proteins; this results in the higher concentration of metal in the liver.

The gill is an important site for the entry of heavy metals that provokes lesions and gill damage [17,18].In the present study, at the end of 8^{th} day,16^{th}, 24^{th} and 32 days, the accumulation was found to be increased in gill to the percent of 231.29%, 233.78%,253.38% and 260.32% respectively. The present results were supported with the findings of [19] in *Mystus vittatus* and [20] in *Cyprinus carpio* exposed to copper. This reduced uptake may be due to inhibition of accumulation caused by the gill damage.

In the present study, the minimum accumulation was observed in the kidney of exposed fish. Similar results were observed by [21]. Kidney is the main gateway for heavy metal detoxification in the body. In kidney tissue, considerable amounts of heavy metal were accumulated. The kidney is also the main organ where heavy metals are deposited in fishes [22], amphibians [23] and mammals [24].Their accumulation in the kidney explains their nephrotoxic effects [25].

In conclusion, the accumulation of hexavalent chromium in any parts of the body will definitely induces morphological changes, biochemical metabolisms, histological alterations and other induced stresses in fish.

ACKNOWLEDGEMENT

The author K.Parvathi is thankful to Dr.M.Ramesh Unit of Toxicology, Bharathiar University, Coimbatore, Tamil nadu, India, for the help rendered in all research aspects.

REFERENCES

[1] Canli M, Ay O, Kalay M. Turk J Zool 1998; 22(3): 149-157.
[2] Voegborlo RB, Methnani AME, Abedin MZ. Food Chem 1999; 67(4): 341-345.
[3] Dirilgen N. Turk J Chem 2001; 25(3): 173-179.
[4] Vutukuru SS. IntJ Environ Res Public Health 2005; 2(3): 456-462.
[5] Vutukuru SS. Bull Environ Contam Toxico, 2003; 70: 118-123.
[6] More TG, Rajput RA Bandela NN. Enviro Sci Pollut Res 2003; 22: 605-616.
[7] Mansour SA, Sidky MM. Ecotoxicological studies. Food Chem 2002; 78: 15-22.
[8] Arunkumar Singh, Rana KS, Sunitha solanki. Indian J Environ and Ecoplan 2004; 8(1): 217-219.

[9] APHA, AWWA; WPCP, Standard methods for the examination of water and wastewater. 20TH ed. American public Health Association. 1998.
[10] Sprangue JB. Water Res 1971; 5: 245-266.
[11] Dybeam B. Fisher Tech 1983; 212: 1-13.
[12] Heath AG. Water pollution and fish physiology 1987; 359.
[13] Seymore T, Du Preez HH, Van Vuren JHJ, Deacon A, Strydom G, South Africa Koedoe 1994; 37(2): 1-18.
[14] Vinodhini R, Narayanan M. Int J Environ Tech 2008; 5 (2): 179-182.
[15] Mayers TR, Hendrick J. Histopathology. In GMR and, S R Petrocelli Eds. Fundamentals of aquatic toxicology. 1984; 14.
[16] Ferguson HW, Systematic pathology of fish. 1989.
[17] Lock RA, Van Overbeeke AP. Comp Biochem Phys 1981; 69(1):67-73.
[18] Bols NC, Brubacher J, Ganassin RC, Lee LEJ. Dev Comp Immunol 2001; 25(8): 853-873.
[19] Subathra S, Karuppasamy R. Arch Environ contam Toxicol 2008; 54: 236-244.
[20] Peyghan R, Razijalaly M, Baiat M, Rasekh. Aquaculture international 2003; 11: 597-604.
[21] Jyotsna singh, Kant K, Sharma HB, Rana KS. Asian J Exp Sci 2008; 22(3): 411-414.
[22] Hogstrand C, Haux C, Mini-review. Comp Biochem Physiol 1991; 100 : 137-141.
[23] Suzuki KT, Kawamura R. Comp Biochem. Physiol 1984; 79C: 255-260.
[24] Torra M, To-Figueras J, Brunet M, Rodamilans M, Corbella J. Bull Environ Contam Toxicol 1994; 53: 509-515.
[25] Savolainen H, Cadmium associated renal disease. Ran Fail 1995; 17: 483-487.