PHS Scientific House
PHARMAHEALTHSCIENCES

International Journal of Pharma Research and Health Sciences

Available online at www.pharmahealthsciences.net

Original Article

Effect of Cadmium Chloride on Biochemical Profile and Enzyme Activity in *Tilapia Mossibica*

Praveen Goswami *, Utkarsh Kaushik, Shilpi Damor, Preeti Sharma, Neha Sharma
Department of Zoology, Poddar International College , Jaipur, Rajasthan, India

ARTICLE INFO

Received: 04 Nov 2016
Accepted: 18 Dec 2016

ABSTRACT

Toxicity of aquatic ecosystems due to accumulation of heavy metals has received considerable attention. Cadmium is utilized in number of applications like chemical fertilizers & pesticides and considered as environmental pollutants. The present study was designed to evaluate the effect of cadmium on Tilapia mossibica. Alteration in fish protein, glycogen and glucose was measured in tissues exposed to sub-lethal concentration of cadmium chloride for 15 days. LC50 was measured and found to be 36.848 mg/l. protein concentration tend to decrease in different tissues of fish in liver, heart and muscles. Glycogen concentration also showed marked decrease in liver, heart and muscles. Thus it can be concluded that cadmium badly influences blood parameters in living organism and lead to hematological disorders and cause oxidative stress

Keywords: Cadmium, *Tilapia mossibica,* LC50, Protein, Glycogen, Glucose

Corresponding author *
Dr. Praveen Goswami
Department of Zoology, Poddar International College , Jaipur, Rajasthan, India
Email: drpraveen.goswami@gmail.com

1. INTRODUCTION

Environmental pollution and its hazard on aquatic biota associated with is major point of concern during the last few decades. Contamination of freshwater from different source has become a matter of major concern around the globe[1, 2, 3]. Industrial effluents, domestic sewage, pesticides, fertilizers, etc are some of the sources which pollute the river [4, 5]. Heavy metals in industrial effluents contain a large array of toxic substances higher concentration of which can cause harmful effects on the aquatic organisms. It leads to alterations in the physical, chemical and biological properties of water bodies as well as that of the environment [6, 7, 8]. Metals are used for variety of purpose [9, 3] but toxicity is major concern because they impose serious health impact and survival of fishes[3]. One such metal is cadmium which is environmental pollutants and is toxic for living organisms. It is finds its applications in plastic industries, manufacturing of batteries, pigments, etc.[10]. Reports showed the toxicity of cadmium on kidney, liver, gill, heart, blood parameters and cause oxidative stress[11, 12]. Further evidences have suggested that in *Labeo rohita* and *Catla catla* Cd accumulated in non-edible fishes is lesser in comparison to that of edible fishes [13]. Therefore, present study was undertaken to determine evaluate $LD_{50}$the effect of cadmium chloride on biochemical profile and enzyme activity in *Tilapia mossibica.*

2. MATERIALS AND METHODS

Adult and live *Tilapia mossibica* were collected from the local market and brought to laboratory. Only healthy fishes were taken for experiment. Fishes were acclimatized in glass aquaria for 15 days and were fed with fish food and water in the aquaria was replaced by freshwater at every 24 hrs. Stock solution of Cadmium Chloride was prepared by dissolving appropriate amount of $CdCl_2$ in distilled water.

Sub-lethal studies

Fishes were exposed to 2 sub lethal concentrations of Cadmium for a chronic period of 15 days to determine the protein and glycogen level in liver, heart and muscles. The sub lethal concentrations of Cd i.e., 15^{th} of 96 hrs and $1/10^{th}$ of 96 hrs were determined on the basis of the LC_{50} value of 96 hrs exposure of the test fish, to the heavy metal Cd as $CdCl_2$.

For selection of test concentration, some pilot tests were carried out. The range of concentrations was selected between 0 to 100% mortality. In order to maintain the concentration of cadmium, water in the aquarium was changed every 24 hrs during the exposure. The mortality rate of *Tilapia mosambica* was recorded at 96 hrs exposure to heavy metal, $CdCl_2$.

The LC_{50} value for 96 hrs was determined by static renewal bioassay following probit analysis [14]. For studying the protein and glycogen levels in the liver, heart and muscles, fishes were divided in two groups as control and experimental. After exposure to 15days, both control and experimental fishes were sacrificed and liver, heart and muscle were processed for protein estimation[15]. Glycogen estimation was done by Anthrone reagent method of Van der Vier, (1954) [16] as modified by Mahendru and Agrawal (1982) [17].

3. RESULTS AND DISSCUSION

Test fish, *Tilapia mossambica* were exposed to 2 sub lethal concentrations of heavy metal Cadmium (Cd) as ($CdCl_2$). On the basis of the LC_{50} value of 96 hrs (360 ppm), the value of 2 sublethal concentrations i.e., $1/5^{th}$ of 96 hrs and $1/10^{th}$ of 96 hrs were recorded to be 72 ppm ($1/5^{th}$ of 96 hrs) and 36 ppm ($1/10^{th}$ of 96 hrs). The fishes were exposed to these 2 sublethal concentrations i.e., 72 ppm ($1/5^{th}$ of 96 hrs) and 36 ppm ($1/10^{th}$ of 96 hrs) for a period of 15 days and protein and glycogen level was recorded in different tissues.

LC50 value of cadmium chloride for the fish *Tilapia mosambica* was determined by Probit-regression analysis (Table 1) using SPSS 15 and LC50 was found to be 35.847mg/l.

Table1: Probit-regression analysis of *Tilapia mossambica* against cadmium chloride at 96 hours post exposure.

Concentration in mg/l	Total no. of fish	Observed responses	Expected responses	LC50 mg/l
10	10	1	0.779	36.848
20	10	2	1.920	
30	10	4	3.740	
40	10	4	5.902	
50	10	9	7.814	

From the data presented, it is clear that at the end of 1/10th and 1/2 exposure to sub-lethal concentration for 96 hours, Protein content decreased in order of liver>heart >muscle. This decrease in protein level may be due to metabolic utilization of keto acids to gluconeogenesis pathway (for synthesis of glucose) or for maintenance of ionic and osmo-regulation[18]. Similar observations were observed by Jana and Padhay (1987)[19] in the muscles of *C. punctatus* after the treatment with heavy metals[19]. Ravichandran (1994)[20] observed decreased the protein in muscle *Oreochromis mossambicus*. The level of protein from control and experimental tissues are presented in Table2. A significant reduction in protein levels in all tissues were observed and compared to control group. The level of glycogen from control and experimental tissues are presented in table 3. A significant reduction in glycogen levels in all tissues were observed as compared to the control fishes. In the liver of control fish, the glycogen content was 9.18 mg/100 mg of wet weight of tissue, which was reduced to 7.7 mg at 1/10 of 96 hrs (36 ppm) of cadmium and this value reduced further to 6.72 mg /100 mg of wet weight of the tissue at $1/5^{th}$ of 96 hrs of cadmium (72 ppm).

Liver is the chief organ of carbohydrate metabolism and level of glycogen was found to be highest in liver. Muscle glycogen acts as a source of glucose for glycolysis while liver glycogen acts as a source of glucose to maintain the glucose level in blood. As the level of glycogen decreases in fish, when exposed to toxicant, it may be due to its rapid utilization to meet energy needs. The results of our studies are supported by the other workers [21].

Table2: Average changes in the protein level (mg/g) in certain tissues of freshwater fish, *Tilapia mossambica* after chronic (15 days) exposure to 2 sublethal concentrations - $1/10^{th}$ of 96 hrs (36 ppm) and $1/5^{th}$ of 96 hrs (72 ppm) of heavy metal Cadmium (Cd) as $CdCl_2$

Organs	Control	Cadmium (Cd) as $CdCl_2$	
		$1/10^{th}$ of 96 hrs	$1/5^{th}$ of 96 hrs

Liver	30.0±0.49	23.30±0.60***	19.10±0.67***
Heart	14.00±1.0	11.50±0.66**	9.2±1.13***
Muscle	36.50±0.67	36.0±0.28@	34.50±0.67**

@: Non-significant; *: Significant at P< 0.05; **: Highly significant at P<0.01; *: Very highly significant at P<0.001.**

Table 3: Average changes in the Glycogen level (mg/g) in certain tissues of freshwater fish, *Tilapia mossambica* after chronic (15 days) exposure to 2 sublethal concentrations - 1/10th of 96 hrs (36 ppm) and 1/5th of 96 hrs (72 ppm) of heavy metal Cadmium (Cd) as $CdCl_2$

Organs	Control	Cadmium (Cd) as $CdCl_2$	
		1/10th of 96 hrs	1/5th of 96 hrs
Liver	9.18±0.38	7.7±0.78**	6.72±0.82***
Heart	3.42±0.42	3.1±0.34@	2.52±0.34*
Muscle	6.94±0.68	6.34±0.6@	5.62±0.38**

@: Non-significant; *: Significant at P< 0.05; **: Highly significant at P<0.01; *: Very highly significant at P<0.001.**

Thus, contamination by heavy metals is a serious threat to aquatic organisms because of their toxicity, long persistence, bioaccumulation and biomagnifications in the food chain. The present study reveals that Cadmium has a tangible effect on the protein and glycogen levels in certain tissues of fresh water fish, *Tilapia mosambica*, which may cause severe to fatal physio-metabolic dysfunctions.

4. CONCLUSION

The present study reveals that heavy metals may induce biochemical alterations in the different organs of fish. These biochemical investigations can be used to study the mode of action of toxicants and the cause for death by poisoning of aquatic organisms. Thus biochemical alterations in fish can be considered as biomarkers to access the health status of the fishes as well as aquatic bodies polluted by toxicants. Thus environmental protection is the major requirement of the society.

5. REFERENCES

1. Voegborlo RB, Methnani AME, Abedin MZ. Mercury, cadmium and lead content of cannedTuna fish. Food Chem. 1999; 67(4):341 – 345.
2. Vutukuru SS, Suma C, Madhavi KR, Pauleena JS, Rao JV, Anjaneyulu Y. Studies on the development of potential biomarkers for rapid assessment of copper toxicity to freshwater fish using *Esomus danricus* as model. Int J Environ Res Public Health. 2005; 2:63-73.
3. Rauf A, Javed M, Ubaidullah M, Abdullah S. Heavy metal levels in three major carps (*Catla catla, Labeo rohita, Cirrhina mrigala*) from the river Ravi, Pakistan. Pak Vet J. 2009; 29:24-26.
4. Mance G. Pollution threat of heavy metals in the aquatic environments. Elsevier, London 1987.
5. Maruthanayagam C, Sharmila G. Haemato-Biochemical variations induced by the pesticide monocrotophos in *Cyprinus carpio* during the exposure and recovery periods. Nat Environ Poll Tech. 2004; 3: 491-494.
6. Woodlings JD, Brinkman SF, Horn BJ. Non Uniform accumulation of Cadmium and Coppper in kidneys of wild brown trout *Salmo trutta* populations. Arch Environ Contam Toxicol. 2001; 40:318-385.
7. Beaumont MW, Butler PJ, Taylor EW. Exposure of Brown trout, Salmo trutta, to a sublethal concentration of Copper in soft acidic waters: Effects upon muscle metabolism and membrane potential. Aquat Toxicol. 2000; 51: 259-272.
8. Jagadeesan, G., Jebanesan, A. and Mathivanan, A.: In vivo recovery of organic constituents in gill tissue of *Labeo rohita* after exposure to sub lethal concentrations of mercury. J Exp Indelleriia. 2001;3: 22-29 2001.
9. Kaushik U, Joshi SC. Silver nanoparticles: green synthesis, optical properties, antimicrobial activity and its mechanism using *Citrus sinesis*, Asian J Pharma Clin Res. 2015; 8(6): 179-184.
10. ATSDR (Agency for Toxic Substances and Disease Registry), Toxicological profile for Cadmium. US Department of Health and Human Services. Atlanta, GA. 1997
11. European Union. Heavy metals in wastes, European Commission on Environment. Finney, DT., 1971. Probit Analysis. 3rd ed. Cambridge University Press. London. 2002.
12. Young RA. Toxicity Profiles: Toxicity Summary for Cadmium, Risk Assessment Information System, RAIS, University of Tennessee. 2005.
13. Nawaz S, Nagra SA, Saleem Y, Priydarshi, A. 2010. Determination of heavy metals in fresh water fish species of the River Ravi, Pakistan compared to farmed fish varieties. Environ Monit Assess. 2010; 164(1-4):461-471.
14. Finney DJ. (1971): Statistical methods for biological analysis. 3rd edition, London.
15. Lowry OH, Rosenbrough NJ, Farr AL, and Randall RJ. Protein measurement with Folin phenol reagent. J Biol Chem. 1951; 193:265-275.
16. Van dar Oost R, Beyer J, Vermeulen NPE. Fish bioaccumulation and biomarkers in environment risk assessment: A Review. Environ Toxicol Pharmacol. 2003; 13:57-149
17. Mahendru VK, Agarwal RA. Changes in metabolism in various organs of the snail, Lymnia acuminate, following exposure to trichlorofon. Acta Pharmacol and Toxicol. 1982; 48:377-381.
18. Schmidt NB. Osmoregulation: Effect of salinity and heavy metal. Fed Proc. 1975; 33:2137-2146

19. Jana S, Padhyay. Effect of heavy metals on some biochemical parameters in the freshwater fish *Channa punctatus.* Environ. 1987; **5**(**3**):488-493.
20. Ravichandran. Impact of phenol metabolism in the fresh water fish *Oreochromis mossambicus*. J Exotoxicol Environ Monit. 1994; 4(1): 33-37.
21. Bedii C, Kenan E. The effects of cadmium on levels of glucose in serum and glycogen reserves in the liver and muscle tissues of *Cyprinus carpio* (L.,1758). Turk J Vet Anim Sci. 2005; 29:113-117.

Conflict of Interest: None

Source of Funding: Nil