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Alteration in some Biochemical Parameters of Clarias batrachus due to Cadmium Chloride Toxicity

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ABSTRACT

Cadmium compounds are serious pollutants of aquatic environment because of their environmental persistence and ability to be accumulated by aquatic organisms. The present research was designed to study the sub lethal concentration of $CdCl_2$ on some biochemical parameters of *Clarias batrachus.* The fishes selected for the experiment were 20 in number, arranged in 4 groups, 5 in each group. The average length and weight of *Clarias batrachus* was 11 inches and 255 gms respectively. One of the 4 groups was kept as control and the rest three groups were experimental ones exposed to 2.5 mg/litre sub lethal concentration of $CdCl_2$ for the time period of 15, 30 and 45 days respectively. After exposure, it was observed on one hand that the glucose level showed a significant decrease and on the other hand an increase was observed in total protein, cholesterol, albumin and globulin. The result of recent research work clearly indicates that the cadmium disturbs the energy metabolism of *Clarias batrachus* by and large. This in future will lead to death of fish species and finally affects the whole population of the individual organism.

Keywords: *Clarias batrachus*, Cadmium, Toxicity, Biochemical parameters, Aquatic organisms

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INTRODUCTION

The rapid increase in population and the development in industrial and agricultural sectors have created a serious threat to all kinds of life in the form of pollution which has now become a global problem. Growth in industrialization is one of the most serious threats to mankind, domestic animals, fishes and wild life through its litters. While on one hand technological development has improved the quality of life, on the other hand it has created a number of health hazards. The toxic chemicals discharged into air, water and soil get into food chain from the environment. By entering into the biological system they disturb the biochemical processes leading to health abnormalities.

To measure the toxic effects of different pollutants in the aqueous environment, fish could be very important organism. Blood parameters are considered pathophysiological indicators of whole body and therefore are important in diagnosing the structural and functional status of fish exposed to toxicants. The major pollutants are heavy metals. Various organisations listed 24 extremely hazardous substances. These include heavy metals and one such heavy metal is cadmium. Cadmium, a non-essential heavy metal has been listed in the "Black list" of European community[1]. It has also been classified as b-class (soft) metal. It is a non-biodegradable element with no known biological function and is reported to be a major contaminant of aquatic ecosystems causing adverse effects on aquatic organisms [2]. The major sources of adulteration include gilding, paper, PVC plastic, pigments and ceramic industries, battery, mining and smouldering units and many other modern industries[3]. It also enters into aquatic bodies through sewage sludge and with the runoff from agricultural lands as it is one of the major components of the phosphate fertilizers[4], where it produces deleterious effects on aquatic flora and fauna by affecting various physiological, biochemical and cellular processes[5].

Walking catfish can be found in a variety of habitats, but they are most frequently encountered in muddy or swampy water of high turbidity[6].The catfish *Clarias batrachus* is widely distributed fish in Asia and Africa. The fish in these areas is extremely popular due to its tasty flesh, unparalleled hardness, rapid growth and high market price. The present work was designed to study the effect of Cadmium chloride on biochemical indices of fish *Clarias batrachus.*

MATERIALS AND METHODS

Fresh water fish species of *Clarias batrachus* were obtained from the river Narmada near Hoshangabad 70 Kms. from Bhopal, Madhya Pradesh. Before introducing into the laboratory condition the fishes were checked for any external injury and were treated with 0.1% KMno4. After that fishes were maintained in laboratory condition for 15 days for acclimatization. During acclimatization period fishes were fed with

fish food once daily. The 20 fishes were selected for experiment irrespective of their sex. The average length and weight of *Clarias batrachus* was 11 inches and 255gms respectively. To affirm the experiment the toxicity tests were conducted to determine the safe concentration value of $CdCl_2$ for 15, 30 and 45 days. The physico-chemical analysis of water was done according to Standard Methods published by American public health association[7] (table.2). The fishes were divided into four groups with 5 fishes in each group. First group was kept as control and the rest three groups were maintained in sub lethal concentration of $CdCl_2$. The sub lethal concentration of $CdCl_2$ for *Clarias batrachus* was 2.5mg/litre. Both control and treated fishes were sacrificed at particular time and blood was collected from caudal peduncle by using sharp scalpel. The blood obtained was taken in sterilized centrifuge tubes and allowed to stand for about an hour. The serum was obtained by using technique of centrifugation at 2000 rpm for 30 minutes. Various biochemical parameters were analysed such as Glucose, Cholesterol, Total protein, Albumin and Globulin by applying standard methods.

RESULTS AND DISCUSSION

The fresh water environment nowadays is continuously polluted by the heavy metals cleared by industrial stations situated on or near the aquatic bodies. The aquatic organisms especially fishes are more susceptible to these pollutants[8].Cadmium chloride is one of the heavy metal that poses toxic effects on the fish which is evident from the present investigation. The LC_{50} values observed in present study were found nearer to the reported values of other workers on different fishes[9]. The biochemical alteration in *Clarias batrachus* was seen with a sub lethal concentration of 2.5 mg/litre cadmium chloride for 15, 30 and 45 days in comparison to control. The biochemical factors are the best indicators of stress situations produced by heavy metals. In *Clarias batrachus* there was observed a decrease in glucose value after being subjected to the treatement (figure.3). The glucose displayed a decreasing trend with values ranging from 92.78 mg/dl ± 0.68, 80.24 mg/dl ± 0.56, 72.71 mg/dl ± 0.78 and 68.19 mg/dl ± 0.38(Table. 1) for control, 15, 30 and 45 days. This may be attributed to affinity of cadmium for ligands like phosphate, cystenyle and histidyl side chains of proteins that can bind with carrier protein molecules resulting in inhibition of sugar and amino acid transportation[10]. It has been observed that metal ions block the active absorption of glucose by the intestinal epithelial cells. Many other workers reported hypoglycemic disorder in air breathing fishes due to various metal contaminants[11] and this may result in failure of coping with high-energy demand in stress situations. *Clarias batrachus* showed a significant increase in cholesterol values ranging from 191 mg/dl ± 0.62, 194 mg/dl ± 0.44, 198 mg/dl ± 0.65 and 203 mg/dl ± 1.13(Table.1) for control, 15, 30 and 45 days respectively and resulted in hypercholesterolemia. This may be attributed to

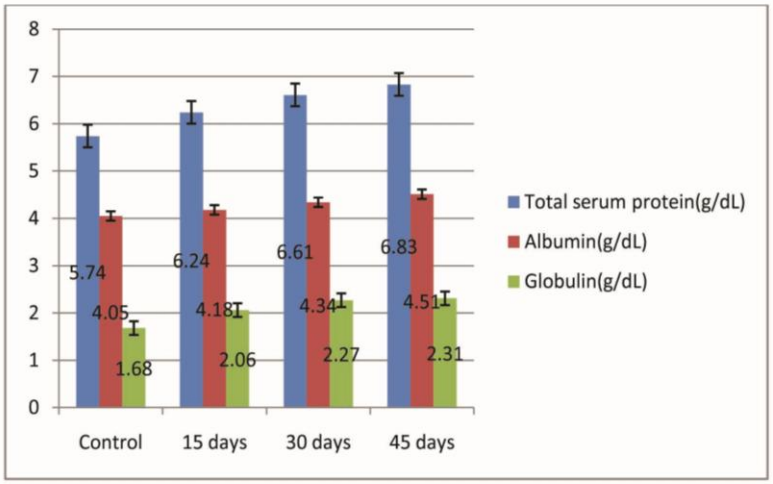

Figure 1: showing protein, albumin and globulin level alteration in *Clarias batrachus* Linn. exposed to 2.5 mg/litre cadmium chloride for 15, 30 and 45 days

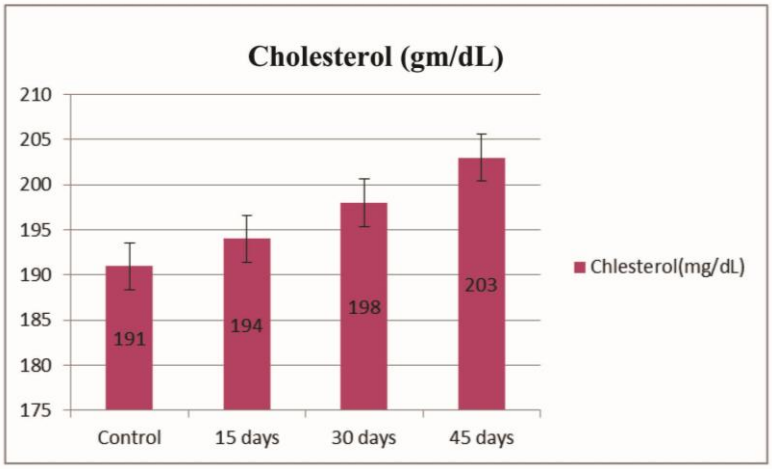

Figure 2: showing cholesterol content alteration in *Clarias batrachus* Linn. exposed to 2.5 mg/litre cadmium chloride for 15, 30 and 45 days

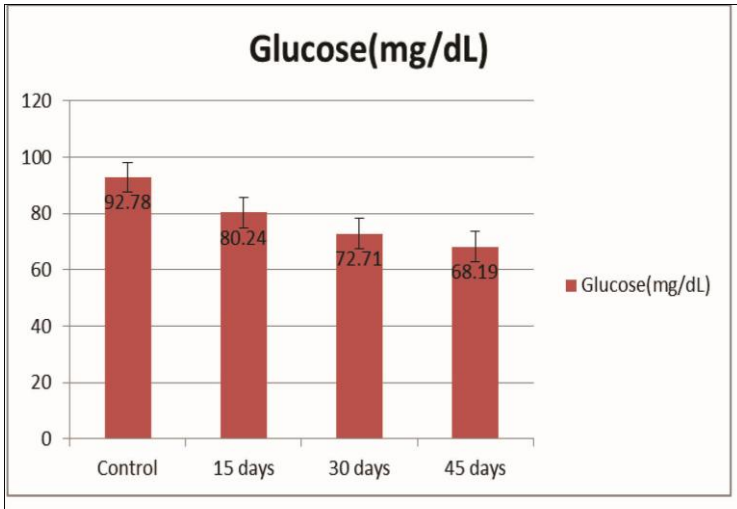

Figure 3: showing Glucose level alteration in *Clarias batrachus* Linn. exposed to 2.5 mg/litre cadmium chloride for 15, 30 and 45 days.

Table 1. Effect of cadmium chloride on biochemical parameters of *Clarias batrachus.*

Parameters	Control			15 days				30 days				45 days	
	Mean±SE	Min.	Max.	Mean±SE	SD	Min.	Max.	Mean±SE	SD	Min.	Max.	Mean±SE	SD
Total serum protein (g/dL)	5.74±0.04	6.12	6.40	6.24±0.03	0.11	6.22	6.99	6.61±0.10	0.36	6.59	6.99	6.83±0.05	0.16
Serum Albumin (g/dL)	4.05±0.01	4.11	4.26	4.18±0.01	0.06	4.25	4.40	4.34±0.01	0.05	4.44	4.59	4.51±0.01	0.05
Serum Globulins (g/dL)	1.68±0.04	1.86	2.29	2.06±0.04	0.15	1.82	2.65	2.27±0.10	0.35	2.15	2.46	2.31±0.04	0.13
Serum Cholesterol (mg/dL)	191±0.62	193	197	194±0.44	1.46	196	202	198±0.65	2.16	197	208	203±1.13	3.74
Serum Glucose (mg/dL)	92.7±0.56	77.5	82.2	80.2±0.56	1.87	69.9	75.6	72.71±0.78	2.60	65.82	68.35	68.19±0.38	1.27

Values are Mean±SE and SD of the 5 test replications.

Table.2 : Physico- chemical analysis of aquarium water during the course of experiment

S No.	Parameters	Calculated value
1	Temperature	20.36^{o} C
2	pH	7.33
3	Alkalinity mg/litre	183.33
4	Chloride mg/litre	2.53
5	COD mg/litre	9.07
6	Hardness mg/litre	163.33
7	BOD mg/litre	1.5

impairment of liver and inhibition of enzymes, which change cholesterol into bile acids[12]. Also, reduced lipoprotein lipase activity plays a role in the increment of plasma lipid[13]. Proteins play a vital role in physiology of living organisms. All biological activities are regulated by enzymes and hormones, which are also proteins. Assessment of protein content can be considered as a diagnostic tool to determine the physiological phases of the cells[14]. The total serum protein level showed an increasing trend with values ranging from 5.74 g/dl ± 0.04, 6.24 g/dl ± 0.03, 6.61 g/dl ± 0.10 and 6.83 g/dl±0.05 (Table. 1) for control, 15, 30 and 45 days respectively. It is admitted on all hands that Cadmium competes with Zn for binding with the same sulphahydral group present on the protein and that eventually results in inactivation of protein which perturbs the physiology of the cell. Proteins are too sensitive and early indicators of heavy metal poisoning. It has been reported that advancement in protein content of rat serum was due to textile mill effluents[15]. Also, it has been reported that there was an enhancement in total serum protein content due to cadmium toxicity[16]. It is evident from the experiment that both parameters i.e. albumin and globulin showed a consistent increasing drift with an increase in time period. The albumin values were 4.05 g/dl ± 0.01, 4.18 g/dl ± 0.01, 4.34 g/dl ± 0.01 and 4.51 g/dl ± .01(Table. 1) and the globulin values recorded were 1.68 g/dl ± 0.04, 2.06 g/dl ± 0.04, 2.27 g/dl ± 0.10 and 2.31 g/dl ± 0.04 (Table. 1) for control, 15, 30 and 45 days respectively. The increase in albumin and globulin was due to enhancement of microsomal protein synthesis suggested by many workers.

Furthermore some changes of colour fading, seizing of activeness, appearance of white patches and change in feeding behaviour were observed during the course of experimentation. No mortality was confirmed during the course of experiment.

CONCLUSION

In conclusion, the results of this study showed that the fishes were stressed after being exposed to sub lethal concentration of cadmium chloride. The heavy metal cadmium chloride altered the activity of biochemical parameters of fish significantly and thus resulted in the instable physiological state of fish. Therefore sub lethal concentration of cadmium chloride has some deleterious effects on biochemistry of blood of Clarias batrachus.

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REFERENCES

1. Mason C F. Biology of freshwater pollution. III Edition Longman, U.K. 1996; 1-4.
2. Hollis L, McGeer JC, Mc Donald DG, Wood CM. Cadmium accumulation, gill Cd binding, acclimation and physiological effects during long term sub lethal Cd exposure in rainbow trout. Aquat Toxicol 1999; 46, 101-119.
3. Gupta DK, Rai UN, Singh A, Inouhe M. Cadmium accumulation and toxicity in Cicer arietinum L. Poll Res 2003; 22:457-463.
4. Cherian MG, Goyer AA. Cadmium toxicity. Comments Toxicology1989; (3):191-206.
5. Gill TS, Pant JC, Tewari H. Bronchial pathogenesis in a fresh water fish, Puntius conchonius (Ham), chronically exposed to sub lethal concentration of cadmium. Ecotoxicol. Environ Saf 1988; 15(2):153-161.
6. Talwar PK, Jhingran AG. Inland fishes of India and adjacent countries. A.A. Balkema, Rotterdam, the Netherlands. Toxicol. 1992; 72(4):725-735.
7. APHA. Standard methods for examination of water and waste water. 20th Edn. American public Health Association Washington DC 1998:. 19-76.
8. Pathan TS, Sonawane DL, Khillare YK. Toxicity and behavioural changes in freshwater fish *Rasbora daniconius* exposed to paper mill effluent. Botany Res Int 2009; 2(4): 263-266.
9. Srivastava RK, Srivastava S. Cadmium (Cd) induced hematological changes in a freshwater catfish, Heteropneustes fossilis. J Adv Zool 2002; 23(1): 23-29.
10. Alvarado F. Transport of sugars and amino acids in the intestine evidences for a common carrier Science 1966; 151:1011-1012.
11. Sastry, Sunita. Effect of cadmium chromium on the intestinal absorption of glucose in snake head fish Channa punctatus. Toxicology Letters 1982; 10:293-296.
12. Murray RK. Harpers Biochemistry. 22nd edition Prentice Hall International Inc. 1991:-678.
13. Agarwal A, Sharma P. Effect 0f sulphur dioxide on total lipid cholesterol level in blood of albino rats. J Environ Biol 1999; 20 (4): 335- 338.
14. Kapila M, Raghothaman G. Mercury, copper and cadmium induced changes in the total protein level muscle tissue of an edible estuarine fish Boleophthalmus dessumieri. Cuv J Envi Biol 1999; 20 (3): 231-234.
15. Kurde S. Effect of textile mill effluents and dyes on the haematological parameters in albino rats. Ph. D. Thesis 1990.
16. Rajanna B, Chapatwala KD, Vaishnav DD, Desaiah D. Changes in ATPase activity in tissues of rat fed on cadmium. J Envi Biol 1981; 2(1): 1-9.