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Analysis of the harmful effects of heavy metals on the body and some organs of cat fish (*Clarias batrachus*) of Kosi region with special reference to cadmium

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Abstract : Discharge of heavy metals into aquatic environment from various sources, even below permissible levels, creates health hazards in aquatic organisms. The persistence and ubiquitous nature of these pollutants coupled with their tendency to accumulate in organisms ultimately produce toxic reactions in aquatic animals, especially fish. The heavy metal like cadmium, considered as one of the most toxic heavy metals.

Key words: *Clarias batrachus*, cadmium, toxicity

INTRODUCTION

Cadmium is a nonessential toxic element which enters body via a number of routes including food, water and air and by smoking or cigarettes. In blood it is mainly accumulated in the red cells and binds to a low molecular weight protein, Metallothionein plays a major role in homeostasis of cadmium More than 80% of cadmium is bound to metallothionein and found in liver and kidney There is a protein in the body called metallothionein which is formed from the amino acid cystein that transports Cd, Zn, Cu, & possibly other metals in the body. It is possible that excessive cadmium competes for transport sites with Cu & Zn and may even be preferentially transported by metallothionein and this is the reason why cadmium in excessive amounts is so toxic to the body.

Rivers and lake shores are the areas primarily affected by diluted cadmium waste from industrial facilities in big cities. The cadmium-related contamination of the aquatic habitat has greatly increased in the last decades, resulting in an increase of cadmium deposits in tissues of aquatic organisms in all food chain systems. It is important to note that cadmium is a highly toxic element for all mammals and fish. Cadmium levels have constantly been increasing, and consequently, the research on cadmium has become quite topical and urgent. Accumulation of cadmium in living organisms is a major ecological concern, especially because of its ability to accumulate very quickly. By contrast, the excretion of cadmium from living organisms is a slow process. In fish, cadmium can cause a number of structural and pathomorphological changes in various organs.

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MATERIALS AND METHODS

The fish were procured live from non-polluted river of Koshi with the help of fishermen. They were brought to the laboratory in wide mouthed large earthen pots half filled with natural water and covered with mosquito net.

Thereafter, healthy fish of an average length (11-15 cm) and weight (25-28 g) were transferred one by one with the help of small hand net to 40 litre rectangular glass aquaria for acclimation to various laboratory condition for a fortnight.

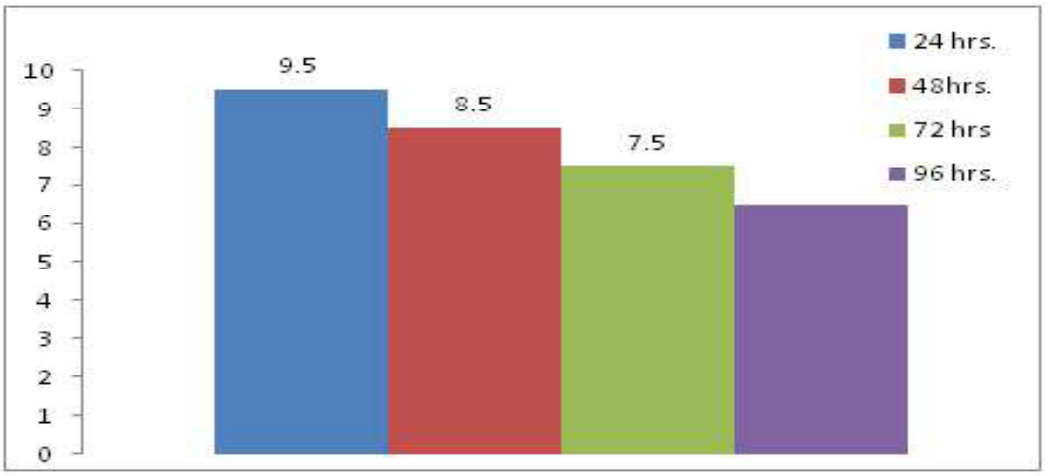
The fish were not supplied any food for the first three days. The fish were adjusted to natural photoperiod and ambient temperature. Running tab water was used in all the experiments. Running tap water was used in all the experiments and no aeration was done. They were fed with chopped goat liver every day ad libitum at 11.00 A.M sharp. The feeding was stopped 24 hr before the start of experiment and no food was supplied to them during the period of experimentation. However, the feeding schedule was strictly followed during chronic experiments to avoid starvational effects.

The fish were held in diluted water for at least one day before the start of a test, Exposure units were static and not aerated during the 96 hours test. The cadmium concentration was transferred one by one with the help of small hand net from the acclimatizing aquaria to the experimental ones. All the precautions as suggested by APHA, AWWA and WPCF (1985) were strictly followed during the bio-assay. Assays were terminated and the results discarded if and when the control mortality exceeded 10% in addition, A stock solution of cadmium chloride was prepared by simple dilution technique as described by concentrations of cadmium chloride and their percent survival at different time intervals (24, 48, 72 and 96 hours) were recorded as a measure of acute toxicity. The LC_{50} values for the aforesaid time intervals were determined by regression equation.

RESULTS AND DISCUSSION

The toxicity of cadmium chloride obtained under static system has been shown by regression equation in Table-II, Fig.-1-5. The 24hr, 48 hr, 72 hr and 96 hr of LC50 values of cadmium chloride by regression equations are 9.5 ppm, 8.5 ppm, 7.5 ppm & 6.5 ppm respectively.

Fig: - LC50 values (ppm) of cadmium chloride different time intervals obtained by regression equations



The formula of Hart *et al.* (1945) when applied to the LC_{50} values of cadmium chloride, gave the sublethal does of 2.31 ppm respectively.

Behavioural response:

The control fish shows a tendency to remain at the bottom of the aquarium with little disturbance. However, at lethal concentration of cadmium chloride the fish show prominent behaviour abnormalities viz. surfacing, rapid opercular movements, convulsions etc. Besides profuse mucus secretion with its coat deposited over the gills, gyratory swimming movements by moribund fish are the other observed behavioural responses noted during the present investigation. Loss of equilibrium before death is a symptom shown all the test fish.

Effects on organs

Total protein in liver, kidney testis and ovary:

Tables-1,reflects the results of the present study on total protein content in the cadmium chloride exposed fish *Clarias batrachus.*

Table-1: Levels of total proteins (mg/g wet tissue) in the tissue of *Clarias batrachus* chronically exposed to cadmium chloride (2.31ppm) for 30 days. Values are mean ± SE of 5 observations.

Tissue	Control	Cadmium chloride exposed
Liver	104.11±1.87	75.58 ±2.57(-27.4)
Kidney	174.926±0.1	169.972±2.532(-2.82)
Testis	81.41±1.47	70.0±1.26(-14.01)
Ovary	120.93±1.95	90.93±1.90(-24.8)

Total lipids in liver, kidney and ovary:

The results of total lipid have been found to be quite interesting is the sense that there has been depletion in its level in all the organs studied. In liver it has been found to be depleted by 3.22% is kidney by 1.96% is testes by 13.34% and in ovary 10.04% The highest account of total lipid has been estimated is kidney (173.2 ± 4.82 mg/g wet tissue) followed by liver (45.95 ± 1.89 mg/g wet tissue) ovary (21.11 ± 1.03 mg/g wet tissue) and testis (16.71 ± 0.80) mg/g wet tissue). The above decreasing order is as follows kidney> liver>ovary>testis.

As against these values to level of total lipid lowers down in the cadmium exposed fish. These are assessed to be 169.8b+-3.564; 44.47± 1.63 18.99± 0.72 and 14.48± 0.83 mg/ g wet tissue in kidney, liver, ovary & testis respectively. Thus present observation suggests that cadmium chloride either does not affect lipid molecules as severely as protein & carbohydrates or their mobilization takes place at a later stage. In treated group the decreasing orders is as follows

Kidney >Liver > Ovary > Testis.

Table-2: Levels of total lipid (mg/g wet tissue) in the tissue of *Clarias batrachus* chronically exposed to cadmium chloride (2.31ppm) for 30 days. Values are mean ± SE of 5 observations.

Tissue	Control	Cadmium chloride exposed
Liver	45.95 ±1.89	44.47 ± 1.63(-3.22)
Kidney	173.2 ± 4.82	169.8 ± 3.564(-1.96)
Testis	16.7 ± 0.80	14.48 ± 0.83(-13.34)
Ovary	21.11±1.03	18.99 ± 0.72(-10.04)

Total cholesterol, in liver, kidney, testis & ovary:

Table-3, reflects the results of the present study in total cholesterol content in the cadmium chloride exposed fish *Clarias batrachus*.

The total cholesterol content is liver, kidney, testis, and ovary of the control fish has been analysed to be 6.54± 0.73; 10.54 ±0.73; 3.43± 0.64 and 4.27± 0.42 mg/g wet tissue respectively. As evident the highest account of total cholesterol has been found is kidney followed by liver, ovary, tests. A perusal of Table-3, reveals that a considerable increase in the level of total cholesterol occurs when the fishes are subjected to cadmium stress. It elevates to 9.17± 0.65 mg/g wet tissue in liver. Which is equivalent to increase 40.21%. In kidney its level has been estimated to be 3.76± 0.63 mg/g wet tissue which account to a loss of 47.43%. The total cholesterol level in the testis and ovary of the treated fish group increases by 9.62% and 44.02% which has been measured to be 3.76± 0.63 and 6.15± 0.66 mg/g wet tissue, all the organs reflect statistically highly significant ($P<0.001$) increases is the level of total cholesterol except testis which is non-significant.

Table-3: Profiles of tissue cholesterol (mg/g wet tissue) in the tissue of *Clarias batrachus* chronically exposed to cadmium chloride (2.31ppm) for 30 days. Values are mean ± SE of 5 observations.

Tissue	Control	Cadmium chloride exposed
Liver	6.54±0.73	9.17±0.65(+40.21)
Kidney	10.54 ±0.73	15.54±0.83(+47.43)
Testis	3.431±0.64	3.76±0.63(+9.62)
Ovary	4.27±0.47	6.15±0.66(+ 44.02)

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