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Behavioural abnormalities in *Catla catla* by cadmium concertration pollution in pond water

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Abstract- Pesticides also affect non-target organisms. These affects may be physiological and behavioural which may be manifested by death & sterility. With the discovery of new uses of cadmium, its presence in the environment has increased. Cadmium is used in the production of television picture tube phosphorus, nickel cadmium batteries, motor oils, curing agents for rubber, fungicides, phosphate fertilizers, stearate stabilizers for plastics (polyvinyl chloride) and shields for nuclear reactors. Cadmium is used primarily for electroplating other metals or alloys to protect them against corrosion and in the manufacture of low melting point alloys or solders. Fish is generally appreciated as one of the healthiest and cheapest source of protein and it has amino acid compositions that are higher in cysteine than most other sources of protein. Heavy metals like copper, iron and zinc are essential for fish metabolism while some others such as mercury, cadmium, arsenic and lead have no known role in biological systems. Behavioural changes of hyper-activity and jumping observed in the Cadmium poisoned fishes in all tanks were due to skin irritation, respiratory rate impairment and coughing induced by the toxicants on the fishes especially. Weak swimming and reduced equilibrium (swimming upside down) were symptoms of a dying fish. Death resulting from acute CdSCO, might be due to increased heart failure, hypertension, gastric haemorrhage, convulsion, paralysis, heart failure and suffocation. Cadmium chloride poses toxic elements on the carp fish *Catla catla* which is evident by the findings of present.

Keywords : Pesticides, polyvinyl chloride, Cadmium chloride poses, *Catla catla*

INTRODUCTION

Some pesticides kill not only the target organisms but they also adversely alert many non-target organisms. Hence the term biocide is often used for them. In the environment, a biocide may be detoxified or its toxicity is changed in some way. A good example of the second possibility is DDT, which is quite toxic to many insects and relatively nontoxic to birds. DDT is metabolized by detritivores along two pathways, under anaerobic condition to TDE (also called DID) and under aerobic condition to DDE.

These metabolites, DDD and DDE both are toxic However, the biocidal activity of the metabolites is different from DDT. DDE is relatively nontoxic to insects, but it seriously affects female birds. It disrupts their calcium metabolism. As a result, the eggs laid by affected birds may have very thin shells (Peakall, 1974).

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Many workers have reported the manifestation of toxic effects of cadmium on various fishes. Hover, effects of Cadmium on freshwater fishes, especially on carp fish, *Catla catla* have been documented less. The present work is aimed to evaluate LCSO/96h of Cadmium chloride and to observe the variations in opercular beats, behavioural modulations and haematological indices of freshwater fish, *Catla catla*, having good nutritive value and can serves as a better indicators of freshwater streams, lakes and ponds.

MATERIALS AND METHODS

The freshwater fish, *Catla catla* are selected as the test organisms for the present study. They were collected from the Kalyani Dam Reservoir, near Tirupati, with the help of local fishermen, and immediately brought to the working laboratory and acclimatized to laboratory conditions for 15 days prior to the experiments. Stock solution of Cadmium chloride (CdCl 2.21/2 11,0, M.W. = 228.35AR Grade), was prepared by dissolving weighed amount of salt in double distilled water. For toxicity tests ten aquaria of 50 liter capacity were taken having 30 liters of dechlorinated and oxygenated tap water (Physico-chemical properties of water: pH = 7.6:00.2; Temp. 26+20C; Alkalinity 66:4,5 mg/L; Total Hardness = 259+2.5 mg/l; D. O. = 7.640.2 mg/L). Series of live concentrations of Cadmium chloride viz. 140, 200,280, 380, 500 mg/l (Toxic range was predetermined by exploratory tests) was prepared by adding calculated amount of stock solution. One aquarium having normal water without adding Cadmium chloride, served as control, in which country animals are maintained.

Adult 10 fishes of similar size and weight (average length 16±1.5cm and weight 21.5 2.0gm) were introduced to each test as well as control aquaria from stocking tank. The fish were acclimated to laboratory conditions in dechlorinated tap water for 2 weeks prior to the assay in 100L capacity plastic tanks. The mean values for the test water quality were as follows; temperature 22+10C; pH 5.7+0.4; dissolved oxygen 4.710.7ppm hardness 36+1.24ppm. The fish were fed ad libitum daily with pelletized formulated feed. Fish were maintained at photoperiod of 12 light, 12h dark regime. Feeding was suspended 24 hour before start and throughout the experiment to avoid dissolved Cadmium losses due to particulate adsorption. Proper aeration was maintained in test as well as control aquaria by air pumps and stone diffusers throughout the experimental period. Mortality was recorded at 24 hrs. The LC_{50} values of various intervals were calculated according to method of Finney *et al.*

Stock solutions of $CdCl_2$.H-0 were prepared by dissolving toxicant in distilled water to a final volume of 10ml. The stock was then serially diluted into relevant treatment concentrations. The toxicant in the test chamber was renewed completely with fresh solution of the same concentration every 24 hour. 1/5th concentration of 96 LC_{50} is taken as sub lethal concentration for haematological analysis for over a period of 3 days, 7days, 15days and 30 days. Four replicates were maintained simultaneously, 10 fish were introduced in each concentration per tank. The experimental fish were also fed with formulated feed ad lib m as in control. After expiry of each exposure period blood was collected from each fish by means of a hypodermic syringe at the base of caudal peduncle, and immediately transferred to EDTA containers for haematological analysis. Haemoglobin (Hb) was estimated as cyanmethemoglobin according to Ochei and Kolhakter. RBC and WBC were determined according to the classical method using the Neuber hemocytometer. Hematocrit was determined using microhematocrit tubes and a haematocrit centrifuge. Blood was centrifuged at 1200 xg for 5 minutes and the haematocrit value was obtained. Data were analyzed by one-way analysis of variance (ANOVA) followed by Duncan's Multi Mample

RESULTS AND DISCUSSION

The experimental fish sub lethal concentration of Cadmium chloride caused various behavioral abnormalities in fish such as-an erratic increased swimming, surfacing and hyperactivity, restlessness, abnormal swimming, and secretion of mucous which was followed by loss of balance and succumbing of fish, when they are initially exposed to cadmium chloride test solution. Throughout the exposure period the fishes showed various aggressive behavior abnormalities such as nudge and nip, fin flickering, partial and S-jerk and burst swimming increased significantly ($P<0.05$) compared with control. The behavioral abnormalities observed in fish treated with sublethal concentration cadmium chloride are summarized.

The pathological effects of the deposits of CdCI included irritation of the skin, which may be more severe in gill filaments and respiratory lamellae than the skin thus interfering with the ability or gill to carry oxygen for respiration. This is in addition to the fact that the presence of metals in the water had already reduced the dissolved oxygen content of the water in which the fish lives' more concern is the effect on the gills than the skin because the metals only caused irritation of the latter (skin), while in the former (gill) the metals interfered with the normal ability of the gill to carry oxygen for respiration.

Behavioural changes of hyper-activity and jumping observed in the Cadmium poisoned fishes in all tanks were due to skin irritation, respiratory rate impairment and coughing induced by the toxicants on the fishes especially. Weak swimming and reduced equilibrium (swimming upside down) were symptoms of a dying fish. Death resulting from acute CdSCO, might be due to increased heart failure, hypertension, gastric haemorrhage, convulsion, paralysis. heart failure and suffocation:

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Investigations and LC_{50} values observed in present study are nearer to the reporting of other workers on different fishes. Behavioral alterations have been established as sensitive indicators of chemically induced stress in aquatic organisms. Behavioural alterations like erratic swimming, restlessness and surfacing, observed in present study may be an avoiding reaction to the heavy metals as also observed by various workers. The avoidance

Table. 1. Behavioral abnormalities monitored in the present study

S.No	Exposure Period	Monitored behavioural changes
1	After 24 hrs exposure	-restlessness, rapid surfacing, peeling of skin and color fading -slightly reduced activity -gradual increase in colour fading
2	After 48 hrs exposure	-gill adhesion and thin film of mucous on gills, opperculm and general body surface at this stage -nudge and nip -fish moving towards surface water and gulping of air is increased.
3	After 72 hrs exposure	-loss of balance and jerky movements during swimming. -the school formation, a characteristic of this fish -weakned in test animals as compared to control -prominent ulcerations on the base of caudal fin, pectoral fin and on trunk of fish.- -heamorrages were also identified on fins and trunk of some fish
4.	After 96 hrs exposure	-A thik mucous film was formed on whole body and gills, in all test fish -The experimental fishes lost their natural colouration and became almost reddish black -s-jerk movements and brust swimming -fin flickering

reaction may be related to narcotic effects or to change in sensitivity of chemo receptors. The immediate physiological consequence of the lamellar fusion is the reduction in the surface area available for gaseous exchange, which could adversely affect respiratory physiology of the fish. A wide range of function has been attributed to fish mucous including protection against environmental contaminants and UV radiation. Many workers are of the opinion that some components of the fish mucous, probably the acidic and/or sulphated glycoprotein moieties have a metal binding and ameliorative effect against ambient toxicants. Daoust *et al.* suggested that the lamellar adhesion in gills might be result of contact stress, which causes erosion of mucous coating and epithelial lining leading to alterations in the chemical composition and thickness of the mucus layer due to interaction with xenobiotics. Erosion of the epithelial lining and alteration in mucous coating has also been observed in the present study also. It is well known that the presence of glycoproteins in the mucus is indicative of its metal binding capacity as cadmium specially binds-SH.

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