HEAD KIDNEY DAMAGE DUE TO THE TOXIC EFFECT OF ZINC SULPHATE IN THE AIR BREATHING FISH *Clarias Batrachus (Lin)*

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ABSTRACT

The aim of study was to assess the effect of zinc sulphate on head kidney in the fresh water clarias batrachus (Lin). The fish were diving into four groups. After exposure to sub lethal concentration of zinc sulphate, the tissue like head kidney of the fish showed increased cortisol secrealion, after 7, 14 and 21 days . The internal cells in the head kidney were found to increased in number.

Key Words: *Zinc sulphate, head Kidney, clarias batrachus*

Introduction

In aquatic animals the external surfaces are much more structurally and physiologically delicate than comparable liquid exposed surfaces in terrestrial animals. Thus particular metals could be toxic to an aquatic animal because of its surface acting as well as whatever internal effect. It might have metals which are mostly likely to be internally toxic. Only those that are readily absorbed and have little, if any surface activity in natural water. These are typically found as lipid soluble, organometallic complexes that are readily permeable to biological membrane.

Heavy metals are available in small quantities in water and are further added due to soil erosin and leaching of minerals. Fresh water pollution due to heavy metals has become hazardous due to discharge of industrial effluents. This wide spread problem has ultimate effect on aquatic life specially the fishes.

Amongst various water pollutants, heavy metal poses a great threat to fishes. Heavy metal zinc is used in various industrial operation forms and excessive zinc finds its way into lakes and river. Exposure to excess zinc has been reported, to bring about biochemical as well as histological changes in various organs like Kidney and gills of fishes (Agrawal and Shrivastava, 2003, Gupta and Srivastava, 2006).

As an essential heavy metal and it plays an important role in various biological processes including oxidative phosphorylation gene regulation and free radical homeostasis as an essential cofactor (Feder, 1996) fish constitute available commodity from the standpoint of human consumption, aquatic undoubtedly affect fish healt and survival. Fresh water bodies receive number of toxicants, these are accumulated in the fish of fin through food chain or by absorption through general body surface which affect severely their life supported system at molecular and biochemical level. Once toxic substances enter into the body they damage and weaken the mechanism concerned leading to physiological, pathological and biochemical disorder (Bais and Arsta, 1995)

Metal which are mainly beneficial, indeed essential such as zinc and copper may become pollutants when present in excess by exhibiting toxic effects on organism (Mason, 1991)

Therefore, trace metals like Cr, Mn, Fe, Co, Ni, Cu, Zn, etc are essential for the growth of organisms. The essential trace metals may be beyond certain optimum threshold levels, hazardous and toxic.

Material and method

The fish were collected from local sources. They were treated with 0.5% $KMNO_4$ for 5 minutes for dermal disinfection. Then they were acclimatized to laboratory condition and were feed on small

piece of earthwarm. The fish weighing 50 to 55 gms were selected for experimental work. Throughout the experiment the water used was aged tap water which was stored in a large overhead tank for about 10 day's. The physiochemical parameters of the aged tap water was determined periodically as per standard methods (APHA 1998).

Preparation of experimental aquarium

96 h Lc_{50} and sub-lethal concentration of zinc sulphate for the fish clarias batrachus was taken from literature, which was 18 mg/L from the calculated (3mg/L) and the fish were exposed to this concentration for 21 days to study the histopathological structures of trunk kidney.

Aqueous solution of zinc sulphate ranging from 10 to 100 ppm was added to glass aquaria, containing 25 liters of water. The toxicant solution was added drop by drop with constant stirring and then acclimatized fishes were transferred to glass aquaria (60 x 30 x 30 cm) containing 25 liters of toxicant treated water. The fishes were fed (25 mg/earthworm/gm fish/day) once in a day.

Fishes were divided into four groups.

Group – I – Containing fishes in aged tap water which served as control.

Group – II – Fish Kept in toxicant water containing 03 mg/L of zinc sulphate for 7 day's.

Group – III – Fish kept in toxicant water containing 03 mg/L of zinc sulphate for 14 day's.

Group – IV – Fish kept in toxicant water containing 03 mg/L of zinc sulphate for 21 day's.

The toxicant solution and aged tap water (Control) were renewed every day to maintain uniform test concentration throughout the experimental period.

Observation

5 fish in each group were tested for histopathological studies of the fish Kidney. The sections were cut 5 micron thickness and were stained with Haematoxylene-Eosin (HE) stain. After exposure to sub-lethal concentration of ZnSO4, the tissue like head kidney of the fish *clarius batrachus* showed varied degenerative changes after 7, 14 & 21 days. The generative histopathological changes observed the head kidney were remarkable in the ZnSO4 treated fish.

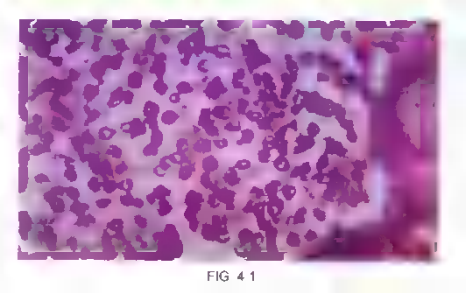

Fig. 1 T.S. of Head Kidney of Control fish, illustrating Normal structure.

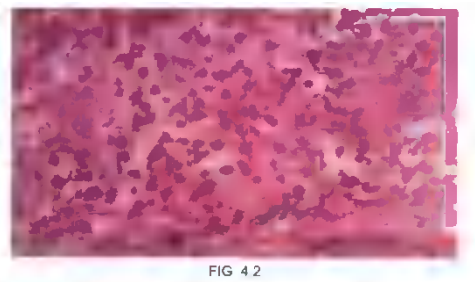

Fig. 2 T. S. of Head Kidney illustrating the histomorpological changes after Exposure of the fish clarias bactrachus to experimental toxicant for 7 days.

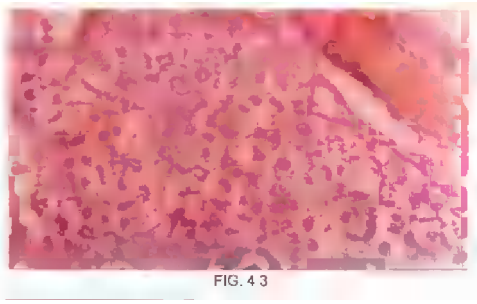

Fig. 3 T. S. of Head Kidney illustrating the histomorpological changes after Exposure of the fish clarias bactrachus to experimental toxicant for 14 days.

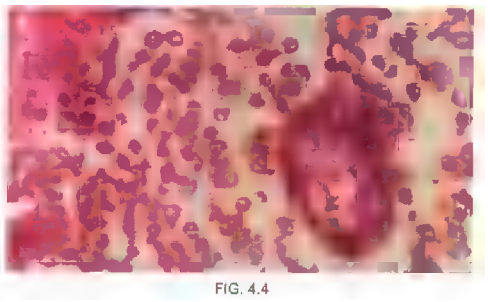

Fig. 4 T. S. of Head Kidney illustrating the histomorpological changes after Exposure of the fish clarias bactrachus to experimental toxicant for 21 days.

The experimental fish exposed to sub-lethal concentration of zinc sulphate exhibited abnormal behavioral response. During exposure time, fish initially showed rapid movements, faster opercular activity, surfacing and gulping air. They showed erratic swimming with jerky movement, hyperexcitibility, convulsion and tendancy of escaping from aquaria. These activities were increased initially and subsequently reduced. Beside on interesting observation was noted that there was a remarkable body dispigmentation along with profuse mucus secreation and its coagulation all over body. This was followed by loss of equilibrium and fish slowly moved upward in vertical directions. Thereafter, fish become progressively lethargic and lost their sense of equilibrium completely. Ultimately the fish lay down on the bottom of the aquaria with their belly upward before death.

Result and discussion

In *clarius batrachus*, the Kidney is differentiated into 'Head Kidney'. Internal cells are found to be concentrated around the large blood vessels in the head Kidney of *clarius batrachus* in the form of small lobules (fig. 1) the internal cells are circular having rounded nuclei towards one side. The cromaffin cells are also found in the head kidney in groups among the internal cells. They possess distinct nuclei in the centre. These cells are oval or oblong unlike internal cells which are circular (fig. 1) All the fish exposed to toxicant showed increased number of internal cells upto 7 days of exposure, but latter on the number appears to be slightly declined (fig. 2). In ZnSO4 treated fish hyperplasia was also observed in internal cells. Such hyperplasia was much prominent in 14 days treated fish. On the contrary the cells exhibited Shrikage (fig. 3)

Chromaffin cells were found to be more affected due to ZnSO4. They become distorted and lost their identity after 21 days of exposure (fig. 4) But their number was found to be increased.

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In the present study it is clear, that the pituitary internal axis in the fish, clarias batrachus might have been activated during heavy metal exposure, indicating its role in stimulation of the inter renal cells of kidney. This suggest an increased need of hormone of head kidney (Corticosteroids) in toxicant stressed fish. Lee et al. (1983), Wendelar Bolga and Balm (1989) also reported increased of inter renal cell of head kidney in teleost fish under toxicant stress. Elevation of the level of corticosteroids and catecholamines during toxicant stress was due to increased in number of inter renal cells (Billard et al., 1981). The chromaffin cells of fish head kidney secrete catecholamines (adrenaline and nonadrenaline) Which are released

in blood circulation after toxicant stress to face toxic environment (Nilsson, 1983)

Catecholamines released by chromaffin cells of head kidney maintain the oxygen carrying capacity of blood (Brown, 1993). Catecholimines also release additional erythrocytes in blood circulation (Nilsson, 1983) to increase the oxygen carrying capacity of the blood. All the above findings of various workers indicate that the fish became adopted to the pollutant stress due to catecholamine secreation from chromaffine cells of head Kidney.

Conclusion

After exposure to sub-lethal concentration of zinc sulphate, head Kidney of the fish clarias batrachus showed the internal cells in the head kidney were found to be increased in number and showed increased cortisol secreation. The degenerative changes observed in the head kidney of fish might be due to biomagnifications of heavy metals compounds.

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