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Studies on Zinc sulphate induced alternation in Hepatosomatic index and Renalsomatic index in the freshwater fish *Channa orientalis* (Sch.)

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ABSTRACT: The fresh water fish *Channa orientalis* when exposed to zinc sulphate concentration shows behavioral changes with histopathological alternations in detoxifying organs. Treatment of the fish *Channa orientalis* with the sublethal concentration of zinc suplhate resulted in statistically significant reduction in HSI in all three experimental groups. Trunk kidneys of the fish exposed to sublethal concentration of zinc sulphate resulted in statistically significant increase in RSI in all three groups of experimental fishes. These changes were time dependent.

Key words: Toxicity, *Channa orientalis,* Zinc Sulphate, HIS, RSI.

INTRODUCTION

Heavy metal contamination of aquatic ecosystem has long been recognized as a serious problem. Heavy metal contamination may have devasting effect on ecological balance of recipient environment and diversity of aquatic organism (Forambi *et. al.,* 2007). These heavy metal pollution posses a great threat to fishes. When fishes are exposed to great elevate level of metal in polluted aquatic ecosystem, they tends to take these metals up from their direct environment (Charjan 1997; Hoo *et. al.,* 2004). The fish constitutes a valuable commodity from the stand point of human consumption. So the heavy metal contamination of fresh bodies and aquatic biota becoming a serious concern from human health point of view. Heavy metal pollution of aquatic ecosystem poses a serious environmental hazard because of their persistence and toxicity. These heavy metals are available in the water and are further added into aquatic ecosystem as a result of direct input of atmospheric deposition, leaching of mineral and soil erosion due to rain water which causes the hazardous effects on aquatic biota specially fishes (Mulley *et. al,* 1996). These heavy metal toxicants are accumulated in the fish through general body surface which affect severally their life support system at molecular biochemical levels. Once these toxic substance enters into body, they damage and weaken the mechanism concerned leading to physiological, pathological and biochemical disorders (Arasta *et.al.* 1999). Most trace metals are important for the customary functioning of the physiological processes in fish. Abnormal high concentration of metals can, however cause cellular and histological changes. Exposure of fish to Zinc can result in damage of organs and various behavioral, physiological, biochemical changes (Heath, 1995) with alternation in Hepatosomatic and Renalsomatic indices. Although *Zinc* is an essential element for living organisms, its presence in fresh water in higher concentration has long been known to have toxic effect of varying intensities.

Hence the present study was aimed to investigate the toxic effect of zinc sulphate on hepatosomatic and renalsomatic indices of detoxifying organs of fresh water fish *Channa orientalis* at laboratory condition.

MATERIALS AND METHODS

The freshwater fish *Channa orientalis* were obtained from local sources. They were treated with 0.5 % $KMnO_4$ for five minutes for dermal disinfection. Then they were acclimatized for period of fortnight to laboratory condition and were feed on small pieces of earthworm. The fishes were of 12-14 Cm in length with weighing 18-30 g were selected for the experiment. The physicochemical parameter of the aged tap water was determined periodically as per standard methods (APHA 1998). The *Zinc sulphate* ($ZnSO_4.7H_2O$) was selected as a heavy metal toxicant for the experiment.

The fishes are exposed to different concentration of zinc sulphate for 96 hours. The acclimatized 10 fishes were transferred to glass aquaria (60 × 30 × 30 cm) containing 25 liters of toxicant treated water. The fish were fed (25 mg / earthworm / gm fish / day) once in a day. Observations were made for 24 hours, from which the different concentrations were selected for the full scale experiment; behavioral changes in the fishes were observed and recorded. The 96h LC_{50} of zinc sulphate for the *Channa orientalis* was found to be 4.72 mg/l. 5 fish in each group were tested for histopathological studies of the fish liver. Student 't' test was performed on the data of HSI and RSI as given by Fisher (1950).

Table 1: Physicochemical Parameters of water.

1	pH	7.5 ± 0.5
2	Temp.	23° ± 1°C
3	Dissolve O_2	6.5 ± 0.3 mg/L
4	Total Hardness	232 ± 3 mg/L
5	Total Alkalinity	243 ± 3 mg/L

Calculation of HSI and RSI

Hepatosomatic Index (HSI):
The Hepato-Somatic Index was determined (Htun-hun, 1978) as:

$$HSI = \frac{Liver\ weight}{body\ weight} x\ 100$$

Renalsomatic Index (HSI):
The Renal-Somatic Index was determined (Htun-hun, 1978) as:

$$RSI = \frac{Kidney\ weight}{body\ weight} x\ 100$$

RESULTS AND DISCUSSION

During the course of experiments no mortality were recorded in control and experimental fishes exposed to sub lethal concentration of zinc sulphate. Certain changes were observed in the coloration, feeding behavior and activeness of the fishes.

Both the types of fishes initially became more active but later their activity ceases. The fish's coloration fades a little, fluctuating responses were observed in feeding behavior. Table 2 shows the Hepato-somatic and Renal-somatic indices recorded from control and exposing *Channa orientalis* to sub lethal concentration of zinc sulphate for 10 days, 20 days and 30 days. The following results were obtained.

1. **Effect of sublethal concentration of ZnSO4 on Hepatosomatic index (HSI):**
In fishes the liver is primary detoxifying organ which determine its hepatosomatic index (HSI). In the present investigation there was a continuous reduction in HSI upto thirty days of exposure to zinc sulphate. Treatment of the fish *Channa orientalis* with the sublethal concentration of zinc suplhate resulted in statistically significant reduction in HSI in all three experimental groups.

Table 2. The HSI and RSI of control and $ZnSO_4$ treated fish *Channa orientalis.*

Duration	HSI		RSI	
	Control	Experimental	Control	Experimental
10 Days	1.092 + 0.076	0.751* + 0.034	1.018 + 0.026	1.042* + 0.036
20 Days	1.076 + 0.042	0.706* + 0.028	1.034 + 0.020	1.066* + 0.026
30 Days	1.084 + 0.034	0.654** + 0.040	1.082 + 0.032	1.096* + 0.040
Values are mean + SD of the five observation * P< 0.005, ** P<0.01				

After 10 days and 20 days the HSI was significant at P < 0.05 while after 30 days it was significant at P < 0.01 (Table 2). Sindhe and Kulkarni (2004) also reported decreased HSI in the fish *Notopterus notopterus* under chronic exposure of various heavy metal salts for 12 months.

The decreased HSI was also reported by Joshi (2011) and and Shelkar *et al.*, (2013) in the fish *Clarias batrachus* under exposure of zinc sulphate for 30 as well also by Kingdom and Allison (2011) Hepatosomatic Indicies of *Pellonula leonensis* in different season.

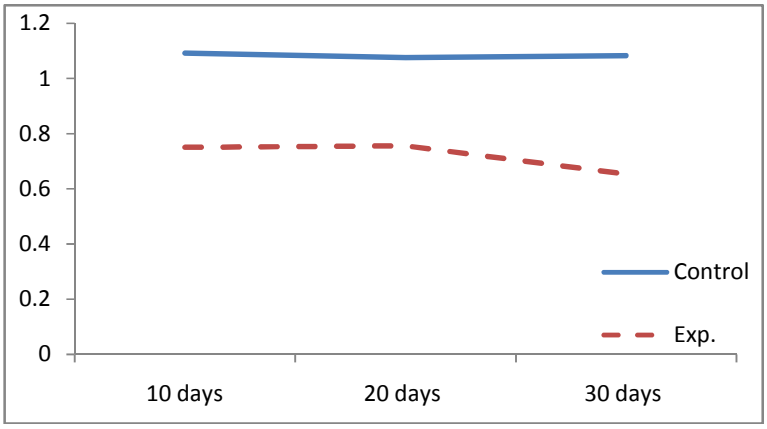

Fig. 1. Graph showing the HSI of control and $ZnSO_4$ treated fish *Channa orientalis.*

2. Effect of sublethal concentration of $ZnSO_4$ on Renal-somatic index (RSI)

Trunk kidney of the fish acts as the secondary detoxifying organ due to its excretory nature. In the present investigation the renal somatic index (RSI) is remarkably increased after exposure to zinc sulphate for thirty day. Trunk kidneys of the fish exposed to sublethal concentration of zinc sulphate resulted in statistically significant increase in RSI in all three experimental fishes which was significant at $P < 0.05$ (Table 2). The increased RSI in present investigation is due to accumulation of heavy metal salts and the unexcreted products due to impairments in excretory function (Das *et.al.*, 1988). Joshi (2011) and Shelkar *et al.*, (2013), (Charjan, 2013). were also reported increased RSI in the fish *Clarias batrachus* under exposure of zinc sulphate for 30 days.

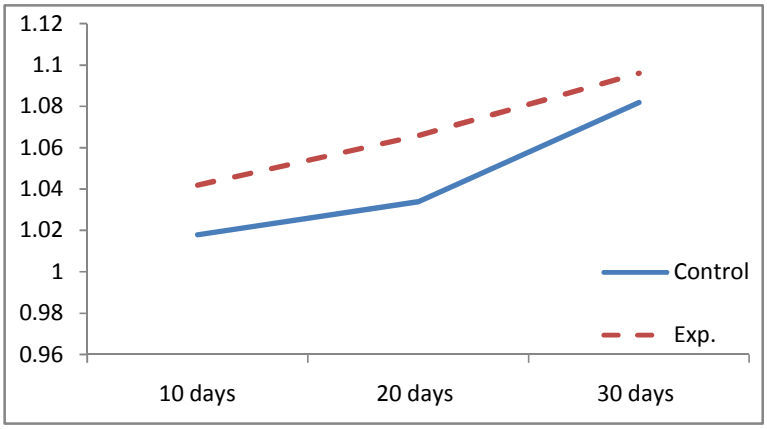

Fig. 2. Graph showing the RSI of control and $ZnSO_4$ treated fish *Channa orientalis.*

CONCLUSION

In conclusion, the present study proved that the heavy metal salts i.e. Zinc sulphate causes the alternations in Hepato-somatic and Renal-somatic indices of detoxifying organs i.e. Liver and Kidney of fish *Channa orientalis* and these effects were time dependent.

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