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Impact of Zinc Sulphate on Gills of Fish *Ophiocephalus punctatus*

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ABSTRACT

Due to the fast industrialization and urbanization, the river pollution in India has reached to peak of threshold limits. The continuous discharge of effluent containing heavy metals and their compounds at an unprecedented and constantly increasing rate, even below permissible level from various industries into aquatic bodies may result in accumulation and subsequent magnification up to dangerous level due to their toxicity, non- degradable nature and solubility in water. Heavy metals enter in the organism through food chain. It causes disorder in the aquatic ecosystem which leads to effect on aquatic life. In the present paper investigation was undertaken to study the effect of zinc sulphate on gills of the fresh water fish Ophiocephalus punctatus. The toxicity of zinc even at sublethal level causes drastic changes in the gill histology. The estimated protein concentration increased, whereas, glycogen and lipid content were found to be reduced in the gills during the exposure periods.

KEY WORDS: Gills, Glycogen, Lipid, Protein, Zinc.

INTRODUCTION

Zinc enters in aquatic habitats through various ways. Zinc is one of the essential elements required by aquatic animal like fish. But, if enters in body more than requirement, it becomes harmful and may adversely affect the behaviour and physiology of organism (Kumar 2015). Zinc is an essential and beneficial element in human metabolism. Zinc in traces is essential to sustain biological processes such as optimum body growth, development, reproduction and as immune stimulant. It's presence is essential for smooth working of various important enzymes like DNA and RNA polymerase, reverse transcriptase, alcohol dehydrogenase, sarbitol dehydrogenase, glucose -6- dehydrogenase etc. Its deficiency leads to retardation of growth, chronic renal disease, digospermia, cessation of estrous and menstrual cycle in mammals (Sawarkar 2017).

It is required in very little quantity for normal growth and functioning of the aquatic organisms like fish. But, if consumed in excess amount, Zinc starts to accumulate in different organs of fish (Nussey 2000). Toxicity of the heavy metals causes morphological and biochemical alterations in the aquatic organisms (Elaiyaraja 2018). The excessive zinc from the environment may enter into the fish body through nutrients, general body surface and gills. Gills are first organs which are affected by this toxicant. Zinc is mostly found in nature as the sulphide.

MATERIAL AND METHODS

The fish, *Ophiocephalus punctatus*, common air breathing fresh water teleost, which are locally priced as food fish and abundant in various lakes near Amravati (Maharashtra state in India) were used in the present study. Fish weighing 20-25 gm and between 10-12 cm in length were purchased from local fish market. The fish were treated with 0.1% solution for 1 to 2 minutes to clear any dermal infection. They were maintained under laboratory condition in aquarium for acclimatizing them for seven days. They were fed with commercial feed. The water in the aquarium is changed daily to remove detritus.

a) Water used - Water used throughout experiment was aged tap water. The physiochemical parameters of aged tap water were determined periodically (Table 1) as per standard method for

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examination of water and waste water (APHA, 1998). The same water also served a control medium throughout the experiment.

b) Test Toxicant - Zinc sulphate, a salt of zinc was used as toxicant for present study.

c)Bio assay study - To study effect of toxicant on gills LC50 was determined for 24 hours, it was found to be 20.5 mg / l. The sub lethal concentration of 6 mg of $ZnSO_4$ /l of water was selected. For histopathological and biochemical study fish were taken at 7 days, 14 days, 21 days and 28 days.

d)Histopathological Studies -For histopathological study gills were fixed in aqueous Bouin's fluid. After proper fixation tissue were washed with running tap water and then dehydrated in different grades of alcohol. Clean in xylene and finally paraffin blocks were prepared. Sections cut at 6 u were stained with haematoxylin, eosin stain.

e)Biochemical Studies - Protein, glycogen and lipids contents of gills were estimated in 7, 14, 21 and 28 days exposed fishes.

Table 1: Physiochemical properties of water used to keep fish, *Ophiocephalus punctatus*

Sr. No.	Parameter	Range
1	PH	7.4 0.5
2	Temperature	25°C 20°C
3	Dissolved oxygen	6.3
4	Total hardness	65 – 90

RESULTS AND DISCUSSION

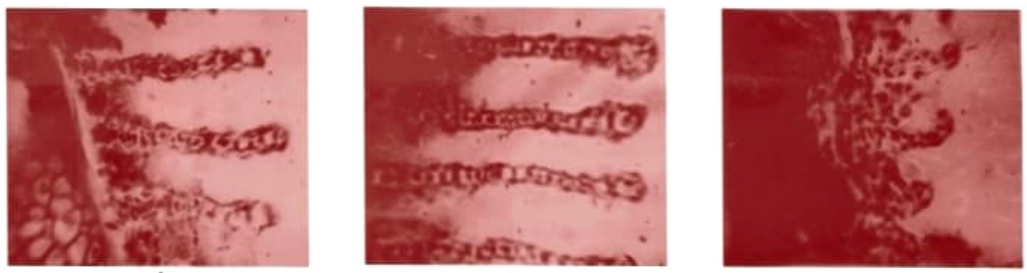
In fish, gills are considered to be the first and main organ to be affected by action of toxicant. In freshwater fish, the large surface area of gill is exposed to environmental water which is having very thin barrier between external and internal media of the animal (Murugan 2008). This may lead to higher zinc uptake by gill tissue. Gills are seat of gaseous exchange. The gill lamella of control fish shows respiratory epithelial cells, pilaster cells situated in between blood capillaries and chloride cells located at the base of the two adjacent lamellae (Fig. - 1a).

The first change in zinc sulphate treated fish after 7 days is swelling at the tip of secondary lamellae followed by hypertrophy and mild hyperplasia (Fig. -1b). As the exposure continued further for 21 days, the increased hyperplasia is accompanied by fusion of

Table 2: The results of biochemical estimation of protein, glycogen and lipid in gill tissue of the *Ophiocephalus punctatus*

Biochemical estimation	Control	Experimental			
		7 days	14 days	21 days	28 days
Protein	141.35 ± 4.2	149 ± 2.8	154.08 ± 2.6	168.85 ± 1.6	174.15 ± 2.2
Glycogen	60.00 ± 0.8	55.85 ± 1.00	54.25 ± 1.5	50.08 ± 1.8	48.41 ± 1.6
lipid	0.12 ± 0.02	0.10 ± 0.03	0.10 ± 0.01	0.08 ± 0.02	0.11 ± 0.01

Each value (μg / mg wet tissue) is the mean of 5 estimations ($\pm SD$)



A B C

Fig. 1: Histological section of gill. a) Normal gill b) Infected gill after 7 days c) Infected gill after 28 days

adjacent lamellae and the epithelium was lined by several layers of cells instead of single layer as observed in the control. As exposure continues for 28 days, desquamation of the hyperplasic epithelium was observed (Fig. -1c). There was cytoplasmic vacuolation and the nuclei became pycnotic. The lamellae were also seen shortened and were covered by mucous layer. The pillar cells were hypertrophied and the blood vessel between two rows of pillar cells was dilated.

Histopathological investigations can be used as biomonitoring tools or indicators of health in toxicity studies because they show preliminary symptoms of disease caused due to toxic response (Meyers and Hendricks, 1985). Because of drastic changes in the gill histology after treatment of sublethal concentration of zinc sulphate, disorder and imbalance in the metabolic state of fish might have caused and hence that reflected in biochemical changes. The results of biochemical estimation of protein, glycogen and lipid in gill tissue of Ophiocephalus punctatus are shown in Table 2.

Increase in protein content was observed in gills of experimental fish. It might be due to stimulation of protein synthesis to form detoxification enzymes. Glycogen content was decreased due to increased glycogenolysis after zinc intoxication and there is slight decrease in lipid content of gill tissue.

CONCLUSION

Gills remain in close contact with the external environment, hence, are the primary target of the toxicant. The toxicity of ZnSO4 even at sub lethal level may cause severe damage to gill tissue and reduce nutritive value of the fish significantly.

REFERENCES

APHA (1998) American Public health Association: Standard Method for Examination of Water and Waste Water. 20th ED

Elaiyaraja C., S. Subha, Sobana K. A. and Arunachalam A. (2018) Effects of zinc sulphate on the biochemical changes in the fish Cyprinus carpio. International Journal of Zoology and Applied Biosciences Vol. 3 No 5: Pages 390-395

Kumar M., A. Ratna, R. Prashad, S.P. Trivedi, Sharma Y.K. and Shukla A.K. (2015) Assessment of Zinc bioaccumulation in fish Channa punctatus exposed chronically. Global Journal of Bio-Science and Biotecnology Vol. 4 No 4: Pages 347-355

Meyers,T.R. and Hendricks, J.D. (1985) Histopathology. In: (Eds., Loux, D.B., 108 Dorfman, M.) Fundamentals of Aquatic Toxicology: Methods and Applications., Hemisphere USA Pages 283-330

Murugan S.S., R. Karuppasamy, Poongodi K. and Puvaneswari S. (2008) Bioaccumulation pattern of Zinc in freshwater fish Channa punctatus (Bloch.) after chronic exposure. Turkish Journal of Fisheries and Aquatic Sciences Vol.8: Pages 55-59

Nussey, G., Van, V.J.H.J. and Du, P.H.H. (2000) Bioaccumulation of chromium, manganese, nickel and lead in the tissues of the moggel, Labeo umbratus (Cyprinidae), from Witbank dam, Mpumalanga. Water SA Vol. 26: Pages 269-284

Sawarkar A. S. (2017) Zinc induced histopathological and biochemical anomalies in the liver of fish Ophiocephalus punctatus, International Journal of Life Sciences, Special Issue, A8: Pages 147-150