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RESEARCH ARTICLE

EFFECT OF COPPER SULFATE ON THE SERUM ELECTROLYTE CHANGES IN THE FRESH WATER FISH, *NOTOPTERUS NOTOPTERUS* (PALLAS)

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ABSTRACT

The present study was carried out to find out the changes induced by one of the type of stress conditions such as heavy metal copper sulfate, It is discharged into freshwater environments in large concentrations as an industrial effluent and severely affect the freshwater fauna, especially fishes. The serum electrolyte changes in the fish, *Notopterus notopterus* was investigated after copper sulfate exposure at sub lethal concentration. The significant changes were observed in the serum electrolytes, sodium values were found higher, potassium values were lower and calcium values were higher in the fish exposed to copper sulfate. The changes in the environmental factors such as pollutants cause stress to the fish which may bring disturbance in the blood parameters effecting the survival of fish.

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INTRODUCTION

Copper sulfate is a fungicide used to control bacterial and fungal diseases that are controlled by this fungicide includes mildew, leaf spots, blights and apple scab. It is also used as an algaecide, an herbicide in irrigation and municipal water treatment systems, and as a molluscicide, a material used to repel and kill slugs and snails. Copper sulfate is a naturally occurring inorganic salt and copper is an essential trace element in plant and animal nutrition. It is available in dusts, wettable powders and fluid concentrates, it is blue and odourless and gives off moisture when exposed to air. Copper sulfate is highly corrosive to plain steel, iron and galvanized pipes. It should not be stored in metal containers. It is indefinitely stable when kept dry and is stable to heat, cold or light. Burning copper sulfate may produce irritating or poisonous gases, and pollution may be caused by runoff from fire control or dilution water. There has been an excessive use of metals in industries in India (Lokhande and Kelker, 1999). They cause greatest threat to the health of Indian aquatic ecosystem (Joshi *et al*., 2002; Ohe *et al*., 2004; Satyaparmeshwar *et al*., 2006). Among metals, copper a group IB metal is used in industries like organic chemicals, fertilizers, iron and steel works, electrical works, antifouling paints, pulp and paper industries, pesticides, fungicides and automobile industries. It is discharged into freshwater environments in large concentrations as an industrial effluent and severely affect the freshwater fauna, especially fishes (Venkataramana and Radhakrishnaiah, 2001; Lodhi *et al*., 2006).

The present study was carried out to find out the changes induced by heavy metal copper sulfate on the serum electrolytes in the fish, *Notopterus notopterus.*

MATERIALS AND METHODS

Fresh water fish *Notopterus notopterus* (70-80 g body weight) were brought from Bheema River around 40 km away from Gulbarga. Fish were acclimatized for laboratory conditions for 7 days before the beginning of the experiment. Stable temperature of 27±3 is an optimum temperature during the whole period of study. The pH was detected twice during experiment before and after the completion of experiment by hand pH-meter. Fish were fed with earth worm and boiled egg pieces once daily from the day of arrival until the end of the experiment. The light provided for all aquaria during adaptation and experimental period was the natural photoperiod without interference, which was about 12 hours of light: 12 hours of dark/day during the days of study. The present study was carried out during March.

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The fish were exposed to sub lethal concentration of copper sulfate 3 (ppm) for 10 days. Water was renewed every 2 days with the same concentration of $CuSO_4$ for 10 days after which blood samples were collected. The sub lethal concentration were calculated after obtaining lethal concentration (LC_{50}) for 96 hrs. The copper sulfate having mol weight of 249.68 obtained from Loba chemicals ((Indo – Australian company) dissolved in water. About 50 fishes were used for determination of LC50. The fish were divided into four groups containing 10 fishes in each. Group I was kept control and group II, III, IV and V were exposed to cuso4 in different concentrations separately in aquaria containing sixty liters of water. The LC 50 at 96 hr was studied by obtaining the mortality of the fish at 96 hrs. The concentration at which the line crosses 50%. Survival line is the LC_{50} value (Shingadia and Sakthives, 2003).

Statistical treatment of the data

The experimental data was analyzed statistically by adopting varied statistical methods. Standard deviation and probability test i.e., 't' test were calculated. The student't' test was carried out to know the levels of significance using the standard formula. All the values of P below 5% level are designated as significant, and the values above 5% level are designated as non-significant (Mungikar, 2003). The experimental data was analyzed statistically by adopting varied statistical methods using statistical software S.P.S.S 7.5

Blood parameters

Blood samples collected from caudal blood vessels, this collected blood was centrifuged for serum separation. Sodium and Potassium were determined by colorimetric method, calcium was determined by modified Arsenazo method.

RESULTS AND DISCUSSION

The results obtained from the present investigation clearly shows that the fish *N. notopterus* survived well from 15 to 25ppm for 96hr, when 50% mortality was the criterion designation for determining the lethal concentration. The survival rate of fishes gradually decreased in all media with an increase in the concentration of copper sulfate. The observed lethal concentration (LC_{50}) for 96 hr was 30 ppm.

Table 1. Concentration of blood electrolytes in the fish *N. notopterus* exposed to copper sulfate

Ex- group/ parameters	Sodium (Na)	Potassium (K)	Calcium (Ca)
Control	74.13 ± 13.07	14.96 ± 1.59	9.01 ± 0.68
Copper sulfate (3 PPM)	98.44 ± 22.56**	13.43 ± 1.02^{NS}	9.97 ± 0.35**

Each value is expressed as mean ± SD, N = 6. NS = Not significant, * = significant P = < 0.05, ** = significant P = < 0.01, *** = significant = P < 0.001

The serum electrolyte sodium values were found higher, potassium values were lower and calcium values were found higher in the fish exposed to copper sulfate. Stress is an abnormal physiological condition of fish resulting when its collective adaptive responses to an environmental factor(s) are extended to or approaching the fish's limit of tolerance for that factor. Dallinger and Kautzky, (1985) indicated that the uptake of cadmium, copper and zinc from food could be the main route of metal uptake by rainbow trout *Salmo gairdneri*, although high level of elimination through faeces occurs. The teleost kidney functions primarily as a regulator of body fluid and secondarily as an excretory organ and electrolyte regulator. The freshwater fish is hypertonic to its environment and water continually diffuses across the gills into the blood. The kidney eliminates this excess water and reabsorbs most of the body electrolytes. Since copper is one of the element, which is needed for iron absorption, excess of copper may alter the blood biochemical levels. The gill functions not only as a respiratory organ, but also as an excretory and ion-regulating organ. The heavy metal exposure known to induce changes in blood parameters in fish (Heath, 1991). The blood electrolytes which are sodium (Na^+), potassium (K^+), chloride and calcium (Ca^{++}), and phosphorus (P^+) are commonly used to determine the physiological characteristics, toxicity and health status of fish (Percin *et al*., 2010). Monovalent ions namely, sodium (Na^+), and potassium (K^+) play an important role in osmoregulation and homeostasis. In vertebrates, the Na^+ concentration in the extracellular fluid surpasses that in the cytosol whereas K^+ is higher in the intracellular fluid compared to the plasma. Thus, the levels of serum electrolytes offer important knowledge concerning the health status of diseases of and impact of stress on fish (Evans, 1993).

Conclusion

The data presented here support the theory that prolonged exposure to elevated levels of copper sulfate may decrease the immune response, induce serum electrolytes changes indicative of a pathologic response, and may increase mortality. The pathologic changes are sufficient to affect the normal physiology of the fish and will probably result in decreased growth and increased susceptibility to diseases. The results reported in this study have potential implications for fish in nature.

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