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Toxic effect of copper sulphate on protein alterations in esturine fish, *Mugil cephalus*

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ABSTRACT

Heavy metals are common pollutants of estuarine ecosystems where they induce adverse effects on the aquatic biota. Copper is one of the most toxic heavy metal to fish and consumption of fish after copper treatment in water may pose a serious risk to human health. Fishes are generally used as pollution indicators in water quality management. Chronic effects include reduced growth, shorter lifespan, reproductive problems, reduced fertility and behavioral changes. Esturine fish, *Mugil cephalus* is an important fin fish species of Uppanar estury in Cuddalore region having good nutritional values. Fishes living in close association with the sediment may accumulate copper sulphate. In the present observation, the toxic effects of the copper sulphate LC_{50} 35 µg/L ($CuSO_4$) on (10% and 30%) two sublethal concentrations of total protein in gill, liver and muscles tissues of the esturine fish, *Mugil cephalus* were estimated during the periods of 5, 10 and 15 days exposure. There is decreased in all tissues on comparison with control. The results indicated the toxic nature of the heavy metal copper sulphate.

1. Introduction

Copper sulphate is frequently used as an algaecide in commercial and recreational fish ponds to control growth of phytoplankton and filamentous algae, and to control certain fish diseases (Tucker and Robinson, 1990). Conversely, above a particular concentration, copper is toxic to fishes including such cultured species as salmonids, cyprinids and catfishes (Wurts and Perschbacher, 1994). Consequently, treating plankton with copper compounds might lead to copper bioaccumulation reaching a toxic stage in fish. The toxic effect of copper is correlated to its aptitude for catalyzing oxidative reactions, leading to the production of reactive oxygen species (Lopes et al., 2001). Fishes are superlative organisms to examine aquatic systems because they engage positions towards the zenith of food pyramids and could, consequently, imitate effect of heavy metals on other organisms including human beings as well as direct stresses on themselves (Vander et al., 2003).

Pollution of the natural environment by heavy metals is a worldwide problem because these metals are indestructible and when they exceed a certain concentration, most of them have toxic effects on living organisms (Alam et al., 2002). Fish species are widely used to biologically monitor variation in environmental levels of anthropogenic pollutants (Vinodhini and Narayanan, 2008; Palaniappan and Karthikeyan, 2009). Heavy metals enter the aquatic environment by atmospheric deposition, by weathering from the geological matrix, or from anthropogenic sources, such as industrial discharge, sewage, agricultural waste, and mining wastes (Ebrahimpour and Mushrifah, 2010).

Copper pollution appears in the aquatic environment from natural and anthropogenic sources such as mine washing, agricultural leaching and direct application as algaecide and molluscicide. Moreover, liver is known to be the primary organ for copper storage in fish (Trivedi et al., 2012). The gill is the first tissue contacting with the contaminants in the water. Due to its large surface area and the small diffusion distance between the water and blood, the gills are primarily affected by contaminants such as metals. In general, the gill cells respond rapidly to various chemicals to overcome physiological impairment or tissue damage, and chemicals may have a negative effect on the overall gill function, enhancing fish susceptibility to toxic compounds and potentially leading to fish mortality (Demir et al., 2016). The gill is the main place for copper uptake, and because it has a constant and direct contact with the external environment (Atabati et al., 2015). The copper sulphate is worldwide used as an algaecide and a fungicide in aquaculture and agriculture (Lasiene et al., 2016). In the aquaculture industry, copper sulphate is used as a therapeutic chemical for various ectoparasitic and bacterial infections. It is reducing the incidence of fish parasites such as protozoa, trematodes, and external fungi and bacteria. It also inhibits growth of bacteria (Nouh and Selim, 2013; Lasiene et al., 2016).

2. Materials and methods

The esturine fish, *Mugil cephalus* were collected from Uppanar estury on the Cuddalore area and were brought to the laboratory in large plastic troughs and acclimatized for one week. Healthy, fishes having equal size (length 10 to 15 cm) and weight (50 to 100 g) were used for experimentation. Stock solution of copper copper sulphate ($CuSO_4$ + 5 H_2O) was prepared by dissolving appropriate amount of salt in distilled water. The physico-chemical characteristic of test water have analyzed regularly during the test periods following the standard method describe by APHA (1998). Batches of 10 healthy fishes were exposed to different concentrations of insecticide copper sulphate to calculate the medium lethal concentration LC_{50} value (35 µg/L) using probit analysis Finney method (1971). The fishes (Four groups) were exposed to two sublethal concentrations ($1/10^{th}$ and $1/30^{th}$ µg/L) of copper sulphate for 5, 10 and 15 days respectively. Another group was maintained as control. At the end of each exposure period, fishes were sacrificed and tissues such as gill, liver and muscle were dissected and removed. The tissues (10 mg) were homogenized in 80% methanol, centrifuged at 3500 rpm for 15 minutes and the clear supernatant was used for the analysis of total proteins. Total protein concentration was estimated by the method of Lowry (1951).

3. Result

The changes in the total protein of gill, liver and muscles of esturine fish, *Mugil cephalus* exposed to sublethal concentrations of copper sulphate were studied along with control fish. The data was supported by various statistical analyses and the standard deviation of the mean was calculated.

Esturine fish, *Mugil cephalus* treated with 10% sublethal concentration of copper sulphate showed a decreasing trend in the gill protein (Table 1 and Figure 1). The control protein values were recorded respectively to 5, 10 and 15 days of exposure periods. Total protein content in the gill of fish, *Mugil cephalus* treated with sublethal concentration of copper sulphate on (10%) showed a decreasing trend when compared to control (Table 1 and Figure 2). The total liver protein was noticed in the 10% sub lethal concentration of copper sulphate treated fish (Table 1 and Figure 3).

Table I: Total protein content (mg/g) in tissues of esturine fish, *Mugil cephalus* exposed to 10% and 30% sublethal concentrations of copper sulphate (Means ± SD , N=3)

Exposure	Treatment	Gill	Liver	Muscles
5 days	Control	6.23 ± 0.11	8.68 ± 0.09	9.35 ± 0.15
	10% SLC	5.85 ± 0.08	6.67 ± 0.19	7.56 ± 0.19
	30% SLC	5.12 ± 0.07	6.21 ± 0.16	6.79 ± 0.18
10 days	Control	6.36 ± 0.29	8.61 ± 0.26	9.33 ± 0.22
	10% SLC	4.70 ± 0.11	5.66 ± 0.31	6.13 ± 0.13
	30% SLC	4.24 ± 0.09	5.33 ± 0.12	5.84 ± 0.11
15 days	Control	6.39 ± 0.11	8.68 ± 0.32	9.36 ± 0.15
	10% SLC	4.01 ± 0.15	4.83 ± 0.18	5.44 ± 0.18
	30% SLC	3.67 ± 0.19	4.55 ± 0.25	5.14 ± 0.08

Values are mean three observations ± SD

Figure 1: Total protein content (mg/g) in gill tissues of esturine fish, *Mugil cephalus* exposed to 10% and 30% sublethal concentrations of copper sulphate.

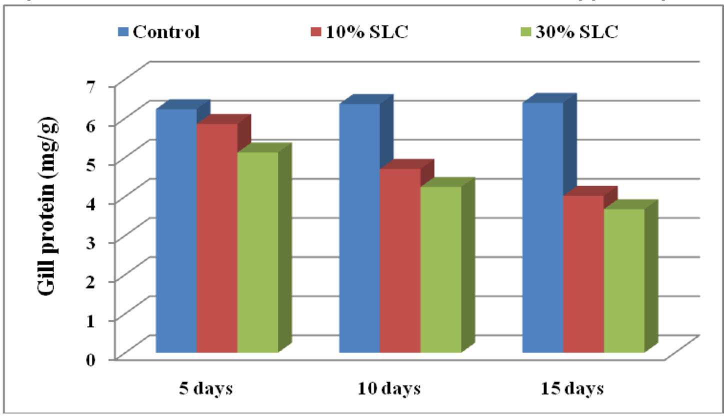


Figure 2: Total protein content (mg/g) in liver tissues of esturine fish, *Mugil cephalus* exposed to 10% and 30% sublethal concentrations of copper sulphate.

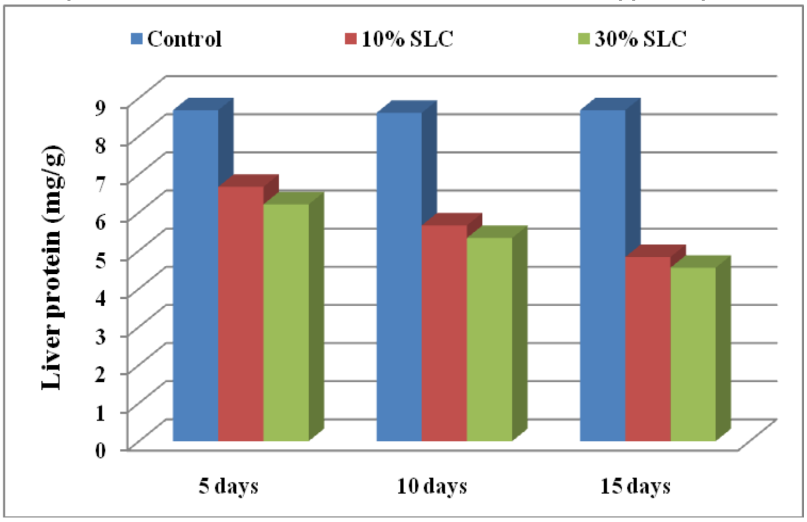
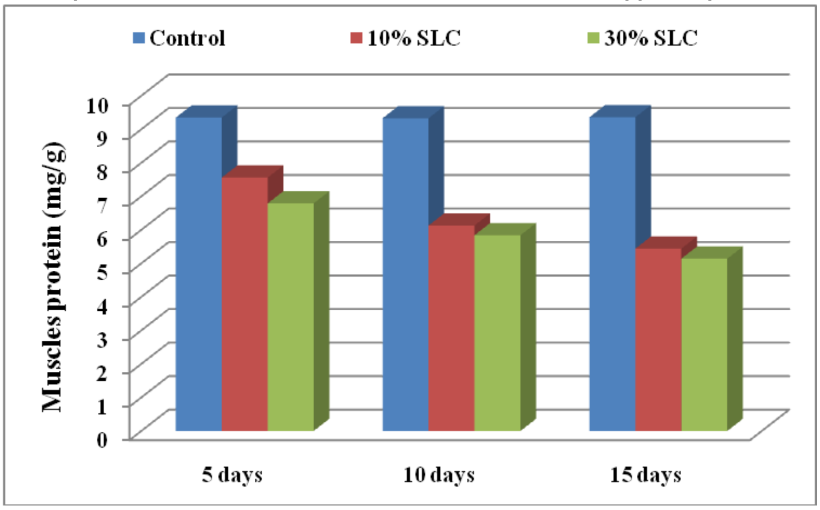


Figure 3: Total protein content (mg/g) in muscles tissues of esturine fish, *Mugil cephalus* exposed to 10% and 30% sublethal concentrations of copper sulphate.



4. Discussion

The change in biochemical composition of an organ due to heavy metal stress indicates the change in activity of an organism. It reflects light on the utilization of their biochemical energy to counteract the toxic stress. Heavy metal salts affect the metabolism of the esturine mud crab, *Scylla serrata*. Alterations in metabolic processes, following exposure to heavy metal stress have been always used as an indicator of stress. But there is a vast difference in the pattern & metal induced physiological alterations from metal to metal and animal to animal. Protein content in the tissue of animal is an important essential organic constituent which plays a vital role in the cellular metabolism. All enzymes are proteins in nature and they control sub cellular functions and accelerate the rate of metabolic action in the body of organism.

In present study, fish *Mugil cephalus* of the protein contents in the selected tissues was decreased in chronic concentration of copper sulphate as compared to the control. According to (Tucker and Robinson, 1990) the decrease of protein may be due to alterations of membrane permeability. To elevate the level of repair, the proteolytic action increase, resulting decreased of protein contents (Demir et al., 2016). The depletion in the protein content was reported from the muscles of fish, *Clarias batrachus* after treatment with pesticide by the Vinodhini and Narayanan, 2008. Atabati et al. (2015) studied variation in protein metablism in *Barytelephusa cunicularis*. Lasiene et al. (2016) reported decrease in protein contents in the fresh water bivalve *Corbicula striatella* after heavy metal stress most of the time. Trivedi et al. (2012) reported that sodium arsenide decreased in the concentration of protein in catfish *Clarius batractus.* More, Vinodhini and Narayanan, (2008) observed similar results in fresh water crab, *Barytelphusa guerini* in blood, gill, hepatopancreas, and muscle exposed to cadmium sulphate and copper sulphate. In present stress, ionic copper sulphate might have caused severe disturbances of the metabolism in the animal. Chronic exposure of copper sulphate alone showed a remarkable decrease in protein content in *Barytelphusa cunicularis* than the chronic doses of heavy metal salts with caffeine.

5. Conclusion

In the present study in total protein content in the gill, muscle and hepatopancreas of wet tissues in esturine mud crab, *Scylla serrata* were declined when compared to control.

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References

1. Alam M., Tanaka A., Allinson, G., Laurenson L., Stagnitti F. and Snow E.A. (2002). comparison of trace element concentrations in cultured and wild carp (*Cyprinus carpio*) of Lake Kasumigaura, Japan. *Ecotoxicol. Environ. Saf*., 53 (3): 348-354.
2. APHA. (1998). Standard methods for the examination of water and wastewater, 20 edition. APHA, Washington, USA.
3. Atabati A., Keykhosravi A., Askari-Hesni M., Vatandoost J. and Motamedi M. (2015). Effects of copper sulfate on gill histopathology of grass carp (*Ctenopharyngodon idella*). *Iran. J. Ichthyol*., 2: 35-42.
4. Demir Y., Oruc E. and Topal A. (2016). Carbonic anhydrase activity responses and histopathological changes in gill and liver tissues after acute exposure to chromium in brown trout juveniles. *Hacettepe J. Biol. Che.,* 44: 515-523.
5. Ebrahimpour M. and Mushrifah I. (2010). Seasonal variation of cadmium, copper, and lead concentrations in fish from a freshwater lake. *Biol. Trace Ele. Res*., 138(1): 190 - 201.
6. Finney D.J. (1971). Probit analysis, 3rd (Ed.), Cambridge University Press, London, 333.
7. Lasiene K., Straukas D., Vitkus A. and Juodziukyniene N. (2016). The influence of copper sulphate pentahydrate ($CuSO4{\cdot}5H2O$) on the embryo development in the guppies (*Poecilia reticulata*). *Ital. J. Ani. Sci*., 15: 529 - 535.

8. Lopes P.A., Pinheiro T., Santos M.C., Mathias M. & Collares-Pereira, M.J. (2001). Response of antioxidant enzymes in freshwater fish populations (*Leuciscus alburnoides* complex) to inorganic pollutants exposure. *Sci. Environ.,* 280: 153-163.
9. Lowry O.H., Rosebrough N.J., Farr A.L. & Randall R.J. (1951). Protein measurement with the Folin phenol reagent. *J. Biol. Chem.,* 193: 265–275.
10. Nouh W.G. and Selim A.G. (2013). Toxopathological studies on the effect of formalin and copper sulphate in Tilapia as a commonly used disinfectant in aquaculture. *J. Appl. Environ. Biol. Sci*., 3: 7–20.
11. Palaniappan, P. and Karthikeyan, S. (2009). Bioaccumulation and depuration of chromium in the selected organs and whole body tissues of freshwater fish *Cirrhinus mrigala* individually and in binary solutions with nickel. *J. Environ. Sci*., 21(2): 229 - 236.
12. Trivedi M.H., Sangai N.P. & Renuka A. (2012). Assessment of toxicity of copper sulphate pentahydrate on oxidative stress ındicators on liver of gold fish (*Carassius auratus*). *Bull. Environ. Pharmacol. Life Sci*., 1: 52 - 57.
13. Tucker C.S. and Robinson E.H. (1990). Channel Catfish Farming Handbook. Van-Nostrand-Reinhold, New York, USA.
14. Vander O.R., Beyar J. and Vermeulen N.P.E. (2003). Fish bioaccumulation and biomarkers in environmental risk assessment. *Environ. Toxicol. Pharmacol.,* 13: 57 - 149.
15. Vinodhini R. and Narayanan M. (2008). Bioaccumulation of heavy metals in organs of fresh water fish *Cyprinus carpio* (Common carp). *Int. J. Environ. Sci. Tech*., 5(2): 179 - 82.
16. Wurts W.A. and Perschbacher P.W. (1994). Effects of bicarbonate alkalinity and calcium on the acute toxicity of copper to juvenile channel catfish (*Ictalurus punctatus*). *Aquacult*., 125: 73-79.

