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RESEARCH ARTICLE

TOXIC EFFECT OF COPPER SULPHATE ON BIOCHEMICAL ALTERATIONS IN A ESTUARINE MUD CRAB, *SCYLLA SERRATA*

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ABSTRACT

Heavy metal pesticides are common pollutants of freshwater ecosystems where they induce adverse effects on the aquatic biota. Estuarine mud crab, *Scylla serrata* is an important crustacean species of Agniyar estuary in Thanjavur region having good nutritional values. Crabs living in close association with the sediment may accumulate copper sulphate. In the present investication, the toxic effects of the copper sulphate LC_{50} 4.85 ppm (CuSO4) on some biochemical characteristics (total protein in muscle, gill and hepatopancreas) of the estuarine mud crab, *Scylla serrata* were estimated. There is decreased in all tissues on comparison with control. The results indicated the toxic nature of the heavy metal copper sulphate.

INTRODUCTION

Good experimental data on copper toxicity are more difficult to obtain than for zinc. In hard water, copper precipitate out as a basic carbonate which is very slow to redissolve. It is difficult to prepare experimental solution in such waters because the colloidal precipitate which can be formed is not acutely toxic and the amount of copper present in the toxic ionized form may be variable. Copper sulphate has been widely used in the past as an algaecide in fish-bearing water, at concentrations which would be toxic if the metal was present in the toxic ionized form. However most, if not all of this inactive copper will ultimately enter sediment sinks where it may have limited bioavailability for organisms living there (Figuero *et al.,* 2006). Heavy metals are recognized as a strong biotoxicants, because of their persistent nature and cumulative action to the aquatic flora and fauna (Sharma and Agrawal, 2005). The discharge of heavy metals by industries pose a serious water problem due to the toxic properties of these metals and their adverse effects on aquatic life. According to the survey conducted by Central Inland Fisheries Research Institute (CIFRI, 1981), these heavy metals are well known pollutants which are often encountered in many rivers of India, and there is every possibility of deterioration of water quality and hence including man and various organisms are presenting a potential threat for survival. Heavy metals are economic poisons used to control a wide range of animal and plant pests.

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The fresh water environment is becoming increasingly polluted throughout the biosphere with various heavy metals and as heavy metals are non-biodegradable, their concentration in the environment increases. These environmental pollutants bring about damage to different organs or disturb the physiological and biochemical processes within the organism.

In the aquatic invertebrate, Beaby and Eaves, (1983) observed that molluscscan accumulate higher concentration of metal ions than other groups of invertebrates. Among the heavy metals copper is important metal which is mostly used in the industries, paints and ceramics. The fertilizers are the main sources of copper, zinc and mercury which cause the pollution to the different media (1984). Intoxication of copper reduces growth, survival and rate of reproduction in the aquatic invertebrates.

MATERIALS AND METHODS

The estuarine mud crab, *Scylla serrata* were collected from Agniyar estuary in Thanjavur area and were brought to the laboratory in large plastic troughs and acclimatized for one week. Healthy, intermoult (stage C-3) male crabs having equal size (Carapace width 25 to 30 mm) and weight (20 to 25 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 crabs were exposed to different concentrations of insecticide copper sulphate to calculate the medium lethal concentration LC_{50} value (4.85 ppm) using probit analysis Finney method (1971). The fishes (Four groups) were exposed to the sub lethal concentration (0.48 ppm) of copper sulphate for 24, 48, 72 and 96 hr respectively.

Another group was maintained as control. At the end of each exposure period, crabs were sacrificed and tissues such as liver, gill and muscle were dissected and removed. The tissues (10 mg) were homogenized in 80% methanol, centrifuged at 3500 rpm for 15 min. and the clear supernatant was used for the analysis of total proteins. Total protein concentration was estimated by the method of Lowry (Lowry *et al.,* 1951).

RESULTS

The changes in biochemical composition of muscle, gill and liver of estuarine mud crab, *Scylla serrata* exposed to acute concentrations of copper sulphate were studied along with control crab. The data was supported by various statistical analyses and the standard deviation of the mean was calculated. Estuarine mud crab, *Scylla serrata* when treated with 10% sublethal concentration of copper sulphate showed a decreasing trend in the gill protein (Table 1 and Fig. 1). The control protein values were recorded respectively to 24, 48, 72 and 96 hours of exposure periods. Total protein content in the muscle of estuarine mud crab, *Scylla serrata* treated with sublethal concentration of copper sulphate on (10%) showed a decreasing trend when compared to control (Table 1 and Fig. 2).

Table 1. Total protein content (mg/100mg) in wet weight tissues of estuarine mud crab, *Scylla serrata* exposed to 0.48 ppm (10%) copper sulphate. Means + SD (N=4)

Exposure	Treatment	Gills	Muscles	Hepatopancreas
24 hrs	Control	0.140 ± 0.038	0.192 ± 0.012	0.195 ± 0.022
	Copper sulphate	0.12 ± 0.022	0.167 ± 0.025	0.175 ± 0.036
48 hrs	Control	0.152 ± 0.033	0.195 ± 0.017	0.192 ± 0.017
	Copper sulphate	0.102 ± 0.009	0.150 ± 0.021	0.165 ± 0.012
72 hrs	Control	0.145 ± 0.017	0.185 ± 0.012	0.187 ± 0.017
	Copper sulphate	0.095 ± 0.019	0.135 ± 0.021	0.153 ± 0.012
96 hrs	Control	0.140 ± 0.014	0.189 ± 0.012	0.192 ± 0.009
	Copper sulphate	0.085 ± 0.019	0.125 ± 0.013	0.145 ± 0.013

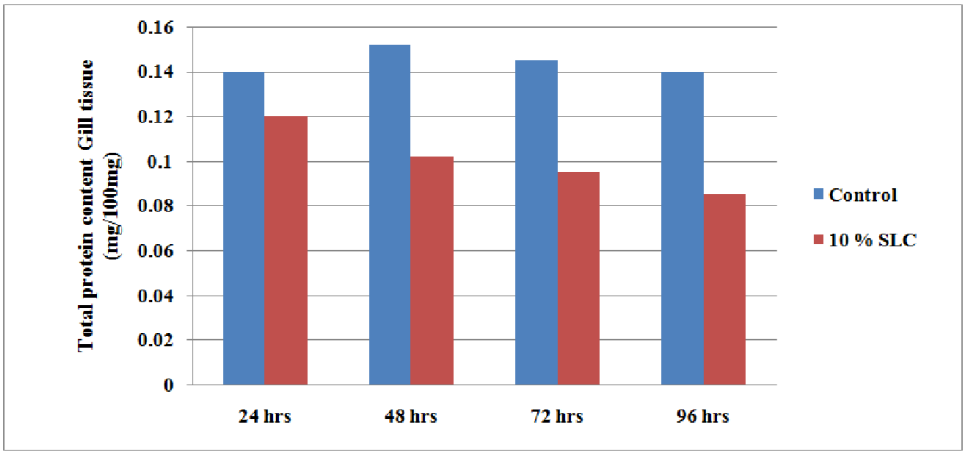

Fig.1. Total protein content (mg/100mg) in wet weight gill tissues of estuarine mud crab, *Scylla serrata* exposed to 0.48 ppm (10%) copper sulphate

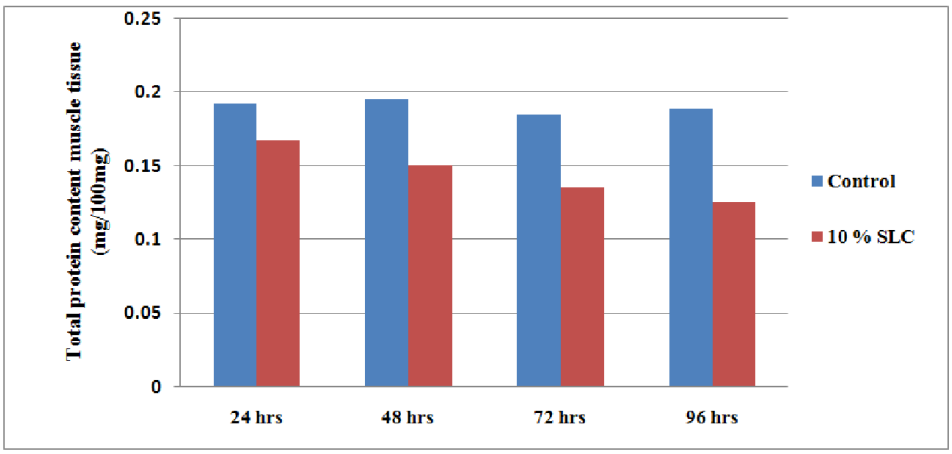

Fig.2. Total protein content (mg/100mg) in wet weight muscle tissues of estuarine mud crab, *Scylla serrata* exposed to 0.48 ppm (10%) copper sulphate

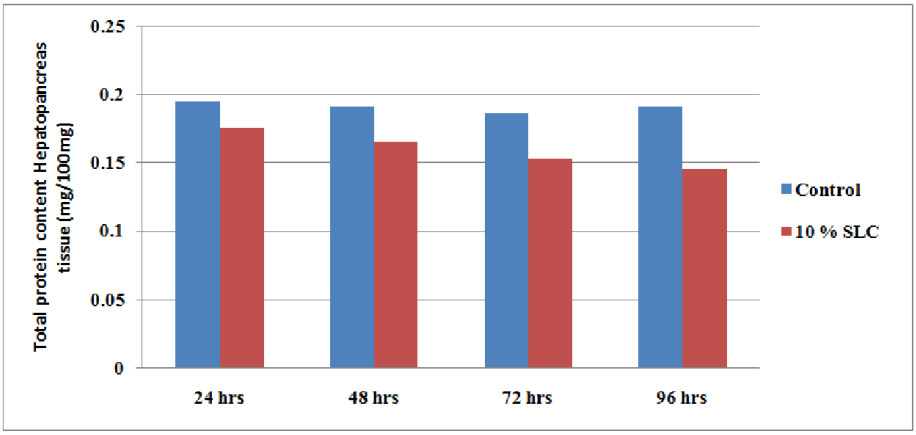

Fig.3. Total protein content (mg/100mg) in wet weight hepatopancreas tissues of estuarine mud crab, *Scylla serrata* exposed to 0.48 ppm (10%) copper sulphate

The total hepatopancreas protein was noticed in the 10% sub lethal concentration of copper sulphate treated fish (Table 1 and Fig. 3).

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 estuarine 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, estuarine mud crab *Scylla serrata* of the protein contents in the selected tissues was decreased in chronic concentration of copper sulphate as compared to the control. According to Abel, (1974) 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 (Kabeer *et al.,* 1977). The depletion in the protein content was reported from the muscles of fish, *Clarias batrachus* after treatment with pesticide by the Yagana Bano *et al*. (1981). Nagabhushanm and Kulkarni, (1979) studied variation in protein metablism in *Barytelephusa cunicularis*. Mukherjee and Sinha, (1993) studied the effect of heavy metal toxicity on haematological and biochemical aspect in the fresh water major carps, *Labeo rohita*. Katticaran *et al*. (1995) studied the copper induced alterations in total carbohydrate and protein level in the bivalve, *Sunetta scripta*. Mahajan and Zambare, (2001) reported decrease in protein contents in the fresh water bivalve *Corbicula striatella* after heavy metal stress most of the time. Kumar *et al.* (1995) reported that sodium arsenide decreased in the concentration of protein in catfish *Clarius batractus.*

More, (2012) and Sawant *et al.* (2012) 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.

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

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