

Toxicity Evaluation and Its Effects on Barytelphusa Gureini

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Abstract: The main objective of this study was to evaluate the acute toxicity of cadmium which is one of the most deleterious heavy metals in the aquatic fauna. The fresh water field crab, *Barytelphusa gureini* is an important human food source in different parts of India. Evaluation of the toxic effect of cadmium chloride on the experimental crab for the Lc50 value was carried out. The present study evaluates toxicity of cadmium chloride and its impact on the proteins of hepatopancreas, muscle, hemolymph, gills and gonads of the fresh water field crab *Barytelphusa gureini*. The significant role of cadmium chloride in the above organs of the experimental animal discussed and the results correlated with the findings of the earlier researches.

Keywords: *Barytelphusa gureini*, cadmium chloride, lethal concentration

I. INTRODUCTION

Cadmium (Cd) is one of the most toxic heavy metals for human populace; the main source of non occupational exposure to Cd includes smoking, air, food and water contaminated by Cd. In addition, herbal medicine is the another source of Cd. The World Health Organization (WHO) estimates that 4 billion people or 80 percent of the world population presently use herbal medicine. Acute or chronic exposure of Cd causes respiratory distress, lung, breast and endometrial cancers, cardio vascular disorders and endocrine dysfunctions [1, 2].

Cadmium is a non essential heavy metal but it has accumulative polluting effect, and causes toxicity to aquatic organisms even in minute concentrations. It is highly toxic for aquatic organisms when it is deposited in bottom sedimentation. It is seriously harmful to the growth of aquatic life and survival, resulting in decline of their population. At the same time, as aquatic food products, these animals exposed to Cd might threaten human health. In recent past major attention has been paid to the toxic effects of the heavy metals that have accumulated in aquatic ecosystems and their inhabitants. Therefore, it is regarded as one of the most toxic elements in the environment.

Proteins play a crucial role in virtually all-biological processes, they are important organic substances required in tissue building and repair. Under extreme stress conditions, protein supplies energy in metabolic pathways and biochemical reactions. Toxicity tests allowed determining these effects and evidence of the biological responses of aquatic organisms to contaminants. It was thought worthwhile to study the impact of excessive cadmium chloride in aquatic biota. Therefore, an attempt has been made to investigate the effect of cadmium chloride on protein in some vital organs of fresh water crab *Barytelphusa gureini*. The significant role of cadmium chloride in vital organs discussed and the results correlated with the findings of the earlier researchers.

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II. MATERIALS AND METHODS

Experimental animals:

Adult specimens of fresh water field crab *Barytelphusa gureini* were collected from the outskirts of paddy fields of Pune district (Maharashtra), and were brought to the laboratory. They were acclimatized in the laboratory for seven days before they were used for experimentation. Only healthy crabs weighing between 30-40 grams were selected for experimentation to avoid problems of sex and size. The animals were fed with small pieces of goat flesh and uncooked oats. The physico-chemical parameters of water were estimated and were as follows: dissolved oxygen: 7.2 -7.4 ppm, pH 7.0 - 7.2, temperature: $29 \pm 2.0^{\circ}\text{C}$, salinity: 0.4 - 0.5 $\mu\text{g/mL}$, and total hardness: 280 - 288 mg/L [3].

Toxicity bioassay:

The acclimated crabs of equal size were divided into five experimental groups of six crabs each and treated with different concentrations of cadmium chloride (3.5 – 6.5 $\mu\text{g/mL}$) respectively. The mortality rate was noted up to 96 hours, the test medium and dead crabs were removed with an interval of 24 hours immediately. The Lc 50 was calculated by using Probit analysis method Finney [4]. After finding Lc50, the crabs were treated with a sub lethal concentration of cadmium chloride (4.5 $\mu\text{g/mL}$) for 24, 48, 72 and 96 hours respectively. The other group of crabs kept as control. Each group of crab was maintained in plastic trough of 30 liter capacity and was starved for 24 hours, prior to and during the course of experiment for the estimation of total protein. The estimation was carried out by using Lowry method.

Statistical analysis:

Two ways ANNOVA was used to test the differences between the two groups. In all statistical analysis significance was assessed at $P < 0.05$ level. Thus the results were found to be statistically not significant.

III. RESULTS

The biochemical response of cadmium chloride in fresh water field crab *Barytelphusa gureini* was studied at sub lethal concentration (4.5 $\mu\text{g/mL}$) for 24, 48, 72, and 96 hour of periods. The total protein was estimated and compared with the control group of crabs. Table (1) reveals that a significant decline in the total protein in various organs of *Barytelphusa gureini* at sub lethal concentration of copper sulphate as follows: hepatopancreas (48.2 %) > muscle (36.2 %) > hemolymph (powder form) (32.3 %) > gill (29.5 %) > gonad (24.7 %).

Table (2) shows a significant increase in the total protein in various organs of control crab *Barytelphusa gureini*, gonad (0.088mg/100mg) < gill (0.108 mg/100mg) < hemolymph (0.121 mg/100mg) < muscle (0.175 mg/100mg) < hepatopancreas (0.210 mg/ 100mg). The results were compared with each other, and also with the findings of other researchers. The first part of the results deals with the quantitative estimation of total protein in various organs, their comparative study and biological significance of controlled *Barytelphusa gureini*. The other part deals with the effect of cadmium chloride on the estimation of total protein, its comparative study with reasoning.

Table. 1

Tissues	Exposure time	Control mean \pm S.D	Treated mean \pm SD	Paired t test values	P values	Decrease %
Hepatopancreas	0-96 hr	0.210 \pm 0.19	0.077 \pm 0.022	16.309	<0.05	48.2
Muscle	0-96 hr	0.175 \pm 0.15	0.091 \pm 0.012	10.941	<0.05	36.2
Hemolymph	0-96 hr	0.121 \pm 0.08	0.099 \pm 0.022	10.700	<0.05	32.3
Gill	0-96 hr	0.108 \pm 0.11	0.117 \pm 0.027	22.248	<0.05	29.5
Gonad	0-96 hr	0.088 \pm 0.09	0.163 \pm 0.075	24.955	<0.05	24.7

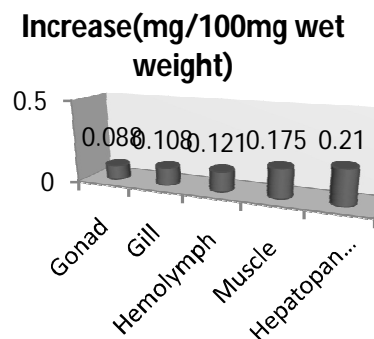
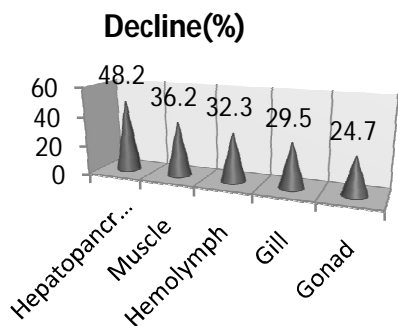
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Table.2

Tissues	Control	24hr	48hr	72hr	96hr
Gonad	0.088±0.09	0.082±0.03	0.076±0.03	0.062±0.01	0.054±0.02
Gill	0.108±0.11	0.096±0.01	0.087±0.01	0.078±0.02	0.065±0.01
Hemolymph	0.121±0.08	0.112±0.01	0.102±0.01	0.095±0.03	0.082±0.02
Muscle	0.175±0.15	0.163±0.03	0.151±0.03	0.144±0.04	0.136±0.01
Hepatopancreas	0.210±0.19	0.198±0.02	0.184±0.05	0.172±0.01	0.158±0.03



IV. DISCUSSION

Biochemical analysis of the important organs like hepatopancreas, hemolymph, muscles, gonads and gills of crustaceans yielded interesting information on the exchange and movement of chemical substances between the various organs throughout the course of their annual cycle [5]. Environmental stressors can alter both the quantity and quality of protein in crustaceans. Exposure to contaminants such as pesticides and heavy metals can increase or decrease total protein depending on the species, concentration and duration of exposure. The majority of crustaceans undergo a period of natural depletion for a part of their life cycle. During such environmental stress, they utilize the body energy reserve as fuel for metabolic activities, survival and combat against the stressors. The metabolic strategies employed to resist stress vary considerably from species to species.

Hepatopancreas:

Depletion of protein content in the hepatopancreas of marine edible crab *Scylla serrata* due to organochlorine pesticide dimecron toxicity was reported [6]. Marked decrease in the protein content in the hepatopancreas of fresh water field crab *Paratelphusa hydrodromus* in response to pesticide malathion toxicity was reported [7]. The effect of endosulfan in the hepatopancreas of the fresh water field crab *Barytelphusa gureini* was studied and noted the decrease in protein [8]. The present results showed a considerable decrease in the amount of protein in the hepatopancreas of *Barytelphusa gureini* which indicates that during the stress of cadmium chloride it is preferably consumed as reserve source material. Since protein has high calorific value than that of carbohydrates they might have been utilized for energy production during stress condition.

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Muscle :

Decrease in protein content in the muscles of prawn *Metapenaeus monoceros* due to phosphomidon exposure was reported [9]. Observations were made about the decrease in protein content in the muscles of prawn *Penaeus indicus* after exposure to the pesticide *phosphomidon* and methyl parathion by [8]. Protein depletion in the muscles of freshwater prawn *Macrobranchium malcolmsoni* in response to dichlorvos exposure was noted [10]. Maximum decrease in protein content in the muscle tissues of a crab *Sesarma quadratum* when treated with 9.3 ppm copper chloride solution for 21 days was observed [11]. The effect of endosulfan in various tissues of the fresh water field crabs *Barytelphusa gureini* were studied and noted a remarkable decrease in protein content in the muscle tissues [8].

The decrease in protein content in the muscle of the present experimental crab *Barytelphusa gureini* exposed to sub lethal concentration of cadmium chloride suggested that the protein might have been channeled for energy production in which these products play a pivot role during stress condition. Since protein forms the rich source of energy reserve whose calorific value is twice that of equivalent weight of carbohydrates. It is preferably utilized as reserve food source material and source of energy for muscle contraction.

Hemolymph:

It has been shown that the hemolymph of crustaceans contain considerably high percentage of protein as compare to carbohydrate and lipid [12]. It play an important role in transporting protein from the hepatopancreas to different vital organs such as muscle, gonads gills etc. It also function as β - 1,3 glucon-binding protein in the crustacean's immune recognition [13]. It has been shown that when *Spirolothelphusa hydrodroma* treated with chlorpyrifos the protein content decreased in haemolymph [14]. The decrease of protein was high at (0.04ppm) sub lethal concentration of chlorpyrifos for 30 days of exposure period. In the present study the decline of protein in haemolymph of *Barytelphusa gureini* may be used as energy source to counteract heavy metal stress prevailing on the different vital organs during the exposed period of toxicity.

Gills:

It was noted that when *Spirolothelphusa hydrodroma* treated with chlorpyrifos the protein content decreased in gills. The decrease of protein was high at (0.04ppm) sub lethal concentration of chlorpyrifos for 30 days of exposure period [14]. A decline in protein content in the gills of fresh water prawn *Macrobranchium kristensis* in response to pesticide exposure [15]. It was reported that fresh water crustaceans subjected to 1.4 ppm of copper sulphate for 60-80 days demonstrated a gradual decrease in gill protein [16,17]. Maximum decrease in protein content in the gill tissues of a crab *Sesarma quadratum* was reported when treated with 9.3 ppm copper chloride solution for 21 days [11].

The depletion of protein content was observed in the gills of the present experimental animal *Barytelphusa gureini* when exposed to sub lethal concentration of cadmium chloride. This indicates that during the stress period protein might have been channeled for energy production during hypoxic condition. More amount of energy may be utilized for the repair of necroses gill tissues, intake of oxygen and removal of contaminants to maintain the homeostasis. Since gills act as an organ of excretion and respiration.

Gonads:

Reports about the depletion of protein contents in the gonads of marine edible crab *Scylla serrata* due to organochlorine pesticide dimecron were recorded [6]. Similar marked decrease in protein content in the fresh water field crab *Paratelphusa hydrodromous* in response to pesticide malathion toxicity was observed [7]. Decrease in protein, in the gonads of fresh water field crab *Barytelphusa gureini* studied and noted when treated with endosulfan [8]. Observations were made about the depletion of protein in the gonads of prawn *Metapenaeus monoceros* due to phosphomidon exposure.

The present study reveals the decline of protein in the gonads of *Barytelphusa gureini* at the sub lethal concentration of cadmium chloride toxicity. It is suggested that the depletion of protein may be because it is used as energy to overcome the heavy metal stress on various vital organs and the gonad itself rather it is used in the formation of yolk and the maturation of gonads. It is conclude that the depletion of protein content in different vital organs of the present experimental animal, induce to diversification of energy to meet the impending demand during the toxic stress of cadmium chloride. The present observations are in agreement with the findings of earlier researchers.

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