IMPACT OF HEAVY METALS CADMIUM SULPHATE AND MERCURY SULPHATE ON CARBOHYDRATE CONTENT IN ESTUARINE CRAB SCYLLA SERRATA

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Abstract

In present investigation the estuarine crab Scylla serrata exposed to cadmium sulphate and mercury sulphate (17.2mg/L, 6 mg/L) for the up to 24, 48, 72, 96, 120 hrs respectively. The carbohydrate content was estimated in the different tissue of Scylla serrata such as hepatopancreas muscle, chelate legs gills and heart. There was significant depletion in carbohydrate content in different organ of crab Scylla serrata. The depletion is maximum in hepatopancreas followed by muscle, chelate legs and gills as hepatopancreas was supported to store glucose and to utilize it for energy production to counter of the heavy metals. The reduction of carbohydrate in muscle also supported that glycogen was utilized first from hepatopancreas and then from muscle. These heavy metals damage gills as well as decreased glycogen contents such damage affect their efficiency and result in tissue hypoxia and elevated blood glucose as an anaerobic energy source. The carbohydrates are energy rich compound in stress condition to meet energy demand, in crab carbohydrate content is minor percentage of total biochemical composition. The decrease in glycogen in tissue also suggested the impairment may involve shift of the equilibrium of inter conversion of glycogen, lactic acid and glucose toward the enhanced mobilization of store polysaccharide through anaerobic glycolysis to lactic acid.

Key words: Scylla serrata, Carbohydrate, cadmium sulphate, Mercuric sulphate

Introduction

Carbohydrate is an important biochemical constituent of an animal tissue which acts as building blocks of cell and is immediate source of energy which is integral part of life process, Intertidal organisms adapt to various environmental condition to restoring the variation in carbohydrate metabolism (Kulkarni & Kulkarni 1998).

Carbohydrate metabolism is broadly divided in to the anabolic segmentation or glycolysis in which breakdown of glucose or glycogen through Embden- Meyerhof pathway and the aerobic segment that consists of oxidation of pyruvate to acetyl-coA to be utilized through citric acid cycle (Nelson and Cox 2005). Glycolysis is the process focused for energy production during stressful condition in marine organisms. In intertidal crab carbohydrate metabolism is routed through same pathway as observed in mammals (Momin, 1973). The depletion of glycogen in the tissue is an indication of typical stress response, when aquatic organisms are challenged with pesticide and glycogen depletion in different tissue after toxic stress has been reported in several studies with aquatic organisms Therefore the present investigation an attempt has been made to assess effect of heavy metals cadmium sulphate and mercuric sulphate on carbohydrate metabolism in crab *Scylla serrata.*

Changes in the tissue concentration of carbohydrates and proteins in fishes have received a good deal of attention because of their relationship to the "traditional" stress responses of other vertebrate animals. Fish, under acute stress from abiotic or biotic factors, are somewhat similar to other vertebrates as they mobilize and use carbohydrates.

Material and method

In present studies the crab *Scylla serrata* were collected from shiroda beach. Stocks of freshly collected crabs were acclimated to the laboratory condition for one week prior to exposure. They were maintained in glass aquaria. The crabs were acclimatized for a week fed with bivalve pieces to overcome starvation stress. Only healthy crabs ranging between 40-45 gms weight were selected for the present work. Active crabs of more or less uniform size were selected exposed to the concentration of cadmium sulphate (17.2mg/L) for a period of 24, 48, 72, 96, 120 hours. A control group was also maintained. At the end of each test period crabs were removed from the aquarium and used for analysis of glycogen.

At the end of each exposure period the crab were sacrificed, and the hepatopancreas, muscle, chelate leg, heart, gills tissue rapidly excised and blotted to remove the adhering blood. A weighed quantity of each tissue was immediately transferred to the test tube containing 30% KOH solution. Glycogen content of this tissue was estimated by anthrone method (Siefter *et al.*, 1950). The tissue homogenate was mixed with 1ml of 30% KOH and kept in water bath at 70^{o}c for 5 to 7minntes. The digested solution from each test tube was transferred to 100 ml dilution flask and made up to the mark with distilled water. 5ml of these solutions were transferred to separate test tubes to each of which 10 ml freshly prepared anthrone reagent (0.2% anthrone in 95 % concentrated sulphuric acid) was added with usual precautions. The contents of the tube thoroughly mix. The tube was kept boiling water bath for 8 to 10 minutes, removed from the water bath and cooled to room temperature. Simultaneously, blank and standards were prepared by using distilled water, glucose respectively following the same above procedure. The intensity of green colour was measured calorimetrically at 420nm.The value were read from standard graph of glucose. The glucose value so obtained was converted into glycogen by multiplying the former by the factor 1/1.11 (Seifter et al., 1950).

Result and discussion

In the present study, total carbohydrate content in hepatopancreas, muscle, chelate legs, gills and heart was decreased 24 hrs, 48 hrs, 72 hrs, 96 hrs and 120 hrs exposed to cadmium sulphate and mercuric sulphate shown in table (1,2) Fig (1, 2)

1:**Carbohydrate in different tissue of crab Scylla serrata exposed Cadmium Sulphate**

Hours	**Hepatopancreas**	**Muscle**	**Chelate leg**	**Gill**	**Heart**
Co	7.10 ±0.36	10.37 ±	6.11 ±	3.63 ±	1.42 ±

ntrol		0.20	0.19	0.27	0.05
24	6.58 ± 0.38	9.22 ± 0.27	5.26 ± 0.09	3.15 ± 0.20	1.26 ± 0.18
48	5.72 ± 0.28	10.51 ± 0.20	5.0 ±0.12	2.95 ±0.05	1.14 ± 0.17
72	5.21 ± 0.33	9.85 ±0.24	4.65 ± 0.36	2.42 ± 0.37	1.10 ± 0.17
96	4.09 ± 0.13	7.25 ± 0.41	3.75 ± 0.27	1.97 ± 0.05	0.90 ± 0.90
120	3.22 ± 0.33	6.16 ± 0.25	3.31 ± 0.35	1.62 ± 0.14	0.73 ±0.04

- Values are means ±SD of six individual observation, p>0.05, p < 0.01, p, 0.01 significant when student's test was applied between control and experimental groups.

Table 2: **Carbohydrate in different tissue of crab Scylla serrata exposed Cadmium Sulphate**

Hours	**Hepatopancreas**	**Muscle**	**Chelate leg**	**Gill**	**Heart**
Control	7.10 ±0.36	10.37 ±	6.11 ±	3.63 ±	1.42 ±
		0.20	0.19	0.27	0.05
24	6.37± 0.41	8.20 ± 0.20	5.00 ± 0.01	3.00 ± 0.20	1.20 ± 0.18
48	5.53 ± 0.51	7.75 ± 0.41	4.35 ± 0.27	2.60± 0.01	1.08 ± 0.17
72	4. 50 ± 0.33	6.42 ±0.18	3.41 ± 0.26	2.10 ±0.05	1.00 ± 0.01
96	3.37± 0.41	5 20 ± 0.53	2.90 ± 0.08	1.60± 0.05	0.76 ± 0.90
120	2.98 ± 0.13	5.08 ± 0.20	1.74 ± 0.33	1.40 ± 0.44	0.60± 0.04

- Values are means ±SD of six individual observation, p>0.05, p < 0.01, p> 0.01 significant when student's test was applied between control and experimental groups.

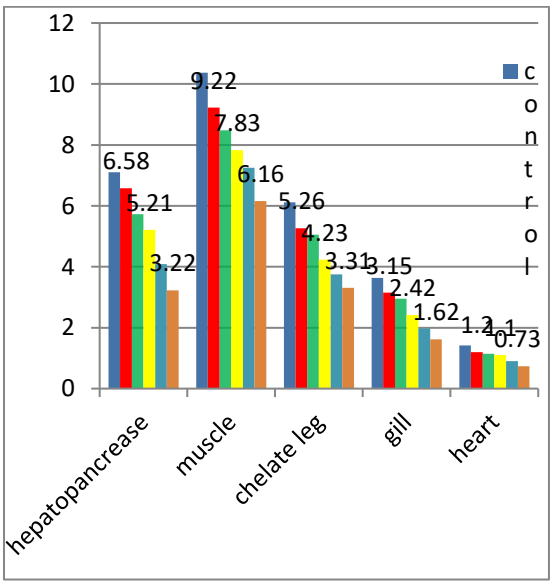

Figure 1:-Carbohydrate content in different tissue of crab Scylla serrata exposed to Cadmium Sulphate

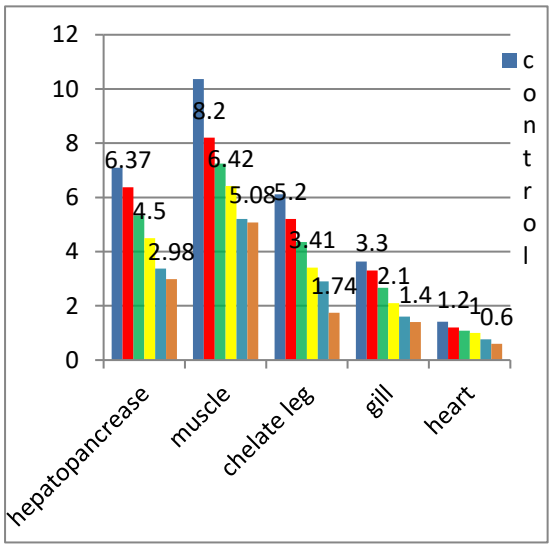

Figure 2:-Carbohydrate content in different tissue of crab Scylla serrata exposed to Cadmium Sulphate

RESULT CORBOHYDRATE

Cabohydrate content estimated in hepatopancreas, gills, muscle, heart and chelate legs of estuarine crab *Scylla serrata* during time interval 24 hrs, 48 hrs, 72 hrs, 96 hrs, 120 hrs exposure to cadmium sulphate and mercuric sulphate are given in table(1 and 2) And fig. (1and 2) along with control. The control values showed little fluctuation due to change in environmental factors the maximum. The carbohydrate content was found to be range in hepatopancreas (7.10, 6.58, 5.72, 5.21, 4.09, 3.22), muscle (10.37, 9.22. 8.48, 7.83, 7.25, 6.16), chelate legs (6.11, 5.26, 5.05, 4.23, 3.75, 3.31), Gills(3.63, 3.15, 2.95, 2.42, 1.97, 1.62), heart (1.42, 1.20, 1.14, 1.09. 0.90, 0.73) in exposure to cadmium sulphate and in Mercuric sulphate hepatopancreas (7.10, 6.37, 5.33, 4.53, 3.37, 2.98), Muscle (10.37, 8.22, 7.25, 6.42, 5.33, 5.08), Chelate legs (6.11, 5.22, 4.35, 3.41, 2.90, 1.74), gills (3.63, 3.53, 3.27, 3.02, 2.59, 1.40) heart (1.42, 1,26, 1.01, 0.975, 0.600, 0,116) respectively.

Above result clearly indicate that the effect of cadmium sulphate and mercuric sulphate varies from organ to organ and also varies with tissue. Mercuric sulphate was more toxic and showed more decreased of total carbohydrate.

Overall result of this investigation shows the maximum amount of carbohydrate content was observed in muscle 10.37 mg/gm wet tissue exposed to mercuric sulphate and minimum amount of carbohydrate content was recorded in heart 0.116 mg/gm wet tissue in mercuric sulphate exposure. As exposure period increased the total carbohydrate content decreased in different issue of crab *Scylla serrata*. The carbohydrate content was measured in mg/gm wet tissue.

In present investigation the carbohydrate content was decrease in different organs of crab *Scylla serrata* (Gills, hepatopancreas and muscle) exposed to cadmium sulphate and mercury sulphate. These heavy metals damage gills as well as decreased glycogen contents such damage affect their efficiency and result in tissue hypoxia and elevated blood glucose as an anaerobic energy source. Crustacean hyperglymic hormone elevated blood sugar during hypoxia (Deshmukh, 1983; Pathak and Rangnekar 1979; Hohnke and Scheer 1951; Parvathi 1970; Reddy *et al.*, 1994).

The glycogen profile of liver, testis and ovary in response to mercury response showed significant decline. The liver and testis showed statically more decline than ovary (Jha, Mammata Kumari & Jha 2010). In crab *Scylla serrata* glycogen decreased is more marked in hepatopancreas exposed to nickel (Maykar *et al.,* 2003). This indicate that there is an impairment in the synthesis of glycogen and at the same time utilization of reserve food for energy needs, Fall in muscle glycogen suggest an increase turnover of glycogen and that the muscle glycogen does not contribute toward hyperglycemias (Ranganathan & Ramamurthi, 1974).

Noojahan *et al.,* (2002) showed carbohydrate was decrease in different organ of treated and untreated effluent cause more decrease in hepatopancreas in *Scylla serata.* Increasing concentration of effluent caused more decrease in hepatopancreas followed by muscle and gill as hepatopancreas was supported to store glucose and to utilize it for energy production to counter of the effluent. Satparamesher *et al.,* (2006) reported reduction of carbohydrate in muscle also supported that glycogen was utilized first from hepatopancreas and then from muscle in fresh water mussel, *Lamellidens marginalis* under the influence of chromium. Similar result showed in the crab, *Oziotelphusa sensex sensx* . The decrease in glycogen level in fish *Gambusia affinis* signifies their utility to meet the higher energy demands under phosphamidon induced stress condition. The decrease in glycogen in tissue also suggested the impairment may involve shift of the equilibrium of inter conversion of glycogen, lactic acid and glucose toward the enhanced mobilization of store polysaccharide through anaerobic glycolysis to lactic acid (Veena Sakthivel, 2002).

Selvasum *et al.,* (2006) reported that the fish *Oreochromis mossambicus* exposed to sub lethal concentration of cadmium for period of 96 hours. The carbohydrate, lipid and protein content were decreased by increasing cadmium concentration. Nirmala and Eliza (2005) reported that Carbohydrate, protein and lipid remarkably reduced when fish *Cirrhina mrigala* exposed to a phosphamidon. Satparamesher *et al.,*(2006) showed the Level of glycogen and pyruvic acid was decreased while lactic acid showed an increased activity these appear due to shifting of carbohydrate metabolism from aerobic to anaerobic type due to toxicity of copper in fresh water mussel, *lamellidan marginalis* exposed to copper sulphate. Randhir and Tarun (2012) showed that endosulphan induced biochemical change in the blood and liver of fish Anabas testdineus. Maheswari and Selvarajan (1997) reported that phosolone decrease glycogen concentration and increase protein bound sugar level. Alter carbohydrate Metabolism and inhibits in vitro oxygen utilization in neural tissue of crab *Scyllla serrata*.

Reddy and Bhagyalakshmi (1994) showed that cadmium decreased glycogen in crab, *Scylla serrata*. Lorezon *et al.,* (2000) reported the changes in the haemolymph glycogen level in the shrimp *Palaemon elegans* due to heavy metal toxicity. Baby Joseph et al., showed

similar result in prawn *Macrobrachium lamerii* .

Kalyanaraman and P. Senths Kumar (2009) reported the depletion of carbohydrate in the edible lobster *Thenus orientates* may be due to its rapid utilization to meet the energy demands under the impact of heavy metal lead. Reduction of carbohydrate in the reproductive and other tissues indicated the possibility of active glyconeolysis Akhster Ali Siddiqui and siddiqui Afsheen (2007) reported a declining trend in the oxygen consumption after exposure to copper sulphate in the crab, tissue acidosis due to reduced oxygen transport must be also *Barytelphusa guerini*.

Sreenivasula Reddy *et al.*, (2011) Reported cadmium and mercury induced hyperglycemia in fresh water crab, *Oziotelphusa sensex*. Blood glucose level increased in fish Channa gachua (Deshmukh and Sonawane, 2008). Significant decrease in glycogen, total carbohydrate and pyruvate and increase lactate level in hepatopancreas and muscle increased glyconeolysis increased lactate content indicated reduced mobilization of pyruvate into citric acid cycle total protein decreased and free amino acid ammonia, urea increased suggesting increased in proteolysis and trasamination of amino acids.

Conclusion

The heavy metal cadmium sulphate and mercuric sulphate attached carbohydrate metabolism in the crab *Scylla serrata* where increased glycolysis was prominent in the form of reduced level of glycogen in tissue like hepatopancreas muscle, chelate legs gills and heart. The changeover of the carbohydrate is due to anabolic metabolism. The carbohydrates are energy rich compound in stress condition to meet energy demand, in crab carbohydrate content is minor percentage of total biochemical composition. (table 1, 2 and Fig.1, 2)

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