



Short Communication

Effect of Cadmium Chloride on the Biochemical content in different Tissues of the Freshwater Fish *Ophiocephalus striatus*

Bais U.E. and Lokhande M.V.

Department of Zoology, Indira Gandhi (SR) College, CIDCO, New Nanded. 413603, MS, INDIA

Available online at: www.isca.in

Received 5th September 2012, revised 18th September 2012, accepted 20th September 2012

Abstract

The effect of cadmium chloride on the fresh water fish *Ophiocephalus striatus* was assessed. The 96 hours LC₅₀ of the cadmium chloride was found to be 0.63 mg/lit. The fishes were exposed to the experimental concentration of cadmium chloride for 96 hours. After the control 96 hours exposures the glycogen levels were estimated in the muscles, gill, liver, kidney and heart. In the present investigation it clearly indicates that very adverse effect of cadmium chloride on fish. Kidney is the major target organ which shows the maximum reduction of protein level following to the liver but the total free amino acid level increased significantly.

Keywords: Protein, free amino acid, *Ophiocephalus striatus*.

Introduction

Protein are of the most important and complete group of biological material comprising of nitrogenous constituents of the body and performing different function, proteins are involved in several major physiological events. Therefore the assessment of protein content can be considered as a diagnostic tool to determine the physiological phases of organisms. The amino acids are the basic building block of all proteins. Those amino acids which exist in free form in tissues and not bound to proteins are called as free amino acids. Normally during diseased conditions in plants and animals there will be a change in the total free amino acids composition. Hence the estimation of total free amino acid gives as indication about the physiological and health condition of animal. They introduced the ninhydrin method and it is widely used for estimation of total free amino acids¹.

Material and Methods

The fishes were used in this experiments are collected from their habitat and acclimatized to one week in laboratory conditions in glass aquaria. The initial weight and length of fish were 100± gms. and 25 – 30 cm. respectively. The room temperature between 35–38°C. Two glass aquarium is used one is control and another is experimental each aquaria filled with 20 lit water and introduced 10 fishes in each aquaria. In experimental aquaria dissolved 0.6 mg/lit CdCl₂. After 96 hrs. both control and experimental fishes were carefully dissect out and gill, liver, muscle, kidney and heart is used for determination of total protein by standard method suggested Lowery method² and estimating the free amino acids suggested by standard method¹.

Results and Discussion

Levels of protein content of different organ of *Ophiocephalus striatus* exposed to median lethal (LC 50) at 96 hours conc. Of

cadmium chloride in table-1 and variation in the levels of total protein content in different organs in terms of % decrease over control in *Ophiocephalus striatus* exposed to median lethal (LC 50) at 96 hours conc. of cadmium chloride in table -2. In the present investigation the protein level in all the tissues of toxicant exposed (LC₅₀) at 96 hrs fish was significantly reduced. The order of decrease in toxicant exposed fish observed in following manner Kidney > Liver > Heart > Gill > Muscle.

Table-1
Levels of protein content in different organ of *Ophiocephalus (channa) striatus* exposed to median lethal (LC₅₀) at 96 hrs. conc. of cadmium chloride (CdCl₂)

Sr. No.	Organ.	Exposure	
		Control mg/gm wet.wt.	Expt. (LC ₅₀) at 96 hrs. mg/gm wet.wt.
1	Muscle	152.01 ± 3.71	135.21 ± 2.02*
2	Gill	131.04 ± 2.60	112.14 ± 1.57**
3	Liver	139.12 ± 2.72	109.20 ± 1.90***
4	Kidney	91.15 ± 3.11	71.08 ± 1.06***
5	Heart	82.10 ± 1.66	70.20 ± 1.39*

Values are mean ± SD of six replicates * P < 0.05, ** P < 0.01, *** P > 0.01 significant when student's 't' test was applied between control and experiment groups.

In present study clearly indicate that very adverse effect of CdCl₂ on fish. Kidney is the major target organ which shows the maximum reduction of protein level following to the liver. Proteins are important organic substances required in tissue binding and repair, under extreme stress conditions protein supplies energy in metabolic pathways and biochemical reaction reported the³.

Table-2

Variation in the levels of total protein content in different organs in terms of % decrease (↓) over control in *Ophiocephalus (channa) striatus* exposed to median lethal (LC50) at 96 hrs. conc. of cadmium chloride (CdCl₂)

Parameter	Muscle % (↓)	Gill % (↓)	Liver % (↓)	Kidney % (↓)	Heart % (↓)
Total Protein	11.05	14.42	21.50	22.01	14.49

The loss of protein in different tissues of toxicant exposed fish is probably due to the excessive proteolysis to overcome the metabolic stress. He reported the highest reduction of protein in liver of *H. fossilis* exposed to long term chronic toxicity of copper sulphate⁴. He shows the Hg is extreme toxic in case of *Cyprinus carpio* as compare to chromium and nickel, he also stated that highest reduction of protein level in kidney and liver of *Cyprinus carpio* as compare to chromium and nickel⁵.

The decrease in the protein content in CdCl₂ exposed fish as observed in present study in all the tissues may be due to the metabolic utilization of the keto acids to gluconeogenesis. Pathway for the synthesis of glucose or due to directing the free amino acids for the synthesis of proteins or for the maintenance of osmo and ionic regulation. In present study free amino acid and glucose content is increased significant in all the tissues of experimental fish. Which supports above statement about the protein decreased level? Above similar results is mentioned by⁶ She is mentioned the highest reduction of protein in liver and lowest in muscle in case of *Catla catla* exposed to sub lethal doses of cadmium chlorides.

Levels of total free amino acids content in different organs of *Ophiocephalus (channa) striatus* exposed to median lethal (LC50) at 96 hrs. conc. of cadmium chloride in table- 3 and Variation in level of total free amino acids content in different organs in terms of % increase (↑) over control in *Ophicocephalus (channa) striatus* exposed to median lethal (LC50) at 96 hrs. conc. of cadmium chloride in table- 4.

Table-3

Levels of total free amino acids content in different organs of *Ophiocephalus (channa) striatus* exposed to median lethal (LC50) at 96 hrs. conc. of cadmium chloride (CdCl₂)

Sr. No.	Organ.	Exposure	
		Control mg/gm wet.wt.	Expt. (LC50) at 96 hrs. mg/gm wet.wt.
1	Muscle	39.10 ± 1.46	44.12 ± 2.29*
2	Gill	31.41 ± 1.80	37.11 ± 1.49*
3	Liver	65.12 ± 1.80	78.60 ± 1.50***
4	Kidney	71.14 ± 1.94	86.14 ± 1.98*
5	Heart	48.11 ± 2.29	54.28 ± 0.98*

Values are mean SD of six replicates significant at *P < 0.05, **P < 0.01, ***P > 0.01 significant when student's 't' test applied between control experimental groups.

Table-4

Variation in level of total free amino acids content in different organs in terms of % increase (↑) over control in *Ophicocephalus (channa) striatus* exposed to median lethal (LC50) at 96 hrs. conc. of cadmium chloride (CdCl₂)

Parameter	Muscle % (↑)	Gill % (↑)	Liver % (↑)	Kidney % (↑)	Heart % (↑)
Total free amino acid	12.83	18.14	20.70	21.08	12.82

In the present investigation free amino acid level in all the tissues of toxicant exposed fish was significantly increased (table- 3). The order of increase in toxicant exposed fish over the control is observed in following manner Kidney > Liver > Gill > Muscle > Heart (table-4).

In present study levels of total free amino acid level increased significantly. They reported that the concentration of free amino acid and the activities of proteases were increased in gill, liver, and kidney of carp *Cyprinus carpio* exposed to cadmium also they observed an increase in the activities of GOT and GPT and they suggested that the observed proteolysis is intended to increase the role of protein in energy production during cadmium stress⁷.

Protein degradation and subsequent utilization of the released amino acids for anaplerotic reaction or energy production represent an important mechanism for changes in the total free amino acids concentration. In present investigation reduction in protein content in different tissues of cadmium exposed fish is evident that proteolysis is main reason for increases in total free amino acids. Also in present study serum urea level is significantly increases for these reasons for detoxification of urea total free amino acids concentration is increases in cadmium exposed fishes under stress condition.

Under the increased energy demand associated with toxicant-induced stress invertebrates may degrade proteins to augment the available energy supply, thus altering the free amino acids pool^{8,9}.

Similarly, fish preferentially generate aerobic energy from protein catabolism¹⁰. Further more¹¹ provided the first evidence for a novel mechanism of follicular atresia in teleost involving cathepsin mediated yolk proteolysis confirmed by a significant increase in oocyte free amino acid content after 72 hrs. Culture in serum-free medium. On the other hand, the environmental factors may generate a common signal, which in turns changes the gene expression of protein synthesis⁵.

One of the possible alterations could be the induction of heat shock proteins (hsps). They found that under stressful condition hsps are strongly induced and protein synthesis of other proteins is inhibited¹².

Accordingly¹³, in their work on the levels free amino acids in the plasma of workers exposed to heat, carbon monoxide and heat and carbon monoxide suggested that the inhibition of the synthesis of other cellular proteins might thus lead to a relative

surplus of free amino acids and a subsequent increase in their free plasma levels. Increased levels of various heat shock proteins have been measured in tissues of fish exposed to environment contaminants such as heavy metals¹⁴⁻¹⁷. Polycyclic aromatic hydrocarbons¹⁸ and pesticides¹⁹.

Conclusion

In the present study the protein content is decreased in all the organs of experimental fishes table-1. Protein decreased 11.05% in muscle, 14.42 % in gills, 21.50% in liver, 22.01% in kidney and 14.42% in heart table-2. Under stress full condition protein supplies energy source in metabolic pathway. The loss of protein in different organs in experimental fishes probably due to the excessive proteolysis to overcome the metabolic stress. Proteins can use for synthesis of glucose through increases the rate of gluconeogenesis. The free amino acids level is increased significantly in all the organs of experimental fishes table-3. Free amino acids increased 12.83% in muscle, 18.14% in gills, 20.70% in liver 21.08% in kidney and 12.82% in heart table-4. Increased free amino acids possibly due to the proteolysis is increased which increased the activity of GOT and GPT. In present investigation increased SGOT, SGPT and depletion in protein possibly responsible for increased free amino acids. Also in present study increased serum urea level in experimental fish for detoxification of urea possibly free amino acids concentration increases in kidney for detoxifying the harmful excretory materials.

Acknowledgement

Authors are thankful to the principal Dr. N.V. Kalyankar, Yeshwant Mahavidyalaya, Nanded for providing the laboratories facilities during the work period.

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