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ORIGINAL RESEARCH ARTICLE

Effect of Aluminium Chloride on the Biochemical Changes in Different Tissues of the Freshwater Fish, *Labeo rohita* (HAM)

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ABSTRACT

The effect of Aluminium chloride on the freshwater fish *Labeo rohita* was assessed. Sub-lethal concentration (LC_{50}) for 96 hours of exposure was found to be 32.5 ppm. The fishes were exposed to the experimental concentration $1/4^{th}$ of Aluminium chloride for 96 hours. The estimated total proteins concentration in the tissues (kidney, gill, muscle and liver) were found to be (-3.48, -28.24, -36.85 and -38.36%) respectively, are found to be decreased. The estimated free amino acids concentration in the tissues (gill, muscle kidney and liver) were (4.18, 8.14, 10.78 and 11.64%) found to be increased during the exposure periods. The present results showed that variation in biochemical parameters which is an adaptive response of vertebrates due to sublethal exposure of Aluminium chloride.

Key words: LC_{50}, Heavy metal, Aluminium chloride, Tissues and *Labeo rohita.*

1. INTRODUCTION

Aluminium is one of the most expensive metals on the earth. At the present time, Aluminium is used for everything from medications to door frames, car bodies and its compounds have a wide variety of uses including structural materials in construction air craft's and the production of metal alloy, glass, ceramic, rubber pharmaceuticals and water proofing textiles [1]. The rapid industrialization and green revolution introduced a large variety of toxicity substances into the environment. These chemicals are creating serious ecological problems particularly aquatic pollution [2]. Effects of heavy metals on the protein profile of different tissues in freshwater fishes have been studied [3]. The alternation in biochemical contents in different tissues of fish due to toxic effects of different heavy metals have been reported by number of workers [4-8].

Fishes constitute an important link in the food chain also its form protein-rich food for human beings [9]. Fish are ideal sentinels for assessing the perturbations in behaviour, oxygen uptake and biochemical profiles under toxic chemical exposure [10]. Fish are often at the top of the aquatic food chain and heavy metals accumulate in the tissues of the fish and cause cumulative deleterious effects at various functional levels ultimately leading to their death [11]. Earlier reports suggest that aluminium because toxic effects in a number of tissues and organ of aquatic biota depending on its chemical form as well as the level, duration and the route of exposure [12]. The occurrence of such subtle alterations at the biochemical level has the potential to serve as 'early warning signals' [13].

Study of heavy metal toxicity to fish showing changes in different biochemical constituents such as protein and amino acid helps in understanding their correlation with ability to overcome toxic effect and also the changes induced by heavy metal toxicity [14]. Fish is very important to man as it is one of the most readily available and valuable source of high grade and cheap protein, which is easily digestible. It is a highly priced food fish with good market demand [15]. *Labeo rohita* is a cyprinid species, it is very sensitive than some of the other fish as and crabs and they are native inhabitant of rivers, streams, lakes and canals of India, Bangladesh, Myanmar, Nepal and Pakistan. It is the most important among the three Indian major carp species used in carp culture systems. In India, it has been transplanted into almost all riverine systems including the

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freshwaters of Andaman, where we can now find a successfully established population. The *Labeo rohita* fish was chosen for the present study the following reason: It is sensitive to toxicants, they are abundant and the availability in high throughout the year and they are economic and ecological importance. They can be reared easily in the laboratory. Hence, in the present attempts have been made to find out the effect of aluminium chloride toxicity on the biochemical changes in different tissues of fish *Labeo rohita*.

2. MATERIALS AND METHODS

The freshwater fish *Labeo rohita* (weight: 7±0.5 gm and length: 6±0.5cm) used in the present study were collected from the Maheshwari fish farm at Nalladai, Mayiladuthurai, Tamil Nadu, India. The fishes were acclimatized in the laboratory condition two weeks before experiment. Significant signs of unusual behavioural criteria were not observed in the control fishes throughout the acclimation and test period. During the acclimatization, the fishes were fed with pellet feed daily in the evening uneaten feed was removed the next day morning followed by 100% water exchange.

The biochemical constituents *viz*., total protein content was estimated as method as described by Lowry *et al.* [16] and free amino acids content was estimated as method described by Pande *et al*. [17] in four different tissues *viz*., gill, liver, kidney and muscle of the healthy fishes (control) and of those from the fishes exposed to sub-lethal concentration.

3. RESULTS

The levels of various biochemical constituents in mg/g of the wet weight of tissue in control fish, *Labeo rohita* exposed to the experimental concentration 1/4th of aluminium chloride for 96 hours are given in Table - 1 and Table - 3. The fish showed stress condition during exposure period as fast swimming, fast opercular movements, dashing with the walls of aquarium and reduced feeding in the present study.

Total Proteins

In the present investigation, the level of protein content in various tissues of *Labeo rohita* after exposure to aluminium chloride is given Table - 1. The amount of protein level in all the tissues of toxicant exposed fish was significantly decreased when compared with control (**Table 1**). The percentage of variation in protein content of toxicant exposed fishes over control are observed in following manner kidney > gill > muscle > liver are (-3.48) > (-28.24) > (-36.85) > (-38.36%) respectively (**Table 2**). Highest and lowest levels of total proteins were observed in kidney and gill tissues. The decrease in the protein content as observed in the present study in most of the fish tissues may be due to metabolic utilization of the ketoacids to gluconeogenesis pathway for the synthesis of glucose or due to directing the free amino acids for the synthesis of proteins.

Table 1: Levels of total proteins content in different tissues of fish *Labeo rohita*, exposed to the experimental concentration 1/4th of aluminium chloride for 96 hours

S. No	Tissues	Exposure	
		Control mg/gm wet.wt.	Sub-lethal (LC_{50}) at 96 hrs. mg/gm wet.wt.
1	Gill	90.32±0.09	64.81±0.03
2	Liver	140.37±0.04	86.52±0.18
3	Kidney	121.62±0.05	117.35±0.03
4	Muscle	81.87±0.14	51.70±2.28

*value are mean of five replicates±S.D

Table 2: Variation in the levels of total protein content in different organs in terms of % increase over control in *Labeo rohita*, exposed to the experimental concentration 1/4th of aluminium chloride for 96 hours

Tissues	Muscle %	Gill %	Liver %	Kidney%
Total protein	-36.85	-28.24	-38.36	-3.48

Free amino acids

Levels of free amino acid content in different organs of *Labeo rotita* exposed to sub- lethal concentration (LC_{50}) at 96 hours aluminium chloride are given in (**Table 3**) and the percentage of variation in free amino acid content in different organs are given in (**Table 4**). The free amino acids content is found to be increased when compare with control the increase of amino acid content in muscle is 25.81 followed gill 45.64, liver 45.13 and kidney 50.34% respectively. Highest and lowest levels of free amino acids were observed in liver and kidney tissue. Variation in the free amino acid showed the stress due to aluminium chloride in sub-lethal exposure of fish *Labeo rohita*.

Table 3: Levels of free amino acids content in different tissues of fish, *Labeo rohita*, exposed to the experimental concentration 1/4th of aluminium chloride for 96 hours

S. No	Tissues	Exposure	
		Control mg/gm wet. wt.	Sub-lethal (LC50) at 96 hrs. mg/gm wet. wt.
1	Gill	2.87±0.07	4.18±1.51
2	Liver	8.02±2.25	11.64±0.81
3	Kidney	7.17±2.58	10.78±1.56
4	Muscle	6.47±2.01	8.14±1.52

Values are mean of five replicates ± S.D

Table 4: Variation in the levels of free amino acids content in different organs in terms of % increase over control in *Labeo rohita*, exposed to the experimental concentration 1/4th of Aluminium chloride for 96 hours

Tissues	Muscle %	Gill %	Liver %	Kidney%
Free amino acids	25.81	45.64	45.13	50.34

4. DISCUSSION

Heavy metals are natural components of earth's crust. More concentration of these heavy metals can enter the water affect the aquatic organisms. In the present analysis, the total protein level is decreased in all treated fish tissues, the decrease of protein may be due to extreme proteolysis to overcome the metabolic stress, as deposited protein in the cytoplasm can easily be used to replace the loss of proteins that occur during physiological stress [18]. Schmidt Nielson [19] stated that the decreased trend of protein content in various tissues of *Labeo rohita* may be due to metabolic utilization of keto acids in the synthesis of glucose or for the osmotic and ionic regulation. The fall in protein level of exposure may be due to increased catabolism and decreased anabolism of proteins. The changes and decrease in protein level might also be due to inhibition of metabolizing enzymes by administration of toxicants. Several other investigations also revealed a decrease in protein profiles with toxicants. Decrease in protein content under toxicity stress has already being reported [20, 6]. Tilak *et al.* [21] reported a decrease in protein content in *Channa punctatus* exposed to sub-lethal concentration of fenvalerate. A significant decrease was reported in the protein content in almost all tissues in *Ctenopharyngodon idella* by Tilak and Yacob [21]. Tilak *et al.* [21] reported that the freshwater fish, *Labeo rohita* was exposed to sublethal concentrations of pesticide mixture of monocrotophos and fenvalerate, the protein content was found to be decreased. Nagaraju and Venkata Rathnamma [22], reported a decrease in protein levels in *Labeo rohita* exposed to sub lethal concentration. Thenmozhi [23] reported malathion causes reduction in total proteins in the various tissues of *Labeo rohita.* Similar results were obtained by many workers [22, 23, 24, 25, 26, 27, 28, 29, 30]. All these investigations support the present study of decreasing trend of proteins in the tissues of the *Labeo rohita* exposed to aluminium chloride.

In the present analysis, free amino acid level in all the tissues of toxicant exposed fish was significantly increased. Amino acids are essential intermediates in the process of protein synthesis and its degradation products appear in the form of different nitrogenous substances. Amino acids and some nitrogenous compounds play an important part during osmotic stress hence increase or decrease in free amino acid content provide valuable information during stress phenomenon at the tissue level. The increased free amino acid level suggests tissue damage probably due to augmented proteolysis activity. Increment in free amino acid level was the result of breakdown of protein for energy requirement and imparted incorporation of amino acid is protein synthesis [31]. James *et al.* [20] found that the increase in concentration of free amino acid attributed to stepped up proteolysis or increase synthesis of free amino acid by transaminase reaction. Shoba *et al.* [7] observed free amino acids were not detected in the tissues of control as well as treated fish, free amino acid were detected in the muscle, liver and kidney tissues of the fish exposed to the lethal concentration and not in the gills. Thenmozhi [23] reported malathion causes increase in free amino acid in the various tissues of freshwater fish *Labeo rohita*. Bais and Lokhande [32] reported that cadmium chloride causes increase in free amino acids in the various tissues of freshwater fish *Ophicephalus striatus.* De Smet and Blust [33] has reported that proteolysis is intended to increase the role of proteins in the energy production during heavy metals stress. Stress condition induced elevation in the transamination pathway [34].

CONCLUSION

The present study inferred that different tissues of freshwater fish *Labeo rohita* biochemical changes in total protein levels decreased and free amino acids levels increased. Variations of biochemical constituent are due to the adaptive response which is characteristic of vertebrates due to sub-lethal exposure of aluminium chloride. Fish with low protein value is not used for nutritional food purpose, so that cultured fish with high nutritive value could safely be utilized for human consumption.

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