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Chromium Induced Alterations on Total Atpases in Different Tissues of a Fresh Water Fish, *Labeo Rohita*

KEYWORDS: Chromium, ATPase, Labeo rohita, Tissues.

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ABSTRACT *The present investigation was carried out to study the effect of Chromium on total ATPases, in selected tissues of a fresh water fish Labeo rohita. The alterations in ATPase activity on exposure to sub lethal concentration (1/10th of LC50/96 hrs) of chromium for 7days and 30 days was investigated in the present study. Results revealed statically significant (p<0.05) decrease in total ATPases in various tissues of experimental animals when compared to the control with an increase in exposure days. The inhibition of ATPase activity could change the sodium and potassium gradients across the cell membrane and disrupts the ionic movement in the neuronal cells. The results suggest that ATPase has a particular sensitivity to chromium.*

INTRODUCTION

The aquatic environment was extensively contaminated with heavy metals released from domestic, industrial, and other anthropogenic activities. The heavy metal pollution of water is a major global environmental problem with the advent of agricultural and industrial revolution, most of the water resources are becoming contaminated (Khare et al., 2002) which cause deleterious effects on aquatic fauna.

Among pollutants, metals are of special concern because of their diversified effects and the range of concentrations that could cause toxic ill-effects to fish (Rauf et al., 2009). Fishes are an important protein component of human nutrition, and those from contaminated sites present a potential risk to human health. Heavy metals are able to disturb the integrity of the physiological and biochemical mechanisms in fish that are not only an important ecosystem component but also used as a food source (Basha and Rani, 2003). Fish may accumulate large amounts of heavy metals from contaminated water that make them an adequate indicator of metal pollution that could be utilized to predict potential risk to the human beings associated with the use of contaminated water and fish (Papagiannis et al., 2004).

Chromium is considered as a heavy metal and pollutant as well as an essential micronutrient. Wastewater pollution by chromium originating from electroplating, dyeing, tannery, hard-alloy steel and stainless steel manufacture, has affected the life on earth. Chromium is found commonly in surface waters (Farag et al., 2006) in small quantities, which is considered as the most detrimental pollutant to the aquatic organisms, especially to the fish. Adenosine triphosphatases (ATPases) are complex set of enzyme systems found in invertebrates and vertebrates. These enzymes play a central role in physiological functions of a cell as energy transducers by coupling the chemical reactions (Takao 1985). ATPases exist in all cell membranes and regulate the ionic concentrations inside the cells and represent a complex enzyme system which has requirement for Na^+, K^+ Ca^{2+} and Mg^{2+} ions for their activity. ATPases regulate the cellular volume, osmotic pressure, and membrane permeability due to the transport of ions through biological membranes (Li et al., 2011). The enzymes Na+/K+ ATPases and Mg2+ ATPases have a relatively high sensitivity to certain classes of heavy metals and other pollutants. The assessment of ATPase activity may therefore be used as an early warning signal of metal-induced damage to different organs of the freshwater fish *Labeo rohita.*

MATERIALS AND METHODS:

Healthy live specimens of *Labeo rohita* (average length 10±2cms and average weight 15±2gms) were obtained from local ponds and transported to the laboratory treated with 0.05% $KMnO_4$ solution for 2 minutes to avoid dermal infection, kept in large cement tanks and supplied with clean de-chlorinated tap water and were acclimatized for about 2 weeks prior to the experiment with a photoperiod of 12:12 light and dark cycle with constant aeration and filtration. During the period of acclimatization, the fish were fed with commercial fish feed to satiety twice daily. Analytical grade Chromium as Potassium dichromate supplied by BDH (India) was used as a metal toxicant throughout the experiment.

Fishes were divided into 3 groups containing 10 fishes each with the I group serving as control without any treatment, the group II, III fish were exposed to sub lethal concentration ($1/10^{th}$ of LC_{50} 96hrs, 10ppm) of Potassium dichromate for 7days and 30 days after determining LC50 value (Finney, 1964). After stipulated time, the animals were sacrificed and the tissues like brain, liver, kidney and gills were isolated in cold for enzyme analysis. ATPase activity was assayed by the method of Fritz and Hamrick (1996) as reported by Desaiah and Ho (1979.)

STATISTICAL ANALYSIS:

Data obtained was analyzed using the SPSS/PC+ Statistical package (ver.11.5). Significant difference between control and experimental groups were determined using Duncan's test for multiple range comparisons. Results were considered as statistically significant at 95% confidence level ($p<0.05$).

RESULTS

The exposure of fish, *Labeo rohita* to sub lethal concentration of Potassium dichromate for 7days and 30 days caused significant alterations in Total ATPases are represented in Table-1 Results reveal that the Total ATPase were significantly decreased after 7days and 30days exposure periods when compared to control, being statistically significant ($p<0.05$). The Total ATPase activity showed a decreasing trend with an increase in exposure days.

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Table: 1- Effect of Chromium on the activity of Total AT-Pases (µmol Pi liberated/mg protein/h) in different tissues of freshwater fish, Labeo rohita.

Name of the tissue	Control	Experimental	
		7 Days	30 Days
Brain	32.15 ± 0.08	30.05 ± 0.54 (61.29)	25.94 ± 0.79 (48.51)
Liver	36.14 ± 0.48	34.23 ± 0.65 (58.56)	29.08 ± 0.45 (44.32)
Kidney	28.14 ± 0.58	25.39 ± 0.35 (62.12)	21.48 ± 0.28 (48.19)
Gills	40.33 ± 0.24	37.34 ± 0.46 (52.28)	33.40 ± 0.40 (42.51)

Values are expressed as Mean ± SD (n=6), All Values are Significant at p<0.05 level. Values in Parenthesis indicate percent change over control.

DISCUSSION

Metals may alter enzyme activity or function by binding to a number of sites on proteins, that cause conformational changes and this may prevent substrate binding. ATPase activities, one of the significant key physiological responses, were analyzed with chromium . ATPase regulates the sodium metabolism and active cation transport through the membrane and maintains the ingredients required in the propagation of the nerve impulse .Metals which are present in the ambient medium is lypophilic in nature. It comes in direct contact with gills and ruptures the chloride cell membrane through which the metal enters blood and reaches the target tissues.

The ATPases which are localized in the chloride cells of the gills and are primarily used as specific markers for damage of ions transport in fish (Takao K. 1985). Alteration in ATPase activity reflects change in membrane permeability. The reduction of ATPase has been suggested to cause disturbances in cellular metabolism, leading to histotoxic hypoxia in the fish. ATPases could be attributed to pathological changes in tissues such as liver and gills which are involved in the exchange of ions between the fish and the surrounding water and to the reduction of Na^+-K^+-ATPase activity, which plays a central role in whole body ion regulation under toxicant exposure (Begum 2011). Many enzymes require Na^+ and K^+ for the transport of ATP which participates in several metabolic processes. Thaker et al. (1996) found significant inhibitions of Na^+-K^+-ATPase in the gills, intestine and kidney of coastal teleost *Periophthalmus dipes,* with a general dose-and duration dependent inhibitory trend following exposure to chromium (VI). In support to our present study many authors reported the deline in Atpase activity (Monteiro et al.(2005), Shwetha et al. (2012). Das and Mukherjee (2003) observed the inhibition of ATPase activities in brain, kidney and liver of the Indian major carp, Labeo rohita following cypermethrin treatment. The results are in good agreement with Berna Kulac et al. (2012), who observed a decline in Na+/K+-ATPase Mg2+-ATPase and Ca2+-ATPase activities after exposure to salinity+Cd combinations. ATPases are very sensitive to chemical interaction and can be used as reliable biomarker for the mechanistic toxicity studies of toxicants. Thus, In the present investigation, the fish tissues even under sublethal concentrations recorded significant reduction in total ATPase activity under chromium exposure.

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