Research Paper

Volume : 3 | Issue : 5 | May 2014 • ISSN No 2277 - 8179

Impact of Chromium on Glycogen in different types of muscles of a fresh water fish, Labeorohita

Zoology

KEYWORDS : Chromium, muscle, Labeorohita and glycogen

*** M. CYNTHIA SAILAJA**	Department of Zoology, S.V. University, Tirupati- 517502 * Corresponding Author
M. PRAVEENA	Department of Zoology, S.V. University, Tirupati- 517502
K. JAYANTHA RAO	Department of Zoology, S.V. University, Tirupati- 517502

ABSTRACT

Chromium is considered as a heavy metal, pollutant and as well as essential micro nutrient. Glycogen is a major fuel for aerobic metabolism and place an important role in osmo regulation. The present investigation was carried out to study the effect of chromium on glycogen in selected muscle tissues of a fresh water fish, Labeorohita. The alterations in glycogen activity on exposure to sub lethal concentration (1/10 of LC50, 96hrs) of chromium for 7 days and 30 days was investigated in the present study. In the present investigation cardiac muscle is found to have higher glycogen content compared to the rest of the tissues and the sequence is as follows CM > CR > PR > PP > CW.

Introduction:-

The aquatic environment is facing major pollution problems due to inorganic and organic chemicals released from industries and household water. Among the environmental pollutants, many metals plays major role due to their potential toxic effect and ability to bio-accumulate in aquatic eco systems. Heavy metals including both essential and non-essential elements have a particular significance in ecotoxicology. Since they are highly persistent and all have the potential to be toxic to living organism (Adenyi and yusuf, 2007).

The heavy metals accumulate in various tissues in significant amounts which become highly toxic and dangerous to fish. 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 (Rant et al.,2009). Heavy metals are able to disturb the integrity of physiological and biochemical mechanisms in fish that are not only an important ecosystem component but also used as food source (Basha and Rani, 2003).

Chromium is an essential element for organism such as Cu, Zn and Fe and acts as an insulin cofactor in animals. It is used widely in various metallurgy and chemical industries such as metal and electrode plating, leather tannery.

The increase of chromium concentration in aquatic environments results in accumulation in organisms which then transferred to higher trophic levels through the food chain (Langard and Norseth, 1979:Abbas and Ali 2007). Chromium is commonly found in surface waters (Farag, et al., 2006) in small quantities, which is considered as most determinant toxicant to fish. Fishes are very good biosensors of aquatic contaminants and as bio-indicator species respond with great sensitivity to changes in the aquatic environment.

Material & Methods:-

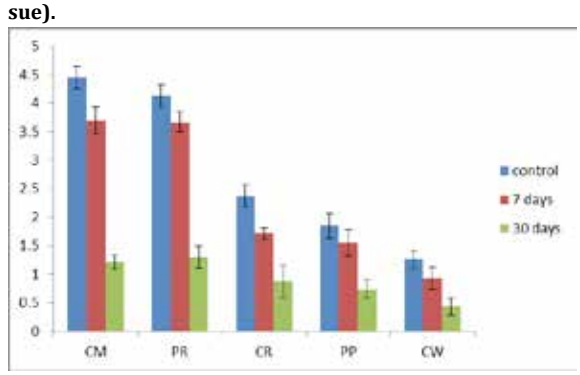
Labeo rohita is a fresh water major carp commonly found in AP. Labeo rohita ranging in weighing from 15± 2 gms and length of 10 ± 2 cm were procured from local ponds and transported to the laboratory, treated with 0.05 % KMnO4 solution for 2 min to avoid dermal infection. Fishes were kept in large cement tanks and supplied with clean de-chlorinated tap water and acclimatized for about two weeks prior to the experiment under natural photo period with constant aeration. During this period the fish were fed with commercial fish feed twice a day. Analytical grade chromium as Potassium dichromate supplied by BDH was used as a metal toxicant throughout the experiment.

Fishes divided into three groups containing 10 fishes each with the I group serving as control without any treatment. The group II, III fish were exposed to sublethal concentration ($1/10^{th}$ of LC_{50} 96 hours, 10 ppm) of Potassium dichromate for 7 days and 30 days after determining LC_{50} values (Finney, 1964). At the end of the each exposure period fishes were sacrificed and the muscle tissues like Pectoral pink, Pectoral red, Cardiac, Caudal white and Caudal red were isolated. Glycogen content was estimated by the method of Carrol et al., 1956

Results:-

Glycogen is a major polysaccharide and found to have a major role in carbohydrate metabolism and place an important role through glucose and lactic acid. In the present study, cardiac muscle is found to have higher glycogen content compare to the rest of the tissues and the sequence is as follows CM > CR > PR > PP > CW.

Fig 1.1: Changes in the glycogen levels in different muscle tissues of Control, 7 days and 30 days Chromium treated fish, Labeorohita (mg of glycogen/ gm wet weight of the tissue).



Types of Muscles

Discussion:-

The higher content of glycogen in cardiac muscle may be due to rich carbohydrate metabolism. The glycogen content can be attributed to the increase synthesis of glycogen in the fibers or to the glycogen sparing action of fatty acid oxidation with increased fat utilization. Higher amounts of glycogen in caudal and pectoral red muscle may be due to increased synthesis of glycogen than pink and white muscle. Glycogen serves as major source of energy for muscular work or movement. Low amounts of glycogen in fast muscles produce much of work for sudden burst of activity by anaerobic metabolism (Raynar and Keenan, 1967). Thus caudal white and pectoral pink muscles are highly capable of using glycogen as the fuel, and even may get depleted of their glycogen after prolonged muscular work (Drummond and Black, 1960). Witten bergur (1968) has reported about 1.5 time's higher glycogen content in the red muscle in contrast to the white muscle of carp. The red muscle usually has an adaptation for fat metabolism and contains high glycogen.

The present investigation, depletion of glycogen has been re-

corded in both 7 and 30 days experimental fish (fig1.1). Depletion of glycogen is pronounced in caudal red (-27.79%) followed by, caudal white (-26.09%), cardiac muscle (-16.95%), pectoral pink (-16.04%) and pectoral red (-11.10%) muscles of 7 days exposed fish. The consistent depletion is observed in 30 days exposed fish and it is highly significant in all the tissues.

Pesticide result in either anoxia or hypoxic conditions in surrounding environments (Jayantha Rao and Moorthy, 1983) these conditions normally increase glycogen utilization (Dezwan, 1973) and might have resulted in decrement of glycogen in tissues of fish. Decrease in glycogen was also supported by Upadyay and Shukla(1968) and Yasur et al., (1989) during stress conditions. Decrease in glycogen level in fish due to pesticide effect has been reported (Sambasiva Rao, 1984;Sasthry and Sunitha, 1984; Vijayavel et al., 2006 and Crestani et al, 2005). Tripati et al., (2003) reported decreased glycogen levels in Channa punctatus with an organophosphate, Dimethoate; Chandra mouli (2008) in Heteropneustes fossilis exposed to cypermethrin, Shaffi (1978) with copper intoxication and Rani et al., (1989) with ammonia toxicity.

Depleted glycogen levels following chromium stress reported in Cyprinus carpio communis (Ambrose et al., 1994; Shalaby et al., 2005) under hypoxic conditions also supports this view. A consistent decrease in tissue glycogen reserves observed in this study suggests impaired glycogenesis. Further, the decline in glycogen might be partly due to its utilization in the formation of glycoproteins and glycolipids, which are essential constituents of various cells and other membranes.

Summary and Conclusion:

The glycogen content is very high in cardiac tissue and then followed by pectoral red and caudal red muscles due to carbohydrate metabolism. Caudal white and pectoral pink muscles showed less amount of glycogen is due to higher glycolytic activity. Depletion of glycogen is observed in both 7days and 30 days of chromium exposed fish.

REFERENCE

1. Adeniyi,A.A and Yusuf'K.A.,2007.Determination of heavy metals in fish tissues,water and bottom sediments from Epe and Badagry Lagoons,Lagos,Nigeria. | 2. Basha, P.S and Rani A.U (2003). Cadmium induced antioxidant defence mechanism in fresh water teleost oreochromus mossambicus. Ecotoxical Environ. | 3. Carrol, N.V.,Longley, R.W and Row, J.H. (1956) Glycogen determination in liver and muscle by use of anthrone reagent. J.Biol.chem. | 4. Chandra mouli ,K.(2008), Effect of cypermethrin on carbohydrate metabolism in a selected fish Heteropneustes fossilis.M.Phil dissertation submitted to S.V.University,Tirupathi,India. | 5. Crestani,M.,Menezes,C.,G lusezak,L.,Dosantosmiron,D.,Lazzari,R.,Duarate,M.F.,Morsch,V.M.,Pippi,A. V.P.Vieira (2005). Effect of clomazone herbicide on haematological and some parameters of protein and carbohydrate metabolism of silver cat fish Rhamdia quelen.Ecotoxicol.Environ Saf.2006 Sep:65(1):48-55. | 6. Dezwan,C.A.(1973)"Environmental pollution by pesticides", flenum Press, London | 7. Farag. A.M., T.May, G.D Marty, M.Easton, D.D. Harper, E.E. little and L. Cleavland, (2006). The effect of chronic Chromium exposure on the health of chinook salmon (Onchorhyncus tshawytscha). Aquat toxical. | 8. Finney,D.J(1964) Probit analysis 2nd Edition,Cambridge University Press,London. | 9. Jayanth rao,K and Murthy,V.S.R (1983). Hypoxia induced the heamopoitic tissue in fresh water fish, Tilapia mossambica exposed to phosphomidon, Geobios. | 10. Rani, V.J.S., Venkateshwarlu, P. and C. Janaiah (1989). Changes in the carbohydrates metabolism of C. batrachus when exposed to two Organophosphorus insecticides. J. Environ. Biol., 10 (2): 197-204. | 11. Rauf A.,Javed Mand Ubaidullah M 2009.Heavy metal levels in three major carps(Catla catla,Labeo rohita and Cirrhina mrigala) from the river Ravi.Pakistan. | 12. Rayner, M.D and Keenan, M.J (1967). Role of red and white muscles in the swimming of ffskip jack Tuna, Nature. | 13. Samba Siva Rao, ,K.R.S.(1984).Studies on the toxic impact of carbaryl and phenthoate on some metabolic aspects of a murrel Channa punctatus(Bloch)-A Synergic study, Ph.D. thesis,S.V.University,Tirupathi,India. | 14. Sastry ,K.V. and Sunitha .(1984).Chronic toxic effects of chromium in Channa punctatus,J.Environ.Biol.,5(1):47-52 | 15. Shaffi,S.A (1978).Variations in tissue glycogen content, serum lactate and glucose levels due to copper intoxication in three fresh water teleosts.Curr.Sci.,47:954-956. | 16. Tripathi et al ., P.K .,Srivasthava ,V. K. and A.Singh(2003).Toxic methods of Dimethoate(organophosphate) on metabolism and enzyme system of fresh water teleost fish Channa punctatus.Asian Fisheries Science 16:349-359. | 17. Upadyay,O.V.B and G.S.Shukla (1989). Impact of phosphomidon in the carbohydrate metabolism of a fresh water prawn, Macrobranchinus lamarrei. Environ .Res.41(2):59-597. | 18. Vijayvel, K.,Rani,E.F.,Anbuselvam, C. and Blasubramaniam (2006). Interactive effect of monocrotophos and ammonium chloride on the fresh water fish Oreochromis mossambicus with reference to lactate/pyruvate ratio. Pesticide biochemistry and physiology. 86(3): 157-161.