MINOR RESEARCH PROJECT

of

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"Evaluation of Toxicity of Heavy Metals Mercury And Chromium To Fresh Water Fishs Labeo Rohita and Cirrhinusmrigala" Vide UGC, SERO, Sanction Letter: F.MRP-3371/ (UGC/SERO) Dt.july,2010.

EXECUTIVE SUMMARY

In the present investigation static acute toxicity tests were conducted to evaluate adverse effects of heavy metals mercury and chromium on the fresh water fishes *Labeo rohita* and *Cirrhinus mrigala* under standardised and reproducible conditions which permit a comparison with other xenobiotics and species tested.

Abrupt changes in the quality to the holding water in the present investigation was avoided since bio-availability and toxicity of pollutant to acquatic biota were reported to be primarily determined by the physico- chemical nature of aquatic environment . In the present study the susceptibility of *Labeo rohita* and *Cirrhinus mrigala* to heavy metals Mercury and Chromium might exclusively be due to the toxic stress of the pollutant .

Homeostatic system of the fish which is continuously adopted to the normal demands of the aquatic environment are challenged or stressed by anthropogenic habitat alterations. Mortality of the fish under acute stress may be

at a stage of exhaustion during which adoptive mechanisms are in adequate and homeostasis not regained.

Chromium, the experimental heavy metal toxicant is an essential trace metal. Toxicant of chromium to the fish is well known and is species specific.

Toxicity is a relative property of a chemical which refers to its potency to induce a harmful effect on an organism. It's is a function of concentration of the toxicant and duration of exposure. In the present study, decrease in LC_{50} with increase in exposure period was evident as it is further signified by the co-efficients of the fitted regression equation. Increase in the test concentration was found to enhance mortality of *Labeo rohita and Cirrhinus mrigala*.

Acute exposure to heavy metals and other toxicants produces immediate effects. Data from lethality tests are quantal, that is the animals live or die. However it is important to have sublethal effect of criteria that indicate toxic stress at a stage before death, so that early observations will permit rapid action to prevent mass mortality.

Growth of fish is the cumulation of many bio-chemical processes mediated and catalysed by the enzymes, and bio–chemical alternations may be induced by toxicants before growth become evident. Enzymes that exclusively mediate food metabolism , and other bio-chemical reactions were proved to be poisned by toxicants like heavy metals . Many chemicals at relatively low doses

effect the metabolism of the bio-ta by altering normal enzyme activity with some of these the interactions there is high reactivity with ultimate debiliating effect of the whole developing from a variety of non-specific biochemical malfunction .

Presence of acid and alkalane phosphatase and differences in the activity of them among tissues of *Labeo rohita* and *Cirrhinus mrigala* is in different tissues of fish in the sequence of intestine >liver >brain >kidney where as Alp activity is in the sequence of the intestine >kidney>liver>brain irrespective of the fish species. In the general activity was more pronounced then AcP activity in all the tissues in the control fish. Phosphatases activity in control fish thus reveals species specifics activity and tissue specific distrubtion.

For the respective experimental fish species *Labeo rohita and Cirrhinus mrigala* the median lethal concentrations after 96h exposure were 200.0 mg/l, and 175.0 mg\l respectively for the heavy metal chromium, of the two fish studied, *Cirrhinus mrigala* is more susceptible to the toxicant chromium, thus indicating the fact that the toxicity of a pollutant might differ between species or in other words toxicity is species specific.

Median lethal concentration of chromium were 200.0 and 175.0. mg/l for the experimental species *Labeo rohita* and *Cirrhinus mrigala* tolerance respectively after 96h. This limit is comparatively higher than that of many of the fish. Fish that show 96h LC_{50} below 100mg/l include *Aldrichetta fosteri*, *Salvilenus fontinalis*

and *Salmo gairdneri* and *Fundulus heteroclites* .An exceptional higher LC_{50} value of 346.70 mg/l was recorded for the fish *Cyprinus carpio* communis . Hence it may be deduced that both the test species are moderate by sensitive to the metal chromium. The environmental parameters by the presence of the heavy metal pollutants might have resulted in considerable decrease in metabolic rate including nuclic acid synthesis. Differences in LC_{50} values may be understood in terms of altered physico- chemical properties of the holding water and size of the test animal.The present toxicity studies on *Labeo rohita* and *Cirrhinus mrigala* reveal that *Labeo rohita* is considerably hardy and *Cirrhinus mrigala* considerably sensitive.

Impact of sublethal concentrations of heavy metals Mercury and chromium on enzyme activity reveal significant decline in the activity in tissues of *Labeo rohita* and Cirrhinus mrigala irrespective of the concentrations and exposure periods.

Acid phosphate is a hydrolytic enzyme which takes part in the dissolution of dead cells and as such is a good indication of stress condition in the biological system.It is known that alkaline phosphate is involved in trans phophorylation reactions. The cause of inhibition may be uncoupling of phosphrylation under the stress of heavy metals. The reported inhibition of phosphates in different tissues might be related to the ability of the toxicant to alter cellular configuration by binding the membrane.

Depleted levels of phosphates activity were reported in fish exposed to pesticides in Cyprinus carpio treated with industrial effluents containing heavy metals and in *Catla catla* exposed to heavy metal cadmium .

Concentration dependent decline in AcP and AlP activity is in accordance with the results of previous studies and Maximum decline in intestine Alp activity in the present study conforms with the reports of sugawara and sugawara. Chromium being accumulated in the kidney and intestine of fish is reported to inhibit Na^+ K^+ ATP ase activity in kidney and intestine .

Phosphatases are strongly advocated to be good indicators of stress conditions in the biological system and from the present study it is emphatically deduced that intestine AcP and AlP activity against chromium could be used as indicators of heavy metal pollution because impact of chromium on phosphatase activity were proved to be statistically significant with reference to concentration as well as exposure period.

Life depends on a complex network of chemical reactions brought about by enzymes, the largest and most highly specialised class of proteins. Hence any modifications of an enzyme pattern might have far reaching consequences in the living organism. Transaminases play an important role in the utilization of protines and carbohydrates and they belong to the transferase group. Both of the enzymes, glutamic oxalacetate transaminase and glutamic pyruvate transaminase occur in the cytoplasm and are transferred to the inner membrane of mitochondrion.

Activity of GOT and GPT in brain, Liver, Iintestine and Kidney tissues was comparatively higher in the control fish *Labeo rohita* than *Cirrhinus mrigala*. GPT activity was more pronounced than GOT in all tissues irrespective of the fish species. GOT activity was found to be more in brain while GPT activity was the highest in liver. Under the sublethal toxic stress of chromium the observed pattern of stimulation of GOT and GPT was found to be dose and duration dependent. Inhibition of enzyme activity was not observed at any concentration in any tissue in the present study.

Maximum enhanced GOT activity was observed in liver tissue of both the experimental fish, *Labeo rohita* (86.27%) and *Cirrhinus mrigala* (89.22%) under the influence of heavy metal chromium at the highest dose and longest duration. On the contrary maximum stimulation of GPT activity was observed in brain tissue of both the fish. *Labeo rohita* (70.54%) and *Cirrhinus mrigala* (85.48%) under the stress of chromium at the highest concentration and exposure period. Enhanced GOT and GPT activity having fluctations between tissues least stimulation of both the enzymes was observed in kidney at the highest dose and longest duration irrespective of the fish species.

Enhanced activity of GOT and GPT clearly shows the attempt of the organism to fight the stress caused by pollutants. Further the increased activity of GOT and GPT indicate well established link between carbohydrate and protein metabolism providing source of keto acids for kerb's cycle and gluconeogenesis.

Since toxic chemical pollutants often affect the activity of enzymes atleast to some degrees, enzymes and logical candidates to use as biomonitors. To this end efforts are being made to develop various types of monitoring systems using bio chemicals as a best system in place of the whole animals .

To conclude, a multiplicity of interactive parameters appears to be involved in disrupting the highly balanced hemeostastic system of fish. Among the fish studied *Cirrhinus mrigala* was observed to more susceptible to heavy metals Mercury and chromium than *Labeo rohita* irrespective of the test concentrations and exposure period. Among the toxicants studied heavy metal Mercury was observed to be more toxic than Chromium.

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