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Effect of Sodium Fluoride (NaF) Toxicity on Biochemical Changes in Fresh Water Fish *Cirrhinus mrigala*

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Abstract:
Fishes are regarded as an important high grade protein containing food staple of Indian people. Ever increasing water pollution level, especially sodium fluoride (NaF), in natural and inland freshwater reservoir condition has made significant biochemical changes in the fishes. In view of this, the investigations on effects of acute and chronic sodium fluoride toxicity to fish Cirrhinus mrigalahave been carried out. The changes in glycogen, protein and lipid content of selected tissues like muscle, liver, gill and kidney were examined. The study revealed a highest loss of glycogen, protein and lipid percentage in all tissues as compared to control.
Keywords: *Sodium fluoride; biochemical; body tissue.*

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I. Introduction

Inorganic Fluorides are introduced into the environment as a result of natural emission and anthropogenic sources. Depending on metrological condition and season, gaseous and particulate inorganic fluorides are transported in air and ultimately are deposited on land or open water bodies. Important anthropogenic sources of fluoride to the aquatic environment inclued municipal waste and effluents from fertilized producing plants and aluminium refineries. In water mobility and transport of inorganic fluoride are dependent on PH, water hardness, and the prescience of ion exchange mineral. In water inorganic fluoride remain dissolved in solution under acidic condition, low hardness, and the presence on ion exchange material (Cuker and Shilts 1979; Sahu and Karim 1989.) As a consequence free fluoride levels are generally low (Skjelkvale 1994, Radic and Barlic 1995). Inorganic fluoride are toxic to aquatic organism and may cause adverse biological effect such as change in carbohydrate, lipid, and protein metabolism , reproduction , impairment, reduce embryonic and development life stage, and alternation size and growth. Sodium fluoride (NaF) is the most common inorganic fluoride to toxic aquatic organism reported by Sanders and Cope (1966). Toxicity studies with fluoride containing different effluent by Woodwiss and Fertwell (1974), Damkaer and Dey (1989), Camargo (1991), Camargo and Tarazona (1991), Samal (1994) reaction to fluoride has been examined in several studies on aquatic animal, chiefly on fishes. If fishes exposed to poisons amount of sodium fluoride (NaF) become apathetic, loss weight, violent movement, increases secretion and wander aimlessly (Neuhold and Singler 1960). Sodium fluoride (NaF) acts as poisons and interupting metabolic process such as glycolysis, lipid and synthesis of protein particularly fishes (Julio A. Camargo, 2003). Significant alternation in protein metabolism on acetylcholinesterase activities and oxygen consumption in fresh water crabes have been described by Reddy and Venugopal (1990). Inorganic fluoride toxicity is negatively correlated to water hardness and positively correlated totemperature (Pimentel and Bulkley 1983). The initial phase of acute inorganic fluoride intoxication in fresh water species such as rinbow trout and carp is characterized by apathetic behavior accompanied by Neuhold and Sigler 1960 and Newhold 1972). In many cases, the surviving young fish had curved spines (Singler and Neuhold 1972). The present studies was under taken to evaluate the toxic effect on sodium fluoride (NaF) on biochemical changes in different tissue such as gill, liver, kidney and muscle of fresh water carp C. mrigala.

II. Material and Method

The fresh water fisheC. mrigala measuring about 6 to 7 cm. in length were collected from state government fish seed rearing centre. The collected fish were maintained under laboratory condition at 28-30 oc for 10 days acclimation and were then divided in different group having 10 fishes in each. All the group except control were transferred to separate glass aquarium containing different concentration (10 L) sodium fluoride (NaF) grade to determine toxicity LCo and LC50 value and fish behaviour. Acute toxicity experiment were conducted for 96h and chronic toxicity for 30 days using a static bioassay technique. Toxic medium was

changed at an interval of 24hrs. During experimentation temperature, pH, oxygen contains and hardness of the water determined. After acute exposure 96h fishes were sacrificed to obtained gills, liver, kidney and muscle. The pooled samples of the organs were used for estimation of glycogen, total protein and total lipid. Same method was applicable for the chronic exposure for 30 days for estimation of glycogen, total protein and total lipid. Biochemical Alternation in experimental Fish exposed to the Sodium Fluoride (NaF). The experiment was conducted for acute and chronic, during the fish and provided food in adequate amount. The aquarium water was changed on after 24h, and fresh dose of the sodium fluoride (NaF) was given. Total protein lipid and glycogen were estimated by standard method by Lowry et al., Folch et al., and De Zawn A and Zandi D.I. respectively.

III. Results and Discussion

Glycogen:

Biochemical changes were observed in the glycogen, protein and lipid content in different tissue of C. mrigala after acute exposure to sodium fluoride (NaF). The changes in glycogen content in different tissue such as liver, gill, muscle, and kidney of the fish *C. mrigala* after exposed to sodium fluoride for acute doses, 935ppm and 960ppm for 96 hrs are given in table 1. The glycogen content in liver was most significantly decrease ($p < 0.05$ to $p < 0.001$) in experimental fishes compared to other organs like muscle, gill, and kidney. (Given in Table no.1; Fig. no 1)

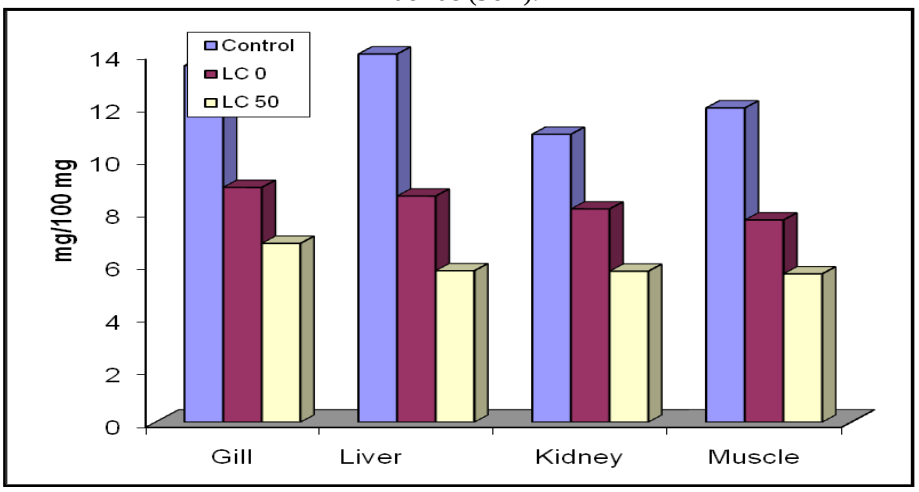
Table No. 1

Changes in glycogen content in different tissues of *Cirrhinus mrigala* after acute exposure to sodium fluoride (96 hrs).

Tissue	Control	Acute Exposure	
		LC_0 (935ppm)	LC_{50} (960ppm)
Gill	13.56 ± 0.745	8.93** ± 1.134	6.80*** ± 1.095
Liver	14.00 ± 0.322	8.60*** ± 0.838	5.76*** ± 1.012
Kidney	10.95 ± 0.582	8.11** ± 0.468	5.74** ± 0.617
Muscle	11.95 ± 0.582	7.69** ± 0.452	5.64*** ± 0.233

(Values expressed in mg/100mg wet tissue); Each value is the mean of five observations.
± SD, Values are significant at P < 0.05 *, P < 0.01**, P < 0.001***

Figure 1: Changes in glycogen content in different tissues of *Cirrhinusmrigala* after acute exposure to sodium fluoride (96 h).



Protein:

There was significant decrease in the protein content of all the tissues analysed after acute exposure to sodium fluoride compared to control. Muscle showed maximum decline in protein content than gill, liver and kidney in a progressive manner, after chronic exposure as compared to acute.

The protein content in different tissues of *Cirrhinus mrigala* was in the order of muscle > liver >gill > kidney. (Table 2, Fig 2).

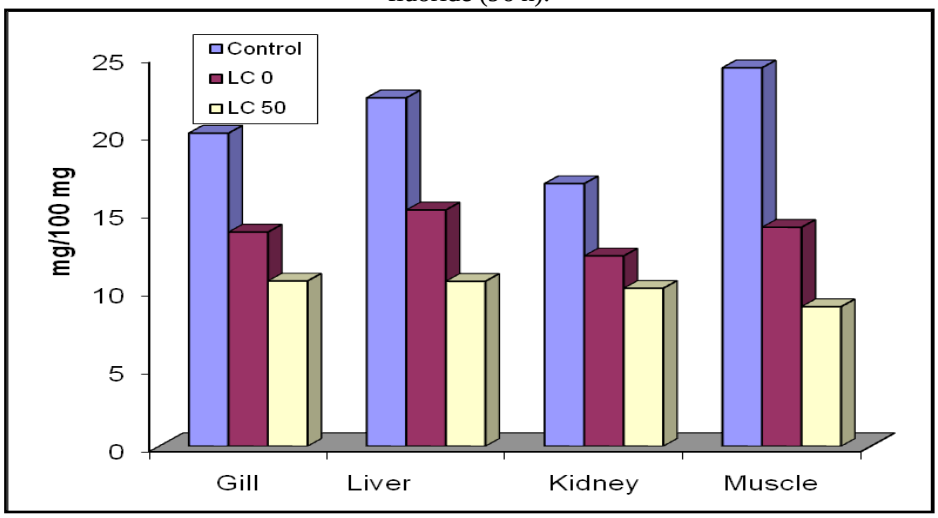
Table No. 2

Changes in protein content in different tissues of *Cirrhinus mrigala*after acute exposure to sodium fluoride (96 hrs).

Tissue	Control	Acute Exposure	
		LC_0 (935ppm)	LC_{50} (960ppm)
Gill	20.10 ± 0.19	13.75*± 0.31	10.61*** ± 0.21
Liver	22.37 ± 0.32	15.17* ± 0.24	10.59***± 0.26
Kidney	16.86 ± 019	12.22* ± 0.56	10.14** ± 032
Muscle	24.30 +0.22	14.06** ± 0.41	8.96*** ± 0.26

(Values expressed in mg/100mg wet tissue);Each value is the mean of five observations.
± SD, Values are significant at P < 0.05 *, P < 0.01**, P < 0.001***

Figure 2: Changes in protein content in different tissues of *Cirrhinus mrigala* after acute exposure to sodium fluoride (96 h).



Lipid:

After acute (96 h) and chronic (30 days) exposure to sodium fluoride, the lipid content was found decreased in different tissues of freshwater fish *L. rohita* as compared to control. Kidney showed maximum decline in lipid content followed by liver, muscle, and gill, after acute and chronic exposure.

Lipid content in different tissues of the freshwater fish *Cirrhinus mrigala* was in the order of muscle > liver > gill >kidney. (Table 3, Fig.3).

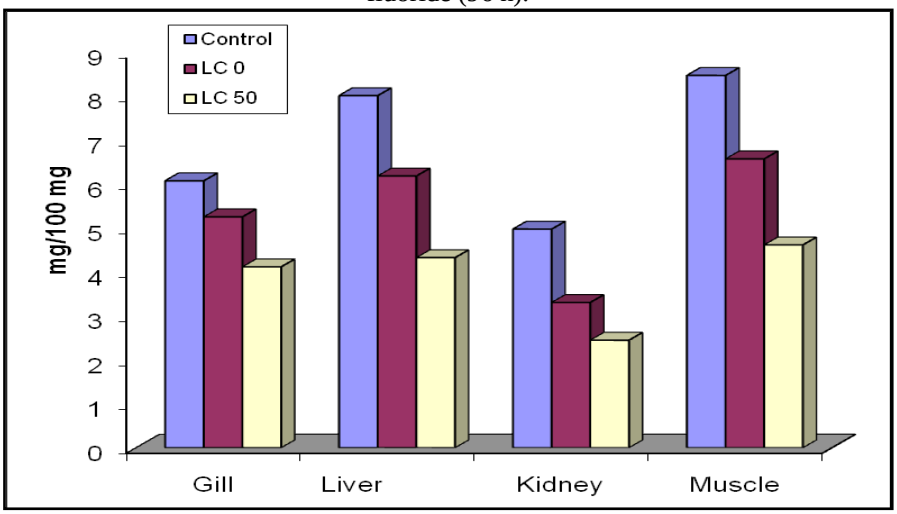
Table No. 3

Tissue	Control	Acute Exposure	
		LC_0 (935ppm)	LC_{50} (960ppm)
Gill	6.08 ± 0.508	5.26* ± 0.679	4.12** ± 0.477
Liver	8.02 ± 0.426	6.19* ± 0.580	4.33** ± 0.812
Kidney	4.98 ± 0.481	3.31** ± 0.535	2.45*** ± 0.627
Muscle	8.48 ± 0.469	6.58* ± 0.638	4.62** ± 0.622

Changes in lipid content in different tissues of *Cirrhinus mrigala* after acute exposure to sodium fluoride (96 h).

(Values expressed in mg/100mg wet tissue);Each value is the mean of five observations.
± SD, Values are significant at P < 0.05 *, P < 0.01**, P < 0.001***

Figure 3: Changes in lipid content in different tissues of *Cirrhinus mrigala* after acute exposure to sodium fluoride (96 h).



IV. Conclusion

Toxic effects of inorganic sodium fluoride (NaF) change the normal physiological function of the experimental organism. Biochemical changes were observed in glycogen, protein and lipid content in various tissues of experimental fish in acute concentration of sodium dluoride. Glycogen is the prime sources of energy showed decreasing order after acute exposure to sodium fluoride concentrations. Decrease in glycogen at acute concentration was more in gill and liver. Gill affected as they are first organ to come in contact with toxicant, while liver affected as it is prime detoxifying organ. Influx of glycogen to meet the demand created due to stress responsible for increasing glycogen while increased glycolysis may result in decrease glycogen level. The depletion of glycogen level in the specific tissues indicates the possibility of active glycogenolysis, subsequent hypoxia that increases carbohydrate consumption. In present investigation, depletion of protein was to be found in acute concentration of sodium fluoride in different tissues due to proteolytic activity in anaerobic conditions, rapid utilization of body protein under stress condition as well as sodium fluoride interrupt the metabolic process of protein synthesis in fishes. Lipids serves as the reserve energy sources, which decreases significant when exposed the experimental fish in acute concentration of sodium fluoride. The decrease may be due to inhibition of lipid synthesis by fluoride as well as increased utilization of stored lipid as a source of energy to conduct regular metabolic functions under the stress of NaFtoxicant.

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