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Impact of Sodium Fluoride (NaF) on Protein and Lipid Concentration of Fresh Water Fishes Labeo rohita

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Abstract:

The toxicity of Sodium fluoride (NaF) to fresh water fish *L. rohita* was evaluated after exposure to the study of acute (96hrs.) toxicity. The changes of biochemical parameters in muscle, liver, gill and kidney tissues were recorded. Muscle shows the greatest loss of protein due to exposure of NaF followed by liver, gill and kidney. Liver shows significant reduction of lipid and glycogen in comparison with other selected tissues of the experimental fish species.

Keywords: Sodium fluoride; *Labeo rohita*; biochemical; body tissue.

Introduction:

Inorganic Fluorides were 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 aluminum refineries (Woodiwiss and Fertwell, 1974). 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). Free fluoride level in freshwater is generally low (Skjelkvale 1994; Radic and Barlic, 1995).

Inorganic fluoride are toxic to aquatic organism and may caused adverse biological effect such as change in carbohydrate, lipid, and protein metabolism, reproduction, impairment, reduce embryonic and development of life stage, and alternation size and growth (Samal, 1994).

Aquatic animals such as fish and invertebrates can take up fluoride directly from the water or via food (Hemens and Warwick, 1972; Nell and Livanos, 1988). Fluoride tends to be accumulated in the exoskeleton of invertebrates and in the bone tissue of fishes. Fluoride toxicity depends upon increasing fluoride concentration in the aquatic medium, exposure time and water temperature (Neuhold and Sigler, 1960; Angelovic et al., 1961; Hemens and Warwick, 1972).

Fluorine interferes with various metabolic activities and alters the levels of protein, lipids, glycogen, and cholesterol of fish (Kumar et al., 2007). The present studies was under taken to evaluate the toxic effect on sodium fluoride on biochemical changes in different tissue such as gill, liver, kidney and muscle of fresh water carp *Labeo rohita*.

Material and Method:

The fresh water fishes *Labeo rohita* measuring about 6 to 7 cm in length were collected from state government fish seed rearing center. The collected fish were acclimatized under laboratory condition at 28-30^{0}C for 10 days and then divided into different groups having 10 fishes in each. All the groups except control were transferred to separate plastic container containing different concentration (10 L) sodium fluoride (NaF) to determine toxicity LC_0 and LC_{50} value and fish behavior. Acute toxicity experiment was conducted for 96hrs. Toxic medium was changed at an interval of 24h. During experimentation temperature, pH, oxygen content and hardness of the water were determined using standard methods by APHA. After acute exposure 96hrs fishes were sacrificed to obtained gills, liver, kidney and muscle. The pooled sample of the organ was used for estimation of glycogen, total protein and total lipid.

Biochemical parameters like total protein, lipid and glycogen were estimated by Lowry et al. (1951), Folch et al. (1957), and De, Zwann and Zandee (1972) respectively.

Result:

The alteration in total glycogen, protein and lipid were calculated from *Labeo rohita* after acute (96hrs.) exposure to sodium fluoride. The significant changes were observed in the experimental fish. The glycogen content in different tissues of *Labeo rohita* was *in* the order of liver> muscle> gill> kidney. After the acute exposure to sodium fluoride, the glycogen content from all the tissues decreased significantly (Table 1.). The maximum loss of glycogen was recorded in liver, while minimum in kidney.

After the acute exposure to sodium fluoride, the protein content from all the tissues decreased significantly (Table 2). Muscle showed the greatest loss of protein as compared to all other tissues. In acute exposure studies, the muscle protein loss was more significant ($P<0.05$) followed by, liver, gill and kidney.

The lipid content was found to decrease after exposure to acute concentration of sodium fluoride in different tissues of *Labeo rohita.* It was found to decrease in order of liver > muscle > gill > kidney (Table 3).

Table: 1 Changes in glycogen content in different tissues of *Labeo rohita* after acute exposure to sodium fluoride (96 hrs)

Tissue	Control	Acute Exposure	
		LC_0 (910ppm)	LC_{50} (935ppm)
Gill	11.98 ± 0.865	7.53** ± 0.745	6.12*** ± 0.579
Liver	15.40 ± 1.072	8.82*** ± 0.964	6.57*** ± 0.932
Kidney	10.49 ± 1.102	8.28* ± 0.974	7.29** ± 0.777
Muscle	11.42 ± 0.834	7.32** ± 0.675	6.45*** ± 0.606

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

Table:2

Changes in protein content in different tissue of *Labeo rohita* after acute exposure to sodium fluoride (96 hrs)

Tissue	Control	Acute dose	
		LC_0	LC_{50}
Gill	17.73 ± 0.33	12.43 ± 0.57 *	9.73 ± 0.64 **
Liver	21.90 ± 0.20	16.85 ± 1.00 *	13.83 ± 0.85 **
Kidney	15.37 ± 0.16	9.77 ± 0.50 *	7.19 ± 0.47 **
Muscle	23.45 ± 0.24	15.22 ± 0.46 *	10.02 ± 0.62 **

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

Table: 3 Changes in lipid content in different tissue of *Labeo rohita* after acute exposure to sodium fluoride (96 hrs)

Tissue	Control	Acute dose	
		LC_0	LC_{50}
Gill	11.95 ± 0.48	9.36 ± 0.54 NS	5.71 ± 0.56 **
Liver	11.64 ± 0.43	8.66 ± 0.41 NS	5.65 ± 0.52 **
Kidney	8.54 ± 0.35	6.31 ± 0.36 NS	3.42 ± 0.25 **
Muscle	9.10 ± 0.55	6.42 ± 0.38 NS	3.67 ± 0.31 **

Each value is the mean of five observations. (Values expressed in mg/100mg wet tissue)

± S. D. values are significant at P<0.05 *, P< 0.01**, P< 0.001***

Discussion:

The decreases caused by sodium fluoride (NaF) in protein content of muscle, liver, gill, and kidney was observed, this result is similar to the observation of (Gupta R. 2003). This biochemical changes may due to blocking of the metabolism of amino acid and its preventing cells from synthesizing protein. In fact study has shown that sodium fluoride (NaF) inhibit protein synthesis and interferes with amino acid metabolism (Pandit CG, Narayana RD, 1940). Another possible reason may be depletion of protein for its utilization in conversion to glucose (Sirvastava N, Kaushik N, Gupta P. 2002).

The percentage of glycogen increases significantly was found in the tissue of liver and muscle and decreases in the tissue of gill and kidney. The increased glycogen level in liver and muscle in lethal concentration due to disturbance of carbohydrate metabolism as it has been observed to effect enzyme involved in glycogen turnover at higher sodium fluoride concentration (Strochkova LS, Zhvoronkov AA in 1983). Several other studies have revealed that sodium fluoride inhibit glycolytic enzyme (Camargo JA 2003). The percentage of glycogen decreases may be due to enhanced conversion of glycogen to glucose to meet and increased energy requirement under stress condition of sodium fluoride in liver and muscle.

The total lipid decrease in liver, gill, muscle, and kidney due to inhabitation of lipid synthesis by sodium fluoride as well as increased utilization of storied lipid as a source of energy to conduct regular metabolic function. Sodium fluoride is well known as an inhibitor of various enzyme like lipase, phosphatase, and esterases. The interference of sodium fluoride was also observed in fatty acid oxidation and inhibit the enzyme acyl-co-A synthesis (Batenburg JJ, Vanden Bergh SG. 1972). Thus decreased lipid content in various tissue may be due to the

inhibition of these enzyme. Total lipid decreased in muscle, liver, and testis of the fluoride exposed catfish was observed by Sashi et al. in rabbits in 1989.

From the result obtained here , it is cleared that sodium fluoride (NaF) interferes with various metabolic activities and biochemical changes are observed in the level of protein, glycogen, and lipid content in experimental fish *L rohita.*

The initial phase of acute inorganic fluoride intoxication in fresh water species such as rainbow 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).

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