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STUDY OF BEHAVIOURAL CHANGES IN FRESHWATER FISH, TILAPIA MOSSAMBICA EXPOSED TO ACUTE TOXICITY OF SODIUM FLUORIDE DURING WINTER SEASON

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ABSTRACT

he acute toxicity effect of sodium fluoride on the behaviour of a fresh water fish ,Tilapia mossambica (Oreochromis mossambicus) was studied during winter .The purpose of the study was to establish LC50 value and regression equation of sodium fluoride on freshwater fish, Tilapia mossambica by using static bioassay tests. The result were recorded for behaviour in acute treatement for control, LCO and LC50 after 24, 48, 72 and 96 hrs. The test fish exhibited erratic swimming ,loss of equilibrium, discolouration of skin, decline in the opercular movement, motionless at the bottom ,moderate amount of mucous was secreted all over the body. It is concluded that sodium fluoride is toxic to Tilapia mossambica and affect their behaviour.

KEYWORDS: Sodium Fluoride, Tilapia mossambica, Acute toxicity, Behaviour, winter.

INTRODUCTION:

Fluoride is a general protoplasmic poison but it is not possible yet to describe in detail the mechanism by which it produces the death Hodge & Smith, (1965). A survey of the literature reveals that fluoride affects a wide range of animals Fujii and Honda, (1972) Bogin et al., 1976; Suketa and Mikami, (1977).

Studies on the effect of to find out the acute toxicity sodium fluoride on carp and impact of sodium fluoride on rainbow trout showed altered oxygen consumption the fish, Tilapia mossambica violent and erratic movements of of the body and secreted from Bheemariver. excees mucus Neuhold and Sigler, (1960). Fluoride is one MATERIAL AND METHODS: of the components, which are The fishes, Tilapia toxic at high concentrations. mossambica (Oreochromis The toxic effects of elevated mossambica) were collected fluoride on various aquatic from Bheema river at Takli species, humans, livestock and (Solapur District). Takli is plants are well documented. located on the South side of Gikunju, (1992); Dwevedi et al the Solapur. It is 28 km away ., 1997; Marippan et al., 2000; from Solapur. (M.S.) and soon Camargo, (2003). Hence the present study was undertaken

behaviour of the freshwater (Oreochromis mossambicus)

after collection the fishes were brought to the laboratory.



The fishes were maintained in an aerated glass aquaria and acclimatized for 4 weeks at laboratory condition. During the period of acclimatization the fishes were fed with commercial fish food. The well acclimatized healthy fishes weighing 10-15 gm and 5-8 cm in length were selected for experimentation. Static bioassay studied were conducted by using different concentrations of sodium fluoride from 35.0 to 95.0 ppm. And a batch of 10 fishes was exposed to ten different concentrations.

Table 1
Regression equation (Y = α + β X), 95% fiducial limits (m1±m2) with LC ₀ and LC ₅₀ for <i>T. Mossambica</i>
(Oreochromis mossambicus) exposed to sodium fluoride during winter season.

Season	Duration	$Y = \alpha + \beta X$	95% fiducial		Calculated	Observed	
	in hr.	•	limits (ppm)		LC ₅₀ (ppm)		
			M1	M2		LC₀ (ppm)	LC ₅₀ (ppm)
winter	24	1.504 +0.0783X	76.53	81.69	78.61	56.0	80.0
	48	1.432 +0.0847X	69.51	73.87	71.69	50.5	73.0
	72	1.322+0.0975X	62.87	66.11	64.49	43.5	66.0
	96	1.149+0.1294X	58.05	66.97	62.51	35.0	65

Each batch of fishes was maintained in separate tank for 96 hr. The percent mortality was noted at an interval of 24 hr up to 96 hr and observed median lethal concentration (LC_0 value) of sodium fluoride for *Tilapia Mossambica (Oreochromis mossambicus)* was determined. After repeating the experiments thrice and by using Finneys (1964) probit method, the regression equation with 95% fiducial limits was established and LC_0 and LC_{50} values were determined.

For behaviour study experiments. The well acclimatized healthy fishes weighing 10-15 gm & 5-8 cm in length were divided into 3 group each containing 10 fishes. The fish, *Tilapia Mossambica (Oreochromis mossambicus)* were exposed to three different concentrations grouped in two sets of sodium fluoride. In the first group the fishes were exposed to LC_0 concentration for 96 hr (35 ppm). In the second group the fishes were exposed to LC_{50} concentration (65 ppm). The third group was used as control. Fish behaviour were observed & recorded.

Table 2								
Temperature	рН	Do (mg/l)	Total hardness					
			(mg/l)					
25-26° c	7.5-7.7	4.4-4.5	135-140					

Result:

The physico-chemical parameters of the test water used in the experiment were as follow in table no. 2 according to method described by APHA(1980).

The acute toxicity effect of sodium fluoride on *Tilapia mossambica (O. Mossambicus)* shown in Table no. 1 by giving respective regression equation, LC_{50} values & fiducial limits.

For the winter 24 hr. of toxicity experiment 10 animals for each concentrations were exposed to the different sodium fluoride concentrations ranging from 56.0 ppm to 104.0 ppm. The results were subjected for statistical analysis for establishment of regression equation and 95% fiducial limits or confidence limits. The regression equation for winter 24 hr. was Y=1.504 + 0.0783X and the 95% fiducial limits are ranging from 76.53-

81.69 ppm. The calculated LC₅₀ value for 24 hr. is 78.61 ppm and observed LC₀ value was 56.0 ppm and LC₅₀ value was 80.0 ppm.

For the winter 48 hr of toxicity experiments 10 animals for each concentration were exposed to the different sodium fluoride concentrations ranging from 50.5 ppm to 95.5 ppm. The results were subjected for statistical analysis for establishment of regression equation and 95% fiducial limits or confidence limits. The regression equations for winter 48 hr. was Y=1.432+0.0847X and the 95% fiducial limits are ranging from 69.51 – 73.87 ppm. The calculated LC_{50} value for 48 hr. is 71.69 ppm and observed LC_{0} value was 50.5ppm and LC_{50} value was 73.0 ppm.

For the winter 72 hr. of toxicity experiments 10 animals for each concentration were exposed to the different sodium fluoride concentrations ranging from 43.5 ppm to 90.0 ppm. The results were subjected for statistical analysis for establishment of regression equation and 95% fiducial limits or confidence limits. The regression equation for winter 72 hr. was Y=1.322+0.0975X and the 95% fiducial limits are ranging from 62.87-66.11 ppm. The calculated LC₅₀ value for 72 hr. is 64.49 ppm and observed LC₀ value 43.5 ppm and LC₅₀ value was 66.0 ppm.

For the winter 96 hr. of toxicity experiments 10 animals for each concentration were exposed to the different sodium fluoride concentrations ranging from 35.0 ppm to 95.0 ppm. The results were subjected for statistical analysis for establishment for regression equation ad 95% fiducial limits or confidence limits. The regression equation for winter 96 hr. was Y=1.149+0.1294X and the 95% fiducial limits are ranging from 58.05-66.973ppm. The calculated LC₅₀ value for 96 hr. is 62.51 ppm and observed LC₀ value was 35.0 ppm and LC₅₀ value was 65.0 ppm.

Behaviour of controlled group of *Tilapia mossambica* during winter season the fishes were moving normally in aquaria. The dorsal fin was extended. The excreta was more. Mucus on the body was less. Rate of opening and closing of mouth was fast. The pinkish dots at fin endings observed.

Sodium fluoride induced behavioural changes in *Tilapia mossambica* exposed to LC_0 concentration (sodium fluoride NaF) for the intervals of 24, 48, 72 & 96 hr. of acute toxicity during winter season. The opening and closing of the mouth was faster. The movement of fishes was restricted. Excreta were more and sticky. Moderate amount of mucus was secreted all over the body. Dorsal fin was slightly extended. The fishes exhibited reduced swimming activity.

Sodium fluoride induced behavioural changes in *Tilapia mossambica* exposed to LC_{so} concentration (sodium fluoride NaF) for the intervals of 24, 48, 72 & 96 hr. of acute toxicity during winter. The opercular movement were slowed down. The opening and closing of mouth also slowed down. The dorsal fins were not extended. The fishes showed erratic swimming and abnormal swimming. They showed loss of equilibrium. The skin shows marked decrease in the pigmentation associated with appearance of dark patches and rashes. The died fishes float on the surface with yellowish belly upwards and finally settled to bottom.







Fig. 2. 48 hour acute toxicity exposure of NaF to freshwater teleost, *Tilapia mossambica (Oreochromis mossambicus)* during winter.

Fig. 3. 72 hour acute toxicity exposure of NaF to freshwater teleost, *Tilapia mossambica (Oreochromis mossambicus)* during winter.



Fig. 4. 96 hour acute toxicity exposure of NaF to freshwater teleost, *Tilapia mossambica (Oreochromis mossambicus)* during winter.



DISCUSSION:

In the present study, the effect of sodium fluoride on freshwater fish, *Tilapia mossambica (Oreochromis mossambicus)* has the acute toxicity values of the LC_{so} for 24, 48, 72 & 96 hr. were 80.0, 73.0, 66.0 and 65 ppm, respectively. From our observations it can be stated that the LC_{so} values were decreased after 96 hr of treatment. Muley et al., (1996) studied the effect of sodium fluoride *T. Mossamibica* from Rajaram tank, Kolhapur and observed 30 ppm as LC_{o} and 60 ppm as LC_{so} value after 96 hr. of treatment. The acute toxicity of grass carp, etenopharyngodon idella was determined by using static bioassay and established LC_{so} value as 6.5 mg/l after 96 hr. of the treatment by using Nuran Tilak and Swarankumari (2009). Smith et al., (1985) studied the acute toxicity of sodium fluoride for 96 hr on rainbow trout (Oncorynchus mykiss) and found the LC_{so} value as 200 ppm . Camargo and Tarazan (1991) studied the toxicity of sodium fluoride on the fry of both rainbow trout (Oncorynchus mykiss) and brown trout (Salmo trutta) and observed that the LC_{so} value for fry of rainbow trout was 107.5 ppm and for brown trout it was 164.5 ppm.

Behavioural modification is one of the most sensitive indicators of environmental stress and may affect survival rate of fishes Olla et al., (1980).

In the present study, the fish *Tilapia mossambica* when exposed for acute toxicity to sodium fluoride. The opercualr movement were decreased for the protection of the gills. Similar behaviour changes were observed by Jones (1973) in stickle back fish exposed to CuSo4 and pbNo3. The fish *Tilapia mossambica* exposed for acute toxicity to sodium fluoride the fishes showed erratic swimming , imbalanced position are caused by adverse effects of sodium fluoride are central nervous system. Rao and Rao (1981) and Drummond et al., (1986) observed the erratic swimming of the treated fish indicates loss of equilibrium. It is likely that the region in the brain which is associated with the maintenance of equilibrium should have been affected. Excited & erratic swimming was observed by Sulaiman et al., (1989) , Radhaiah and Jayanatha Rai (1988). The fish Tilapia mossambica exposed for acute toxicity to sodium fluoride the fishes showed discolouration of skin may be caused by impairment of pituitary functions reflected by reduction in number & size of chromatophores & their pigment content. Pandey et al., (1990) also reported depigmentation in toxicant exposed fish & attributed it to reduction in number & size of chromatophores. Ram Nayan Singh et al., (2009) observed erratic swimming, decreased rate of opercular movement, copious mucous secretion when fish common carp cyprinus carpia exposed to an organophosphate.

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