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Behavioral Study of *Labeo Rohita* Exposed To Mercury

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Abstract

The present studies of behavioural changes were observed in control and exposed fish. The fish maintained in normal freshwater behaved in usual manner (i.e. they were very active with well-coordinated movements). Also the fish found to be very alert at slightest disturbance and covered one-third area of the bottom. But when exposed to mercury the fish showed erratic swimming, hyper and hypoactive, imbalance in posture, increase in surfacing activity, opecular movement, gradual loss in equilibrium and spreading of excess of mucus all over the surface of the body. The fish ocupied twice the area than that of the control group. They were spread out and appeared to be swimming independent of one another. The swimming behaviour was in a cork-screw palter, rotating along horizontal axis and followed by 'S' jerk, partial jerk, sudden rapid, non directed spurt of forward movement. The fish eventually died with their mouth and opecular wide opened. A change in colours of gill lamellae from reddish to light brown with coagulation of mucus on the gill lamellae was seen in dead fish also fade colour on Lateral line was observed. Scale loss also have spotlighted, through out experiment.

Keywords: Behavioral study, Physico-chemical properties, Mercury and *Labeo rohita.*

Introduction

Industrial development with a rapid pace in the recent times has taken its toll by causing Environmental pollution. The contamination of inland and surface water caused by released of toxic chemicals can be dangerous to the all classes of living organisms if discharged without proper treatment. One such toxic and lethal chemical knows is mercury The industries consequently, discharge large quantities of mercury quantities containing wastes. Serveral physical-chemical methods are employed for the treatment and the levels of total mercury in discharged liquid wastes are brought down to 0.2 mg/L (200 ug/L). But even 0.2mg/L of mercury concentration in aqueous systems is toxic for most of the life forms. There are reports that even mercury concentration as low as 0.01-0.1mg/L are able to kill some sensitive animals species present in waters and fish is one such type of sensitive species. *Labeo rohita* one of the Indian major carp is an edible freshwater fish of great economic importance.

In the present chapter, the experimental study
describe the behavioral study of the said species when exposed to free mercury.

Materials and Methods

Procurement and maintenance of fish:

Fresh water fish, *Labeo rohita* (Length 10$\pm$1cm; Weight 12$\pm$1g) were obtained from Gharni reserviours Latur, Maharastra. India and reared in large cement tank. During acclimatization, the fish were fed with rice bran and soyabean dieat. In the ratio of 2:1 on altermate days. Water of the tank was changed daily to avoid any fungal and bacterial contamination. As well as to maintain standard physicochemical characters.

Physico chemical characterisation of water: The physico-chemical characterization of water used for fish bioassay was carried out according to the methods described in Standard Methods (APHA, AWWA, WEF 1998). The water quality parameters were as shown in table number 1.

Table 3.1 : Physicochemical properties of water used in the laboratory.

Sr. No.	Parameters	Unit value
1	Temperature	28.0 $\pm$ 0.1^{0}C
2	Salinity	198 $\pm$ 0.03 mg/L
3	CO_2	8.9$\pm$0.03 mg/L
4	PH	7.9$\pm$0.02 mg/L
5	DO	6.5$\pm$0.03 mg/L
6	Chloride	45.00$\pm$0.03 mg/L
7	Sodium	1.20$\pm$0.02 mg/L
8	Potassium	29.5$\pm$1.25 mg/L
9	Calcium	16.04$\pm$0.02 mg/L
10	Magnisium	1.0$\pm$0.03 mg/L
11	Hardness	116$\pm$0.47 mg/L
12	Specific gravity	1.00374

Toxicant Selected and Preparation of stock solution:

For the present study, Hg So_4. $7H_2O$ was used as a toxicant. The stock solution of mercury (1000 mg/L) was prepared according to the method prescribed in the Standard Methods APHA, AWWA, WEF, 1998, "Standard Methods for the examination of water and waste water". 20th Edn. American Public Health Association, Washington, DC. For experimental purpose, the required Mercury concentration was drawn for the prepared stock solution.

Toxicity Evaluation:

The percent motrality of fish in different concentration of free Mercuty was determined at 96 h exposure. For this, the experimental fish were divided into batches of ten each, and were exposed to different concentration of mercury sulphate ranging from 15ug/L to 55ug/L (i.e.0.015 to 0.05mg/L). This range was obtained on trial and error basis. Toxicity evalution was carried out in static water (Brummond, R.A. *et. al.,* 1986) and mortality rate was observed and recorded for all the concentration after 96 hours. A batch of fish was also maintained simultaneously in freshwater medium without mercury, which served as negative control. All the experiments were performed in duplicates and repeated thrice to confirm the results. The mean values were derived following the method of Finney D.T., And Dragstedt and Behren's equation (Carpenter P.L. 1982).

Fixation of exposure periods:

In order to understand the influence of time over toxicity the effect of lethal concentration of mercury on *Labeo rohita* was studied at different periods of exposure. Before experimentation, the healthy fish collected from the tank were acclimatized to laboratory conditions in glass trough for fifteen days. Each trough contained 15 L of water with approximately uniform sized fish. They were fed with commercial fish food pallets during acclimatization. The fish were divided into two groups. One group without mercury served as control and the other group was exposed to lethal concentration of mercury for 1, 2, 3 and 4 days, were chosen to observe the short-term effects. During this experiment the behavioural changes were critically observed.

Results

Toxicity Studies:

The percentage mortality of *Labeo rohita* was observed to be 0% and 100% at Mercury concentration of 15ug/L and 55ug/L, respectively (Table 1). The LC_{50} value obtained through sigmoid curve was 36ug/L and linear curve was found to be 34 ug/L. The LC_{50} value obtained were verified using Dragstedt and Behren's equation and was found to be 34 ug/L. thus the average LC50 for 96 h was found to be 34.66ug/L.

Table 3.2 : Mortality of *Labeo rohita* in different of Mercury sulphate at 96h Exposure

Sr. No.	Conc. Of toxicant	Log (Con. Of toxicant	Number of fish			% Mortality	Probit Mortality
			Exposed	Alive	Dead		
1	15	1.176	10	10	0	0	0
2	20	1.301	10	9	1	10	3.72
3	25	1.397	10	7	3	30	4.48
4	30	1.477	10	6	4	40	4.75
5	35	1.544	10	5	5	50	5
6	40	1.602	10	4	6	60	5.25
7	45	1.653	10	2	8	80	5.84
8	50	1.699	10	1	9	90	6.28
9	55	1.771	10	0	10	100	8.09

Behavioural observations :

The behavioural changes were observed in control and exposed fish. The fish maintained in normal freshwater behaved in usual manner (i.e. they were very active with well-coordinated movements). Also the fish found to be very alert at slightest disturbance and covered one-third area of the bottom. But when exposed to mercury the fish showed erratic swimming, hyper and hypoactive, imbalance in posture, increase in surfacing activity, opecular movement, gradual loss in equilibrium and spreading of excess of mucus all over the surface of the body. The fish ocupied twice the area than that of the control group. They were spread out and appeared to be swimming independent of one another. The swimming behaviour was in a cork-screw palter, rotating along horizontal axis and followed by 'S' jerk, partial jerk, sudden rapid, non directed spurt of forward movement. The fish eventually died with their mouth and opecular wide opened. A change in colours of gill lamellae from reddish to light brown with coagulation of mucus on the gill lamellae was seen in dead fish also fade colour on Lateral line was observed. Scale loss also have spotlighted, through out experiment.

Discussion

The behavioural changes are the manifestation of motivational, biochemical, physiological and environmentally influenced state of the organism. The migration of fish to the bottom of the tank following the addition of mercury sulphate clearly indicates the avoidance behaviour of the fish, which was reported (Murthy, A.S. 1987) in trout. The opecular movement of the fish ceases immediately following exposure to mercury. The increase in opecular movement and corresponding increase in frequency of surfacing of fish clearly indicates that fish adaptively shifts towards aerial respiration (by obtaining atmospheric oxygen surfacing) and the fish tries to avoid contact with the mercury through gill chamber (Santha Kumar, M. *et. al.,* 2000, Prashant M.S. *et al.,* 2006). The increased ventilation rate by rapid, repeated opening and closing of mouth and opercular coverings accompanied by partially extended fins (caughing) was observed in the present study. This could be due to clearance of the accumulated mucus debris in the gill region for proper breathing, which was suggested by (Prashant M.S. *et al.,* 2005)

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 (Deva Prakasa Raju, B. 2002, Prashant, M. S. *et al.,* 2005,2006). The erratic swimming, jerky movements and convulsions before death were evident and the serenity varied with pesticide concentration. It indicates the sings of esphyxiation as indicated by gasping to death when fish, *sarotherodan mossambicus* exposed dimethorate (Kalavathy, K.A. *et al.,* 2001)

The surfacing phenomenon of fish observed under mercury exposure might either be due to hypoxic condition of the fish as reported by Radhai A.H., V. *et al.,* 1988 observed under cyanide exposure might either be due to hypoxic condition of the fish as reported by (Radhaiah, V. *et al.,*1988). This fact was clearly evidenced in the present study. The observation on the metabolic shift from aerobic to an anaerobic condition involving glycolytic oxidation with enormous amount of lactic acid accumulation were also seen. Chronic exposure of finish to aroclor was found to induce surfacing pheneomenon of fish as pointed out by (Drummound R.L. *et al.,* 1986).

Aggressive behaviour such as nudge and nip were increased following exposure to the toxic material. Orientation a locomotor pattems were found to be involved in most aspects of fish behaviour such as migration, mating, courtship and feeding, which were altered under stress conditions of environmental toxicants (David. M.1995 Madhab Prasad, *et. al.* 2002).

The hyperexcitability of the fish invariably in the lethal exposure to free mercury/pesticides may probably be due to the hindrance in the fuctionning of the enzyme AChE in relation to nervous system as suggested by many authors (Deva Parkasa Raju, B, 2002, Prashanth M.S.2003). It leads to accumulation of acetylcholine, which is likely to cause prolonged excitatory post synaptic potential. This may first may lead to stimulation and later cause a block in the cholinergic system.

The accumulation and increase secretion of mucus in the fish exposed to fee mercury may be adaptive responses perhaps providing additional protection against corrosive nature of the pesticide and to avoid the absorptions of the toxicant by the general body surface. This agrees to the earlier findings done by (Sabita Borah *et al.,*1995). In the present study as evidenced by the results the abnormal changes in the fish exposed to lethal concentration free mercury is time dependent.

Behovioural characteristics are obviously sensitive indicators of toxicant effect. It is necessary, however, to select behavioural indices of monitoring that relate to the organisms behaviour in the field in order to derive a more accurate assessment of the hazards that a contaminant may pose in natural system. Should be considered for species forming social organizational. If social interactions are not considered, only a certain portion of a population may be protected, and the toxicity of contaminant may be understand. Mercury is notorious for its potentially deadly poisonous characteristics. Its toxicity is critically dependent on speciation and chemical form. Acute toxicity to life forms is generally restricted.

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