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Variations in behaviour of freshwater fish *Garra mullya* caused by the effects of mercuric chloride

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ABSTRACT

An organism changes its response according to change in its environment. These changes are directed actions and are known as behaviour. Behaviour represents an integrated response of the organism, impairment in the functioning of any one of the body systems results in behavioral change. It is usually a very complicated phenomenon through which the animal is able to adjust to changes according in the environment. Behavioural patterns are also modified within limits which vary according to environmental stimuli, fast and slow movement, colour changes, etc. Any alteration in the chemical composition of a natural aquatic environment by pollution usually induces changed in the behaviour of the inhabitant, particularly fishes. When a toxic compound is administered, some changes occur from the normal behavior, and they can be observed externally. These behavioral changes would be caused by the changes in the nervous system caused directly or through metabolic or physiological activities. Due to the toxicity of heavy metals the physiological & behavioural changes occur. So the present investigation is to observe behavioral changes of *Garra mullya* exposed to lethal and sublethal concentration of mercuric chloride.

Keywords: Mercuric chloride, Behavioural changes, *Garra mullya*

INTRODUCTION

Behavioural toxicology has assumed a key place of increasing importance in evaluation of toxic compounds which affect not only target animals but also non-target animals, as it confirms the potentiality of the compound and also the tolerance limit of the animal. It was reported that alterations in the chemical composition of the natural aquatic environment usually affects the behavioural and physiological system of the inhabitants (O' Brien, 1967; Edwards, 1973). It is known that heavy metals have profound physiological and biochemical effects on fishes, the magnitude of which varies with the

concentration and duration of exposure. Behavioural responses to aquatic pollutants have been studied in various fish (Vijayalakshmi, 1994; David *et al*., 2002). A comprehensive work on behaviour in a test organism would value help the toxicologist to decide about the safe level of any pollutants in the aquatic environment. The importance of behavioural aspects for toxicological research is increasingly being emphasized by Devi Swetharanyam (1991); Behera and Patel (1991); Bakshi (1991).

Behavioural responses involve the most complex processes of sensory input, central processing and motor output points to neurotransmitters systems, as key components of these molecular events (Russell, 1978). In recent times, increasing attention has been paid to the neurotransmitter systems and their role in the behaviour of intact organisms as they react to, and manipulate their external physical and social environment.

The present study was undertaken to show the effect of mercuric chloride on the behavioural changes in freshwater fish *Garra mullya.*

MATERIALS AND METHODS

The test fish *Garra mullya*, were taken from the river, and were kept in glass aquariums with freshwater. If the number of death exceeded laboratory without any mechanical injury. In order to prevent skin infection, they were cleaned in a 0.1% $KmNO_4$ solution for two minutes prior to acclimatization. After that, they were rinsed with 5% solution, and any fish that were not acclimatized were thrown away. During acclimatization the fish were feed fish food obtained from market. The fishes were acclimatized for two weeks and water was changed every day and fishes were inspected for disease conditions. The average weight 11± 2 gm & lengths 9±2 cm fish are selected for experiment. Feeding was stopped one day prior to the experimentation. The aging of water is necessary to stabilize its composition and for elimination of residual chlorine which is otherwise highly toxic to the fish. The physicochemical parameters are analysed during the experimental period, according to standard methods suggested by APHA (1998) and IAAB (1998).

Healthy fish sorted in three batches of 10 fish each A, B and C. A batch was considered as control, where the fish did not expose to the heavy metals. In other two batches, fish were exposed to different concentration of mercuric chloride. In B batch fish were exposed to lethal concentration of mercuric chloride i.e. 96 hrs. LC_{50} value 0.26 ppm and C batch they were exposed to sublethal concentration of mercuric chloride i.e. $1/10^{th}$ of 96 hrs. LC_{50} value 0.026 ppm. During the experiment fish were starved and test medium was maintained by changing the old one with fresh medium after every 24 hours.

The control batch A was always normal but on the visual observations on the behavioral response of fish exposed to lethal and sublethal concentration of mercuric chloride were made upto 96 hours. Experiments were conducted in a laboratory where there was no disturbance to the aquaria. The behavioral changes had been maintained according to the method of Klein and Lincer (1974).

To study the changes in behaviour pattern in *Garra mullya* following activities were considered. Response against pollutants, body movement, mucous secretion, position of fish in aquarium, bleding at operculam, body colouration and opercular movement.

RESULTS AND DISCUSSION

After exposure of mercuric chloride, *Garra mullya* exhibits several kinds of behavioral alterations. Early stage of exposure, the fish exhibited restless and jerky movements with a tendency to leap out of the aquarium. After this excited phase, the fish lay flat with decreased opercular movements for some amount of time and then slowly regain the normal swimming rhythm.

The control fish showed normal behariour. They were usually very active and showed fast well-coordinated movements. They were quite alert even at the slightest possible disturbance or external stimulus like touching them with a glass rod.

In present study no such behavioural changes were noticed in the control fish, which remained active and healthy throughout the experimental period. The fast swimming activity may be due to the irritating effect of the exposed heavy metal whereas the excessive secretion is a kind of avoidance by the fish. In the experimental fishes showed characteristic change in behaviour.

Table 1: Behavioural observation made during lethal and sublethal concentrations of mercuric chloride on *Garra mullya*.

Observations	Lethal Concentration (Batch B)	Sub Lethal Concentration (Batch C)
Response against pollutant	In lethal concentration fish showed immediate high excitation and tried to move come out of aquarium	In sublethal concentration fish showed slowly excitation and tried to avoid toxicant
Body movement (Locomotory activity)	Fish swim irregular vertical movement	Fish swim noramly during initial stage but after 24 hrs it swim irregular movement
Skin colour	Fish become pale coloured	Fish become darker
Mucous secretion	Mucous secretion continuo- us in high amount	Mucous secretion was partialy changed.
Position of in aquarium	Initial stage of exposure period fish swim at surface but after 24 hrs. they went to bottom of aquarium.	Fish swim normally on surface and middle but after 72 hrs. they settled down to bottom of aquarium.
Opercular movement	Opercular movement was highly increased after 12 hrs. of exposure	Opercular movement partially increased after 24 hrs. during exposure
Bleeding at operculum	Bleeding often observed at opreculum.	Bleeding rarely observed at opreculum.

The fishes survived rapidly in the experimental media and were trying to jump out of water at short intervals. Later the fishes exhibited restlessness by erratic opercular movement, difficulty in respiration, convulsions and short erratic jerky movements. The fishes in experimental chambers showed mucous secretion to avoid toxic environment.

The subjective observations on behavioural responses of fish to the lethal and sublethal concentrationis of heavy metals and pesticides have been documented by various workers. Fernando and Raja (1984) observed morphological and behavioural changes in *Lepidocephalichthys*, when exposed to mercuric chioride. Azmat H. and *et al*., (2012) were reported *Catla catla* significantly more susceptible to Al toxicity, followed by that of *Labeo rohita* and *Cirrhinus mrigala.* Pandi Prabha and Johanna Rajkumar (2015) also reported Hepato toxicity of lead in Indian major carp *Labeo rohita* (Rohu). Bengeri and Patil (1982) reported erratic swimming and jumping of fishes within short period of exposure. They also observed restlessness, increased opercular movements, violent action of fins, difficulty in respiration, mucous secretion and oozing of blood from gills in *Barbus aurilus* and *Lepidocephalichthys quntea*, when exposed to mercury, copper and zinc. Similar observations are made in present study when the fish *Garra mullya* were exposed to lethal and sublethal concentration of mercuric chloride. It is generally recognised that fish respond to toxic chemicals by increased opercular movements.

The primary action of heavy metals on the nervous system is by inhibiting the enzyme, acetylcholine-esterase which is responsible for the normal functioning of the nervous system. The present observation showed disoriented swimming, jerky movements of the body, loss of equilibrium, delayed weak responses to external stimuli and respiratory distress indicate of the disorder of nervous system. Similar disorders in the nervous system including jerky movements and violent spasme, irregular body movements and loss of equilibrium were recorded by Koundinya and Ramemurthi (1980) in *Sarotherodon mossambicus* exposed to sumithion. Rauf A and *et al.,* (2009) were reported a Heavy metal levels in three major carps (*Catla catla, Labeo rohita* and *Cirrhinus mrigala*) from the river Ravi.

The locomotor behavior of the fish was mainly under the control of central nervous system and disorders in the central nervous system may affect the locomotor behavior thereby the swimming ability of fish. Walia G.K. and *et al., (*2013)observed the Erythrocyte abnormalities in a Freshwater fish *Labeo rohita* exposed to tannery industry effluent. The hyperactivity increased locomotion, disturbance in equilibrium, increased opercular movement, excessive mucous secretion and loss of pigmentation of the body is due to exposure of different toxicants as reported in different species of fishes, such changes were also observed in the present study.

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