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RESEARCH ARTICLE

Fluoride Toxicity on Behavioral and Morphological Variations in Fresh Water Fish Notopterus Notopterus (Pallas)

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Abstract

Fluoride is highly mobile and biological active non-metallic element of aquatic systems. Current investigation revealed altered behavior and morphological changes upon exposure of Fluoride (F) in freshwater *Notopterus Notopterus* fish (Pallas).The adverse effects of F were related to their tendency to accumulate in the skeleton (including the gills) and exoskeleton of living organisms which were visually monitored in fresh *N. Notopterus*, (average weight 94.5g and standard length 24.62cm) were collected from Keenjhar Lake, Sindh, Pakistan. The observations in behavior and morphology were monitored at a regular interval of 7 days up to 28 days at two different concentrations of F (1.5g/70 L and 3.0 g/70L NaF). Experimental evidence suggested that significant morphological and behavioral abnormalities are sensitive indicators of fluoride toxicity in fish that includes body position, feeding habits, opercular movement and swimming movement.

INTRODUCTION

Fluoride ion (F^-) considered as a persistent bioaccumulator and strong potent toxic pollutant since its concentration in many aquatic ecosystems is significantly increasing as a result of man's activity (Janice *et al.,* 2003; Camargo, 2003; Oliveira *et al.,* 1978; Martin and Salvadori, 1983) and adversely effects upon aquatic biota (Julshamn *et al.,* 2004; Camargo 2003; Dave, 1984). Fluoride has affinity to accumulate in the soft tissues of organisms, causes adverse biological effects at very low levels of exposure and is therefore a potent hazardous pollutant to fish (Azmat *et al.,* 2007; Masoud *et al.,* 2006; Rosenquist and Lemperg, 1974; Aziz, 2012).
In the present study of behavioral and morphological changes induced by exposure of the freshwater fish *Notopterus Notopterus* (Pallas) to sodium fluoride (NaF) as the compound often used for investigating fluoride toxicity in fish.

Materials and Methods

Collection of Fish

Healthy living *Notopterus Notopterus* (Pallas) (average weight 94.5g and standard length 24.62cm) were collected from the Fish Farming Zone of Keenjhar Lake, Sindh. Temperature of lake was 30^{O}C. Humidity was 70%. Fish were caught with the help of professional local fisherman by using local fishing nets and motor boat (Fig.1).

Fish Acclimation

Fish were transferred to laboratory under ordinary maintained laboratory conditions Fig 2. Fish were grouped and placed in a fiber glass aquarium containing tap water, size: 36cm x 18cm x 15cm. Air pumps and filters were used to aerating the aquarium water by circulating it. During acclimation all control and treated fish were feed with commercial pellet once a day. Water in aquaria was changed after two days. Chemical analysis of water was done according to standard methods (APHA). The fish were divided into six groups with ten fish in each group. Group 1

served as control while Group II and III served as experimental groups treated with sub-lethal concentration of fluoride (1.5gm / 70 L and 3.0 g /70L NaF).

Behavioral and Morphological Observations

Behavioral responses and morphological changes in fresh water fish, *Notopterus Notopterus* (Pallas) after their exposure to sub lethal concentration of fluoride were visually recorded at 7, 14, 21 and 28 days at 1.5g and 3.0 g /70L NaF. Both Test and control fish were subjected to the complete and careful morphological and behavioral observations.

Results and Discussion

Fig-1: Healthy living *Notopterus Notopterus* (Pallas) at the site of fish collection

Fig-2: Fish were placed in fiber glass aquarium, size: 36cm x 18cm x 15cm

Behavioral and Morphological Changes of the Control and Treated fish

In the present study, the control fish showed normal active locomotory activity, feeding, swimming and respiratory responses. No marked changes in behavioral and morphological symptoms observed during whole study period.

In the beginning of study there were no mortality and significant morphological and behavioral symptoms in fish at two different doses (1.5g/70 L and 3.0 g/70L NaF) on *Notopterus Notopterus* (Pallas) but with the passage of time

fish showed marked changes in spontaneous locomotors activity, marked apathy then loss of orientation and equilibrium and breathing responses. These were sensitive behavioral indicators of toxic exposure to fluoride toxicant in fish (Aziz F 2014; Narwaria *et al.*, 2012; Dube and Hosetti, 2010; Scherer, 1992).Fish exposed to 1.5 g /70L and 3.0 g/70L NaF after 7 and 14 days showed increased mucus secretion and finally gasping for breath, reduction of swimming ability, darkening of color, and then death after long term of exposure (Camargo and Tarazona, 1991) (Fig.3).The accumulation and increased secretion of mucus in the fish exposed to fluoride may be an adoptive protective response to avoid the absorption of the applied toxicant by the overall body surface. (Das and Mukherjee, 2003; Yilmaz et al., 2004; Prashanth *et al;* 2005 and Subathra and Karuppasamy, 2003). This revealed that after a prolong administration of fluoride to laboratory fish can produce homeostasis disorders in homeostasis, growth, development, perception, and behavior.

Observation suggests that gills were main targeted organ due to direct exposure of toxicant. A significant morphological change occur in gills structure, a major respiratory organ in fish, associated with fluoride toxicity which may be due to the marked effects on gill solute and water transport by toxic substances and by alteration of energy metabolism during the period of acclimatization of treated fish (Olson *et al.*, 2005).Maximum mortality rate observed after 90 days and dissection of fish *Notopterus Notopterus* (Pallas) showed dissolved organs like (Fig.4) heart, liver, kidney after their exposure to sub lethal concentration at1.5 g /70L and 3.0 g/70L NaF (Aziz F, 2012).

Fig-3: A darkening of the skin (dorsal side) upon exposure to fluoride

Fig-4: Dissected treated fish heart, liver, kidney were dissolved due to fluoride toxicity and not visualized in open fish

Conclusion

Fluoride is highly toxic and persistent bio accumulator in living organism and has significant potential for producing biological and ecological hazards to aquatic life. Fish are excellent and valuable bio indicators of ecosystem pollution. Fluoride toxicity may lead to significant alterations in behavioral, respiration and morphological parameters at two different doses (1.5g/70L and 3.0 g/70L NaF) on *Notopterus Notopterus* (Pallas). These responses can be used as a tool in ecotoxicology to observe fluoride toxicity in various species of aquatic animals.

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