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Research Article

Mercury toxicity; behavioral changes and recovery in a freshwater teleost *Heteropneustes fossilis* (Bloch)

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Abstract

Present study was aimed to observe the behavioral changes due to Hg (0.1mg/l) toxicity in the freshwater catfish *Heteropneustes fossilis* (Bloch). The fishes exhibited erratic swimming, thick mucus secretion over body surface, skin soars and jerky movements. Fishes tried to leap out of aquarium during experiments. It was further observed that these behavioral changes were suppressed when fishes were simultaneously fed with herbal compound. The recovery experiments confirmed that the behavioral changes due to Hg toxicity were reduced when fed with the herbal compound, indicating its protective effects against Hg toxicity.

INTRODUCTION

The aquatic life of water resources is in danger due to industrial pollutants, domestic, agricultural wastes, heavy metals, etc. Numerous studies confirmed that pollutants are adversely affecting the aquaculture (Opaluwa *et al.*, 2012; Haloi *et al.*, 2013). The presence of pesticides and various toxic metal accumulations were observed and reported in the freshwater and marine fish organs (Ali and Fishar, 2005; Agrahari S and Gopal K, 2007; Karthigayani *et al.*, 2014). It is well-known that Mercury is a highly toxic non-essential heavy metal. In the modern age its application is increasing in industries and agriculture. It gets accumulated and damages the fish organs. The higher concentrations of Hg damage the organs and intern the fish behavior. Consumption of such fishes through the natural food chain reaches to various human tissues (Devlin, 2006).

Any changes in fish behavior are considered as one of the sensitive biomarker to evaluate the exposure to the toxicant (Gerhardt, 2007; Reddy *et al.*, 2011). It had been observed that the fish behavior alters due to the toxicants like heavy metals, pesticides, etc. (Javed, 2012; Ghanbahadur, *et al.*, 2015 and Deshmukh, 2016). Erratic swimming, escaping from toxic water, mucus secretion, convulsions and food intake, etc. can be considered as some common parameters to measure the changes in fish behavior. The preventive and curative effects were also studied by researchers. The herbal compound Liv_{52} is a hepatoprotective drug (Rathore and Verma, 1988; Jain, 2016) and was examined against Hg and other toxicants in fresh water fishes (Kumar and Kothari, 1990, Palas *et al.*, 2014) and in mammals (Keshav and Lal, 2016).

In paucity of literature of the protective action of herbal compound Liv_{52} against Hg toxicity and behavioral changes in fresh water teleost *H. fossilis*, the present study was aimed. The role of herbal compound Liv_{52}, if any, in the recovery process of the Hg exposed fish was also examined.

MATERIALS AND METHODS

The fresh water fish *H. fossilis* was procured from the local water body of Ujjain (MP). The fishes were acclimatized to laboratory conditions in glass aquaria for seven days. Stock solution of $HgCl_2$ was prepared as per the guidelines of APHA (1975). The experimental concentration of $HgCl_2$ was kept at 0.1 mg/l. The indigenous hepatoprotective herbal compound Liv_{52} was tested for its protective role. The food and drug were fed at the rate of 30 and 10 mg/day/fish, with few drops of liquid paraffin, to the fishes of all aquaria respectively. On every fourth day water of all aquaria was changed and fresh metal solution was added to experimental groups.

The acclimatized fishes were divided into groups of 25 each as under:

Group I - Control fed on normal food

Group II - Treated with $HgCl_2$ (0.1 mg /l) and fed on normal food

Group III - Treated with $HgCl_2$ (0.1 mg/l) and fed on food containing drug (Hg + drug)

Group IV - First 30 days treated with $HgCl_2$ (0.1 mg/l) and fed on normal
food then divided into two groups

Group IV A - 30 days kept in Hg free water and fed on normal food, i.e., group **IV A**, Natural recovery

Group IV B - 30 days kept in Hg free water and treated with drug, i.e., group **IV B** Drug recovery

The fishes of these groups were observed daily. The behavioral changes in all the groups were compared with the control group fishes. Fishes from groups I, II and III were observed for 30 days, whereas the fishes of recovery groups were observed for 60 days.

RESULTS AND DISCUSSION

The fresh water fish *H. fossilis* exposed to $HgCl_2$ showed changes in its normal behavior. The fishes of group II, exhibited a change in swimming pattern. During initial exposure, fishes showed jerky movements with rapid and erratic swimming. They exhibited tendency of escaping from the aquarium. On prolonged Mercury exposure the fishes became sluggish and showed uncoordinated swimming patterns. The similar results were observed in recent past (Sabullah *et al.,* 2015; Sehar *et al.* 2014). This may be due to the toxic Hg interference in some of the functions which were controlled by the nervous system of the fishes (Daoust 1981; Thangam and Manju, 2013). In group III (Hg + drug) the jerky movements and erratic swimming were reduced.

An excessive mucus secretion over the body surface was observed in the prolonged Hg exposed fishes. This can be attributed to the increased stress due to toxic effect of Hg and caused changes in the area and number of mucus glands (Akhter and Noori, 2014). The excessive secretion of mucus changed the colour of aquaria water to milky white. During drug recovery (group IV B), experiments fishes exhibited normal swimming behavior and no excessive mucus secretion.

Like other toxicants the mercury toxicity also caused reduction in food intake in the fishes. The food was not fully consumed in metal exposed fishes as against the control group. It was observed that the food intake was slightly higher in group III (Hg + Liv_{52}) as compared to the group II (Hg exposed) fishes. The food intake of the recovery group (IV B) fishes was comparable with the control group fishes. This suggested that Hg caused loss of appetite and the Liv_{52} helped to maintain the normal food intake. Liv_{52} had been reported to increase food consumption in laboratory animals (Reddy *et al.*, 1990; Palas *et al.*, 2014). The efficacy of hepatoprotective herbal compound Liv_{52} with *Ricinus communis* in Wistar rats was also reported in recent past (Navin *et al.*, 2016).

The findings of this investigation revealed that the intoxication of Hg caused uncoordinated swimming activity, excess mucus secretion and also decreased food consumption in *H. fossilis.* This may be due to the damage to nervous system by Hg intoxication, whereas, Liv_{52} helped to maintain normal behavior, especially food intake.

It can be concluded that the herbal compound (Liv_{52}) was almost found effective in controlling the Hg induced abnormal behavior. However, further detailed studies are needed to understand the mode of protective action of the herbal compound (Liv_{52}) against toxic action of Hg.

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