

Behavioural Alterations in *Heteropneustes fossilis* after Endosulfan Exposure

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ABSTRACT

Behavioural changes in a fish form an efficient index to measure any alterations in the environmental conditions. Endosulfan not only changes the physico-chemical characteristics of water but also impose drastic impact on the fish. Any change in the aquatic environment causes altered behavioural responses, ultimately leading to physiological adjustments. Therefore, the present work was undertaken to study the behavioural alterations after sub-acute exposure to the organochloride pesticide endosulfan in the freshwater fish *Heteropneustes fossilis*.

Keywords: Behavioural alterations, Endosulfan, *Heteropneustes fossilis*, Aquatic environment.

INTRODUCTION

Fishes are commonly used as bioindicators of aquatic pollution due to their sensitivity to surrounding environment (Srivastava and Kaushik, 2001). Any change in the aquatic environment causes altered behavioural responses, ultimately leading to physiological adjustments. Behavioural changes are recognised as most sensitive indicators of possible toxic effects (Banee *et al.*, 2008 and Ghanim *et al.*, 2008). The behavioural and the swimming patterns of fish exposed to different insecticides include changes in feeding activities, swimming behavior, Competition, predation, reproduction and species to species, social interactions such as aggression (Rahman *et al.*, 2016). Endosulfan is an off patent organochlorine insecticide and acaricide, highly toxic, potential for bioaccumulation and is endocrine disruptor in nature. It is banned in more than 63 countries including European Union, Australia & New Zealand and other Asian and West African countries and being phased out in United states and Brazil, but it is used extensively in many other countries including India and China. India is the world's largest user of endosulfan and a major producer with three companies -Excell Crop Care, HIL and Coromandel Fertilizers, producing 4500 tons annually for domestic use and another 4000 tonnes for export.

In the present paper the behavioural changes in teleost *Heteropneustes fossilis* due to effect of endosulfan is studied.

MATERIALS AND METHODS

Freshwater teleost *Heteropneustes fossilis* were collected from Purni pond, situated at Village-Ghonghia, Via-Bahera, District-Darbhanga, Bihar, 22 KM away from the CM Science College laboratory with the help of local fisherman. Healthy *Heteropneustes fossilis* fishes of 35-40 gram average weight each, were sorted out for experimental purposes and was brought to the laboratory in a plastic basket filled with water added with commercial feed. Water of the aquaria was changed on the day after feeding. Physico-chemical conditions of

water *i.e.* pH, D.O, CO₂, hardness, alkalinity, chloride content was estimated prior to the experiment. These were estimated by methods given by APHA, AWWA & WPCF (2005).

RESULTS AND DISCUSSION

A record of atmosphere and water temperatures was simultaneously maintained throughout the experiment (Table 1). Hence, no changes were observed in physico-chemical parameters.

Table 1
Physico-chemical characteristics of water (Sub-acute experiment).

Parameters	Values
Atmospheric Temperature(°C)	Maximum-21 Minimum-18
Water Temperature (°C)	Maximum-18 Minimum-15
pH	7-7.5
Dissolved Oxygen (mg/l)	6.75-7.5
Alkalinity (mg/l)	64-68
Hardness (mg/l)	15-18
Chloride content (mg/l)	30-33

Behavioural Changes in *Heteropneustes fossilis* after endosulfan exposure

Marked changes were noted in the behaviour of *Heteropneustes fossilis* during the experiment. Changes in behaviour of the fishes were observed every day and summarised at the intervals of 72h, 96h and 120h.

Table 2
Behavioural changes in *Heteropneustes fossilis* after sub-acute exposure to endosulfan.

Parameters	Duration	Gr I	Gr II	Gr III
Swimming Activity	72 h	+++	+++	+++
	96h	+++	++	++
	120 h	+++	++	+
Surfacing Activity	72 h	+++	++++	++++
	96 h	+++	++++	++++
	120 h	+++	++++	++++
Opercular Movements	72 h	+++	++++	++++
	96 h	+++	++++	++++
	120 h	+++	++++	++++
Body Color	72 h	+++	++	++
	96 h	+++	++	++
	120 h	+++	++	+

+ = Very low, ++ = Low, +++ = Moderate, ++++ = High, +++++ = Very high

In comparison to control, swimming activity declined at 96h in group II & III while it further declined at 120h in group III. In treated grounds, fish showed a tendency to settle at the bottom of the aquaria after 120h of exposure. Surfacing frequency of the fish increased and was very high in group II at 120h and in group II at 120h & in group III from 96h onwards. This mechanism indicates a hypoxic condition as the fish rise to the surface to engulf air from the environment. Simultaneously, an increase in opercular movements was also observed in both the treated groups (II & III) for 72h. In group III very high movements were observed at 96h & 12h. This increase can be correlated with the surface frequency of

the fish. The colour of the body surface became pale in group III at 120h. In the present study, a dose and duration dependent decrease in swimming activity has been observed in the treated group. This may be due to endosulfan uptake by the gills and altered gill structure which led to the respiratory stress (Harit and Srivastava 2017 a) and this way possibly increase the metabolic reactions resulting in energy depletion (Harit and Srivastava, 2007). Similar correlative observations have been recorded in behaviour and protein content in muscles of fish *Labeo rohita* exposed to endosulfan for 96h (Ullah *et al.*, 2016). On the other side high opercular movements & surfacing frequency observed in *Channa punctatus* is indicative of its slow metabolic activity under endosulfan stress. (Harit and Srivastava, 2017 b and Harit and Srivastava, 2018). It has been suggested that stimulation of adrenal glands and hypersecretion of during stress condition inhibits the action of MSH, resulting in pale body colour (Tyagi, 2004). Toxicity study of endosulfan, carbofuran, dichlorvos, dimethoate and phosphate in catfish *Mystus seenghala* was made by Banjara and Singh, 2019. Whereas progressive paling of body colour has been observed in the present study along with an increase in dose and duration of the experiment.

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