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Original Research Paper

Renatosomatic Index of a Freshwater Fish Intoxicated With Pyrethroid Pesticide

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ABSTRACT

This study assessed the effect of fenvalerate pesticide on the kidney condition Renatosomatic Index (RSI) of a freshwater fish *Clarias batrachus*. Fenvalerate is a pyrethroid pesticide. The RSI showed decreasing trend when the fishes were exposed to different sub lethal concentrations i. e., 0.02 ppm, 0.04 ppm and 0.08 ppm of fenvalerate for 96 hours. This condition of kidney of the fish can result from incomplete elimination of the fenvalerate from the kidney, thereby affecting the normal metabolism of the fish. Thus, the pyrethroid pesticide such as fenvalerate should be used with caution in agriculture field applications, as it is likely to introduce acute levels of the toxicant into the environment.

INTRODUCTION

Contamination of aquatic bodies by widely used organochlorine, organophosphate, carbamate and pyrethroid pesticides is posing a potential problem mainly for aquaculture. The pesticides, on reaching to an aquatic system, greatly influence the non target organisms such as fish, lobster, shrimps, mayfly, nymphs and many species of zooplankton (Bradbury & Coats 1989, Oudou et al. 2004). The toxic effects of these chemicals lead to behavioural, physiological, pathological and biochemical disorders that may prove fatal to the aquatic life (Anita Susan et al. 1999, Rathod et al. 2009, Satyavardhan 2010, Satyavardhan 2013). Pyrethroids are metabolized and eliminated significantly more slowly by fish than mammals or birds (Bradbury & Coats 1989), which may explain that this compound causes higher toxicity in fish than in other organisms (Kumar et al. 2010). Fenvalerate is the most widely used compound of the synthetic pyrethroid pesticides and is registered for use in agriculture to protect a wide variety of crops including cotton, soybeans, peaches, pears and nuts from insect pests. It is relatively stable under field conditions with half-lives ranging from 15 days to 3 months in soil, 21 days in water and 2-4 weeks in vegetation (Beyond Pesticides 2000), and it has the potential to affect the mortality and growth of the fish once it enters aquatic ecosystems (Datta & Kaviraj 2006).

Harmful effects of fenvalerate on fishes were observed by several workers (Tripathy 1992, Seth & Saxena 2003, Mushigeri & David 2004). In the aquatic environment, pollutants can affect the physiology of fishes. This may be reflected by changes in the ratios of the weight of particular organs or tissues related to total body mass of the exposed fish (Heath 1991). Besides, organ indices and condition can be used as indicators of change in nutritional energy status of fish (Adams et al. 1996). However, information regarding organosomatic index is meagre (Gabriel et al. 2010, Ogamba et al. 2014).

Hence, this study was undertaken to evaluate the renatosomatic index (RSI) of a freshwater air-breathing catfish *Clarias batrachus*, which are usually found and cultured in swamps and derelict water bodies often contaminated by run offs, exposed to various sub-lethal concentration of fenvalerate, a pyrethroid.

MATERIALS AND METHODS

Live specimens of *Clarias batrachus* of almost the same weight (88± 5.024 g) and length (18±0.76 cm) were procured from the fishermen of wetland area of Saharsa district of Bihar and acclimatized for 15 days in a neat and clean glass aquaria in the laboratory conditions. Fishes were fed daily with wheat flour mixed with egg and goat liver. During the experiment, physicochemical characteristics of the water of the aquarium were estimated as per methods suggested by APHA (2005). After acclimatization, the fish were divided into two broad groups, i.e. experimental and control groups, each having 10 fish. The experimental fish were exposed for 96 hours to lower concentrations of LC_{50}(0.247 ppm) of fenvalerate (Kumari 1914) as a dose dependent experiment. For the present investigation, technical grade fenvalerate (20% EC), Isagro Agrochemical Pvt. Ltd, Andheri (East), Mumbai was used. One third (0.08 ppm),

one sixth (0.04 ppm) and one ninth (0.02 ppm) of LC_{50} value were selected for sub lethal concentration studies according to Sprague (1971). Renatosomatic Index (RSI) was calculated according to the methods adopted from Jenkins (2004) & Adamas et al. (1996). Statistical analysis was performed by the formulae mentioned in Zar (2009).

RESULTS AND DISCUSSION

During the experiment, the physicochemical characteristics of aquarium water were observed and are presented in the Table 1.

Behavioural characteristics are obviously sensitive indicators of toxicant's effect. Control fish maintained a fairly compact school, covering about one third of the bottom during the 96 h exposure. Fish were observed to scrap the bottom surface. When startled, they instantly formed a tight school that was maintained fairly. They were sensitive to light and moved to bottom of the aquarium when light was passed into it. Except a less response to form a dense school towards the end of the study, no other extraordinary behaviour was observed.

When the fish were exposed to the sub lethal concentration of fenvalerate, they migrated immediately to the bottom of the aquarium. The migration of the fish to the bottom of an aquarium following the addition of fenvalerate clearly indicates the avoidance behaviour of the fish, which was reported by Murthy (1987) in trout.

There was a gradual decrease in renatosomatic Index increasing the concentrations of fenvalerate at 96 hours. Renatosomatic Index (RSI) of the fish *Clarias batrachus* in different concentrations of fenvalerate at 96 hours exposure is presented in Table 2.

The general health status of the fish which is known as organ indices is used to assess the physiological condition or well being of the fish and to determine the severity or damage caused by the toxicant on the fish (Simeon et al. 2013). Although Jenkins (2004) and Ogamba et al. (2014) reported elevated condition of RSI and that may be a mechanism to cope with the effect of toxicants. The assumption, that is generally made with organ indices is that, lower than normal values indicate a diversion of energy away from organ or tissue growth in order to combat a stressor (Gabriel et al. 2010). In this study, there was decreased condition (Renatosomatic Index) of the fish due to fenvalerate, similar to those observed in *Clarias gariepinus* exposed to *Lepidagathis alopecuroides* (Gabriel et al. 2009), *Nicotiana tobaccum* (Omoniyi et al. 2002) and monocrotophos (Yaji & Auta 2007). Decrease in condition can result from incomplete elimination of the toxic chemical from the fish organs, thereby interfering with the normal metabolism of the fish and therefore lead to inefficient production and utilization of protein and carbohydrate in the tissues of the fish (Gabriel et al. 2011). The reduction in RSI observed may be indicated by the size of kidney. So the organ associated with blood circulation and blood filtration will be seriously affected (Andersson et al. 1988).

Table 1: Physicochemical characteristics of water of aquaria.

S. No.	Parameter	Value
1	Water temperature	26 ± 2°C
2	pH at 24°C	7.1 ± 0.2
3	Dissolved Oxygen	8.3 ± 0.7 mg/L
4	Total Hardness	105 ± 4.2 mg/L
5	Total Alkalinity	20 ± 1.27 mg/L
6	Chloride	34 ± 1.93 mg/L

Table 2: Renatosomatic Index (RSI) of *Clarias batrachus* in different concentrations of fenvalerate at 96 h exposure.

Number of fish	Concentrations of fenvalerate (ppm)	RSI (average)
10	Control	0.5286 ± 0.036
10	0.02	0.3632 ± 0.005
10	0.04	0.271 ± 0.008
10	0.08	0.167 ± 0.010

CONCLUSION

The toxicant (fenvalerate) caused general disorder on the kidney of the fish at sub lethal concentrations and so there should be general awareness among the common people for its sustainable use, to minimize lethality and stress conditions of the aquatic organisms.

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