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ACUTE TOXICITY AND BEHAVIOURAL RESPONSES OF CYPERMETHRIN TO THE FISH *Anabas testudineus*

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AUTHORS' CONTRIBUTIONS
This work was carried out in collaboration between both authors. Author AKJ designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Author Anupama managed the analyses of the study and managed the literature searches. Both authors read and approved the final manuscript

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ABSTRACT

Cypermethrin a fourth generation pyrethroid was used for this investigation to study the acute toxicity and behavioural responses to the fish *Anabas testudineus* (Bloch). This fish is locally known as "Kabai" and very abundantly found in the wetlands and water reservoirs of Mithila region but tremendous use of pesticides in agriculture sector is adversely affecting the aquatic fauna especially the fishes. The wide use of pesticides not only damaging the fish fauna living in aquatic bed but also put lethal and sublethal impact on human beings due to consumption of pesticides affected fish. The acute toxicity of cypermethrin to the test fish was determined for 24, 48, 72 and 96 hours. The LC_{50} value determined by regression equation was 0.15 ppm, 0.20 ppm, 0.25 ppm and 0.30 ppm respectively. The sublethal concentration was determined 0.106 ppm fishes that were exposed to different concentrations of cypermethrin exhibited exciting and agonistic behaviour. Restlessness, erratic opercular movement difficulty in respiration and convulsions were observed also. The fish came to the surface again and again possibly to gulp the atmospheric air directly and to avoid the toxic environment. Air bubbles were noticed coming out of the mouth. These hyperactive response were marked at higher concentrations and that too in the earlier phase of exposure. However, in the later stage of exposure, the affected fish showed hypoactivity lying for several hours on the side of the bottom of aquaria making very little movement. Another characteristic behavioural change was that some fishes frequently dashed against the walls of the experimental aquaria. Such affected fish at times swam with head downwards jabbing and scraping at the bottom with the snout. This behaviour was quite apparent during later phase of exposure and continued until the fish became quiescent just before death.

Keywords: *Anabas testudineus*; Cypermethrin LC_{50}; regression equation; toxicity.

1. INTRODUCTION

Fishes are one of the most important source of food to human beings because of their high calorific value. About 96% of fish flesh are easily digestible and it accounts for 25% of the total meat consumed by man in the world. The nutritional value of fish has necessitated the governmental agencies to lay special emphasis to pisciculture and it is in this perspective that the pollutional studies in relation to fish and their environment have received much attention during the past decades.

Fishes represent the largest and most diverse group of vertebrates and are excellent experimental models for toxicological research, Law [1]. Fishes are important

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component of food chain so, any effect of toxicant may have adverse influence on the nutritive value of fish and on the human beings due to their consumption, Gupta & Srivastava [2]. Some of the notable experiments on toxicity to fishes are those of organic biocides to *Labeo rohita*, Verma et al. [3] Methonyl to *Cyprinus carpio*, Krishnaveni et al. [4], Nuvan to *Clarias batrachus*, Trivedi & Saxena [5]. Similarly Jha [6] studied the effect of Nuvan on *Heteropneustes fossilis*, Anupama and Choudhary [7] studied the effects of cypermethrin on *Anabas testudineus*. Recently Hussain and Verma [8] studied the effect of Cadmium toxicity on *Channa punctatus* and very recently Jha, [9] studied the Nickel toxicity to the fish *Clarias batrachus*. The present investigation aims to study the acute toxicity and behavioural responses to the fish *Anabas testudineus* (Bloch).

2. MATERIALS AND METHODS

The adult living species of *Anabas testudineus* were collected from a local fish pond and brought to the laboratory in wide-mouthed large earthen pots half filled with natural water and covered with a piece of mosquito net. Every effort was taken to give less stress to the fishes during transportation. The fish were washed with 0.1% $KMNO_4$ solution to remove dermal infections if any. Healthy fishes of average length 12-16 cm and weight 80-100 gm were transferred one by one with the help of small hand net to 40 litre rectangular glass aquaria and acclimatized in the laboratory conditions for a fortnight. For each acute bioassay there were 10 test concentrations and 10 fishes per concentration in addition to the control. The number of aquaria in each set were thus 11 (one control + 10 experimental). Running tap water was used in all the experiments and no aeration was done. They were not given food for the first three days of acclimation and after that fed with chopped goat liver everyday ad libitum at 11.00 am sharp. The feeding was stopped 24 hours before the start by static acute bioassay and no food was supplied to them during the period of experimentation. However, the feeding schedule was strictly followed during chronic experiments to avoid starvational effects. Bioassay was conducted for the determination of LC_{50} value of cypermethrin for 24, 48, 72 and 96 hours following the methods of APHA, AWWA, and WPCF [10]. The sublethal concentration was determined following the formula of Hart et al. (1945).

3. RESULTS AND DISCUSSION

The physico-chemical characteristics of the test water are enlisted in Table 1. The toxicity of cypermethrin obtained under static system have been shown in Table 2 and Figs. 1-4 by regression equation. The 24 hrs, 48 hrs, 72 hrs and 96 hours of LC_{50} values by regression equations are 0.15 ppm, 0.20 ppm, 0.25 ppm and 0.30 ppm respectively. The sublethal concentration of cypermethrin determined was 0.106 ppm when the formula of Hart et al. (1945) was applied.

Fishes that were exposed to different concentrations of cypermethrin exhibited exciting and agonistic behaviour. Restlessness, rapid opercular movement difficult breathing and convulsions were reported. Fish surfaced possibly to gulp the atmospheric air directly and to avoid the toxic environment. Air bubble were noticed coming out of the mouth. In control fishes the rate of opercular movement ranged between 48 - 51 times per minute however, under the cypermethrin stress it was ranged between 61-73 per minute for initial 30 minutes and after that decreased to 36-40 times per minute. At higher concentrations hyperactive response was noticed. Another characteristic behavioural change was that some fishes frequently dashed against the walls of experimental aquaria. Such affected fishes sometimes swam head downwards jabbing and scraping at the bottom of the aquaria with the snout. In the later phase of exposure fish become quiescent just before death.

Table 1. Physico-chemical characteristics of test water

Characteristic unit	No. of obs.	Mean	Range
pH	10	7.6	7.2-7.9
Temperature(°C)	10	24.6	2.3-2.6
Total solids mg/*l*	10	38.5	32.6-38.2
Dissolved solids mg/*l*	10	12.3	10.5 – 12.6
Dissolved Oxygen mg/*l*	10	6.5	5.4 – 7.6
Free CO_2 mg/*l*	5	2.1	1.3 – 3.0
Total hardness mg/*l* as $CaCO_3$	5	180.0	165.0-200.0
Total alkalinity mg/*l* as $CaCO_3$	5	150.0	136.0-165.0

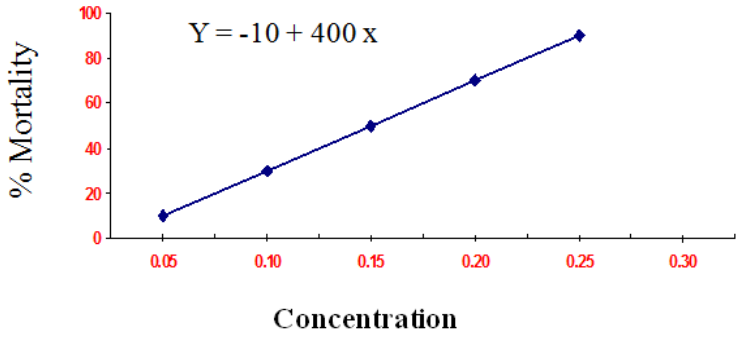

Fig. 1. LC_{50} values of cypermethrin for 24 Hrs to the fish *Anabas testudineus*

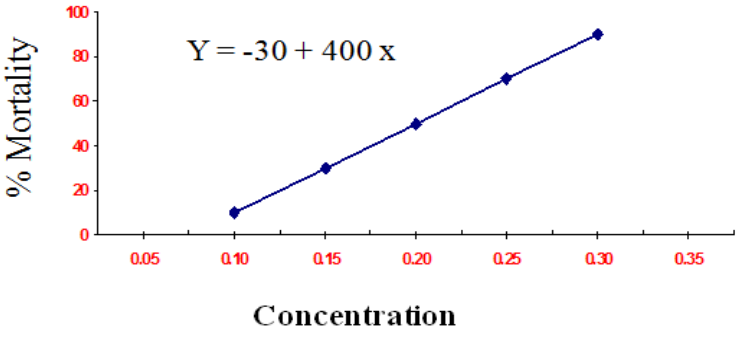

Fig. 2. LC_{50} values of cypermethrin for 48 Hrs to the fish *Anabas testudineus*

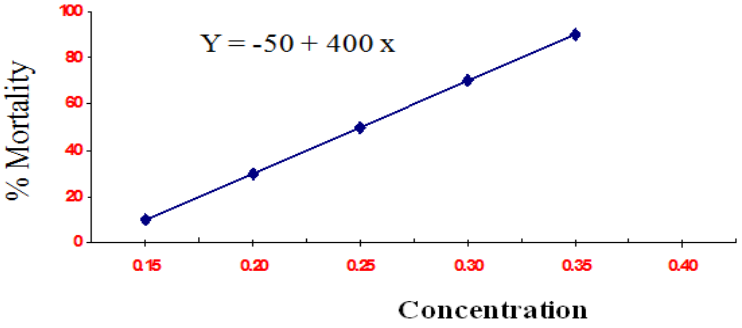

Fig. 3. LC_{50} values of cypermethrin for 72 Hrs to the fish *Anabas testudineus*

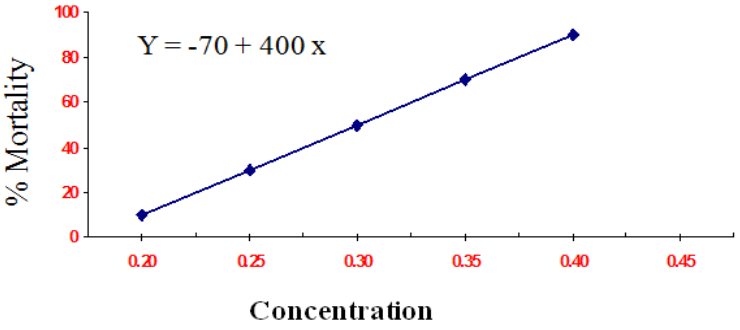

Fig. 4. LC_{50} values of cypermethrin for 96 Hrs to the fish *Anabas testudineus*

Table 2. LC_{50} values of cypermethrin with their regression eqations to *Anabas testudineus*

Synthetic pyrethroid	Time (hr)	LC_{50} (ppm)	Regression equation
Cypermethrin	24	0.15	-10 + 400 x
	48	0.20	-30 + 400 x
	72	0.25	-50 + 400 x
	96	0.30	-70 + 400 x

The present findings are in conformity with those of Steven et al. [11] and Gupta et al. [12]. Similar results were obtained by Choudhary [13] who reported LC_{50} values of fenvalerate to fish *Channa punctatus* for 24, 48, 72 and 96 hrs. i.e. 0.138 ppm, 0.130 ppm, 0.098 ppm and 0.078 ppm respectively. Poonam et al. [14] to the fish *Anabas testudineus* for 24, 48, 72 and 96 hrs. i.e. 0.130 mg/l, 0.098 mg/l, 0.088 mg/l and 0.078 mg/l respectively . Behavioural changes are sensitive indicators of pollutants and the optomotor response is essential for behaviours. Any alteration in the chemical composition of the natural aquatic environment usually affects a change in the behaviour of the animal reflects the physiological status of the body, any alteration in the body metabolism can be visualized through abnormal behaviour.

4. CONCLUSION

The behavioural response of fish under Cypermethrin exposure is due to stress on account of the toxic nature of aquatic environment. The behavioural responses can be used as a tool in biomonitoring programme to monitor ecotoxicity risk of Cypermethrin to the test fishes. The present study has proved significantly that the toxicants deteriorates fish health so, judicious use of pyrethroids is suggested.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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