

MEASUREMENT OF ACUTE TOXICITY AND BEHAVIOURAL RESPONSE OF SYNTHETIC PYRETHROID TO THE FRESH WATER TELEOST, *Oreochromis mossambica*

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ABSTRACT : Release of pesticides into the biosphere contaminate the aquatic ecosystem. Such contamination degrades the water quality and results into large scale fish mortality. Moreover the toxic ability of a particular chemical reduces the fitness of a population. Thus, it was felt necessary to have an accurate method for finding out toxic calculation of a given chemical to a given animal in a specific time. Short term toxicity i.e. Acute toxicity is expressed in term of LC50 are the most widely practiced and accepted method for the determination of such toxic levels. The toxicity of cyhalothrin to *Oreochromis* was evaluated. The LC50 obtained by former method were 3.981 mg/l, 4.898 mg/l, 6.602 mg/l, 0.1mg/l for 24, 48, 72, & 96 hrs. respectively. Gulping the atmospheric air, rapid operculum movement, convulsion, erratic swimming, profuse mucus secretion and its deposition over the gills and loss of equilibrium before death were prominent behavioural changes noticed during present study.

Key words: acute toxicity, LC50, *Oreochromis*, behavioural response, cyhalothrin.

INTRODUCTION :

Water is a marvelous substance flowing, swirling, seeping, constantly moving from sea to land and back again. It shapes the earth's surface and moderates our climate. Water is essential for life. It is the medium in which all the living process occurs. Water dissolves nutrients and distributes them to cells, regulate body temperature, supports structures, and remove waste products. About 60% of our body is water. We could survive for weeks without food, but only a few days without water. Water is the dominant environment. In the process of dominating and controlling nature, man has interfered with nature. He has disrupted & altered his biotic & abiotic environment. He has also discarded the basic principles governing the ecosystem of the biosphere. This leads to environmental pollution increase, if not checked in time, will be potentially dangerous to the very survival of man on the divine planet.

Water pollution is one of the most important problems being faced by both developed & developing world together.

Fertilizers and pesticides are being used indiscriminately in agricultural sector to increase crop yield. Pesticides are included in a broad range of organic micro pollutants that have ecological impacts. Different categories of pesticides have different types of effects on living organisms therefore generalization is difficult. Although terrestrial impacts by pesticides do occur, the principle pathway that causes ecological impact is that of water contaminated by pesticides runoff (Brebhante et al., 1996).

The purpose of toxicity test is to produce data concerning the adverse effects of an agent on test organism. One most common type of toxicity test with aquatic animals is the acute mortality test, which is usually conducted to obtain information about the median lethal concentration (LC50), The data produced by the test generally consist of the percentage of organisms that are killed by different concentration of a toxicant after specified length of exposure like 24, 48, 72 & 96 hrs.

LC50 is a concentration in which 50% of the experimental animals survive. It is interpolation value based on the percentage of dead fishes at two or more concentration at which less than half or more than half of the fish died. With the help of Mortality data straight line were drawn through the point expressing mortality at 24 hrs intervals during 96 hrs period. The concentration at which the line crossed the 50% survival line are the respective LC50 value. Straight line graphical interpolation methods described by Litchfield and Wilcoxon (1949) were used.

The study has been planned to evaluate the acute toxicity range of cyhalothrin and its effects on behavioural response of *Oreochromis mossambica* because it is a food fish with high nutritive value. On the basis of LC50 value so obtained the test animals could be subjected to acute and chronic toxicity test for further studies.

MATERIALS AND METHODS:

Live and healthy specimens of *Oreochromis mossambica* of both sexes 4.2 ± 0.5 cm in length & 0.850 ± 0.5 gms weight were brought from the Diwanshah lake, Bhiwandi. Fishes were examined for injury and diseases and washed in 0.1% KMnO₄ for 10 minutes. They were acclimatized to standard laboratory condition in dechlorinated tap water in glass aquaria 30x18x18 cm with continuous aeration for about 10 days. The physicochemical parameter were maintained as listed in Table No.1

Table No. 1 : The physico – chemical parameters of test water used for toxicological study

Parameters	Value with limits
Temperature	27°C ⁰
pH	7.3
DO	5.6 mg/litre
Free chloride	Nil
Total Acidity	3.5 mg/litre
Total Alkalinity	44 mg/litre
Total Hardness as CaCO ₃	31 mg/litre

Water of aquaria was renewed on alternate days and fishes were fed with live tubifex worm and daphnia available in the market before the change of water. Feeding was stopped two days before commencement of the experiment to reduce the excretory product and to avoid any possible change in toxicity of Endosulfan. Overcrowding was avoided and they were kept free from any disturbances and mechanical shocks. The fishes were exposed to diffused sunlight, the photoperiod being ten to twelve hours. The disease free fishes which were found to have acclimatized satisfactorily were used for bioassay test.

The synthetic pyrethroid insecticide used in the study was cyhalothrin. Cyhalothrin is a fluorinated pyrethrin analog (C₂₃H₁₉ClF₃NO₃). Cyhalothrin is very toxic to aquatic organisms. It is hazardous to the environment; special attention should be given to aquatic animals and mammals. The chemical is toxic to the Nervous system. Ingestion and other exposure to the chemical can cause various symptoms. The type and severity of symptoms varies depending on the amount of chemical involved and nature of exposure.

Before the commencement of acute toxicity test it is necessary to determine the upper and lower limits of the concentration which give 100% and 0% mortality respectively. For this purpose pilot test were carried out using range of concentration for 96hrs. The working solution of the pesticide i.e. Cyhalothrin were prepared using water as a solvent. The water was changed every 24 hrs to keep the desired concentration of the toxicant constant during the 96hrs experimental period. Control test with zero toxicant concentration were simultaneously performed exactly under analogous conditions.

A static bioassay test was performed according to standard methods of APHA et al. (2005) to determine the 96hrs median lethal concentration (LC50) of cyhalothrin. Initial range finding experiments were performed to derive the suitable concentration for LC50 determination by using eleven different concentration of pesticide along with the control group. In each concentration 10 fishes (both male and female) were introduced. Fishes were not fed during acute toxicity test to avoid any change in the media. The mortality was recorded at 24, 48, 72 & 96 hours. Death was defined as total lack of movement. The dead ones were removed immediately and the experiment was repeated thrice. No mortality was observed in the control group during the experimentation. Mortality was calculated by Litchfield and Wilcoxon (1949) graphical method. During this experiment the behavioural changes were also critically observed.

RESULTS AND DISCUSSIONS:

The data of bioassay test is given in Table no. 2 & 3. No fish mortality was observed upto 0.05ppm concentration at 48hrs of exposure. First mortality was recorded in 0.01 ppm on the third day i.e 72 hrs. of exposure while 100% mortality was recorded in 0.30 ppm at 96 hrs of exposure, in 0.45 ppm at 72 hrs of exposure and in 0.50 ppm at 24 hrs of exposure period.

The toxicity of the pesticide was observed to the dose dependent and increased with increasing concentration within

the duration of an exposure. The toxicity range with estimated LC50 value was 3.981, 4.898, 6.602, 0.1 mg/litre for 24, 48, 72 & 96 hrs of exposure respectively. (table no. 2 & 3)

Table No. 2. Percentage mortality of fish when exposed to different concentration of cyhalothrin

Concentrations	24 hrs	48 hrs	72 hrs	96 hrs
0.01	00%	00%	10%	20%
0.05	00%	00%	10%	30%
0.10	00%	10%	20%	50%
0.15	20%	30%	50%	60%
0.20	30%	50%	60%	70%
0.25	50%	60%	60%	90%
0.30	60%	70%	70%	100%
0.35	60%	70%	70%	--
0.40	70%	80%	80%	--
0.45	80%	90%	100%	--
0.50	100%	100%	--	--

Table No.3. : LC50 values of cyhalothrin to the fish *Oreochromis mossambica*

Time in hrs	LC50 values in mg/litre
24	3.981
48	4.898
72	6.602
96	0.1

The recorded value corroborate with the values obtained by log – probit – analysis of Litchfield & Wilcoxon (1949)

During the acute toxicity test behavioural pattern of the fish was observed. The first toxic symptoms was an increased respiratory rate followed by rapid opercular movement in treated fish. After 24 hrs. hyperactivity, erratic swimming and muscular spasm were noticed. During the subsequent period of toxicity i.e. 72 hrs. the fish became very lethargic and frequent body tremors were observed suggesting a neurological disorder. The alteration in the general behaviour of organism is mainly due to its adaptive nature, by which it tries to adopt with the changed environment. Similar finding have been reported by several workers after exposure to different chemical pollutant in fish (Webb and Breilt, 1973 ; Jarvinen et.al. 1977 ; Joshi, 1978 ; Rath and Mishra, 1980;Pansare and Shaikh,2014).

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