

COMPARATIVE STUDY ON THE ACUTE TOXICITY OF PLANT BASED PESTICIDE, KETHRIN AND AN ORGANOPHOSPHATE PESTICIDE, DICHLORVOS TO *Labeo rohita* (HAMILTON)

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ABSTRACT

The present study is aimed to evaluate the acute toxicity of botanical pesticide, Kethrin and an Organophosphate pesticide, Dichlorvos in *Labeo rohita*. Pesticides in agricultural runoff affect fish and other aquatic organisms. Fishes are common indicators of water pollution status. The mortality rate of *Labeo rohita* was monitored under laboratory conditions for the periods of 96 hrs. The toxicity tests were done separately for each pesticide. Data obtained from the toxicity tests were evaluated using the Probit Analysis Statistical Method. The toxicity tests gave 96hrs LC₅₀ values of 21.68, 16.71ppm for Kethrin and Dichlorvos respectively. The fish exhibited erratic swimming, copious mucus secretion, loss of equilibrium and hitting to the walls of test tank prior to mortality. In this study, Kethrin was less toxic to fish as compared to Dichlorvos. Plant based pesticides are biodegradable and are target specific than the highly persistent broad spectrum synthetic chemicals.

KEYWORDS : Dichlorvos, Kethrin, *Labeo rohita*, toxicity, 96h LC₅₀

Increased used of pesticide results in the excess inflow of toxic chemicals, mainly in to the aquatic ecosystem (Kalavanthy et al., 2001). The aquatic environment is currently under threat by the indiscriminate use of synthetic pesticides by the human activities and causing high risk to non-target organisms (Kumar et. al., 2010). Among different classes of pesticides, organophosphates are more frequently used, because of their high insecticidal property, low mammalian toxicity, less persistence and rapid biodegradability in the environment (Singh et al., 2010). Dichlorvos is recommended for application as a high or a low volume spray on crops such as paddy, wheat, soyabean, apple, sugarcane, mustard, sunflower and cashew. The Environment Protection Agency (EPA) has classified dichlorvos as toxicity class 1 highly toxic (URL: 1). Several species of fish are susceptible to deleterious effects when exposed to heavy metals, pesticides and other environmental stressors (Khangrat et al., 1988).

To overcome the hazardous effects of these organic pesticides, plant based pesticides are popularized due to their high efficiency, broad spectrum, low toxicity and green protectin to environment. Some plants contain compounds of various classes that have insecticidal, piscicidal and molluscicidal properties. Unlike synthetic chemical pesticides, which leave harmful residues in the

aquatic environment (Koesomadinata, 1980) botanical insecticides are believed to be more environmentally friendlier because they are easily biodegraded and leave no residues in the environment. Matrine (Kethrin brand name) an alkaloid extracted from the roots of *sophora flavescens* is a very effective and extensively used pesticide. Its roots have been found to contain many alkaloids including matrine and its oxide, oxymatrine.

It would be a big mistake to consider plant products, and this includes botanical insecticides, harmless merely because they are natural. Many botanical pesticides have been found to be toxic to non-target organisms where they induce marked alterations in experimental animals (Mondal et al., 2007). Pesticides are major cause of concern for aquatic environment. The health of aquatic ecosystem is being adversely affected because they serve as ultimate sink for these pesticides. Hence the present study is aimed to evaluate the acute toxicity of botanical pesticide, Kethrin and an Organophosphate pesticide, Dichlorvos in *Labeo rohita* (Hamilton).

MATERIALS AND METHODS

Kethrin contains a minimum of 0.5% EC (500ppm) of matrine, obtained from the roots of shrub *Sophora flavescens* and Dichlorvos 76% EC manufactured by Syngenta India ltd. 14, J. Tata road, Mumbai purchased

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from local market were used for evaluation of their toxicity to fish.

Labeo rohita weighing 60 ± 2 g and average length of 15cm were collected from the Patra Fish Farm, Berkhedhi, Bhopal, Madhya pradesh. The fishes were acclimatized to the laboratory conditions for 15 days. They were fed daily with commercial fish pellets. Water was renewed after every 24hrs. Physio-chemical characteristics of water were determined and maintained.

Experimental Procedure

The experiments were conducted in a series of glass aquariums filled with 60 litre dechlorinated tap water. The stock solutions were prepared for both the pesticides separately and the required quantity of Kethrin and Dichlorvos was drawn from the stock solution to find out the LC_{50} values for 96 h. Different concentrations were prepared and for each concentration a control was maintained. Ten acclimatized fishes of uniform size were exposed to each concentration. Preliminary tests were carried out to find out the median lethal concentration (LC_{50}) of the fish to Kethrin and Dichlorvos for 96h by Probit Analysis Method. The control and the exposed fish were aerated frequently to prevent hypoxic condition of the medium. The control and pesticide exposed fishes were kept under continuous observation during the experimental period. Feeding to fishes was stopped during the experiment. Behaviour of the test fishes was observed and the dead fishes were removed and recorded from time to time during 96 hr exposure

period. The water in the containers was changed every 24 hr and a constant concentration of Kethrin and Dichlorvos was maintained during the period of exposure.

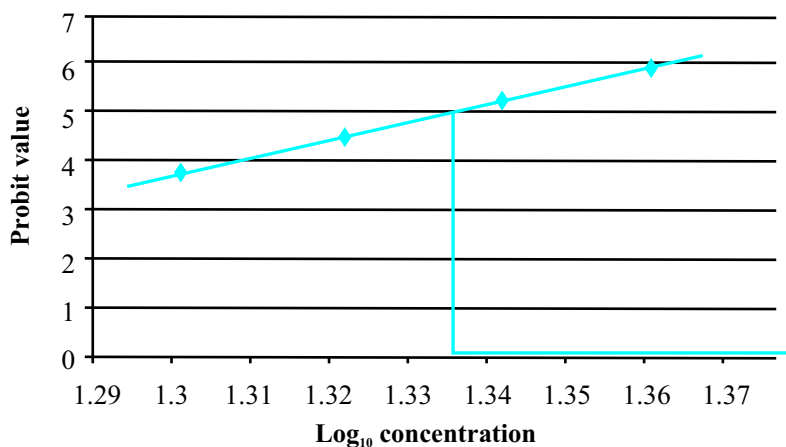
RESULTS AND DISCUSSION

The 96h LC_{50} values of Kethrin and Dichlorvos was found to be 21.68ppm and 16.71ppm respectively. The LC_{50} concentration for 96h was calculated by probit analysis method of Finney's (1971). Table, 1 and 2 shows the relation between the Kethrin, Dichlorvos concentrations and the mortality rate of *Labeo rohita* and the graphs below show the plot of Finney's probits against \log_{10} conc. for calculating LC_{50} values of both the pesticides.

After exposure of both the pesticides, the *Labeo rohita* showed behavioral changes, they aggregated at one

Table 1: The relation between Kethrin concentrations and mortality rate of *Labeo rohita*

Conc. (mg/L)	Log ₁₀ Conc.	Total No.	No. Dead	%Mortality	Probit.
Control		10	0	0	-
19	1.2788	10	0	0	-
20	1.3010	10	1	10	3.72
21	1.3222	10	3	30	4.48
22	1.3424	10	6	60	5.25
23	1.3617	10	8	80	5.84
24	1.3802	10	10	100	-



Graph 1: The plot of Finney's probits against \log_{10} concentrations for Kethrin

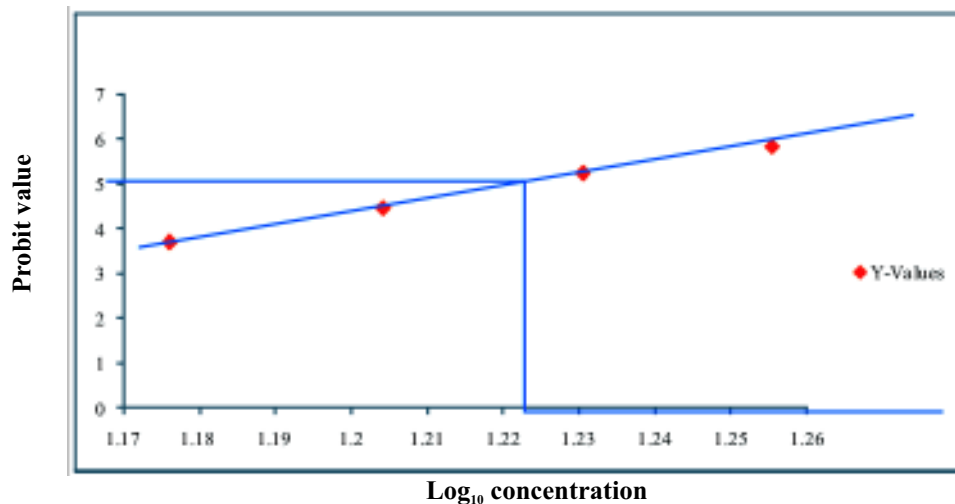
Table 2: The relation between Dichlorvos concentrations and mortality rate of *Labeo rohita*

Conc. (mg/L)	Log ₁₀ C onc.	Total No.	No. Dead	%Mortality	Probit .
14	1.1461	10	0	0%	-
15	1.1761	10	1	10%	3.72
16	1.2041	10	3	30%	4.48
17	1.2304	10	6	60%	5.25
18	1.2553	10	8	80%	5.84
19	1.2788	10	10	100 %	-

corner of aquarium, irregular, erratic and darting swimming movements and loss of equilibrium. They slowly became lethargic, hyper excited, restless and secreted excess mucus all over their bodies. The fish exhibited peculiar behavior of trying to leap out from the pesticide medium which can be viewed as an escaping phenomenon. They often spiral rolled at intervals and finally the fishes sank to bottom with their least operculum movements and died with their mouth opened. The behavioral changes were prominent for the synthetic pesticide Dichlorvos as well as for Kethrin which may be as a result of the froth formation on the surface of water in the test tank exposed to Kethrin.

Recent emphasis is on the use of natural pesticides, which are usually of plant origin to replace deleterious chemical pesticides. Although synthetic pesticides are target specific and effective, their effect on environment is mostly deleterious. Plant based pesticides contain active principles with low half-life period and their effects on the environment are not too detrimental (Sharma et al., 1995). In the present study, the pesticide containing Matrine (Kethrin brand name) is less toxic to fish compared to

Dichlorvos. The 96h LC₅₀ of Dichlorvos is 16.71 ppm whereas for Kethrin it was 21.68ppm indicating the less toxic nature of the plant based pesticide. Characterization of alkaloids in *Sophora flavescens* Ait was reported by (Liu, 2011). Antifeedent activity and acute and residues toxicity of alkaloids from *Sophora flavescens* against formosa subterranean termites was reported by (Henderson, 2007). The LC₅₀ values of Dichlorvos has been reported by various workers as in *Cyprinus carpio* 6gm it was 0.34ppm for 96h (Verma et al., 1981) in *Cirrhinus mrigala* it was 9.1ppm for 96h (Velmurugan et al., 2009) and in *Ctenopharyngodon idella* it was 13.1ppm for 24h (Tilak and Kumari, 2009). Comparison of the LC₅₀ values clearly indicates that the plant based pesticide is less toxic compared to the chemical one. To reduce the chemical load on the environment, it is suggested that use of plant based pesticides should be encouraged (Schmutterer, 1990). However, care should be taken to use even the plant based pesticide at moderate levels. Furthermore, plant based pesticides disintegrate easily into constituent elements without leaving any indelible impression in different regions of the environment (Khan and Ahmed, 2000). It is advocated that more and more plant products should be developed with proper and targeted action and this eventually helps in keeping the environment free from hazardous chemicals. From the present study, it could be concluded that Dichlorvos contamination is dangerous to aquatic ecosystems, and this fact should be taken into consideration when this insecticide is used in agriculture or in the control of mosquito



Graph 2: The plot of Finney's probits against log₁₀ concentrations for Dichlorvos

populations. It can be also concluded that although plant based pesticides are considered as less toxic and environmental friendly, however it might be noticed here that LC₅₀ value of Kethrin was not too high as compared to Dichlorvos and it must be kept in mind that natural pesticides which nowadays are used should not be considered merely harmless because they are natural. These botanical pesticides should be used more cautiously when used in fish inhabiting areas since the excess application can affect the life of organisms. This type of study can also be useful to compare the sensitivity of the various species of aquatic animals and potency of chemicals using LC₅₀ values and to derive safe environmental concentration by which there is no lethality and stress to the animals.

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