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The Toxicity and Mortality Behaviour Impact of Cypermethrin on the Fish Oreochromis Mossambicus

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ABSTRACT

The present study investigates the acute toxicological effects of the synthetic pyrethroid insecticide, cypermethrin on Oreochromis mossambicus fresh water fish species widely used in toxicity testing. Fishes were exposed to sublethal concentrations of cypermethrin and behavioural, physiological mortality responses were recorded. The 96 hrs was 1.93 µg/l using probit analysis (Finney 1971). Obserable effects included erractic swimming, loss of equilibrium and increased opercular movements. The study highlights the susceptibility of Oreochromis mossambicus to cypermethrin, emphasizing its ecological risk and the need for careful regulation of pesticide discharge into aquatic ecosystem.

INTRODUCTION

Cypermethrin a synthetic pyrethroid is widely used agricultural insects pests like cotton, wheat, paddy field, cabbage, brinjal, sugarcane, sunflower etc.(Jahanbakshi et al. 2012, Rose et al. 2015). However, when it enter aquatic systems through runoff or accidental discharges and highly toxic to fish (Bradburry and Coats 1989).

Oreochromis mossambicus commonly known as Mosambique tilapia is a hardy and widely distributed species in fresh water ecosystem. It is aften employed as a model organism in ecotoxicological studies due to its ecological and economical importance.

This study aims to assess the acute toxicity of cypermethrin on Oreochromis mossambicus and determines its LC50 value using probit analysis, Furthermore the research evaluates behavioural and physiological changes in fish, thereby offering insight into the ecological implications of cypermethrin contamination in aquatic environments.

MATERIALS AND METHODS

Test species
Oreochromis mossambicus is almost same size and weight (6-9 cm, 11-16 gm) were collected from a local market of Agra and acclimatized in laboratory condition for 7 days.

Test chemical
Technical grade cypermethrin (purity ≥95%) was used. A stock solution was prepared and diluted to obtain the desired concentrations.

Experimental Design
Fish were divided in to control and experimental groups. Four different concentrations of cypermethrin (1 to 4 µg/l) were selected based on preliminary ranged finding tests. Each group contained five fish and was maintained in aquaria under continuous aeration. The exposed duration was 96 hrs. Behaviour and mortality observations were recorded at 24, 48, 72 and 96 hrs intervals.

Physiochemical parameters
Temperature - 27±1C
pH- 7.2 ± 0.2
DO- 6.5 ± 0.5 mg/l were maintained and monitored regularly.

STATISTICAL CALCULATIONS

Mortality data were subjected to probit analysis to calculate the LC50 using spss.

RESULT

LC50 ANALYSIS

Table 1

Mortality rate of Oreochromis mossambicus after treatment with chlorpyrifos at different time intervals.

S. No	Conc. (µg/l)	No. of fish	Mortality no. of fish			
			24 hrs	48 hrs	72 hrs	96 hrs
1	0	5	0	0	0	0
2	1	5	0	0	0	1
3	2	5	0	1	1	1
4	3	5	1	1	1	1
5	4	5	1	1	1	2

Table 2

Survival number and Percentage mortality of Oreochromis mossambicus after 96 hrs of treatment with chlorpyrifos.

S. N0.	Conc. (µg/l)	No. of fish	Exposure time(hrs)	Mortality Number	% mortality	Survival number
1.	0	5	96	0	0	5
2.	1	5	96	1	20	4
3.	2	5	96	3	60	2
4.	3	5	96	4	80	1
5.	4	5	96	5	100	0

Table-3

Toxicity evaluation of chlorpyrifos to Oreochromis mossambicus.

Experimental animal	Experimental compound	LC_{50} µg/l	Variance	Fiducial limit
Oreochromis mossambicus	Cypermethrin	1.93	0.0285	m_1 = 1.75 (L) m= 2.10 (U)

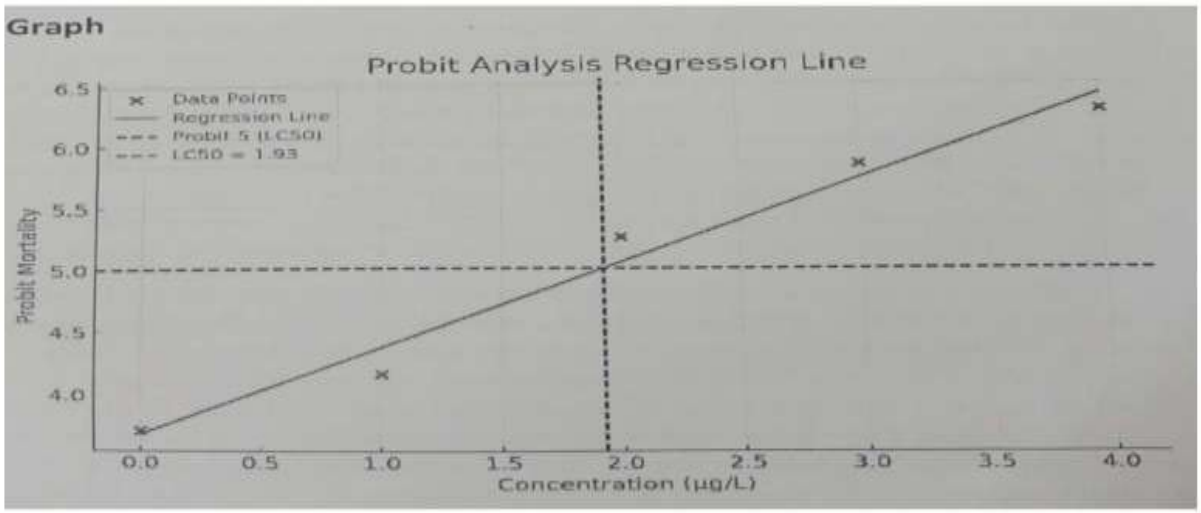

Table 4

Effect of cypermethrin on the morpho behavioural responses of Oreochromis mossambicus.

S. No.	Morpho-Behavioural responses	Concentration of cypermethrin in µg/l				
		Control	24 hrs	48 hrs	72 hrs	96 hrs
1	Effect in fish	No stress	No stress	Stress	Stress	stress
2	Colour of skin	No change	Light yellow	Yellow	Dark Yellow	Very Dark yellow
3	Spiralling movement	Normal	Normal	Restless	Restless	Restless
4	Backword movement	Normal	Normal	Fast	Very Fast	Very fast
5	Opercular movement	Normal	Normal	Fast	Fast	Very fast
6	Swimming activity	Freely	Very Freely	Reduction	Reduction	Reduction
7	Breathing rates	Normal	Normal	Hard	Very Hard	Very Hard
8	Set on the aquarium	All sides	All sides	Top	Top	Top
9	Mortality no. of fish	0	1	3	4	5
10	Survival no. of fish	5	4	2	1	0

DISCUSSION

The results demonstrated that cypermethrin exerts toxic effects on Oreochromis mossambicus with mortality increase in a dose - dependent manner. The value at 96 hrs was estimated to be approximately 1.93 gg/l, indicating high toxicity. Different fish species are reported as follow 0.035 mg/l for Tilapia mossambique (Prashanth et al. 2011), 0.04 mg/l for Oreochromis mossambicus (Karthigayani et al. 2014), 0.4 mg/l for Channa punctatus(Kumaret al 2007), 0.139 mg/L-l in Labio rohita, 0.63 mg/l in Clarias gariepinus, 41.786 gg/L-l in Oncorhynchus mykiss, 4.0 in Labio rohita, 5.13 µg/L in Cirrhinus mrigala, 0.00050ml/l in Channa punctatus, 0.00022 ml/l in Heteropneustes fossilis.

In this study fish of control group were free from such behaviour changes fish mortality indicating cypermethrin and experimental change in behavioral such as irregular, hyperactivity, increased opercular movement, loss of equilibrium, erractic swimming and surface gulping were observed. The behavioural study gives direct responses of the fish to the pesticides and related chemicals (Radhaiah et al. 1987 and Warner et al. 1966). Similar behavioural changes were also observed in guppy fish Poecia reticulata after exposure to cypermethrin (Kakko, l. et al. 2003, Li, X. et al. 2005). Such symptoms suggest that even sub-lethal concentrations can impair the normal physiological function of fish, potentially affecting growth, reproduction and survival. There are reports suggesting that the temperature of the aquatic system plays an important role in the intensity of toxicity of pyrethroid (Kumar et al. 2007). These findings are consistent with previous studies reporting the acute toxicity of cypermethrin on other freshwater species. The high sensitivity of Oreochromis mossambicus makes it a suitable bioindicator for pesticide pollution. Given its widespread use and persistence in water bodies, strict monitoring and control of cypermethrin discharge are essential to safeguard aquatic life.

REFERENCES

[1]. Kumar, S. et al. (2020). "Acute toxicity of cypermethrin on freshwater fish. Environ. Toxicol. and Pharm., 76, 103347.
[2]. Rand, G.M. (1995). Fundamentals of Aqua. Toxicol. Taylor& Francis.
[3]. USEPA (2002). Methods for measuring the acute toxicity of effluents and Receiving waters to freshwater and Marine organisms. EPA-821-R-02-012.
[4]. Velmurugan,B. Mathews, T.& Cengiz, E.I. (2007). Toxicity and histophathology of cypermethrin in freshwater fish. Journal of Ecotoxicol. And Environ. Monitoring, 17(2), 109-115.
[5]. David, M. et al. (2004). Toxicity evaluation of synthetic pyrethroids to fresh water fishes. Environ. Biol.of Fishes, 70 (1): 13-19.
[6]. Jahanbakshi, A., Shaluei, F.& Baghfalaki, M. (2012). Acute toxicity of cypermethrin on the great sturgeon (Huso huso) Juveniles. World J. of Fish and Marine Sci.4 (2) 170175.

[7]. Bradbury, S.P. & Coats, J.R. (1989). Comparative toxicology of the pyrethroid insecticides. In J.R.Coats (Ed), Reviews of Environmental Contamination and Toxicology 108, 133-177.
[8]. Prashnath, M.S., Hiragond, N.C. and Nikam, K.N.(2011). The effect of cypermethrin on different tissuesof fresh water fish Tilapia mossambica. J. of Basic and Clinical Physiology and Pharmacology, 22, 119-115.
[9]. Karthigayani,T. et al. (2014). Effect of cypermethrin toxicity in the gills of the fish Oreochromis mossambicus . J. of Mod. Biotech., 3, 35-41.
[10]. Kumar, A. Sharma, B. and Pandey R.S. (2007). Preliminary evaluation of the acute toxicity of cypermethrin and lambda-cyhalothrin to Canna- punctatus. Bulletin of Environment Contamination and Toxicology, 79, 613-616.
[11]. Das, B.K., Mukherjee,S .C. (2003). Toxicity of cypermethrin in Labio rohita fingerliges: biochemical, enzymatic and heamatological concequences. Comparative Biochemistry and Physiology; 134 :109-121.
[12]. Ayoola, S.O., Ajani, E.K.(2008). Histopathological effects of cypermethrin on Juvenile African Catfish Clarias gariepinus. World J. of Biological Resources. 1:1-14.
[13]. Kucukbay, F.Z., Dorucu, M. Yazlak, H. (2009). Acute toxicity of synthetic pyrethroid cypermethrin to the young Rainbow Trout Oncorhynchus mykiss Walbaum, 1792.Asian J. of Chem. 21 (3):1801-1806
[14]. Marigoudar, S.R., Ahmed, R.N. David (2009). Cypermethrin induced respiratory and behavioural responses of the fresh water teleost, Labio rohita (Hamilton). Veterinarskiariv. 79 (6) : 583-590.
[15]. Veni, S.M.S. and Veeraiah, K. (2014). Toxicity effect of cypermethrin 10% EC. To the freshwater fish Cirrhinus mrigala (Hamilton). International J. of Pure and Applied Zoology. 2 (4) :365-372.
[16]. Zahra, K. Yadav, S. Tanya, Jyoti, Deeksha, Sandeep and Deepti (2016). Assessment of acute toxicity of cypermethrin and its mitigation by green tea extract in fresh water fishes, Channa puctatus. IAJPS. 3 (4) : 374-378.
[17]. Singh, A., Zahra, K. (2017). LC50 assesssment of cypermethrin in
[18]. Heteropneustes fossilis: Probit analysis. Int. J. of Fisheries and Aquatic Studies. 5 (5):
[19]. 126-130.
[20]. Radhaiah, V., Girija, M. and Rao, K.J. (1987). Changes in selected biochemical parameters in the kidney and blood of the fish, (Peters), exposed to heptachlor. Bull. of Environ. Contam. and Toxicol. 39 :1006-1011.
[21]. Warner, R.E., Peterson, K.K., and Burgman, L. (1966). Behavioural pathology in fish. A quantitative study of sublethal pesticide toxication. J. of App. Eco. 3:223-242.
[22]. Kakko, Toimela, T. and Tahti, H. (2003). The synaptosomal membrane- bound ATPase as a target for the neurotoxic effects of pyrethroid, permethrin and cypermethrin. Chemosphere. 51 (6): 475- 480.
[23]. Li, X., Ping, X., Xiumei, S., Zhenbin, W. and Liqiang, X. (2005). Toxicity of cypermethrin on growth, pigments and superoxide dismutase of Scenedesmus obliques. Ecotoxicology and Environ. Safety 60 (2) :188-192.