Original Research Paper

Volume-8 | Issue-8 | August-2018 | PRINT ISSN No 2249-555X

Zoology

ACUTE TOXICITY OF CYPERMETHRIN TO FRESHWATER FISH CHANNA PUNCTATUS (BLOCH)

S.Sanayaima Devi Department of Life Sciences, Animal physiology lab.Manipur University, Canchipur, 795003

W.Vidyarani Devi* Department of Life Sciences, Animal physiology lab.Manipur University, Canchipur, 795003 *Corresponding Author

ABSTRACT The lethal concentration of the synthetic pesticides affect the metabolism of an organism and could alter the population size as well as the habitat of the aquatic organism like fishes. Thus, the aim of the present study was to determine the acute toxicity of cypermethrin insecticide to the freshwater fish *Channa punctatus* (Bloch). Experimental fish were exposed to different concentrations of cypermethrin between range 0.1,0. 08, 0.06, 0.04 and 0.02mg/l for 96hrs in test container.The 96h LC_{50} value of cypermethrin on the fish was found to be 0.40mg/l. The variation in the lethal concentration values was due to its dependence upon various factors viz., sensitivity to the toxicant, its concentration and duration of exposure.

KEYWORDS :

Introduction

Synthetic pyrethroid insecticides are an extensively used in place of organochlorine, organophosphorus insecticides and carbamates to control various types of pests and increase agricultural production. These chemicals are potentially more toxic to fish and other aquatic organisms, and are least toxic to mammals (1,2). The lipophilicity of pyrethroids indicates that these chemicals will be absorbed by fish even from very low concentrations in water (3). However, they are neither fully metabolized nor quickly detoxicated and therefore create serious problems of residue accumulation (4). It was also reported that the acute toxicity tests of pesticides on fish to acquire rapid estimates of the concentrations that caused direct, irreversible harm to test organism (5). Hence, the use of pesticides has increased with the growing awareness of their utility in agriculture production, animal husbandry, post-harvest technology, and in the public health and welfare of mankind.

Since some members of the population of fishes may prove to be excessively susceptible and others may prove to be very resistant to the dose or the concentration of the toxicant that affects 50% of the population (6) exposed in the contaminated water body and they reflect the health of the aquatic ecosystem. Significant changes in the behaviour and external appearance of the fishes habituated in the pesticide-contaminated water body. It has been carried to the catchment areas by rains and floods where this species habituated (7). Such a phenomenon was extensively observed in the catchment areas of Manipur due to increasing use of pesticides in the agricultural field(8). It was also reported that the *C.punctatus* had high nutritive value (9) and the people of the region preferred this species for consumption by the lactating mother and malnourished children. But due to the increased use of this pesticides could affect the health of the dependent person. However, the study about the toxicity level of the *C.punctatus* found in the habitat of the region is still lacking. Thus, In the present study, an attempt has been made to analyze the toxicity of the cypermethrin 10 EC on the freshwater fish *C.punctatus* (Bloch).

Material and methods

The freshwater fish *C.punctatus* size 12-13 cm and weight 18-20 g were brought from ema market of Manipur. The fish were acclimatized to the laboratory conditions at 28 ± 2^0C for 15 days. The water used for acclimatization and conducting experiments was chlorinated tap water.

Acute Toxicity Tests

The containers of the test media are of 20 L capacity, wherein each test five containers were used and each container consisted of 10 fish. The mortality rate was taken into consideration and while taking the data, dead fish was removed immediately. Pilot experiments were conducted to choose the mortality range between 10% and 100%. Base on the pilot experiments, the experiments were conducted to determine the toxicity indifferent concentrations (0.10,0.08,0.06,0.04 and 0.02mg/l) for 96hrs. The data of each concentration was pooled up to calculate the LC_{50} values. The un-weighted regression method of probit analysis and SPSS v20.0 was used to calculate the LC_{50} values [10]. The following results are in mg/L-1.

Results and Discussion

In the present investigation the test species, *C.punctatus* has shown differential toxicity level with the function of period. This shows that the more is the duration period the less is the concentration required. The observed percentage of mortality of *C.punctatus* for cypermethrin in static tests continuous for different hours and different concentrations were shown inTable1, 2, 3 and 4 The observed LC values and 95% confidence limits in static tests were shown in Table 4.

Table 1: Parameter Estimates of the probit analyses for *C.punctatus*

	Parameter	Estimate	Std. Error	Z	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
PROBIT[a]	dose	3.900	.978	3.990	.000	1.984	5.816
	Intercept	5.455	1.297	4.207	.000	4.158	6.752

a. PROBIT model: PROBIT(p) = Intercept + BX (Covariates X are transformed using the base 10.000 logarithm.)

Table 2: Chi-Square Tests for 96 h LC_{50} value of *C.punctatus*

		Chi-Square	dfb	Sig.
PROBIT	Pearson Goodness-of-Fit Test	1.845	3	.605a

a. Since the significance level is greater than .500, no heterogeneity factor is used in the calculation of confidence limits.b. Statistics based on individual cases differ from statistics based on aggregated cases.

Table 3: Cell Counts and Residuals

	Number	concentration	Number of experimental fish	Observed Responses	Expected Responses	Residual
PROBIT	1	-1.699	10	1	1.207	-.207
	2	-1.398	10	6	5.011	.989
	3	-1.222	10	7	7.548	-.548
	4	-1.097	10	8	8.804	-.804
	5	-1.000	10	10	9.400	.600

Table 4.Confidence Limitsfor fish *C.punctatus* at different concentrations

Probability	95% Confidence Limits for dose			95% Confidence Limits for log(dose)a		
	Estimate	Lower Bound	Upper Bound	Estimate	Lower Bound	Upper Bound
LC_1	.010	.002	.018	-1.995	-2.675	-1.752

LC_2	.012	.003	.020	-1.925	-2.540	-1.703
LC_3	.013	.004	.021	-1.881	-2.454	-1.672
LC_4	.014	.004	.022	-1.848	-2.389	-1.649
LC_5	.015	.005	.023	-1.820	-2.337	-1.629
LC_6	.016	.005	.024	-1.797	-2.293	-1.613
LC_7	.017	.006	.025	-1.777	-2.254	-1.598
LC_8	.017	.006	.026	-1.759	-2.219	-1.585
LC_9	.018	.006	.027	-1.742	-2.188	-1.573
LC_{10}	.019	.007	.027	-1.727	-2.159	-1.562
LC_{15}	.022	.009	.030	-1.664	-2.039	-1.516
LC_{20}	.024	.011	.033	-1.614	-1.945	-1.478
LC_{25}	.027	.014	.036	-1.572	-1.866	-1.445
LC_{30}	.029	.016	.039	-1.533	-1.795	-1.414
LC_{35}	.032	.019	.041	-1.497	-1.731	-1.384
LC_{40}	.034	.021	.044	-1.464	-1.672	-1.354
LC_{45}	.037	.024	.048	-1.431	-1.617	-1.323
LC_{50}	.040	.027	.051	-1.399	-1.564	-1.291
LC_{55}	.043	.031	.055	-1.366	-1.514	-1.256
LC_{60}	.046	.034	.061	-1.334	-1.466	-1.217
LC_{65}	.050	.038	.067	-1.300	-1.421	-1.174
LC_{70}	.054	.042	.075	-1.264	-1.377	-1.124
LC_{75}	.059	.046	.086	-1.226	-1.334	-1.065
LC_{80}	.066	.051	.101	-1.183	-1.291	-.995
LC_{85}	.074	.057	.123	-1.133	-1.245	-.910
LC_{90}	.085	.064	.160	-1.070	-1.192	-.797
LC_{91}	.088	.066	.170	-1.055	-1.180	-.769
LC_{92}	.092	.068	.183	-1.038	-1.166	-.739
LC_{93}	.095	.070	.197	-1.020	-1.152	-.705
LC_{94}	.100	.073	.215	-1.000	-1.137	-.667
LC_{95}	.105	.076	.238	-.977	-1.119	-.624
LC_{96}	.112	.080	.267	-.950	-1.099	-.573
LC_{97}	.121	.084	.309	-.916	-1.074	-.510
LC_{98}	.134	.091	.376	-.872	-1.041	-.425
LC_{99}	.158	.102	.512	-.802	-.991	-.291
a. Logarithm base = 10.						

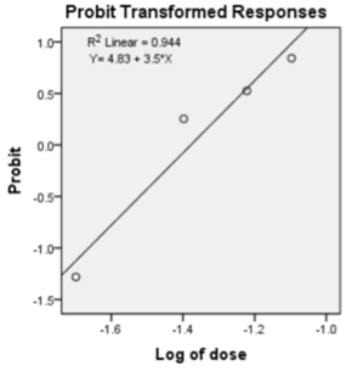

Figure 1: Probit linear relationship of acute toxicity of Cypermethrin to *C.punctatus* (Bloch)

The hyperactivity of the selected species to the pesticide cypermethrin showed the maximum at the LC_{50} (Table 3). This shows that the behavioural characteristics of the species to the cypermethrin exposure is obviously sensitive to the toxicant effect and it is dependent on the exposure time. There observe changes in the behaviour and mortality of the species with the increase of exposure time which is consistent with the study reported by several workers(11,12). This might due to the accumulation of acetylcholine in synaptic and neuromuscular junctions(11,13).

In the present investigation, the 96 hr LC_{50} of Cypermethrin on the freshwater fish *C.punctatus* is estimated as 0.040 (Table 4) however, the probit transformed plot showed strong variation as shown in Figure.1. This showed that the differential tolerance of the selected species to cypermethrin exposure. This indicates that the sensitivity of the experimental species to the various factors like the concentration and the duration of exposure to the pesticide, cypermethrin. It was also reported that the toxicity of the pesticides to the different animals varied due to differential tolerance and exposure rate(14,15).

Conclusion

From the above acute toxicity investigation, it is concluded that the pesticide cypermethrin is highly toxic to freshwater fish *C.punctatus* at LC_{50} values and resulted in significant behavioural changes and increase mortality rate. The lethal concentration of the pesticides to the species indicate the impact of the pesticides on the behaviour and respiratory responses. Thus this study helps in the further study of the toxic effect of the pesticide on the other aquatic species and its impact on the habitat pollution.

Acknowledgement

The authors are thankful to the Head of Department of Life Sciences, Manipur University for providing all the laboratory facilities to carry out the research work.

Reference

1. Malla Reddy P, Bashamohideen M: FenvalarateandCypermethrin induced changes in the haematologicalparameters of Cyprinus carpio. Acta. Hydrochim. Hydrobiol., 1989; 17 (1):101-107.
2. Anonymous.: Extoxnet, Extension Toxicology Network, Pesticide Information Profiles, 1996; http://ace.orst.edu/info/extoxnet/pips/ghindex.html
3. Doharty J D, Nishimura K, Kurihare N, Fujita T:Promotion of norepinephrine release and inhibition of calcium uptake by pyrethroids in brain synoptosomes. Pestic. Biochem. Physiol.,1987; 29: 187-196.
4. Dhawan A, Kaur k: Toxic effects of synthetic pyrethroids on Cyprinus carpio Linn. eggs. Bull. Environ. Contam. Toxicol. 1996;57: 999Ð1002
5. Begum G. Carbofuran insecticide induced biochemical Alterations in liver and muscle tissues of the fish, Clarias batrachus(Linn) and recovery response. Aquatic Toxicol. 2004; 66:83-92.
7. Richardson, M L: Risk Assessment of Chemicals in the Environment. UK RSC Publications, 1988.
8. ENVIS Hub Manipur, Status of Environment and Related Issues. 2015. Directorate of Environment, Govt. of Manipur. Ministry of Environment and Forests, Govt of India.
9. Saikia A k, Abujam S K S and Biswas S P: Food and Feeding habit of Channa punctatus (Bloch) from the Paddy Field of Sivsagar District, Assam. Bulletin of Environment, Pharmacology and Life Sciences. 2012;1(5): 10- 15.
10. Finney D.J. Probit analysis 3ed. Cambridge University Press; 1971.
11. David M, Shivakumar R, Mushigeri S B and Kuri RC. Blood glucose and glycogen levels as indicators of stress in the freshwater fish, under fenvalerate intoxication. J. Ecotoxicol. Environ. Monit.2005; 15: 01-05.
12. Nagaraju B, Sudhakar P, Anitha A, Haribabu G and Rathnamma V.V. Toxicity evaluation and behavioural studies of freshwater fish exposed to Rimon. Int. J. Res. Pharma.2011; Biomed Sci. 2 (2), 722-727.
13. Rao JV, Begum G, Pallela G, Usman PK and Rao RN. Changes in behaviour and brain acetylcholinesterase activity in mosquito fish Gambusia affinis in relation to sublethal exposure of chloropyrifos.Int.J.Environ.Res.PublicHealth. 2005; 34:478-483.
14. Hassanein H M A, Okail H A and Mohamed N K.Biochemical changes in proteins and DNA in due to environmental Ctenopharyngodon idella pollution with the biopesticide (Trilogy). 10 ICCA, Garyounis University, Benghazi, Libya 2007; 18-21.
15. Barbee G C, McClain W R, Lanka S K Stout M J. Acute toxicity of chlorantraniliprole to non-target crayfish (Procambarus clarkii) associated with rice-crayfish cropping systems. Pest manage. 2010; 66:996-1001.