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Toxicity assessment of beta-cyfluthrin with impact on haematology of fish, *Channa punctatus*

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ABSTRACT

Âeta-cyfluthrin, a synthetic pyrethroid pesticide, is commonly used in agriculture for pest control and as household insecticide. It is relatively safe to mammals and birds but highly toxic to non-target aquatic organisms including fish. The 96-hour LC_{50} was determined using standard toxicity assessment tests. Alterations in haematological parameters were recorded after exposure to two sublethal concentrations of beta-cyfluthrin for a period of 15 and 30 days.The results showed a significant decrease in total erythrocyte count, haemoglobin concentration, haematocrit percentage and increase in total leucocyte count in exposed groups.The results of present study indicate a significant toxicological impact of beta-cyfluthrinon in *Channa punctatus* with marked alterations in haematological parameters.

Figures : 05 References : 21 Table : 01

KEY WORDS : Beta-cyfluthrin, *Channa punctatus*, Haematological, LC_{50}, Parameters, Pesticide.

Introduction

Pesticides are chemicals used in agriculture to control various kinds of pests and also as household insecticides.In recent past, there have been a decline in use of traditional pesticides such as organophosphates, organochlorines and carbamates[12]. However, the production of pyrethroidsis is on the rise as they are potent and efficient pest control agents and relatively harmless to mammals and birds[9]. Pyrethroids are synthetic analogs of pyrethrins, the toxic component present in the flowers of *Chrysanthemum cinerariaefolium*.

Beta-cyfluthrin is a commonly used type II synthetic pyrethroid. It is the refined form of cyfluthrin and has about 2-5 times more acute toxicity than cyfluthrin. It is currently used in many formulations all over the world to control a wide range of indoor and outdoor pests[4]. Pyrethroids have been reported to be extremely toxic to aquatic organisms including fish[3,15,18]. Due to improper handling these pesticides can enter water bodies where they alter the physical and chemical properties of aquatic ecosystem. These pesticides may damage the biochemical and physiological process of fish organs[2].

Haematological parameters serve as important indicators of the physiological status of organisms. Any physical or chemical changes in the aquatic environment are reflected in the components of fish blood[5]. The presence of toxicants in the water results in deviations from the normal range of haematological indices. Therefore, haematological tests serve as important tools in toxicological studies. Erythrocyte and leucocyte counts, haemoglobin concentration and hematocrit are some of the most important blood parameters of diagnostic significance[5].

Channa punctatus is a very common freshwater fish found in India. It is a carnivorous, hardy, easily manageable and very economical fish. It can be easily maintained under laboratory conditions and very suitable for toxicological studies.

Material and Methods

Healthy specimens of *Channa punctatus* were obtained from a local source. The fish were treated with 1% $KMnO_4$ to avoid any dermal infections. Before the start of experiment, the fish were acclimated to laboratory conditions for 10 days. Fish were fed commercial fish food pellets. Physico-chemical parameters like water temperature, pH, dissolved oxygen and hardness were constantly monitored during the experiment.

Technical grade beta-cyfluthrin of >95% purity was

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TABLE - 1 : Toxicity evaluation of beta-cyfluthrin for *Channa punctatus*

Experimental animal	Experimental Compound	Regression equation	LC_{50} (μg/L)	Variance	Fiducial limits
Channa punctatus	Beta-cyfluthrin	Y=5.15+5.52 (x'-0.52)	3.08	0.0014	m_1=(+)0.49074 m_2=(-)0.48525

used in this study. Range finding studies were conducted to find out the different concentrations of beta-cyfluthrin for the acute toxicity tests. Beta-cyfluthrin was dissolved in acetone to prepare a stock solution which was diluted to prepare 5 different test concentrations *viz.,* 1, 2, 3, 4 and 5 μg/L, respectively. Five groups of fish (each containing 10 fish) were exposed to a range of these five different test concentrations.This acute toxicity test was conducted in triplicates. Fish mortality was recorded. and 96-hour LC_{50} value was obtained by probit analysis method[8].

For haematological studies, Fish were divided into 3 groups. Group I was the control group. Group II and Group III were the experimental groups. Fish in experimental groups were exposed to two sublethal concentrations of beta-cyfluthrin (0.154 μg/L and 0.304 μg/L) for 15 and 30 days. These concentrations of beta-cyfluthrin were 5% and 10% of the 96 h LC_{50},respectively.Feeding was stopped 24 hours prior to blood collection. For the study of haematological parameters blood was collected after 15 days and 30 days. Haematological parameters were estimated by standard methods. Total erythrocyte count and total leucocyte count were estimated by improved haemocytometer, haemoglobin concentration was estimated by Sahli's haemoglobinometer and haematocrit was measured[21]. The data were analyzed with the help of SPSS statistical software.

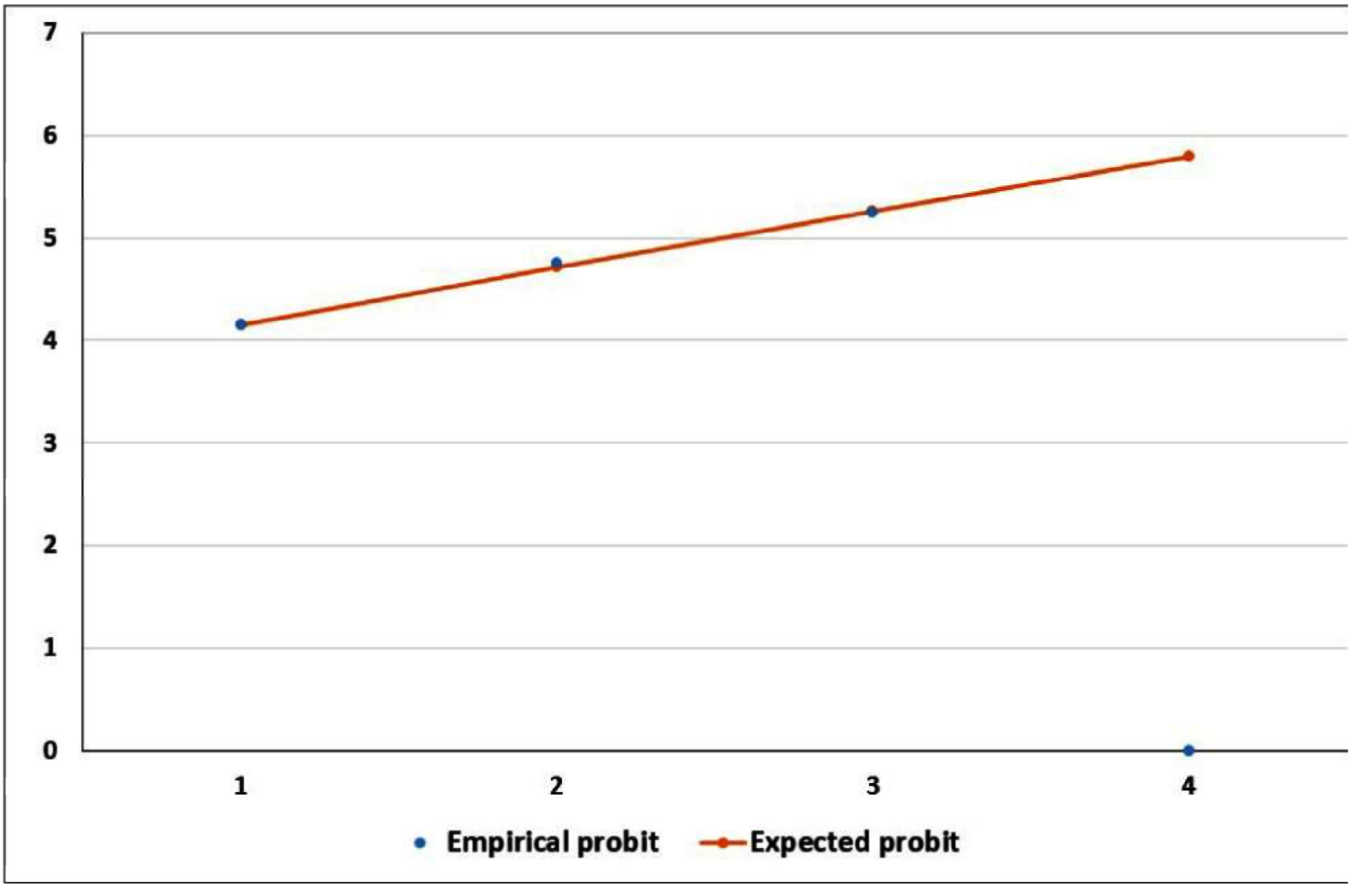

Fig. 1: Regression line for determination of LC_{50} for *Channa punctatus* after beta-cyfluthrin treatment

Results

The results are shown in Table and graphs. LC_{50} value of beta-cyfluthrin was 3.08 µg/L with variance 0.0014, fiducial limits m_1= (+)0.49074 and m_2= (-)0.48525 and regression equation Y=5.15+5.52 (x'-0.52) for the fish *Channa punctatus* (Bloch.) (Table-1 and Fig. 1).

The results of haematological studies are depicted (Figs. 2-5). Total erythrocyte count, haemaoglobin concentration and haematocrit percentatge (packed cell volume) showed a dose dependent decrease after exposure to beta-cyfluthrin for 15 and 30 days. TEC values showed a significant decrease in both the lower and higher concentrations of beta-cyfluthrin when compared to the respective control fish. The decrease in TEC in higher concentration was 7.5 % and 11.8 % more in comparison to lower concentrations of beta-cyfluthrin after 15 and 30 days, respectively. The values of Hb concentration showed a significant reduction in both the lower and higher concentrations of beta-cyfluthrin when compared to the respective control fish. The decrease in Hb conc. in higher concentration was 10.4 % and 16 % more in comparison to lower concentration of beta-cyfluthrin after 15 and 30 days, respectively. Haematocrit percentage showed a significant decrease in both the lower and higher concentrations of beta-cyfluthrin when compared to the respective control fish. The decrease in haematocrit value in higher concentration was 5.73 % and 13.4 % more in comparison to lower concentration of beta-cyfluthrin after 15 and 30 days, respectively. Total leucocyte count showed a significant increase in both the lower and higher concentrations of beta-cyfluthrin when compared to the respective control fish. The increase in TLC in higher concentration was 4.52 % and 14.14 % more in comparison to lower concentration of beta-cyfluthrin after 15 and 30 days, respectively.

Discussion

This study was conducted to assess the acute toxicity of beta-cyfluthrin by LC_{50} and also the effects of sublethal exposure of beta cyfluthrin to *Channa punctatus* fish by using selected haematological parameters.

Several workers reported the acute toxicity values for type II pyrethroids in various fishes. Workers[20] reported 96 h LC_{50} value as 4.83µg/Lfor deltamethrin in *Catla catla,* while others[16] reported 96 h LC_{50}value as 0.75 µg/L for deltamethrin in *Channa punctatus*. Some workers[13] reported 96 h LC_{50} as 4.0 µg/Lfor cypermethrin in *Labeo rohita* and reported cyfluthrin toxicity[6] in various fish species as 0.68 µg/L in rainbow trout, 1.5 µg/L in blue

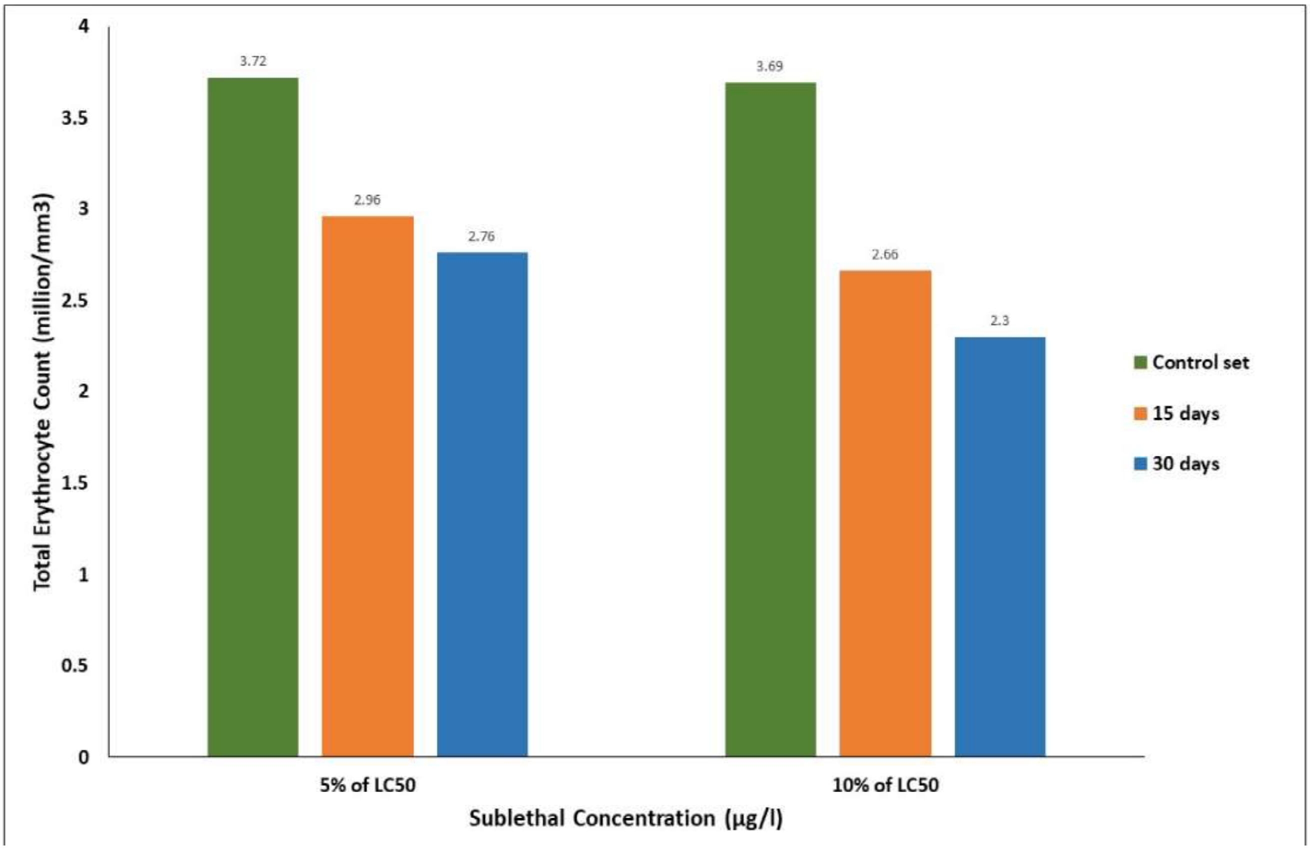

Fig. 2 : Total Erythrocyte Count (TEC) (million/mm^3) in *Channa punctatus* after sublethal treatment of beta-cyfluthrin for 15 and 30 days

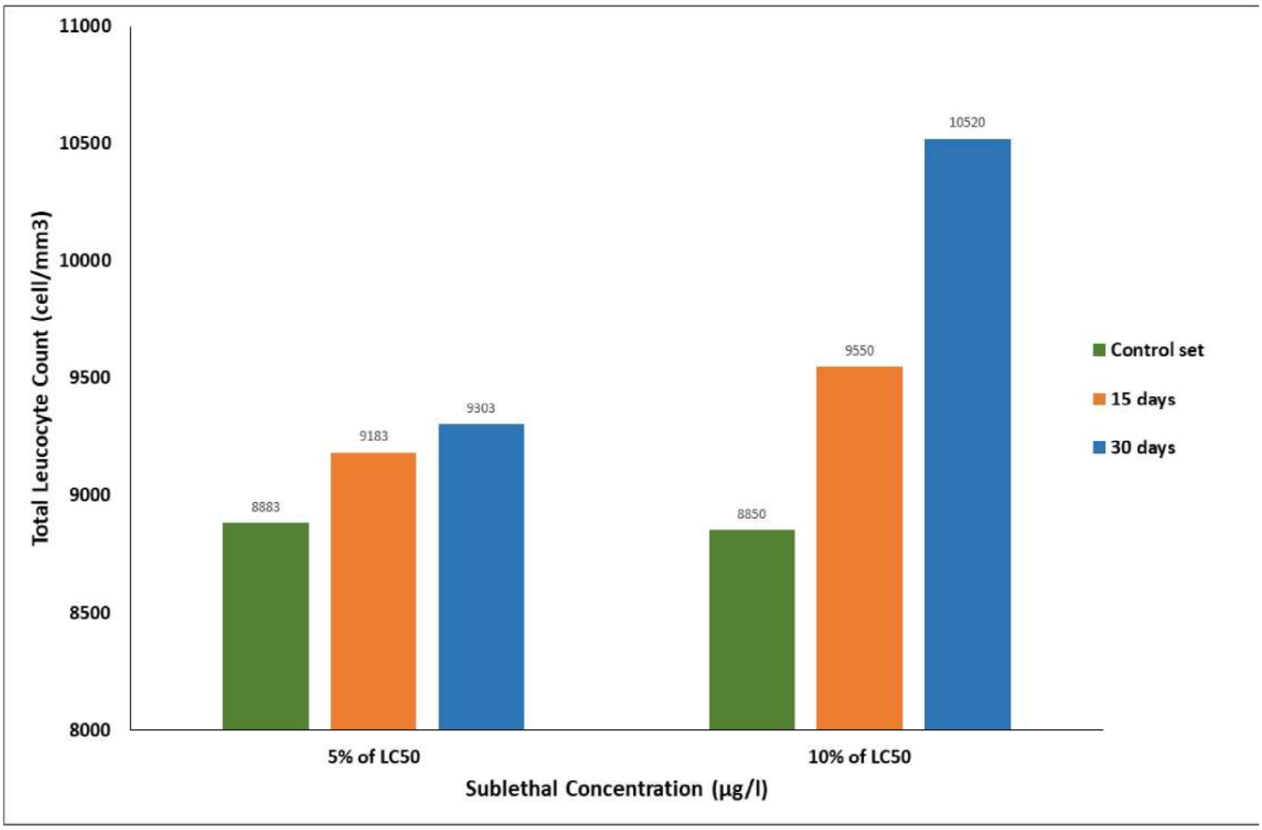

Fig. 3 : Total Leucocyte Count (TLC) (cell/mm3) in *Channa punctatus* after sublethal treatment of beta-cyfluthrin for 15 and 30 days

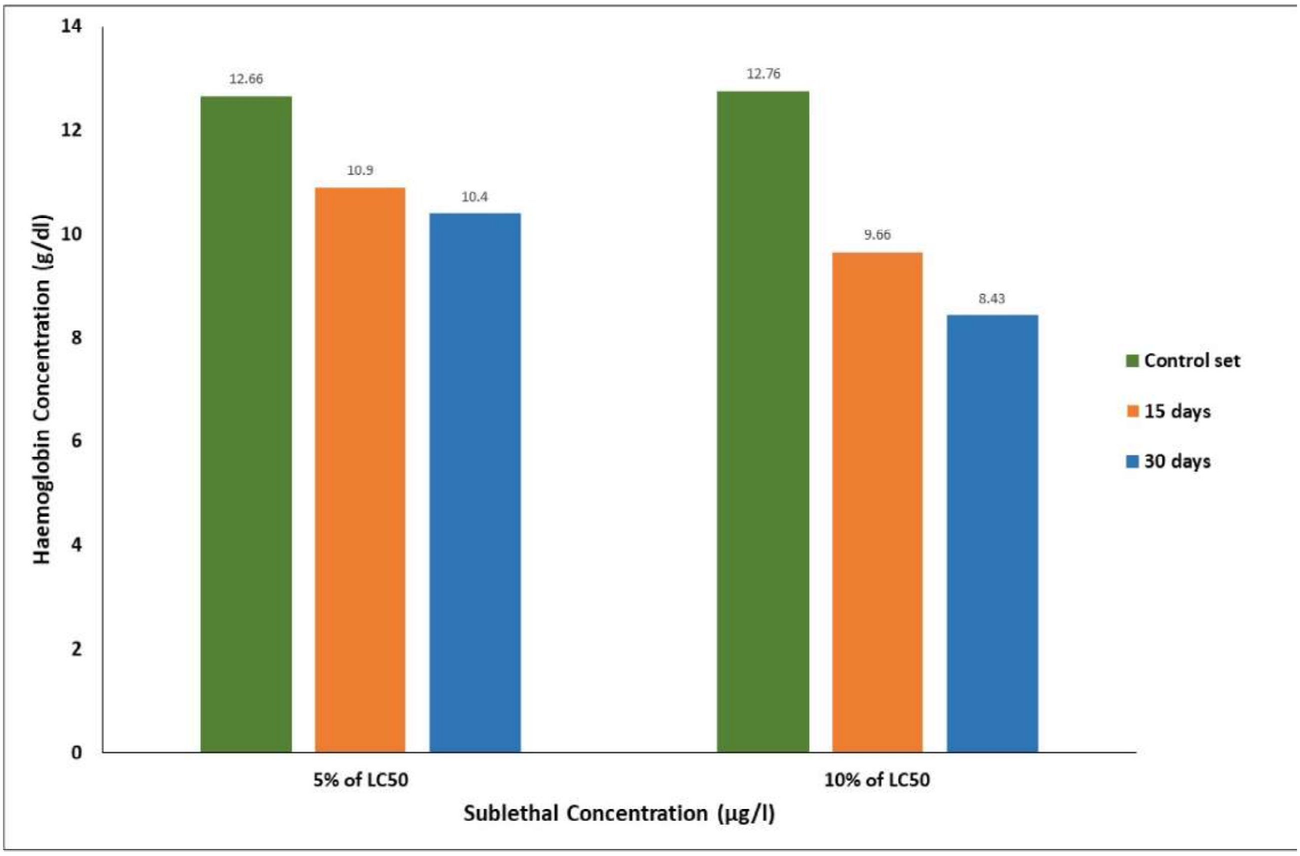

Fig. 4 : Haemoglobin Concentration (g/dl) in *Channa punctatus* after sublethal treatment of beta-cyfluthrin for 15 and 30 days

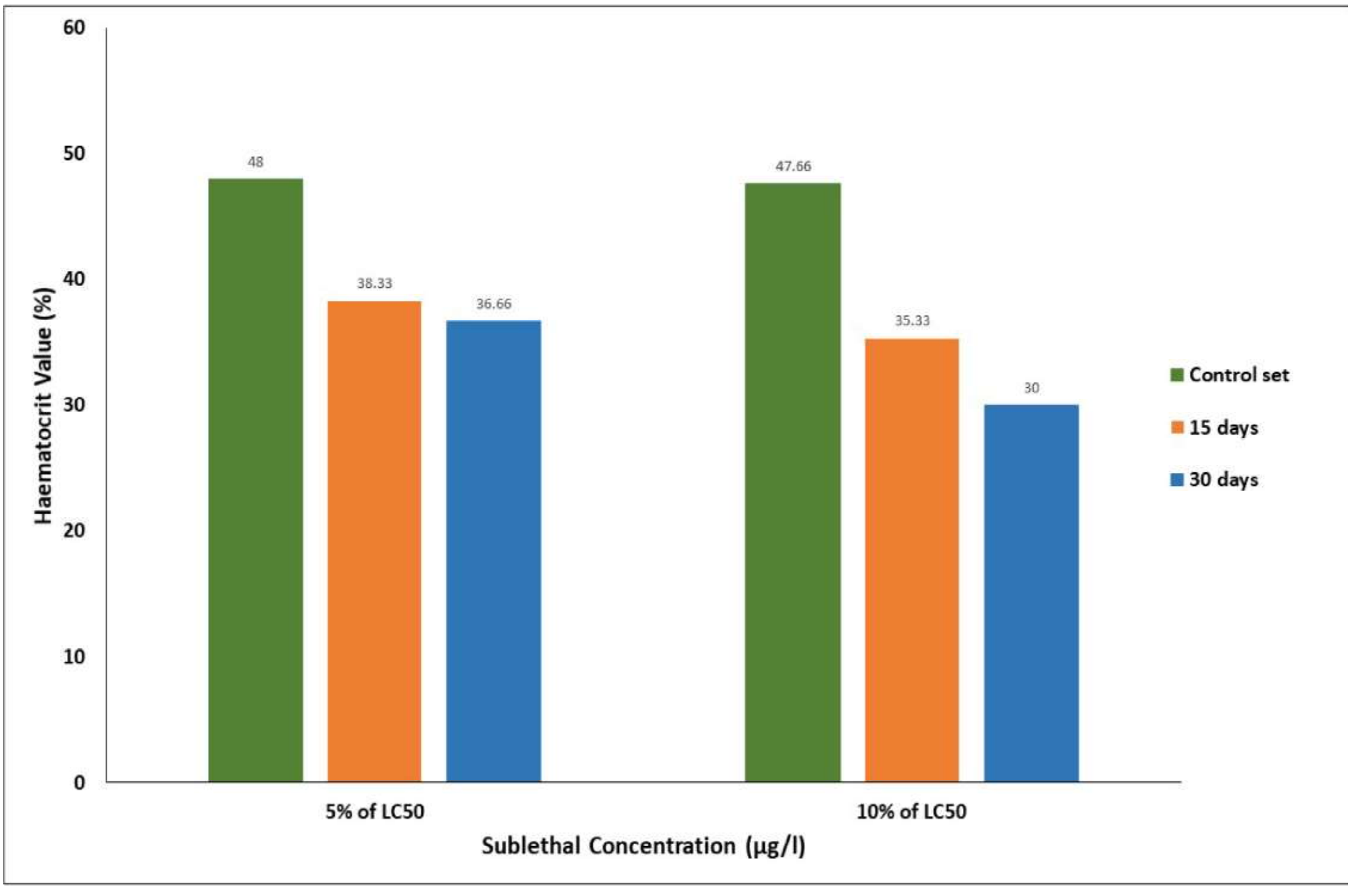

Fig. 5 : Packed Cell Volume (Haematocrit) (%) in *Channa punctatus* after sublethal treatment of beta-cyfluthrin for 15 and 30 days

gill, 22 µg/L in carp (*Cyprinus carpio*) and 3.2 µg/L in golden orfe. An investigator[3] reported 96 hLC_{50}value as 21.07 µg/Lfor cyfluthrin in *Nile tilapia* fry (*Oreochromis niloticus*). The 48 h LC_{50} value for cyfluthrin in guppy fish was estimated as 8.07 µg/L[17].

Haematological parameters are important screening tools for toxicological research.The study of haematological parameters can be very useful in evaluation of general health of fish and may be used as indicators of toxic stress. In the present study a dose dependent decrease in total erythroyte count, haemoglobin concentration and haematocrit percentage (packed cell volume) in *Channa punctatus* was observed after exposure to beta-cyfluthrin for 15 and 30 days. These results are in line with previously reported studies for cyfluthrin and other type II pyrethroids in fishes.

There were reduced levels of erythrocyte count, haemoglobin concentration, haematocrit and elevated levels of total leucocyte count in *Schixothorax esocinus* after exposure to cypermethrin[1] and reduction in WBC count, RBC count and Hb in *Oriochromisniloticus* after exposure to deltamethrin[7]. Similar findings were reported by others[14] for fenvalerate in *C. punctatus*, for cypermethrin in *Labeo rohita*[11]. There was significant reduction intotal erythrocyte count, haemoglobin and haematocrit in *Tor putitora* after cypermethrin exposure[19].

Several workers[5,10,17] reported significant increase in total leucocyte count and decrease in total erythrocyte count, haemoglobin concentration and packed cell volume in several species of fishes exposed with cypermethrin, deltamethrin and fenvalerate.

References

1. Akhtar N, Khan MF, Tabassum S, Ahmad MS, Badshah KD. Effects of cypermethrin on the haematological parameters, biochemical components of blood and histopathological changes in different organs of Chirruh snow trout (*Schixothorax esocinus*). *Pakistan J. Zool.* 2021;**53**(3): 943-953.
2. Banaee M, Mirvaghefei AR, Majazi AB, Rafei GR, Nematdost B. Haematological and histopathological study of experimental diazinon poisoning in common carp fish *(Cyprinus carpio)*. *J Fish (Iranian J Nat Resour).* 2011; **64**(1): 1-14.

3. Benli ACK. Investigation of acute toxicity of cyfluthrin on tilapia fry (*Oreochromis niloticus* L. 1758). *Environ. Toxicol. Pharmacol.* 2005; **20**: 279-282.

4. Bhushan B, Saxena PN, Saxena N. Biochemical and histological changes in rat liver caused by cypermethrin and beta-cyfluthrin. *ArhHig Rada Toksikol.* 2013;**64**: 57-67.

5. Blaxhal P, Daisy KW. Routine haematological methods for use with fish blood. *J. Fish Biol.* 1973; **5**: 771-781.

6. Bradbury SP, Coats JR. Comparative toxicology of the pyrethroid insecticides. *Rev. Environ. Toxicol. Contam.* 1989;**108**: 133-177.

7. Dawood MA, Abdel-Kader MF, Moustafa EM, Gewaily MS, Abdo SE.Growth performance and haematoimmunological responses of *Nile tilapia* (*Oreochromis niloticus*) exposed to deltamethrin and fed immunobiotics. *Environmental Science and Pollution Research.* 2020; **27**: 11608-11617.

8. Finney DJ. Probit analysis-A statistical treatment of sigmoid curve- 3rdedn. Cambridge University Press, London. 1971 : 568.

9. Goulding AT, Shelley LK, Ross PS, Kennedy CJ. Reduction in swimming performance in juvenile rainbow trout *(Oncorhynchus mykiss)* following sublethal exposure to pyrethroid insecticides. *Comp. Biochem. Physiol. C Toxicol. Pharmacol.* 2013; **157**(3): 280-286.

10. Jayaprakash C,Shettu N. Changes in the haematology of the freshwater fish, *Channa punctatus* (Bloch) exposed to the toxicity of deltamethrin. *Journal of Chemical & Pharmaceutical Research.* 2013; **5**(6): 178-183.

11. Khan N, Ahmad MS, Tabassam S, Nouroz F, Ahmad A, Ghayyur S, Rehman AU, Khan MF.Effects of sub-lethal concentration of cypermethrin on histopathological and hematological profile of Rohu (*Labeo rohita*) during acute toxicity. *Int. J. Agric. Biol.* 2018; **20** (3): 601-608.

12. Kumar A, Sharma B, Pandey RS. Lambda-Cyhalothrin and cypermethrin induce stress in the freshwater muddy fish, *Clarias batrachus*. *Toxicological and Environmental chemistry.* 2014;**96**(1):136-149.

13. Marigoudar SR, Ahmed RN, David M. Cypermethrin induced respiratory and behavioural responses in *Labeo rohita. Vet. Arhiv.* 2009; **79**: 583-590.

14. Patole SS, Patil MU,Bhoi SS. Effect of fenvalerate synthetic pyrethroid on a certain haematological parameters of freshwater fish *Channa marulius* (Ham-Bach). *Int. J. Life Sci. Scienti. Res.* 2016; **2**(3): 269-272.

15. Pimpao CT, Zampronio AR, SilvadeAHC. Effects of deltamethrin on haematological parameters and enzymatic activity in *Ancistrus multispinis* (Pisces, Teleostei). *Pesticide Biochemistry and Physiology.* 2007;**88**(2): 122-127.

16. Sayeed I, Parvez S, Pandey S, Bin-Hafeez B, Haque R, Raisuddin S. Oxidative stress biomarkers of exposure to deltamethrin in freshwater fish, *Channa punctatus* Bloch. *Ecotoxicology and Environmental Safety.*2003; **56**(2): 295-301.

17. Selvi M, Sarikaya R, Erkoc F, Kocak O. Acute toxicity of the cyfluthrin pesticide on guppy fish. *Environ Chem Lett.* 2008; https//doi.org/10.1007/s10311-008-0142-5.

18. Sepici-Dincel A, Benli ACK, Selvi M, Sarikaya R, Sahin D, Ozkul IA, Erkoc F. Sublethal cyfluthrin toxicity to carp (*Cyprinus carpio* L.) fingerlings: Biochemical, haematological, histopathological alterations. *Ecotoxicology and Environmental Safety.* 2009; **72**: 1433-1439.

19. Ullah R, Zuberi A, Tariq M, Ullah S.Acute toxic effects of cypermethrin on haematology and morphology of liver, brain and gills of mahseer (*Tor putitora*). *International Journal of Agriculture and Biology.* 2014;**17**: 199-204.

20. Vani T, Saharan N, Mukherjee SC, Ranjan R, Kumar R,Brahmchari RK. Deltamethrin induced alterations of haematological and biochemical parameters in fingerlings of *Catla catla* (Ham.) and their amelioration by dietary supplement of vitamin C. Pesticide *Biochemistry and Physiology.*2011;**101**: 16-20.

21. Wintrobe MM, Lee GR, Boggs DR, Bithell TC, Forester J, Athens JW, Lukens JN. Clinical Haematology, 8th ed., Lea and Febiger, USA. 1981.