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Impact of cypermethrin on the haematology of freshwater Catfish *Mystus vittatus*

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Abstract
The purpose of this study was to see how sublethal amounts of Cypermethrin affected the haematological parameters of *Mystus vittatus* after 96 hours of exposure. In chlorpyrifos-exposed fish, significant decreases in RBC counts, Hb percent, thrombocytes, monocytes percent, eosinophils percent, and basophils percent, as well as significant increases in WBC count, Lymphocytes percent, and Neutrophils percent were observed, while significant increases in WBC count, Lymphocytes percent, and Neutrophils percent were observed. The fish's reaction to Cypermethrin toxicity was highly dependent on the concentration and duration of exposure.

Keywords: Cypermethrin, haematological parameters, *Mystus vittatus*

Introduction
Pesticides are biological toxicants that are used by humans to kill pests in order to increase the production of numerous crops and to reduce the transmission of disease through insect vectors. Pesticide use has posed serious environmental and health risks to organisms, including humans (Prakash and Verma, 2014; Masih, 2021) [10, 7]. Pesticides used indiscriminately in agriculture, animal husbandry, and post-harvest technology pose a threat to the natural water system, rendering it unfit for aquatic life, public health, and human welfare. These pesticides enter the food chain, where their bioaccumulation and biotransformation at various trophic levels have disastrous consequences for the ecosystem (Prakash and Verma, 2018) [11].
Because of the remarkable progress made in creating novel compounds with improved toxicity over the last two decades, a great deal of research has been done on the impact of pesticides on non-target aquatic creatures. The majority of synthetic organic pesticides are particularly harmful to non-target freshwater fauna species, causing population dynamics, complex food webs, and energetic food webs to be harmed (Chandra *et al*., 2001) [3].
The synthetic pyrethroid cypermethrin is used to manage ectoparasites in cattle, sheep, poultry, and some companion animals. Currently, cypermethrin is frequently utilised as a chemotherapeutic treatment in marine cage culture and freshwater aquaculture to combat ectoparasite infestations (Monir *et al*., 2015) [8]. Because of their slow metabolism and delayed clearance of these chemicals, fish are very poisonous (Bradbury and Coats, 1989) [2].
Blood is one of the most sensitive markers of an animal's stress level. It is extremely vulnerable to both internal and external environmental changes. Fish are the most sensitive and best indicators of water pollution of all aquatic species. In fish, the major route of entry for any toxicant is through the gills. It is carried from the gill to other areas of the body via the bloodstream, making blood an appropriate medium for toxicity investigations. The total quantity of blood cells, including erythrocytes and leucocytes, as well as haemoglobin factors, take on significant importance as a measure of the body's response to the harsh environment. Fish is a good source of protein and a simple to digest diet for humans. It is essential for us to meet our dietary needs.
A review of the literature finds a scarcity of information on the acute toxicity of Cypermethrin on freshwater fishes like *Mystus vittatus*, one of Uttar Pradesh's most popular edible catfish species. As a result, the current study was conducted to investigate the harmful effects of chlorpyrifos on the haematological parameters of *Mystus vittatus*, a freshwater catfish.

Materials and Methods

Mystus vittatus, a freshwater catfish with an average length of 7.0-8.0 cm and a weight of 6.0-6.5 gramme, was taken from local freshwater bodies and dipped in 0.1 percent potassium permanganate solution for 2 minutes. The fish were given a 7-day acclimatization period in the lab. The fish were fed commercial feed during acclimation. Prior to the trial, the fish were not fed. For *Mystus vittatus*, the 96-hour LC_{50} of cypermethrin was 0.044 mg/L. (Krishna and Prakash, 2015) [6]. Fish were subjected to sublethal concentrations of cypermethrin (0.015 mg/L) for 96 hours based on 96 LC. A control group was kept in the same conditions as the experimental group. The fish were fed commercial food, and the medium was changed every day to remove faeces and food scraps. For the blood collection, five fish from each batch were sacrificed. On the 24th, 48th, 72nd, and 96th hours of exposure periods, blood samples were obtained from the caudal region after piercing the caudal peduncle of fish from both the experimental and control groups and analysed for haematological alterations. Blood parameters such as TEC, Hb, TLC, Thrombocytes, and DLC were determined using Dacie and Lewis' techniques (1977) [4].

Results and Discussion

Table 1: Effects of sublethal concentration of Cypermethrin (0.015 mg/L) on haematology of *Mystus vittatus* at different exposure period (N=5)

Haematological Parameters	Group	Exposure periods in Hours		
		48	72	96
RBC(TEC) ($x10^6/mm^3$)	Control	3.55±0.014	3.61±0.012	3.52±0.013
	Exposed	3.43±0.012	3.20±0.012*	3.00±0.022**
Hb (g/100ml)	Control	13.3±0.11	13.6±0.12	13.2±0.14
	Exposed	11.7±0.14*	11.2±0.14*	10.8±0.15**
WBC(TLC) ($x10^3/mm^3$)	Control	12.75±0.12	12.78±0.11	12.77±0.12
	Exposed	16.35±0.15*	17.11±0.21**	17.11±0.13**
Thrombocytes ($x10^3/mm^3$)	Control	41.25±5.11	42.11±4.12	41.09±3.19
	Exposed	17.14±1.85*	15.50±3.06**	11.82±3.08**
Lymphocyte %	Control	76.7±1.21	76.4±1.41	76.6±1.29
	Exposed	80.1±1.33*	80.8±1.31*	81.4±1.14**
Monocytes %	Control	8.5±0.77	8.6±0.14	8.5±0.28
	Exposed	6.3±0.59*	5.2±0.44*	5.1±0.24**
Neutrophil %	Control	12.1±0.91	12.2±1.12	12.2±1.13
	Exposed	11.8±0.66*	12.6±0.71*	12.8±0.57**
Eosinophil %	Control	3.4±0.24	3.5±0.26	3.4±0.31
	Exposed	1.7±0.39*	1.4±0.45**	0.9±0.54**
Basophil %	Control	1.2±0.29	1.1±.39	1.2±0.34
	Exposed	0.2±.0*	0.3*	0.2*

*Significant at $P<0.05$; ** significant at $P<0.01$.

Significant changes in haematological parameters of Cypermethrin-exposed catfish, *Mystus vittatus*, were discovered in this study. After 96 hours of exposure to sublethal concentrations of Cypermethrin, significant reductions in RBC count, Hb percent, Thrombocytes, Monocytes, Eosinophils, and Basophils were seen in Cypermethrin-exposed *Mystus vittatus*. The results of this investigation revealed a significant drop in RBC counts and Hb levels in *Mystus vittatus* treated to Cypermethrin. Similar reductions in RBC counts and haemoglobin content have been recorded in various fish species after exposure to organophosphate insecticides (Svoboda *et al*., 2001; Ramesh and Saravanan, 2008) [15, 12]. An increase in the rate at which Hb is destroyed or a decrease in the rate at which Hb is synthesised could explain the considerable decrease in Hb content (Reddy and Bashamohideen, 1989) [13]. Thus, in the current study, a considerable drop in haemoglobin content in Cypermethrin-exposed fish was caused by an increased rate of haemoglobin destruction, a decreased rate of haemoglobin synthesis, or a malfunction/inhibition of the haemopoietic organ.

WBC count increased considerably in *Mystus vittatus* after exposure to sublethal Cypermethrin concentrations in this investigation. Increases in WBC counts (leucocytosis) have been seen in *Cyprinus carpio* subjected to chlorpyrifos acute toxicity (Ramesh and Saravanan, 2008) [12]. However, in the *Cyprinus carpio* subjected to diazinon, decreases in WBC counts (leucopenia) were also seen (Svoboda *et al*., 2001) [15]. The rise in WBC count is linked to an increase in antibody synthesis, which aids in the survival and recovery of fish exposed to pesticides at sublethal concentrations (Joshi *et al*., 2002) [5].

In the present study was a significant reduction in thrombocyte counts with the exposure of the fish to Cypermethrin. However, Adedeji *et al*. (2009) [1] reported a significant increase in thombocyte count in *Clarias gariepinus* exposed to diazinon. The decrease in thrombocytes may be related to decreased thrombocyte production or increased destruction of thrombocytes.

In the current study, the percentage of lymphocytes and neutrophils increased dramatically, resulting in lymphocytosis in fish exposed to sublethal levels of Cypermethrin. In fish exposed to Cypermethrin, the percentage of eosinophils, monocytes, and basophils decreased. After exposure to BHC and distillery effluent, Thakur and Pandey (1990) [16] and Srivastava *et al*. (2007) [14] found an increase in lymphocyte percentage and a decrease in neutrophils and eosinophils in *Clarias batrachus*. As a result, the lymphocytosis observed in this study could be the result of an immune response to the toxicant's stress by producing more antibodies.

Conclusions

After exposing *Mystus vittatus* to a sublethal dose of Cypermethrin for 96 hours, substantial changes in haematological parameters were seen, which could indicate a reduction in the fish's ability to fight disease and diminish its chances of growth and survival. This study clearly shows that the presence of Cypermethrin in freshwater bodies, even at

low concentrations, can have negative effects on fish physiology and may jeopardise their capacity to survive in the wild. As a result, preventative steps should be made to avoid hazardous pesticides from contaminating the aquatic environment.

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