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Toxic Effects of Cypermethrin on Certain Hematological Aspects of Fresh Water Fish *Channa punctatus*

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Synthetic pyrethroids have been used extensively for more than two decades, as possible alternatives of some organophosphate, carbamate or organochlorine insecticides. Cypermethrin is one of the synthetic pyrethroid, commonly used to control insect pests and found to be more effective than organophosphates and carbamates, but synthetic pyrethroids are also reported (Bradbury *et al*, 1985) to be more toxic than organophosphates and carbamates. Although the toxic mechanism of pyrethroids is not yet fully elucidated, but it has been suggested (Clark *et al*, 1985) that they are readily absorbed by the gills of the fish even from very low concentration in water .

Cypermethrin is also regarded as hazardous, since it persists for long time in water. Ruscoe (1977) reported that rapid absorption of this insecticide from riverbanks, pond sediments and organic matter, greatly diminished its concentration in water. Shires (1983) however, reported that fish mortality may occur because of the use of cypermethrin in normal agricultural practice whereas some workers (Chauhan *et al*, 1994, Agarwal and Chaturvedi, 1995 and Nath *et al*, 1996) have reported a decrease in RBC count, haemoglobin and PCV of some fish sps after their exposure to insecticides. Present investigations have been therefore undertaken to study the effect of exposing a common fresh water fish *Channa punctatus* to various concentrations of cypermethrin for different periods.

MATERIALS AND METHODS

Channa punctatus were obtained from local water bodies and acclimatised to laboratory conditions for ten days and then divided in four experimental and one Ctrl (control) group. The experimental fishes were exposed to 0.1, 0.2, 0.35 and 0.5 ppm of cypermethrin. The fishes were reared till their death or a maximum period of 30d whichever was earlier. The fishes were sacrificed after 5, 10, 15, 20, 25 and 30d to examine the effect of cypermethrin on their haematology.

Blood was collected by cutting the caudal peduncle using heparin as anticoagulant. RBC count was determined with Neubauer's counting chamber

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using Hayem's fluid for dilution of blood. Hb percentage was estimated by cyanmethaemoglobin method. PCV and other parameters were determined by standard techniques as described by Dacie and Lewis (1969). Protein concentration was estimated according to Lowry *et al* (1951) using bovine albumin as standard.

RESULTS AND DISCUSSION

The results of the present studies are summarised in table 1-5. The RBC count decreased abruptly on d5 and declined further with the increase in concentration of cypermethrin (Table1).Significant decrease in Hb percentage (Table2), PCV (Table3) and protein concentration (Table4) was also observed with increase in concentration of cypermethrin. The average blood density however, showed little change (Table5).

The exposure to cypermethrin is reported Nath *et al* (1996) to cause enlargement of erythrocytes in *Heteropneustes fossilis*.The erythrocytes also show deformity. This may be the possible cause of decrease in Hb percentage. Nath (1996) also reported significant decrease in TEC, Hb, PCV and MCV in *Heteropneustes fossilis* after their exposure to fenvalerate, which belongs to the same pyrethroid

Table 1. Effect of cypermethrin on RBC (in millions /mm^3) of *C. punctatus*

Conc	0 DAY	05 DAYS	10 DAYS	15 DAYS	20 DAYS	25 DAYS	30 DAYS
Ctrl	2.35 ± 0.89[a]	2.33±0.88[a] **0.85**[b]	2.34±0.88 **0.42**	2.32±0.88 **1.28**	2.31±0.88 **1.70**	2.31±0.88 **1.70**	2.32±0.88 **1.28**
0.1 ppm	-	2.28±0.87 **2.14**	2.20±0.86 **5.98**	2.16±0.85 **6.90**	2.08±0.83 **9.96**	2.02±0.82 **12.55**	1.90±0.80 **18.10**
0.2 ppm	-	1.92±0.80 **17.60**	1.85±0.78 **20.94**	1.80±0.77 **22.41**	1.76±0.76 **23.81**	1.74±0.76 **24.67**	1.70±0.75 **26.72**
0.35 ppm	-	1.18±0.79 **19.31**	1.82±0.78 **22.22**	1.73±0.76 **25.43**	1.71±0.75 **25.97**	1.69±0.75 **26.84**	1.66±0.74 **28.45**

a = mean of 6 individuals ± S.E.

b =percent decrease in RBC above Ctrl

group. Some other workers (Pandey *et al* 1976, Ranganathan and Rammurthi 1978, Goel *et al* 1982) also reported the decrease in RBC count and Hb concentration in fishes after their exposure to various pesticides. These pesticides may cause macrocytic anaemia.

Table 2. Effect of cypermethrin on blood Hb (in gm/100ml) of *C.punctatus*

Conc	0 DAY	05 DAYS	10 DAYS	15 DAYS	20 DAYS	25 DAYS	30 DAYS
Ctrl	13.74 ± 2.14[a]	13.62±2.13[a] **0.87[b]**	13.87±2.15 **0.95**	13.46±2.12 **2.04**	13.40±2.11 **2.47**	13.35±2.11 **2.84**	13.57±2.13 **1.24**
0.1 ppm	-	13.28±2.10 **2.50**	12.90±2.07 **6.99**	12.64±2.05 **6.09**	11.99±2.00 **10.52**	11.22±1.93 **15.95**	9.89±1.81 **27.12**
0.2 ppm	-	10.10±1.83 **25.84**	9.44±1.77 **31.94**	9.27±1.76 **31.13**	8.70±1.70 **35.07**	8.56±1.69 **35.88**	8.38±1.67 **38.25**
0.35 ppm	-	9.96±1.82 **26.87**	9.39±1.77 **32.30**	9.04±1.73 **32.84**	8.80±1.71 **34.33**	8.56±1.69 **35.88**	8.26±1.66 **39.13**

a = mean of 6 individuals ± S.E.

b = percent decrease in Blood Hb above Ctrl.

Table 3.Effect of cypermethrin on packed cell volume (in %) of *C. punctatus*

Conc	0 DAY	05 DAYS	10 DAYS	15 DAYS	20 DAYS	25 DAYS	30 DAYS
Ctrl	39.46 ± 3.63[a]	38.79±3.56[a] **1.70[b]**	37.92±3.55 **3.90**	37.92±3.55 **3.90**	38.50±3.58 **2.43**	37.17±3.52 **5.80**	37.21±3.52 **5.70**
0.1 ppm	-	37.78±3.55 **2.60**	35.54±3.44 **6.28**	34.08±3.37 **10.00**	31.92±3.26 **17.09**	29.79±3.15 **19.85**	27.25±3.01 **26.77**
0.2 ppm	-	27.67±3.04 **28.67**	27.15±3.00 **28.40**	25.00±2.87 **33.98**	24.96±2.88 **35.17**	24.58±2.86 **33.87**	24.08±2.83 **35.29**
0.35 ppm	-	25.79±2.93 **33.51**	25.21±2.90 **33.52**	24.50±2.86 **35.30**	23.87±2.82 **38.00**	23.62±2.80 **36.45**	22.87±2.76 **38.54**

a = mean of 6 individuals ± S.E.

b = percent decrease in PCV above Ctrl.

Table 4.Effect of cypermethrin on protein conc.(in μmg/ml) of *C. punctatus*

Conc	0 DAY	05 DAYS	10 DAYS	15 DAYS	20 DAYS	25 DAYS	30 DAYS
Ctrl	104.1 ± 5.89[a]	105.8±5.94[a] **1.59[b]**	105.0±5.92 **0.80**	101.6±5.82 **2.49**	105.8±5.94 **1.59**	102.5±5.84 **1.60**	110.0±6.05 **5.67**
0.1 ppm	-	99.16±5.75 **6.30**	95.0±5.63 **9.52**	91.67±5.53 **9.83**	91.67±5.53 **3.38**	84.16±5.30 **17.89**	81.67±5.22 **25.81**
0.2 ppm	-	95.00±5.63 **10.23**	90.83±5.50 **13.49**	89.17±5.45 **12.29**	80.83±5.35 **18.90**	83.33±5.27 **18.70**	81.67±5.22 **25.81**
0.35 ppm	-	92.5±5.53 **12.59**	88.33±5.43 **15.88**	87.5±5.40 **13.94**	85.0±5.32 **19.68**	82.50±5.24 **19.51**	80.00±5.16 **27.33**

a = mean of 6 individuals ± S.E.

b = percent decrease in protein conc. above Ctrl.

Table 5. Effect of cypermethrin on blood density (in gm/ml) of *C.punctatus*

Conc	0 DAY	05 DAYS	10 DAYS	15 DAYS	20 DAYS	25 DAYS	30 DAYS
Ctrl	1.08 ± 0.60[a]	1.08±0.60[a] **0[b]**	1.08±0.60 **0**	1.08±0.60 **0**	1.08±0.60 **0**	1.08±0.60 **0**	1.08±0.60 **0**
0.1 ppm	-	1.07± 0.60 **0.92**	1.07±0.60 **0.92**	1.07±0.60 **0.92**	1.03±0.59 **4.63**	1.03±0.59 **4.63**	1.03±0.59 **4.63**
0.2 ppm	-	1.03±0.59 **4.63**	1.03±0.59 **4.63**	1.03±0.59 **4.63**	1.03±0.59 **4.63**	1.03±0.59 **4.63**	1.03±0.59 **4.63**
0.35 ppm	-	1.03±0.59 **4.63**	1.03±0.59 **4.63**	1.03±0.59 **4.63**	1.03±0.59 **4.63**	1.03±0.59 **4.63**	1.03±0.59 **4.63**

a = mean of 6 individuals ± S.E.

b = percent decrease in Blood density above Ctrl.

Pyrethroids belong to the class of lipophilic insecticides which are very easily degraded in the natural environment, but they prove to be toxic to fish because of their poor ability to metabolise these compounds (Demoute, 1989). According to Michael (1989), pyrethroids in fishes gain access, via the gills, directly into the blood stream, persist there and cause alterations in haematology.

Hill (1989) reported that due to high lipophilicity cypermethrin becomes adsorbed on the particulate matter in natural environment which reduces the bioavailability of this compound. Some workers (Shires, 1983, Edwards *et al*, 1987) have also reported the mortality of fishes by cypermethrin in natural environment. In present investigations the mortality was observed at a concentration of 0.5 ppm, whereas lower concentrations were not fatal up to 30d. The present study also indicated a significant change in the haematology of the common fresh water fish *C. punctatus* after its exposure to cypermethrin. It may be the cause of the mortality.

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REFERENCES

Agarwal K, Chaturvedi LD (1995) Anomalies in blood corpuscles of *Heteropneustes fossilis* induced by alachlor and rogor Adv Bios 14: 73-80.

Bradbury S, Joel P, Coasts R, Mckim JM (1985) Differential toxicity and uptake of fenvalerate for mutation in Fat head middows. Environ Toxicol Chem 4: 533-542.

Chauhan RRS, Saxena KK, Kumar S (1994) Rogor induced haematological alterations in *Cyprinus carpio* Adv Bios 13: 57-62.

Clark JR, James M, Patrick J, Douglas PM , James CM (1985) Relative Sensitivity of six estuarine fishes to carbophenothion, chloropyrifos and fenvalerate. Ecotoxicol Environ Saf 10 :382-390.

Dacie JV, Lewis SM (1977) Practical haematology Churchill G. Livingston London (1977).

Demaute JP (1989) A Brief review of the environmental fate and metabolism of pyrethroids. Pestic Sci 27 :375-385.

Edwards R, Millburn P, Hutson DH (1987) Factors influencing the selective toxicity of cis-and trans-Cypermethrin in Rainbow trout, Frog, Mouse and Quail. Biotransformation in Liver, Plasma Brain and Intestine. Pestic Sci 21:1-21.

Goel KA , Tyagi SK, Awasthi AK (1982) Effect of malathion on some Haematological values in *Heteropneustes fossilis*. Comp Physiol Ecol 7 :259-261.

Hill IR (1989) Aquatic organisms and Pyretroids. Pestic Sci 27: 429-465.

Lowry O, Rosebrough N, Farr A, Randall R (1951) Protein measurement with Folin phenol reagent.J Biol Chem 93: 265-275.

Michael E (1989) The pyrethroids, Early discovery, Recent Advances and the future Pestic Sci 27: 337-351.

Nath R (1996) Effect of Fenvalerate on blood parameters of fish *Heteropneustes fossilis* (bloch.) Environ Ecol 14 : 710-712.

Nath R, Banerjee V, Nath R (1996) Effect of Pesticides, methyle parathion and cypermethrin on the air breathing fish *Heteropneustes fossilis.* Environ Ecol 14 : 163-165.

Pandey BN, Chanchal AK, Singh MP (1976) Effect of malathion on oxygen consumption and blood of *Channa punctatus.* Indian J Zoo 16: 95-102.

Ranganathan P, Rammurthi R (1979) Haematological studies in saretherodon *(Tilapia mossambica peters)* exposed to lethal (LC_{50}) 48h. Concentration of sumithion and sevin. Cur Sci 48 :877-879.

Ruscoe CNE (1977) The New NRDC Pyrethroids as agricultural insecticides. Pestic Sci 8: 236-242.

Shires WS (1983) The use of small enclosures to assess the toxic effect of cypermethrin on fish under field condition. Pestic Sci 14: 475-480.