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Effect of Cypermethrin on certain blood parameters of *Catla catla* exposed chronically

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Abstract : *Alterations in blood serum parameters like enzymes, organic and inorganic constituents of Indian major carp, Catla catla after exposure to the sublethal concentration (1/10th of 96hrs TLM) of cypermethrin, i.e., 0.00068 mg/l for 15 and 30 days time intervals have been studied. The 96hrs TLM value of cypermethrin for test fish was found to be 0.0068 mg/l. The activity of all the enzymes studied was found to be elevated significantly after both the time intervals. Change in serum organic constituents like blood urea and blood glucose show significant increase while total protein shows marked decrease. Inorganic constituents show high elevation due to the exposure.*

Key Words: *Catla catla*, Cypermethrin, Blood enzymes, Organic constituents, Inorganic constituents

Introduction

Cypermethrin is a highly active synthetic pyrethroid insecticide, effective against pests of fruit and vegetable crops and represent about 30% of world insecticide consumption. These pesticides from the place of their application enter into the aquatic environment through a variety of ways such as run off from the agricultural fields, effluents released from factories, domestic wastes and also from sewage discharge. Their mean life in water is two weeks but they get rapidly absorbed by aquatic organisms with a significant toxicity (Phillip and Rajasree, 1996).

As blood is the index of state of health of an animal, any stress (Hickey, 1979), change due to any toxicant will show drastic changes at physiological and biochemical levels of fish. Hence, an attempt has been made to study the effect of cypermethrin on certain blood parameters as serum enzymes (SGOT, SGPT, acid phosphatase and alkaline phosphatase), organic constituents (blood sugar, blood urea and blood total protein) and inorganic constituents (sodium ions and potassium ions) of blood in Indian major carp, *Catla catla* (Ham.).

Materials and Methods

The Indian major carp, *Catla catla* commonly called "Bhakur" was used as test fish for the present studies because of its major food value in Indian population. These were collected from the local fish farm.

Cypermethrin 25% E.C. a pyrethroid (Trade name Mortal) was used as test chemical. The experimental sample of the technical grade pesticide used was obtained from 'Crop Health India Ltd., Ghaziabad', (U.P.). Tap water supplied by overhead tank, of the college, was used as diluent medium and it was found fit for experimentation as per "STANDARD METHODS" (APHA, 2005).

Acclimatized fish weighing about 105±10 gm and measuring 11±2cm in size were selected for the experiments and treated with 1/10th 96 hrs TLM for carps to cypermethrin, i.e. 0.00068 mg/l for 15 and 30 days. The 96hr TLM value of cypermethrin for test fish was found to be 0.0068 mg/l. The fish were fed with mixed diet of mustard oil cake and rice bran (1:1 ratio) on alternate days to avoid any physiochemical changes due to starvation. The experimental

solution was renewed after every 48 hrs of intervals to avoid any toxicity due to excreta. The control experiments were also run side by side without any toxicant for 15 and 30 days under similar conditions.

After definite periods of exposure blood of both control as well as treated fish was taken out following method of Steuk and Schoettger (1967) by severing the caudal peduncle and the sample was allowed to clot for 30 min. at room temperature and then centrifuged (2500 rpm for 10 min.) within 2 hrs for collecting the serum. The SGOT and SGPT in the blood serum were estimated following the method described by Reitman and Frankel (1957) while the Alkaline phosphatase and Acid phosphatase have been estimated following the methods of Kind and King (1954) and King and Jegatheesan (1959), respectively. The level of blood urea, blood sugar and total serum protein was estimated following the Diacetyl Monoxine Method (Kalpan and Teng, 1976), Orthotolidine Method (Cooper and Mc Daniel, 1970) and Biuret method (Henry and Winkelman, 1974), respectively. Two inorganic constituents sodium and potassium in blood were estimated by Weinback (1939) and Looney and Dyer method (1942), respectively. Statistical analysis of the data was done by Student's t- test (Fisher, 1978). Activity of SGOT is expressed in b mol of pyruvate/ml/h, activity of SGPT is expressed in b mol of oxalate/ml/h, activity of acid and alkaline phosphatase are expressed in U/l, level of urea and glucose are expressed in m mol/l, level of protein is expressed in g/dl and level of Na^+ and K^+ is expressed in mEq/l.

Results and Discussion

After 15 days intoxication of 0.00068 ppm concentration of cypermethrin, SGOT activity was observed to be activated (3.71%) significantly ($p<0.0001$). Furthermore, this elevation in the activity of SGOT raised (6.97%) significantly ($p<0.0001$) at the same concentration of cypermethrin after 30 days treatment to *Catla catla*. SGPT was observed to be activated (10.48% and 12.67%) significantly after 15 and 30 days exposure respectively. Highly significant ($p<0.0001$) activation (50.62% and 52.17%) was observed in acid phosphatase activity when *Catla catla* was treated with 0.00068 ppm concentration of cypermethrin for 15 and 30 days. A highly significant ($p<0.0001$) activation (22.35%) in the activity of alkaline phosphatase has been observed at 0.00068 ppm concentration of mortal for 15 days treatment to *Catla catla*, while alkaline phosphates activity has been found activated (7.68%) significantly ($p<0.01$) after 30 days treatment of cypermethrin. Change in enzymatic activities in blood after 15 and 30 days exposure have been shown in Table 1 and 2, respectively.

Table 1. Activity of blood serum enzymes in the blood of *Catla catla* in control and after 15 days treatment of Cypermethrin

Treatment	Blood serum enzymes			
	SGOT	SGPT	Acid Phosphatase	Alkaline Phosphatase
Control	43.83±0.045	77.12±0.066	3.20± 0.028	19.64± 0.048
Cypermethrin (0.00068 mg/l)	45.46±0.040	85.21±0.059	4.82± 0.031	24.03± 0.0944
% Alteration	(+3.71)***	(+10.48)***	(+50.62)***	(+22.35)***

Values are mean ± S.E. of six observations; Values in parenthesis indicate percent variation; (+) indicate percent increase. Values are significant at ***0.0001. Activity of SGOT is expressed in b mol of pyruvate/ml/h, activity of SGPT is expressed in b mol of oxalate/ml/h, activity of acid and alkaline phosphatase are expressed in U/l.

Table 2. Activity of blood serum enzymes in the blood of *Catla catla* in control and after 30 days treatment of Cypermethrin

Treatment	Blood serum enzymes			
	SGOT	SGPT	Acid Phosphatase	Alkaline Phosphatase
Control	43.84±0.045	77.19± 0.80	3.22± 0.025	19.65± 0.055
Cypermethrin (0.00068 mg/l)	46.90±0.029	86.97±0.035	4.90± 0.025	21.16± 0.055
% Alteration	(+6.97)***	(+12.67)***	(+52.17)***	(+7.68)*

Values are mean ± S.E. of six observations; Values in parenthesis indicate percent variation; (+) indicate percent increase. Values are significant at *p<0.01; ***0.0001. Activity of SGOT is expressed in b mol of pyruvate/ml/h, activity of SGPT is expressed in b mol of oxalate/ml/h, activity of acid and alkaline phosphatase are expressed in U/l.

Table 3. Level of organic constituents in the blood of *Catla catla* in control and after 15 days treatment of Cypermethrin

Treatment	Organic Constituents		
	Blood Sugar	Blood Urea	Total Serum Protein
Control	35.51±0.032	5.80±0.186	2.626±0.033
Cypermethrin (0.00068 mg/l)	48.21± 0.050	7.47±0.132	1.611±0.041
% Alteration	(+35.76)***	(+28.79)*	(-38.65)**

Values are mean ± S.E. of six observations; Values in parenthesis indicate percent variation; (+) indicate percent increase; (-) indicates percent decrease. Values are significant at *p<0.01; **p<0.001; ***0.0001. level of urea and glucose are expressed in m mol/l, level of protein is expressed in g/dl.

Table 4. Level of organic constituents in the blood of *Catla catla* in control and after 30 days treatment of Cypermethrin

Treatment	Organic Constituents		
	Blood Sugar	Blood Urea	Total Serum Protein
Control	35.52±0.028	5.84±0.198	2.260±0.031
Cypermethrin (0.00068 mg/l)	54.16±0.048	8.39±0.119	2.23±0.042
% Alteration	(+52.47)***	(+43.66)*	(-14.88)*

Values are mean ± S.E. of six observations; Values in parenthesis indicate percent variation; (+) indicate percent increase; (-) indicates percent decrease. Values are significant at *p<0.01; ***0.0001. level of urea and glucose are expressed in m mol/l, level of protein is expressed in g/dl.

The level of urea, sugar and total protein in the blood of *Catla catla* in control and after the treatment of 1/10th conc. of 96 hrs TLM of cypermethrin, (0.00068 mg/l) for 15 and 30 days have been shown in Table 3 and 4 respectively. The level of blood sugar in *Catla catla* was elevated significantly at 0.00068 ppm concentration of cypermethrin when exposed for 15 and 30 days respectively. Highly significant (p<0.0001) elevation (35.76 % and 52.47%) was observed at both the time intervals of exposure.

A maximum significant elevation (43.66%) blood urea level of *Catla catla* was observed at 0.00068 ppm concentration of cypermethrin

after 30 days intoxication followed by 15 days exposure (28.79%) which was significant at ($p<0.01$) level. A significantly lowered (38.65%) total serum protein level of *Catla catla* was observed in 0.00068 ppm concentration after 15 days intoxication of cypermethrin. However, as a result of 30 days treatment total serum protein level was found to be slight but significantly lowered (14.88%).

The level of sodium ions in blood serum of *Catla catla* was elevated (78.91% and 98.84%) after 0.00068 ppm concentration for 15 and 30 days, respectively of cypermethrin which was highly significant ($p<0.0001$).

After 15 and 30 days intoxication of 0.00068 ppm of cypermethrin, the level of serum potassium ions were found to be elevated (29.67% and 55.47%), respectively which were highly significant ($p<0.0001$).

Authors in the present investigation observed a highly significant increase in SGOT activity after the treatment. The more stimulation was observed after 30 days then 15 days interval. The activity of SGPT increased more significantly in blood serum after the treatment of both time intervals for cypermethrin. The more stimulation was observed after 30 days then 15 days interval. Similar tendency of elevation in the activity of SGOT and SGPT was observed by Verma *et al.*, (1981) and Gupta (1980).

Studying the effect on the activity of acid and alkaline phosphatase in blood serum an elevation after exposure to mortal was observed. The elevation in the activity was observed to increase in acid phosphatase and alkaline phosphatase activity due to mortal intoxication for 30 days exposure while slightly less elevation in acid phosphatase activity and still less in alkaline phosphatase activity was observed after 15 days. Present findings are in agreement with those of Lockhart *et al.*, (1975), Thomas and Murthy (1981), Dalela *et al.*, (1980), Garg *et al.*, (1991), Neskovic *et al.*, (1993) and Trivedi *et al.*, (2001).

Table 5. Level of inorganic constituents in the blood of *Catla catla* in control and after 15 days treatment of Cypermethrin

Treatment	Inorganic Constituents	
	Na^+	K^+
Control	30.31± 0.055	12.47± 0.060
Cypermethrin (0.00068 mg/l)	54.23± 0.023	16.17± 0.029
% Alteration	(+78.91)***	(+29.67)***

Values are mean ± S.E. of six observations; Values in parenthesis indicate percent variation; (+) indicate percent increase. Values are significant at ***0.0001. level of Na+ and K+ is expressed in mEq/l.

Table 6. Level of inorganic constituents in the blood of *Catla catla* in control and after 30 days treatment of Cypermethrin

Treatment	Inorganic Constituents	
	Na^+	K^+
Control	30.28± 0.062	12.51± 0.048
Cypermethrin (0.00068 mg/l)	60.21± 0.028	19.45± 0.053
% Alteration	(+98.84)***	(+55.47)***

Values are mean ± S.E. of six observations; Values in parenthesis indicate percent variation; (+) indicate percent increase. Values are significant at ***0.0001. level of Na+ and K+ is expressed in mEq/l.

Thus the constituents like blood urea and blood glucose show significant increase while total protein shows marked decrease in the present study. The elevated blood glucose level may be due to severe nephritis and hepatic disorder. Verma *et al.* (1979) reported similar results in *Saccobranchus fossilis* after chlordane intoxication. Maya (1988), Gill *et al.* (1991) and Maruthanayagam (2004) have also reported the deviation in blood glucose level of fish after the administration of different pesticides. Workers like Hart and Straw (1971), Bansal (1979) and Husain *et al.*, (1987) concluded that alterations in glucose are directly related to pesticide intoxication in fish and mammals. The elevated blood glucose level (hyperglycemia) in present study is indicative of disrupted carbohydrate metabolism which may be mainly due to the enhanced break down of liver glycogen (glycogenolysis). A significant increase in blood urea was observed on the exposure of cypermethrin in present findings which in agreement with these authors also studied the effect of two concentrations of diazinon for 15 and 30 days in *Channa punctatus* and observed that urea nitrogen increased with exposure period and concentration of the pesticide. An inormous increase of 91% in blood urea in *Clarias batrachus* exposed to alachlor was reported by Goel *et al.*, (1984). Singh and Reddy (1989), reported an elevation in blood urea of *Heteropneustes fossilis* due to starvation.

Many other investigators such as Shah and Dubale (1983), Areechon and Plumb (1990), Somnath (1991) and Durairaj and Selvarajan (1992) studied the effect of organophosphates and other toxicants on fish protein. They studied the biochemical and physiological changes in fish tissues and blood due to the organophosphates and other toxicants and concluded that the protein level was decreased in sublethal treatment at most concentrations. The decline in the quantity of protein observed in the present study may possibly be due to catabolic activity of lysosomal enzymes (acid phosphatase) and may be due to augmented proteolysis as well as the action of chemicals on nucleic acids. Authors findings were also in agreement with Bhatnagar (1999), Maruthanayagam (2004) in *Cyprinus carpio* on exposure of monocrotophos and Sweilum (2006) who also reported decreased protein level in *Nile tilapi* (Oreochromis niloticus) after the exposure of sublethal levels of some pesticides.

Inorganic constituents like sodium and potassium elevated in the blood of *Catla catla* exposed to sublethal concentrations of mortal. No satisfactory explanation for increased sodium ions can be attributed, but author is of the opinion that elevated Na^+ might be due to increased osmolarity. Grant and Mehrle (1970) observed complete failure of osmoregulatory process and high loss of Na^+ and Cl^- ions caused by high dose of endrin (430 mg/kg body weight) in gold fish. High loss of inorganic ions as observed in present study may be due to doses of Mortal which caused chronic dysfunction in osmoregularity mechanisms in Catla catla.

The potassium which is the principal ion for intracellular function and involved in the nerves and muscles functions, increased significantly with pesticide treatment in the present study. The increased level of K^+ in blood serum of *Catla catla* might be due to induced renal damage as a result of which, the fish lose the power of actively excreting the excess amount of these ions from the serum. Kumari (1999) supported author's findings. The findings of Logaswamy *et al.* , (2007) also support the present findings.

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