Current World Environment Vol. **1**(2), 189-194 (2006)

Biochemical investigations on monocrotophos exposed fish, *Channa gachua* (Ham.)

PRAKASH CHANDER KOUL, S.A. MASTAN, S.S. MUDASER ANDRABI, JAVED AHMED GANAIE[1] and T.A. QURESHI

Fish Pathology and Toxicology Laboratory, Department of Applied Aquaculture, Barkatullah University, Bhopal - 462 026 (India)
[1]Endocrinology Unit, Department of Biosciences, Barkatullah University, Bhopal - 462 026 (India)

(Received: July 12, 2006; Accepted: September 21, 2006)

ABSTRACT

The freshwater fish, *Channa gachua* was exposed to sub-lethal concentrations of an organophosphorus pesticide, monocrotophos. The fish was exposed to acute toxicity of monocrotophos for 16, 24 and 48 hours while for chronic toxicity it was exposed for 15, 30 and 45 days. The monocrotophos was found to be toxic to the fish, which was found to be increasing with the increase of its concentration. Alterations in various biochemical parameters of fish were observed. The exposure of 0.072 ppm concentration of monocrotophos led to the addition in cholesterol, alkaline phosphatase in plasma, triglyceride in plasma, serum bilirubin, serum creatinine, SGPT and SGOT while reduction in plasma glucose, total protein and lipid peroxidation.

Key words: Biochemical parameters, Monocrotophos, *Channa gachua*.

INTRODUCTION

Monocrotophos is a broadspectrum organophosphorus insecticide used against a wide range of insect pests of a variety of crops. It is one of the highly toxic agricultural chemicals with wide variation in toxicity between different species of fishes (Janardhan *et al*., 1986). The widespread use of monocrotophos results in extensive aquatic contamination by its application intentionally for control of insects and unintentionally by drift of aerial spray, watershed drainage or accidental spillage. Although, monocrotophos is being used extensively in India, studies on its toxicity to aquatic life are relatively rare. Biochemical heterogenicity of different organs are well established in different species of fishes, but the investigation on the sub-lethal effect of organo-phosphates on various biochemical parameters are not sufficiently studied. Therefore, in the present study efforts has been made to investigate the impact of monocrotophos on various biochemical parameters of *C. gachua.*

MATERIALS AND METHODS

Procurement of test animals

For the purpose of present study, healthy, disease free and active, Channa gachua (length 12-18 cm and weight 15-20 gm) were collected from the local fish market, Bhopal and brought to the laboratory. Fishes were maintained in static, aerated 50L aquarium containing filtered tap water and fed with chopped meat @ 5% body weight per day.

Source of pesticide and its exposure

Monocrotophos 36% (AIMOCRON 36 SL) was obtained from the local market, Bhopal. Renewal toxic test method (APHA, 1992) was used to find out the LC_{50} concentration. Fishes were exposed to different sub-lethal concentrations for 16, 24 and 48 hours in acute studies and 15, 30 and 45 days in chronic studies. Control fish were maintained under identical conditions without the pesticide in the medium.

Collection of blood

After each exposure period, the blood was drawn from the dorsal aorta into plastic vials containing 0.1 ml of EDTA for biochemical tests. Then, the blood was gently mixed with the oxalate mixture to avoid coagulation. The biochemical tests were performed by using the kit procured from Merck.

Statistical analysis

The obtained data were subjected to students "t" test to find out the significance of the difference between control and treated values.

RESULTS

In the present study, attempts have been made to investigate the effect of sub-lethal concentrations of monocrotophos on various biochemical parameters. The exposure of 0.072 ppm concentration of monocrotophos led to the addition in cholesterol, alkaline phosphatase in plasma, triglyceride in plasma, serum bilirubin, serum creatinine, SGPT and SGOT while reduction in plasma glucose, total protein and lipid peroxidation in both acute and chronic studies.

Acute studies

In 16 hr exposed fishes, the recorded values of plasma glucose, cholesterol, alkaline phosphatase in plasma, triglyceride in plasma, total protein, serum bilirubin, serum creatinine, SGPT, SGOT and lipid peroxidation were 64.738 ± 0.570 mg/dl, 157.5 ± 0.957 mg/dl, 143.833 ± 1.343 mg/dl, 299.833 ± 1.343 mg/dl, 4.417 ± 0.177 mg/dl, 2.777 ± 0.087 mg/dl, 1.338 ± 0.024 mg/dl, 88.25 ± 0.987 u/l, 527.667 ± 1.105 u/l, and 0.717 ± 0.014 mg/dl, respectively. (Table - 1). In case of 24 hr exposed fishes, the recorded values of plasma glucose, *Cholesterol¸* alkaline phosphatase in plasma, *triglyceride* in plasma, total protein, serum bilirubin, serum creatinine, SGPT, SGOT and lipid peroxidation were 58.376 ± 0.839 mg/dl, 167.167 ± 1.343mg/dl, 146.833 ± 1.343 mg/dl, 279.333 ± 2.285 mg/dl, 4.80 ± 0.081 mg/dl, 2.645 ± 0.106 mg/dl, 1.80 ± 0.012 mg/dl, 90.017 ± 1.558 u/l, 624.5 ± 1.707 u/l, and 0.615 ± 0.0095 mg/dl, respectively (Table -1).

In case of 48 hr exposed fishes, the recorded values of plasma glucose, cholesterol, alkaline phosphatase in plasma, triglyceride in plasma, total protein, serum bilirubin, serum creatinine, SGPT, SGOT and lipid peroxidation were 46.201 ± 1.109 mg/dl, 172.00 ± 1.29 mg/dl, 161.33 ± 1.374 mg/dl, 260.5 ± 1.707 mg/dl, 4.717 ± 0.106 mg/dl, 1.855 ± 0.017 mg/dl, 2.05 ± 0.170 mg/dl, 94.175 ± 1.28 u/l, 681.833 ± 1.343 u/l, and 0.513 ± 0.0137 mg/dl, respectively (Table -1).

Chronic studies

In 15 days exposed fishes, the recorded values of plasma glucose, cholesterol, alkaline phosphatase in plasma, triglyceride in plasma, total protein, serum bilirubin, serum creatinine, SGPT, SGOT and lipid peroxidation were 52.286 ± 1.374 mg/dl, 161.5 ± 0.957 mg/dl, 146.65 ± 0.150 mg/dl, 230.0 ± 1.29 mg/dl, 4.733 ± 0.110 mg/dl, 1.307 ± 0.098 mg/dl, 1.117 ± 0.1067 mg/dl, 79.5 ± 1.707 u/l, 609.667 ± 1.4907 u/l, and 0.595 ± 0.017 mg/dl, respectively (Table - 2). In case of 30 days exposed fishes, the recorded values of plasma glucose, cholesterol, alkaline phosphatase in plasma, triglyceride in plasma, total protein, serum bilirubin, serum creatinine, SGPT, SGOT and lipid peroxidation were 48.576 ± 0.956 mg/dl, 178.517 ± 0.106 mg/dl, 158.567 ± 0.110 mg/dl, 241.33 ± 1.105 mg/dl, 4.60 ± 0.129 mg/dl, 1.503 ± 0.105 mg/dl, 1.15 ± 0.095 mg/dl, 91.167 ± 1.067 u/l, 652.0 ± 1.2909 u/l, and 0.590 ± 0.0129 mg/dl, respectively (Table - 2).

In case of 45 days exposed fishes, the recorded values of plasma glucose, cholesterol, alkaline phosphatase in plasma, triglyceride in plasma, total protein, serum bilirubin, serum creatinine, SGPT, SGOT and lipid peroxidation were 41.493± 0.936 mg/dl, 192.517 ± 0.134 mg/dl, 167.567 ± 0.110 mg/dl, 247.0 ± 1.29 mg/dl, 4.40 ± 0.163 mg/dl, 2.022 ± 0.163 mg/dl, 1.467 ± 0.2808 mg/dl, 110.5 ± 1.707 u/l, 682.833 ± 1.343 u/l, and 0.565 ± 0.1095 mg/dl, respectively (Table - 2). It is evident from the results that the sub-lethal concentration of monocrotophos have influence on various biochemical parameters in exposed fishes.

DISCUSSION

A sizeable amount of organophosphates have been used to boost agricultural yield. The run-off's from treated lands are known to interfere with

Table - 1: Sub-lethal effect of Monocrotophos on certain biochemical parameters of *Channa gachua* (Ham.) Acute studies (0.072 ppm/L)

S. No.	Parameters	Treated fishes	Tested fishes	After 16 hrs.	After 24 hrs.	After 48 hrs.	Control
1.	Plasma Glucose (mg/dl)	25	6	64.738 ± 0.570	58.376 ± 0.839	46.201 ± 1.109	71.601 ± 0.958
2.	Cholesterol (mg/dl)	25	6	157.5 ± 0.957	167.167 ± 1.343	172.00 ± 1.29	125.6 ± 0.129
3.	Alkaline phosphatase in plasma (mg/dl)	25	6	143.833 ± 1.343	146.833 ± 1.343	161.33 ± 1.374	130.798± 0.0106
4.	Triglyceride in plasma (mg/dl)	25	6	299.833 ± 1.343	279.333 ± 2.285	260.5 ± 1.707	119.5 ± 0.957
5.	Total protein (mg/dl)	25	6	4.417 ± 0.177	4.80 ± 0.081	4.717 ± 0.106	5.783 ± 0.106
6.	Serum Bilirubin (mg/dl)	25	6	2.777 ± 0.087	2.645 ± 0.106	1.855 ± 0.017	0.913 ± 0.011
7.	Serum Creatinine(mg/dl)	25	6	1.338 ± 0.024	1.80 ± 0.012	2.05 ± 0.170	0.817 ± 0.014
8.	SGPT (u/l)	25	6	88.25 ± 0.987	90.017 ± 1.558	94.175 ± 1.28	36.650 ± 2.125
9.	SGOT (u/l)	25	6	527.667 ± 1.105	624.5 ± 1.707	681.833 ± 1.343	480.667 ± 1.972
10.	Lipid Peroxidation mg/dl	25	6	0.717 ± 0.014	0.615 ± 0.0095	0.513 ± 0.0137	0.935 ± 0.017

Values expressed in Mean ± S.D. of 6 replicates. Student 't' test was performed between control and treated values.
The mean values are found to be significantly different at 1% level of significance. ($P < 0.01$).

Table - 2: Sub-lethal effect of Monocrotophos on certain biochemical parameters of *Channa gachua* (Ham.) Chronic studies (0.072 ppm/L)

S. No.	Parameters	Treated fishes	Tested fishes	After 16 hrs.	After 24 hrs.	After 48 hrs.	Control
1.	Plasma Glucose (mg/dl)	25	6	52.286 ± 1.374	48.576 ± 0.956	41.493 ± 0.936	72.451 ± 0.867
2.	Cholesterol (mg/dl)	25	6	161.5 ± 0.957	178.517 ± 0.106	192.517 ± 0.134	125.483 ± 0.106
3.	Alkaline phosphatase in plasma (mg/dl)	25	6	146.65 ± 0.150	158.567 ± 0.110	167.567 ± 0.110	132.1± 0.081
4.	Triglyceride in plasma (mg/dl)	25	6	230.0 ± 1.29	241.33 ± 1.105	247.0 ± 1.29	121.833 ± 1.067
5.	Total protein (mg/dl)	25	6	4.733 ± 0.110	4.60 ± 0.129	4.40 ± 0.163	5.133 ± 0.1105
6.	Serum Bilirubin(mg/dl)	25	6	1.307 ± 0.098	1.503 ± 0.105	2.022 ± 0.163	0.760 ± 0.096
7.	Serum Creatinine(mg/dl)	25	6	1.117 ± 0.1067	1.15 ± 0.095	1.467 ± 0.2808	0.718 ± 0.1304
8.	SGPT (u/l)	25	6	79.5 ± 1.707	91.167± 1.067	110.5 ± 1.707	35.0 ± 1.2909
9.	SGOT (u/l)	25	6	609.667 ±1.4907	652.0 ± 1.2909	682.833 ± 1.343	460.5 ± 1.707
10.	Lipid peroxidation(mg/dl)	25	6	0.595 ± 0.017	0.590 ± 0.0129	0.565 ± 0.1095	0.70 ± 0.0129

Values expressed in Mean ± S.D. of 6 replicates. Student 't' test was performed between control and treated values.
The mean values are found to be significantly different at 1% level of significance. ($P < 0.01$).

nutrio-economically important animal and growth in water bodies by altering and disrupting the different physiological processes.

Organophosphorus pesticides are generally much more acute toxic to vertebrates and other aquatic animals. Pesticides containing chlorinated hydrocarbons persist in the environment and are known to have drifted over thousands of kilometers in the water from Antarctic snow. Traces of chlorinated hydrocarbon pesticides in water may be accumulated in fishes up to the levels of more than 10,000 times, the concentration present in the surrounding water. Several pesticides including some, those were washed extensively in agriculture in the past and some, those are still used for the purpose of disease control, have been shown to produce tumors in animals.

Gopal *et al.,* (1980) studied endosulphan induced hyperglycemia in the catfish, *Clarias batrachus.* Mukhopadhyay and Dahadrai (1980) observed a marked decline in liver glycogen and protein contents in the catfish with sublethal concentration of malathion. Sastry and Sharma (1981), and Singh and Shrivastava (1981) studied variations in various carbohydrate metabolites in *Ophiocephalus punctatus* and *Heteropneustes fossilis* treated to toxicants and a mixture of aldrin and formathion, respectively. Carbofuran induced alterations in the activities of alkaline and acid phosphatases. GOT and GPT have been studied in the air-breathing catfish, *Clarias batrachus* (Mukhopadhyay *et al.,*1982). Murthy and Devi (1982) reported decreased level of protein, glycogen and lipid concentration in liver, and increased level in brain of *Channa punctatus* treated with endosulphan. Hyperglycemia, hepatic and muscle glycogenolysis, hyperlactemia and enhanced pyruvate concentrations have been reported in *Channa punctatus* exposed to sevin (Sastry and Siddiqui, 1982). Mishra and Shrivastava (1983) have noticed hyperglycemia and muscle glycogenolysis in *H. fossilis* treated to malathion.

Sastry and Siddiqui (1984) found alterations in levels of plasma protein, glucose, glycogen and lactate concentrations in *Channa punctatus* exposed to sublethal concentration of quinolphos. Gluth and Hanke (1985) observed a consistent decrease in protein and cholesterol contents in *Cyprinus carpio* induced by sublethal concentrations of several pollutants. Ram and Sathyanesan (1987) studied the effect of cythion on the protein level in brain, liver and ovary of *Channa punctatus.* Joshi and Desai (1988) noticed biochemical changes in the liver of *Tilapia mossambica* during continuous exposure to monocrotophos. Alterations in blood glucose values have been reported in *H. fossilis* exposed to sublethal concentration of chlordane for 15,30, 50 and 70 days (Shrivastava and Shrivastava, 1988). Sub lethal concentrations of nuvan exhibited marked changes in the values of protein, carbohydrate and lipid reserves in blood, brain, liver, kidney, testis and ovaries of *Channa punctatus* (Ghosh and Chatterjee, 1989). Rani *et al.,* (1989) noticed a significant decrease in the activities of lactate dehydrogenase and increase in glucose and lactate levels in *Clarias batrachus* exposed to trichlorfom and methyl parathion.

Sastry and Dasgupta (1991) and Yasmeen *et al.,* (1991) noticed significant alterations in blood glucose, lactic acid and protein in *Clarias batrachus, Anguilla anguilla* and *Channa punctatus* acutely or chronically exposed to aldrin, lindane and nuvacron. Baigh *et al.,* (1991) noticed heptachlor induced changes in protein, glycogen and lactic acid contents in functionally different muscles of *Channa punctatus*. Singh and Shrivastava (1993) have noticed hyperglycemia in *H. fossilis* treated with sub-lethal concentrations of organochlorine and organophosphate insecticides.

Conclusions

In the present study, it has been observed that the exposure of monocrotophos led to the decrease in the level of plasma glucose, total protein, and lipid peroxidation, while significant increase was observed in the levels of cholesterol, alkaline phosphatase in plasma, triglyceride in plasma, serum bilirubin, serum creatinine, SGPT and SGOT. Similar results were also noticed by Murthy and Devi (1982), Borah and Yadav (1995), Katty and Sathyanesan (1984), Ram and Sathyanesan (1984), Dalela *et al.,* (1978), Shweta Agrahari (2004), Santhakumar and Balagi (2000), Singh *et al.,* (2003), Tilak *et al.,* (2003) and Sharad Srivastava (2005).

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