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Original Research Paper

Toxicity of Increasing Concentration of an Organophosphorus Pesticide on Blood Chemistry of Indian Catfish *Clarias batrachus*

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ABSTRACT

Pesticides are much overused in the environment despite the fact that they are toxic and hazardous to our health and environment. Enough studies have been done to prove that the use of pesticides is futile and probably does more harm than good in the long run. To know the impact of pesticides in the present investigation, male and female *Clarias batrachus* fish, which are air breathing in nature, were exposed to different test concentrations (2 ppm, 4 ppm, 6 ppm, 8 ppm) of an organophosphorus pesticide, parathion. Increase in the level of blood urea whereas gradual fall in the plasma protein were observed in all the test concentrations of parathion. Parathion toxicity showed an increase in the level of blood glucose upto 6 ppm and thereafter significant fall in its level at 8 ppm. There was a significant rise of blood cholesterol level in initial dose of the pesticide and significant fall in 6 ppm and 8 ppm. Gradual fall in the protein level and increased values of urea might be due to hyperactivity of adrenocorticoides and impaired functions of the kidney of the fish respectively. The rise in the level of blood glucose from control condition upto 6 ppm might be due to secretion of glucagon hormone under stress condition. A significant fall in the blood glucose level at 8 ppm might be attributed to the utilization of glucose by the tissues of extremely active fish at higher dose of the pesticide. A significant rise in the serum cholesterol at lower concentration of parathion is attributed to the stimulation of adrenal gland whereas at higher level, the rise in the blood cholesterol value might be due to increased breakdown of fats into cholesterol and free fatty acids in the fish.

INTRODUCTION

Agrochemicals such as pesticides are routinely employed in the farming practice to protect crops and animals from insects, weeds and diseases. Widespread use of pesticides in agriculture is now a worldwide phenomenon (Saeed et al. 2005, Omitoyin et al. 2006). Natural water conditions are necessary for proper fish culture. But now-a-days several types of pesticides such as organochlorine, organophosphate, carbamates and pyrethroids are used in agriculture and other purposes, which cause pollution in aquatic bodies. Pesticides, once used indiscriminately, alter physico-chemical properties of water and make the aquatic animals such as fish life difficult. Changes in environment and its composition compel the organisms to alter the body physiology in order to cope up with this novel threat. Alteration in the chemical composition of the natural aquatic environment usually affects the behavioural and physiological systems of the inhabitants, particularly those of fishes (Radhaiah et al. 1987, Khan & Law 2005).

Ideally, a pesticide must be lethal to the target pests, but not to non-target species including man. Unfortunately, there is not much controversy of use and abuse of pesticides has surfaced (ICMR 2001). Pesticides interfere and interact with various physiological and biochemical activities of fish dwelling in aquatic environment. *Clarias batrachus*, an Indian air breathing fish, is a usual inhabitant of paddy fields and the waterlogged areas and ditches in the vicinity of paddy fields. In paddy fields, parathion, an organophosphorus insecticide is usually sprayed for the better yields of paddy. The direct spray of parathion on paddy plants or its drainage from such places to ponds and ditches may affect the body metabolism of the fish.

In recent years toxicologists paid much attention to the impact of water pollution on blood biochemistry of several fish species (Natrajan 1982, Gill & Khanna 1975, Eddy & Maloiy 1983, Larson et al. 1984, Thakur 1992, Thakur 1986, Kumari et al. 2006, Tilak et al. 2007, Paul et al. 2007). However, reports available on the effect of parathion toxicity on blood biochemistry of *Clarias batrachus* are meagre. Considering these facts, present investigation was undertaken to analyse the impact of parathion on blood biochemistry of the fish *Clarias batrachus*.

MATERIALS AND METHODS

A common Indian catfish *Clarias batrachus* was used as the experimental animal. Fish of both sexes, male and female, having nearly equal weight and length ranging between 90 and 100 g were collected from local ponds, paddy fields and also from local market for biochemical analysis. Ten fish in different groups were selected sexwise, kept in the laboratory conditions giving proper food for fortnight and then were used. Four groups of the fish of both the sexes were treated with four increasing concentrations of parathion i.e., 2 ppm, 4 ppm, 6 ppm and 8 ppm for 96 hrs. Separate groups of both the sexes were taken as control. Blood from the fish was taken from heart puncture directly.

Blood glucose was estimated by the modified Schaffer Hartman titrimetric technique of King et al. (Varley 1975). Estimation of total blood cholesterol was made by Sackett's method (Varley 1975). Blood urea was estimated by diacetyl monoxime method (Varley 1975). Estimation of plasma protein was made by Kjeldahl method (Varley 1975). The obtained data of each parameter were calculated statistically with appropriate formulas (Mahajan 1999).

RESULTS

Blood glucose, cholesterol, urea and plasma protein values of control, and 2 ppm, 4 ppm, 6 ppm and 8 ppm parathion toxicated male and female fish are presented in Table 1 and shown Figs. 1 to 4.

Blood glucose: The range of blood glucose in control group of male fish was between 68.05 mg/100 mL and 74.08 mg/100 mL whereas the mean value was 71.693 ± 0.659 mg/100 mL of blood. In control group of female fish, range was found between 65.56 and 76.55 mg/100 mL of blood having a mean value of 71.499 ± 1.230 mg/100 mL. The mean value of blood glucose in 2 ppm, 4 ppm, 6 ppm and 8 ppm parathion toxicated male and female fish showed increasing trend upto 6 ppm of parathion and after that there was declining trend (Table 1, Fig. 1).

Blood cholesterol: The range of blood cholesterol value in control group of male fish was found to range from 330.62 mg/100 mL to 352.50 mg/100 mL, whereas it ranged in female fish from 312.05 mg/100 mL to 317.93 mg/100 mL blood. The mean value of control group of male and female fish was 345.780 ± 2.045 and 315.080 ± 0.544 mg/100 mL blood respectively. The average value of blood cholesterol after parathion toxicity increased upto 4 ppm and after that its value decreased in 6 ppm and 8 ppm respectively (Table 1, Fig. 2).

Blood urea: Blood urea level in control group of male and female fish was 65.94 ± 0.918 mg/100mL and 59.767 ± 1.033 mg/100 mL respectively. The range of control values of blood cholesterol was noticed between 61.62 and 71.34 mg/100 mL in male fish and between 56.40 mg/100 mL and 65.87 mg/100 mL in female fish. An increasing trend in mean value of blood urea in 2 ppm, 4 ppm, 6 ppm and 8 ppm of parathion intoxicated male and female groups of *Clarias batrachus* was observed (Table 1, Fig. 3).

Plasma protein: The range of plasma protein in control group of male fish was found to be 921.321 mg/100 mL to 990.125 mg/100 mL. The mean value was obtained 948.958 ± 6.498 mg/mL. In control group of female fish, the minimum and maximum value was 866.634 mg/100 mL and 898.637 mg/100 mL respectively. A decreasing trend was found in the mean values of plasma protein in increasing concentrations i.e., 2 ppm, 4 ppm, 6 ppm and 8 ppm parathion treated male and female fish (Table 1, Fig. 4).

DISCUSSION

In the present investigation, the significant rise in the level of blood glucose from control condition to each of the suc-

Table 1: Effect of parathion toxicity on blood parameters of *Clarias batrachus.*

Fishes	Control	Parathion concentrations (in ppm)			
		2.0	4.0	6.0	8.0
Blood Glucose (mg/100 mL of blood)					
Male	71.699 ± 0.659	85.302 ± 1.075	105.812 ± 0.870	134.341 ± 2.061	67.667 ± 1.376
Female	71.499 ± 1.230	83.729 ± 1.238	103.602 ± 1.869	134.879 ± 3.029	66.618 ± 1.416
Blood Cholesterol (mg/100 mL of blood)					
Male	345.780 ± 2.045	408.629 ± 2.860	478.252 ± 3.716	324.974 ± 2.439	249.044 ± 9.973
Female	315.080 ± 0.544	374.909 ± 2.486	441.714 ± 3.845	289.023 ± 1.299	205.091 ± 1.414
Blood Urea (mg/100 mL of blood)					
Male	65.94 ± 0.918	208.039 ± 2.987	238.849 ± 3.452	404.881 ± 12.979	406.115 ± 3.342
Female	59.767 ± 1.033	207.256 ± 3.572	240.477 ± 3.742	363.066 ± 9.648	413.578 ± 2.354
Plasma Protein (mg/100 mL of blood)					
Male	948.958 ± 6.498	893.794 ± 6.099	771.500 ± 10.946	587.577 ± 8.978	362.358 ± 13.232
Female	882.321 ± 3.819	826.074 ± 4.685	703.261 ± 0.640	520.147 ± 4.051	303.896 ± 12.009

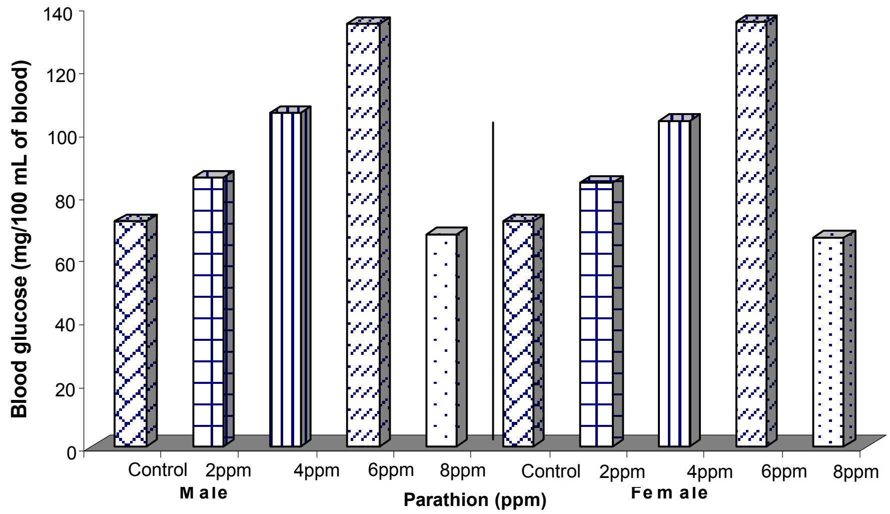

Fig.1: Effect of parathion toxicity on blood glucose of *Clarias batrachus.*

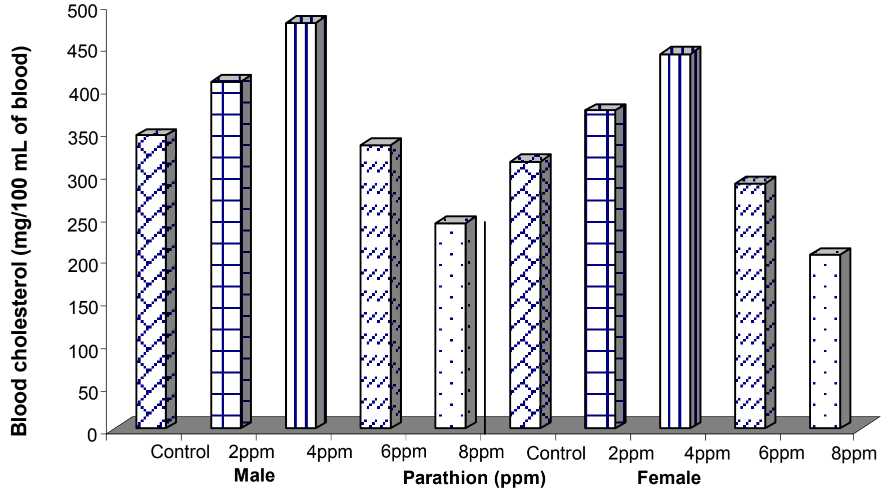

Fig.2: Effect of parathion toxicity on blood cholesterol of *Clarias batrachus.*

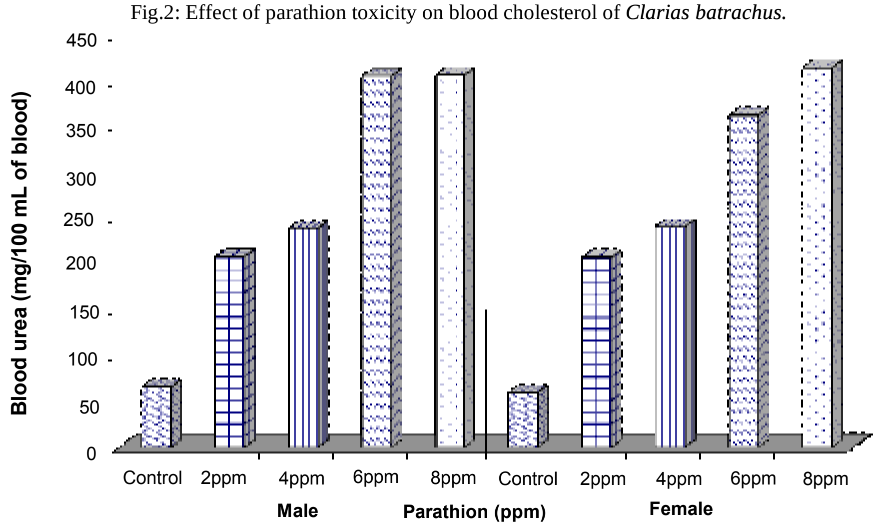

Fig.3: Effect of parathion toxicity on blood urea of *Clarias batrachus.*

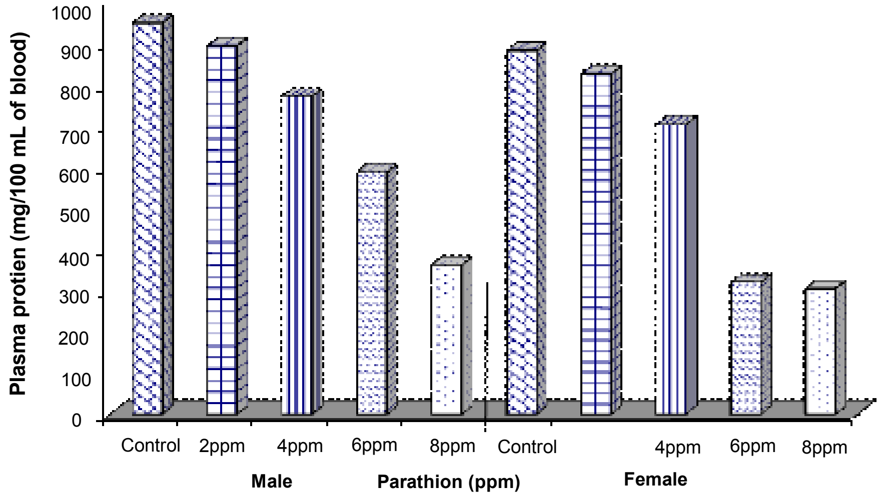

Fig.4: Effect of parathion toxicity on plasma protein of *Clarias batrachus.*

ceeding concentrations of parathion upto 6 ppm might be due to destruction of beta cells of islet of Langerhans and increase in glucagon secretion after the administration of parathion. Elevation in the level of blood glucose might be due to lytic action of glucagon upon liver glycogen with consequent enhanced glycogenolysis and the resultant hyperglycemia (Gill & Khanna 1975, Srivastava & Singh 1981). Further, it might be also because of glycogenolysis in muscle caused by stress induced increased in circulatory catecholamines (Srivastava & Singh 1981). Organophosphorus chemicals have been reported to act as adrenal, pituitary glucocorticoid stressors in fishes (Krishna et al. 1980). The other possible reason behind hyperglycemia might be due to this sort of chemical stress, which enhances epinephrine production from the adrenal gland, that influences glycogenolysis (Harper 1969).

However, a significant fall in the blood glucose level at 8 ppm might be attributed to the utilization of glucose by the tissue of extremely active fish during treated period or to the enhanced production of insulin by beta cells of the islets of Langerhans or of somatostatin by D cells of the pancreatic islet of Langerhans which has an inhibitory action on glycogen (Gorbman et al. 1983).

A good number of references are available regarding increase in the level of blood cholesterol on the administration of different pesticides on different species of fishes (Chitra & Rao 1980, Goel & Garg 1980, Bano 1981, Kondal et al. 1990). Akela et al. (1991) reported a significant rise in the level of serum cholesterol in *Clarias batrachus* exposed to aldrin toxicity. They further recorded significant fall in its level at higher concentration of aldrin. In the present investigation, a significant rise in the blood cholesterol upto 4 ppm concentration of parathion in both the sexes of *Clarias batrachus* might be attributed to the stimulation of adrenal gland due to parathion toxicity. The continuous increase in the concentration of parathion caused severe damage to the liver tissues, which is the active site of lipid storage and synthesis. An increase in the serum cholesterol level might be due to transfer of cholesterol from the liver to the blood and from other organs. Elevated cholesterol associated with impaired hepatic function has been reported by Eisler (1972).

However, a decreased level of cholesterol in the present study beyond 4 ppm concentration might be due to increased breakdown of cholesterol into free fatty acid as observed by Verma et al. (1979). The significant fall in the level of cholesterol at the 6 ppm and 8 ppm parathion concentrations might be due to the tendency of the fish towards acclimation of that concentration (Akela et al. 1991).

In the present investigation, the continuous increase in the level of blood urea due to increasing concentrations of parathion is due to increase in the activity of arginase enzyme in liver which in turn is responsible for the increased synthesis of urea in liver tissue. The other possible reason behind the elevation in its level might be because of necrosis. During necrosis the damage of hepatic cells might have produced various nitrogenous products like ammonia, which might have helped urea synthesis. Neeraja (1983) recorded increased urea synthesis in frog on the effect of induced ammonia toxicity. It is assumed that the protective treatments lowered the free blood ammonia level and increased the amount of plasma urea.

It is also possible that parathion toxicity caused drastic hydrolysis of protein, finally forming amino acids. The amino acids on deamination might have produced ammonia. The ammonia helps in the process of ureogenesis, leading to increased blood urea level. Kumar (1989) reported increased in the blood urea level mainly because of impaired functions of kidney.

In the present study, parathion toxicity caused a gradual and significant fall in the level of plasma protein at each of the succeeding concentration of parathion. Various similar reports are available on the effect of different sorts of insecticides, pesticides and other noxious substances on plasma protein level of different fish specimens (Salma & Qayyum 1978, Goel & Garg 1980, Dalela et al. 1981, Bano 1981). Fall in the level of plasma protein due to administration of parathion is because of adrenocorticoid hyperactivity (Dalela et al. 1981) that caused increased protein catabolism leading to gluconeogenesis. The breakdown of protein into glucose as a result of gluconeogenesis was evident from the finding of the rise in the blood glucose level upto 6ppm parathion concentration.

The active movement of the fish due to administration of parathion toxicity might have demanded continual supply of glucose as a source of energy to the nervous system and skeletal muscles (Yadav 1987) and that demand might have fulfilled by the breakdown of protein into glucose through gluconeogenesis (Akela 1991). It is further suggested that decrease in plasma protein level might be due to excretion of proteins by kidney, resulting from kidney disorders (albuminurea) or impaired protein synthesis due to liver disorders (Dalela et al. 1981).

Thus, parathion toxicity was found to be highly unfavourable for different biochemical parameter adopted in the present study. However, the low concentration of parathion may not be considered so toxic to the aquatic animals, particularly to fish, but the high concentration of this insecticide or its indiscriminate use proved to be dangerous, even lethal to the fish regarding its biochemical parameters.

So continuous use of unsafe dose of agrochemicals for more production of crops must be discouraged not only among farmers but also among common people. Due to surface runoff, these chemicals reach to natural habitats of fishes that ultimately affect the fisheries. There is also possibility of bioaccumulation and biomagnification of pesticides through food chain, which may harm the human beings. Moreover, the population level of common air breathing fishes of India is decreasing day to day. We must think about the nurture the nature for our better future.

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