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IMPACT OF MONOCROTOPHOS PESTICIDE ON SERUM BIOCHEMICAL PROFILE IN FRESHWATER FISH, *CIRRHINUS MRIGALA* (HAMILTON, 1822)

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Abstract: The present exploration was designed to study the effect of sublethal concentrations of monocrotophos on the serum biochemical parameters of *Cirrhinus mrigala* after exposure to 96 hours. The result of study shows that serum biomolecules such as glucose, protein, triglyceride, cholesterol, urea, bilirubin, SGOT and SGPT were significantly altered in monocrotophos exposed fish. The response of the fish towards toxicity of monocrotophos was grossly dependent on the duration of exposure. Thus, this paper gives an overview of the manipulation of fish, *Cirrhinus mrigala* as a biomarker of pesticides through alternation in behavior and biochemical parameters.

Keywords: *Cirrhinus mrigala*, Monocrotophos, Serum biomolecules, Pesticides.

INTRODUCTION

The most important source of water pollution is household, agricultural and industrial effluents which are discharged into ordinary water body. Synthetic chemical pesticides are generally used in contemporary agriculture to aid in the manufacture of high quality food. It acts as biological toxicants and used by the farmers to kill the pests for increasing the yield of many crops and also kill the insect vectors to control the spread of disease. The synthetic pesticides are mainly of two types: Organochlorine and organophosphorus. However, a variety of pesticides such as organochlorines, organophosphates, carbamates and synthetic pyrethroids are easily available in market and now in use (Shinde, 2021).

Insecticide, monocrotophos is an organophosphate and used to control the creepy-crawly pest. Chlorpyrifos was 3.22 fold more toxic than monocrotophos. Aquatic water bodies are frequently polluted with a numerous of potentially dangerous substances. The use of pesticides has caused severe environmental and health hazards to organisms including human beings (Prakash and Verma, 2014). However, the widespread use of pesticides not only brought adverse influence on agro ecosystems but also caused alteration in the ecological balance of many non-target organisms like fishes. These pesticides through surface runoff reach into the aquatic ecosystems and become a global environmental problem. These pesticides enter the food chain and their subsequent bioaccumulation and biotransformation at different trophic levels have catastrophic effect to the ecosystem (Prakash and Verma, 2020).

Developed and developing countries which are succeeding quickly in the field of agriculture, technology and industry are incessantly release a variety of synthetic pesticides into the biosphere. In warm climate, weeds and insect pests normally proliferate and to control these weeds and pests, more and more pesticides (herbicides and insecticides) are used. Excessive use of pesticides and enhanced anthropogenic activities are responsible for harmful emissions as well as climate change (Prakash, 2021; Verma, 2021). In this manner, they are causing a brutal hazard to the environment and frequent use of these pesticides can be injurious to livelihood organisms, pets, and their surroundings (Prakash, 2020). Rhythmic experience to sub-lethal dose of some pesticides can cause physiological and behavioral, biochemical and histological changes in fish. This practice directly or indirectly reduces the fish populations, making them disease sensitive (Verma and Prakash, 2018).

Fish is one of the most important components of food for human beings, because it provides protein, lipids, vitamins, essential amino acids, fatty acids (ω3 polyunsaturated, eicosapentaenoic and docosahexaenoic fatty acids) and minerals for the growth and development of body as well as maintenance of human health by preventing several nutritional deficiency diseases. The fishes are used not only as food, medicine but also as bio-indicators, research models, and active links between ecosystems and vector borne diseases.

The natural physiological activities of the organisms get disturbed on exposure to toxicants. It induces its notorious effect first at cellular or even at molecular level, but ultimately cause physiological, pathological and biochemical alterations (Prakash and Verma, 2019). The biochemical changes occurrence in the body of the organisms give first indication of stress. Several investigators have reported the change in biochemical parameters of aquatic organisms especially in fishes on exposure to pesticides. The total carbohydrate, protein and lipid contents in blood, muscle, liver, gill and brain are altered in freshwater teleost fish after exposure to pesticides.

Chlorpyrifos, a broad spectrum organophosphorus insecticide used against pod borers, fruit borers, stem borers, leaf miners, defoliating caterpillars, sucking pests, termites etc. and in other settings to kill a number of pests, including insects and worms. It acts on the nervous systems of insects by inhibiting the acetylcholinesterase enzyme. Poisoning from chlorpyrifos may affect the central nervous system, the cardiovascular system, and the respiratory system as well as a skin and eyes of the fish (Cox, 1995).

Several studies have been conducted for assessing the toxicity of organophosphorous insecticides on different fish species (Prakash and Verma, 2014; Verma and Prakash, 2018; Kadam and Patil, 2016; Kaur and Mishra, 2019). Perusal of literature reveals paucity of information on acute toxicity of monocrotophos on Indian major carps, *Cirrhinus mrigala* which are nutritious edible and cultivable fish in the study area. In the present study, an attempt was made to examine the toxic effects of sublethal concentration of monocrotophos on the serum biomolecules of freshwater indigenous carp *Cirrhinus mrigala*.

MATERIALS AND METHODS

The healthy fingerlings of *Cirrhinus mrigala* ranging from 8.0-9.0 cm in length and 9.0-10.0 g in weight were collected from local fish forms and washed with 1% solution of $KMnO_4$ for five minute and then transferred to the plastic jar containing 50L dechlorinated tap water for acclimatization. Fishes were acclimated to laboratory conditions for 7 days at room temperature. Fishes were then exposed to sublethal concentrations (7 ppm) for the period of 24, 48, 72 and 96 hours. A control group was maintained in an identical environment. The fishes were regularly fed with commercial food and the medium was changed daily to remove feces and food remnants. Blood samples of fishes were collected from caudal vein in the glass tubes and centrifuged at 3500 rpm for 10 minutes. The serum was used to analyze the blood glucose, protein, triglycerides, cholesterol and urea by methods of Mendel *et al*. (1954), Bergmeyer (1974), Barnes and Blackstock (1973), Warnick (1991) and Pathson and Nauch (1977) respectively.

RESULTS AND DISCUSSION

The toxicants dissolved in water generally disturb the oxygen content of the aquatic ecosystem and found to interfere with aerobic oxidative process involving carbohydrate, protein and lipid metabolisms as revealed by the shift in serum glucose, protein, triglycerides and cholesterol levels (Table 1).

Serum glucose level has long been used as indicators of stress in fish. In the present study, serum glucose level in monocrotophos exposed fingerling of *Cirrhinus mrigala* increased significantly from their respective control groups. In the monocrotophos exposed fishes, the serum glucose increases with increase of the exposure periods (Table 1). Increase in serum glucose level may be due to enhanced conversion of liver and muscle glycogen into glucose to meet an increased energy requirement under stress conditions. From the present investigation, it is clear that the pesticide monocrotophos is very toxic to fishes even at sublethal concentration as it has produced adverse effect on the carbohydrate metabolism by elevating the blood glucose level directly interfering with the glucose regulatory mechanism of blood.

Table1: Effects of sublethal concentrations of monocrotophos on serum biomolecules of *Cirrhinus mrigala* at different exposure period of exposure (N=5).

Serum Biochemical Parameters	**Group**	**Exposure periods (in hours)**			
		24	**48**	**72**	**96**
Glucose (mg/dl)	Control	40.05±0.14	40.74±0.18	40.15±0.19	40.15±0.19
	7ppm	45.14±0.24*	47.18±0.15*	48.58±0.17*	49.51±0.16*
Total Protein(mg/dl)	Control	75.12±0.16	75.87±0.14	76.25±0.17	75.20±0.14
	7ppm	78.14±1.14*	81.12±1.16*	84.25±1.18*	86.15±1.15*
Triglycerides (mg/dl)	Control	57.54±1.11	58.14±0.87	57.85±0.54	57.22±0.53
	7ppm	61.25±1.22	64.32±1.47*	67.25±1.54*	68.23±1.44*
Total Cholesterol (mg/dl)	Control	187.12±1.21	188.02±0.97	189.01±0.57	188.08±0.77
	7ppm	191.24±1.42	193.13±1.25	195.24±1.61*	196.18±1.22*
Blood Urea (mg/dl)	Control	3.98±0.25	4.01±0.35	4.02±0.25	4.01±0.18
	7ppm	5.11±0.14	6.21±0.23*	7.14±0.38*	7.21±0.21*
Bilirubin (mg/dl)	Control	30.00±0.25	29.50±0.24	29.76±0.21	30.10±0.25
	7ppm	23.00±0.23	19.21±0.25	17.75±0.16*	16.10±0.23**
SGOT (Unit/ ml)	Control	55.54±0.24	55.12±0.23	55.32±0.22	54.75±0.21
	7ppm	59.12±0.23	60.42±0.21	62.54±0.25*	63.44±0.27*
SGPT (Unit/ml)	Control	32.12±0.25	32.21±0.25	32.14±0.25	32.11±0.25
	7ppm	37.28±0.14	39.41±0.11	42,12±0.25*	44.54±0.18**

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

Serum protein level reflects the health condition of any organism and it may change under the influence of internal and external factors (Srivastava *et al.*, 2012). In the present investigation, serum glucose level increased significantly in monocrotophos exposed *Cirrhinus mrigala* in comparison to control groups. In the monocrotophos exposed fishes, the serum protein level increases with the increase in the concentration and time intervals (Table 1). In the present investigation, the increase in serum protein might be due to depletion of tissue protein. As the liver has multiple metabolic functions, such damage can have serious effects on the metabolism (Srivastava and Prakash, 2019). Thus in the present study, serum protein level was increased due to depletion of protein content in liver.

In the present study, triglyceride and cholesterol levels were increased significantly in monocrotophos exposed *Cirrhinus mrigala* in comparisons to control. Triglycerides and cholesterol are known to participate in the rise of fat content in tissues. The elevation of these energy reserves in response to pesticides could be due to the fact that excess energy reserves (glucose, protein, triglyceride and cholesterol) are required by organisms to mediate the effect of stress (Srivastava and Prakash, 2018).

In the present investigation, blood urea level increased significantly in monocrotophos exposed *Cirrhinus mrigala* in comparison to control groups. In the monocrotophos exposed fingerlings, the blood urea level increases with increase in the duration of exposure (Table 1). The elevation in the urea level in the pesticide exposed fish may be due to gill dysfunctions as the urea excreted mainly through the gills and kidneys, hence significant increased levels of urea in pesticides exposed fishes were the indication of kidney damage. Thus it can be concluded that even at low concentration monocrotophos is toxic to fishes.

Bilurbin is an excretory catabolic product of haemoglobin. The decrease in bilirubin content in the blood of *Cirrhinus mrigala* exposed to pesticides was probably due to malfunction of liver and causes less secretion of bilirubin into blood and leads to hypobilirubinea (Krishna and Prakash, 2010). The increased level of serum glutamic oxaloacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT) in monocrotophos pesticide exposed fishes are the indication of the liver damage and possible myocardial damage under stress condition (Singh *et al.*, 2011).

CONCLUSIONS

The exposure of *Cirrhinus mrigala* to sublethal concentration of monocrotophos for 96 hours showed significant alternation in serum biochemical parameters. This study clearly indicates that the presence of monocrotophos in fresh water bodies, even in small concentration, could cause deleterious effects on fish physiology and may potentially disturb their growth, development and survival in the natural environment. Thus freshwater fish, *Cirrhinus mrigala* acts as a bioindicator because it is sensitive to monocrotophos and so help in the diagnosis of the pollution.

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