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BIOCHEMICAL CHANGES INDUCED BY DIMETHOATE IN A FRESHWATER FISH *CIRRHINUS MRIGALA* (HAMILTON, 182)

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Abstract

The present work was carried out in the freshwater fish *Cirrhinus mrigala* to evaluate the toxic effect of on the physiological parameters and haematological parameters. Blood glucose and enzyme activity in the intestine, liver and kidney was also carried out. Observations made for a continuous exposure period of 96 hours. An LC50 value for 96 hours was determined and was found to be 6.5 mg/l. An increase in WBC count on exposure to different sub lethal concentrations of dimethoate was also observed.

Keywords: *Pesticide, toxicity, cirrhinus mrigala, dimethoate.*

Introduction

Pesticides are very common in aquatic environment. Generally they are used without proper consideration. As a result the aquatic environment contains mixtures of several pesticides (Mayer, 1974). Pesticides eventually reach the aquatic eco system in considerable amounts via the agricultural run-off, urban run-off and atmospheric fall out through rain etc. Pesticides are major cause of concern for aquatic environment because of their toxicity, persistency, and tendency to accumulate in the organisms. Pesticides are not highly selective but are generally toxic to many target organisms. The pesticide aimed at insect pests, affect the non target aquatic organisms like fish, prawn etc., which are commercially important (Pal and Konar, 1985). Pesticides are posing great threat to aquatic fauna especially to fishes, which constitute one of the major sources of protein rich food for mankind (Sharma and Singh, 2007).

Dimethoate has been used worldwide and many investigations on its toxicity to aquatic and terrestrial organisms have been carried out in addition to studies on occupational risk if it presents to humans. Heavy concentration of pesticides in water in turn leads to oxygen depletion and cases of poisoning and the mass mortality of fishes is not uncommon. With the increasing emphasis on pisciculture and greater awareness of the pollution of natural water sources, physiological, Haematological studies and enzyme bio-assay have assumed greater significance.

In the present study an attempt was made to study the effect of dimethoate on physiology, haematology and on the activity of acid phosphatase and alkaline phosphatase of a freshwater fish *Cirrhinus mrigala.*

Materials and methods

The experimental animal selected for the present study is a common fresh water fish *Cirrhinus mrigala* (18.5±2 gms weight and 13.0±2cms length) produced from a private aquafarm at Thanjavur. The organophosphorus pesticide dimethoate was used for this study. The tap water was used for the preparation of different pesticide concentration in the experiments. The physico chemical parameters of test solutions were determined (Strickland and Parsons, 1973).

Bioassay tests were carried out for determination of 96 hrs LC_{50} values by the method given by Sprague (1973). Ventilation / minute has been measured in control fish as well as in fish following exposure to different sub lethal concentrations. Oxygen consumption of the fish was estimated by winkler's method. Haemoglobin content of blood was estimated using shali's haemoglobinometer with permanent coloured glass comparison standard. After collecting the blood from the fishes, liver, intestine and kidney tissues were also taken out for enzyme assay. The clear supernatants (intestine extract, liver extract and kidney extract) were used for the estimation of activities of acid phosphatase (King's method) and alkaline phosphatase (Kind and King's method)

Results and Discussion

The present work was carried out in the freshwater fish *Cirrhinus mrigala* to evaluate the toxic effect of on the physiological parameters and haematological parameters. The 96 hours LC_{50} value for *Cirrhinus mrigala* exposed to dimethoate was found to be 6.5 mgl/l (Table 1).

Table 1. Mortality of cirrhinus mrigala exposed to different concentrations of dimetheoate at 96 hrs.

Concentration of Pesticide (mg)	No. of fishes exposed	No. of fishes died	% Ki II	Probit Kill (%)	LC_{50}
Control	10	0	0	0	
3.5	10	2	20	4.16	
4.5	10	3	30	4.48	
5.5	10	4	40	4.75	
6.5	10	5	50	5.00	6.5 mg/l
7.5	10	9	10	8.09	

Physiological parameters

In this study oxygen consumption was gradually decreasing with increasing exposure period. It was noted that the rate of oxygen consumption of control fish were 0.560, 0.522, 0.524, 0.507 at 24, 48, 72 and 96 hours respectively. In this study of period ventilation rate was found increasing with increasing concentrations of pesticide and with increasing exposure period. It was recorded that 89, 86, 74, 67 at 24 hrs,48 hrs, 72 hrs and 96 hrs exposure period respectively with 0.5 mg of dimethoate. It was found from 87 to 75 with 1.0 mg of dimethoate at 24 hrs to 96 hrs exposure period. It was found from 69 to 64 at 24 hrs to 96 hrs exposure period with 1.5 mg of dimethoate. It was recorded that 71, 60, 59, 49 with 24 hrs, 48 hrs, 72 hrs and 96 hrs exposure period respectively with 2.0 mg of dimethoate. During the study, the rate of oxygen consumption decreased in the higher concentration as reported earlier by several scientists in the toxicant exposed fishes. Kalavathy *et al*. (2001) reported that the dimethoate is efficiently absorbed across the gill and diffuses into the blood stream resulting in toxicity to the fish.

In the present study, the oxygen consumption was gradually decreasing with increasing exposure periods as observed by Mathivanan (2004) in *Oreochromis mossambicus* exposed to sub-lethal concentarations of Quinolophos. According to Rao (1989) pesticides are known to stimulate the peripheral nervous systems, as a result activity of fish increases which requires more oxygen to fulfill the energy demand. This could be the reason for initial elevation in the rate of oxygen consumption in sub lethal medium. The respiration rate of fish decreased in the subsequent period of exposure which might be due to acclimatization of the fish in the chemical environment.

Haematological parameters

The blood parameters like haemoglobin content, red blood corpuscle count showed a decreasing tendency when exposed to different sub- lethal concentrations of dimethoate. The haemoglobin content observed at 24 hrs, 48 hrs, 72 hrs and 96 hrs was 11.53, 11.36, 11.70 and 11.72 respectively, when exposed to 0.5 mg concentration of dimethoate. Haemoglobin content recorded with 1.0 mg/kl concentration was declining from 11.07 to 9.97 at increasing exposure periods. From 11.26 to 9.86 with 1.5 mg/l concentration at 24 hrs to 96 hrs exposure period and from 11.10 to 8.86 at increasing exposure period with 2.0 mg/l concentrations.

The total RBC count showed decreasing tendency with increasing exposure period. It was recorded that from 4.50 to 4.01 at 24 hrs, 48 hrs, 72 hrs and 96 hrs exposure period respectively with 0.5 mg/l concentration. The total WBC count showed increasing trend from 3.17 to 3.91 at increasing exposure period from 24 hrs, 48 hrs, 72 hrs and 96 hrs exposure period respectively with 0.5 mg/l concentration.

The Blood glucose level also showed increasing tendency. It was recorded that from 55.64 to 60.79, from 58.72 to 63.71, from 62.13 to 66.00 and from 65.93 to 70.62 at increasing exposure period with 0.5 mg, 1.0 mg, 1.5 mg and 2.0 mg of pesticide concentration respectively. In agreement with the present finding, decrease in haemoglobin content and RBC was observed in the *T. mossambica* treated with carbaryl and sumathion (Koundinya and Ramamurhy, 1979). Similar results were obtained by Pohatkar and Dande (2000). Hemavathi and Rao (2000) reported that decreased haemoglobin content of fish may be affecting the oxygen consumption.

Activity of acid and alkaline phosphatase in intestine, liver and kidney

In intestine, acid phosphatase activity was recorded as 4.261at 24 hrs, 4.016 at 48 hrs, 3.926 at72 hrs, 3.826 at 96 hrs on exposure to 0.5 mg of dimethoate. Similar declining trend was recorded in liver and kidney also with increasing concentration of dimethoate and increasing pesticide exposure period. The alkaline phosphatase activity showed decreased trend in intestine, liver and kidney, which the fish exposed to four different sublethal concentrations of dimethoate. In intestine it was showed a declining tendency from 6.643 to 6.187, from 6.670 to 6.187, from 6.660, 6.184 and from 6.520, 6.128 with pesticide concentration of 0.5 mg, 1.0 mg, 1.5 mg, 2.0 mg respectively at increasing exposure period. Verma *et al.* (1980) have suggested uncoupling of oxidative phosphrylation is the main cause for the inhibition of phosphatase activity. Shakoori et al., (1994) noticed a decreased alkaline phosphatase activity in the intestine liver and kidney might be due to inhibition of enzymes, changes in the mitochondrial membrane function, uncoupling of oxidative phophorylation, and disturbed metabolic pathways etc.

In the present study, a decrease in acid phosphatase and alkaline phosphatase activity in the intestine, liver and kidney on exposure to sub – lethal concentration of dimethoate is in supportive of the above findings. The finding of this study showed that dimethoate had some effect on physiological and haematological parameters of *Cirrhinus mrigala*. Although the LC_{50} dose of 6.5 mg/l. it is shown that the ¼ LC_{50} dose examined in this study also caused important changes in the physiological, haemotological parameters and enzyme activity in *Cirrhinus mrigala*. Therefore the pesticides in farmlands should be controlled to prevent possible contamination by leaching into the aquatic environments. In this way, aquatic organisms especially fish could be protected from these kind of toxic chemicals.

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