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RESEARCH ARTICLE

IMPACT OF MALATHION TOXICITY ON HAEMATOLOGICAL RESPONSE IN A FRESHWATER FISH, OREOCHROMIS MOSSAMBICUS

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ABSTRACT

Impact of pesticides is common pollutants of freshwater ecosystems where they induce adverse effects on the aquatic biota. Freshwater fish, *Oreochromis mossambicus* is an important carp species in Tamil Nadu region having good nutritional values. Fishes living in close association with may accumulate pesticides. In the present study, the toxic effects of the malathion LC_{50} 0.25ppm on some Haematological parameters (RBC, WBC, Hb and MCH) of the freshwater fish, *Oreochromis mossambicus* were estimated. There is decreased in RBC, Hb and MCH on comparison with control and increased in WBC on compared with control. The results indicated the toxic nature of the pesticide malathion.

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INTRODUCTION

Malathion, a widely used insecticide is known to cause serious metabolic disturbances in non-target species, like fish and fresh-water mussels (U.S.E. Prot. Agen. 1972). Malathion is a organophosphorous insecticides (OPs). It is frequently used for the control of insects on fruits and vegetables. Malathion has also been used to control mosquitoes, flies, miscellaneous household insects, animal parasites, and human head and body lice (Hayes, 1982). Malathion has been used in malaria eradication programs in Africa and Central America or in wide-scale pest control, including the Mediterranean fruit fly in the Unites States, through aerial applications. The reason for such widespread use lies in its relatively low toxicity to mammals and high selectivity toward insects, paralleled by a moderate persistence in the environment, when compared with other OPTs (Wauchope *et al.,* 1992). Although the use of many pesticides is heavily regulated in some parts of the world, studies to assess toxicity of organophosphate insecticides used in India are required to establish safety levels, as some of those are still licensed in this country and more stringent control is needed. Malathion is one of several OP pesticides developed to substitute organochlorides. OPs are less persistent in the atmosphere, being easily linked to organic matter, being adsorbed to sediments and particled material in suspension (EPA, 2000). Toxicity and biochemical Malathion is an organophosphorous insecticide widely used in agriculture and houses for the control of diseases vectors. It is a major source of environment poisoning in developing countries (WHO, 2003). Toxicological tests have shown that malathion affected central nervous system, immune system, adrenal gland, liver and blood. *Oreochromis mossambicus* is edible freshwater fish of great economic connotation and it is used in the composite fish culture. Pesticides in the aquatic environment can negatively affect the ecosystem. Although the aquatic environment is not the actual target of such pesticide, but the widespread use of them had led to some serious problems including toxic residues in grass and toxicity of non-target organisms such as mammals, birds and fish (Saeed *et al.,* 2012; Shankar *et al.,* 2013).

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MATERIALS AND METHODS

Fish, *Oreochromis mossambicus* were collected from Cuddalore area and were brought to the laboratory in large plastic troughs and acclimatized for one week. Healthy, fish having equal size (length 10 to 12 cm) and weight (20 to 25 g) were used for experimentation. Stock solution of malathion was prepared by dissolving appropriate amount of salt in distilled water. The physico-chemical characteristic of test water have analyzed regularly during the test periods following the standard method describe by APHA (1998). Batches of 10 healthy fishes were exposed to different concentrations of insecticide malathion to calculate the medium lethal concentration LC_{50} value (0.25 ppm) using probit analysis Finney method (1971). The fishes (Four groups) were exposed to the two sub lethal concentrations (1/10th and 1/30 th mg/L) of malathion for 10, 20 and 30 days respectively. Another group was maintained as control. At the end of each exposure period, Fish was collected and gently wiped with a dry cloth to remove water. Caudal peduncle was cut with a sharp blade and the blood was collected in a watch glass containing EDTA, an anticoagulant (6% Ethylene diamine tetra acetic acid). The blood was mixed well with the EDTA solution by using a needle and this sample was used for determining the Red Blood Corpuscle Count (RBC), White Blood Corpuscle Count (WBC), Haemoglobin count (HB), Mean corpuscular haemoglobin (MCH).

RESULTS

The toxic effects of malathion on the haematological parameters of *Oreochromis mossambicus* such as number of red blood corpuscles (RBC), white blood corpuscles (WBC), haemoglobin content (Hb), and mean corpuscular haemoglobin (MCH). The observations were made at the end of exposure periods (7, 14, 21 and 28 days) to calculate the percentage of increase and decrease of different haematological parameters. Responses in the haematological parameters of *Oreochromis mossambicus* in different concentrations of malathion are presented in Table 1.

Table 1. Haematological parameters of fish *Oreochromis mossambicus* under sub lethal concentrations of malathion

Blood parameters	Treatment	Exposure periods (days)			
		7 days	14 days	21 days	28 days
RBC ($10^6/mm^3$)	Control	1.65 ± 0.06	1.58 ± 0.05	1.63 ± 0.44	1.61 ± 0.43
	10% SLC	1.46 ± 0.27	1.41 ± 0.24	1.21 ± 0.04	1.23 ± 0.25
	30% SLC	1.24 ± 0.05	1.18 ± 0.20	1.15 ± 0.04	1.03 ± 0.04
WBC ($10^3/mm^3$)	Control	4.62 ± 0.18	4.57 ± 0.31	4.59 ± 0.04	4.65 ± 0.05
	10% SLC	5.41 ± 0.42	5.87 ± 0.07	6.41 ± 0.07	6.88 ± 0.09
	30% SLC	5.64 ± 0.11	6.09 ± 0.09	6.74 ± 0.07	7.05 ± 0.06
HB (g/100ml)	Control	5.62 ± 0.04	5.36 ± 0.05	5.38 ± 0.31	5.51 ± 0.04
	10% SLC	4.83 ± 0.03	4.28 ± 0.04	4.22 ± 0.23	4.16 ± 0.04
	30% SLC	4.32 ± 0.04	4.27 ± 0.24	4.17 ± 0.21	4.07 ± 0.04
MCH (Pg)	Control	8.77 ± 0.04	8.69 ± 0.05	8.50 ± 0.04	8.77 ± 0.04
	10% SLC	7.61 ± 0.06	7.59 ± 0.39	7.47 ± 0.22	7.24 ± 0.04
	30% SLC	7.53 ± 0.30	7.48 ± 0.03	7.21 ± 0.12	7.13 ± 0.19

Values are mean ± SD – or + indicate present decrease or increase over control

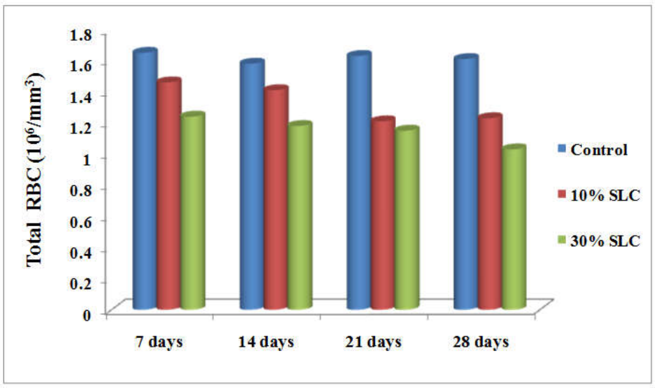

Fig. 1. Total RBC content of fish *Oreochromis mossambicus* under sub lethal concentrations of malathion

Total erythrocytes of *Oreochromis mossambicus* showed a significant decreasing tendency at 10 and 30% sublethal concentrations when compared to control. A marked decrease of 1.46 ± 0.27, 1.41 ± 0.24, 1.21 ± 0.04, 1.23 ± 0.25 were recorded in the of RBC in 10% sublethal concentration at 7, 14, 21 and 28 days.

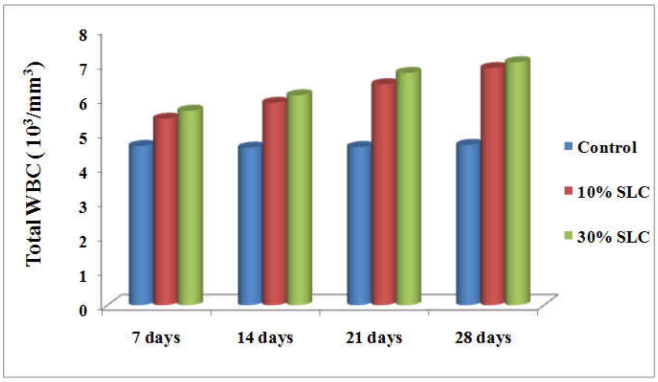

Fig. 2. The total WBC of fish *Oreochromis mossambicus* under sub lethal concentrations of malathion

The values were 1.24 ± 0.05, 1.18 ± 0.20, 1.15 ± 0.04 and 1.03 ± 0.04 for 7, 14, 21 and 28 days at 30% sublethal concentration (Table 1 and Fig. 1). The leucocytes number of *O. mossambicus* was increased with the increasing concentrations of malathion (Table 1 and Fig. 2) when compared to control. The increase in the number of leucocytes was found to be 5.41 ± 0.42, 5.87 ± 0.07, 6.41 ± 0.07 and 6.88 ± 0.09 in 10% sub lethal concentration for 7, 14, 21 and 28 days. The values were 5.64 ± 0.11, 6.09 ± 0.09, 6.74 ± 0.07 and 7.05 ± 0.06 for 7, 14, 21 and 28 days at 30% sublethal concentration.

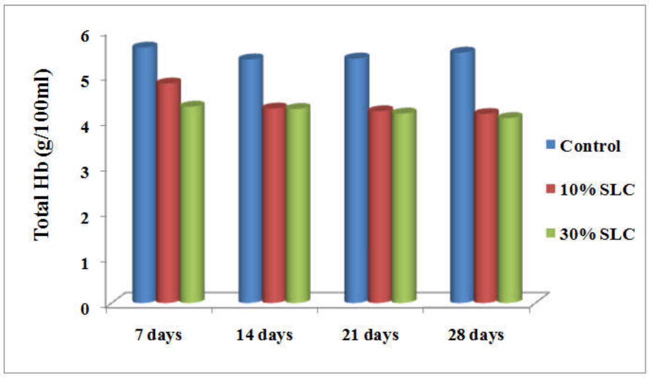

Fig. 3. Total Haemoglobulin of fish *Oreochromis mossambicus* under sub lethal concentrations of malathion

The haemoglobin content was measured from *O. mossambicus* in 10 and 30% sublethal concentrations showed decreasing trend with a significant reduction of malathion, when compared to control. The decrease in the haemoglobin amount was found to be 4.83 ± 0.03, 4.28 ± 0.04, 4.22 ± 0.23 and 4.16 ± 0.04 at 7, 14, 21 and 28 days exposure at 10% sublethal concentration. The values were 4.32 ± 0.04, 4.27 ± 0.24, 4.17 ± 0.21 and 4.07 ± 0.04 for 7, 14, 21 and 28 days at 30% sublethal concentration (Table 1 and Fig. 3). The MCH count of *O. mossambicus* showed a significant decreasing tendency at 10% and 30% sublethal concentrations of malathion, when compared to control. The decrease in the amount of MCH was found to be 7.61 ± 0.06, 7.59 ± 0.39, 7.47 ± 0.22 and 7.24 ± 0.04 at 7, 14, 21 and 28 days at 10% sublethal concentration. The values were 7.53 ± 0.30, 7.48 ± 0.03, 7.21 ± 0.12 and 7.13 ± 0.19 for 7, 14, 21 and 28 days at 30% sublethal concentration (Table 1 and Fig. 4).

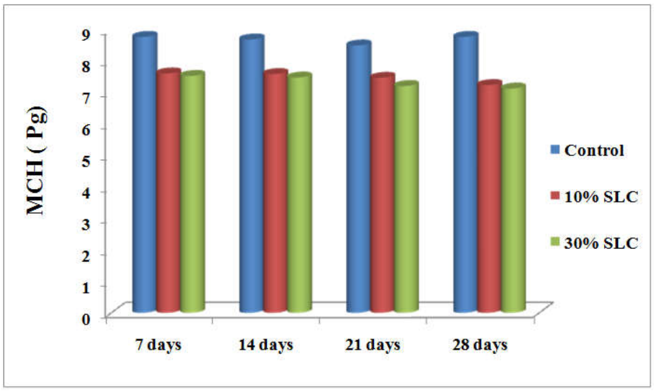

Fig. 4. The total MCH of fish *Oreochromis mossambicus* under sub lethal concentrations of malathion

DISCUSSION

In recent years haematological variables have been used more to determine the sublethal concentrations of pollutants (Wedemeyer and Yasutake, 1977). Gill *et al.* (1991) on the other hand suggested that the fish experience respiratory difficulty when they confront toxic environment and try to compensate for the reduced oxygen uptake at the gill surface by increasing the level of blood constituents concerned with oxygen uptake and delivery. However, a prolonged exposure exhausts the haematopoietic potential revealed by lowered RBC count and haemoglobin. An anaemic condition is generally indicated by the tendency of lower RBC count and haemoglobin content as seen in fishes exposed to environmental pollution (Ramesh, 2001). In the fish *Channa punctatus* exposed to malathion haemoglobin percentage decreased significantly. This indicates that malathion caused anaemia. This may be due to a decreased rate of production of red blood cells or an increased loss of these cells. The results showed that malathion treatment inflicted a drastic reduction in the total count of RBC's. The reduction was dosage dependent. However, the number of WBCs was deviating significantly from normal values. The significant decrease in the WBC count may be due to a generalised stress response (Ruparelia *et al*., 1990). White blood cells play a genotoxicity induced by malathion in *Channa punctatus* major role in the defence mechanism of the fish and consist of granulocytes, monocytes, lymphocytes and thrombocytes. Leucocyte count showed greater and quite different pattern change due to malathion exposure when compared with the erythrocyte levels of the control group. Blood of all experimental groups contained higher concentrations of leucocytes than those of controls. An increase in lymphocyte number may be the compensatory response of lymphoid tissues to the destruction of circulating lymphocytes (Shah and Altindag, 2005). Gill and Pant (1985) have reported that the stimulation of the immune system causes an increase in lymphocytes due to injury or tissue damage. It has been observed that, there was a progressive increase in the number of micronuclei with increases in the intensity of exposure to malathion, whereas the number of RBCs and haemoglobin percentage decreased significantly from normal values. However, the number of WBCs was deviating significantly from normal values. Increase in the total leucocyte count has been attributed to several factors like increase in thrombocytes, lymphocytes or squeezing of WBC in peripheral blood (Agarwal and Srivastava, 1980). Increase in the TLC could be due to stimulated lymphopoiesis and/or enhanced release of lympohocytes from lymphomyeloid tissues as has been expressed by Das and Mukherjee (2000). Such lymphocyte response might be due to the presence of toxic substances or may be associated with the pollutant induced tissue damage. The lymphocytic response in the fishes may be a result of a direct stimulation of the immunological defense due to the presence of a foreign substance (Agarwal and Srivastava, 1980). The WBC showed greatest sensitivity to changes in the environment and the most important of leucocytes were lymphocytes. Leucocytosis which may be directly proportional to the severity of the causative stress condition may attribute to an increase in leucocyte mobilization. In the present observation, total erythrocytes, haemoglobin and mean corpuscular haemoglobin of *Oreochromis mossambicus* showed a significant decreasing tendency at 10 and 30% sublethal concentrations when compared to control. Further, the increase in WBC in the present study count could be attributed as an adaptive value of fishes under insecticide stress.

Conclusion

The present study reveals that due to the influence of malathion the amount of RBC, Hb and MCH have been decreased in blood of fish *Oreochromis mossambicus*. But the amount of WBC has been increased as an immunological defense to survive against the toxic substance in the malathion. The discharge of pesticide malathion with present condition into water bodies will definitely affect the fish population.

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