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Toxicity of Malathion to the Freshwater Fish *Tilapia mossombica*

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Malathion is a versatile, organophosphorus pesticide, widely used throughout the world. The wide applicability of malathion provides many occasions for its entry into the aquatic environment. In addition to it entering waters from surface runoff (U.S. E.P.A. 1972) malathion is also directly applied to inland and coastal marshes for mosquito eradication (GUERRANT et al. 1971, PINKOVSKI 1972), thus causing havoc to the fish fauna and resulting in fish kills (DARSIE & CORRIDEN 1959, MULLA 1961). Due to its wide use and being toxic to fresh water fishes it was felt worthwhile to assess the toxicity potential of malathion on the widely available, edible fresh water teleost Tilapia mossambica.

MATERIALS AND METHODS

Collection and maintenance of fish: Fishes weighing 8 ± 2 g were collected from local fresh water tanks and transferred to large cement fish tanks in the aquarium, where a continuous and gentle flow of water was maintained constantly. They were fed daily with groundnut cake and frog muscle twice a week. Before experimentation these fishes in batches of 6 each were acclimated to tap water in large glass troughs. After acclimation, the fishes were exposed to malathion in the same troughs.

Malathion: All investigations were conducted using technical grade malathion (95% w/w). A stock solution of 1000 ppm (mg/mL) was prepared in acetone. Acetone formulation was distributed in the form of water emulsion, in required dilutions with tap water. Acetone used in the quantity was reported to be non-toxic to fish (PICKERING et al. 1962).

Bioassay: The bioassays were conducted in static waters by adopting the procedure of DOUDOROFF et al. (1951). Two methods were used for LC_{50} determination. 6 concentrations of malathion were used (1, 2, 4, 6, 8 and 10 ppm) for computing LC_{50} as

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described by FINNEY (1964), while 5 concentrations in log-2 proportions (1 to 16 ppm) were used for DRAGSTEDT and BEHRENS method as described by CARPENTER (1975). Each time 10 fishes were used for each concentration, exposing 2 fishes per 15 L of test solution. These arrangements tended to maintain almost similar ratio of fish weight to water volume in the experiments. Each experiment in selected concentrations of malathion was repeated 5 times, noting every time the number of fish killed in each concentration for 48 h. The average mortality in each concentration was chosen to determine the LC_{50} by both the methods mentioned above.

RESULTS

Exposure of fishes, to malathion for 48 h. showed nil mortality in 2 ppm; 10% mortability in 4 ppm; 60% mortality in 6 ppm; 90% mortality in 8 ppm and 100% morality in 10 ppm, respectively (Table 1). The percent mortality of fish in different concentrations of malathion in 48 h. (Table 1) was plotted against malathion concentration (mg/L), which showed a typical sigmoid curve. The LC_{50} value, as determined by graphical method (FINNEY 1964) was found to be 5.5 mg/L. When probit mortality was plotted against log concentration of malathion, it showed a straight line. The LC_{50} value obtained through this straight line was found to be 5.6 mg/L.

For subsequent verification of the LC_{50} values the method of DRAGSTEDT-BEHRENS was employed, by exposing the fish to log-2 concentrations of malathion (1,2, 4, 8, 16 ppm) for 48 h. The percent mortality is calculated from the cumulative mortality (Table 2). The LC_{50} was calculated adopting the following formula:

$$\log LC_{50} = \log A + \frac{50 - a}{b - a} \times \log 2$$

where A = concentration of malathion whose mortality is below 50% mortality, i.e. 4 mg/L (Table 2).

a = % mortality observed immediately below 50% mortality, i.e. 9.1% (Table 2).

b = % mortality observed immediately above 50% mortality i.e. 91% (Table 2).

The LC_{50} value calculated by this method was found to be 5.7 mg/L. Thus the average LC_{50} value obtained from three sources was found to be 5.6 ± 0.1 mg/L.

TABLE - 1, Mortality of T. mossambica in different concentrations of malathion at 48 h. of exposure. Mortality expressed in both percent and probit kill.

Each value represents an average of 5 replications.

Malathion concentration (mg/L)	Log concentration	No. of fishes exposed	No. of fishes dead	Percent kill	Probit kill
1	0.0000	10	0	0	-
2	0.3010	10	0	0	-
4	0.6021	10	1	10	3.7
6	0.7782	10	6	60	5.2
8	0.9031	10	9	90	6.3
10	1.0000	10	10	100	8.7

TABLE - 2, Mortality of T. mossambica in log 2 concentrations of malathion at 48 h. of exposure (DRAGSTEDT-BEHRENS method as described by CARPENTER 1975). Percent mortality calculated from cumulative mortality.

Each value represents an average of 5 replicates.

Malathion concentration (mg/L)	Results at 48 h.		Cumulative mortality		Percent Mortality
	Live	Dead	Live	Dead	
1	10	0	30	0	0
2	10	0	20	0	0
4	9	1	10	1	9.1
8	1	9	1	10	91
16	0	10	0	20	100

DISCUSSION

In the present study, the sigmoid curve obtained by plotting log concentration of malathion versus percent mortality showed a straight line, when malathion concentration was plotted against probit mortality thus agreeing with the probit analysis (FINNEY 1964). The LC_{50} values obtained by the graphical (Table 1) and calculated methods (Table 2) were almost same with a standard deviation of ± 0.1. Thus the mean LC_{50} value (5.6 mg/L) obtained through the three sources was taken as the LC_{50} of malathion for the species T. mossambica.

The LC_{50} value of different species of fish like fatheads, blue gills and guppies to malathion (Technical) were reported to be 21 mg/L, 0.12 mg/L and 0.88 mg/L, respectively, for 48 h. of exposure (PICKERING et al 1962). MOUNT & STEPHAN (1967) reported LC_{50} value of 9 mg/L for fatheads in static bioassays. For the same blue gills reported by PICKERING et al. (1962) the LC_{50} value was found to range from 0.045 to 0.12 mg/L (U.S.D.I. 1963) and 0.14 mg/L, (MACEK et al. 1969). Thus it is evident that the toxicity differs from species to species, (PICKERING et al 1962) and in some cases from place to place, which may be due to differences in assay techniques and purity of insecticides as reported by CHAMBERS & YARBROUGH (1974).

In general, the LC_{50} value of T. mossambica obtained in the present study, when compared with other species reported by PICKERING et al. (1962), suggests that malathion is relatively more toxic to T. mossambica (LC_{50} = 5.6 ppm) than fathead minnows (LC_{50} = 23 ppm) but less toxic when compared to blue gills (LC_{50} = 0.12 ppm) and guppies (LC_{50} = 0.88 ppm). These variations in the LC_{50} of malathion to the different species might be due to differences in the capacity of the fish to tolerate brain cholinesterase inhibition, (MACEK & MCALLISTER 1970).

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