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Acute Endrin Toxicity on Oxidases of *Ophiocephalus punctatus* (Bloch)

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Pesticides of organochlorinated group such as endrin are of economically useful poisons. The extreme toxicity of endrin in water has been studied in fishes (FERGUSON et al. 1965, SAANIN 1960 and TARZWELL 1965). Pathologic conditions associated with endrin were reported in gills, liver, brain, pancreas and gonads of Salmo clarki (ELLER 1971), while chronic endrin poisoning affected growth, gonad development, serum characteristics, total and differential body fat and behaviour in Carassius auratus (GRANT and MEHRLE 1970). GRANT and SCHOETTGER (1972) observed that organochlorine compounds also blocked glucogenolysis and affected thyroid activity. A number of physiological alterations were reported in liver and kidney of teleost fishes exposed to endrin (SASTRY and SHARMA 1978).

In view of the paucity of literature on the effect of endrin on oxidases, the present work has been made to examine the alteration in activities of oxidases after exposure to LC(50) of endrin for 96 h by bath.

MATERIALS AND METHODS

Living fishes, 15 ± 3 cm in length and 60 ± 8 g in weight, were collected from local fresh water sources. Water used in tests had a temperature of 29 ± 4°C, pH of 6.9 and hardness of 150 ppm (as $CaCO_3$). Prior to experimentation, fishes were acclimatized to laboratory conditions for 2 days. Solution containing 0.005, 0.01, 0.02, 0.04, 0.08 ppm of endrin were made up and 20 litres of each put in each aquarium (24" x 12" x 12"). Ten acclimatized fishes were placed in each. A control was maintained in endrin - free tap water.

To estimate the activities of oxidases, 10% (W/V) homogenates of liver and kidney of fishes exposed to LC(50) of endrin for 96 h were prepared in 0.25M ice-

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cold sucrose solution using a chilled Potter-Elvehjem homogenizer. The homogenates were centrifuged for 20 minutes at 1000 g and the clear supernatant fluids were used as the source of enzymes. The activities of oxidases were estimated by triphenyl tetrazolium chloride method (SRIKANTAN et al. 1955). The incubation time was one hour at 37°C. The activity is expressed in terms of mg formazen liberated per mg of enzyme protein per hour. Protein was determined by the method of LOWRY et al. (1951) with bovine serum albumin as the standard. The t test described by FISHER (1950) was employed to calculate the statistical significance between control and experimental values.

RESULTS

The endrin concentration and survivality of fishes with 96 h are shown in table 1.

TABLE 1

Relation between endrin concentration and survival

Concentration of endrin (ppm)	Mortality	Survival (%)
0.005	0	100
0.01	2	80
0.02	3	70
0.04	6	40
0.08	10	0

The LC(50) for 96 h was 0.033 ppm. It was determined by straight line graphical interpolation as described by DOUDOROFF et al. (1951).

The results of physiological experiments are presented in table 2.

It is evident from the table 2 that the activities of all the three oxidases were inhibited in both the tissues of fishes treated with endrin. However, the inhibition of lactic dehydrogenase in the kidney was statistically significant to controls.

TABLE 2

The activities of dehydrogenase in control and experimental fishes

Enzyme	Tissue	Number of experiments conducted	Control	Experimental	't' (Sign.Diff.)
Succinic dehydrogenase	Liver	3	1.6731±0.121[a]	1.2031±0.301	1.778(-)
	Kidney	3	1.4932±0.083	1.0132±0.089	1.112(-)
Pyruvic dehydrogenase	Liver	3	2.2371±0.437	1.7210±0.131	1.421(-)
	Kidney	3	3.0320±0.713	2.0313±0.432	1.473(-)
Lactic dehydrogenase	Liver	3	1.3373±0.049	1.0314±0.231	1.619(-)
	Kidney	3	3.0892±0.601	1.0732±0.307	3.696(+)b

a. Values are Mean ± S.E.
b. (+) indicates statistically significant differences from control values at 95 percent confidence interval.

DISCUSSION

Very little work has been done on the effects of endrin on enzyme activities soan attempt has been made to examine the effect of this pesticide on the activities of succinic, pyruvic and lactic dehydrogenases. Exposure of O. punctatus for 96 h to endrin in vivo resulted in the decrease of the activities of all the dehydrogenases in both the tissues.

The inhibition of succinic dehydrogenase in both the tissues of fishes might be due to the attachment of endrin with the mitochondrial membrane or the enzyme molecule itself. However, further work is needed in support of above view. Since, succinic dehydrogenase is a mitochondrial enzyme responsible for energy release, it seems reasonable to assume that endrin exert a direct inhibitory effect on this enzyme by excessive concentration in this subcellular organelle. McCORKLE and YARBROUGH (1974) reported that mirex exerts direct inhibitory action on succinic dehydrogenase in rabbit. The present findings are in accordance with the above observations. Pyruvic and lactic dehydrogenases are associated with cellular metabolic activity. According to HENDRICKSON and BOWDEN (1973) and GERTIG et al. (1970), a number of organochlorine compounds appear to inhibit lactic dehydrogenase which may be due to the result of some direct effect on enzyme molecules. Lactic dehydrogenase present in most of the animal tissues catalyses the interconversion of pyruvic acid to lactic acid. It acts as a pivotal enzyme between glycolytic pathway and the tricarboxylic acid cycle.

The diminished enzyme activities may be either due to decreased synthesis of enzymes in the tissues or due to damage of cytoplasmic organelles or enzyme inhibition by endrin. No possible explanation can be given at this primary stage as further experiments are in progress.

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