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Toxic Effect of Fenvalerate on Fructose-1,6-Diphosphate Aldolase Activity of Liver, Gill, Kidney, and Brain of the Fresh Water Teleost, *Tilapia mossambica*

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Recently, many new broad spectrum of pesticide have been developed which have the potential use for wide spread in the environment. In large scale application of these pesticides by methods like crop dusting, orchard and forest spraying, some inevitably enter the aquatic ecosystem and sometimes adversely effecting nontarget organisms such as freshwater fishes (Johnson 1973). Fenvalerate is a synthetic pyrethroid insecticide, derived from the flowers of Chrysanthemum (Pyrethrum) species. Several workers have reported that the activity of aldolase, an important enzyme in the glycolytic chain (where it breaks down fructose-1,6-diphosphate) has been altered by pesticides in fishes (Bhatia et al. 1973; Rao 1984). But the effect of pyrethroid, fenvalerate on aquatic organisms is very scanty. Therefore, an attempt has been made to observe the toxic effect of fenvalerate on the aldolase activity of liver, gill, kidney and brain tissues of the fish, Tilapia mossambica.

MATERIALS AND METHODS

The collection and maintenance of the fish, T. mossambica (Peters) was described earlier by Radhaiah et al. (1987). The fish were exposed to different concentration of fenvalerate according to their biomass ratio (g/L) as suggested by Doudoroff et al. (1951) and the LC50 value (0.045 mg/L) for 48 h with fenvalerate (93% active ingredient) was determined by the method of probit analysis (Finney 1964) . One fifth of the LC50 (0.009 mg/L) was taken as the sub-lethal concentration, and the fish were exposed for 10 and 20 days. The control fish were maintained under identical conditions without pesticide in the medium. After the stipulated period, the tissues like liver, gill, kidney and brain were isolated both from control and experimental fishes. Homogenates used for the estimation of aldolase acti-

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vity were prepared in glass distilled water.

Aldolase (EC.4.1.2.13) activity was assayed by the colorimetric method of Bruns and Bergmeyer (1965) in which the triose phosphates formed were estimated with 2,4-dinitrophenyl hydrazine. The incubation mixture in a final volume of 3 mL contained 1.75 mL of collidine buffer (pH 7.4), 0.25 mL of fructose-1,6-diphosphate (0.1 M, pH 7.4) and 1 mL of enzyme. The mixture was incubated at 37°C for 15 min and the reaction was arrested by the addition of 3 mL of cold 10% (w/v) trichloroacetic acid. Aldolase activity was expressed as μmol FDP cleaved/mg protein/h. Significance of the differences was assessed through students "t" test (Pillai and Sinha 1968).

Synthetic pyrethroid, fenvalerate (α-cyano-(3-phenoxy phenyl) methyl-4-chloro-alpha-(1-methyl ethyl) benzene acetate) was obtained from Searle India Ltd., Bombay, used for the experimental purpose.

RESULTS AND DISCUSSION

Activity levels of aldolase was increased with duration of exposure in all the tissues as shown in Table 1. The maximum percent increase was observed in liver after exposure to 10 and 20 days (49%, 87%) followed by gill (28%, 59%), kidney (17%, 52%) and brain (21%, 41%) tissues, and these changes are statistically significant ($P < 0.001$).

The elevation in the aldolase activity in all the tissues under fenvalerate intoxication indicated rapid cleaving of C-C bands of hexoses leading to the formation of trioses, which are made available for further oxidation (Harper et al. 1978). The toxic effects are probably being countered in a large measure in liver as compared to other tissues, because the rate at which the trioses are formed is high in liver tissue. Under normal conditions there is an equilibrium between dihydroxy acetonephosphate and glyceraldehyde-3-phosphate, but it was reported that during toxic stress a shift in the equilibrium of glyceraldehyde-3-phosphate dihydroxy acetone phosphate towards right (Nikkila and Ojala 1963) resulting in formation of large quantities of dihydroxy acetone phosphate molecules which are converted into glyceraldehyde-3-phosphate. Because of this shift, triose metabolism via the glycolytic route is enhanced to ensure more energy under fenvalerate toxicity. Increased levels of aldolase activity in different animals like fishes (Bhatia et al. 1973; Rao 1984), freshwater mussel (Srinavasamurthy et al. 1983) were reported under pesticidal intoxication.

In support of this it has been reported that several pesticides usually shift aerobic metabolism towards anerobic metabolism with the simultaneous increase in glycolytic pathway by the activation of aldolase to provide energy for the animals (Losota 1973; Vasilos et al. 1976). The present study suggests that the glycolytic

Table 1. Changes in the activity levels of aldolase (μmol of FDP cleaved/mg protein/h) in liver, gill, kidney and brain tissues of controls and in fish exposed to 0.009 mg/L fenvalerate.

Tissues	Control	Exposed fish in days	
		10	20
Liver	1.05 ±0.08	1.56* ±0.32 (49.14)	1.97* ±0.04 (87.38)
Gill	0.52 ±0.04	0.67* ±0.03 (28.26)	0.83* ±0.07 (59.23)
Kidney	0.83 ±0.05	0.97* ±0.01 (17.65)	1.26* ±0.12 (52.35)
Brain	0.62 ±0.06	0.75* ±0.04 (21.00)	0.87* ±0.03 (41.03)

Each value represents the mean of six individual observations, Mean S.D., values in paranthesis indicates percent change over control. *$P < 0.001$.

pathway was altered in the fish under fenvalerate intoxication.

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