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Sublethal Effect of Methyl Parathion on Tissue Proteolysis in the Freshwater Mussel, *Lamellidens marginalis* (Lamarck)

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The decrease in soluble proteins, structural proteins and free amino acids with an increase in protease activity in the mantle and foot tissues of methyl parathion-exposed mussels suggests enhanced proteolysis. The increased soluble proteins and decreased protease activity in hepatopancreas tissue suggests the possible diversion of the system slowly towards synthetic face to mitigate the methyl parathion impact.

Key Words: **Methyl parathion, Proteins, Protease, Ammonia,** *Lamellidens marginalis*

Introduction

The increasing demand for organic pesticides in public health and agriculture (Hayes 1964, Long 1971) resulted in the production of numerous formulations (Macdonald & Deichmann 1970) which form a group of economically useful poisons (Datta & Dikshith 1973) causing imbalances in the ecosystems (Mrak 1969). There is an increasing concern about their toxic hazards due to their indiscriminate use in the environment (Matsumura et al. 1972). Several attempts have been made to evaluate these hazards on biota (Majumdar & Solomon 1971, Robert et al. 1975). Since the literature concerning the toxic effects on the physiological and metabolic changes in the freshwater mussels is rather scanty and since protein forms a major constituent of animal body, this aspect (tissue proteolysis) was chosen to study the effect of methyl parathion (organophosphorus pesticide of much use in this region) on selected tissues of freshwater mussel, *Lamellidens marginalis* (Lamarck).

Materials and Methods

The freshwater mussels, *Lamellidens marginalis* were collected from unpolluted fresh water ponds and acclimatised to laboratory condition for one week. They were fed with freshwater plankton. The technical grade methyl parathion of 80% purity was used for experimentation.

The preparation of standard stock solution of methyl parathion has been described earlier (Siva Prasada Rao & Ramana Rao 1979). LC_{50} was found to be 23.44 ppm for 48 hr. Hence the freshwater mussels weighing

20±2 grams were exposed for 48 hr in five batches of 10 each at 8 ppm (sublethal concentration), since sublethal concentration is about 1/3 of LC_{50} value (Konar 1969). Suitable controls were maintained for the same period.

After exposure, three tissues namely foot, mantle and hepatopancreas were isolated and kept in cold. These tissues were employed for the estimation of soluble and structural proteins (separated by centrifugation of tissue homogenates at 1000 g) by the method of Lowry et al. (1951). Protease activity and free amino acid (FAA) levels were estimated by the method of Moore and Stein (1957), while free ammonia was estimated by the method of Bergmeyer (1965). The statistical co-relations were conducted using student '*t*' test as described by Bailey (1965).

Results and Discussion

The data in table 1 show the following trends. The soluble, structural proteins and free amino acids showed a decrease in foot, and mantle tissues and an insignificant increase in the hepatopancreas tissue of methyl parathion-exposed (MPE) mussels. The ammonia content increased significantly in all the three tissues of MPE mussels. The protease activity showed an increase in foot and mantle tissues and an insignificant

Table 1 *Levels of soluble proteins, structural proteins, total free amino acids (mg/g wet wt. tissue) protease activity (mg of amino acids formed/mg protein/hr) and ammonia (μmoles/g wet wt. tissue) in the normal (NR) and methyl-parathion-exposed (MPE) mussels*

Component	Foot		Mantle		Hepatopancreas	
	NR	MPE	NR	MPE	NR	MPE
1. Soluble proteins	37.64 ±1.51	34.92 ±1.46 −7% P<0.025	13.64 ±0.50	10.65 ±1.05 −22% P<0.001	17.90 ±2.26	21.02 ±2.47 +17% NS
2. Structural proteins	16.88 ±4.26	8.92 ±2.09 −47% P<0.005	5.39 ±1.46	3.79 ±1.84 −29% NS	3.72 ±0.43	4.50 ±1.88 +21% NS
3. Free amino acids	1.529 ±0.325	1.280 ±0.216 −16% NS	1.310 ±0.210	0.967 ±0.125 −26% P<0.01	2.204 ±0.325	2.405 ±0.452 +9% NS
4. Ammonia	2.09 ±0.33	3.14 ±0.43 +50% P 0.005	2.60 ±0.12	3.49 ±0.32 +34% P<0.001	6.73 ±0.46	8.90 ±0.85 +32% P<0.001
5. Protease	0.0153 ±0.0048	0.0271 ±0.006 +77% P<0.01	0.1339 ±0.021	0.1869 ±0.071 +39% NS	0.1109 ±0.0308	0.081 ±0.006 −27% NS

Each value is the mean ± SD of 6 individual observations
The signs + or − indicates percent increase or decrease over normal
p='*t*' test; *NS*=not significant

decrease in hepatopancreas tissue of MPE mussels. The above results clearly indicate that the behaviour of the hepatopancreas towards methyl parathion toxicity is quite different from that of foot and mantle.

The decrease in soluble, structural proteins and FAA in the foot and mantle tissues of MPE mussels suggest the possible utilization of these compounds for metabolic purposes. This clearly suggests the enhanced proteolytic activity in these tissues during the stress condition. This was clearly supported by our study, since the protease activity showed an increase in foot and mantle tissues. The decrease in FAA of mantle and foot tissues might suggest the occurrence of transaminase activity to meet the excess energy demands under methyl parathion stress condition, since the pesticides are known to induce elevation of aminotransferases (Kabeer 1979).

But in the hepatopancreas, an insignificant increase in soluble proteins, structural proteins and free amino acids have been observed, suggesting the possible diversion of the system towards synthetic phase to face the augmented stress condition. In consonance with this, the protease activity in the hepatopancreas was also decreased. Free ammonia level was found to increase in all the MPE mussel tissues,suggesting the occurrence of more oxidative deamination of amino acids.

From the above results, it can be suggested that the metabolism of hepatopancreas was so oriented towards the synthetic phase than the other two tissues, since hepatopancreas (liver in case of vertebrates) is a vital centre for metabolic and synthetic functions suggesting that the animal is trying to adapt slowly to the methyl parathion stress condition by enhancing the synthetic potential.

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