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Effect of Cadmium Exposure on the Activity of Phosphatases in the Hepatopancreas of Crab *Scylla serrata* (Forskal)

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Inhibition of alkaline phosphatase and augmentation of acid phosphatase activity were observed in the hepatopancreas of crabs exposed to sublethal concentrations (0.3, 0.6 and 1.5 mg.l^{-1}) of Cd for different periods (10, 20 and 30 d) compared to control. The variation in the activity of phosphatases can be attributed to the rate of differential uptake of Cd.

Since invertebrate poikilotherms are relatively open systems, their component parts, cellular enzymes, etc. often vary directly with the environment[1,2]. A number of enzymes have been shown as possible indicators of pollutant contamination[3,4]. Many heavy metals have been reported to alter the activity of various enzymes in marine organisms[5,6]. In this paper, effects of sublethal concentrations of Cd on the specific activities of alkaline phosphatase (EC 3.1.3.1) and acid phosphatase (EC 3.1.3.2) in the hepatopancreas of intertidal crab *Scylla serrata* are reported.

Juvenile crabs of intermoult stage and of more or less uniform size (4.5 to 5.5 cm breadth) were collected from Bassein creek, Bombay. They were acclimated for 7 d in aerated seawater of temperature 27° to 29°C, *p*H 7.8 to 8, dissolved oxygen 6.3 to 6.8 mg l^{-1} and salinity 30×10^{-3}. After acclimation the crabs were exposed separately to Cd concentrations of 0.3, 0.6 and 1.5 mg.l^{-1} in glass aquaria each containing 3 l of seawater and 10 crabs. These 3 concentrations of Cd were selected with reference to 96 h LC_{50} values of Cd (24.0 mg.l^{-1}), for intermoult crabs[7]. Aliquots from a stock solution of Cd chloride prepared earlier were added to seawater in the experimental tanks to get the desired concentrations of toxicant. Identical conditions were maintained during experimentation. The crabs were fed clam flesh on alternate days after which the water was renewed. At the end of each exposure period (10, 20 and 30 d), hepatopancreas was removed and the activities of alkaline and acid phosphatases were estimated[8-10].

The activities of enzymes showed contrasting trends— inhibition of alkaline phosphatase and augmentation of acid phosphatase activity (Table 1). However, these changes were insignificant compared to control values in case of acid phosphatase while in case of alkaline phosphatase they were significant.

The inhibition of alkaline phosphatase activity as a result of Cd stress is due to disruption in the process of oxidative phosphorylation during the formation of energy rich compounds[11]. Similar inhibition in alkaline phosphatase was observed in fishes due to Pb toxicity[12]. The inhibitory action of the heavy metal on enzymes is due to the binding of the metal with the enzyme proteins[13]. Thus the inhibition of alkaline phosphatase observed presently might be due to direct binding of the enzyme protein with Cd.

Table 1— Acid and Alkaline Phosphatase Activity (mg P liberated h^{-1} mg^{-1} protein) in Hepatopancreas of *S. serrata* after Exposure to Cd
[Values are mean of 5 determinations ± SEM]

Period (d)	Control	Cadmium concentrations (mg l^{-1})		
		0.3	0.6	1.5
	Acid phosphatase			
10	4.98 ±0.897	5.192 ±2.144	5.96 ±0.5	5.941 ±1.162
20	3.92 ±1.98	3.77 ±0.35	4.2 ±0.967	4.914 ±1.73
30	2.606 ±0.425	2.897 ±0.883	2.745 ±0.371	3.763 ±0.254
	Alkaline phosphatase			
10	2.773 ±1.43	1.561 ±0.457	1.192 ±0.976	2.634 ±0.908
20	1.920 ±0.239	5.541* ±0.189	1.342 ±0.448	1.086* ±0.143
30	1.513 ±0.905	0.996 ±0.148	1.742 ±0.465	0.832 ±0.425

*$P < 0.05$

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Cellular damage is reported to bring about an increase in acid phosphatase activity in tissues[14-19]. The damage to hepatic cells of the exposed crabs observed during the present work, thus, may account for the increase in acid phosphatase activity. Acid phosphatase, a lysosomal enzyme may help augmenting the autolysis of the cell. The increase in lysosomal activity in the injured cells occurs as a part of prenecrotic changes[14,20]. Elevation of acid phosphatase activity has also been attributed to increased histocytic reaction resulting from excess of pollutant[12]. Thus the variations in the activity of both the phosphatases can be attributed to changes in the rate of uptake of Cd which causes either detoxification or enhancement of pollutant stress.

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