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Influence of Naphthalene on Esterase Activity During Vitellogenesis of Marine Edible Crab, *Scylla serrata*

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Naphthalene is one of the prominent diaromatic fractions of crude and refined oils and it is a polycyclic aromatic hydrocarbon (PAH) . Generally PAHs are less sensitive to photooxidation and therefore are more persistent in water (Rand and Petrocelli 1985). PAHs are rapidly accumulated by aquatic organisms reaching levels higher than those in the ambient medium and affect normal function of the aquatic life (Kulkarni and Masurekar 1984). Hence, naphthalene was selected as a toxicant in the present investigation.

Reproduction is the main energy demanding physiological process. Several workers have observed definite fluctuation in the hepatopancreatic reserves of crustaceans correlated to ovarian maturation (Anilkumar and Adiyodi 1980: Balasubramanian and Subramoniam 1987). However an understanding of the enzyme systems that attend to the synthesis and breakdown of the substrate in the hepatopancreas, then mobilization via haemolymph and their resynthesis (or) direct accumulation in the ovary is meagre. Esterases are the enzymes involved in the breakdown of lipid. In dismantle the complex is lipid yolk. In an isopod, (Doyle et al. 1959) it is found that the freshly laid eggs contain a significant quantity of esterases which show a gradual increase during embryogenesis suggesting the possibility of the embryonic synthesis of this enzyme in addition to the stored esterases in the eggs.

Although, a number of workers have studied the effects of pollutants on enzymes changes in ovary and hepatopancreas of crustaceans (Baskaran et al. 1987: Elumalai et al. 1997: 1998). However very little information is available

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regarding the effect of sevimol on different molt cycle of prawn *Macrobrachium kistnesis* (Sarojini and Reddy 1984).

The objective of this study was to investigate the acute effects of the naphthalene on esterase activity during vitellogenesis of marine edible crab, *Scylla serrata.*

MATERIALS AND METHODS

Female *Scylla serrata* were collected from Pulicate lake near Chennai, Tamil Nadu. They were acclimated to the laboratory temperature (28 ± l°C), in a large glass aquaria for one week, adjusting the level of water to keep them just submerged. The water was changed daily. They were fed with flesh fresh prawns and divided into two groups. Crabs belonging to group I were reared in naphthalene free-seawater and treated as control. Crabs belonging to group II were exposed to sublethal concentration of naphthalene at 0.020 mg/L concentration. The treatment were continued up to 96 hr. After, the exposure to naphthalene, the ovarian stages were classified based on the criteria explained by Balasubramanian and Subramoniam (1987). Hepatopancreas and ovary were separated from the exposed and control crabs. Total lipid content was quantified according to the method of Folch *et al.* (1957). Esterases was estimated by the method of Rahim and Sih (1969) using p-nitrophenyl acetate as substrate. The enzyme activities were expressed as mgp-nitrophenol/mg protein/hr. Protein was estimated according to the method of Lowry *et al.* (1951), using bovine serum albumin as standard. Each experiment was replicated five times and the data were subjected to Student's 't' test (Zar 1984).

RESULTS AND DISCUSSION

The effects of naphthalene on lipid and esterase activity of hepatopancreas and ovary during the vitellogenesis of the marine edible crab, *S. serata* are presented in Table 1. Quantification of lipid content in the control ovary is not detectable in Stage I and the lipid content level gradually increases in Stage II but shows a steep increase in Stage V, which marks the intense vitellogenesis within the oocytes. There is a drastic decline in the lipid content in the spent stage VI, the

Table 1. Effect of naphthalene on esterase activity and lipid content in hepatopancreas and ovary during ovarian maturation of marine edible crab, *Scylla serrata.*
(C = control; T = Treated; ND = NOT Detectable)

Stages		Esterase (mg p-nitrophenol/mg protein/hr)		Lipid (mg/l00 mg wet tissues)	
		Hepatopancreas	Ovary	Hepatopancreas	Ovary
I	C	0.471 ± 0.098 (100)	0.419 ± 0.035 (100)	4.2 ± 0.95 (100)	ND
	T	0.200 ± 0.014*** (42.46)	0.217 ± 0.51*** (15.78)	0.68 ± 0.28*** (16.19)	ND
II	C	0.879 ± 0.14 (100)	0.605 ± 0.082 (100)	5.0 ± 1.0 (100)	3.8 ± 0.49 (100)
	T	0.415 ± 0.10*** (47.21)	0.218 ± 0.034*** (36.03)	2.2 ± 0.46*** (44)	1.2 ± 0.70*** (31.57)
III	C	0.989 ± 0.12 (100)	0.676 ± 0.10 (100)	6.2 ± 1.20 (100)	5.2 ± 1.20 (100)
	T	0.477 ± 0.056*** (48.23)	0.220 ± 0.022*** (32.54)	2.4 ± 0.40*** (38.70)	2.1 ± 0.40*** (40.38)
IV	C	1.119 ± 0.12 (100)	0.795 ± 0.10 (100	8.2 ± 1.20 (100)	5.8 ± 0.80 (100)
	T	0.690 ± 0.10*** (61.66)	0.327 ± 0.061*** (41.13)	3.2 ± 0.37*** (39.02)	2.4 ± 0.42*** (41.37)
V	C	0.993 ± 0.10 (100)	1.318 ± 0.13 (100)	7.4 ± 1.40 (100)	7.2 ± 1.20 (100)
	T	0.505 ± 0.062*** (50.85)	0.586 ± 0.10*** (44.46)	2.6 ± 0.40*** (35.13)	2.8 ± 0.37*** (38.88)
VI	C	0.591 ± 0.057 (100)	0.401 ± 0.043 (100)	4.8 ± 0.80 (100)	4.8 ± 0.80 (100)
	T	0.286 ± 0.080*** (48.39)	0.178 ± 0.031*** (44.38)	1.4 ± 0.24*** (29.16)	1.6 ± 0.24*** (33.33)

Values are expressed in means ± SD of 5 observations. Values in parentheses are percentage change from control (100%). Asterisks indicate values which are significantly different from controls (student's 't' test : Zar 1984).
*** $p < 0.001$.

lipid content of hepatopancreas shows a gradual increase from stage I to stage IV. However, sharply declines in the stage V and VI. In the present investigation lipid content in hepatopancreas and ovary of different ovarian stages of *S. serrata* decreased after exposure to naphthalene. The decline in the lipid content might be due to the utilization of lipids for energy demands under the stress condition (Harper *et al.* 1977: Elumalai *et al.* 1997) .

The esterase activity of the control ovary showed a gradual increase from stage I to V and then decline in the spent stage VI. The hepatopancreatic esterase activity showed that a gradual increase upto stage IV. However in the subsequent stages V and VI the esterase activity declines sharply in the hepatopancreas. Maximum esterase activity in stage IV hepatopancreas coincides with the rapid mobilization of lipid from the hepatopancreas suggesting that these enzymes are specifically involved in the hydrolysis of complex lipid reserves for their release. On the contrary, the esterase activity increases specifically in the ovary during the progressive accumulation of lipid substances. It may be suggested that these esterases are only stored along with the lipid substances in the ovary for its specific role in hydrolysing the lipid yolk during embryogenesis (Ezhilarashi and Subramoniam 1984). In insects, the highest activity of non-specific esterases has been reported insects of intense lipid deposition such as fat of the body (Gilbert *et al.* 1965). In the present investigation esterase activity in hepatopancreas and ovary of different ovarian stages of *S. serrata* decreased after exposure to naphthalene. This is in accordance with the findings of Elumalai *et al.* (1997). Decrease in the esterase activity in hepatopancreas and ovary might be due to the alteration in the lipid metabolism by the naphthalene stress. Baskaran *et al.* (1987) also reported the decreased esterase activity in *Paratelphusa hydrodromous* exposed to metacid. Inhibition of esterase activity suggests the alteration in the lipid metabolism since, the esterase plays significant role in the breakdown of lipids into a small chain fatty acids and thereby producing energy for other metabolic purposes (Vedbrat and Whitt 1975).

In the present study high esterase activity in the hepatopancreas and a moderate amount in the ovary in

S. serrata suggests that they may be involved in various metabolic events occurring simultaneously. The reduced levels of lipids and important enzymes of lipid metabolism might be due to introduction of naphthalene into the circulatory system and interference with the function of female reproductive system. Hence, it can be concluded that naphthalene affect the vitellogenesis of *S. serrata.*

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