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Effect of Naphthalene on Carbohydrate Metabolism During Vitellogenesis in Marine Edible Crab, *Scylla Serrata*

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Marine pollution is associated with the changes in the physical, chemical and biological conditions of the sea waters (Nammalwar 1974). Although a number of workers have studied the effect of naphthalene on various physiological and biochemical responses of Marine organism (Sujatha *et al.* 1990 ; Elumalai *et al.* 1997). Generally the reproductive tissues are the main targets for many environmental factors. For instance exposure to pesticide like monocrotophos resulted in various gonadal tissue abnormalities (Subburaju *et al. 1987).* It is well known that the hepatopancreas in crustaceans functions as storage site of organic reserves which are mobilised to the gonad during the reproductive cycle to meet specific requirements (Balasubramanian and Subramoniam 1987). Considering the extent of studies on the biochemical changes of metabolities in relation to gonadal maturation (Balasubramanian and Subramoniam 1987), information on the effect of environmental pollutants on this aspect is meagre as compared to studies available in fishes (Costa and Ruby 1984).

It is therefore of interest to study changes in tissue glycogen and haemolymph freesugar changes related to vitellogenesis of the marine crab, *Scylla Serrata* exposed to chemical stress. Hence, naphthalene is selected in this study as it is a diaromatic fraction of the crude and refined oils which is considered to be the most toxic component of the water soluble fraction of the crude and refined oils (Nagabhushanam *et al.* 1991).

MATERIALS AND METHODS

Female *Scylla Serrata* were collected from pulicate lake near Madras, Tamil Nadu. They were acclimated to the laboratory temperature (28 ± 1°C) in large glass aquaria for one week, adjusting the level of water to

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keep them just submerged. The water was changed daily. They were fed with flesh 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 naphthalene at 0.020 mg/L concentration.

The treatments 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).

Stage I Immature, prepubertal and reproductively inactive ovary; white and thread like in appearance.
Stage II Reproductively active, showing peripheral undulations for the formation of ovarioles and white in colour.
Stage III Ovariole formation and Oogonial proliferations completed. The ovary is white in colour opaque and thicker than the previous stage.
Stage IV Beginning of vitellogenesis and the ovary acquires colouration from pale to deep yellow
Stage V Bright orange - coloured ovary with vitellogenesis at its peak. Lipid Yolk deposition completed.
Stage VI Spent ovary with a few unspawned Oocytes undergoing resorption and the crab with the sponge.

Muscle, hepatopancreas and ovary were separated from the exposed and control crabs. The haemolymph was collected after prechilling the animals for 5 min. The haemolymph was drained directly into prechilled centrifuge tube from the cut end of propodus or dactylus of an appendage. The glycogen content was estimated by the method of Carol1 *et al.* (1956), using glucose as standard. Free sugar level was determined by the method of Roe (1955), using glucose as standard.

RESULTS AND DISCUSSION

The effects of naphthalene on haemolymph free sugar level and glycogen content of muscle, hepatopancreas and ovary during vitellogenesis of S. *Serrata* are presented in Table 1. The haemolymph freesugar level of the control crab was high only in initial stage of vitellogenesis. The high free sugar level declined to traces at the onset of vitellogenesis (Spent Stage VI). In the present investigation decrease in the free sugar level of haemolymph was observed in pollutant exposed *S. Serrata* in this level (Sujatha *et al.* 1990). They have suggested that decline in the free sugar level might be due to the utilization of energy demand under stress condition.

Glycogen content of ovary of the control crab was high only during initial stages of vitellogenesis. This high

Table 1. Effect of naphthalene on haemolymph free sugar level and tissue glycogen content of *Scylla Serrata* in various stages of ovarian development. [C = control; T = Treated]

Stages		Haemolymph Free sugar	Tissue glycogen		
			Muscle	Hepatopancreas	Ovary
I	C	1.21 ± 0.45 (100)	0.58 ± 0.12 (100)	1.29 ± 0.41 (100)	1.41 ± 0.27 (100)
	T	0.48 ± 0.08** (39.78)	0.25 ± 0.07*** (43.27)	0.61 ± 0.09** (47.29)	0.71 ± 0.09*** (50.42)
II	C	1.44 ± 0.36 (100)	0.48 ± 0.10 (100)	0.88 ± 0.24 (100)	0.68 ± 0.12 (100)
	T	0.61 ± 0.27** (42.56)	0.24 ± 0.03*** (50.92)	0.28 ± 0.09*** (31.86)	0.37 ± 0.12** (53.85)
III	C	1.57 ± 0.61 (100)	0.78 ± 0.10 (100)	1.51 ± 0.62 (100)	1.10 ± 0.45 (100)
	T	0.58 ± 0.27* (36.96)	0.46 ± 0.11** (58.95)	0.77 ± 0.11* (50.89)	0.53 ± 0.17* (48.18)
IV	C	1.42 ± 0.27 (100)	1.03 ± 0.47 (100)	1.38 ± 0.41 (100)	0.77 ± 0.13 (100)
	T	0.48 ± 0.13*** (33.98)	0.50 ± 0.11* (48.45)	0.64 ± 0.26** (46.88)	0.38 ± 0.08*** (50.19)
V	C	0.48 ± 0.07 (100)	1.37 ± 0.29 (100)	1.15 ± 0.36 (100)	0.82 ± 0.14 (100)
	T	0.20 ± 0.45*** (42.38)	0.57 ± 0.16*** (41.42)	0.55 ± 0.10** (47.87)	0.47 ± 0.10** (57.61)
VI	C	0.24 ± 0.08 (100)	1.51 ± 0.58 (100)	0.90 ± 0.28 (100)	0.56 ± 0.08 (100)
	T	0.19 ± 0.02^{NS} (78.83)	0.68 ± 0.29*** (45.10)	0.46 ± 0.10* (51.55)	0.34 ± 0.10** (60.99)

The results were expressed as mg/lOO mg of wet tissue for muscle, Hepatopancreas and ovary and mg/mL for haemolymph ± indicates standard deviation of five observations. In parentheses are % change from control (100%).

^{NS}Not significant, $^{*}P < 0.05$, $^{**}P < 0.01$, $^{***}P < 0.001$

content dropped to traces during vitellogenesis (Stages IV and V) . In hepatopancreas of control crab, the glycogen content was initially high at stage III of ovarian maturation declined sharply in the spent stage VI. In the muscle of control crab the glycogen was sharply rise in the spent stage. In addition, a decline in the organic reserves in stage II may therefore be due to heavy water intake occurring in the fresh moult stage (Balasubramanian and Subramoniam 1987).

In the present investigation, decrease in the glycogen content in the ovary, hepatopancreas and muscle observed in naphthalene exposed *S.Serrata* in this content (Dhavale and Masurekar 1986; Elumalai *et al.* 1997) states the decreased level of glycogen in tissues of toxicant exposed animals. This also suggests a typical stress response confirming the prevalence of hypoxic condition at the tissue level, since anoxia or hypoxia increase carbohydrate consumption (Dezwaan and Zandee 1972) thereby creating a sort of stress on animals even at sublethal resulting in extra expenditure of energy (Keller and Andrew 1973). Decrease in glycogen content in hepatopancreas and muscle of other pollutant exposed crustaceans have been observed by other works (Ghosh and Shrotri 1992). They have also suggested that the decreased level of glycogen in toxicant exposed animals seemed to induce the glycogenolysis, possibly by increasing the activity of glycogenphosphorylase to meet the energy demand under stress condition or the chemical may have an effect on glycogenesis by inhibiting the activity of glycogen synthetase.

In the present study the haemolymph free sugar level and glycogen content of muscle, hepatopancreas and ovary of different ovarian stages of *S.serrata* were decreased after exposure to naphthalene. Hence, it can be concluded that naphthalene affects the vitellogenesis of *S.Serrata.*

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