Table 1 *Activity levels of mitochondrial and cytosolic enzymes of Anabas testudineus after thiouracil and thyroid hormones administration (values are mean ± S.E. for 6 fish)*

Treatment	LDH (μmol NADH/min, mg protein)	Catalase (μmol H_2O_2/min/mg protein)	(nmol NADH oxidized/min/mg protein) Cyt. MDH	Mit. MDH	G 6-PDH
Control	2.61 ± 0.39	136.17 ± 43.42	866.05 ± 30.77	184.00 ± 42.16	58.13 ± 12.80
100 μg thiouracil	2.62 ± 0.22	103.17 ± 15.16	780.30 ± 84.23	225.32 ± 18.77	62 92 ± 10.15
300 μg thiouracil	2.53 ± 0.27	121 73 ± 24.75	547.21 ± 97.98**	117 57 ± 9 05**	51 51 ± 5 11
100 μg thiouracil + 5 μg T_3	2.19 ± 0.35	120.59 ± 15.21	331.86 ± 44.82***	89.45 ± 16.43***	34.87 ± 4.73*
100 μg thiouracil + 5 μg T_4	2.51 ± 0.29	112.19 ± 19.28	460.24 ± 64 07***	102.76 ± 12.35***	39 19 ± 4.95*

* $P < 0.01$; ** $P < 0.005$; *** $P < 0.001$.

spectrophotometrically using B&L Spectronic 2000 spectrophotometer at 25°C. Protein was estimated[7] using BSA as standard. Students *t* test was used for statistical analysis[8].

Administration of 100 μg thiouracil while, produced no change in LDH, cyt. MDH mit. MDH, G 6-PDH and catalase activities, 300 μg thiouracil produced significant decrease in the activities of cyt. MDH and mit. MDH. However, 300 μg thiouracil injection had little effect on LDH, G 6-PDH and catalase activities. Administration of T_3 and T_4 to thiouracil-treated fish while, significantly inhibited the activities of cyt. MDH mit. MDH and G 6-PDH, produced no effect on LDH and catalase activities (table 1).

The unchanged activities of LDH and catalase after thiouracil and thyroid hormones administration seem to support the earlier report about the least response of these enzymes to thyroid hormones[1]. Lee and Lardy[9] reported that LDH activity was not altered by thyroid hormone administration or thyroidectomy in rat.

The decreased activity of G 6-PDH, cyt. MDH and mit. MDH after thyroid hormone injection to thiouracil-treated fish, clearly demonstrate the inhibition these enzymes by thyroid hormones. It has been shown in rat that thyroid hormones had little influence on MDH in either cytoplasmic or mitochondrial fractions[9]. The decreased activity of G 6-PDH implies reduced emphasis of HMP shunt and reduced synthesis of fatty acids in the liver of *A. testudineus*. It may be suggested that the decreased MDH and G 6-PDH activities after thyroid hormone injection to thiouracil-treated fish, may be due to the decreased availability of NAD and NADP in the liver as reported earlier[1].

The present study clearly establishes the fact that exogenous administration of thyroid hormones in *A. testudineus* inhibit the anabolic and stimulate or produce no effect on the catabolic enzymes, regardless of thyroid dysfunction by antithyroid drug administration.

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LIPASE ACTIVITY IN AESTIVATED SNAIL, *PILA GLOBOSA*: NEUROENDOCRINE INVOLVEMENT

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AESTIVATION is an enigmatic phenomenon and several aspects of hibernatory and aestivatory torpor in gastropods have been touched briefly by the

Table 1 *Activity of lipase (μmol of PNPA cleaved/mg protein/h) in the hepatopancreas of active/aestivated snail administered with ganglionic extracts of aestivated/active snail*

	Activity in the control	Activity after the administration of ganglionic extracts				
		Cerebral	Buccal	Pleuropedal	Supra-intestinal	Visceral
Active	0.22 ± 0.014	0.30 ± 0.018 (36.36)	0.25 ± 0.016 (13.64)	0.27 ± 0.011 (22.73)	0.29 ± 0.015 (31.82)	0.26 ± 0.014 (18.18)
Aestivated	0.31 ± 0.018	0.49 ± 0.020 (58.06)	0.37 ± 0.011 (19.35)	0.43 ± 0.021 (38.71)	0.39 ± 0.015 (25.81)	0.41 ± 0.018 (32.26)

Each value is mean ± SD of six individual observations; Values in parentheses are per cent changes over control; All values are significant at $P < 0.05$.

earlier researchers[1-3]. Amongst gastropods, the aestivation metabolism of *Pila globosa* received a good investigative attention in this laboratory[4]. However, the neuroendocrine involvement in the regulation of lipid metabolism received scant attention. Hence, an attempt was made to examine the nature of lipase activity in relation to neuroendocrine involvement during aestivation.

Collection, maintenance of snails and the mode of induction of aestivation have been described elsewhere[5]. Three month aestivated snails were used for the present study. The five ganglia (each weighing 5–10 mg), viz., cerebral, buccal, pleuropedal, supra-intestinal and visceral from normal and aestivated snails were isolated separately and the like ganglia were pooled. One per cent extract was made in 80% ethanol, centrifuged at 1000 *g* at 27°C ± 1 for 20 min and the supernatant was saved. A hole was drilled near the operculum and 0.2 ml of the extract was injected (from active to aestivated snails and vice versa) into the foot carefully under asceptic conditions and the hole was closed immediately with sealing wax. The control snails (six) received the same treatment except that in place of the extract, 0.2 ml of 80% ethanol was injected. The snails were allowed to move about freely in containers having autoclaved water with 1000 IU of pencillin/l added to it. After 1 h hepatopancreas was isolated in cold and lipase activity (μmol of para nitrophenyl acetate (PNPA) cleaved/mg protein/h) was estimated by the method of Huggins and Lapides[6].

Lipase activity was assayed in the hepatopancreas of active, aestivated and ganglionic-administered snails. Increased lipolytic activity (0.31 μmol of PNPA cleaved/mg protein/h) was observed in the hepatopancreas of aestivating snails when compared to that of normal snails (0.22 μmol of PNPA cleaved/mg protein/h). Similar elevation was noticed in both normal and aestivated snails upon administration with ganglionic extracts. Of the five ganglia tested in both the types (normal and aestivated snails), the effect of cerebral ganglia was more than that of other four ganglia, buccal, pleuropedal, supra-intestinal and visceral. In general, the ganglia of normal snails elicited more activation when compared to that of aestivated snails (table 1).

The increased lipase activity during aestivation is attributed to the lack of synchronization between synthesis and liberation of digestive enzymes in the absence of food. Moreover, the mobilization of lipid reserves (by lipolysis) to maintain the metabolic needs of animals during suspended animation is one of the reasons for the elevated lipase activity. The depletion of fat reserves of the digestive gland of some molluscs during suspended animation also supports the above contention[7].

It was reported that several hormones and pharmacological agents are known to increase lipolytic activity[8] and the increased lipolytic activity upon the treatment with ganglionic extracts may also lead to the speculation that the existence of such principle(s) in ganglia. Steinberg[9] reported that the elevation in cyclic AMP levels is one of the causative factors for the activation of lipase activity and the same mechanism may be prevailed to elevate the lipase activity in the snails under the aegis of ganglionic principle(s).

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STAPHYLINID BEETLE, *PAEDERUS FUSCIPES* CURTIS.—A POTENTIAL BIO CONTROL AGENT IN RICE

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RICE is the foremost food crop of the developing world and also a major source of protein for masses in Asia[1]. It is subjected to attack by more than 100 insect pests, 20 being of major importance[2]. During the past several years, there has been an increased interest in the utilization of natural enemies, particularly predators for the regulation of rice insect pests[3–5]. Due to abnormal increase in the number of insect pests associated with the rice crop, integrated pest management strategies require a systemic study of the natural enemy complexes of rice pests. Among them, the predatory beetle (*Paederus fuscipes* Curtis.) is highly abundant in the rice fields and this, if conserved or augmented, can regulate many insect pests. An attempt was made to study the predatory potential of the beetle on rice hoppers under green house conditions at the Paddy Breeding Station of this university.

Natural occurrence

Natural occurrence of this predatory beetle in large numbers was noticed in certain rice ecosystems of Avinashi at Coimbatore district during January and February, 1988. The predatory beetle population ranged between 5 and 20/m^2 and it was identified as *Paederus fuscipes* Curtis. (Staphylinidae: Coleoptera). Beetles are small, 9 mm long, elongate, brightly coloured with black sclerotized head, red thorax and bluish abdominal segments. Hind wings are well-developed. They are very active and nocturnal in habit. They occur in paddy fields ready for harvest and are found in the field bunds, cracks and crevices in the soil. They are highly attracted towards the moist soil and shady places. The grubs are predacious and prey upon dead and disabled ants. Adult beetles are known to secrete toxic substances cutaneously or from their pygidial glands. The substances cause blisters on the skin which subside in 3–4 days.

Predatory potential

The predatory potential of the adult staphylinid beetle on the adults of brown plant hopper (BPH), *Nilaparvata lugens* Stal., white backed plant hopper (WBPH), *Sogatella furcifera* Horvath. and green leaf hopper (GLH), *Nephotettix virescens* Distant was studied in three different experiments by caging in the potted rice plants with definite number of hoppers along with prestarved (4 h) two adult beetles. Thirty adults of each type were provided in each experiment as food for every two adult beetles. Five replicates (hills) were maintained in each experiment.

The number of each type consumed by beetles was recorded daily. Fresh population of hoppers (BPH/WBPH/GLH) was provided each day to maintain a constant population of 30/replication. The predatory potential was assessed for five days.

The data collected on their predatory rate on BPH, WBPH and GLH are presented in table 1. The results revealed that each staphylinid beetle consumed on an average 8.7 BPH or 8.3 WBPH or 8.4 GLH per day. The information on the predatory rate of the staphylinid beetle on rice hoppers will help us to fix an appropriate threshold level for rice

Table 1 *Predatory rate of staphylinid beetle, Paederus fuscipes Curtis. on different species of rice hoppers*

Rice hopper	Stage	Number of hoppers introduced	Mean number consumed by a beetle per day
N. lugens	Adult	30	8.7[a]
S. furcifera	Adult	30	8.3[a]
N. virescens	Adult	30	8.4[a]

[a]Mean numbers are not significantly different at 5% level.