Proc. Indian Acad. Sci., Vol. 88 B, Part I, Number 1, February 1979, pp. 25–28,
© printed in India.

Neural control of glutamate dehydrogenase activity in the apple snail, *Pila globosa* (Swainson)

Y SRINIVASA REDDY, P ARUNA, C SREE RAMULU CHETTY, R CHANDRAMOHAN NAIDU and K S SWAMI
Department of Zoology, S V University, Tirupati 517 502

MS received 25 March 1978

Abstract. Effects of the three ganglionic extracts, viz., cerebral, pleuropedal and visceral ganglia from active and aestivated snails on glutamate dehydrogenase activity in the foot and digestive gland of active *Pila globosa* were studied. The activation with cerebral ganglia was less when compared with visceral and pleuropedal ganglia in foot but in case of digestive gland, the activation reached with cerebral ganglia extract surpassed all other ganglionic effects. The significance of these findings was discussed.

Keywords. Aestivation; *Pila globosa*; glutamate dehydrogenase.

1. Introduction

Recent studies have shown that the nitrogen excretory metabolism of *Pila globosa* is under neural control (Nayeemunnisa 1972; Shylaza and Alexander 1975). Active snails accumulated urea and uric acid characteristic of aestivated snails when extract of cerebral ganglia of aestivated snails was injected into active snails. Aestivated snails excreted more ammonia when active snail cerebral ganglia extract was injected into them. But studies on hormonal control of excretory metabolism hitherto were confined only to final excretory products, viz., ammonia, urea and uric acid and there are no reports of the control on the enzymes involved. Also, the kinetics of neuronal action was not known. The present study dealing with the time course action of three major ganglia, viz., cerebral, pleuropedal and visceral ganglia of active and aestivated snails on glutamate dehydrogenase activity aims at these two problems and some interesting conclusions were made.

2. Materials and methods

Pila globosa brought to the laboratory from ponds in and around Tirupati were acclimated in aquaria for about a week. They were fed with *Hydrilla* and *Vallisnaria* leaves *ad libitum*. Aestivation was induced in some of the snails as described earlier (Srinivasa Reddy *et al* 1974). Three month aestivated snails were used for the present study.

The three ganglia, viz., cerebral, pleuropedal and visceral from active and aestivated snails were isolated separately and extracts of the same ganglia were pooled. A 1% extract was made in 80% ethanol, centrifuged and the supernatant was saved. A hole was drilled near the operculum and 0·2 ml of the extract was injected into the foot of active snail carefully under aseptic conditions and the hole was closed immediately with sealing wax. The control 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 in containers having autoclaved water with 1000 I.U. of pencillin/litre added to it for stipulated time periods after which digestive gland and foot were isolated and a 5% homogenate was prepared in 0·25 M sucrose solution. The GDH activity was estimated by the method of Nachlas *et al* (1960) and the activity expressed in μ moles formazan formed/mg protein/hr.

3. Results and discussion

An appraisal of the results (figures 1 and 2) shows that the extracts of all the ganglia increased the glutamate dehydrogenase activity. The activation realised with extracts from active snail was more than that with aestivated snails. In general maximum activation was reached in 60 min and in most cases exactly at 1 hr but for a stray case of cerebral ganglia effect on foot where maximum activation was reached at 2 hr. There was a tendency to reach normal levels at 3 hr period and in some cases the activity dropped to subnormal levels probably to make up the loss of metabolites due to prior abnormal activity levels of the enzyme. Incidentally it could be seen that subnormal levels of enzyme activity reached only with aestivated ganglionic extracts though the activation with them was much less, a strange contradiction, an accurate answer for which is not available at this stage. It could also be mentioned that during aestivation in the laboratory glutamate dehydrogenase activity decreased in its activity in the tissues of *Pila globosa* (Raghupathirami Reddy and Swami 1967).

The maximum activation with visceral and pleuropedal ganglia was more than with cerebral ganglia of both active and aestivated snails in the case of foot. The activations reached were 658, 512 and 148, 138% for pleuropedal and visceral ganglia respectively of active and aestivated snails. With cerebral ganglia of active and aestivated snails the maximum activations were 448 and 74%. It appears that the enzyme activities in tissues are controlled by secretions of innervating ganglia. The activation with aestivated ganglia were 510, 374 and 374 less for pleuropedal, viscereal and cerebral ganglia respectively than with the corresponding ganglia from active snails. Two possibilities exist. Either the aestivating snail ganglia might be releasing an inhibitory principle (hormone?) or the quantum of the activating principle secreted by aestivating snail ganglia is much less than that secreted by active snail ganglia. Another conclusion that could be made from the results was that the neural principle had a very short half life 15–60 min indicating that it is labile and would be continually secreted and broken down to maintain the activity levels of the enzyme at physiologically viable concentrations. Further studies are in progress to know the nature of the ' principle '.

In digestive gland, the activation reached with cerebral ganglia extract surpassed all other ganglionic effects indicating *in vivo* influence of secretions of this ganglia

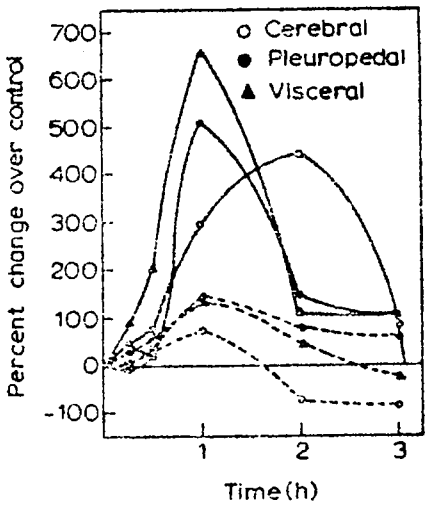

Figure 1. Effect of different ganglionic extracts on glutamate dehydrogenase activity of foot of active and aestivated *P. globosa*. Solid lines represent active snail ganglionic extracts, dashed lines effects of corresponding ganglia from aestivated snail.

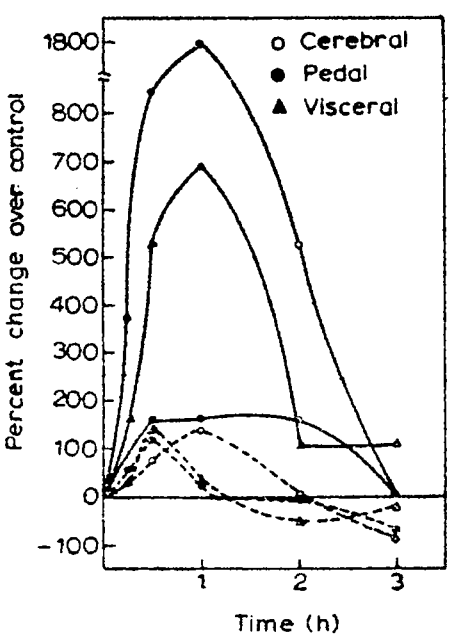

Figure 2. Effect of different ganglionic extracts on glutamate dehydrogenase activity of digestive gland of active and aestivated *P. globosa* (see legend of figure 1).

on digestive gland. It could not be said beyond doubt whether neural principles secreted by the three ganglia was/were same or different or was it secreted by cerebral ganglia, the other two ganglia acting as just storage and release sites.

Acknowledgement

CSRC and PA are thankful to CSIR for fellowships, during the tenure of which the work has been done.

References

Nachlas M M, Margulies S I and Seligman S I 1960 Sites of electron transfer to tetrazolium salts in the succinoxidase system; *J. Biol. Chem.* **235** 2739–2743

Nayeemunnisa 1972 Aspects of nitrogen excretion during aestivation in the amphibious snail, *Pila globosa*; *Comp. Biochem. Physiol.* **42** 1049–1053

Raghupathirami Reddy S and Swami K S 1967 Respiratory enzymes during aestivation of the Indian apple snail, *Pila globosa* (Swainson); *Life Sci.* **6** 341–345

Shylaza R and Alexander K M 1975 Studies on the physiology of excretion in the fresh water prosobranch, *Pila virens*; *Indian J. Exp. Biol.* **13** 363–365

Srinivasa Reddy Y, Venkateswara Rao P and Swami K S 1974 Probable significance of urea and uric acid accumulation during aestivation in the gastropod, *Pila globosa* (Swainson); *Indian J. Exp. Biol.* **12** 454–456

Srinivasa Reddy Y and Swami K S 1976 Some metabolic effects of aestivation on glycolysis in *Pila globosa* (Swainson); *Indian J. Exp. Biol.* **14** 191–193