VENTROMEDIAL NEUROSECRETORY NEURONS (TYPE A) IN THE SUBOESOPHAGEAL GANGLION OF MORIMUS FUNEREAUS MULS. (1869) DURING POSTEMBRYONIC DEVELOPMENT. Vera Nenadović, Marija Mrdaković and Larisa Ilijin, Department of Insect Physiology and Biochemistry, “Siniša Stanković” Institute for Biological Research, 11060 Belgrade, Serbia and Montenegro

The presence of one pair of ventromedial neurosecretory neurons (vmnsn, type A) has been described in the suboesophageal ganglion (SG) of many insect species from different orders (Raabe, 1982). These neurons synthesize arginine–vasopressin neuropeptides, which have a diuretic effect on the Malphigian tubules and/or inhibit water resorption in the rectum (Philippis, 1983; Spring, 1990). Investigations of temperature stress in 2 and 3 year old larvae of Morimus funereus confirmed the presence of one pair of vmnsn SG and brain neurosecretory neurons belonging to type A. Changes of their activity were noticed already after six hours of exposure to unfavorable temperature, which points to a significant role of its neurohormones in the processes of acclimation and acclimatization to thermal stress (Ivanović et al., 1975a, 1975b).

Investigations of differentiation of the cerebral neuroendocrine system during embryonic development of M. funereus showed that 6 to 7 day old embryos had a general morphological plan of cerebral complex structure. A large number of paraldehyde–fuchsin positive (PF+) neurosecretory neurons (type A) in various phases of differentiation were found in the brain, suboesophageal ganglion, and frontal ganglion. The highest level of differentiation was noticed in SG, which underlines the functional and evolutionary significance of its neurohormones (Stanić et al., 1978; Nenadović et al., 1986).

The present work gives the results of investigations of changes in the size and number of vmnsn SG during postembryonic development of M. funereus.

The suboesophageal ganglion of newly hatched larvae is still more developed than the brain. Brain lobes are feebly differentiated and distant. As flattened foils, they lean against the gut in such a way that their lateral parts are in a ventral position. Corpora allata are well–developed, while the corpus cardiacum is insufficienly differentiated and has a small number of visible axons and intrinsic neurons, which is characteristic of embryos (Nenadović et al., 1978, 1987).

The suboesophageal ganglion of newly hatched larvae is characterized by well–developed neuropil and a large number of PF+ neurosecretory neurons. Embriotic traits are less expressed in SG than in the brain, i.e., neurons of SG are more differentiated than brain neurons (Nenadović et al., 1985; Nenadović, 1992).

In view of the long postembryonic development of M. funereus, the question arises as to how long cytodifferentiation of PF+ neurosecretory neurons of its SG lasts.

The M. funereus larvae used in this experiment were reared in laboratory conditions from hatching to sacrificing (constant temperature of 23°C, relative humidity of 70%, absence of light, and artificial diet according to Roberts, 1986). Under these conditions, larval development lasts 6.5 months and pupal development 15 days (Nenadović et al., 1989; Stanić et al., 1989; Nenadović, 1992). Individuals were sacrificed on the fourth day after molting into the first, third, fourth, sixth, and eighth larval instars (the eighth being the last larval instar, L8); in the prepupal and pupal stages; in pharate adults; and in 24–h adults. Each group consisted of five individuals. Head capsules were fixed in Bouin’s fixative. Standard histological procedure was used for embedding in paraffin. Serial paraffin sections of 5μm were stained using the paraldehyde Thionine Phloxine and Alcian Blue Phloxine techniques (Panov, 1980). Tissue analysis was performed using a light microscope. The size of pericarya was expressed as average values of the product of their larger and smaller diameter.

The results presented on Fig.1 show increase in size of vmnsn from the first to eighth larval instar (LI). The size of these neurosecretory decreases in the prepupa and pupa, i.e., at the beginning of and during metamorphosis. The size of vmnsn SG increases in adults and they become larger than larval neurons. According to Panov (1968), the synthetic activity of neurosecretory tissues can increase by increase in number and/or size of their neurons. Both mechanisms have been described for protocerebral neurosecretory neurons of type A (A1, A2, L1, L2 etc.) in M. funereus (Nenadović, 1992). Similar results have been obtained in Tenebrio molitor (Janković–Hladni, 1971), which is in agreement with results obtained in other insect species (Satija and Kaur, 1965; Weeks and Levine, 1990).

A high number of PF+ vmnsn SG is evident at the beginning of the first larval instar (which lasts 6–7 days), but there were only three pairs of neurons (one pair of dorsal and two pairs of lateral neurons) on the fourth day of the first instar. Their number and position did not change during further postembryonic development. There are two possible causes of decrease in number of vmnsn SG in the first instar of M. funereus larvae: death or migrations of neurons. Neuron death is best investigated in insect metamorphosis (Singh and Srivastava, 1974; Schwarc and Truman, 1982), but it is also known to happen in specific phases of embryonic and postembryonic development under the influence of many exogenous and neurohormonal fac-
tors (Fahrbach, 1997). Migrations of PF+ neurons to other parts of central nervous system also appear to be possible, in view of the presence of arginine-vasopressin like neurons in the protocerebrum and first thoracic ganglion of some insects (Girardie et al., 1984). Since diuresis in insects is under neuroendocrine control (Spring, 1990), further investigations on vmnsn SG would be of great importance for solving both theoretical and practical problems.

Acknowledgements — This work was supported by the Ministry of Science, Technology, and Development of Serbia, project No 1615. The authors are grateful to Dr. Jelisaveta Ivanović and Dr. Jelica Lazarević for useful suggestions.


Fig. 1. Size of vmnsn SG during postembryonic development of Morimus funereus M. I, III, VI, LLI — larval stages, PP — prepupa, P — pupa, PhA — pharata adult, A — adult.

Fig. 2. Vmnsn SG in larval instar IV (×640).