Thesis Title	Study on the Structure and Function of Neuroendocrine Organs in Giant Afrigan Snail, *Achatina Fulica*
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ABSTRACT

The land snail *Achatina fulica* is a hermaphroditic snail belonging to the Subclass Pulmonata, Order Stylommatophora. The nervous system of *A. fulica* is composed of 13 ganglia: 1 pair of buccal ganglia, 1 pair of cerebral ganglia, 1 pair of pleural ganglia, 1 pair of parietal ganglia, 1 pair of pedal ganglia, 1 pair of tentacular ganglia and a single visceral ganglion. The

ganglia are connected with one another via a connection. All ganglia give rise to many nerve branches which supply various organs of the body.

The histological structure of all ganglia is rather similar. The ganglia are surrounded by two layers of connective tissue; the outer layer is thicker and loosely arranged than the inner layer. Within the ganglia, there are five sizes of nerve cells or ganglionic cells, i.e., the globuli cells (5-7 um), the small cells (< 20 um), the medium cells (20-39 um), the large cells (40-99 um) and the giant cells (> 100 um). In the cerebral ganglia and tentacular ganglia, there are masses of very small cells or globuli cells which have the diameter in the range of 5-7 um.

The ganglionic cells arrange themselves around the mass of nerve axons or neuropil. In general, nuclei of the ganglionic cells are round but nuclei of the giant cells have irregular shape. The numbers of giant cells in each ganglion vary; there are 16, 14, 8, 6, 4 and 4 giant cells in the pedal, parietal, cerebral, visceral, pleural and buccal ganglia of adult snail, respectively.

The ultrastructures of the ordinary neurons are rather similar. They contain mitochondria, rough endoplasmic reticulum, ribosomes, lysosomes, lipid droplets, microtubules, Golgi apparatus and electron-dense elementary granules (800-1400^{0}A) in the cytoplasm.

From observation, the appearance of neurosecretory cells in the nervous system of *A. fulica* is found in the cerebral ganglia and optic tentacles. These neurosecretory cells give positive reaction with chrome-haematoxylin phloxine and paraldehyde-fuchsin. Their cytoplasm stains blue-black and deep purple while their nuclei stain black and red with chrome-haematoxylin phloxine and paraldehyde-fuchsin, respectively.

In the cerebral ganglia, there are about 104 to 110 neurosecretory cells (23-30 um) in each ganglion. These cells arrange themselves into 2-3 layers attached to the periphery of the procerebrum of the cerebral ganglion. In the posterior of optic tentacles, the neurosecretory cells or collar cells (12-25 um) arrange themselves in groups around the finger-like processes of tentacular ganglion. There are about 2168 cells per mm^2 in the optic tentacles of mature snails.

Under transmission electron microscopy, the neurosecretory cell in the cerebral ganglia contains round and slightly heterochromatic nucleus and many organelles in the cytoplasm, such as many extended rough endoplasmic reticulum, Golgi apparatus, mitochondria, microtubules, ribosomes, lysosomes, lipid droplets and abundant electron-dense elementary granules with a mean diameter of $1,600^0$A. The ultrastructure of the collar cell in the optic tentacles is similar to that of neurosecretory cells in the cerebral

ganglia. However, the electron-dense elementary granules in the collar cells have a mean diameter of 4,000^{0}A.

The nervous system of *A. fulica* has already been well organized occurred in the newly-hatched snails. During development, all the ganglia and the number of nerve cells in the ganglia increase with increasing age of snails. In addition, the number and size of large cells and giant cells are also increased. In parallel with development of the nervous system, neurosecretory cells in the cerebral ganglia first appear in two-month-old snails (9 cells per ganglion) and are abundant (108-110 cells per ganglion) in mature snails. The collar cells in the optic tentacles of *A. fulica* have already occurred in newly-hatched snails. Similar to the other cells, the collar cells increase in size and number with increasing age of snails.

The study on seasonal variation of neurosecretory cells in the nervous system of *A. fulica* indicated that the numbers of neurosecretory cells in cerebral ganglia are high in April, May and August, with the highest number in May. The numbers of neurosecretory cells in cerebral ganglia are rather low in January, February and December. Moreover, the neurosecretory cells in cerebral ganglia appear to have a large diameter in May.

The numbers of collar cells in the optic tentacles of *A. fulica* are rather constant throughout the year except during

November. Moreover, it can be observed that the size of collar cells remain the same throughout the year.

The effects of neurosecretory cells on development of germ cells in the ovotestis and on body growth of *A. fulica* were studied. The injection of snails with cerebral ganglion homogenate and with optic tentacle homogenate revealed that both substances have no effect on body growth of *A. fulica*. However, the cerebral ganglion homogenate appears to increase the oocyte production while the optic tentacle homogenate seems to increase the production of spermatozoa in the ovotestis of snails.