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# Development of Neurosecretory Cells in Thoracic Ganglion and Changes Associated with Development and Metamorphosis in Larvae, Juveniles and Adults of *Macrobrachium lamerrii*

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**A B S T R A C T**

Four types of neurosecretory cells, designed as A, B, C and D were distinguished in the thoracic ganglion and their development was studies from 24 hours (hatching) to adult stage. The changes during development and their regulation in the process of metamorphosis were observed. It was found that the neurosecretory cells are playing a key role during metamorphosis.

## Introduction

The various physiological activities crustaceans are controlled by neuroendocrine centres. Throughout the nervous system of crustacean neurosecretory cells are located producing physiologically active substances. Neurosecretory cells are the modified neurons. In a typical neurosecretory cell the neurosecretory materials is synthesized in the cell body and is then transported along the axon to the axon terminal, where it is stored until released. The pattern of distribution, the cell number and secretary activity is not constant. As the structure of organs is different in larvae and adults, consequently physiology and behaviour are different in both. Hormonal regulation is characteristic during larval life. The histogenesis of the neurosecretory system of thoracic ganglion is undertaken in this paper to interpret the changes and regulation during development.

## Materials and Methods

Berried forms of *M. lamerrii* were obtained from Kham River near Aurangabad, and maintained in aerated tanks. By 29-30$^{th}$ day of embryonic development larvae hatched out and those were maintained in aerated finger

bowls. Water was changed twice daily and the larvae were fed with green algae. The thoracic ganglion of larvae at 24 hrs (after changing), 5 days, 10 days, 15 days, 21st day and a juvenile immature stage and mature adult stage animals were fixed in Bouin's fixative. After processing the tissues (dehydration, paraffin embedding and sectioning at 4-5 µ) the sections were stained with Aldehyde fuchsin.

## Results and Discussion

### Neurosecretary system in one-day-old larvae

The larvae measured 4.2 – 4.5 mm. In longitudinal section the three lobes of the thoracic ganglion were clearly distinguished. The third lobe was the largest of all the three. The neurosecretary cells were seen surrounding the intact neuropile area. The staining intensity of A, B cells were moderate. Cell number, diameter and staining intensity of these cells were given Tables 1-3.

### Neurosecretary system of 5-day-old larva

The larva measured 4.6 – 4.9 mm cells were a little advanced in size from the previous stage. The giant neuron made its appearance on left side of the middle lobe. Neurosecretary activity was moderate. The number of cells (A, B, C and D) their diameters and staining intensity were given in Table 1-3.

### Neurosecretary system of 10-day-old larva

The larvae measured 4.8 – 5.2 mm. Metamorphosis occurs in IV stage (8-12 days) of development. As this is the critical stage of metamorphic development, many changes were seen associated with this stage. The number of cells, neuropile area was increased. Giant neuron became distinct. Cells were clearly distinguishable. The staining intensity of neuro pile area and the neurosecretary material of A, B, C cells were very good so the rate of synthesis and transport of MSM was very active. No vacuoles were seen. The number of cells, their diameters and staining intensity were indicated in Tables 1-3.

### Neurosecretary system of 15-day-old larva

The larvae (post larval stage) measured 5.2 – 5.5 mm. The staining intensity of A,B,C cells was less than that of precious stage. No vacuoles were observed. The number of cells, their diameters and staining intensity were indicated Tables 1-3.

### Neurosecretary system of 21-day-old larva

Larvae measured 5.4 – 5.8 mm in length. The dorsomedian group of NS cells made their appearance. More cells were observed surrounding the middle and last lobe. Neurosecretary activity was moderate. On the left side, just at the transition between first and middle lobe the giant neuron was distinctly seen. The number of cells, their diameters and staining intensity were indicated in Tables 1-3.

### Neurosecretary system in juvenile

This measured 1.0 – 2.0 mm in length. In addition to dorsomedian, the ventromedian group of cells also made their appearance. The lateral group though made their appearance but not clear. The staining intensity of cells and neuropile area was good so the rate of transport was in progress. The number of cells, their diameters and staining intensity were given in Tables 1-3.

### Neurosecretary system in adults

The neurosecretrary cells were very distinct, and they occurred as discrete groups along the

mid dorsal, mid ventral and median regions. A,B,C cells were present in dorsal, mid ventral and median regions. B, C, and D cells were present in the postero lateral, antaro lateral, and mid lateral regions. No giant neuron was observed in the first lobe. A type cell was present in the last lobe. In the median and last lobe B type of cells were notices while C and D were found in all the three lobes of thoracic ganglion.

**Table.1** Type of number of Neurosecretory cells in the thoracic ganglia of *M. lamerrii* during development

| Days of development | Type of cells | | | |
|---|---|---|---|---|
| | A | B | C | D |
| **1** | 1 | 2-3 | 6-7 | 10-15 |
| **5** | 1 | 3-4 | 8-10 | 20-24 |
| **10** | 2 | 4-6 | 10-15 | 25-30 |
| **15** | 1 | 5-8 | 15-20 | 30-35 |
| **21** | 1 | 8-9 | 20-25 | 35-40 |
| **Juvenile** | 2-3 | 8-12 | 23-28 | 38-46 |
| **Adult** | 3-4 | 10-13 | 30-35 | 46-52 |

**Table.2** Neurosecretory material intensity of different neurosecretory cells in thoracic ganglion during development of prawn *M. lamerrii*

| Days of development | Type of cells | | | |
|---|---|---|---|---|
| | A | B | C | D |
| **1** | * | * | - | - |
| **5** | * | * | * | - |
| **10** | *** | ** | * | - |
| **15** | ** | * | * | - |
| **21** | ** | * | * | - |
| **Juvenile** | *** | ** | * | |
| **Adult** | *** | ** | * | - |

No neurosecretary material
*Presence
**Medium
*** Maximum

**Table.3** Neurosecretary cell diameters (µ) at different days during development of thoracic ganglion in *M. lamerrii*

| Days of development | Type of cells | | | |
|---|---|---|---|---|
| | A | B | C | D |
| **1** | 11.48 ± 1.16 | 8.82 ± 0.956 | 4.76 ± 3.2 | 2.24 ± 0.56 |
| **5** | 13.16 ± 0.72 | 8.96 ± 1.02 | 6.6 ± 0.00 | 2.52 ± 0.39 |
| **10** | 1.0 ± 1.02 | 9.24 ± 0.72 | 7.3 ± 0.56 | 2.98 ± 0.85 |
| **15** | 14.56 ± 0.56 | 10.36 ± 0.72 | 8.21 ± 0.86 | 4.46 ± 0.56 |
| **21** | 15.68 ± 0.56 | 10.48 ± 1.02 | 8.59 ± 1.16 | 5.32 ± 0.72 |
| **Juvenile** | 20.2 ± 2.8 | 15.74 ± 1.24 | 11.5 ± 0.7 | 7.12 ± 0.72 |
| **Adult** | 35.92 ± 4.5 | 20.5 ± 2.8 | 13.16 ± 0.72 | 8.52 ± 1.44 |

The present study on the development of neurosecreatry cells revealed the presence of 4 types of cells. A cells are largest, few in number, B type of cells were medium seized and distributed in all the ganglia. C and D were small and abundant.

The longitudinal sections of thoracic ganglia revealed the distribution of different neurosecretary cells mainly on the periphery of neuropile area on both dorsal and ventral sides – By 5$^{th}$ day a single A cells was seen. The C and D cells were present in groups but could not be clearly differentiated – By 10$^{th}$ day of development the A, B, C cells revealed increase in their staining intensity of neurosecretory material. By 21$^{st}$ day the localization of mid dorsal group was stopped. By the rime juvenile centres immature stage, the localization of neurosecretory cells was organised into definite groups. In adults the central ventral side group was more prominent.

The distribution of neurosecretary cells in thoracic ganglia of *M. lamarrii* was found to be similar to that in Caridina rajadhari and M. kistensis, in cardina rajadhari, M. kistensis and P. Indicus. At immature stages the neurosecretary types are found in all phases of secretary cycle. (Otsu, 1960; Esatman – Recks and Fingerman, 1984; Takayangi *et al.*, 1986; Yano *et al.*, 1988; Kulkarni *et al.*, 1991; Joseph, 1996; Zacharia, 2001).

The staining intensity was decreased immediately after molting (post-molt) the neurosecretary potential was also reduced in neurosecretary cells during premolt. They observed a gradual building up of PEM through intermolt and premolt stage. Vijayan (1988). In P. Indicus a high percentage of active neurosecretory cells in premolt and low percentage in post molt and intermolt was observed.

From the above reports it can be concluded that the activity of neurosecretary cells are in accordance with their physiological activities. During this investigation the neurosecretary material intensity was found to be more at 10 days (IV stage) than that of 15 days (post larval stage). These larvae metamorphose at IV$^{th}$ satge (8-12 days) of their development. So the neurosecretory material intensity is more at IV$^{th}$ stage (critical meramorphic stage) and it consequent decrease by post-larval stage (15 days). From this we may conclude that the neurosecretary cells are playing a key role during meramorphosis.

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