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Histomorphology of the Hypothalamo - Neurosecretory System of the Indian Scad, *Decapterus tabl* (Berry)

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Abstract

Hypothalamus of *Decapterus tabl* consists mainly of the nucleus preopticus (NPO), nucleus lateralis tuberis (NLT) and their axonal tracts. NPO is a paired structure situated on either side of the third ventricle antero-dorsal to the optic chiasma. It is highly vascularized structure and looks inverted L-shape in sagittal sections. NPO is divisible into a dorsal pars magnocellularis (PMC) comprising large neurons and pars parvocellularis (PPC) formed by smaller neurosecretory cells. NLT neurons are distributed uniformly in the infundibular floor adjacent to the pituitary stalk. Neurons of PMC and PPC contribute beaded axons to form neurohypophysial tracts. Herring bodies are also noticed in the neurohypophysis. Neurosecretory cells (NSC) of both the NPO and NLT depict fluctuations in their secretory activity in response to the gonadal maturation.

Introduction

Hypothalamus is a strategic point in the vertebrate brain that mediates the organismic endocrine responses and adjustments to the environmental changes (Peter, 1973, Bhattacharya, 1992). The vertebrate hypothalamus comprises groups of neurosecretory cells (NSC) which control the secretion and release of various trophic hormones of the pituitary by elaborating releasing (-RH) or inhibiting (-IH) hormones (Peter, 1977). Hypothalamus also contains receptors specifically sensitive to the hormones which, in turn, regulate its activity through feedback mechanism (Ball, 1981). Though several workers have described the hypothalamo-neurosecretory complex of teleosts inhabiting freshwater (Maksimovich, 1987), such studies are very few among marine species (Tischenko *et al.*, 1976). An attempt was therefore made to record the hypothalamo-neurosecretory system of the Indian scad, *Decapterus tabl* (Berry).

Material and Methods

50 specimens of *Decapterus tabl* (Berry) of both the sexes (size 13-16 cm) were collected by operating FAO trawl net on board FORV Sagar Sampada (cruise no. 49) from the north-east coast (18° 40.5' N; 84° 35' E) (Bay of Bengal). Their brain along with pituitary and a piece of gonad (to judge the maturity stage) were extirpated and fixed immediately in freshly prepared aqueous Bouin's solution. After 24 hours, they were washed in running tap water and preserved in 70% ethyl alcohol. The tissues were dehydrated and serial sections cut at 6-8μ and stained in Mallory's triple, aldehyde fuchsin (AF) and chrom-alum-hematoxylin-phloxine (CAHP). Gonads were stained in hematoxylin-eosin.

Results and Discussion

Hypothalamo-neurosecretory complex of *Decapterus tabl* consists mainly of the nucleus preopticus (NPO), nucleus lateralis tuberis (NLT) and their zonal tracts. The neurosecretory cells of NPO are generally bipolar and stain readily with aldehyde fuchsin (AF) and chrom-alum-hematoxylin-phloxine (CAPH) but they are also positive to acid fuchsin in Mallory's triple stain. (Fig. 1) NPO is a paired structure situated on either side of the third ventricle antero-dorsal to the optic chiasma. It is highly vascularized structure and looks inverted L-shape in the sagittal section. The small horizontal limb comprises of sparsely distributed neurons whereas the cells are closely packed in the vertical limb. The NPO is divisible into a dorsal pars magnocellularis (PMC) comprising of larger neurosecretory cells (Fig. 1) and a ventral pars parvocellularis (PPC) formed of smaller cells (Fig. 3). Thus, we observe a progressive reduction in the size of NSC from dorsal to the ventral aspect of NPO. Interestingly, PMC and PPC neurons exhibit depletion of the secretory granules in their cytoplasm in the matured (stage V) specimens of both the sexes (Figs. 2, 4). However, a few acid fuchsin-positive colloid-like materials are seen among the PMC neurosecretory cells of matured female scad (Fig. 2).

The NLT cells are distributed uniformly in the infundibular floor adjacent to the pituitary stalk (Fig. 5). They are negative to AF and CAHP but stain readily with acid fuchsin in Mallory's triple stain. Based on the distribution and size of the neurosecretory cells, NLT may be divisible into pars anterior (Fig. 6), pars posterior (Figs. 7, 8) and pars inferior (Fig. 9). The neurons are variously shaped and their size range from very small to the larger ones with polymorphic nuclei. A progressive reduction in the size of neuronsecretory cells from anterolateral to the ventrolateral aspect of NLT is seen in

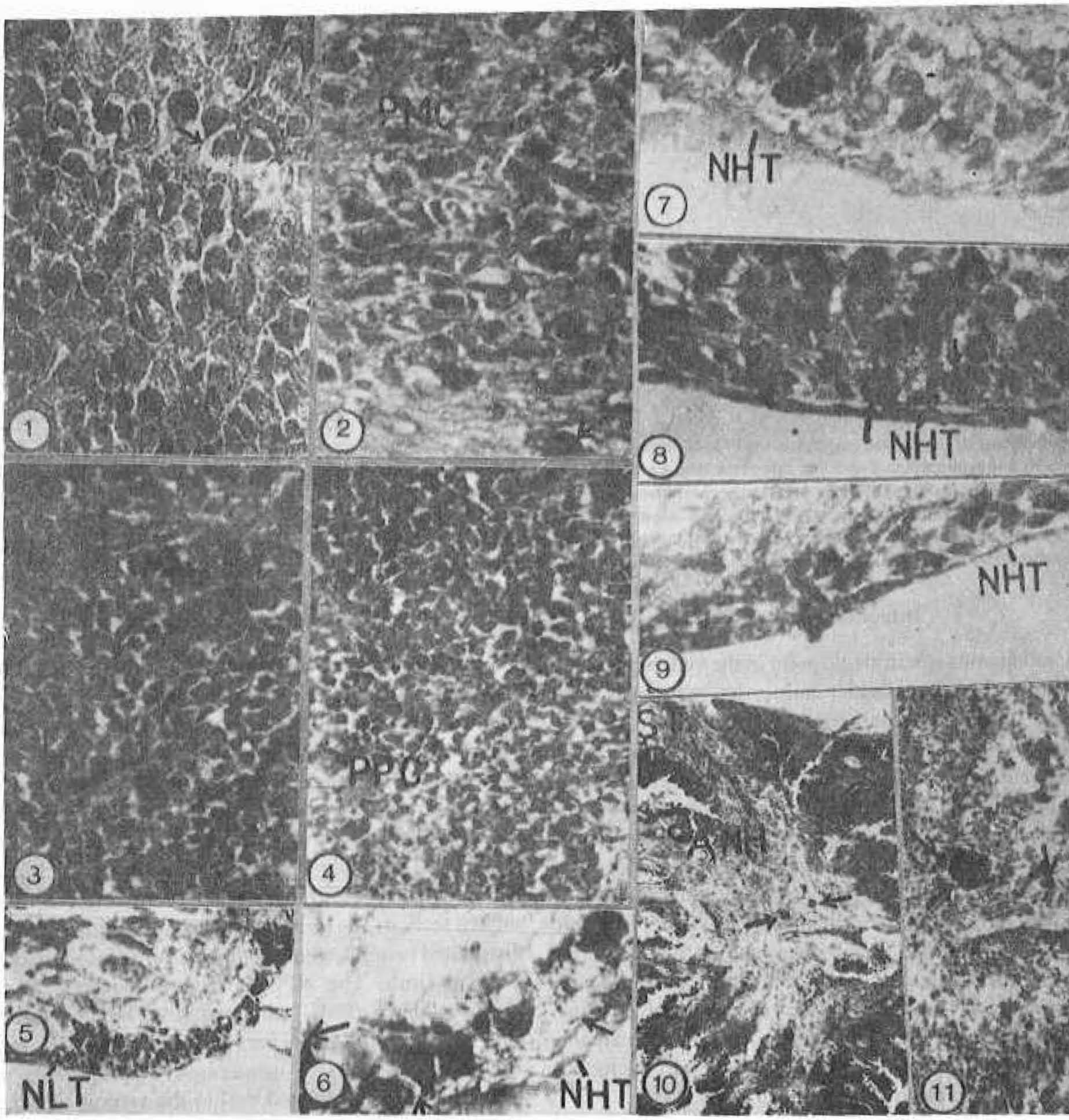

Fig. 1 Dorsal region of nucleus preopticus (NPO) of a maturing (stage IV) female *Decapterus tabl* showing pars magnocellularis (PMC). Mark the presence of large neurosecretory cells and their axon (arrow). Mallory's triple.X400.

Fig. 2 PMC of matured (stage V) female *Decapterus tabl* exhibiting the degranulated and vacuolated neurosecretory cells. Acid fuchsin-positive colloid-like material (arrow) and blood vessel (broken arrow) are also seen. Mallory's triple. X400.

Fig. 3 Ventral region of NPO of maturing male *Decapterus tabl* showing darkly stained small neurosecretory cells of pars parvocellularis (PPC). Mallory's triple. X400.

Fig. 4 PPC of matured female *Decapterus tabl* depicting vacuolation in the neurosecretory cells. Mallory's triple. X 4000.

Fig. 5 Nucleus lateralis tuberis (NLT) of a maturing male *Decapterus tabl* showing the distribution of acid fuchsin positive neurosecretory cells. Mallory's triple. X 100.

Fig. 6 Magnified view of fig. 5 to show the variously shaped neurosecretory cells of pars anterior part of NLT. NHT = neurohypophysial tract; arrow = axons. Mallory's triple X 400.

Fig. 7 NLT pars posterior neurosecretory cells of maturing female *Decapterus tabl* exhibiting differential staining responses. Mark the neurons with polymorphic nuclei. Mallory's triple X 400.

Fig. 8 NLT pars posterior of matured female *Decapterus tabl* depicting increase in the staining response and hyperplasia. A few cells exhibit vacuolaton too. Also, mark the presence of colloid-like neurosecretory material (arrow). Mallory's triple. X 400.

Fig. 9 NLT pars inferior of matured female *Decapterus tabl* showing small-sized neurosecretory cells. Mallory's triple. X 400.

Fig. 10 Anterior neurohypophysis of matured female *Decapterus tabl* showing the presence of acid fuchsin-positive Herring bodies (arrow). ANH = anterior neurohypophysis; ST = infundibulum. Mallory's triple. X 100.

Fig. 11 Magnified view of Fig. 11 to show the details of Herring bodies. Mark the variation in their size (arrow). Mallory's triple. X 100

Decapterus tabl. These neurons are generally bipolar but a few multipolar cells are also observed. Interestingly, NLT pars posterior neurons of maturing female scad (stage IV) show moderate staining intensity (Fig. 7) whereas this response is more pronounced in the matured females (stage V). At places, a few acid fuchsin-positive neurosecretory colloid-like materials are also seen (Fig. 8).

Neurosecretory cells of NPO and NLT contribute beaded axons to form neurohypophysial tract which enters the pituitary gland through infundibulum. Herring bodies of varying sizes are also observed in anterior and posterior neurohypophysis of the matured specimens (Figs. 9, 10).

The basic cytoarchitectonic pattern of *Decapterus tabl* hypthamo-neurosecretory system resembles those described for the freshwater teleosts. Generally, the neurosecretory cells of NPO stain with AF and CAHP (Maksimovich, 1987) but they are also stainable with acid fuchsin in *Decapterus tabl* (Figs. 1-4). A similar staining response has also been noticed in the freshwater clupeid, *Notopterus chitala* (Prakash *et al.*,1984) Indian mackerel, *Rastrelliger kanagurta* (Pandey, 1993) and the hard-tail scad, *Megalospis cordyla* (Pandey, unpublished).

NPO is reported to play important role in the spawning activities and its secretion do influence gonadal maturation in teleosts (Belsare, 1967). We observed vacuolation in the neurosecretory cells of PMC (Fig. 2) and PPC (Fig. 8) of matured (both sexes) *Decapterus tabl*. Belsare (1967, *Channa punctatus*), Viswanathan and Sunderaraj (1974a, b, *Heteropneustes fossilis*), Tischenko *et al.* (1976, *Coregonus autumnalis migratorus*), Saksena (1976, *Glossogobius giuris*), Rao *et al.* (1979, *Clarias batrachus*), Moitra and Mediya (1980,*Cirrhinus mrigala*), Zolotnitskiy (1980, *Scophthalamus maeoticus)*, Rai and Pandey (1986, *Colisa fasciata)* and Das and Sinha (1988, *Labeo bata*) also noticed depletion of neurosecretory material during spawning season of the fish. Presence of colloid-like neurosecretory material has been reported in the NPO of the maturing and matured specimens of *Porichthys notatus* (Sathyanesan, 1965), *Channa punctatus* (Belsare, 1967; Chandrasekhar and Khosa, 1972), *Phoxinus phoxinus* (Bhargava, 1969), *Clarias batrachus* and *Heteropneustes fossilis* (Chandrasekhar and Khosa, 1972), *Glossogobius giuris* (Saksena, 1979), *Scophthalamus maeoticus* (Zolotnitskiy, 1980), *Notopterus chitala* (Prakash *et al.*, 1984), *Rastrelliger kanagurta* (Pandey, 1993), and *Megalospis cordyla* (Pandey, unpublished). Similar structure are also encountered in the NPO (PMC) of matured *Decapterus tabl* (Fig. 2)

NLT has been reported to be a second neurosecretory centre in the teleostean hypothalamus (Billenstein, 1963). However, there are stray records of its absence among a few species (Charlton, 1932; Kobayashi *et al.*, 1959). Kobayashi *et al.* (1959) remarked that season or age factors may be responsible for the absence of stainable granules in the NLT. Terlou and Ekengren (1969) have also commented "From a morphological and physiological point of view, this is very unlikely. The poor stainability of the neurosecretory material in the NLT can cause secretory activity to be overlooked in large neurons". The neurosecretory cells of NLT pars anterior (Fig. 6) pars posterior (Figs. 7, 8) and pars inferior (Fig. 9) of *Decapterus tabl* are readily stainable with acid fuchsin. Fluctuations in the secretory activity of pars posterior cells with maturity (Figs. 7, 8) suggest their involvement in the maturation of the fish. Viswanathan and Sunderaraj (1974a, b) also recorded histological variations in the activity of NLT cells of female *Heteropneustes fossilis* in response to gonadal cycle as well as sex steroid administration. In *Colisa fasciata* (both sexes), Rai and Pandey (1986) noticed the accumulation of neurosecretory materials during prespawning and its depletion (probably because of resease) during spawning phase of the reproductive cycle.

We noticed the occurrence of neurosecretory colloid like material in NLT pars posterior of matured *Decapterus tabl* (Fig. 8). Zolotnitskiy (1980) has also recorded similar structures in the form of different-sized drops in lateral nucleus of the Black Sea turbot, *Scopthalamus maeoticus*.

Herring bodies are seen in the anterior and posterior neurohypophysis of *Decapterus tabl* (Figs. 10, 11). Sathyanesan (1965-*Poricthys notatus*, 1970-*Clarias batrachus*), Bhargava (1969 - *Phoxinus phoxius*), Saksena (1979 - *Glossogobius giuris*), Zolotnitskiy (1980 - *Scophthalamus maeotics*), Pandey (1993 - *Rastrelliger kanagurta*, unpublished-*Megalospis cordyla*) have also observed a similar distribution of Herring bodies which are assumed to be accumulated neurosecretory material that help increase the surface area for the release of biologically active principles in the circulation (Sathyanesan 1965; Bhargava, 1969; Saksena, 1979; Zolotnitsky, 1980).

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