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Morphology of the Pineal Gland in the Freshwater Fish, *Notopterus Notopterus* (Pallas)

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ABSTRACT

The pineal gland of Notopterus notopterus consists of 3 separate but distinctly connected components and it is located dorsal to the forebrain immediately below or within the skull roof. The pineal complex is well vascularized in this species The diagrammatic presentation was constructed based on the thick free hand sections and it was found that it has an end vesicle (EV) present just below the roof of cranium, a long and curved pineal stalk (PS) and a dorsal sac (DS). Histological studies showed that the pineal gland consist of about 80% of the cells that have rounded vesicular nuclei, which are pinealocytes. These pinealocytes positively stain with haematoxylin and eosin, the remaining cells may be astrocytes, which cannot be seen on H&E stained slides. melatonin administration at different doses alters the GSI (TSI),HSI and BSI.

KEYWORDS : pineal gland, melatonin ,Notopterus notopterus

Introduction:

The size of the pineal organ varies considerably amongst fish species, in some species pineal gland is large and covers most of the telecephalic and in some others it is conspicuous and lacks characteristic vesicle form (Eksrom and Meissl.1997). The pineal gland is a small endocrine gland in the vertebrate brain, it produces the serotonin a derivative of melatonin a hormone that effects the modulation of wake/sleep pattern and seasonal fluctuation. The pineal complex of teleostean fish consists of pineal and parapineal organ and this pineal organ is directly a photo sensory organ (Migaud *et al*.2006) that contains photoreceptor cells similar to those of the retina. In some of the teleost, the area of the skull covering the pineal organ is specialized "the pineal window" this window seems to facilitate light penetration to the organ (Dodt, 1963). In view of non availability of location and structural details of pineal complex in the fresh water fish, *Notopterus notopterus*, the present study is undertaken to find out the structure and its location along with effects of melatonin on gonads.

Materials and Method:

Live specimen of *N.notopterus* were obtained and transported to the laboratory to observe the pineal gland, the head of the fish was separated from the body mass, eyes and other material is removed only brain intact with the cranium was kept and fixed in freshly prepared Bouin's fluid. After 72 hrs the tissue were dehydrated in ascending grades of alcohol cleaned in xylene and infiltered in paraffin post filtration the tissue were embedded. Thin free hand sections of were taken of the block and the sections were stained in H&E and observed under compound microscope. The hormone "melatonin" was dissolved in alcohol. The solution was prepared by dissolving 5mg of melatonin in 1ml of alcohol and 99ml of distilled water was added to the solution. The 100ml contains 5000µgm of melatonin and different doses of the hormone were administrated to the fish.30-35 fishes were collected for the experimental study and fishes were divided into 4 groups 6 in each

Group1:- served as control and being injected with vehicle (saline)

Group2:- were injected with 0.2ml solution that contains 10µgm of melatonin for 5 days in morning.

Group3:- were injected with 0.5ml solution (25µgm melatonin) subcutaneously for 5 days in morning.

Group4:- were injected with 0.5ml solution (25µgm melatonin) subcutaneously for 5 days twice in a Day. One dose in morning and other in evening.

After the termination of experiments, the experimental and control fishes were scarified bi decapitation. Gonads were dissected out carefully and processed for further studies.

Observation:

In this study an attempt was made to know the general morphology of pineal gland. Pineal gland of *N.notopterus* is located dorsal to the forebrain immediately below or within the skull roof. The well vascularized pineal complex of this species consists of 3 separate but distinctly connected components. The diagrammatic presentation was constructed and it was found that it has an end vesicle (EV) present just below the roof of cranium, a long and curved pineal stalk (PS) and a dorsal sac (DS). The histological studies showed that the pineal gland consist of about 80% of the cells that have rounded vesicular nuclei, these are pinealocytes which positively stain with haematoxylin and eosin, the remaining cells may be astrocytes, which cannot be seen on H&E stained slides.

The melatonin administration causes alteration in gonado-somatic index (GSI- TSI) which marginally increased after 10µgm administration of melatonin where as marked increase was noticed after 25µ administration once in a day. However, there is decline in the TSI value after administration of melatonin at 25µgm twice in a day.the changes were also noticed in hepato-somatic index (HSI) and brain –somatic index (BSI) (table-1 and fig.1)

Discussion:

The available literature on the pineal complex of teleost fishes with ultrastructural studies , there appears to be large interspecific variation with regards to its fine structure of pineal photoreceptor cells . Although the shape and size of end vesicle of pineal varies widely depending on the species, it may be larger and conspicuous or insignificant, reduced and rudimentary in some species studied (Sastry and Satyanesan., 1981). Histologicaly the teleost pineal closely resemble sensory structure. The pineal organ is made up of 3 kinds of cells photoreceptor cells, supportive cells and ganglions. The photoreceptor cells stain less intensely and have numerous blood vessels surrounding and these cells are the most numerous of epithelial cells. In the fish *N.notopterus* the cells which were observed in the end vesicle are photoreceptor cells. The pineal stalk of *N.notopterus* is long and curved, basally attached to dorsal sac which is distinctly observed. The pineal stalk in other teleost fishes reported to show variation in shape. In some fishes it is fine strand like or thin and shorter or long slender or hollow tube like (Fenwick, 1970). Similarly in the fish *N.notopterus* the pineal stalk is long slender and hollow tube like. In teleost , pineal complex is photosensory organ that contains photoreceptor cells similar to those of retina. It is a small endocrine gland that produces the hormone "melatonin" the common output signal that effects the modulation of wake/sleep pattern and seasonal function and released into the blood stream. Melatonin is important in controlling the reproductive seasonality by stimulating the final stages of sexual maturation. The gonadal response to melatonin varies and it depends on time, mode and administration of the hormone. In the carp *Catla catla* graded doses of melatonin was

administrated for different durations and the testicular response was studied in each reproductive phase, it was found that the response of the testis almost identical (Bhattachaya *et al*., 1970). Renuka and Joshi (2010) also reported that the GSI decreased in fish *Channa punctatus* that received melatonin daily by injection mode during long photoperiod. There are reports available in birds that the pineal gland and its hormone play an inhibitory role in the development of testis till the attainment of seasonal peak (Sengupta and Kumar maitra., 2006). Ammano *et al.,* (2000) reported that melatonin treatment to the male fish, *Masu salmon* had a stimulatory effect on GSI. In the present study administration of melatonin at a dose of 10µgm increases testicular activity, whereas the melatonin administration at a dose of 25µgm twice in a day decreases TSI compared to 25µgm of melatonin once in a day.

Conclusions:

The pineal gland of *N.notopterus* is located dorsal to the forebrain immediately below or within the skull roof. The well vascularized pineal complex of this species consists of 3 separate but distinctly connected components such as an end vesicle (EV) present just below the roof of cranium, a long and curved pineal stalk (PS) and a dorsal sac (DS). The histological studies showed that the pinealocytes positively stain with haematoxylin and eosin, melatonin administration at different doses alters the GSI (TSI), HSI and BSI.

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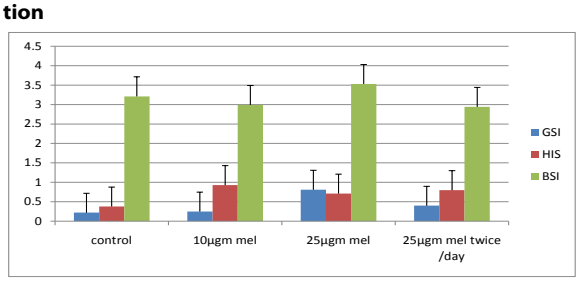
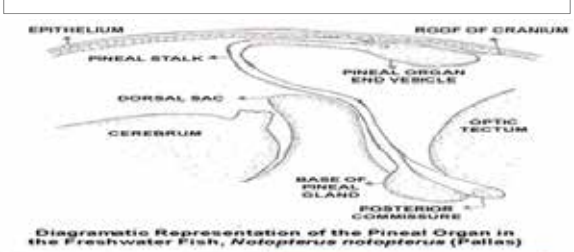
Table-1: Showing GSI (TSI), HIS and BSI of *Notopterus notopterus* under different doses of melatonin administration.

	Control	10µgm melatonin	25µgm melatonin	25µgm melatonin(twice / day
GSI	0.22±0.07	0.25±0.03	0.81±0.03	0.40±0.10
HIS	0.38±0.02	0.93±0.30	0.71±0.10	0.80±0.15
BSI	3.21±0.02	2.99±0.03	3.13±0.20	2.94±0.40

Mean ± SD (n=06)

Figure-1: Showing GSI (TSI), HSI, and BSI of *Notopterus notopterus* under different doses of melatonin administration





Diagrammatic Representation of the Pineal Organ in the Freshwater Fish, *Notopterus notopterus* (Pallas)

Above photographs showing pineal stalk and end vesicle.

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