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HISTOLOGICAL STUDY OF PITUITARY GLAND IN TELEOST

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Abstract:

In teleost fish, the pituitary gland is essential for controllingin regulating growth, metabolism, reproduction, and osmoregulation through its dynamic endocrine functions.Adenohypophysis and neurohypophysis make up the pituitary gland, which is further divided into the pars and rostral pars distalis, pars intermedia and pars nervosa,which house specialized hormone-secreting cells. These regions exhibit significant species-specific structural and functional adaptations influenced by environmental factors, developmental stages, and reproductive cycles. These studies provide a deeper understanding of teleost endocrine regulation and its evolutionary adaptations.

Keywords: Pituitary gland, Teleost, Hormones, Pars Nervosa, Pars Intermedia, and Pars Distalis

Introduction:

The pituitary gland is a crucial endocrine gland situated bellow the hypothalamus in the brain. All vertebrates depend on it to regulate a number of physiological processes, including as growth, reproduction, stress response, and general homeostasis. By releasing different peptide hormones into the bloodstream, the gland relays information from the brain to the peripheral organs. The ectodermal Rathke's pouch is where the adenohypophysis originates (Schlosser, 2017).

As part of the neuroendocrine system, it functions by secreting hormones that affect target tissues and organs, thus regulating vital biological functions(Schreibman *et al*., 1973).Still, it has

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been discovered that some pituitary endocrine cells in fish have endodermal origins.In vertebrates, the pituitary gland is essential for controlling vital physiological functions like growth, reproduction, and metabolism. In teleost fishes, its structure and function exhibit species-specific adaptations to environmental and ecological demands and conducted a comparative study of the pituitary gland in *Channa striata* (snakehead) and Heteropneustesfossilis (stinging catfish), highlighting differences in cellular organization and functionalityMasram*et al.* (2019).

Pituitary gland consisted of adenohypophysis and neurohypophysis, with regions RPD, PPD and PI showing various hormone-secreting cells. Lactotropic (LTH), somatotropic (STH), gonadotropic (GTH) and adrenocorticotropic (ACTH)rewiew byGorghate*et al*., (2023).The anterior pituitary (pars distalis), intermediate lobe (pars intermedia), and posterior pituitary (pars nervosa) are the three primary anatomical portions of the teleost fish pituitary gland.Each of these sections is in charge of manufacturing a distinct hormone. The pars distalis, the largest and most diverse region, contains a range of endocrine cells, such as Thyroid, gonadotrophic, lactotrophic, somatotrophic, and corticotrophic(Narayan *et al*., 1984). In order to control metabolism, growth, reproduction, and stress reactions, these cells secrete hormonesadrenocorticotropic hormone (ACTH), growth hormone (GH), prolactin (PRL), thyroid-stimulating hormone (TSH), gonadotropins (follicle-stimulating hormone (FSH) and luteinizing hormone (LH), and others (Villaplana et al., 1996; Golan et al., 2016).

Understanding the histological architecture of the teleost pituitary gland provides valuable insights into the mechanisms of hormonal control and adaptation to environmental changes. The pituitary's functional complexity is reflected in its diverse cellular composition and the structural variations found across different teleost species (Schreibman *et al*., 1973).Understanding the timing and regulation of hormone release at crucial stages like metamorphosis and sexual maturation requires research on development. In fact, histological alterations in the pituitary-thyroid axis in the flounder *Paralichthys olivaceus* have been linked to metamorphosis, a process in which significant alterations in cell populations occur to facilitate the transition from larval to juvenile stages (Miwa and Inui, 1987).

In addition to developmental and reproductive functions, the teleost pituitary gland is highly responsive to environmental stressors. Exposure to pollutants, such as herbicides, has been shown to induce significant histopathological changes. For example, trifluralin, a common herbicide, has been reported to cause pituitary enlargement and histopathological alterations in affected fish, reflecting an adaptive or toxic response to environmental stress (Couch, 1984).Recent advances in immunohistochemistry and ultrastructural analysis have further enhanced our understanding of pituitary gland organization. In species like carp (*Cyprinus carpio*), immunohistochemical evaluations have identified key hormones needed for reproductive regulation, especially in relation to aquaculture practices where hormone-induced spawning is critical (Mousa*et al*., 2018). Ultrastructural studies have also identified the intricate networks of stellate cells in the teleost pituitary, which are said to have experienced acrucial role in modulating hormone release and maintaining the structural integrity of the gland (Golan *et al*., 2016).

Review of literature:

The middle lobe's pars intermedia, the anterior pituitary's pars distalis, and the posterior pituitary's pars nervosa are the three primary anatomical areas of the teleost pituitary gland, and they are each in charge of secreting distinct hormones. Numerous endocrine cells, including as somatotrophs, lactotrophs, thyrotrophs, gonadotrophs, and corticotrophs, are found in the pars distalis, the most important and diverse area of the pituitary (Narayan *et al*., 1984). To regulate metabolism, growth, reproduction, and stress response, these cells release the following hormones: adrenocorticotropic hormone (ACTH), prolactin (PRL), thyroid-stimulating hormone (TSH), gonadotropins (follicle-stimulating hormone (FSH) and luteinizing hormone (LH), and growth hormone (GH) (Villaplana et al., 1996; Golan et al., 2016; Narayan et al., 1984; Fawzia et al., 2015).

Between the pars distalis and the pars nervosa is the pars intermedia, is primarily associated with the production of melanocyte-stimulating hormone (MSH), responsible for pigment regulation in many fish species. This region shows significant variability among teleost species, often reflecting environmental adaptations related to habitat, behaviour, and life cycle obtained by (Miwa and Inui, 1987; Fontaine *et al*., 2020).

Zambrano, 1972, obtained the pars nervosa is the smallest region and serves as the neurohemal organ, where neurohormones such as vasopressin and oxytocin are released into the bloodstream. This region also contains specialized glial cells, called pituicytes, which provide structural and functional support, regulating neurohormone release observed byFerrandino and Grimaldi, (2008).The staining process of distinct cell types varied, according to histochemical examinations of the pituitary gland in different teleost fish.In early investigations, by Matty and Matty(1959), demonstrated that the pituitary glands of several teleost species showed deep histochemical changes, with thyrotropes and somatotrophs and showing differential staining techniques that indicate specific roles in hormone production and secretion.

Review thathistological and ultrastructural study of pituitary gland of *Pangasius pangasius*, pituitary glands were dissected, fixed, sectioned, and stained with techniques like Hematoxylin-Eosin and Nissl's staining, and analyzed using light and electron microscopy (TEM)Gorghate*et al*., 2023).They found pituitary gland consisted of adenohypophysis and neurohypophysis, with regions RPD, PPD, and PI showing various hormone-secreting cells. Lactotropic (LTH), somatotropic (STH), gonadotropic (GTH), and adrenocorticotropic (ACTH).(Gorghate*et al*., 2023; Mousa*et al*., 2018).

Cell types in distinct regions (RPD, PPD, PI) and their distribution are evaluated by looking at the histological architecture of different cells in *Notopterusnotopterus* pituitary gland.They discovered that basophilic cells in PPD, GTH and TSH cells were found.Whereas ACTH and PRL cells were observed in RPD. Seasonal forms in TSH,GTH and testicular activity correlated with reproductive phases.(Chakrabarti and Choudhury 2015).Histochemical investigation of the carp's *Cyprinus carpio* pituitary glandusing various staining they observed pituitary had round-oval anatomy with acidophilic prolactin cells in the In the pars distalis rostral,basophilic thyrotropin cells in little quantity,chromophobic ACTH cells, and gonadotropin cells in the pars

distalisproximal(Ekici and Timur 2013).The another part that is neurohypophysis contained unmyelinated nerve fibres and pituicytes.(Ekici and Timur 2013).

Examination of the pituitary glands in several teleost fish using histochemistry,applied histochemical methods like chrome alum/haematoxylin and PAS on observing pituitary glands.They showed neurosecretory material concentrated near the adeno-hypophysis, with type cynophiles staining positive, RNA was present in nucleoli, with minimal differences in extra-nucleolar RNA. These findings reveal histological diversity in teleostpituitary cellsobtained by Matty and Matty(1959).Fontaine*et al*., (2020), according to them, sex steroids have both direct and indirect effects on gonadotroph cell plasticity in the pituitary of teleost fish (Fontaine et al., 2020).In gilthead sea bream *(Sparus aurata*) larvae examined by Villaplana *et al*. (1996), the pituitary gland's reported early creation in *Sparus aurata* L. (Teleostei) demonstrated an adenohypophyseal-neurohypophyseal link during early development.

They found newly hatched larvae showed an embedded pituitary with undifferentiated endocrine cells and no neurohypophysis. Thanday 2, the neurohypophysis began to evaginate, and distinct adenohypophyseal regions emerged. The differentiation of endocrine cells progressed over time, with increasing secretory granules, while some undifferentiated cells persisted even at 65 days after thatblood vessels appeared in the neurohypophysis by day 16, marking the establishment of pituitary structure (Villaplana*et al*., 1996).

Clarias batrachus, a cat fish observed pituitary gland is oval-shaped, located ventrally behind the optic chiasmaand attached to the infundibulum by a short neural stalk.It is made up of theadenohypophysis and neurohypophysisobserved by Lehri (1966). The rostral and proximal pars distalis and pars intermedia make up the adenohypophysis, whilst nerve fibres and neuroglial cells are found in the neurohypophysis (Lehri 1966).

Conclusion:

The histology of the pituitary gland in teleost's reveals its complex and adaptive nature, with significant species-specific structural and functional diversity influenced in regulating growth, reproduction, stress response and osmoregulation. Overall, the teleost pituitary exemplifies a highly dynamic neuroendocrine system essential for physiological regulation, adaptation, and survival in varying conditions, with implications for both ecological research and aquaculture.

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