

## HISTOMORPHOLOGY OF THE THYROID GLAND IN THE DOMESTIC FOWL (*Gallus domesticus*)\*

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Thyroid is an unique endocrine gland, having a widely separated pair of thyroid lobes on each side of the trachea at the level of the clavicle in birds. The literature regarding the histomorphology of the thyroid gland in the domestic fowl is scanty, which prompted to take up this study. This study forms a basis for correlating the possible functions of the thyroid gland in relation to growth, production of layer and broiler chicken and the diagnosis of deficiency syndrome.

### Materials and Methods

Thyroid glands were collected from six male and six female layer chick at day old, 4<sup>th</sup> week and 8<sup>th</sup> week, growers at 12<sup>th</sup> week, 16<sup>th</sup> week and 20<sup>th</sup> week and layers at 28<sup>th</sup> week, 40<sup>th</sup> week and 72<sup>nd</sup> week old from a local poultry farm at Namakkal. Thyroid glands were also collected from six male and six female broiler chicken at 2<sup>nd</sup> week, 4<sup>th</sup> week and 8<sup>th</sup> week from a local poultry farm at Namakkal.

The materials were fixed in different fixatives, processed and sections of 5-6mm thickness were cut and used for different staining techniques. The following staining techniques were used for this study.

1. Ehrlich's haematoxilin and eosin staining method
2. Silver, Orcein and aniline blue staining method

3. Masson's trichrome staining method
4. Van Gieson's method
5. Verhoeff's staining method
6. Masked metachromasia method
7. Singh's modification of the Masson-Hamperl argentaffin technique

### Results and Discussion

The thyroid glands were encapsulated by a capsule which consisted of well developed collagen fibres, reticular fibres and very few elastic fibres. It was frequently thickened in areas where small arteries, veins and nerves were present on the surface of the gland as reported by Hodges (1974). The capsule was made up of three layers. The external layer was a mesothelial layer lined with simple squamous epithelium, the middle layer was rich in fat cells, blood vessels and nerves and the inner layer was closely adherent to the gland. Yaswant Singh and Bharadwaj (1982) reported the same three layers as outer "Capsule serosa", middle "Capsule adiposa" and the innermost "Capsule fibrosa" in the White Leghorn chicken.

The reticular fibres were more in younger age groups than in older and were replaced by collagen fibres with aging. Hence in older age groups the collagen fibres predominated at the expense of reticular fibres. The increased production of thicker collagen fibrils masked

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the relatively smaller and static number of thin reticular fibres formed at an early age, thereby giving an appearance of abundant and increased amount of collagen fibres. The capsule which was thickened at the posterior pole of the gland might be due to its contact with the parathyroid gland. The capsule was thinner in the female birds than in the male birds as observed by Yasawant Singh and Bharadwaj (1982). The trabeculae radiating from the capsule were dividing the gland into incomplete lobules as reported by Fitzgerald (1969) in coturnix quail. The capillaries and nerve fibres in the stroma surrounded each and every one of the follicles in a basket like manner. It might be a provision for easy emptying of the follicular secretion into the blood stream. A distinct basement membrane was lacking in all the age groups as reported by Fitzgerald (1969) in coturnix quail. The interfollicular connective tissue was scanty. Isler *et al.* (1968) described it as an incomplete wrapping of follicles by connective tissue in rat, rabbit, guinea pig, hamster and dog.

The micrometric studies revealed that there was a general trend towards the increase in the follicle size with age and follicles of older age groups were distended and irregular. This is in agreement with the observations made by Mathur (1971) in the thyroids of mammals. It has been postulated that the variations in the size and shape of the follicle depend upon various factors like species, age, sex, diet, climate, season and hypothalamo-hypophyseal system. Besides the diversity in the type of the epithelium as well as the shape and size of the follicles observed in the present study might also be related to the functional activities of the thyroid follicles. The change in the follicular epithelium due to aging may be attributed to two factors. Firstly, the mechanical pressure causes the distension of follicles and secondly, the altered density of basement membrane and increased collagen fibres which may act as a barrier in the way of exchange between the plasma and epithelium. These factors are in addition to those generally assigned to

histomorphological changes, the thyroid follicles undergo, under different physiological status. Thus there was a gradual and steady accumulation of unutilised colloid within the follicles and the follicular epithelium underwent forementioned changes with age.

Pantic (1974) had described five types of follicular epithelial cells in the thyroid gland of mammals. Those are follicular (including parafollicular) cells, colloid, ciliated AR and U cells. Out of these five types of cells, the two main glandular cells producing biologically active hormones, viz., thyroxin (follicular cells) and thyrocalcitonin (parafollicular cells) were observed in the present study (Fig.).



**Fig. Photomicrograph showing the active thyroid follicle in the thyroid gland of a 6 week old male broiler chicken.**

**F- Follicular cells, PF - Parafollicular cells**

Small and medium sized follicles dominated the larger ones which is in accordance with the findings of Yaswant Singh and Bharadwaj (1982). The cytoplasmic granules observed in the supranuclear zones of follicular cells resembled the peripheral colloid in staining behavior. Derobertis (1974) reported the intracellular colloid in the follicular cells of the thyroid gland in rat. Ingbar and Woeber (1968) described the secretion and resorption of thyroid hormones in man at or near apical surface of the follicular cells. Williams (1944) reported that the follicular cells secrete the

hormones towards the lumen of the follicle in rat and mice. Nadler *et al.* (1964) found that in human being the thyroglobulin is synthesized within the thyroid from its precursors and move progressively towards the apex, to be discharged into the follicular lumen. Among the follicular cells, occasionally large spongy unstained cells were noticed. Hoyt *et al.* (1973) considered such cells in pigeon thyroid as the poorly fixed epithelial cells. The thyroid follicles were flat in the central zone and spherical in the peripheral zone of the thyroid gland. This indicates that the functional heterogeneity of the thyroid follicles in the thyroid gland.

The diameter of the thyroid follicles in the right and left thyroid was almost constant both in layer and broiler chicken. This suggested that the thyroids were equally functional in all the age groups. The height of the epithelium reflects its stage of activity. In aged birds, the height of the follicular epithelium was low which might be due to poor activity of the thyroid gland.

The thyroid follicles were filled with a homogenous colloidal mass. In the follicles which were lined with simple cuboidal or low columnar epithelium the colloid was predominantly basophilic, while those follicles lined by simple squamous epithelium had acidophilic colloid. Stein (1940) reported that the freshly secreted colloid in human thyroid assumed a blue colour and later, on aging it became pink. Beresford (1983) recorded that the thyroid colloid was acidophilic when dense and basophilic when dilute. The present study also confirms the earlier findings.

The quantity of the colloid varied according to the activity of the thyroid gland. In the inactive follicles it was more and thick due to accumulation of large amount of colloid without being utilised, whereas in active follicles it was lesser and thinner due to regular production and consumption. The solid form of the colloid

observed in the older age groups might probably be due to prolonged stasis of colloid in the follicle. The colloid was supposed to be amphoteric because it exhibited different colour reactions by different staining procedures. Physiological significance ascribed to this multiple staining reaction appeared to be due to difference in the concentration of protein that depended upon the direction and rate of penetration of fixatives into the tissue.

The parafollicular cells were large with spherical nucleus and faintly stained cytoplasm. They were found singly or in small clumps along the follicular cells and also in the interfollicular space which is in accordance with the findings of Yaswant Singh and Bharadwaj (1982) in White Leghorn chicken and Roy *et al.* (1983) in mammals. In Masson Hamperl's silver stain, it showed argyrophilia. Roy *et al.* (1983) recorded that the parafollicular cells exhibited argyrophilia when stained by De Fano's and Devenport's technique. The parafollicular cells showed metachromatic property by masked metachromasia stain as recorded by Petko *et al.* (1976) in rats. In aged birds, the parafollicular cells were having eosinophilic cytoplasm due to the staining of granules.

The lightly stained eosinophilic cells, often observed in the intercellular space as cluster of large sized cells could be considered as the parafollicular cells with different functions. Hoyt *et al.* (1973) reported similar parafollicular cells in pigeon also. The cluster of polyhedral cells in the interfollicular zone resembled the follicular cells in their histological and histochemical details. These cell clusters were the tangential cuts of the thyroid follicles in which the section passed through the follicular wall close to the colloidal mass. Hoyt *et al.* (1973) reported the interfollicular cells as the tangential section of small follicles in the section.

## Summary

The histomorphological study of the thyroid gland was carried out using 156 birds in both sexes of layer chicks, growers and layers as well as in broilers of different age groups. The thyroid capsule was made up of collagen, reticular and a few elastic fibres. The reticular fibres were more in younger age groups than in older and were replaced by collagen fibres with aging. The thyroid follicles varied in size and shape both in layer and broiler chicken. The diameter of the follicles showed tendency to increase in size and became irregular in outline with advancing age. The follicular epithelium consisted of two types of cells namely the follicular cells and parafollicular cells. The active follicles were small and spherical in shape which were lined by cells varying from cuboidal to low columnar. The inactive follicles were large, swollen and lined by simple squamous cells. In the follicles lined with cuboidal or low columnar epithelium, the colloid was basophilic whereas in the follicles lined with simple squamous epithelium, it was acidophilic. The parafollicular cells showed argyrophilia in Masson Hamperl's silver stain and metachromasia in masked metachromasia stain. In aged birds they had eosinophilic cytoplasm.

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