# HISTOMORPHOLOGICAL STUDIES ON THE THYROID GLAND IN FEMALE KUTTANAD DUCK *(ANAS PLATYRHYNCHOS DOMESTICUS)*

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Received : 18.06.2013 Accepted : 06.09.2013

**ABSTRACT**

*The study was conducted on 104 female Kuttanad ducks from day-old to 24 weeks of age and the birds were selected randomly from a single hatch for the study. The thyroid glands were collected from eight birds in each group at fortnightly intervals. After recording the gross features, the material was fixed using different fixatives and then processed for histological studies. The paired thyroid glands in the day old Kuttanad ducklings were placed at the base of the neck between the common carotid artery and the jugular vein. The thyroid glands were enclosed by a thin capsule consisting of well-developed collagen, reticular and a very few elastic fibres and associated fibroblasts. The substance of the gland consisted of roughly spherical thyroid follicles closely packed together that they presented a polyhedral appearance in cross section. Each follicle was lined by single layer of cells. Based on the type of epithelium and nature of colloid, the follicles were catagorised as active and inactive follicles. Mean epithelial height of the active follicles increases from day-old duckling upto sixth week. From eight weeks onwards there was a gradual decrease in the mean epithelial height up to 24 weeks. A homogenous translucent colloidal mass filled the thyroid follicles. From the Thyroid Activity Index, it was inferred that the thyroid activity fell under three categories as moderately active, strongly active and very active.*

**Key words**: epithelium, follicle, Kuttanad duck, thyroid

## INTRODUCTION

Thyroid gland is critical in tissue differentiation and development of many body systems. In birds, it controls the basal metabolic rate, differentiation and development of the central nervous system, development and growth of muscles and bones, control of reproduction and integumentary development including feathering. The only gland in the body of both mammals and birds that stores hormone in its inactive form. The substance of the gland consists of roughly spherical thyroid follicles. The follicles are lined by endodermal epithelium of varying height depending on the state of activity. The epithelial in the quail varied from

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columnar to squamous types depending on the functional status of the thyroid; lining of the thyroid follicles varies in different birds depending on the functional status of the thyroid (Enura *et al*., 1977). Likewise, King and McLelland (1981) reported that in quiescent glands of laying hens, the follicles were reduced very much in their height and became almost squamous in their shape with a spindle shaped nucleus. As this type of work is lacking in ducks particularly in Kuttanad, a comprehensive study was undertaken to document the epithelial diversification of thyroid gland in these birds at different ages.

## MATERIALS AND METHODS

The study was carried out in 104 female Kuttanad ducks from day-old to 24 weeks of age and the birds were selected randomly from a single hatch for the study. Thyroid glands were collected from eight birds in each group at fortnightly intervals. After recording the gross features, the material was fixed in 10% neutral buffered formalin and then processed for histological studies. Sections of 5µm thickness were cut with the help of microtome and stained using different techniques. The activity of thyroid gland was evaluated using Thyroid Activity Index (TAI) cited by Davis and Davis (1954) for English sparrow. The data were analyzed statistically (Snedecor and Cochran, 1994).

## RESULTS AND DISCUSSION

The paired thyroid glands in the day old Kuttanad ducklings were placed at the base of the neck between the common carotid artery and the jugular vein. The thyroid glands were enclosed by a thin capsule consisting of well-developed collagen, reticular and a very few elastic fibres and associated fibroblasts. The substance of the gland consisted of roughly spherical thyroid follicles. They were so closely packed together that they presented a polyhedral appearance in cross section. Parchami and Fatahian Dehkordi (2012) reported in duck that the gland consisted of roughly spherical randomly distributed micro and macro follicles with very little interstitial tissue between them. Follicles with different sizes and shapes were noticed in various age groups. The variations in the size and shape of the follicles might be due to various factors like species, age, sex, diet, climate, season and hypothalamohypophyseal system. In day old birds, ratio of the stroma to parenchyma was relatively more. At this stage, follicles were small and were dispersed towards the periphery of the gland with a few larger follicles seen towards the centre. Fritschi (1926) reported the same findings in fowl. With the advancement of age, the total number of follicles, large follicles and small follicles showed an increased trend (Tab. 1).

Each follicle was lined by a single layer of cells. Based on the type of epithelium and nature of colloid, the follicles were catagorised as active follicles and inactive follicles. Active follicles were lined by simple cuboidal epithelium with a basophilic colloid, while the inactive follicles were lined by simple squamous epithelium with acidophilic colloid as reported by Hodges (1974) in fowl, Richard *et al.* (1973) in white Carneau pigeon and Enura *et al*.(1977) in quail. The lining epithelium was columnar in day-old ducklings and the cells contained a large, round to oval, centrally placed vesicular nucleus and a finely granular cytoplasm. The follicles were shrunken with very little colloid

and greatly vacuolated colloid. Most of the follicles were active in nature at this stage. Largest follicle was identified in 24th week old birds with a diameter of 154.24 ±1.51µm. In these follicles, the epithelium was very thin and of squamous variety. Mean epithelial height of the active follicles in day-old ducklings was 9.32±0.21µm and it increased up to sixth week (Tab. 2).

From eighth week onwards, there was a gradual decrease in the mean epithelial height up to 24 weeks (Tab. 2).This can be further supported by calculating thyroid activity index which is based on the assumption that a thyroid gland with relatively high, columnar epithelium and highly vacuolated colloid is more active than the one with low, flattened epithelium and non-vacuolated colloid. From TAI, the thyroid was catagorised as moderatively active from day old to two week old birds with the cell height of 9.32 µm. The cells were cuboidal in shape with the oval nucleus touching the membrane. Small and large follicles were throughout the gland with many vacuoles. From four weeks, the glands became strongly active upto six weeks of age and had a mean cell height of 16.00 µm. This period was characterized by maximum activity of the gland. It also coincided with the rapid growth phase of the gland and the bird itself.

From eight weeks onwards, the glands were categorized as very active up to 24thweek. The cells were columnar in shape with round nucleus in the centre of the cell. Small and large follicles were distributed throughout the gland with many vacuoles. Oakeson and Lilley (1960) observed in the White Crowned Sparrow that the mean epithelial cell height ranged from 1.0 µm for the least active thyroid to 8.48 µm for the most active glands. Increase in the height of the cells in the thyroid follicles in Kuttanad ducks indicated the higher secretory activity as against low epithelium might be due to poor activity of the thyroid gland as reported by George and Naik (1964) in starling. Kobayashi (1954) reported that lengthening the period of day light lowered the height of epithelial cells in the thyroid follicle of Canary.

Unequal staining of the colloid in active follicles was evident in 14th week old birds. In highly active follicles, besides the colloid, epithelial cytoplasm also showed vacuolations. In quiescent glands of laying hens, the follicles were large being swollen with considerable amount of accumulated colloid. The lining cells were reduced very much in their height and became almost squamous with a spindle shaped nucleus by 24 weeks of age as cited by King and McLelland (1981) in domestic fowl. The diversity in the type of epithelium as well as the shape and size of the follicles observed in the present study might be related to the functional activities of the thyroid follicles. The change in the follicular epithelium due to aging might be attributed to two factors as reported by Balasundaram (1995) in domestic fowl. Firstly, the mechanical pressure caused the distension of follicles and secondly, the altered density of basement membrane and increased collagen fibres acted 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 in the thyroid follicles under different physiological conditions. Thus, there was a gradual and steady accumulation of unutilized colloid within the follicles and the follicular epithelium underwent aforementioned changes with age.

**Table 1**
Total number of follicles (in C.S) and number of large and small follicles of thyroid gland in Kuttanad ducks at different ages (Mean ±S.E.)

| Age | Total number of follicles (in C.S) | Number of Large follicles | Number of Small follicles |
|---|---|---|---|
| Day-old | 84.50±0.34 | 3.17±0.17 | 81.33±0.42 |
| 2 weeks | 95.33±0.88 | 4.50±0.22 | 90.83±0.65 |
| 4 weeks | 101.83±1.64 | 5.50±0.22 | 96.33±1.80 |
| 6 weeks | 103.00±1.37 | 6.33±0.33 | 96.67±1.20 |
| 8 weeks | 107.66±0.68 | 7.83±0.31 | 99.83±0.95 |
| 10 weeks | 112.17±1.51 | 9.17±0.48 | 103.00±1.71 |
| 12 weeks | 112.70±2.78 | 9.37±0.80 | 103.33±2.67 |
| 14 weeks | 125.00±1.10 | 9.83±0.83 | 115.17±1.14 |
| 16 weeks | 128.50±2.77 | 12.50±1.65 | 116.00±1.10 |
| 18 weeks | 132.33±1.28 | 13.50±1.71 | 118.83±0.70 |
| 20 weeks | 136.67±1.80 | 16.00±0.93 | 120.67±1.20 |
| 22 weeks | 144.50±0.76 | 19.50±0.22 | 125.00±0.58 |
| 24 weeks | 148.17±0.31 | 20.17±0.40 | 128.00±0.52 |

**Table 2.**
Epithelial cell heights of active and inactive follicles of thyroid gland in Kuttanad ducks at different ages (Mean ±S.E.)

| Age | Cell height of active follicles (µm) | Cell height of inactive follicles (µm) |
|---|---|---|
| Day-old | 9.32±0.21 | 1.52±0.03 |
| 2 weeks | 9.32±0.00 | 1.48±0.02 |
| 4 weeks | 16.00±0.22 | 1.48±0.02 |
| 6 weeks | 16.00±0.22 | 1.48±0.02 |
| 8 weeks | 15.80±0.21 | 1.48±0.02 |
| 10 weeks | 15.80±0.21 | 1.48±0.02 |
| 12 weeks | 15.32±0.17 | 1.42±0.01 |
| 14 weeks | 15.32±0.17 | 1.42±0.01 |
| 16 weeks | 15.32±0.17 | 1.42±0.01 |
| 18 weeks | 15.32±0.17 | 1.42±0.01 |
| 20 weeks | 15.00±0.00 | 1.36±0.00 |
| 22 weeks | 15.00±0.00 | 1.36±0.00 |
| 24 weeks | 15.00±0.00 | 1.36±0.00 |

## CONCLUSION

Epithelial diversification of the thyroid gland seen in the present study confirmed that the state of thyroid gland activity will change the epithelial lining of the follicles. The epithelium was columnar during high activity and squamous type when the gland was inactive, and these can be correlated with the physiological state of the birds.

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