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Histological Structure of the Thyroid Gland in Duck: A Light and Electron Microscopic Study

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Abstract**—**The present investigation aimed to study the histomorphometric characterizations of the thyroid gland of the duck. Five adult male and five adult female ducks were used in the experiment. Results showed that the overall histological structure of the thyroid gland of the duck were similar to those of the other vertebrae. The gland consisted of roughly spherical randomly distributed micro and macrofollicles with very little interstitial tissue between them. Each follicle is lined by a single layer of epithelial cells enclosing a cavity, the follicular cavity, which is filled with colloid. Ultrastructural findings showed that the apical surface of the follicular cells bears a variable number of short, irregularly distributed microvilli which are apparently more numerous on the columnar cells than on the lower, relatively inactive cells. Mitochondria and rough endoplasmic reticulum occupy the subnuclear region of the follicular cell, whereas the Golgi complex, free ribosomes and colloid droplets were found in the apical cytoplasm. At light or electron microscopic levels, there was no sex difference in histomorphometric characteristics of the thyroid glands.ls.

Keywords**—**Duck, Thyroid gland, Light microscopy, Electron microscopy

I. Introduction

AVIAN thyroid glands are paired, oval, dorso-ventrally flattened bodies which lie in a ventro-lateral position in the posterior part of the neck. They occur one on either side of the trachea in close proximity to the common carotid arteries and jugular veins, at about the level where the common carotid arteries divide to give off the anterior cervical and vertebral arteries [6]. The gland is organized into spherical follicles whose walls are composed of epithelial cells that surround a lumen filled with colloid [18]. Each follicle is lined by a single layer of cells of endodermal origin. The shape of these cells, together with the size and shape of the follicles, depends upon the activity of the thyroid gland [6]. Similar to the function of thyroid hormones in mammals, thyroid hormones in birds regulate body weight, plumage growth, fertility, secondary sex characteristics, and lipid metabolism [18]. In available literature, there is little information characterizing histomorphological structure of the thyroid gland in duck. The aim of the present investigation was therefore to study the thyroid gland histological structure in duck.

II. Materials And Methods

Five adult male and five adult female ducks were used in the experiment. After two weeks, the animals were deeply anesthetized with ketamin and fixed by intravascular perfusion via the left ventricle with buffered formalin. The thyroid glands of all animals were dissected and were immersed immediately in 10% buffered formalin for light microscopy or 2.5% glutaraldehyde in 0.1 neutral buffer for electron microscopy.

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Paraffin-embedded sections were cut at 5 µm and stained with haematoxylin-eosin. For electron microscopic study, the glands were fixed by immersion in 2.5% glutaraldehyde in 0.1 M sodium cacodylate buffer for two hours, washed with buffer, postfixed in 1% osmium tetroxide in buffer, dehydrated with ethanol and embedded in resin. Ultrathin (70-90 nm thick) sections of the thyroid glands were cut and mounted on 200 mesh copper grids and stained with uranyle acetate and lead citrate. Stereological measurements were performed using an image analyzer (Yamamoto - Image J '9 Image J). All stereological results were statistically evaluated by Student t-test. Results are reported as mean ± SEM with a significance level of 0.05.

III. Results

The thyroid gland of the duck has a delicate connective tissue capsule which completely surrounds the gland. Delicate connective tissue septa penetrate the gland. The gland consisted of roughly spherical randomly distributed micro and macrofollicles with very little interstitial tissue between them. Each follicle is lined by a single layer of epithelial cells enclosing a cavity, the follicular cavity, which is filled with colloid. The follicular cells have their apical ends facing toward the follicular cavity, and their basal surfaces resting on the basal lamina. The intercellular boundaries are distinct and fairly obvious under the light microscope. The nucleus occupies most of the cell volume and there appears to be only cell membrane between the nucleus and the lumen of the follicle (Figure 1 and 2). Ultrastructural findings show that the apical surface of the follicular cells bears a variable number of short, irregularly distributed microvilli which are apparently more numerous on the columnar cells than on the lower, relatively inactive cells. The organelle component of the follicular cell includes mitochondria, rough endoplasmic reticulum, free ribosomes, lysosomes and colloid droplets. The mitochondria are oval shaped. It would be proper to mention that mitochondria and rough endoplasmic reticulum occupy the subnuclear region of the follicular cell, whereas the Golgi complex, free ribosomes and colloid droplets were found in the apical cytoplasm. At light or electron microscopic levels, there was no sex difference in morphological characteristics of the thyroid glands (Figure 3). Results obtained from micrometric measurements of the thyroid gland in both sexes are shown in Table 1. The important findings are as follows:

The volume densities of the follicles, epithelium and colloid and the height of follicular cells are higher in males than in females but the differences are not statistically significant ($p>0.05$).

The volume density of interstitium is greater in females than in males but the difference is not statistically significant ($p>0.05$). Therefore it can be stated that in accordance with morphological properties, there was no sex difference in morphometric values of the thyroid glands.

TABLE I
AVERAGE MICROMETRIC MEASUREMENTS IN μM OF THE THYROID GLAND PARENCHYMA IN MALE AND FEMALE DUCKS

Parameters / gender	Follicle Vv(%)	Epithelium Vv(%)	Interstitium Vv(%)	Colloid Vv(%)	Height of follicular cells (μm)
Male	**84±6**	**14±6**	**16±4**	**70±4**	**5.8±0.5**
Female	**81±5**	**13±4**	**19±5**	**68±4**	**5.2±0.6**

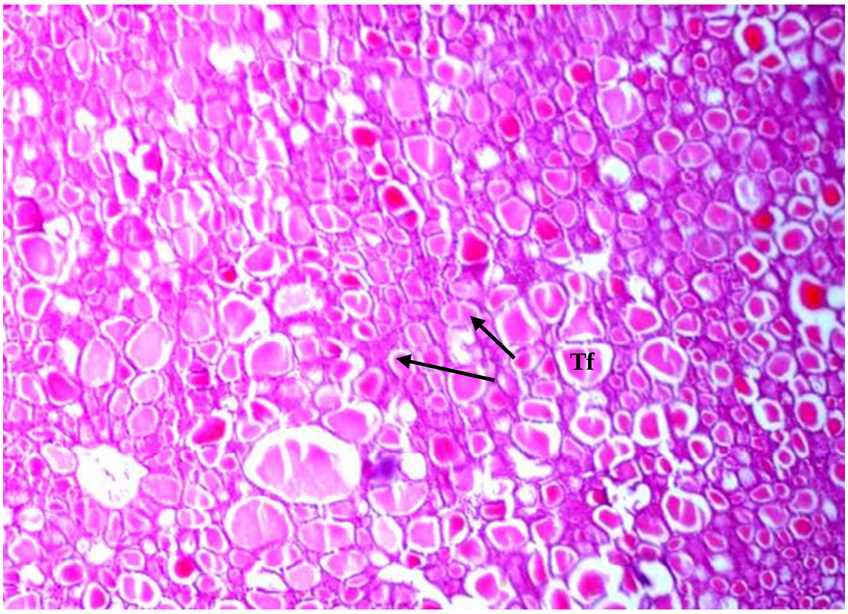

Fig. 1 Light microscopic structure of the thyroid gland in male duck. Note that thyroid follicles (Tf) of varying sizes are distributed throughout the gland parenchyma

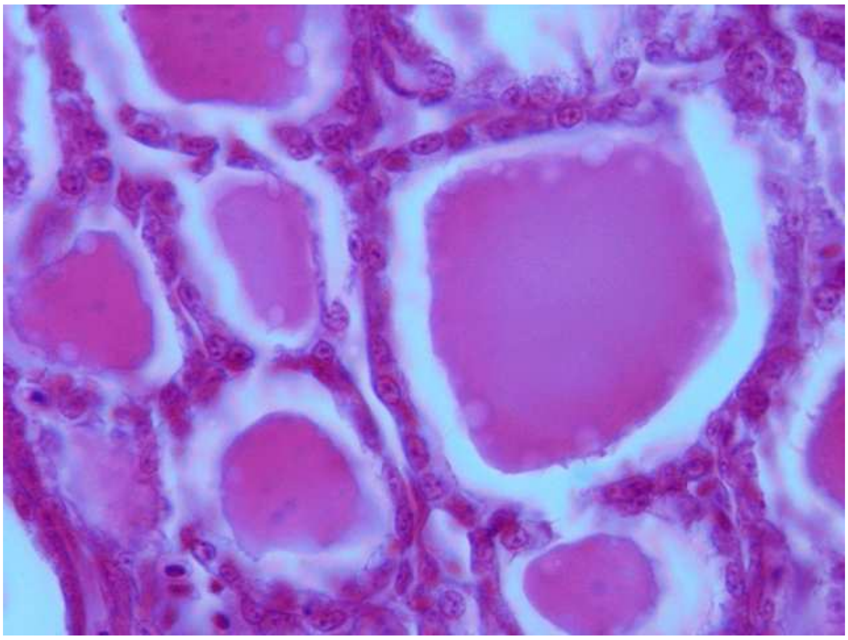

Fig. 2 Higher magnification of thyroid follicles in male duck. Note the presence of colloid surrounded by the follicular cells

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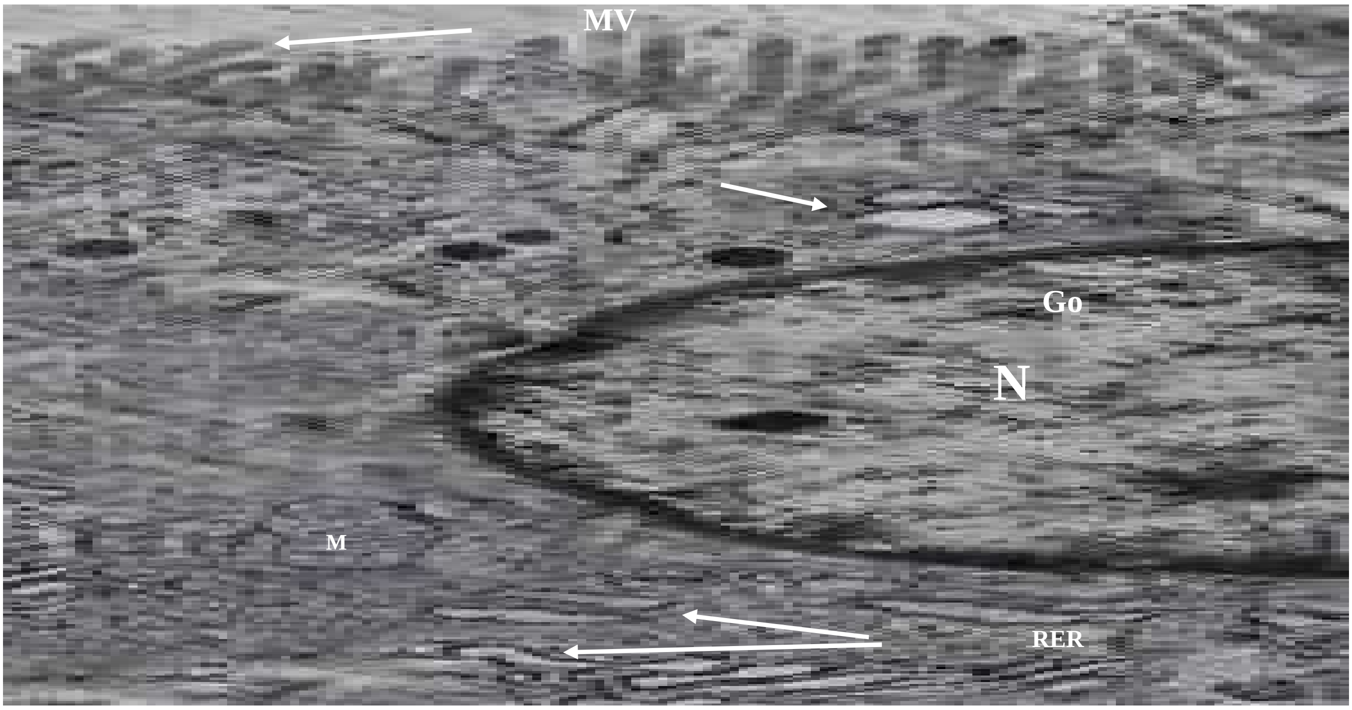

Fig. 3 Transmission electron micrograph of a thyroid follicular cell in female duck. Mitochondrion (M), Rough endoplasmic reticulum (RER), Golgi complex (Go), Nucleus (N) and Microvilli (MV). Note that mitochondria and rough endoplasmic reticulum occupy the subnuclear region of the follicular cell

IV. Discussion

Results obtained from the present study clearly showed that overall histological organization of thyroid gland in duck in both light and electron microscopic levels were similar to those of the other vertebrates [6, 12]. In some animals, the size distribution pattern of thyroid follicles is different between the peripheral and central gland regions. In rats, the larger thyroid gland follicles are mostly located at the periphery of the thyroid lobes [15]. Penel et al. (1987) [11] stated that the large follicles at the periphery mainly serve as a pool of old hormone, whereas the smaller, centrally distributed ones are responsible for thyroid hormone secretion. Sekulić et al. (2007) [13] stated that the peripheral thyroid follicles in the pigs show increased synthetic and secretory activity in comparison to the centrally placed ones. Fatahian Dehkordi and Parchami (2011) [4] stated that in dogs, unlike rats and pigs, no statistically significant differences were detected in the stereological parameters between the peripheral and central thyroid regions. Results obtained from the present investigation showed that the thyroid gland of the duck consisted of roughly spherical randomly distributed micro and macrofollicles with very little interstitial tissue between them. Each follicle is lined by a single layer of epithelial cells enclosing a cavity, the follicular cavity, which is filled with colloid. The follicular cells have their apical ends facing toward the follicular cavity, and their basal surfaces resting on the basal lamina. The intercellular boundaries are distinct and fairly obvious under the light microscope. Ultrastructural findings of the present study showed that the apical surface of the follicular cells bears a variable number of short, irregularly distributed microvilli which are apparently more numerous on the columnar cells than on the lower, relatively inactive cells. The microvilli phagocytize colloid from follicular lumina so that thyroid hormones formed on the scaffold of thyroglobulin can be processed intracellularly and released into the circulation [6-18]. Data obtained from the present investigation also showed that there was no sex difference in morphometric values of the thyroid glands in duck. In both birds and mammals, thyroid and gonadal functions have often been linked through positive or negative thyroid-gonadal interrelationships and, in most species studied; thyroid activity follows an annual cycle closely correlated with the sexual cycle [1]. Presence of androgen receptors has been reported in thyroid tissue of rat, primate and human [2, 14]. Estrogen receptors are also observed in pituitary thyrotrophs and thyroid follicular cells [5, 16]. Gonadectomy suppresses the function of the thyroid gland in the lizards [3], rabbits [10] and dogs [4]; but in the rat [6] pigeon and the duck the thyroid gland is stimulated after castration and the activation of the pituitary thyrotroph shows an apparent relationship between thyroid and gonadal function [17]. Malendowicz and Bednarek (1986) [7] stated that volume fractions of epithelium and stroma are higher and that of colloid lower in male than in female rats and the epithelium/colloid ratio is higher in the males. They also stated that the average volume of a thyroid follicular cell is higher in males than in females, although the thyroid gland contained similar numbers of follicular cells in both sexes. They concluded that the sex dimorphism in the rat thyroid depends upon a difference in the mean volume of thyroid follicular cells, with males having larger cells than females. However, in both sexes the thyroid gland contains a similar quantity of these cells. Malendowicz and Majchrzak (1981) [8] stated that after reaching puberty in the female thyroid gland a gradual lowering of the volume fraction of epithelium and an increase in volume fraction of colloid are observed. Due to these changes epithelium/colloid ratio in female rats markedly declines between 42 and 84 days of postnatal ontogenesis while in the male rats this ratio is higher and does not show such a distinct decline.

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References

[1] I. Assenmacher, D. Maurel, and M. Jallageas, “Thyroid-gonadal interrelationships as factors regulating reproductive and molting cycles. In: J. Boissin (ed.) Endocrine Regulations as Adaptive Mechanisms to the Environment,” Paris, CNRS., pp. 363-369, 1986.

[2] S.K. Banu, P. Govindarajulu, and M. M. Aruldhas, “Testosterone and estradiol differentially regulate the proliferation of thyrocytes in immature and adult Wistar rats,” Steroids, vol. 67, pp. 573-579, 2002.

[3] A. Chandola, D. S. Kumar, and J.P. Thaplival, “Thyroid activity and oxidative metabolism in a species of Gecko (Hemidacty%lus flavi'viridis Ruippell) in relation to sex hormones,” J. Endocrinol., vol. 63, pp. 191-199, 1974.

[4] R. A. Fatahian Dehkordi, and A. Parchami, “Effect of Orchidectomy and Chronic Androgen Administration on Thyroid Gland in Adult Male Dogs: A Light and Electron Microscopic Study,” World App. Sci. J., vol. 11, no. 3, pp. 289-294, 2011.

[5] R. Hampl, J. Nemec, J. Jeresova, I. Kimlova, and L. Starka, “Estrogen receptors in human goitrous and neoplastic thyroid,” Endocrinol. Exp., vol. 19, pp. 227-230, 1985.

[6] R. D. Hodges, “The histology of the fowl,” Academic Press, 1974, pp. 440-444.

[7] L. K. Malendowicz, and J. Bednarek, “Sex dimorphism in the thyroid gland,” Acta Anat., vol. 127, pp. 115-118, 1986.

[8] L. K. Malendowicz, and M. Majchrazak, “Sex dimorphism in the thyroid gland. III. Morphometric studies on the rat thyroid gland in the course of postnatal ontogenesis,” Endokrinologie, vol. 77, pp. 297-302, 1981.

[9] H. Miki, K. Oshimo, H. Inoue, T. Morimoto, and Y. Moden, “Sex hormone receptors in human thyroid tissue,” Cancer, vol. 66, pp. 1759-1762, 1990.

[10] C. Penel, J.B. Rognoni, and P. Bastiani, “Thyroid morphological and functional heterogeneity: impact on iodine secretion,” General Physiol. Biophys., vol. 4, pp. 55-68, 1985.

[11] D. A. Samuelson, “Textbook of veterinary histology,” Saunders Co, 2007, pp. 407-409.

[12] M. Sekulić, B. Šošić-Jurjević, B. Filipovi, N. Nestorović, N. Negić, M. M. Stojanoski, and V. Miloševic, “Effect of estradiol and progesterone on thyroid gland in pigs: a histochemical, stereological, and ultrastructural study,” Micros. Res. Techn., vol. 70, 44-49, 2007.

[13] D. R. Nathaniel, “Effect of gonadectomy on the follicular cell and inclusions in mitochondria of rabbit thyroid gland,” Am. J. Pathol., vol. 91, pp. 137-148, 1978.

[14] P. J. Sheridan, H.C. McGill, J. Jean, C. Lissitzky, and P.M. Martin, “The primate thyroid gland contains receptors for androgens,” Endocrinology, vol. 115, pp. 2690-2693, 1984.

[15] B. Šošić-Jurjević, B. Filipović, V. Milošević, N. Nestorović, N. Negić, and M. Sekulić, “Effects of ovariectomy and chronic estradiol administration on pituitary–thyroid axis in adult rats,” Life Sciences, vol. 79, pp. 890-897, 2006.

[16] L. Stefaneanu, K. Kovacs, E. Horvath, R.V. Lloyd, M. Buchfelder, R. Fahlbusch, and H. Smyth, “In situ hybridization study of estrogen receptor messenger ribonucleic acid in human adenohypophysial cells and pituitary adenomas,” J. Clin. Endocrinol. Metabol., vol. 78, no. 1, pp. 83-88, 1994.

[17] A. Tixier-Vidal, and I. Assenmacher, “Some aspects of the pituitary thyroid relationship in birds. Proceedings of the Second Intemational Congress on Endocrinology, London, Edited by S. Tavlor, Amsterdam, Elsevier Publishing Co., 1964, pp. 172-182.

[18] G. C. Whittow, “Sturkie’s Avian Physiology,” Academic press, NewYork, London, 2000, pp. 461-471.