Original Article

Comparative Histological and Ultrastructural Studies of the Thyroid Gland in Postnatal and Adult Female Egyptian Frugivorous Bat (Rousettus *aegyptiacus*)

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ABSTRACT

Introduction: The thyroid gland is primarily made up of endoderm-derived follicular cells which produces thyroid hormone in all vertebrates. Thyroid hormone is best known for its role in controlling metabolism in adults, although it is also required for several processes throughout development.

Aim of the Work: This study was conducted to compare the histology and ultrastructure of the thyroid gland in Rousettus aegyptiacus with age.

Material and Methods: A total of 20 thyroid gland samples, including 10 for each stage (postnatal (seven days after birth) and adult (10 months age) were used, the entire thyroid gland was separated from the neck region and prepared for histological, histochemical and transmission electron microscopic examinations.

Results: In the adult stage, thyroid gland made of vast number of follicles of various shapes and sizes which lined with follicular epithelial cells that were flattened squamous to cuboidal having rough endoplasmic reticulum with dilated cisternae. In postnatal bats, the thyroid gland consisted of smaller follicles with reduced colloid and lined with columnar follicular epithelial cells containing hyperactive rough endoplasmic reticulum with highly dilated cisternae and Golgi bodies that imparted a vacuolated appearance to the cytoplasm. Short and sparse microvilli were detected on the follicular cells, and their quantity increased in postnatal bats. Among the apical vesicles, secretory vesicles, colloid droplets, and lysosome-like structures were found with different sizes and electron densities, and their appearance changed in postnatal bats. Due to the presence of particular basal cells in adult bats, parafollicular cells were found away from the follicular lumen; however, in postnatal bats, it was found between follicular cells in the basal position with numerous dense cytoplasmic granules.

Conclusion: The general histological and ultrastructural features of the thyroid gland of postnatal and adult R. aegyptiacus have similarities to that of other mammals.

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Key Words: Basal cells, parafollicular cells, rousettus aegyptiacus, thyroid, ultrastructure.

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INTRODUCTION

The endocrine system plays a vital role in maintaining body homeostasis[1]. The thyroid gland is one of the largest ductless glands, situated on the lateral aspect of the trachea[2]. This gland and its hormones are essential in all stages of mammalian development, including reproduction and growth[3-7]. It is recognized as an important modulator of reproductive functions, including both hyperthyroidism and hypothyroidism[8,9]. Moreover, it plays a crucial role in the development and function of the cardiovascular, nervous, and immune systems[10,11]. The thyroid gland performs highly specific functions such as the synthesis, accumulation, and release of hormones containing iodine and calcitonin. The hormonal profiles of the thyroid gland have been investigated during various phases of the reproductive cycle in the bat Macrotus waterhausii[12], rats[13], Mollossus planceps[14], Epomops franqueti[15], cows[16], and goats[17].

This gland is a morphologically simple organ with two lateral lobes and a connecting isthmus; each lobe consists of numerous ball-like structures termed follicles and interfollicular connective tissues with blood capillaries observed throughout vertebrates[18]. Each follicle is composed of one layer of simple epithelium that surrounds a follicular lumen and a few parafollicular cells that are found either alone or in groups, basally or on the outside of the follicular epithelium. Each follicular epithelial cell has an exocrine polarity, despite being an endocrine cell[19]. A high molecular glycoprotein known as thyroglobulin is secreted from the follicular epithelial cells and stored in the follicular lumen in the form of acidophilic colloid[20].

The thyroid gland has been examined histologically in various seasonally breeding microchiropteran bats[21,22]. In Scotophilus heathi[23] and Taphozous longimanus[24], the thyroid gland exhibited considerable seasonal changes in colloid amount, follicular epithelial height, and weight throughout distinct periods of the reproductive cycle, indicating that it is inactive during winter hibernation and quiescent but active during the breeding season and the time of recrudescence. Thyroid follicles of varied sizes were found in Camelus dromedarius during both summer and winter[25].

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The thyroid glands of young adult goats exhibited cuboidal follicular epithelial cells having sparse short microvilli that decreased in quantity as the goats grew older and substantially dilated cisternae of rough endoplasmic reticulum, which decreased in activity and frequency in the thyroid gland of older goats that had flattened follicular epithelial cells lining the lumen[26].

During late pregnancy and lactation activity, the follicular epithelium of the bat Taphozous kacchensis was found to be characterized by the presence of well-developed Golgi apparatus, dilated rough endoplasmic reticulum, mitochondria with lamellar cristae, and apical blebs toward the luminal plasma membrane, indicating the synthesis of the thyroid hormone plasma thyroxine T4[27]. The formation of additional lysosomal bodies during pregnancy suggests the use of stored colloid and the release of thyroid hormone into the bloodstream[28].

Parafollicular cells (C cells) were found to be located between follicular cells in the basal position containing numerous dense cytoplasmic granules. The morphology of these cells (C cells) was investigated by[29] in the thyroid gland of a bat during different phases of the reproductive cycle. They reported that these cells are more developed during pregnancy and lactation than during estrus; release serotonin, calcitonin, and somatostatin; and are responsible for regulating the seasonal fluctuations in plasma calcium concentration in T. kacchensis female bats[30]. In addition to the ordinary follicular epithelial cell, another cell type lining the thyroid follicles, termed as the basal cell, was found to be situated in the basal region of follicles in all examined bats[31]. Hibernating bats were characterized by partially or completely degranulated basal cells containing cytoplasmic granules that varied significantly in appearance, ranging from dense solid granules to empty vesicles in partially degranulated cells, whereas empty vesicles filled the cytoplasmic matrix in completely degranulated basal cells[32]. Basal thyroid cells exhibit seasonal changes in the granular endoplasmic reticulum, whereas the Golgi complex remains a well-developed organelle throughout the year. These basal granular cells are involved in secretory activities[33-35]. Till now, few reports on the thyroid gland of R. aegyptiacus bat; therefore, this study aimed to compare the histology and ultrastructure of the thyroid gland in R. aegyptiacus with age.

MATERIAL AND METHODS

Collection of bat samples

This study was conducted on 20 live, apparently normal and healthy Egyptian fruit-eating bats, R. aegyptiacus (10 adult females and 10 postnatal), which were captured alive from Abu Rawash, Giza city, Egypt. After capture, they were euthanized by iso flurane, and sacrificed by decapitation immediately after they arrived in the laboratory. The entire thyroid glands were separated from the neck region, the excess fat and connective tissue attached to the gland were separated, and the glands were prepared for examinations.

Histological examination

Small pieces of the thyroid gland were fixed in Bouin's fluid and 10% neutral buffered formalin immediately for 24 h. Tissue samples were dehydrated in an ascending series of ethyl alcohol, cleaned with xylene, and embedded in paraffin. Sections of 5-µm-thickness were mounted and stained with hematoxylin and eosin[36]. For the histological examination, all preparations were examined under a microscope.

Histochemical examination

Periodic acid–Schiff procedure

Sections were treated with the periodic acid–Schiff reagent (PAS)[37]. Sections were immersed in 0.5% periodic acid for 5–10 min, washed for 5 min in running tap water, rinsed in distilled water, and then treated with Schiff's reagent for 20–35 min. Three changes of freshly prepared M/20 sodium acid sulfite solution, each lasting 2 min, were applied to the sections. This was followed by washing for 5 min in tap water before being rinsed in distilled water. Dehydration was performed in an ascending series of ethyl alcohol, after which the sections were cleared in xylene and mounted in Canada balsam. This reaction is based on the oxidation of the glycol linkages by periodic acid in the polysaccharides of thyroglobulin in colloid, thus producing aldehydes. These liberated aldehydes react with the leucofuchsin of Schiff's reagent, producing a magenta-colored compound.

Transmission electron microscopic examination

After removing the thyroid gland lobes, small portions of the organ were sliced into 1-mm3 sections and processed quickly according to the protocol of Tanta University's Faculty of Medicine's EM unit with the following steps:

Fixation in a mixture of formaldehyde/glutaraldehyde (4: 1) at pH 7.4, postfixation in 2.0% buffered osmic acid, dehydration in an ascending series of ethyl alcohol, infiltration in a solution of propylene oxide and epon mixture initiated at 1:1 and then 1:3 overnight, embedding using freshly prepared araldite epon mixture, polymerization at 60°C, sectioning by ultracut Reichert Jung ultramicrotome, and staining of semithin sections with toluidine blue for light microscopy.

Ultrathin 60-nm slices were cut and picked up on copper grids for electron microscopy; uranyl acetate and lead citrate were used to stain the ultrathin sections. A Philips 400T transmission electron microscope with an 80 kV accelerating voltage was used to analyze the slices (Tanta, Egypt). Photographs were taken on Kodak EM sheet films, which were processed, enlarged, printed, and investigated.

RESULTS

Microscopic examination

The thyroid gland of R. aegyptiacus is a bilobed structure situated in the neck, embracing the upper part

of the trachea and the lower part of the cartilage and larynx. The lobes are present on either side of the trachea and connected by the isthmus. In both stages, the lobes contained several follicles, ranging in shape from spherical and oval to irregular, covered by an outer capsule that penetrated the glandular tissue as trabeculae and septa, giving rise to incomplete partially enclosed areas. The parafollicular cells are present in the basal part of the follicular cells. The interfollicular stroma was primarily reticular and remarkably abundant in vascular and capillary plexus (Figures 1A, 2A).

Histological and histochemical examination of adult thyroid

In adult bats, the thyroid gland was composed of a large number of follicles of different shapes and sizes with a diameter of 37.70 ± 12.77 µm. The follicles were separated from one another by irregular masses of interfollicular tissue. Based on the size, shape, diameter, and histological structure of different follicles in the thyroid gland, they are classified into two types: type (a) large-sized follicles and type (b) medium-sized follicles. These follicles contained a large amount of colloid (Table 1), lined by flattened squamous or cuboidal follicular epithelium and had apical microvilli that were short, irregular in shape and spaced along the surface of the cell so rare cilia projecting into the colloid. Few parafollicular cells with pale cytoplasm and irregular granular basal epithelial cells were found in the basal portion of the follicular epithelium (Figures 1A–C). A large amount of the colloid showed a highly positive reaction of thyroglobulin with PAS stain (Figures 1D,E).

Histological and histochemical examination of postnatal thyroid

In postnatal bats, the thyroid gland consisted of a large number of smaller follicles with a diameter of 30.00 ± 9.10 µm, a reduced colloid, and a high cuboidal or columnar follicular epithelium (Table 1). These follicles were actively producing and secreting hormones as they were packed with the complete Golgi apparatus and rough endoplasmic reticulum. In this stage, parafollicular cells were more frequent than adult cells (Figures 2A,B). Reduced colloid containing thyroglobulin was found, which exhibited weak affinity with PAS stain (Figures 2C,D).

Transmission electron microscopic examination of adult thyroid

Large follicles bordered by flattened follicular squamous to low cuboidal epithelial cells with elongated or spherical nuclei were discovered by TEM in the thyroid gland of adult female R. aegyptiacus. Interfollicular connective tissue was extended between thyroid follicles having minute blood capillaries, and the lumina of the follicle was filled with a large amount of homogeneous acidophilic colloid material, which contained hormones stored in cavities as glycoprotein secreted by the follicular epithelial cells (Figures 3A,B).

The elongated compressed regular nucleus of flat squamous follicular epithelial cells contained condensed chromatin clumps, oval mitochondria with collapsed cristae, numerous lysosomes, secretory vesicles, and a few scattered small microvilli were also observed (Figure 4A).

Another lining of follicular epithelial cells of cuboidal shape possessing an oval-to-round regular nucleus and chromatin clumps was found at the periphery (Figures 4B–F). Rough endoplasmic reticulum was well developed and dilated, appearing as elongated elliptical cisternae dotted with ribosomes in the lateral and basal cytoplasm (Figure 4B). Primary lysosomes containing thyroglobulin were observed as highly dense small granules formed in the Golgi apparatus, which moved to the apical plasma membrane for exocytosing their contents into the follicular cavity (Figures 4A,B). Flattened sacs, small vesicles, and vacuoles of the Golgi apparatus were located next to the nucleus or in the supranuclear region; a few oval or round mitochondria were present, but they were more in number than the squamous follicular epithelial cells (Figure 4C). Electron-dense granules were found in the apical cytoplasm of thyroid follicular epithelial cells in both stages, and the number of these granules was increased in adult bats (Figures 4C,D).

At the apical surface of the adult follicular epithelial membrane, few stunted, thin, and finger-like microvilli were identified, indicating diminished endocytic activity. Their thyroid hormones formed intracellularly were generated on the scaffold of thyroglobulin and transferred to circulation by microvilli; the colloid from the follicular cavity was phagocytosed by these microvilli (Figure 3C).

Three types of granular vesicles were discovered in the apical part of the follicular cell cytoplasm, and a few dense small, round apical vesicles were located subapically (Figure 4D). Large vesicles with the same electron density as that of colloid droplets were assumed to be colloid (Figure 4E), and a number of secretory vesicles appeared as very dense little round structures similar to lysosomes and increased in the thyroid gland of adult bats (Figure 4A).

Few oval or circular parafollicular cells (C cells) were discovered alone or in groups basally between two follicular epithelial cells near to the basement membrane but away from the follicular cavity in adult bats due to the presence of certain basal cells that surrounded the cavity (Figure 5A). C cells showed large slightly indented nucleus and pale cytoplasm with secretory granules that were distributed in the cytoplasm but condensed apically, and a few oval or rod-shaped mitochondria with collapsed cristae (Figures 5A–C).

Transmission electron microscopic examination of postnatal thyroid

The lining cells of the thyroid gland in the postnatal stage were columnar or tall cuboidal as they were actively producing secretory hormones. They were packed with abundant highly dilated endoplasmic reticulum and

Golgi bodies, which indicated a higher metabolic rate in postnatal bats than in adult bats, and numerous finger-like thinner microvilli were also found (Figures 6A–D). Columnar follicular epithelial cells contained an irregular nucleus with lobe-like indentations, indicating that the shape of the nucleus was influenced by the shape of the cell and nucleolus, chromatin aggregates were scattered throughout the nucleoplasm and concentrated marginally. Significantly expanded elongated rough endoplasmic reticulum sprinkled with ribosomes was found, and there were also free ribosomes scattered throughout the cytoplasm, with a large number of hyperactive mitochondria with lamellar cristae and hypertrophied Golgi bodies (Figures 7A–E). Golgi apparatus and enormous colloid droplets were detected in postnatal bats, which could indicate the synthesis of thyroglobulin and its secretion by follicular cells into the follicular lumen. Because of the hyperactivity of all these organelles, the cytoplasm showed a vacuolated appearance; these vesicles or vacuoles filling the cytoplasm were irregular in shape, generally with torn membranes, and the space between the membrane fragments was very small.

The C cells featured a large regular nucleus with secretory granules distributed throughout the pale cytoplasm and found between two follicular epithelial cells near the basement membrane. There were numerous hypertrophied mitochondria. Neonates (postnatal bats) had greater Golgi apparatus and rough endoplasmic reticulum than adults (Figures 8A,B).

Large colloid droplets were found to be fused with smaller highly dense granules (probably lysosomes) in postnatal active bats, indicating phagocytosis by lysosomes for releasing hormones from colloid droplets (Figures 7C,D). Consequently, some cytoplasmic membrane structures showed an irregular or spherical multivesicular appearance, resulting in a vacuolated appearance of the cytoplasm. Thyroid hormones were either stored as glycoprotein in acidophilic colloid in cavities in adult and postnatal bats (Figure 9B) or reabsorbed from these cavities and released into the surrounding interstitial spaces, before being released from the follicular epithelial secretory cells, which appeared only in the active postnatal stage (Figure 9A).

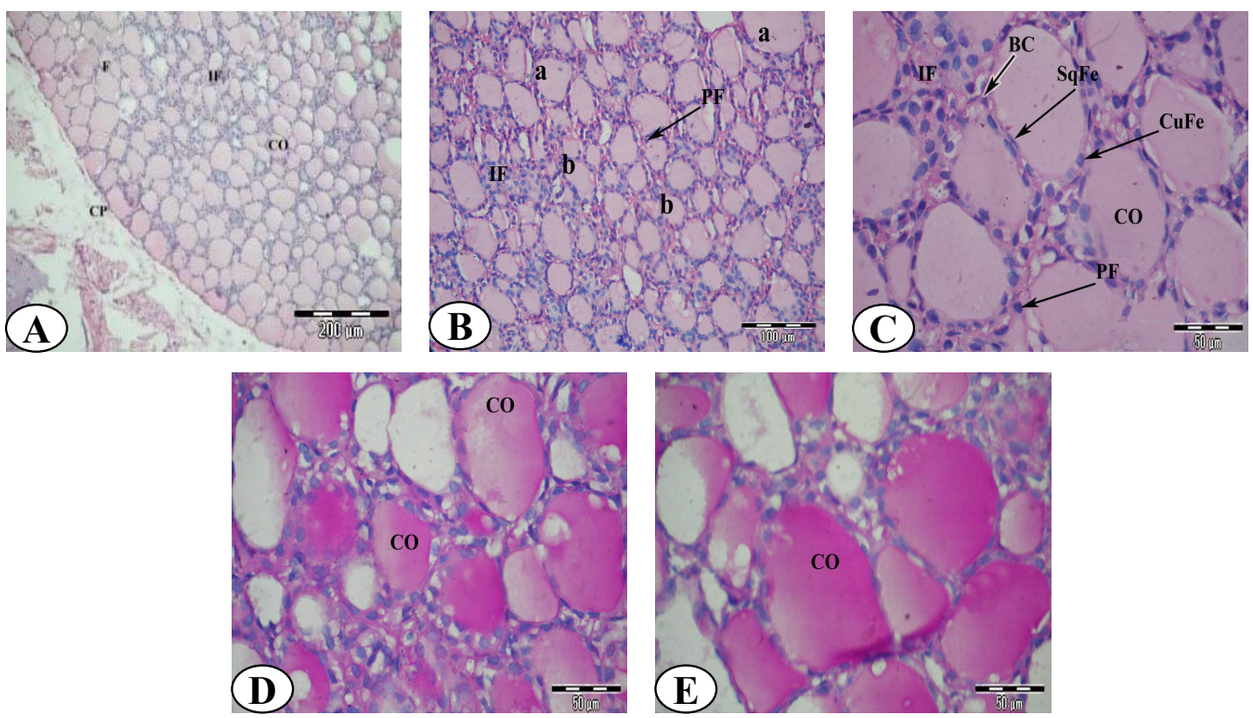

Fig. 1: H&E-stained sections of the thyroid gland of an adult R. aegyptiacus showing:
(A): Thyroid gland with capsule (CP) and several types of follicles loaded with colloid (CO), ×100.
(B): A magnified section of the thyroid gland reveals large (a) and medium (b) colloid-filled follicles (CO). A few parafollicular cells (PF) can be seen, ×200.
(C): High magnification of (B) revealing squamous (SqFe), cuboidal (CuFe) follicular epithelial cells that surround the lumen, basal cells (BC), and parafollicular cells (PF), ×400.
(D), (E): Magnified region of the thyroid gland reveals a strongly positive reaction of thyroglobulin with PAS stain, ×400.

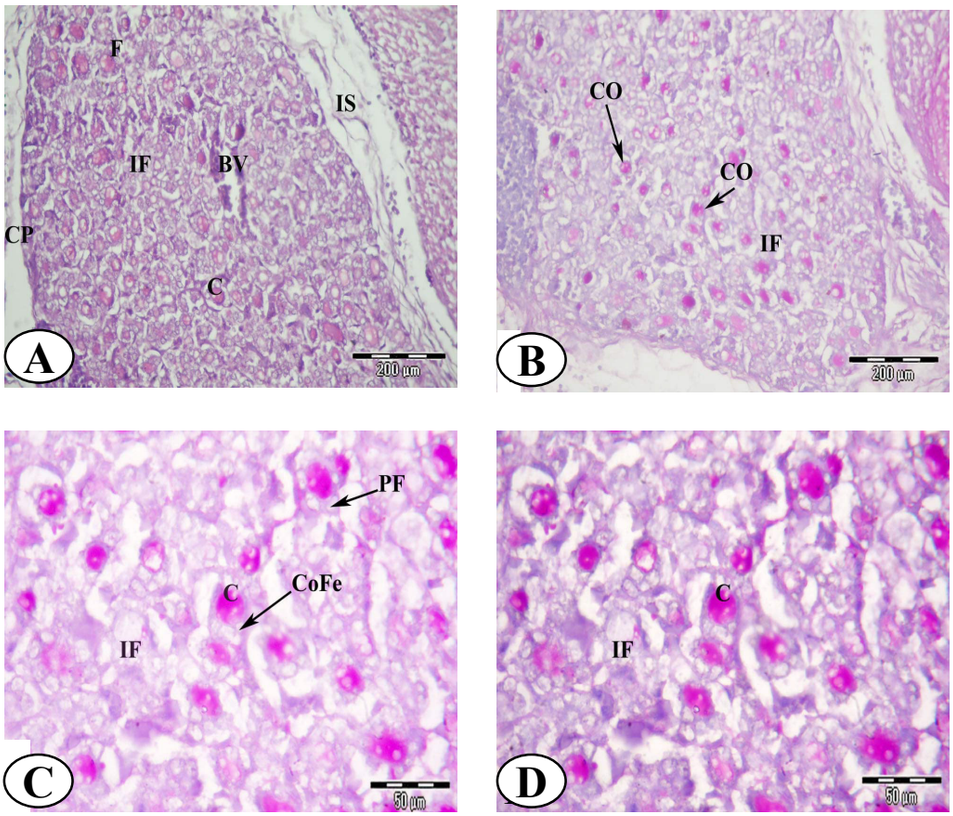

Fig. 2: H&E-stained thyroid gland sections of postnatal R. aegyptiacus showing:
(A): Capsule-covered thyroid gland (CP) with small follicles filled with decreased colloid (CO), ×100.
(B): Magnification of thyroid follicles bordered with columnar follicular epithelial cells (CoFe), basal parafollicular cells (PF), and blood vessels (BV), ×200.
(C), (D) thyroid gland sections stained with PAS showing decreased colloid containing thyroglobulin, ×100 and ×400, respectively.

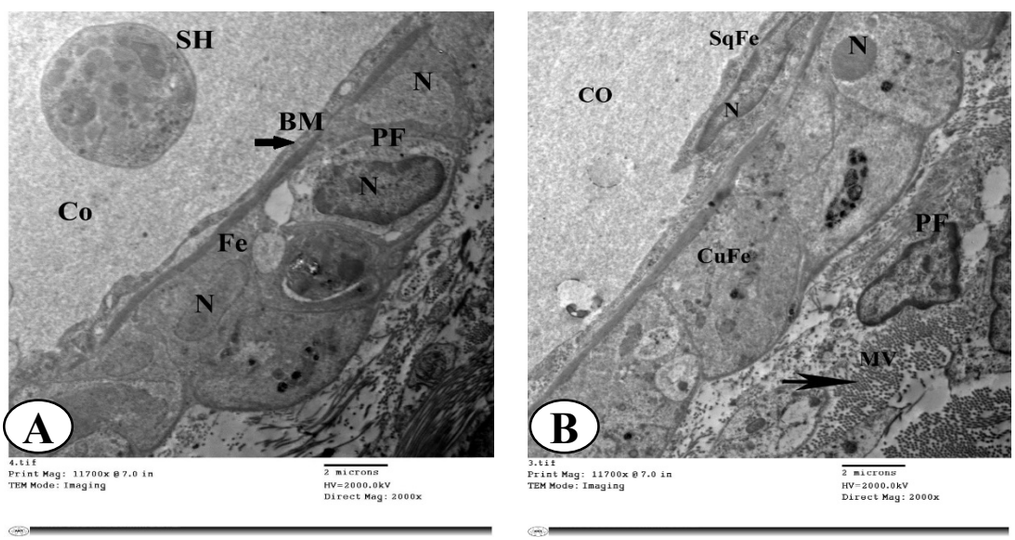

Fig. 3: (A,B): Electron micrographs of the thyroid gland of adult female R. aegyptiacus showing large inactive follicles [Fo] lined by squamous [SqFe] to cuboidal epithelium [CuFe] with elongated-to-round nucleus [N], respectively, with chromatin clumps [Ch] and lumina of the follicle filled with large electron-dense homogeneous colloid material [Co] having thyroid hormones stored in cavities as glycoprotein [SH].

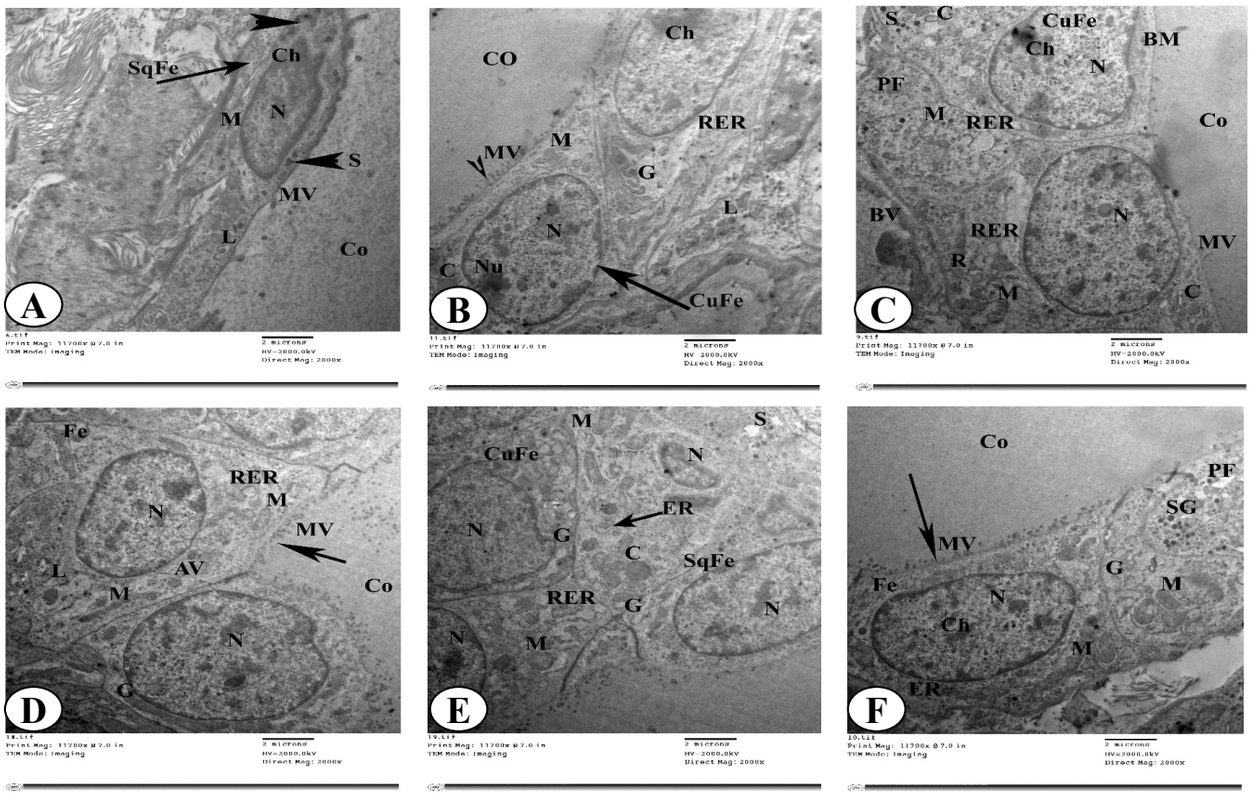

Fig. 4A: Magnified image of a follicular epithelial squamous cell [SqFe] with elongated compressed nucleus [N] and condensed chromatin clumps [Ch]. Mitochondria [M] with collapsed cristae, small extremely electron -packed granules, secretory vesicles [S], lysosomes [L], and a few short microvilli [MV] extending from the apical tips of follicular cells into the cavity can be observed.

Fig. 4: (B–F): Magnified electron micrographs showing a cuboidal follicular cell with a round -to-oval regular nucleus [N], nucleolus [Nu], and chromatin [Ch] that appear as clumps near the cell periphery. Rough endoplasmic reticulum [RER] appeared as elongated cisternae sprinkled with ribosomes [R], lysosomes [L], few mitochondria [M] that may be active, pale small round apical vesicles [AV], dense secretory vesicles appearing as lysosomes-like bodies [S] and large vesicles of colloid droplets [C].

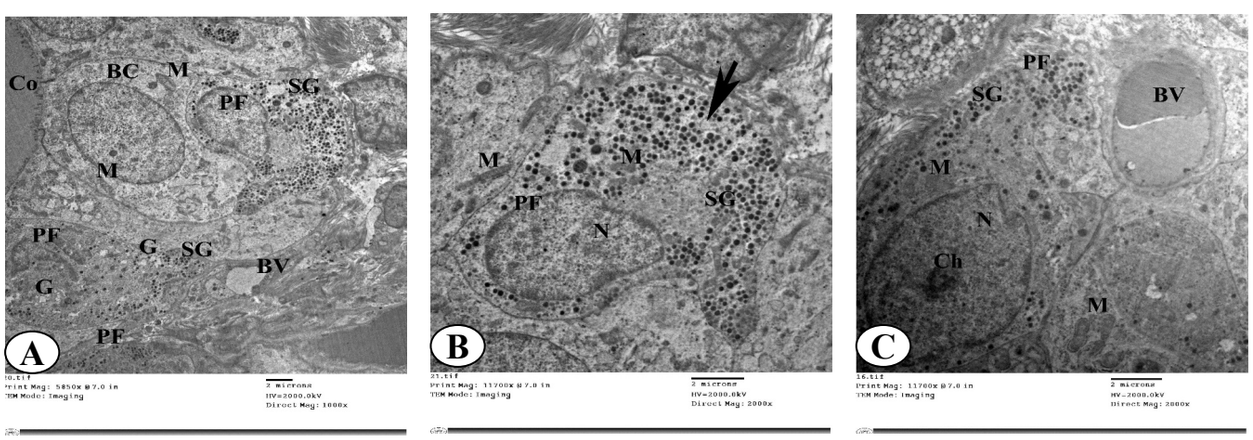

Fig. 5 (A–C): Electron micrographs of an adult parafollicular cell (PF) showing either large oval nucleus with regular nuclear membrane, Fig. 5A,B, or slightly indented nucleus [N]. Secretory granules [SG] are distributed in the cytoplasm but condensed apically. Few oval or rod-shaped mitochondria [M] are present with collapsed cristae and microvilli [MV] protruding into the colloid. The basal cell (BC) lies beneath the parafollicular cell and characteristic to adult bats (Fig. 5A).

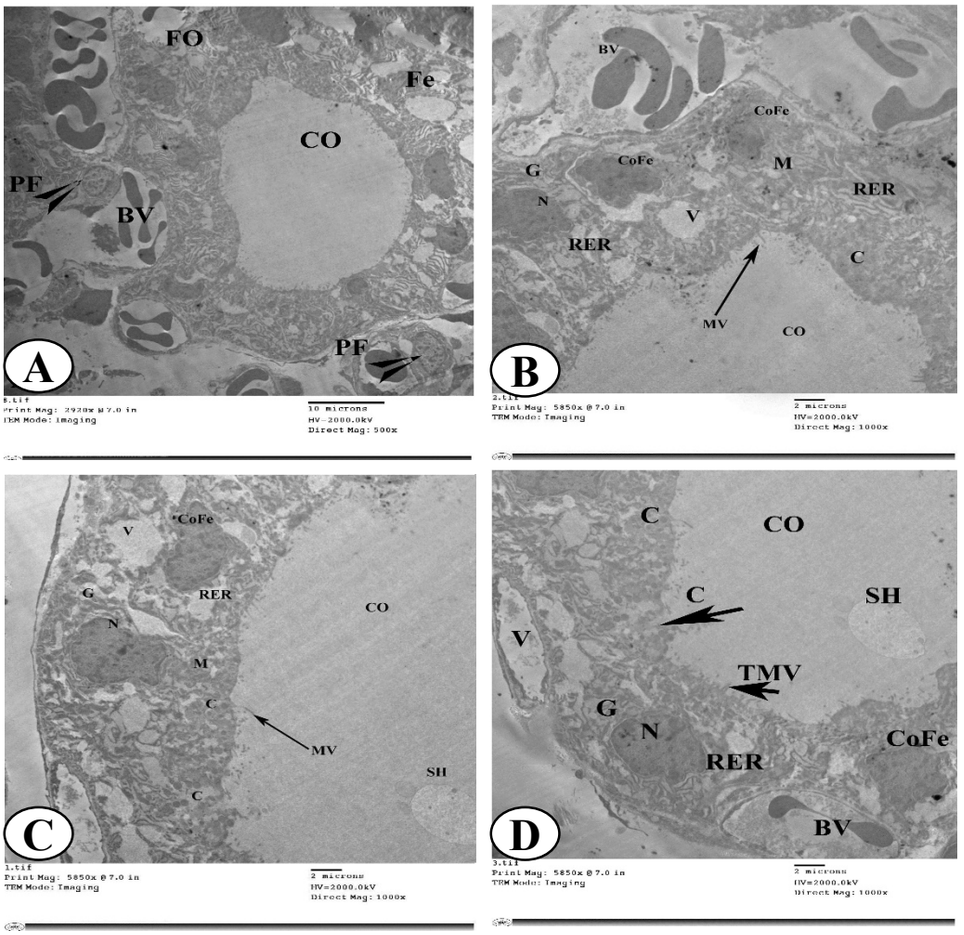

Fig. 6 (A–D): Electron micrographs of the thyroid gland of postnatal R. aegyptiacus showing small active follicles [Fo] lined by columnar epithelium [CoFe] with oval basal nucleus [N] and lumina of the follicle filled with decreased colloid material [Co]. Several thin finger-like microvilli (TMV) and colloid droplets in the apical cytoplasm near the lumen [C].

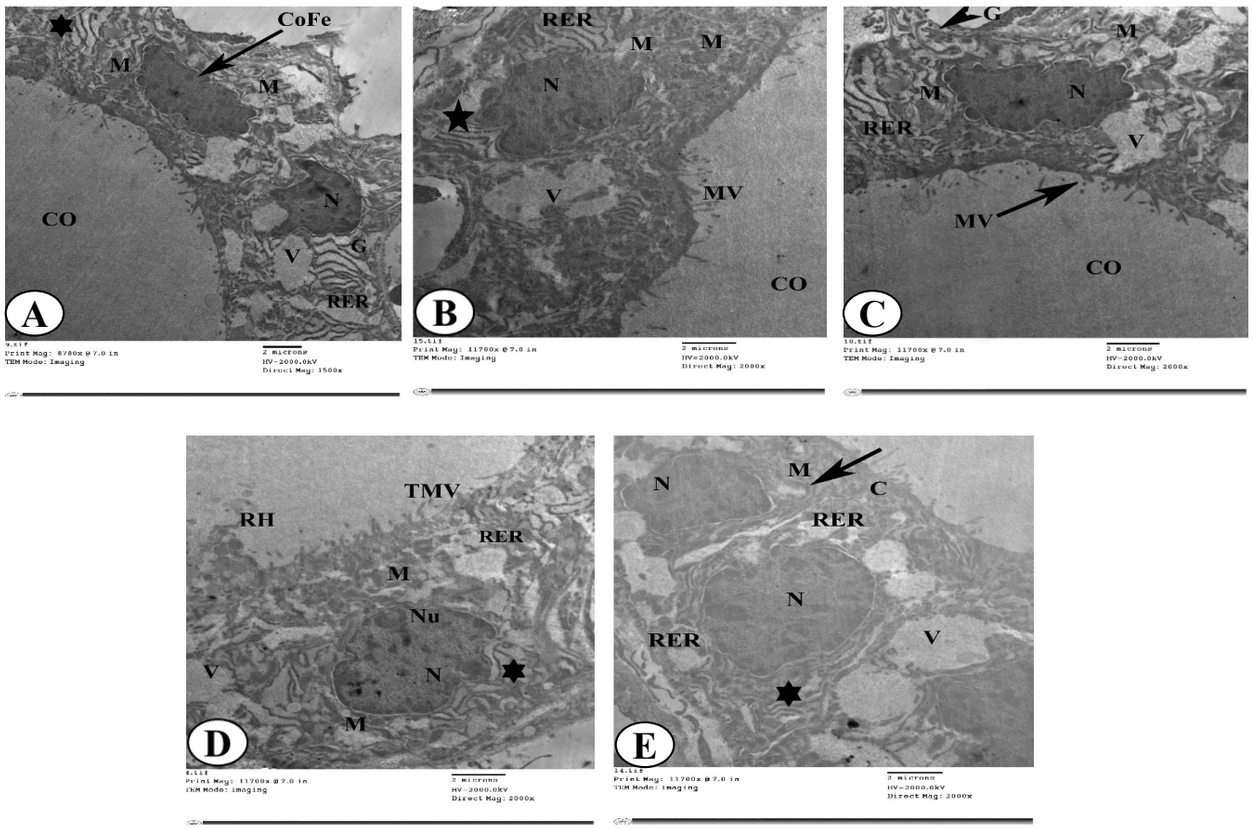

Fig. 7 (A–D): Electron micrographs of active collumnar follicular cell [CoFe] with oval irregular indented nucleus [N] with nucleolus [Nu] and chromatin clumps [Ch] dispersed throughout the nucleoplasm. There are several dilated profiles of rough endoplasmic reticulum [RER, star], which appear as elongated cisternae dotted with ribosomes, as well as ribosomes dispersed throughout the cytoplasm, a large number of hyperactive mitochondria with lamellar cristae [M] and hypertrophied Golgi bodies [G].

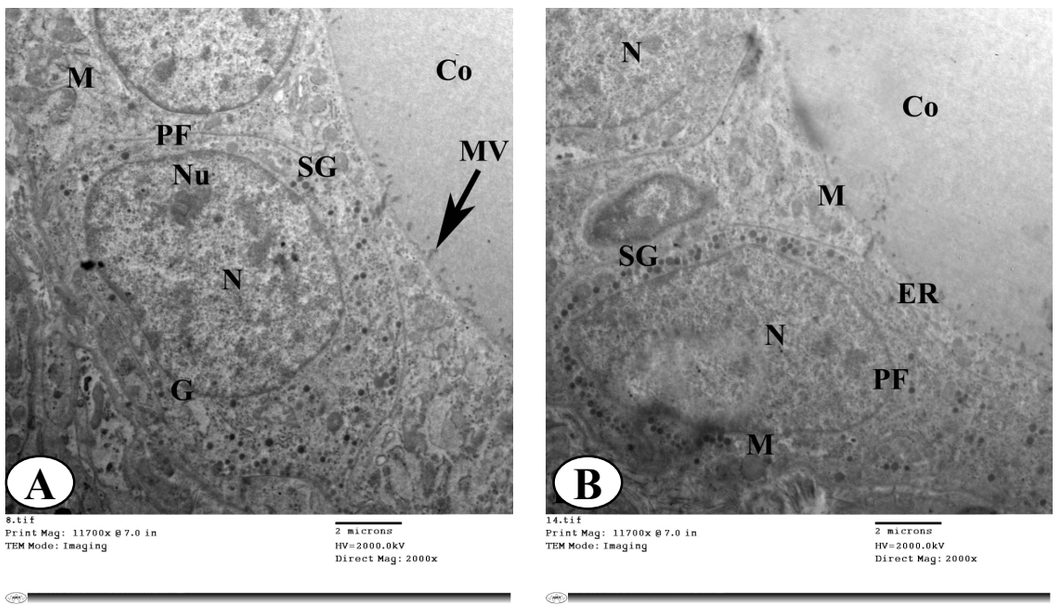

Fig. 8 (A,B): Electron micrographs of postnatal parafollicular cell (PF) showing large regular nucleus [N]. Secretory granules [SG] are distributed throughout the pale cytoplasm. Mitochondria [M] are numerous and hypertrophied. Thin finger-like microvilli [TMV] protruding into the colloid, rough endoplasmic reticulum [ER], and Golgi apparatus [G] can be observed.

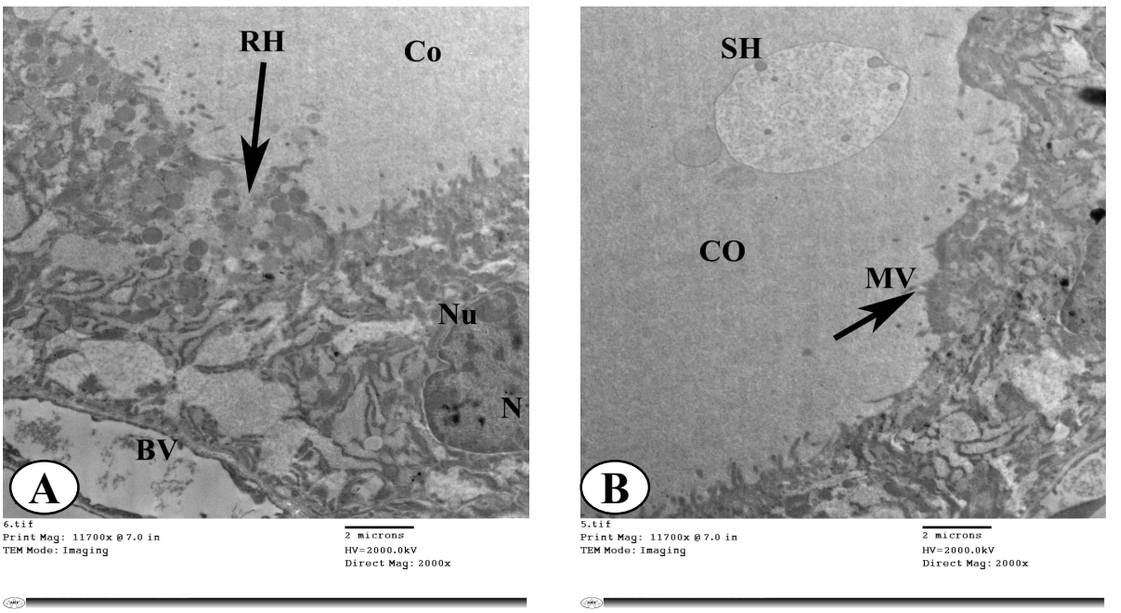

Fig. 9 (A,B): Electron micrographs showing thyroid hormones either stored [SH] in cavities as glycoprotein in colloid, Fig. 9B, or reabsorbed from cavities and released into the surrounding interstitial spaces and then released from the follicular epithelium secretory cells as released hormone [RH], Fig. 9A.

Table1: Diameter of thyroid follicles, colloid and epithelial cells height in adult and postnatal bat, R. *aegyptiacus.*

		Range	Mean ± S. D	F. test	*p. value*		
Colloid	Post	20 – 50	33.20 ± 9.25	47.263	0.001*	P1	0.001*
	Adult	34 – 80	58.50 ± 14.37			P2	0.001*
Follicle	Post	24 – 54	30.00 ± 9.10	14.457	0.001*	P1	0.001*
	Adult	20 – 60	37.70 ± 12.77			P2	0.870
Cell height	Post	1 – 4	2.50 ± 1.08	14.773	0.001*	P1	0.001*
	Adult	1 – 2	1.50 ± 0.53			P2	0.004*

DISCUSSION

The thyroid gland is essential for the growth and maturation of many target tissues, so great differences occur in this gland at different stages of life[25]. This study aimed to compare structure of thyroid gland in postnatal and adult R. aegyptiacus. The gland of both stages showed the presence of follicular and parafollicular cells, whose cytoplasmic organelles were similar to those of several mammals, including sheep and camels[25,38]. There were slight differences which may be due to differences in climate and species. The follicular lining epithelial cells were squamous in the thyroid gland of adult bats with flattened compressed nuclei to cuboidal cells with rounded nuclei, as observed by[40] in White Fulani cattle. As previously reported in the West African Dwarf goat[27], columnar follicular cells lining the follicle of postnatal thyroid gland had a circular or oval nucleus with an irregular nuclear membrane with lobe-like indentations, indicating that the nucleus shape had changed, showing that the nucleus' form was influenced by the cell shape and other cytoplasmic components. Colloid droplets, a few atrophic microvilli, abundant apical vesicles, lysozymes, and highly expanded cisternae of the rough endoplasmic reticulum were detected in the follicular epithelial cells. Similar to several mammals[39], the number and size of these organelles in the examined bats varied with age.

The cuboidal cells in adult bat had stunted microvilli formed on the apical portion and were thinner, finger-like, and maximal in number in the postnatal thyroid gland. In the flat squamous follicular epithelial cells, microvilli were short and sparse, indicating low endocytosis activity. The thyroid follicular cells engulfed the colloid in the follicular cavity by microvilli, so that the thyroid hormone was released into the circulation after intracellular processing in the thyroglobulin scaffold[41]. The cytoplasm of follicular cells revealed a variety of mitochondrial forms, which were most common in the apical cytoplasm adjacent to the colloid, with circular, oval, bar-shaped, or dumbbell-shaped outline. These mitochondria were more active and abundant in postnatal bats, but less so

in adult bats. Similar findings have also been reported in camels[25] and sheep[38]. In this study, rough endoplasmic reticulum was located more basally and laterally in the cytoplasm of thyroid follicular epithelium than apically, and these cisternae were highly expanded in the thyroid of postnatal rather than in adult bats, which appeared as irregular, elongated, oval cisternae, as previously reported by[27] in West African Dwarf goats and Bakerwali goats. In both stages of thyroid development, there were vacuoles, small vesicles, and flattened sacs of the Golgi complex above or next to the nucleus. Colloid droplets and large Golgi complexes were found regularly in postnatal bats, which could imply a functioning thyroid gland. The presence of secretory vesicles, Golgi complex, and Rough endoplasmic reticulum (RER) demonstrates that follicular epithelial cells are active in the production and secretion of thyroglobulin in the follicular cavity[25,42].

Examined the mechanism by which secretory granules containing thyroglobulin are generated in the Golgi apparatus and transported apically of the plasma membrane[43], where they exocytosed their contents into the cavity of thyroid follicles. Granules with high electron density were observed in the apical end of the cytoplasm of follicular epithelial cells in both stages of R. aegyptiacus; these granules were increased in terms of density and number in adult bats compared to those in postnatal bats and resembled the primary lysosomes of West African Dwarf goats as reported by[27,44]. Colloid droplets with lysosome fusion demonstrated the importance of lysosomal function in releasing thyroid hormones from thyroglobulin in colloid droplets[45].

A few C cells may be one or two in each follicle appeared circular or oval in shape in adult bats between two follicular cells close to the basement membrane but away from the follicular cavity. However, their number increase in postnatal bats, their forms changed to be elongated and were detected alone or in clusters between two follicular epithelial cells, next to the basement membrane as in the thyroid gland of cattle and adult pigs as reported by[46] and that of the West African Dwarf goat analyzed by[27].

Parafollicular cells were found to be extremely rare in humans[48] and deer[49]. A few cells were found in hamsters epifollicularly, whereas others were found between follicular epithelial cells, yielding different results. They can be found in the interfollicular or intrafollicular sites in Sprague-Dawley rats, exactly as they were found in humans[50]. These cells were abundant in most investigated mammals such as dogs, cats, rats, and rabbits[47]. In bats[27] and West African Dwarf goats, parafollicular cells play a similar role in the metabolism of calcium via calcitonin.

According to the present study, the histology and ultrastructure of the thyroid gland of R. aegyptiacus are identical to those of other species of mammals, and the gland was found to be more active in postnatal bats. This activity was reduced in adult bats as they get older due to aging changes in the organelles of cells.

CONFLICT OF INTERESTS

There are no conflicts of interest.

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الملخص العربى

دراسات نسيجية ودراسات تركيبية مقارنة للغدة الدرقية في أنثى الخفافيش المصرية بعد الولادة والبالغة

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تتكون الغدة الدرقية بشكل أساسي من خلايا جرابية مشتقة من الأديم الباطن (الاندوديرم) والتي تنتج هرمون الغدة الدرقية في جميع الفقاريات. يشتهر هرمون الغدة الدرقية بدوره في التحكم في التمثيل الغذائي لدى البالغين ، على الرغم من أنه ضروري أيضًا للعديد من العمليات خلال التطور. أجريت هذه الدراسة لمقارنة الأنسجة والبنية التحتية الدقيقة للغدة الدرقية في خفاش اكل الفاكهة المصري مع تقدم العمر. تم استخدام ٢٠ عينة من الغدة الدرقية لخفاش اكل الفاكهة المصري، ١٠ لكل مرحلة (ما بعد الولادة والبالغة) ، وتم فصل الغدة الدرقية بالكامل عن منطقة الرقبة وتجهيزها للفحوصات النسيجية والكيميائية النسيجية والفحوصات المجهرية الإلكترونية. في مرحلة البلوغ (عشر شهور) ، تتكون الغدة الدرقية من عدد كبير من البصيلات (الجيوب) بأشكال وأحجام مختلفة مبطنة بخلايا طلائية ظهارية جرابية تم تسطيحها حرشفية إلى مكعبة ذات شبكية إندوبلازمية خشنة مع صهريج متوسع. في خفافيش ما بعد الولادة (عمر سبع ايام) ، تتكون الغدة الدرقية من بصيلات (جيوب) أصغر مع غروانية منخفضة ومبطنة بخلايا طلائية ظهارية جرابية عمودية تحتوي على شبكة إندوبلازمية خشنة مفرطة النشاط مع صهاريج متوسعة وأجسام جولجي تضفي مظهرًا مفرغًا على السيتوبلازم. تم الكشف عن الميكروفيلي (الاهداب) القصير والمتناثر على الخلايا الجرابية ، وزادت كميتها في الخفافيش بعد الولادة. من بين الحويصلات القمية ، تم العثور على الحويصلات الإفرازية ، والقطرات الغروانية ، والتركيبات الشبيهة بالجسيمات بأحجام مختلفة وكثافة إلكترونية ، وتغير مظهرها في الخفافيش بعد الولادة. نظرًا لوجود خلايا قاعدية معينة في الخفافيش البالغة ، تم العثور على خلايا جرابية بعيدًا عن التجويف الجريبي ؛ ومع ذلك ، في الخفافيش بعد الولادة ، وجد بين الخلايا الجرابية في الوضع الأساسي مع العديد من الحبيبات السيتوبلازمية الكثيفة. مم سبق يمكن استنتاج ان السمات النسيجية والتركيبية العامة للغدة الدرقية في فترة ما بعد الولادة والبالغة من خفاش اكل الفاكهة المصري تتشابه مع تلك الموجودة في الثدييات الأخرى.