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Histomorphological study of thyroid gland in local adult female cats (*Felis catus*)

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ABSTRACT

This study was designed to investigate the histomorphological characteristics of thyroid glands in local female cats (*Felis catus*). Eight healthy adult female cat were obtained from local supplier. Half number of animal used to conduct anatomical study, whereas the other half used for histological examination. Gross anatomy (shape and color) location of female cats thyroid were described and macroscopic measurements (weight, length, width, thickness, volume and weight) were listed in tables and statistically analyzed. For microscopic aspect, specimens from each lobe of thyroid were fixed in 10% formalin and processed routinely, then stained followed stains: H & E, periodic acid Schiff (PAS) stain and Masson's Trichrome stain. Anatomically, thyroid glands in female cats consist of two completely separated reddish brown compact lobes (right and left), no isthmus present. Its lobes located at the most cranial part on lateral aspect of the trachea. Statistically, there were no significant differences at ($p < 0.05$) in the anatomical parameters between right and left thyroid lobes. Histologically, thyroid glands covered by a capsule of connective tissue which sent many vascular septa into the glandular parenchyma dividing it into many different sizes and shapes of lobules which contains numerous of different sizes and shapes of follicles. Statistically there was no significant differences at ($p < 0.05$) in the capsule thickness and diameters of different sized follicles between right lobe and left lobes. Each follicle lined by simple cuboidal epithelium. No significant differences in heights of epithelium between right and left lobes. Para follicular cells (C-cells) were observed as a single cells interspersed between the follicular cells or as a small groups of 2-3 cells present between the follicles. Thyroid follicle that contained colloid material gives positive reaction with PAS stain.

Keywords: *Felis catus*, Female, Histomorphology, Thyroid gland.

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Introduction

Thyroid gland is a vital endocrine glands in the body present in all mammals. Generally, it is a bi-lobed reddish brown structure, consisted of left and right lobes joined together by a thin isthmus. Usually it is situated in the cranial part of the trachea (Chaudhary *et al.*, 2013). Histologically, thyroid gland surrounded by a capsule, made up of many lobules, which consisted of different sizes and shapes of follicles that vary in its size and lined by simple squamous cells with abundant collide within the follicular cavity when the follicles are inactive (Petrova *et al.*, 2014), while when very active, it lined by simple



columnar cells with scanty collide. In a normal state or during average activity, the cells are simple cuboidal, and the cavity is filled with a moderate amount of colloid (Shoyele *et al.*, 2019). Thyroid gland secretes thyroglobulin hormones (T4),(T3) and Calcitonin (McLaughlin *et al.*, 2019). Review of literature revealed a paucity in published studies on thyroid glands of adult indigenous cats up to date, therefore the present investigation aimed to describe the histomorphological structures of thyroid glands in local adult female cats (*Felis catus*).

Materials and methods

Eight adult healthy female cats were brought from local supplier in Baghdad- province. All animals were weighed by digital balance. The cats weight was 3.5 Kg. Four cats used for anatomical observations. After euthanazia by IV injection of xylazine (Tom and Sue, 2007),the morphological observations of two thyroid lobes were recorded. The whole gland was removed carefully and other anatomical parameters were recorded and listed in table. Four female cats used for histological study. After routine histological technique, the histological sections stained with Harris Hematoxyline and Eosin, Periodic Acid Schiff Reagent (PAS)and Masson Trichrome Stain (Luna, 1968; Bancroft and Stevens, 2012), and examined by using light microscope (Olympus/ Japan) and photographed by using (Olympus/ Japan) microscope and Future Win Joe camera, with different magnifications. All histological parameters were measured by using the fijiwin32 (2).zip- WinRAR software and listed in table. The Statistical Analysis System-SAS (2012) program used to explore the differences factors in studied parameters (T test) was used to significant compare between means in this study at $p < 0.05$.

Results

The thyroid gland in local adult female cats located in the cranial part and on the lateral sides of the trachea and embedded in cervical fascia. Appeared as reddish brown, consist of two lobes, coated by thin capsule. The right and left lobes were totally separated and no isthmus was observed. Right lobe was slightly cranial and shorter than the left one (Figure. 1).

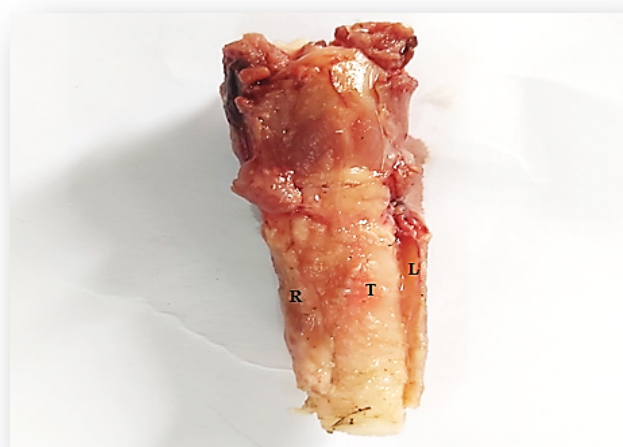


Figure. 1: Gross anatomy of thyroid gland in Female Local Cat Shows: Right lobe(R), Left lobe (L), Trachea (T).

It was extend between the first and sixth tracheal ring, whereas the left lobe extend from the second till the seventh tracheal ring. Thyroid lobes showed as elongated oval or elliptical compact mass with round cranial end and narrow caudal end with two smooth surfaces and lateral and medial surfaces (Figure. 2, 3). The lateral surface of each lobe appeared convex, related to common carotid artery, vasosympathetic trunk, jugular vein, and sternomastoideus which crossed the ventral borders of the two lobes. While the medial surface was flat - slightly concave and related to tracheal rings (Figure. 2, 3), Has dorsal and ventral borders, While the isthmus due to the two lobes were completely separated (Figure. 1).



Figure. 2: Gross anatomy of thyroid gland in Female Local Cat Shows: Right lobe(R), Trachea (T).

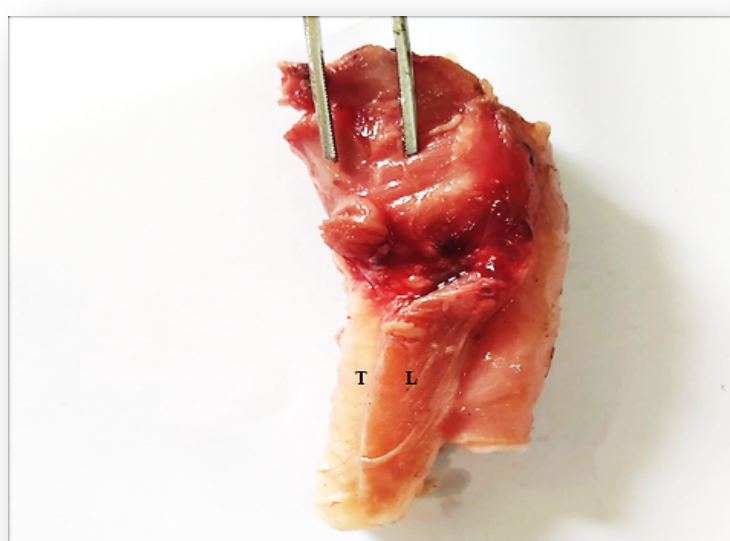


Figure.3: Gross anatomy of thyroid gland in Female Local Cat Shows: Left lobe (L), Trachea (T).

Mean weight of thyroid gland, relative weight, volume and mean weight, length, width, thickness and volume of the right and left lobe were recorded in (Table 1), no significant differences in these parameters between the two lobes at $p < 0.05$.

Table. 1: Anatomical Parameters of the Right and Left Lobes of the Thyroid Glands in Female Local Cats.

Anatomical Parameters	Right Lobe	Left Lobe
Weight g	0.7 ± 0.2	0.8 ± 0.1
Length mm	2.2 ± 0.2	2.5 ± 0.3
Width mm	0.7 ± 0.3	0.9 ± 0.2
Thickness mm	1.8 ± 0.3	2.0 ± 0.1
Volume ml	0.8 ± 0.1	1 ± 0.1

The general structure of thyroid gland in adult female cats showed common pattern of mammalian histomorphology. Its coated by thin capsule composed of an inner dense irregular connective tissue made from collagen and elastic fibers, fibroblasts and thin outer layer of adipose tissue interpose with collagenous fibers and a few elastic fibers (Figure. 4,5). From capsule a thin septa extend into the glandular parenchyma dividing it into clear large and small size lobules (Figure. 6).

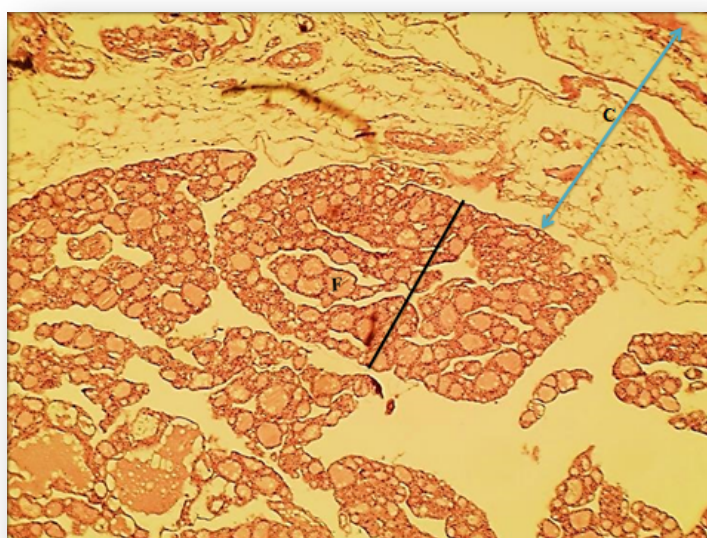


Figure. 4: Histological Section of thyroid left lobe in female local cat shows: Capsule (C), Lobule (black arrow), Follicle (F) X4 H&E Stain

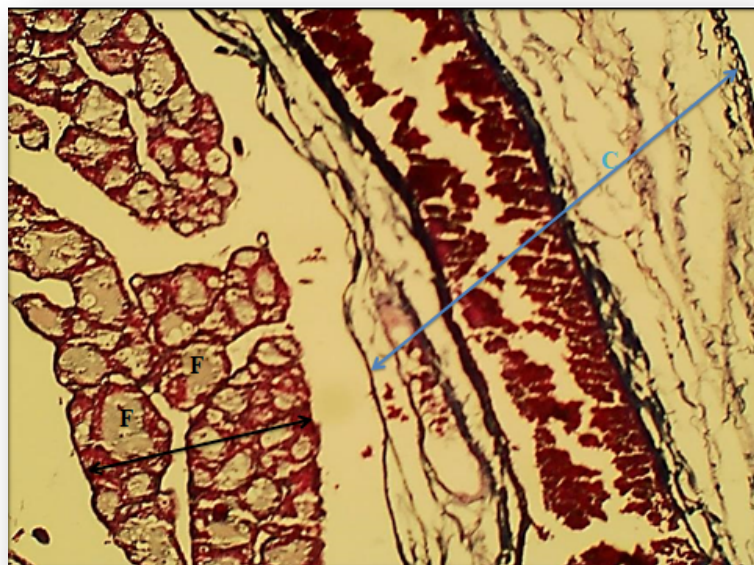


Figure.5: Histological Section of thyroid right lobe in female local cat Shows: Capsule (C), Lobule (black arrow), Follicle (F), X10 Masson Trichrome Stain.

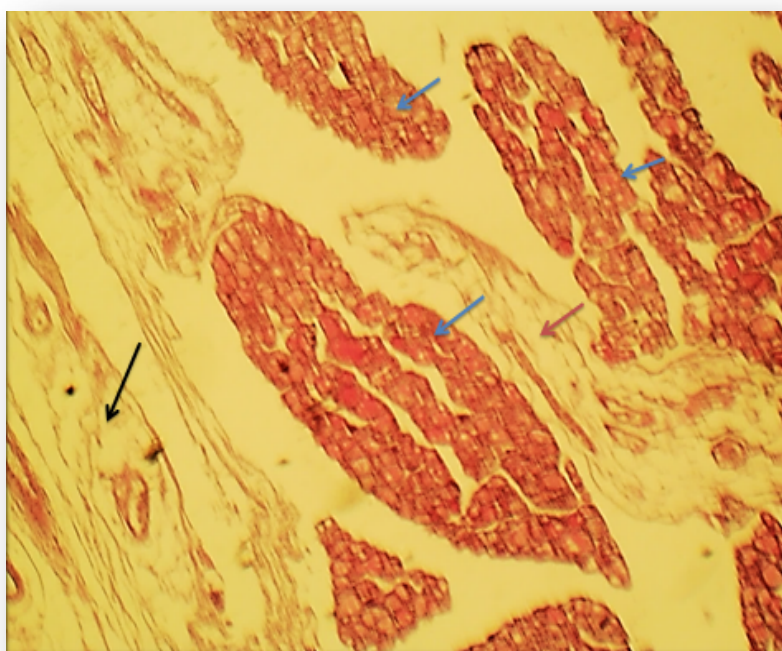


Figure. 6: Histological Section of Left lobe of thyroid gland in female local Cat Shows: Capsule (black arrow) , Trabeculae (Red arrow), Lobule (blue arrows) X4 H&E Stain

The mean capsule thickness of right and left lobes showed in (Table. 2). There are no significant differences in this parameters between right and left lobes at $p < 0.05$ (Table 2).

Table. 2: Histological Parameters of the Right and Left Lobes of the Thyroid Glands in Female Local Cats.

Histological parameters(μm)	Right Lobe	Left Lobe
Thickness of capsule	150.4 \pm 0.01	150.8 \pm 0.03
Diameter of small Follicles	23.5 \pm 2.73	22.1 \pm 3.94
Diameter of Medium Follicles	55.8 \pm 2.41	56.02 \pm 1.9
Diameter of Large Follicles	82.5 \pm 2.4	83.10 \pm 2.6
Height of Follicular Cells	5.1 \pm 0.6	5.3 \pm 0.3

The lobules of the right and left lobes were composed of an aggregations of various shapes and size of follicles, which surrounded by a basement membrane, thin connective tissue with collagen fibers, fibroblast and numerous of capillaries. Different shapes of follicles were observed as rounded, oval, polygonal, elongated and irregular follicles. Both rounded and oval shaped follicles were predominated (Figure. 7). There were three main sized follicles were identified; large, medium and small-sized follicles. Large follicles dispersed with small and medium-sized follicles were spread through right and left lobes and contains the colloid substance (Figure. 7).

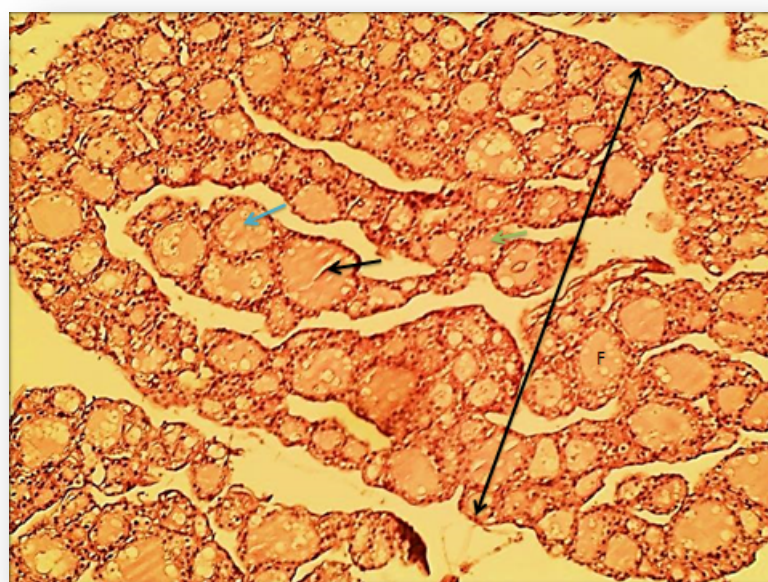


Figure.7: Histological section of left lobe of thyroid gland in female local cat shows: Lobule (double arrow), different shapes and sizes of follicles large(black arrow), Medium (blue arrow),Small(green arrow) X10 H&E Stain

The mean diameters of small, medium and large size follicles of right and left lobe were recorded in (Table. 2), and no significant differences in these parameters between two lobes at $p < 0.05$. The lining epithelium of the follicles was simple cuboidal epithelium with spherical nuclei (Figure. 8).

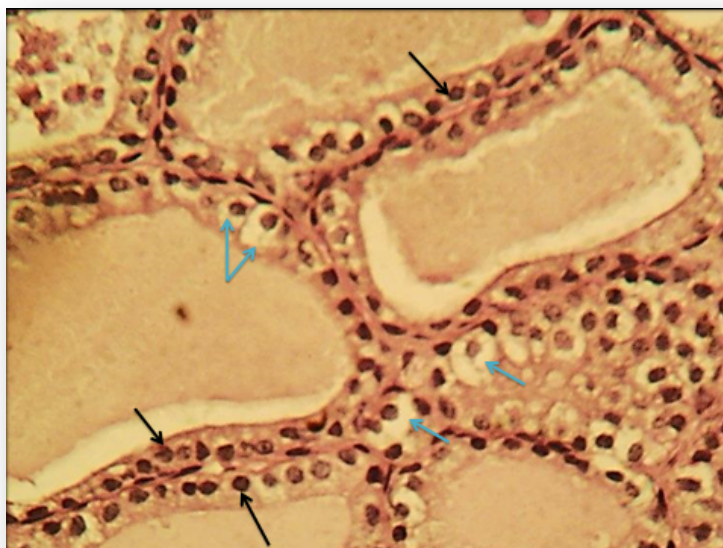


Figure.8: Histological section of thyroid right lobe of gland in Female local cat shows: Lining epithelium of follicles Simple Cuboidal Epithelium (black arrows),Para Follicular Cells (blue arrows) X400 H&E Stain

Mean height of follicular cells in the right and left lobes were listed in (Table. 2). No significant difference between right and left lobes at $p < 0.05$. Also thyroid gland consisted of a thin network of interfollicular connective tissue rich in blood capillaries which surrounded of each follicles (Figure.9).

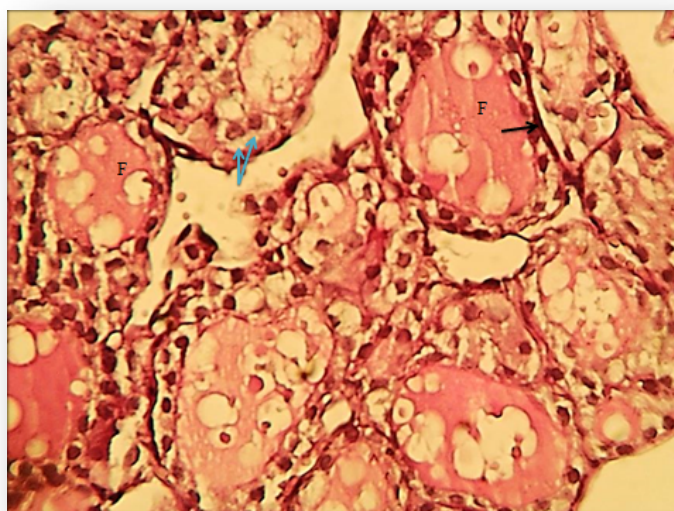


Figure.9: Histological section of Right lobe of thyroid gland in female local cat shows: Follicles(F), connective tissue (black arrow) Para-follicular cells (blue arrows) X100 PAS Stain

Parafollicular cells observed as large oval - round cells, more stained cytoplasm than the follicular cells with densely stained nuclei, some of these cells present between the follicular cells. The base of follicular and the parafollicular cells were rested on a distinct basement membrane and other cells arranged in groups in between the follicles (Figure.8, 9).

Thyroid follicles contains variable amount of homogenous eosinophilic colloid material in an intrafollicular spaces (Fig. 9, 10) and many or few peripheral visible empty vacuoles observed in stored colloid. Colloid display density in different degree, some follicles contains densely stained eosinophilic colloid material that reacted strongly positive with PAS showed magenta color, but few follicles contain faintly stained colloid which reacted weakly positive towards PAS (Figure. 10).

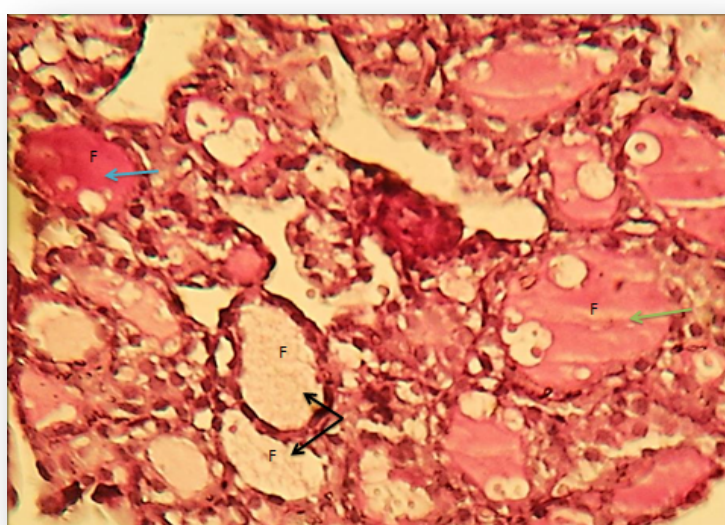


Figure.10: Histological section of Right lobe of thyroid gland in female local cat shows: Follicles (F), black arrows (empty follicles), strong (blue arrow), moderate(green arrow) X100 Positive reaction for PAS Stain

Discussion

The current study showed the thyroid gland in local cats constructed of two lobes, located in the cranial part of the trachea as in other domestic animals such as goat (Salih, 2018). However the situation of thyroid gland is variable, in majority of animals; Ali, (2014) showed that in donkey and sheep, the thyroid lobes located in neck anterior, frontal to the tracheal upper part and inferior to the larynx. The two lobes of cat were separated and the isthmus was absent, as reported by Mark *et al.*, (1984) in dog and cats, but disagree with Altaay, (2007) in buffalo in which the two lobes were connect by a transverse thin strand isthmus. In general, the thyroid gland shape in cats observed as in domestic animals such as in goat (Dawood, 2014).

Statistically, the weight, length, width and volume of left lobe in cats slightly higher than those of the right one, but not significant similar, findings by Dawood, (2014) in goat. Whereas the dimensions of the two lobes; length and width in cats were lesser than that observed in goat (Hamad, 2008). This differences may be due to the species

variation. The histological structure of cats thyroid gland was similar to those observed in other domestic animals as in dogs (Aughey and Frye, 2010). The capsule thickness of both lobes in cat was thinner than that reported in goat by (Adhikary *et al.*, 2003), this may be due to the species variation.

From the capsule of studied cats a vascularized trabecular strands extend into the glandular parenchyma and dividing it into distinct lobules which consisted of an aggregation of follicles that surrounded by a basement membrane, inter follicular connective tissue and a network of capillaries which provides an abundant blood supply for follicular cells, this observation was in line with Ali (2014) in sheep, but in contrast with Altaay, (2007) in buffalo that the trabeculae divides the parenchyma into poorly defined lobules. Thyroid gland is an endocrine gland which secretes T3, T4 and calcitonin hormones that plays a critical role in metabolism and maintenance of calcium, constant body temperature in mammals (Banks, 1993), and respond quickly to the changes in the environmental condition, this action of thyroid allows the animal to adapt to the variation in environmental temperature, thyroid hormones are involved in thermoregulation of the body (Nazki *et al.*, 1987).

The thyroid parenchyma was represented by a various follicles, a thin inter follicular connective tissue which containing an extensive peri follicular capillaries, sinusoids, collagen fibers and fibroblast were observed in thyroid of cats as found in pigs by Igbokwe and Ezeasor, (2015).

Currently, each lobule in both lobes was consisted of an aggregation of a various shapes and sizes of follicles and three main sized of follicles, this was in agreement with Prasanth *et al.*, (2012) in cat, but in contrast with Kausar and Shahid, (2006) in camel in which there were only large and small sized follicles. Statistically, there was no significant differences in mean follicular diameters between the two lobes in studied cats, this may be due to that two lobes have the main functional activity of the thyroid gland. The microscopic examination of thyroid in cats showed uniformly distributed of variable sized follicles, as reported by Ali, (2014).

The lining epithelium of follicles in cats was simple cuboidal epithelium, similar finding by Shehan, (2017) in goat. Statistically, the height of follicular cells showed that there were no significant differences in the height of follicular cells between right, left lobe, this result indicate that cats may be in the active stage, this observation was parallel with that found in goat by (Dawood, 2014). They reported that the follicles lined mostly by simple cuboidal to flattened epithelium and columnar epithelium. The epithelial height is an indicator of follicular activity (Banks, 1993). The very active follicles are lined by simple cuboidal epithelium or simple columnar epithelium, whereas in inactive state, it is lined by simple cuboidal to squamous epithelium (Roy *et al.*, 1978). The para follicular cells appeared in thyroid structure of cats as oval to rounded larger and lighter than the follicular cells with densely nuclei and they were occupied two locations that were inter follicular cells and para follicular positions, they present numerous in between the follicles, this finding similar to those found by (Lupulescu and Petrovici, 1968) in dogs and cats and (Prasanth *et al.*, 2012) in cat, but differ from those found in buffalo in which these cells were in one or in a group of two - three cells (Hussin and Altaay, 2009). In most mammals the role of para follicular cells in calcium metabolism through calcitonin (Igbokwe *et al.*, 2015). The thyroid follicles in studied cats contains a variable amounts of homogenous colloid material, which was PAS positive due to its thyroglobulin an iodinated glycoprotein substance (Kierszenbaum and Tres, 2012; Santos *et al.*, 2013). Similar findings by Ali *et al.*, (2015) in sheep. Some of follicles contains peripheral colloid vacuoles between the

epithelial cells and follicular colloid which indicate their metabolic activity. These findings well agreed with (Peksa *et al.*, 2011) in cattle.

References

- Adhikary GN, Quasem MA, and Das SK. (2003).** Histological Observation of Thyroid Gland at prepubertal , pubertal, and castrated Black Bangel Goat. Pak. J. Biol. Sci. 6 (11): 998-1004.
- Ali AS. (2014).** Anatomical and histological study of thyroid gland in female local donkeys (*Eqws African usasinus*) at Basrah city. J. AL-Qadisiya, Vet. Med. Sci. 13(1): 85-87.
- Ali MA, Sadoon AAH, Samera AD. and Sawsan AA. (2015).** anatomical and histological study of thyroid gland in local iraqian sheeps. J. international academic research for multidisciplinary, Issue 3 (3): 196- 201.
- Altaay MM. (2007).** Anatomical and Histological study of thyroid and parathyroid glands in Iraqi buffalo Bubalis with referring to the seasonal change. A Thesis Submitted to the concile of veterinary Medicine college, university of Baghdad for the Degree of Master of Science in Veterinary Medicine Anatomy and Histology.
- Aughey E. and Frye FL. (2010).** Comparative veterinary histology with clinical correlates Mansoupublishing Ltd, London, U. K. 154-157.
- Bancroft JD. and Stevens A. (1990).** Theory and Practice of Histological Techniques. 3rd Ed., Churchill Livingstone, London, UK. 109-121
- Banks WJ. (1993).** Applied Veterinary Histology. "Endocrine System' 3rd ed. Mosby Year Book. Baltimore Boston London. 408-427.
- Chaudhary P, Singh Z, Khullar M, Arora K. (2013).** Levator glandulae thyroideae, a fibro-musculoglandular band with absence of pyramidal lobe and its innervation: a case report. J Clin Diagn Res. 7(7):1421-4.
- Dawood MS. (2014).** Anatomical, Histological and Biochemical Evaluation of Normal, Subtotal and Unilateral Thyroidectomy in Indigenous Iraqi Goat (*Caprus hrieus*). for the Degree of Doctor of Philosophy in Veterinary Medicine/Anatomy, Histology ad Embryology. College of Veterinary Medicine Baghdad University.
- Hamad E SA. (2008).** seasonal changes in the morphology and morphometry of the thyroid gland of the nubian goat. (B.V.Sc. University of Nyala). A Thesis submitted in Partial Fulfillment of the Requirement for the Degree of Master of Veterinary Science (M.V.Sc).
- Hussin A M and Al-Taay MM. (2009).** Histological study of the thyroid and parathyroid glands in iraqi buffalo "*bubalus bubalis*" with referring to the seasonal changes. Bas.J.Vet.Res.8 (1) :26-38.
- Igbokwe C O, Ezeasor D N and Umar MB. (2015).** Ultrastructure of the thyroid gland in adult West African dwarf goat (*Capra hircus*). Int. J. Morphol., 33(2): 532-537.
- Kausar R and Shahid RV. (2006).** Gross and microscopic anatomy of the thyroid gland of the one-humped camel (*Camelusdromedarius*). Pakistan Vet. J., 26; (2): 88-90.
- Kierszenbaum AL. and Tres LL. (2012).** histology and cell biology An Introduction to Pathology 3rd Ed. 123-128.
- Luna LG. (1968).** Manual of Histological ,3rdedition ,Grow-Hill book.
- Lupulescu, A. and Petrovici, A. (1968).** Ultrastructure of the thyroid gland. (4), Pp: 64-67.

- Mark E, Peterson DVM, David V. and Becker MD. (1984).** "Radionuclide thyroid imaging in 135 cats with hyperthyroidism" .Vet. Radiology. (25): 23-26.
- Mark E, Peterson DV M, David V and Becker MD. (1984).** "Radionuclide thyroid imaging in 135 cats with hyperthyroidism" .Vet. Radiology. 25: 23-26.
- May NDS. (1970).** The anatomy of the sheep. 3rd Ed. University of Queens Press. 128-132.
- McLaughlin MB, Jialal I. (2019).** StatPearls Stat Pearls Publishing; Treasure Island (FL): Sep 30, Calcitonin. Med. J. 16 (1): 109-114.
- Nazki AR, Singha SP S , Sodhi S P S and Rattan PJS. (1986).** Effect of seasonal environments on the adrenal, cortical and thyroidal hormones of sheep. Indian J. Ani. Scien. (56): 327-330.
- Peksa Z, Trainicek J, Dusova H, Konecny R. and Hasonova L (2011).** Morphological and histometric parameters of the thyroid gland in slaughter cattle. J. Agrobiol. 28 (1): 71-84.
- Petrova I, Mitevska E, Gerasimovska Z, Milenkova L, Kostovska N. (2014).** Histological structure of the thyroid gland in apolipoprotein E deficient female mice after levothyroxine application. Pril (Makedon Akad Nauk Umet Odd Med Nauki). 35(3):135-40.
- Prasanth BA, Jagapathi RP, Patki HS and Chandrasekhara RTS. (2012).** Histology of the Thyroid and Parathyroid Glands of Cat. Indian Vet. J. 89 (9): 84 – 85.
- Roy KS, Saigal RP, Nandad B S, and Nagpad S K. (1978).** Gross, histomorphological and histochemical changes in thyroid gland of goat with age. Anat. sch. Anze., (143): 86-95.
- Salih A AM. (2018).** Comparative Anatomical and Histological study of the thyroid gland in adult male indigenous gazelle (*Gazella subgutturosa*) and Rams (*Ovis aris*). M.V.Sc. Thesis, College of Veterinary Medicine. University of Baghdad
- Santos MC, Nascimento G C, Nascimento AG, Carvalho VC, Lopes M. SAS. (2012).** Statistical Analysis System, User's Guide. Statistical. Version 9.1th ed. SAS. Inst. Inc. Cary. N.C. USA.
- Shehan NA. (2017).** Histological and histological analysis of thyroid gland in slaughter male local iraqian goats (*Capra Aegagrus*). Int. J. Agric. Sci. and Vet.
- Shoyele O, Bacus B, Haddad L, Li Y, Shidham V. (2019).** Lymphoproliferative process with reactive follicular cells in thyroid fine-needle aspiration: A few simple but important diagnostic pearls. Cytojournal. 16:20.