NIGERIAN VETERINARY JOURNAL

ISSN 0331-3026

Nig. Vet. J., June 2016 **Vol. 37 (2): 64-71.**

ORIGINAL ARTICLE

Gross, Histological and Histomorphometric Studies on the Thyroid Gland of One Humped Camel (*Camelus dromedarius*) found in the Semi-Arid Region of North Eastern Nigeria

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SUMMARY

Thyroid glands are endocrine glands present in all mammals and secretes thyroxin, triiodothyronine and calcitonin as its major hormones which plays important role in metabolism, regulation of energy and nutrient absorption, as well as calorigenesis and normal reproductive function. We studied the thyroid gland of one humped camel found in the Northeastern part of Nigeria. A total of 18 pairs of thyroid glands(10 female and 8 male) were randomly collected from apparently healthy camels' slaughtered at the Maiduguri municipal abattoir and were used for the studies. Grossly, the thyroid glands of both the male and the female camel studied appeared reddish brown in colour and irregular in shape. There was a significant difference ($p<0.05$) between the weights and lengths of the male and female thyroid gland with the female higher than the male on both parameters. Histologically, the thyroid gland studied is covered by a thick fibrous connective tissue capsule and consists of numerous follicles of various sizes. Lining the follicles are squamous to low cuboidal cells with basally located round or spherical nucleus. The area of the nucleus of the male thyroid gland (380.06 ± 20.484µm) was slightly greater than that of the female (366.09 ± 29.45µm). For the epithelial height and follicular diameter, the female thyroid gland showed a slight increase (49.597 ± 1.459µm and 362.16 ± 21.820µm respectively) compare to the male (48.75 ± 1.414µm and 363.93 ± 21.624µm respectively). Presence of parafollicular cells and fibroblast in this gland were also noted.

Key words: Thyroid gland, parafollicular cells, colloid, gross, histomorphometrics.

INTRODUCTION

Thyroid gland is one of the endocrine glands present in all mammals. The hormones secreted by this gland include; thyroxin (T4), triiodothyronine (T3) (Kausar and Shahid, 2006; Banks, 1993) and Calcitonin (Machado-Santos *et al.*, 2013). Among

others, these hormones plays important role in metabolism (Kausar and Shahid, 2006), regulation of nutrient absorption, energy regulation andcalorigenesis (McNabb and Wilson 1997) and normal reproductive function (Boswell *et al*., 1994, Schwartz *et al.,* 1996). During embryogenesis, thyroid deficiency can occur and could lead to limited nervous, muscle and skeletal systems development (McNabb and Wilson 1997).

Histologically, the thyroid gland consists of follicles which are lined by follicular cells (Kausar and Shahid 2006) with connective tissues filling the interfolliclar spaces (Kausar and Shahid, 2006). In all vertebrates including the camel, the thyroid gland concentrates large amount of iodine for the synthesis of thyroxin (Kausar and Shahid, 2006).

The one-hump camel *(Camelus dromedaries)* have been said to have a multi-purpose function such as transportation, racing (Osuebeni *et al.,* 1999) as well as food for human consumption both in the arid and semi-arid areas of the world (Maina *et al.,* 2014, Dorman, 1986). They are morphologically, behaviourally and physiologically adapted to the semi-arid environments of northern Nigeria playing an important role in the economy of the country (Maina *et al.,* 2014). Recently, Maina *et al., (*2014) reported the need for more basic research of the Nigerian indigenous camel if its productivity is to be improved. The aim of this research therefore is to investigate and compare the gross and microscopic anatomy as well as histomorphometricsof the thyroid glands of the male and female one humped camel found in the semi-arid region of North Eastern Nigeria.

MATERIALS AND METHODS

Samples used for this study were collected from Maiduguri, Borno state, Nigeria. The city lies between latitude 10.2^0N and 13.4^0N, longitude 9.8^0 and 14.4^0 with an area of 69,436sq km located in the North Easter corner of Nigeria. It shares borders with Niger to the North, Chad to the Northeast and Cameroun to the East (Maina *et al.,* 2014).

A total of 18 pairs of thyroid gland from 10 female and 8 male were randomly collected from apparently healthy camels' slaughtered at the Maiduguri municipal abattoir and were used for this study. Thyroid glands collected were transported in ice packs to the Department of Veterinary Pathology laboratory, University of Maiduguri, Nigeria for gross examination and thereafter, fixed and sent to Department of Veterinary Anatomy, University of Abuja, were it was processed for histology.

Gross examination

The method used for gross examination of the gland was a modified method by Usende *et al.,* (2014). Briefly, the length and width of the gland was obtained using thread and meter rule while the weight of the gland was obtained using a bench top sensitive scale (LP 502A, China). For the length and width, threads was placed at the two opposite highest vertical and horizontal points of the gland respectively, and the lengths of the threads obtained using meter rule.

Histological examination

Immediately after gross examination, 4-5mm of tissue were taken from all samples and fixed in 10% formalin. Fixed tissues were prepared for light microscopy as described by Bancroft and Steven (1990).Paraffin blocks were sectioned at 5µm and stained with Haematoxylin and Eosin, Masson's trichome, Periodic Acid Schiff (PAS), Alcian blue (AB) PH 2.5, and Giemsa stains. The sections were studied using high powered light microscope (Bio-microscope YJ 2015DN, Ningbo Yujie Optical Instrument Co., Ltd, Zhejiang, China) at x40 to 400 with inbuilt camera connected to a laptop (Samsung, South Korea) for photomicrographs.

Histomorphometrics

This was done using analytic computer enabled software (Motic Images Plus 2.0). The parameters measured include:

Epithelial height: This was obtained by drawing a line from the length of the epithelial basement membrane to the apical surface of the epithelial cell at x400 and 10 fields from each sample was examined.

Follicular diameter: A straight line was drawn both vertically and horizontally from the basement membrane to the opposite basement membrane of the same follicle and figures obtained were divided by two. Five perfect follicles from each field at x100 were examined from all samples.

Area of nucleus and perimeter: This was obtained by drawing a circle with the computer software to cover the entire nucleus as much as possible and figures were automatically generated. At least 10 nuclei from five perfect follicles from each field at x100 were examined from all samples

Colloid area/volume and perimeter: This was obtained by drawing a circle with the computer software to cover the entire colloid as much as possible and figures were automatically generated. At least 10 colloids from five perfect follicles from each field at x100 were examined from all samples

Colloid diameter: A straight line was drawn both vertically and horizontally through the colloid and figures obtained were divided by two. Five perfect follicles with colloid from each field at x100 were examined from all samples.

Statistical analysis

All numerical data generated from the gross and histomorphometric studies from both sexes of camels thyroid glands were subjected to statistical analysis using student t test Graph pad prism version 4 and expressed as mean±standard deviation (SD). Values of $P<0.05$ were considered statistically significant.

RESULTS

Gross findings

Grossly, the thyroid glands of both the male and the female camel studied appeared reddish brown in colour and irregular in

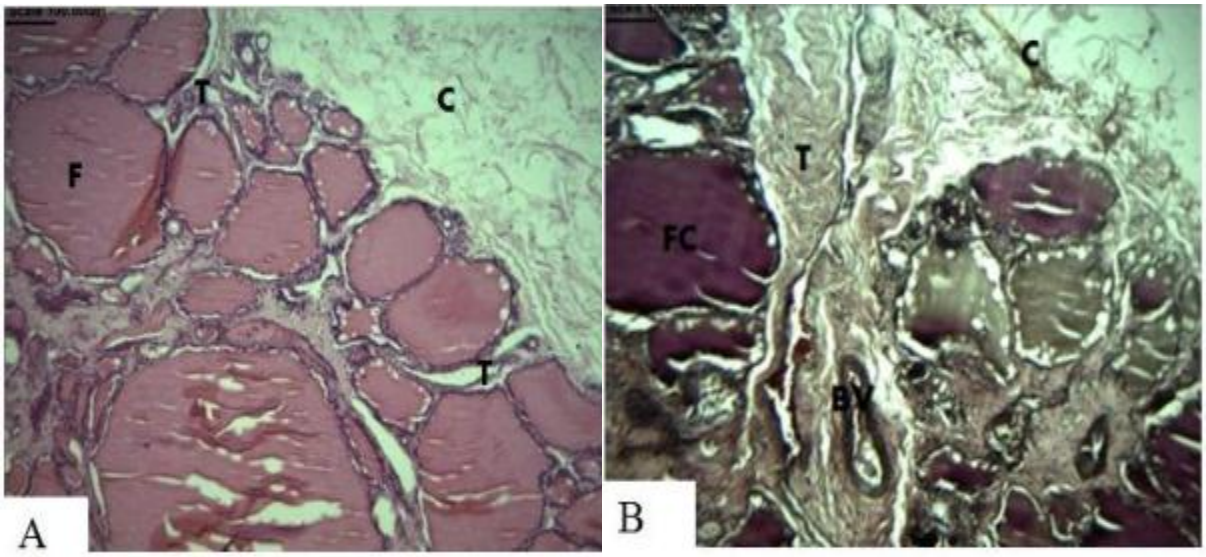

PLATE I: Photomicrograph of a section of the thyroid gland of female one-humped camel *(Camelusdromedarius)* found in the Northeastern semi-arid region of Nigeria. Note the extensive gland capsule (C), trabeculae (T) and large follicles (F) containing colloid (FC) at the margin of the capsule, and blood vessel (BV) in the trabeculae. A=H&E X100 and B=MT X100

shape. There are two lobes (left and right) which appeared lobated. In both sexes studied, the left lobe appeared larger than the right lobe. The results of the length, width, diameter and weight of the thyroid gland of both sexes of camel studied are presented in table 1.There was a significant difference ($p<0.05$) between the weights and lengths of the male (45.20 ± 1.439g and 5.34 ± 0.054cm respectively) and female (54.01 ± 0.519g and 5.92 ± 0.136cm respectively) thyroid gland with the female higher than the male on both parameters. However, the width and diameter of the two sexes showed no significant difference ($p>0.05$).

Microscopic findings

The thyroid gland of the one humped studied is covered by a thick fibrous connective tissue capsule (Fig. 1a and b). Extending from the capsule into the gland parenchyma is the trabeculae which branch to divide the gland into numerous follicles of various sizes (Fig. 2). Larger follicles are seen immediately after the capsules and follicles become small down the parenchyma (Fig. 2). There are presence of blood vessels both at the capsule and the trabeculae (Fig. 1b). The follicles are separated by interfollicular (interstitial) connective tissue (Fig.3a and b). Present in this interfolliclar connective tissues are fibroblast and parafollicular cells (Fig. 3a and 4). Lining the follicles are squamous to low cubical cells (Fig. 3 and 4). All follicles studied in both sexes of camel are filled with the gel-like material called colloid (Fig. 2, 3, 4 and 6). However, the colloid in some of the male samples studied appeared serrated (Fig. 4). The colloid of all samples studied stained positive to PAS but negative to Alcian blue stain (Fig. 5 and 6). The nuclei are located close to the basement membrane and are spherical or round in shape (Fig. 3 and 4). The results of the comparative histomorphometric studies of the male and female thyroid gland are presented in table 2. Although there was no significant difference ($p>0.05$) in all the parameters measured, the area of the nucleus of the male thyroid gland (380.06 ± 20.484µm) was slightly greater than that of the female (366.09 ± 29.45µm). The same pattern was seen in the both the large and smaller colloid volume/area and perimeter for the male and female thyroid glands of the Nigerian camel. For the epithelial height and follicular diameter, the female thyroid gland showed a slight increase (49.597 ± 1.459µm and 362.16 ± 21.820µm respectively) compare to the male (48.75 ± 1.414µm and 363.93 ± 21.624µm respectively).

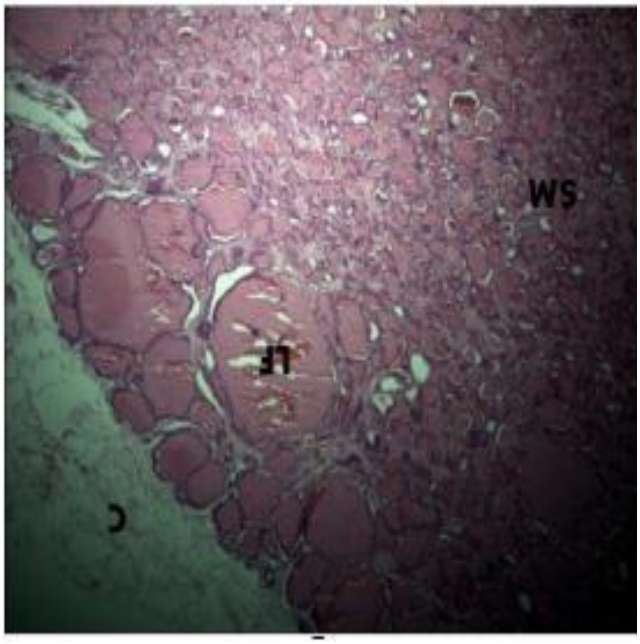

PLATE II: Photomicrograph of a section of the thyroid gland of female one-humped camel *(Camelusdromedarius)* found in the Northeastern semi-arid region of Nigeria. Note the distribution of large (LF) and small (SM) follicles in the gland. H&E X40

DISCUSSION

The present study looked at the gross, histologic and histomorphometric aspect of the thyroid gland of one-humped camel found in the Northeastern part of Nigeria and compared these parameters between sexes. The glands in this study appeared

Table I: Gross comparative morphometric results of the male and female thyroid gland of camel *(camelus dromedarius)* found in the Northeastern Nigeria

Gross parameters	Male	Female
Weight(g)	45.20 ± 1.439[a]	54.01 ± 0.519[b]
Length (cm)	5.34 ± 0.054[a]	5.92 ± 0.136[b]
Width(cm)	2.99 ± 0.196[a]	3.12 ± 0.240[a]
Diameter (cm)	0.97 ± 0.005[a]	1.11 ± 0.080[a]

[ab] Means with different superscript row wise are significantly different (P < 0.05)

Table II: Comparative histomorphometric results of the male and female thyroid gland of camel *(camelusdromedarius)*found in the Northeastern Nigeria

Parameters	Male	Female
Area of Nucleus (sqμm)	380.06 ± 20.484*	366.09 ± 29.451*
Perimeter of nucleus (μm)	89.99 ± 2.534*	89.23 ± 2.752*
Colloid Area (sqμm)	58851.43 ± 823.8*	53912.43 ± 1571*
large follicles	29221 ± 932.3*	28912.43 ± 114.5*
small follicles		
Colloid perimeter	1044.04 ± 86.059*	1030.72 ± 85.469*
large follicles (μm)	561.06 ± 27.52*	572.17 ± 30.63*
small follicles (μm)	48.75 ± 1.414*	49.597 ± 1.459*
Epithelia height (μm)	362.16 ± 21.820*	363.93 ± 21.624*
Follicular diameter (μm)		
Luminal diameter (μm)	291.35 ± 19.123*	291.15 ± 18.235*
large follicles	185.56 ± 20.146*	179.26 ± 17.207*
small follicles		

* Means within the same row are not significantly different (P> 0.05)

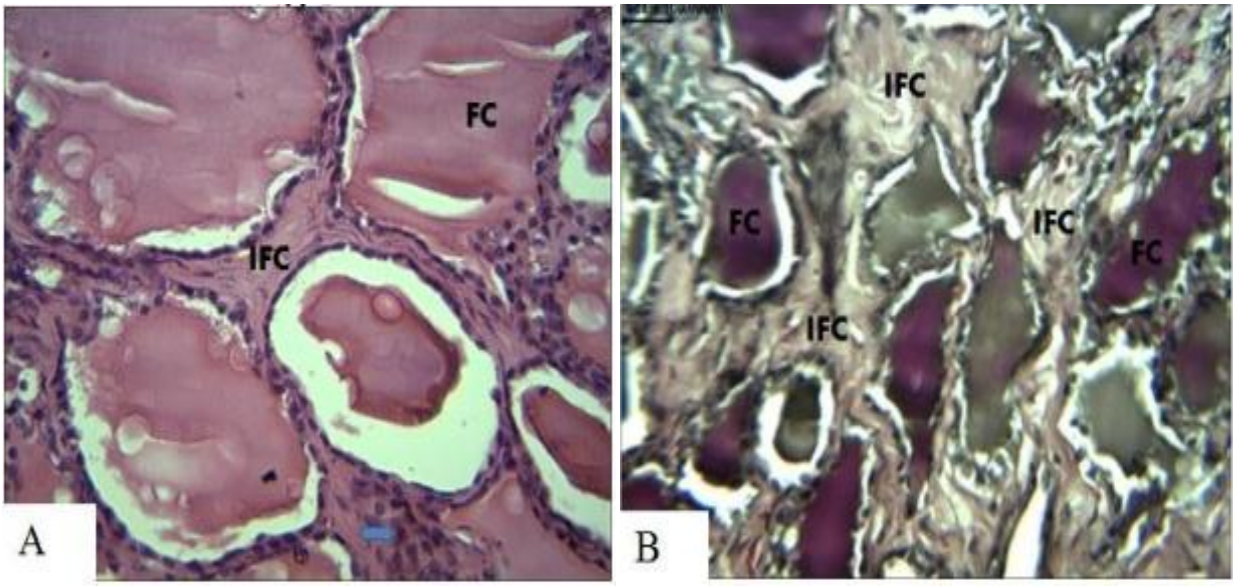

PLATE III: Photomicrograph of a section of the thyroid gland of one-humped camel *(Camelus dromedarius)* found in the Northeastern semi-arid region of Nigeria. Note the extensive interfollicular connective tissue (IFC) investment, fibroblast (Thick arrow) and follicles containing colloid (FC). A=H&E X400 and B=MT X100

reddish brown in colour similar to the findings of Kausar and Shahid (2006) and Schwartz and Dioli (1992). The gross parameters such as weight, length, width and diameter of the thyroid gland studied are similar to what was reported by Kausar and Shahid (2006) and Abdel-Wahab and Hamza, (1970). We however, showed that the weight and length of the gland was higher in female than in male. This finding is contrary to earlier finding of Rejeb *et al.,* (2011) who in all the three age groups studied, showed that the weight of the gland is higher in males than females. The mean diameters (0.97 and 1.05 cm) recorded in the two sexes showed no significant difference and are in same range with the two age groups studied by Kausar and Shahid (2006) and 0.5 to 1.5 cm reported in adult camels (Schwartz and Dioli, 1992). The mean length was greater in the female than the male corresponding to their weights. Earlier, Kausar and Shahid (2006) reported lengths of 5.36 and 6.36 cm in the two age groups they studied; our result is in agreement to their work and to 3-8 cm reported in camel (Schwartz and Dioli, 1992). Similarly, we report no significant difference between sexes in the width of the gland. Again, our reported width is in agreement with 3.35 and 3.53 cm earlier reported by Kausar and Shahid (2006) and also in the range of 1-4 cm (Schwartz and Dioli, 1992) of camel. Histologically, we showed that the gland is covered by a thick fibrous capsule. This has been reported for mammals (Dellman and Brown, 1981; Arthur 1969) and camels (Kausar and Shahid, 2006; Abdel-Magied *et al*, 2000; Atoji *et al.*, 1999). Trabeculae extend from the capsule to divide the gland into follicles of variable sizes. We showed that large follicles are located at the peripheral parts while small follicles are more centralized. This is similar to the report of Ahmadpanahi and Yousefi (2012). They are lined by squamous to low cubical epithelium, similar to previous reports (Abdel-Magied *et al*, 2000; Atoji *et al.*, 1999) in specie of camel. Each follicle is filled with colloid and we showed that colloid from the male thyroid glands studied appeared serrated. This can be attributed to the activity of the gland as colloid of very active glands appears serrated (Arthur, 1969) and confirmed with our PAS results. The PAS and Alcian blue stains results are consistent with the report of Machado-Santos *et al.*, (2013). Parafollicular or C-cells are present in this study and have been reported in cattle and buffaloes (Kausar and Shahid, 2006). However, our finding on the C-cells is contrary to earlier reports of Abdel-Magied *et al*., (2000) and Kausar and Shahid (2006). Our histomorphometric studies of the gland of both sexes showed no significant difference. Although, Dellman and Brown (1981) reported numerous follicles sizes ranging from 20 to 500µm in diameter for mammals thyroid gland corresponding to the diameters we reported, there have been little information on histomorphometrics of this gland in camels. We have for the first time given a detailed histomorphometric report

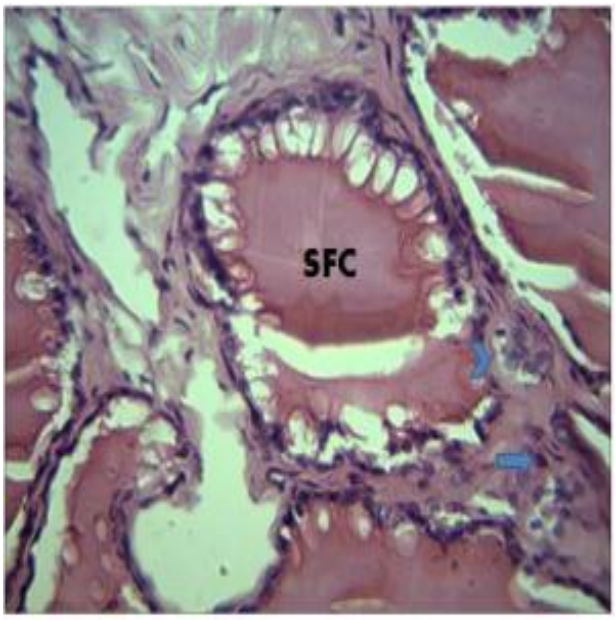

PLATE IV: Photomicrograph of a section of the thyroid gland of male one-humped camel *(Camelusdromedarius)* found in the Northeastern semi-arid region of Nigeria. Note the serrated colloid (SFC), fibroblast (thick arrow) and parafollicular cells (chevron) of the gland. H&E X400

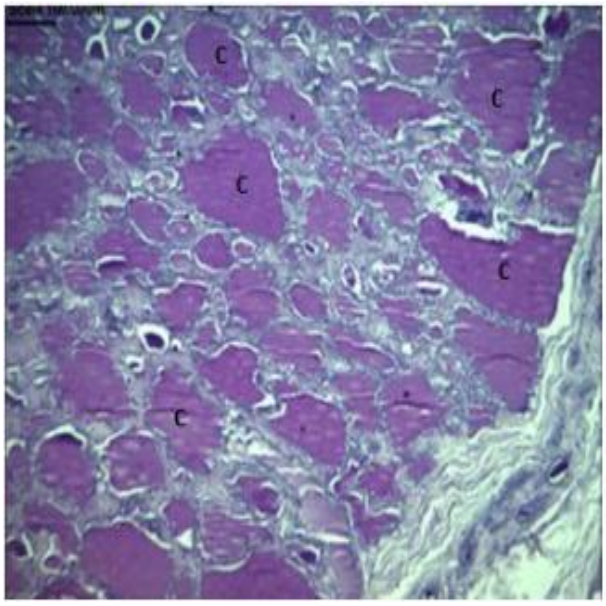

PLATE V: Photomicrograph of a section of the thyroid gland of one-humped camel *(Camelusdromedarius)* found in the Northeastern semi-arid region of Nigeria. Colloid (c) of the gland follicles showed positive staining to Periodic Acid Schiff (PAS) stain. PAS X100

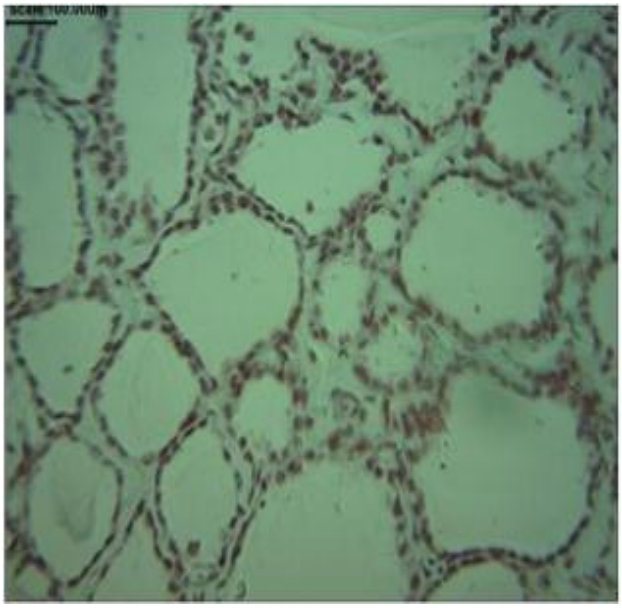

PLATE VI: Photomicrograph of a section of the thyroid gland of one-humped camel *(Camelus dromedarius)* found in the Northeastern semi-arid region of Nigeria. Colloid of the gland follicles

of this gland in one humped camels found in the Northeastern part of Nigeria.

Hence, we concluded that thyroid gland of one-humped camels found in the Northeastern part of Nigeria showed significant differences in weight and length between the male and the female but no such difference exist with reference to the width, diameter and histomorphometrics. We also reported the presence of parafollicular or C-cells in the camel thyroid gland of one-humped camel slaughtered at Maiduguri abattoir.

ACKNOWLEDGEMENTS

The authors acknowledge Dr. Umar K.A for the statistical analysis of data used in this work and Dr Erondu V.C for his technical assistance.

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