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Histological and histochemical studies of parathyroid gland in one-humped camel (*Camelus dromedarus*)

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Abstract

Thirty one-humped camels were grouped into three: juvenile (Group A), adult (Group B), and old ages (Group C), were used for the study. The camel parathyroid gland tissues were obtained from camels slaughtered at the Kano Metropolitan abattoir. The glands were prepared for standard histological study using haematoxylin and eosin (H and E) stains for light microscopy. For histochemical studies, Periodic Acid Schiff (PAS) special stain was used to demonstrate glycogen and glycoprotein. The results showed that the parathyroid glands are surrounded by a thin capsule of connective tissue. They have abundant stroma of connective tissue, with large smooth muscles all over. The tissue of the parathyroid gland consists of clusters of principal or chief cells. There are two different functional stages of the principal cell. The light principal cell has a large, pale nucleus and pale cytoplasm (described as inactive). The dark principal cell is a smaller cell, with a small, dark nucleus and a dark cytoplasm (active cell). The presence of oxyphil cells was observed. Histochemical studies showed that the tissue of the parathyroid gland in one-humped camel reacted negatively to the Periodic Acid Schiff (PAS) stain. The parathyroid gland consisted of densely packed chief cells (light and dark cells), oxyphil cells, and abundance of adipose cells in the adult male and female. These cells were absent in the younger group, which is generally identical to what is found, specifically, in cows, goats, and in humans, which signifies that one-humped camel can be introduced as an experimental research animal model for human parathyroid gland, in understanding the etiology and possible solution to human parathyroid diseases and osteoporosis. The study of parthyroid gland will enhance the provision of basic and clinical information on endocrinology and related research fields, such as animal breeding and biotechnology in one humped camel.

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Introduction

Dromedary camel is described as the 'ship of the desert', as its toes have adapted to walking on sand without sinking, carrying heavy loads and transporting them across the deserts (Snow, 1992). Even though the traditional usages of camel in most countries have been replaced by motorized transport, however, its cultural and economic importance have been maintained by using them for racing, durbar racing, military mascots, meat and milk provisions, hair and leather materials, transportation, and as traction animals (Yagil 1982; Snow, 1992). The breeds of the one-humped camel

found in Northern Nigeria as indigenous are "Ja" (dark brown), "Fari" (grey white), "Bula" (pied colored), and "Bakin-biri" (brown black), identified based on their phenotypic trait of color (Abdussamad *et al.,* 2011).

The parathyroid glands, in one-humped camel, are anatomically positioned on the dorsal border and the cranial pole of the thyroid gland. They are identified as separate parathyroid structures from the architecture of the thyroids (Metwally & Attia, 2006). In humans, most people have four parathyroid glands (right and left superior parathyroid glands, and right and left inferior parathyroid glands) (Bacha & Bacha, 2000). Each is surrounded by a capsule of connective tissue. Its parenchyma is highly vascularized (Metwally & Attia, 2006). The parathyroid secretes parathormone which regulates the level of calcium and phosphorous in the plasma (Ojo, 1987). Hence, the glands are essential for life in most animals and humans (Bensley, 2007).

The parenchyma of the parathyroid gland consists primarily of clusters and cords of principal or chief cells (Bacha & Bacha, 2000). In many studies it was reported that mammalian parathyroid gland contains two types of cells; the principal cells (or chief cells) and the oxyphil cells (Ojo, 1987; Dellmann, 1993; Bacha & Bacha, 2000; Fleischer *et al.*, 2004; Singh, 2010). There are two different functional stages of the principal cell. The light principal cell is inactive and has a large, pale nucleus and pale, acidophilic cytoplasm . The dark principal cell is a smaller, active cell with a small, dark nucleus and a deeply acidophilic cytoplasm (Bacha & Bacha, 2000). In the sheep and goat, light cells tend to be located peripheral to the more central, dark cells (Bacha & Bacha, 2000). In the other domestic mammals these cells are distributed randomly (Bacha & Bacha, 2000). However, some described three types of principal cells; light, dark and clear cells (inactive (light) and active (dark) forms) (Ojo, 1987; Dellmann, 1993; Fleischer *et al.*, 2004; Singh, 2010).

There is paucity of information on the anatomical studies of the endocrine glands of the indigenous one-humped camel, despite the fact that these endocrine glands are involved in the dromedary's mechanisms of adaptation to hostile environment through which it survives for long periods without food and water. The studies on the parathyroid glands of the indigenous one-humped camel is pertinent to enhance the understanding of how the animal adapts to its environment, as this will provide baseline information on the camel for future related researches. It could be useful in comparative anatomy and evolutionary studies with other species of the order *artiodactyla* and higher orders like humans. It could also enhance and provide basic and clinical investigative information in endocrinology and related research fields, such as animal breeding and biotechnology. The aim of this work was to histologically and histochemically evaluate the morphology of the parathyroid gland in indigenous one-humped camel found in Nigeria.

Materials and Methods

Experimental animals

Thirty one-humped camels, comprising 15 males and 15 females, between the ages 1-5, 6-10 and above 10 years, representing juvenile (Group A), adult (Group B), and old ages (Group C), respectively were used for the study. The camel's parathyroid gland tissues were obtained from camels slaughtered from the Kano Abattoir, following standard protocols and procedures (Nagpal *et al.*, 1989).

Physical examination and age determination

Physical examination was conducted on each camel few minutes prior to slaughter. Only apparently healthy camels were used for this study. The ages of the animals were determined using dentition as described by Faye (1997).

Histological and histochemical studies

The parathyroid glands was removed along with the thyroid gland, and immediately fixed in 10% neutral buffered formalin. Enough tissue needed were cut and prepared for standard histological study using paraffin tissue technique for light microscopy, according to Bancroft & Gamble (2008). This was done in the Department of Histopathology, Aminu Kano Teaching Hospital (AKTH), Kano.

For histochemical studies, the tissue blocks were sectioned and stained with periodic acid schiff (PAS) special stain to demonstrate glycogen and glycoprotein content (Bancroft & Gamble, 2008).

Slides obtained were studied with the binocular light microscope (Olympus) at different magnifications. Photomicrographs of slides were taken using a microscope armscope digital camera attached to a computer system via USB.

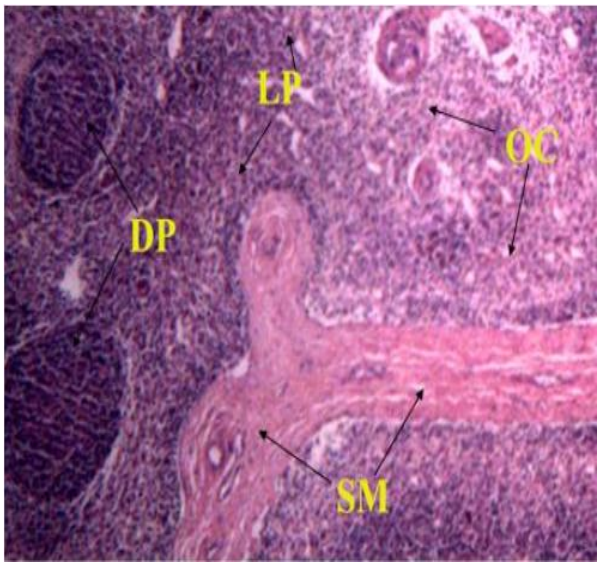

Plate I: Parathyroid gland tissue section (longitudinal) from among the female of group A. It showed clusters of dark principal cells **(DP),** the light principal (**LP**) cells and the oxyphil cells (**OC**) and smooth muscle **(SM)** (H&E × 40)

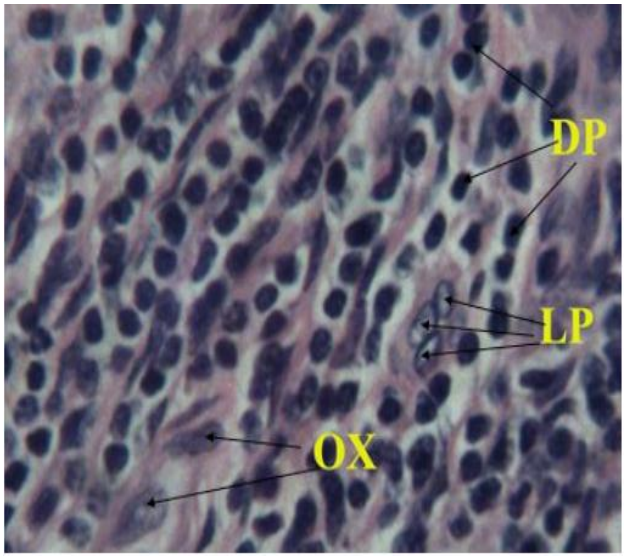

Plate II: Parathyroid gland tissue section (longitudinal) from among the female of group A. Note the dark principal **(DP)**, and the light principal **(LP),** and the Oxyphil cells **(OX)** with paler and bigger cytoplasm and Nucleus (H&E × 250)

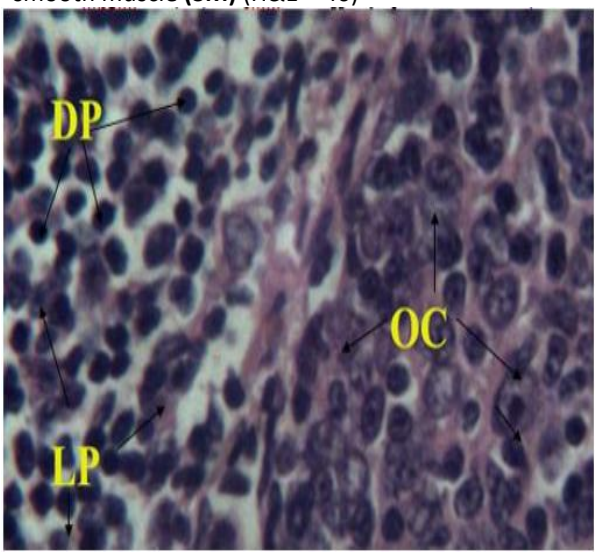

Plate III: Parathyroid gland tissue section (longitudinal) from among the male of group A. Note the principal cells; the dark principal (DP), and light principal (LP) packed cords, while some were scattered. The Oxyphil cells (OC) are shown with paler and bigger cytoplasm and nucleus (H&E × 450)

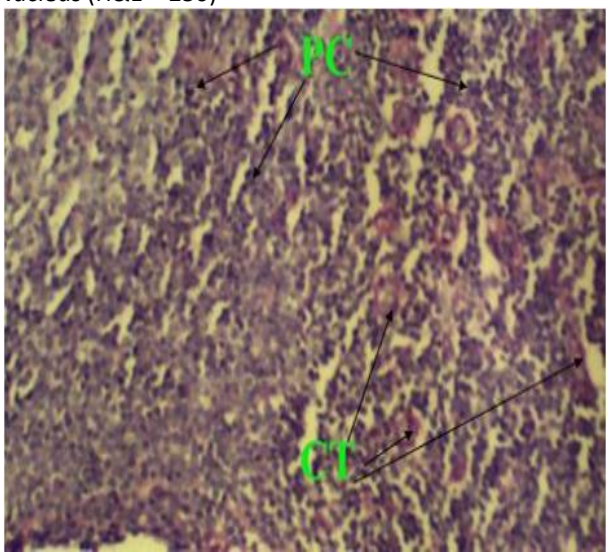

Plate IV: Parathyroid gland tissue section (Longitudinal) from among the male of group A, showing the principal cells (**PC**) and connective tissues (**CT**), but the reaction to PAS is negative (PAS × 100)

Results

In the juvenile group (Group A), the parathyroid glands were surrounded by a thin capsule of connective tissue. It has abundant stroma of connective tissue, with large smooth muscles all over (Plate I). The tissue of the parathyroid gland consists of clusters of principal or chief cells (Plate I-III). There are two different functional stages of the principal cells. The light principal cell has a large, pale nucleus and pale cytoplasm (described as inactive) (Plates II and III). The dark principal cell is a smaller cell, with a small, dark nucleus and a dark cytoplasm (active cell) (Plates II and III). The dark cells tend to be located peripheral to the more central, light cells. The

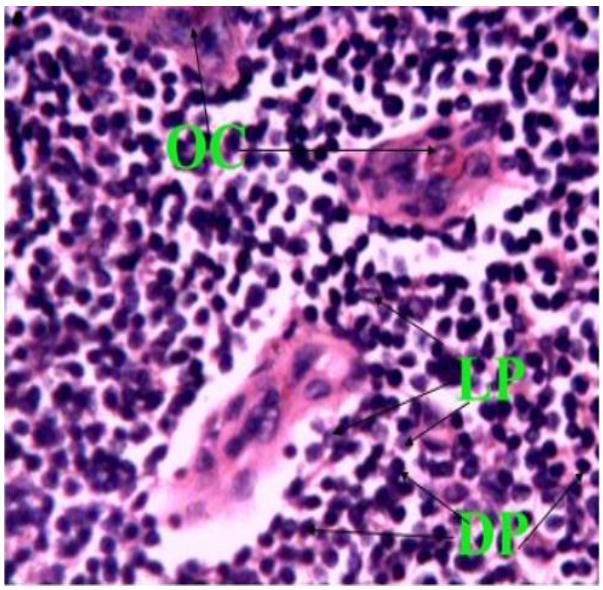

Plate V: Parathyroid gland tissue section (longitudinal) among the female of group B showing clusters and cords of light principal cell **(LP)** and dark principal cell (**DP**) and abundant oxyphil cells (**OC**) and stroma of vascular connective tissue (H&E × 250)

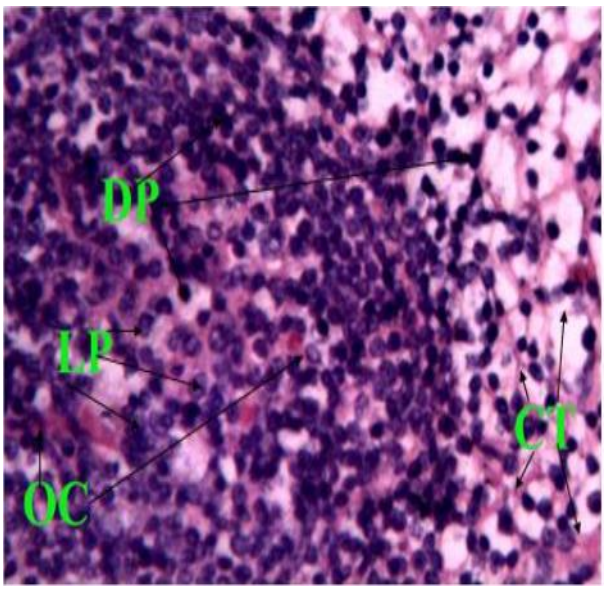

Plate VI: P Parathyroid gland tissue section (transverse) among the male of group B showing clusters and cords of principal cells; light principal cell **(LP)** and dark Principal cell (**DP**), abundant oxyphil cells (**OC**), and mesh of vascular connective tissue (**CT**) (H&E × 250)

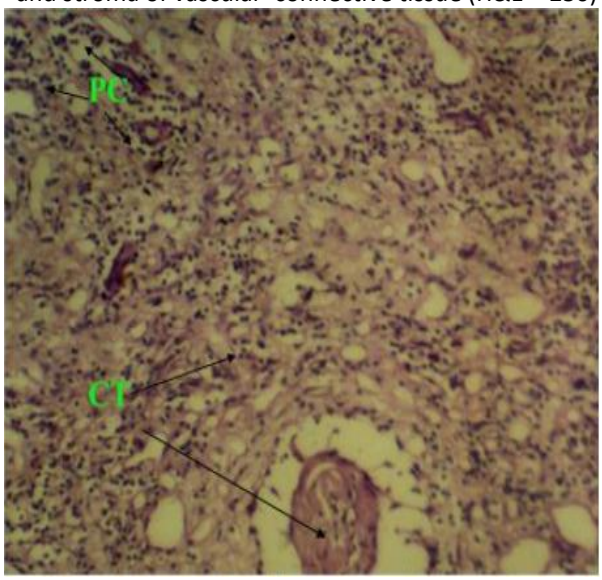

Plate VII: Parathyroid gland tissue section (transverse) among the male of Group B showing the principal cells (**PC**), and connective tissue (**CT**), which the reaction is negative to PAS (PAS × 100)

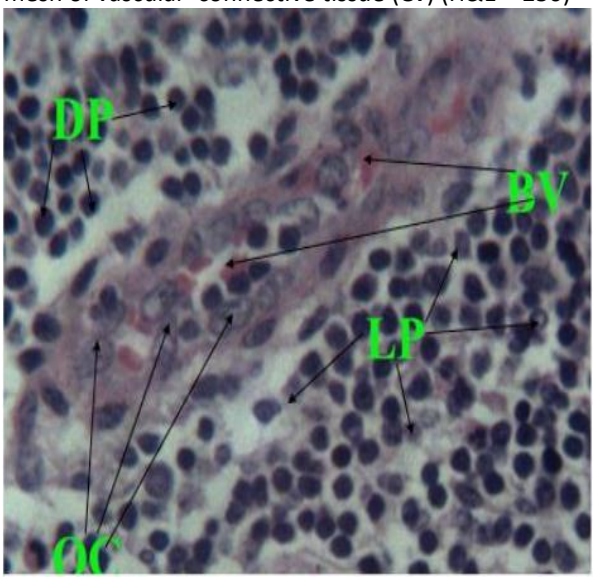

Plate VIII: Parathyroid gland tissue section (transverse) among the female of group C, showing the clusters of dark principal cells (**DP**) and light principal cells (**LP**). Note the oxyphil cells (O**C**) with larger and paler nucleus, and blood vessels (**BV**) (H&E × 400)

presence of oxyphil cells was observed in this juvenile group (Plate III). The histochemical studies showed that the tissue of the parathyroid gland in one-humped camel reacted negatively to the periodic acid Schiff (PAS) (Plate IV). No variations, in the histological features and histochemical reactions, were observed between the male and female parathyroid tissues in this group.

In the adult group (Group B) all the histological features found in the juvenile group, presented

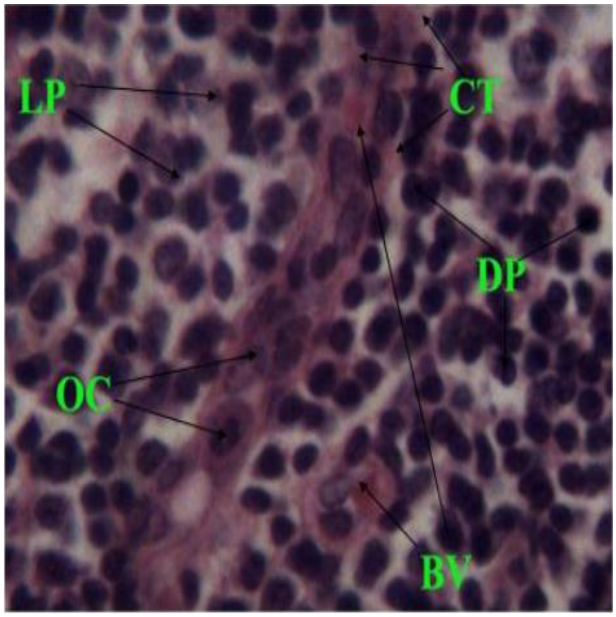

Plate IX: Photomicrograph of parathyroid gland tissue section (transverse) among the male of Group C, showing the clusters of dark principal cells (**DP**) and light principal cells (**LP**). Note the oxyphil cells (O**C**) with larger and paler nucleus, and blood vessels (**BV**) (H&E × 400)

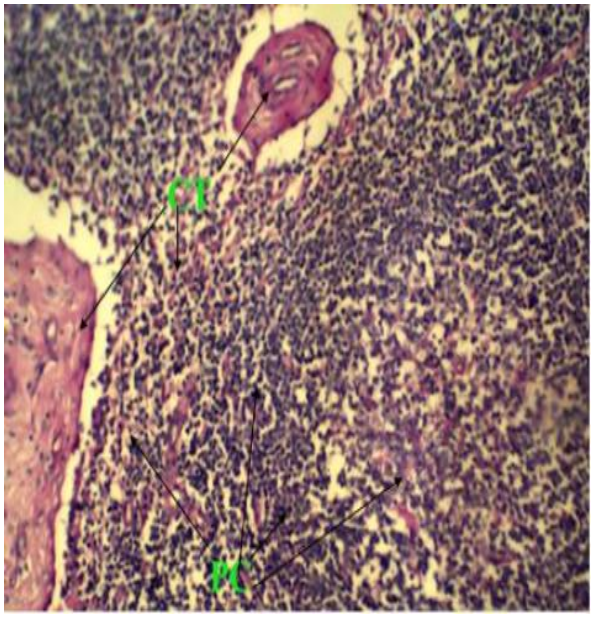

Plate X: Photomicrograph of Parathyroid gland tissue section (transverse) among the male of group C, showing the principal cells (**PC**), and connective tissue (**CT**), the reaction is negative to PAS (PAS × 100)

above, were also found here (Plates V and VI).

However, the dark principal cells were observed to be located peripheral to the more central light cells (Plates V and VI). They also have abundant oxyphil cells, which are large cells with acidophilic cytoplasm and pyknotic nucleus (Plates V and VI). There were abundance of adipose cells especially in the male (plates V and VI). Similarly, in the histochemical stain the tissues in the adult group reacted negative to the Periodic Acid Schiff (PAS) (Plate VII). The old age group (Group C) has similar histological features as in juvenile and adult groups presented above (Plates VIII and IX). The position of dark and light principal cells, abundance and appearance of oxyphil cells, and abundance of adipose cells (however was more in female, not male as in adult group) were like that of the adult group (Plates VIII and IX). The periodic acid schiff (PAS) reaction was negative as in all groups (Plate X).

Discussion

The study sought to investigate the histology and histochemistry of parathyroid gland in Indigenous one-humped camel. Despite the breed, species, and physical environment of the camel indigenous in Northern Nigeria, the parathyroid gland was found to be similar histologically to that of other camels elsewhere (Nagpal *et al.*, 1989), to that of the cow (Charles *et al.,* 2000) and to that of humans (Singh*,* 2010). These results signify that one-humped camel can be introduced as an experimental research animal model for human parathyroid gland, in understanding the etiology and possible solution to human parathyroid diseases and osteoporosis.

The parathyroid glands were surrounded by a thin capsule of connective tissue. It has abundant stroma of connective tissue, with large smooth muscles all over, with no difference among all the age groups. This conforms to what was found in the pig and cow especially the well-developed stroma of connective tissue, but is sparse in other mammals (Bacha & Bacha, 2000).

Earlier studies reported mammalian parathyroid gland contains two types of cells; the principal cells (or chief cells) and the oxyphil cells (Dellmann, 1993; Ojo, 1987; Bacha & Bacha, 2000; Fleischer *et al.,* 2004; Singh, 2010) and this was found in this study. It was also reported that oxyphil cells were large cells with an acidophilic cytoplasm and pyknotic nucleus (Banks , 1993; Bacha & Bacha, 2000; Singh, 2010), which occur in small quantities in the horse and cow, particularly older animals (Bacha & Bacha, 2000)**.** The cells do not occur in the parathyroid gland of the dog, cat, rat, and chicken, many species of lower animals, human fetus and man until ten years of age (Ojo, 1987 and Dellmann, 1993;

Fleischer *et al.*, 2004). The cells first appear in late childhood and increase in number following advancement in age often forming nodules in parathyroid of older persons (Banks, 1993; Fleischer *et al.,* 2004). In addition, the result of histochemical studies in all the age groups, in this study, showed that the tissue of the parathyroid gland, in indigenous one-humped camel, reacted negatively to the periodic acid schiff (PAS) stain**.** This may be explained by the fact that the parathyroid gland tissues were normal, as PAS is used to detect glycogen in tissues that have abnormal excess glycogen or they specifically store glycogen. It was reported that in most mammals and lower species of animals the oxyphil cells are present in the adult, and contain glycogen particles and free ribosome, granular endoplasmic reticulum, Golgi apparatus and secretary granule which are poorly developed, suggesting that oxyphil cells of normal parathyroid do not have an active function in the biosynthesis of parathyroid hormone (Capen & Martin, 2003). In most mammals there is a higher oxidation and hydrolytic enzymes activity in the chief cells than in the oxyphil cells (Nakanishi *et al*., 2004). The functions of the oxyphil cells are not known (Banks, 1993; Singh, 2010).

However, in this study, oxyphil cells appeared in all age groups, including the juvenile camel, though less abundant compared to the adult group. Mescher (2013) reported that oxyphil cells role, in humans, is complimentary to principal cell's secretion of the parathyroid hormone (PTH), and transitional derivatives of the principal cells. If this is established, its signifies that the younger camel can be used, and will be cheaper to be used, as a research model of the etiology of parathyroid diseases, especially hypoparathyroidism, and other abnormalities related to bone and muscle in humans and other mammals. This is a proof of the resilience and strength of camel specie. Even the younger ones, keeping in mind the role of PTH in regulation of blood calcium, and hence bone and muscle normal development and function.

The present study observed abundance of adipose cells in the parathyroid glands of the adult indigenous one-humped camel, but not seen in the juvenile camels.

In conclusion, the histological and histochemical presentations of the parathyroid in the indigenous one-humped camel were similar generally to those of other mammals and are pertinent to enhance the understanding of the camel is peculiar characteristics, and clinically may contribute to better treatment of parathyroid diseases, as well as provide baseline information for future related researches.

References

Abdussamad AM, Holtz W, Gauly M, Suleiman MS & Bello MB (2011). Reproduction and breeding in dromedary camels; insights from pastoralists in some selected villages of the Nigeria-Niger corridor. *Livestock Research for Rural Development,* **23** (8): 11-12.

Bacha WJ & Bacha LM (2000). *Color Atlas of Veterinary Histology*. Second edition. Lippincott Williams & Wilkins. A Wolters Kluwer Company. SF757.3, B33 2000. Pp 191 – 200.

Bancroft JD & Gamble M (2008). *Theory and Practice of Histological Techniques.* Fourth edition, Churchill Livingstone, London, UK. Pp 83-87

Banks WJ (1993). *Endocrine System in Applied Veterinary Histology.* Third edition, Mosby Books Incorporated, New York, USA. Pp 408-428.

Bensley SH (2007). The normal mode of secretion of in the parathyroid gland of the dog. *Anatomy Record,* **98**(3): 361-381.

Capen C & Martin SL (2003). *The Thyroid Gland, Veterinary Endocrinology and Reproduction,* fifth edition. Iowa State University Press, Ames, Iowa. Pp 35-69.

Charles CC, Adalbert K & Clarence RC (2000). The ultrastructure, histopathology, and histochemistry of the parathyroid glands of pregnant and non-pregnant cows fed a high level of vitamin D. *Laboratory Investigations,* **14**(10): 1809-1825.

Dellman ND (1993). *Textbook of Veterinary Histology.* Fourth Edition, Lea and Febiger, Philadelphia. Pp 280-282.

Faye B (1997). *The dromedary Camel Age Determination Guide*. First edition. Sanofi Press, Libourne, France. Pp 126.

Fleischer C, Becker D, Hamele-Bena T, Breen L & Silverberg SJ (2004). Oxyphil parathyroid adenoma: A malignant presentation of a benign disease. *Journal of Clinical Endocrinology and Metabolism,* **89** (12): 5948 – 5951.

Mescher AL (2013). *Junqueira's Basic Histology, Text and Atlas.* Thirteenth International Edition. McGraw-Hill Companies, Singapore. Pp 425.

Metwally MA & Attia HF (2006). Anatomical and

Histological studies on the Parathyroid gland. Retrieved from http://www.tlt.net/book/researches/8.doc, retrieved 15-05-2014.

Nagpal SK, Sudhakar LS, Yashwant S & Dhingra LD (1989). Histomorphology of parathyroid gland of camel. *Indian Journal of Animal Science,* **59** (1): 80-84

Nakanishi M, Sawamoto O, Kawashima M, Kuwamura M & Yamate J (2004). Morpholgical changes in the parathyroid gland of rats with humoral hypercalcaemia of malignancy. *Journal of Comparative Pathology,* **131** (1): 92-97.

Ojo SA (1987). *Essentials of Veterinary Histology,* Volume 2, Ahmadu Bello University Press, Zaria, Nigeria. Pp 430-441.

Singh I (2010). *Textbook of Human Histology.* Seventh edition. Jaypee Brothers Medical Publishers Limited. New Delhi. Pp 313-318.

Snow L (1992). An Introduction to the Racing Camel. *Proceedings to the First International Camel Conference.* R & W Publication LTD Newmarket Suffolk, UK. Pp 215-217.

Yagil R (1982). *Camels and Camel Milk*. Animal Production and Health. Food and Agricultural Organization (FAO) of the United Nations, Rome. Pp 25.