

## Embryonic differentiation of the rectum of one humped camel (*Camelus dromedarius*): A histomorphology

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### Research Paper

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A research was conducted on the rectum of 35 fetuses of the one-humped camel collected from the Sokoto metropolitan abattoir, over a period of five months at different gestational ages for histomorphological differentiation. The approximate age of the fetuses was estimated and categorised into first, second and third trimester. Gross observation, result and discussion were critically highlighted, Histological observation of the tissues in this study revealed a complete structure of the tubular organ. The rectum was found to consist of four layers namely: *Tunica mucosa*, *Tunica sub mucosa*, *Tunica muscularis* and *Tunica serosa*. The epithelium of the *Tunica mucosa* was stratified squamous epithelium with varying degree of stratification along the length at first trimester and transformed to low columnar /cuboidal epithelium at second trimester. At third trimester, the epithelium was simple columnar epithelium. The lamina propria mucosa was found absent at first trimester but prominent at second and third trimester. The *Lamina muscularis* mucosa was found prominent at third trimester but not identified at first and second trimester. At first trimester of age, *tunica submucosa* was prominent while at second trimester, it consisted of connective

tissue cells and fibres scattered all over the layers with preliminary blood vessels. The cells and fibres were undifferentiated at this stage. There was no evidence of secretory cells within the layer. At third trimester of age, the connective tissues and blood vessels were found prominent throughout the length of the rectum. The *tunica muscularis* of camel rectum consist of two band of smooth muscle sandwich with skeletal muscle layers. At first trimester this layer did not differentiate into these three zones but only longitudinal orientation of smooth muscle layer. At second trimester, the layers of three zones with clear demarcation was observed, while at third trimester, the skeletal muscle layer appeared to be much thicker than the two longitudinal smooth layer. A thin layer of connective tissue comprising of undifferentiated cells lined the rectum externally was observed in all the stages of development. Based on the above findings, it showed that development of the camels' rectum was morphological in succession over a period of time.

**Key words:** Camel, rectum, embryonic differentiation, histomorphology.

### INTRODUCTION

The digestive anatomy and physiology of dromedarian camel at embryonic level is least understood when

compared to Llama, Guanaco, Cattle, Sheep, Goat and Pig (Bello et al., 2012). The description of dromedarian

camel is usually made as if it is identical with Llama specie (Bello *et al.*, 2012; Franco *et al.*, 2004). Though, they are pseudo-ruminants that possess a three-chambered stomach, lacking the omasum that is part of the four-chambered stomach of the order Ruminantia (Belknap, 1994; Bello *et al.*, 2012). The true camels (*Camelus dromedarius* and *Camelus bactrianus*) are closely related anatomically to the South American Camelids (Georgieva and Gerov, 1975; Wilson *et al.*, 1990; Belknap, 1994; Umaru and Bello, 2012).

Research work dealing with morphology, physiology, pathology, gross and developmental anatomy of various organs and system of dromedarian camel has been carried out in many countries using foetal and adult camel (Georgieva and Gerov, 1975; Asari *et al.*, 1985; Malie *et al.*, 1987; Belknap, 1994; Franco *et al.*, 2004; Bello *et al.*, 2012; Umaru and Bello, 2012; Wilson *et al.*, 1990). Despite the importance of camels' large intestine to its adaptation to desert environment, little attentions have been paid for the developmental changes of the caudal part of the small intestine in this area. Thus, paucity of information on the prenatal development of camel rectum exists; hence the present study was undertaken to bridge the information gap.

## MATERIALS AND METHODS

The study was carried out on 35 foetuses of the one-humped camel collected from the metropolitan abattoir, Sokoto using standard animal ethics approved by the government, at different gestational ages. The collected foetuses were then taken to the Veterinary Anatomy laboratory of Usmanu Danfodiyo University; where the weight and age of the foetus were determined. The foetal body weight was measured using electrical (digital) weighing balance for the smaller foetuses and compression spring balance (AT-1422), size C-1, sensitivity of 20 kg X 50 g in Kilogram for the bigger foetuses. The approximate age of the foetuses was estimated by using the following formula adopted by El-wishy *et al.*, 1981:

$$GA = (CVRL + 23.99)/0.366,$$

Where GA is age in days and CVRL is the Crown Vertebral Rump Length.

Foetuses below 130 days were designated as first trimester, 131- 260 days as second trimester and 261 - 390 days as third trimester (Bello *et al.*, 2012). Crown Vertebral Rump Length (CVRL) was measured (cm) as a curved line along the vertebral column from the point of the anterior fontanel or the frontal bone following the vertebral curvature to the base of the tail. Based on this, foetal samples were divided into 3 main groups as described by Bello *et al.* (2013). The digestive tract of each fetus was collected by placing the fetus on dorsal

recumbency and a mid-ventral skin incision was made *via* the abdomino-pelvic region down to the thoracic, to the neck up to the inter-mandibular space in order to remove the entire digestive tract. 1 cm<sup>2</sup> thick of sample from each segment was collected and fixed in 10% formalin solution. After fixation was achieved, the tissue sample was processed for paraffin blocks preparation. The sections of 5 µm were subjected to haematoxylin and eosin for routine morphology (Luiz and Jose, 2005). The standard sections were examined under light microscope and micrographs taken using Sony digital camera(X5) with 12.1 mega pixel.

## RESULTS AND DISCUSSION

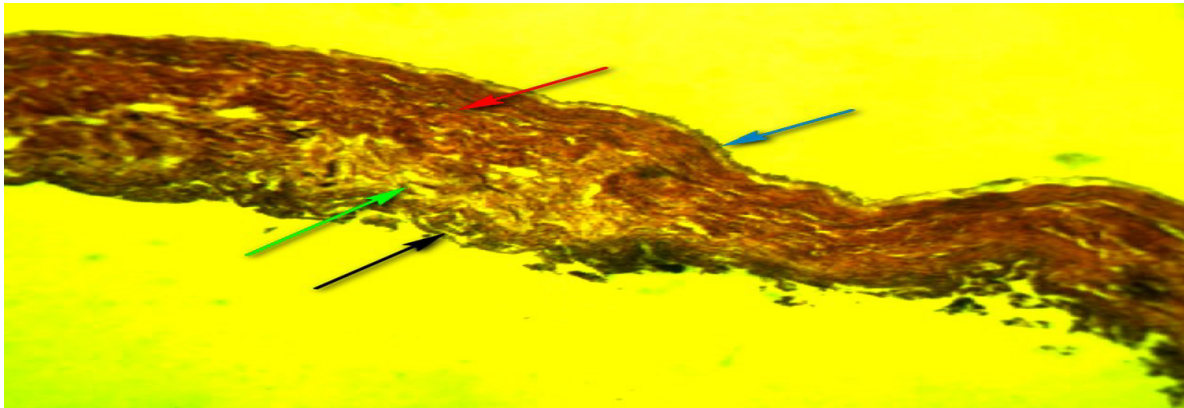
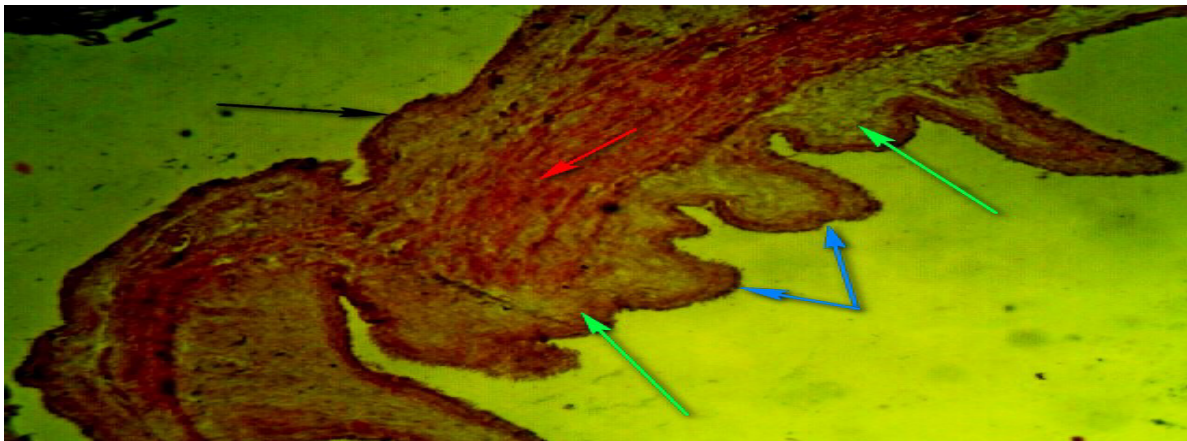
The study attempted to contribution to the histological differentiation of the camel large intestine. Result of the investigation revealed that there was an increase in the body weight, organ weight and individual segments of the large intestine in the fetuses with advancement in gestation period (Table 1). This is in agreement with the observations of (Jamdar and Ema, 1982; Bello *et al.* 2012 and Sonfada, 2008), who observed obvious body weight increase with advancement of gestation period in different species of animals. Bello *et al.* 2013, suggested that nutritional status and health condition of the dam played a vital role in the development of the fetus hence increase in weight of the fetus grossly, the color of the rectum was whitish at first trimester and grayish in second and third trimester. The rectum was divided into two main portions namely the sacculated part and the thin part which formed the long part of the rectum in the second and third trimesters. At first trimester the thin part was not differentiated. Similar findings were reported on the color and divisions of rectum of various animals at different gestational ages such as Llama (Smuts and Benzuidenhout, 1987; Malie *et al.*, 1987) and nutria (Perez *et al.*, 2008a). On the other hand, the sacculated part was not found in sheep (Sisson *et al.*, 1975; May, 1977), cattle (Wilson *et al.*, 1990; Dyce *et al.*, 2002) and pampas deer (Perez *et al.*, 2008b). While in horse, there were two regions of sacculated portion with constriction between them prenatally (Sisson *et al.*, 1975).

The internal mucosa of the rectum of the camel was pinkish at first trimester and grayish in color at second and third trimester, with thin longitudinal folds at the thin part and crossed longitudinal and circular folds at the sacculated portion. This is in line with the findings of some researchers, who reported that the internal mucosa of large intestine of other domestic animals had circular folds "Plicae Circulares"(Junqueira *et al.*, 1995; Dellmann and Eurell, 1998).

Histological observation of the tissues in this study revealed a complete structure of the tubular organ. The rectum was found to consist of four layers namely: *Tunica mucosa*, *Tunica sub mucosa*, *Tunica muscularis* and

**Table 1:** The CVRL and weight of fetuses at various trimesters (mean±SEM).

Parameters	First Trimester	Second Trimester	Third Trimester
Number of sample (N)	13	11	11
CVRL (cm)	20.06 ± 3.0	60.27 ± 4.0	103.83 ± 6.0
Fetal weight (Kg)	1.40 ± 0.6	6.10 ± 0.5	17.87 ± 0.6

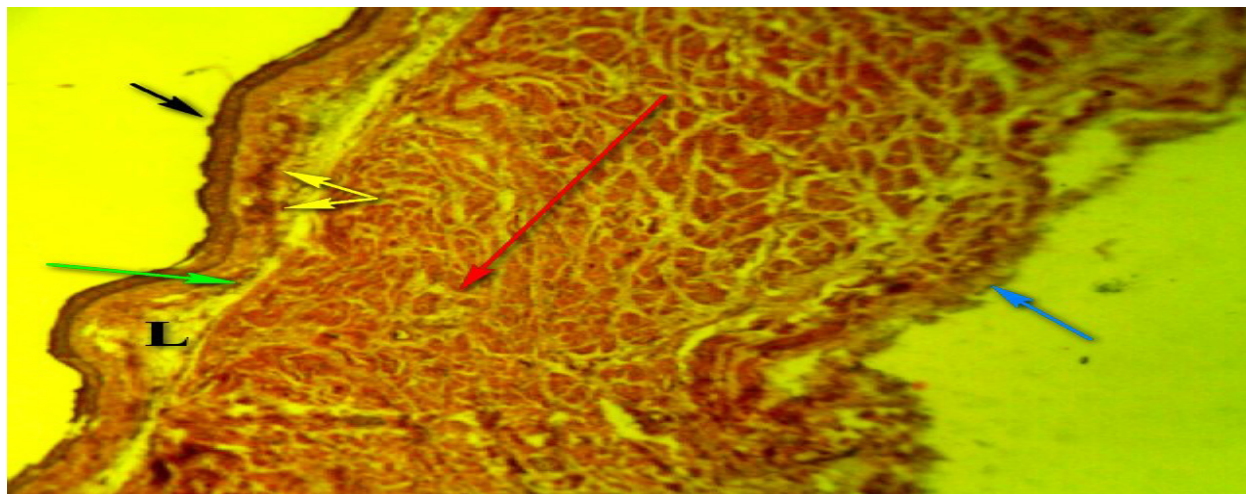
**Plate 1.** Transverse section of the rectum at first trimester showing Epithelium (Black arrow), Submucosa (Green arrow), tunica muscularis (Red arrow), serosa (Blue arrow), 150x.**Plate 2.** Transverse section of the rectum at second trimester showing Epithelium (Blue arrow), Submucosa (Green arrow), internal (circular) layer of tunica muscularis (Tm2), external (longitudinal) layer of tunica muscularis (Tm1), Skeletal muscle (Red arrow) serosa (Black arrow), 400x.

*Tunica serosa.* The distinguishing features observed in the developmental stage at tunica mucosa were, *lamina epithelialis*, *lamina propria mucosa* and *lamina muscularis mucosa*. At *tunica muscularis* the divisions were inner circular muscularis layer and outer longitudinal muscularis layer.

At first trimester, the thin portion was small and straight in shape. At second and third trimesters, the sacculated portion of the rectum was prominent, large and rounded in shape followed by thin part. The thin part was directed craniodorsally touching the base of the sacral bone. The

study findings agree with those reported in Llama by Smuts and Benzuidenhout, (1987) who concluded that the rectum begins at the pelvic inlet called colo-rectal junction below the fifth lumbar vertebrae at second and third trimester.

From the study, the epithelium of the *Tunica mucosa* was stratified squamous epithelium with varying degree of stratification along the length at first trimester (Plate 1) and transformed to low collumnar /cuboidal epithelium at second trimester (Plate 2). At third trimester, the epithelium was simple collumnar epithelium (Plate 3).



**Plate 3.** Transverse section of the rectum at third trimester showing simple columnar Epithelium (Black arrow), Submucosa (Yellow arrow), internal (circular) layer of tunica muscularis (Green arrow), external (longitudinal) layer of tunica muscularis (Blue arrow), Extensive skeletal muscle in between (Red arrow) serosa (Tser), 400x.

Similar observations were seen on Llama, cow, sheep, horse, rodent, human, monkey, dog and cat (May, 1977; Wilson et al., 1990; Bello et al., 2012; Asari et al., 1985; Bello et al., 2013; Franco et al., 2004; Umaru and Bello, 2012; Georgieva and Gerov, 1975).

The lamina propria mucosa was found absent at first trimester but prominent at second and third trimester (Plate 2 and Plate 3).

The *Lamina muscularis* mucosa was found prominent at third trimester but not identified at first and second trimester. The above finding showed that the development of the laminae of the camel's rectum was in succession.

At first trimester of age, *tunica submucosa* was prominent (Plate 1) while at second trimester, it consisted of connective tissue cells and fibres scattered all over the layers with preliminary blood vessels. The cells and fibres were undifferentiated at this stage. There was no evidence of secretory cells within the layer (Plate 2). At third trimester of age, the connective tissues and blood vessels were found prominent throughout the length of the rectum. The above findings were contrary to those of ruminant, horse (Georgieva and Gerov, 1975) and cat (Schummer et al., 1979), which showed the presence of submucosa lymphoid cells at the different region of the rectum in that specie of animals. The *tunica muscularis* of camel rectum consist of two band of smooth muscle sandwich with skeletal muscle layers. At first trimester this layer did not differentiate into these three zones but only longitudinal orientation of smooth muscle layer (Plate 1). At second trimester, the layers of three zones with clear demarcation was observed (Plate 2), while at third trimester, the skeletal muscle layer appeared to be much thicker than the two longitudinal smooth layers (Plate 3). The above finding was in conformity with that of

Llama (Watrous et al., 1995) and Bacterian camel (Luciano et al., 1979).

A thin layer of connective tissue comprising of undifferentiated cells lined the rectum externally was observed in all the stages of development. This was observed at first trimester and became well developed at second and third trimester of age (Plate 1, 2 and 3).

### Conclusion

The development of the camels' rectum based on embryonic stage was histologically in succession. The thin part of the rectum was not divided at first trimester but differentiated into two parts; the thin portion and the sacculated portion at second and third trimester. The information obtained in this study will serve as a base-line data for the camel specie in this environment.

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### REFERENCES

- Asari M, Oshige H, Wakui S, Fukaya K, Kano Y (1985). Histological development of bovine abomasus. *Anat. Anz.* 159:1-11.
- Belknap EB (1994). Medical problems of llamas. In: *The Vet. Cl. of N. Amer., Food Animal Practice, Update on Llama Medicine.* Johnson LW (Editor). Philadelphia, W. B. Saunders Co.

- Bello A, Onyeanusi BI, Sonfada ML, Adeyanju JB, Umaru MA (2012). A biometric study of the digestive tract of one-humped camel (*Camelus dromedarius*) fetuses. *Sci. J. Zoology* 1(1):11-16. <http://www.sjournals.com/index.php/SJZ/article/view/159>.
- Bello A, Sonfada ML, Umar AA, Umaru MA, Shehu SA, Hena SA, Onu JE, Fatima OO (2013). Age estimation of camel in Nigeria using rostral dentition: *Sci. J. Animal Sci.* 2(1):9-14. <http://www.sjournals.com/index.php/SJAs/article/view/278>.
- Bustanza, A.V. (1979). South American Camelids. In: IFS Symposium Camels. Sudan. p. 73-108.
- Dellmann HD, JA Eurell (1998). Textbook of Veterinary Histology. 5th Edn., Lippincott Williams and Wilkins, Baltimore, USA.
- Dyce KM, Sack WO, Wensing CJG (2002). Text book of *veterinary anatomy*. 2nd Edn., London, W. B. Saunders Co., PP: 643-644.
- El-Wishy AB, Hemeida AB, Omer MA, Mubarak AM, El-Syaed MA (1981). Functional changes in the pregnant camel with special reference to fetal growth. *British. Veterinary J.* 137:527-537.
- Franco A, Masot AJ, Gómez L, Redondo E (2004). Morphometric and immuno histochemical study of the rumen of red deer during prenatal development. *Journal of Anatomy*; 204:501-513.
- Georgieva R, Gerov K (1975). The morphological and functional differentiation of the alimentary canal of pig during ontogeny. I. Development and differentiation of the fundic portion of the stomach. *Anat. Anz.* 137:12-15.
- Jamdar MN, Ema AN (1982). The submucosal glands and the orientation of the musculature in the oesophagus of the camel. *J. Anat.*, 135:165-171.
- Junqueira LC, Carneiro J, Kelly I (1995). Basic Histology, 11th Edn., McGraw-Hill Co., Medical Publishing Division, NY, Chicago; pp. 260-265.
- Luciano L, Voss-wermbter G, Behnke M, Engelhardt WV, Reale, E (1979). Die Struktur der Magenschleimhaut beim Lama (*Lama guanaco* and *Llama*) I. Vormägen. *Gegenbauers Morphol. Jahrb.* 125: 519-549.
- Luiz CJ, Jose C (2005). Basic Histology Text and Atlas 11<sup>th</sup> ed. McGraw-Hill.
- Malie M, Smuts S, Bezuidenhout AJ (1987). Anatomy of the dromedarius camel. Clarendon press, Oxford, Pp. 101-140.
- May NDS (1977). The Abdomen. In: The Anatomy of the Sheep: A Dissection Manual, May NDS (Ed.). 3rd Edn., University of Queensland, Queensland, pp. 67-101.
- Perez W, Clauss M, Ungerfeld R (2008a). Observations on the macroscopic anatomy of the intestinal tract and its mesenteric folds in the pampas deer (*Ozotoceros bezoarticus*, Linnaeus 1758). *Anat. Histol. Embryol.*, 37: 317-321.
- Perez W, Lima M, Bielli A (2008b). Gross anatomy of the intestine and its mesentery in the nutria (*Myocastor coypus*). *Folia Morphol.* 67:286-291.
- Schummer A, Nickel R, Sack WO (1979). The alimentary canal. In: The Viscera of Domestic Mammals. New York, Springer-Verlag, Pp. 99-202.
- Sisson S, Grossman JD, Getty R (1975). The Digestive System. In: Sisson and Grossman's the Anatomy of the Domestic Animals, Sisson, S., J.D. Grossman and R. Getty (Eds.). 5th Edn. WB Saunders Company, Philadelphia, USA. 1(2):2095.
- Smuts MMS, Benzuidenhout AJ (1987). The Anatomy of the Dromedary. Clarendon Press, Oxford, P.230.
- Sonfada ML (2008). Age related changes in musculoskeletal Tissues of one-humped camel (*Camelus dromedarius*) from foetal period to two years old. A Ph.D Thesis, Department of Veterinary Anatomy, Faculty of Veterinary Medicine, Usmanu Danfodiyo University, Sokoto, Nigeria.
- Umaru MA, Bello A (2012). A study of the biometric of the reproductive tract of the one-humped camel (*Camelus dromedarius*) in orthern Nigeria. *Scientific Journal of Zoology*, North America, Available at: <http://www.sjournals.com/index.php/SJZ/article/view/395>.
- Watrous BJ, Pearson EG, Smith BB, Snyder SP, Blythe LL, Riebold TW, Hedstrom OR (1995). Megaesophagus in 15 llamas: a retrospective study (1985-1993). *J. Vet. Internal Med.*, 9:92-99.
- Wilson RT, Araya A, Melaku A (1990). The One-Humped Camel: An Analytical and Annotated Bibliography 1980-1989. UNSO Technical Publication. Bartridge Partners, Umberleigh, North Devon EX379AS U.K.