Journal of Advances in Biological and Basic Research 01[02] 2015
www.asdpub.com/index.php/jabbr e-ISSN-2454-6097

Original Article

Gross embryonic diffrentiation of the one humped Camel (*Camelus dromedarius*) stomach

A. Bello[a*], B.I Onyeanusi[b], M. L Sonfada[a], J. B Adeyanju[c], M.A Umaru[d] and J.E Onu[a]

[a]Department of Veterinary Anatomy, Usmanu Danfodiyo University, Sokoto;
[b]Department of Veterinary Anatomy, Ahmadu Bello University Zaria;
[c]Department of Veterinary Surgery and Radiology, Usmanu Danfodiyo University, Sokoto;
[d]Department of Theriogenology and Animal production, Usmanu Danfodiyo University, Sokoto, Nigeria.

***Corresponding Author**
Dr. A. Bello
Department of Veterinary Anatomy,
Usmanu Danfodiyo University,
Sokoto, Nigeria
Contact No.: +234(0)8039687589.
E-mail: abccrcfge28@gmail.com

Keywords:
Camel,
Embryonic differenciation,
Gross,
Stomach

Abstract

An embryonic gross differentiation study was conducted on the stomach of 35 foetuses of the one-humped camel collected from the Sokoto metropolitan abattoir, over a period of five months at different gestational ages. The approximate age of the foetuses was estimated from the crown vertebral rump length (CVRL) and samples were categorised into first, second and third trimester. The mean body weight of the foetus at first, second third trimester ranged from 1.40 ± 0.06 kg, 6.10 ± 0.05 kg and 17.87 ± 0.6 kg respectively. The mean weights of the entire digestive system at first, second and third trimester were 0.80 ± 0.07 kg, 2.13 ± 0.04 kg and 4.86 ± 0.08 kg respectively. The mean weights of the digestive tract at first, second and third trimester were 0.53 ± 0.07 kg, 1.03 ± 0.05 and 2.43 ± 0.07 kg respectively. Camels' stomach was observed to comprise of the voluminous smooth compartment rumen, a relatively small beans shape reticulum and a tubular abomasum at first trimester. At second and third trimester the stomach was found to comprise of a voluminous compartment I (rumen) which is subdivided by a strong muscular pillar into a dorsal smooth part and a ventral coarse part, a relatively small compartment II (reticulum) and a tubiform compartment III (Abomasum). Based on the findings in the study, camels' stomach had little/few similarities with true ruminant in terms of development.

1. Introduction

Camels are in the taxonomic order *Artiodactyls* (even-toed ungulates), sub order *Tylopoda* (pad-footed), and Family *Camelidae* [1][2]. 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 [2][2]. The true camels (*Camelus dromedarius and Camelus bacterianus*) are closely related to the South American Camelids, (Llama, Alpaca, Vicuna and Guanaco) anatomically [4].

Tylopoda and Ruminantia independently developed forestomach during evolution [2]. Species of both suborders of Artiodactyla ruminate and have in common large forestomach with extensive microbial digestion to achieve a superior digestibility of diets rich in cell wall constituents. However, gross anatomy and the microscopic structure of the forestomach mucosa are very different in camelids compared to ruminants [5].

Research work on the morphology, physiology, pathology, gross and developmental anatomy of various organs and system of dromedarian camel has been reported in different countries by many researchers on foetal and adult camel but little of such studies have been conducted on the developmental changes of the entire stomach of the camel fetus. [2] [5-12]; Thus, paucity of information on the prenatal development of camel stomach exists; hence the present study was undertaken to bridge the information gap.

2. Materials and method

The study was carried out on 35 foetuses of the one-humped camel collected from the metropolitan abattoir, Sokoto, 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 20kg X 50g in Kilogram for the bigger foetuses. The approximate age of the foetuses was estimated by using the following formula adopted by El-wishy [17].

[GA = (CVRL + 23.99)/0.366] .....Where GA is in days [17]

Fetuses below 130 days were designated as first trimester, 131- 260 days as second trimester and 261 - 390 days as third trimester [2]. Crown Vertebral Rump Length (CVRL) is measured 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 adopted by Bello *et al [12]*. The digestive tract of each fetuses were 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.

The length, width and diameter of the various segments of the stomach were taken. The length of the rumen was taken from the craniodorsal grove to the caudoventral grove and the width as the distance from the dorsal grove to the ventral grove. The length of the reticulum was taken from the cranial grove (rumino-reticular junction) to the caudal grove (reticulo-abomasal junction) and the width as the distance from the dorsal smooth border to the ventral coarse border. The length of the abomasum was taken as the greater length from the reticulo-abomasal junction to the pyloric antrum of the abomasum and the width was taken as the circumference of the organ as described by Malie *et al* [4] in 1987. The diameter was calculated from their respective circumference. Data obtained were presented in mean ± standard error of mean and student-t test was employed to analyse the data using SPSS version 17.0 statistical soft ware.

3. Result and Discussion

The current study attempted to increase the information about the normal development of the camel stomach. From the results obtained in the study, it was observed that there was increase in body weight, organ weight and individual segments of the stomach in the fetuses with advancement in gestation period as shown in table II. This is in agreement with the observations of Jamdar and Ema [13], and Sonfada [2], who observed obvious body weight increase with advancement of gestation period in different species of animals. Bello *et al* [2] in *2012* 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.

The observed increase in weight, length and diameter of various segments of the stomach in the study is in line with the findings in bovine, porcine and caprine specie by other authors [18]. The gastric indices observed in the study showed significant difference in relation to the age (P≤ 0.05) and the indices were decreasing with advancement in gestation (body development) and similar developments were seen in the study of Georgieva and Gerov [18]; in pocine specie; Bello *et al* [2] in 2012 in camel specie. The observed increase in volume of the entire stomach with advancement of gestation in the study is in line with the findings by other authors [2] [13][18].

Table I: Relationship between Mean CVRL and weight of fetuses (Mean Bodyweight) of the fetuses at various trimesters

Parameters	First Trimester	Second Trimester	Third Trimester
Number of sample (N)	13	11	11
CVRL (mean±SEM)	20.06 ± 3.0	60.27 ± 4.0	103.83 ± 6.0
Fetal weight (Kg) (mean±SEM)	1.40 ± 0. 6	6.10 ± 0.5	17.87 ± 0.6

Table II: Mean Lengths of the various compartments of the stomach (rumen, reticular and abomasum), and volume at various trimesters.

Parameters	First Trimester	Second Trimester	Third Trimester
Rumen (mean±SEM)	7.47 ± 1.67^{a}	13.83 ± 1.67^{b}	20.75 ± 1.33^{c}
Reticulum (mean±SEM)	1.97 ± 0.43^{a}	3.47 ± 0.47^{b}	6.93 ± 0.27^{c}
Abomasum (mean±SEM)	12.67± 2.33^{a}	18.33 ± 0.40^{b}	25.75 ± 0.37^{c}
Volume (cm^{3}) (mean±SEM)	136.67± 8.30^{a}	283.33± 6.50^{b}	353.33± 7.65^{c}

^{abc}*: means on the same row with different superscripts are significantly different (P < 0.05).*

Table III: Mean widths/ diameters of the various compartments of the stomach (rumen, reticulum and abomasum) at various trimesters.

Parameters	First Trimester	Second Trimester	Third Trimester
Rumen (mean±SEM)	1.93 ± 0.17^{a}	6.43 ± 0.43^{b}	11.50 ± 1.00^{c}
Reticulum (mean±SEM)	1.00 ± 0.40^{a}	2.63 ± 0.30^{b}	4.05 ± 0.20^{c}
Abomasum (mean±SEM)	1.33 ± 0.20^{a}	3.00 ± 0.23^{b}	4.25 ± 0.30^{c}

^{a,b,c}*: means on the same row with different superscripts are significantly different (P < 0.05).*

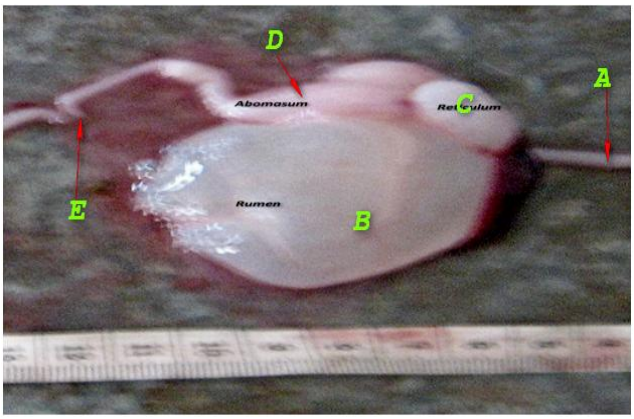

Plate 1: Photomicrograph of Camel stomach at 1st Trimester showing Oesophagus (A), rumen (B), reticulum(C), abomasum(D and small intestine(E).

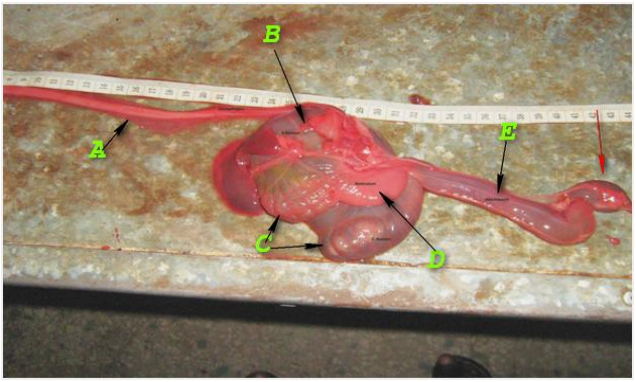

Plate 2: Photomicrograph of Camel stomach at 2ND Trimester showing Oesophagus (A), Smooth part of the rumen(B), coarse part of the rumen(C), reticulum(D), abomasum(E) and abomasal antrum(Red arrow).

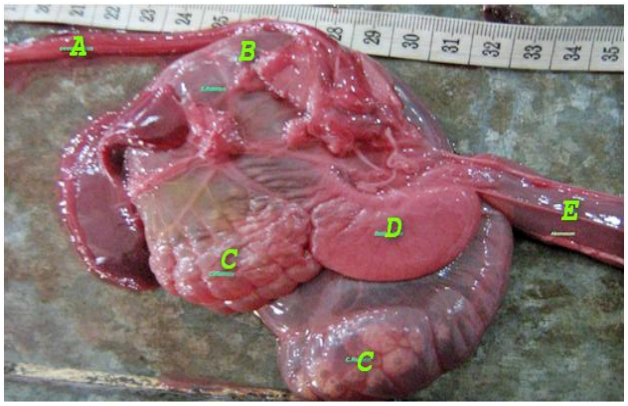

Plate 3: Photomicrograph of Camel stomach at 3rd Trimester showing Oesophagus(A), Smooth part of the rumen(B), coarse part of the rumen(C), reticulum(D) and abomasum(E).

From the study, camels' stomach was observed to comprise of the voluminous smooth compartment rumen, a relatively small beans shape reticulum and a tubular abomasum at first trimester (plate 1). At second and third trimester the stomach was found to comprise of a voluminous compartment I (rumen) which is subdivided by a strong muscular pillar into a dorsal smooth part and a ventral coarse part, a relatively small compartment II (reticulum) and a tubiform compartment III (Abomasum) (plate 2 and 3). This was in line with the observations of many scholars [14] [15], but contrary to the findings of Lesbre and Mayhew and Ctruz-orive, who reported that during the development of the camel fetus, the abomasum had a constriction or demarcation that showed a primitive omasum but disappear early at post-natal period.

The division of the camel stomach into 3 major compartments i.e. rumen, reticulum and abomasum as there was no omasum in all the three phases of the gestational age (plate 1, 2 and 3) is in line with the finding of Luciano *et al* [14] and Belknap [16], who observed that the abomasum was a long narrow tube-like structure with no constriction and contrary to the findings of Mayhew and Ctruz-orive, 1974 who reported that during the development of the camel fetus, the abomasum had a constriction or demarcation that showed a primitive omasum but disappear at post-natal period.

Lesbre (1903) and Leese (1927) stated that the camel has only three compartments compared with the bovine's four compartments, i.e. the missing compartment being the omasum, or third compartment. Hegazi (1950) describes the camel as having the same four compartments as other ruminants, but with the external constrictions between the omasum and abomasum being less well defined in the camel. Bello *et al* [2] *in* 2012 stated that the Llama and guanaco stomachs consist of only three compartments. Based on the findings, camels' stomach had little/few similarities with true ruminant in terms of development. [21-23]

References

[1] Wilson R.T. Studies on the livestock of Southern Darfur. Sudan V. Notes on camels. *Tropical Animal Health Production*, 1995; 10:19-25.

[2] Bello A., Onyeanusi B.I., Sonfada M.L; Adeyanju J.B., Umaru M. A. A biometric study of the digestive tract of one-humped camel (camelus dromedarius) fetuses, *Scientific Journal of Zoology* 2012; 1(1): 11-16.

[3] Sonfada, M.L. 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 2008.

[4] Malie, M. Smuts S. and Bezuidenhout A. J. Anatomy of the dromedarius camel. Clarenden press, Oxford, 1987Pp 101-140.

[5] Umaru, M.A and Bello, A. A study of the biometric of the reproductive tract of the one-humped camel (Camelus dromedarius) in orthern Nigeria. *Scientific Journal of Zoology*, 2012; 1 (5):82-86.

[6] Bustinza, A.V. South American Camelids. In: IFS Symposium Camels. Sudan. 1979: Pp 73–108.

[7] Asari M., Oshige H., Wakui S., Fukaya K., Kano Y., Histological development of bovine abomasus. *Anat. Anz*. 1985; 159:1-11.

[8] Wilson R. T.; Araya, A. and 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.

[9] Reece, W. O. Physiology of domestic animals. Williams and Wilkins. CH. 11, 1997: pp. 334.

[10] Franco A, Masot A.J, Gómez L, Redondo E. Morphometric and immuno histochemical study of the rumen of red deer during prenatal development. *Journal of Anatomy* 2004; 204:501–513.

[11] Hena S. A, Sonfada M.L., Onyeanusi B.I., Kene R.O.C, Bello A. Radiographic studies of developing calvaria at prenatal stages in one-humped camel. *Sokoto Journal of Veterinary Sciences.* 2012; 10(1): Pp13-16. http://dx.doi.org/10.4314/sokjvs.v10i1.3

[12] Bello A., Sonfada M.L., Umar A.A., Umaru M.A., Shehu S.A., Hena S.A., Onu J.E., Fatima O.O. Age estimation of camel in Nigeria using rostral dentition: *Scientific Journal of Animal Science* 2013; 2(1) 9-14.

[13] Jamdar, M. N. & Ema, A. N. The submucosal glands and the orientation of the muscul-ature in the oesophagus of the camel. *J. Anat.* 1982; 135:165-71.

[14] Luciano, L., Voss-wermbter, G., Behnke, M., Engelhardt, W. V. and Reale, E. Die Struktur der Magenschleeimhaut beim Lama (Lama guanacoe and Lama llama) I. Vormagen. Gegenbauers *Morphol. Jahrb*. 1979; 125: 519-549.

[15] Sukon, P. (2009). The Physiology and Anatomy of the Digestive tract of Normal Llamas. PhD Thesis, Oregon State University, Corvallis.

[16] Belknap, E. B.(1994). Medical problems of llamas. In: The Vet. Cl. of N. Amer., Food Animal Practice, Update on Llama Medicine. Johnson, L. W. (Editor). Philadelphia, W. B. Saunders Co.

[17] El-Wishy, A.B, Hemeida, A B., Omer, M.A., Mubarak, A.M. and El-Syaed, M.A. Functional changes in the pregnant camel with special reference to fetal growth. *British Veterinary Journal.* 1981; 137, 527-537.

[18] Getty, R.(1975). Digestive system of the sheep. In: Sisson and Grossmans. The Anatomy of Domestic Animals. 5th Ed. Philadelphia, W. B. Saunders Co.Pp.477-84.

[19] DeNardi, F. G. & Riddell, R. H. The normal esophagus. *Am. J. Surg. Pathol.* 1991; 15:296-309.

[20] Fawcett, D. W. & Raviola, E. The esophagus and stomach. In: Fawcett, D. W. (Ed). A Textbook of Histology. 12th ed. New York, Chapman & Hall, 1994; Pp.593-616.

[21] Luiz C. J. and Jose C. (2005): Basic Histology Text and Atlas 11th ed. McGraw-Hill

[22] Schummer, A.; Nickel, R. & Sack, W. O. The alimentary canal. In: The Viscera of Domestic Mammals. New York, Springer-Verlag, 1979: Pp 99-202.

[23] Smith, J. A. Noninfectious, metabolic, toxic and neoplastic diseases of Camelids. In: The Vet. Cl. Of N. Amer., Food Animal Practice, Llama Medicine. Johnson, L. W. (Ed.). Phildelphia, W.B. Saunders Co. 1989: Pp.103-4.

[24] Watrous, B. J.; Pearson, E. G.; Smith, B. B.; Snyder, S. P.; Blythe, L. L.; Riebold, T. W. & Hedstrom, O. R. Megaesophagus in 15 llamas: a retrospective study (1985-1993). *J. Vet. Internal Med*., 1995; 9:92-9.

