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Gross morphology and morphometry of foetal and adult dromedary tongues

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Abstract

Gross morphology and morphometry of apparently normal tongues of forty antenatal and ten adult dromedaries (*Camelus dromedarius*) of both sexes, procured from the Maiduguri Metropolitan abattoir, were studied. This was with the aim of documenting information on these aspects. The thirteen months dromedary gestation period was divided into four quarters for the purpose of the foetal tongue morphometric study, with ten foetuses per quarter. The prenatal and postnatal tongues were grossly observed to be flat apically and oval basally. They were highly flexible, like other ruminants' tongues, and relatively small to the overall sizes of the study animals. The highest lingual weight percentage of the body weight of 0.39% was attained at the second prenatal growth phase of the dromedary while the least, 0.16%, was attained in the adult. The foetal tongues showed levels of significant increases in sizes and weights throughout the prenatal growth phases. It was concluded that the dromedary tongue is similar to other ruminant tongues and most of the salient gross features, like gustatory and non-gustatory papillae, of the dromedary tongue were already obvious as early as the first prenatal growth phase (2 – 3 months) and the remaining three periods were associated with size increases. In the prenatal dromedary tongues studied, the salient gross features of the tongue were fully evident right from the first quarter of gestation (first three months of prenatal life), but were relatively small in size. Likewise; the mean dimensions and the weights obtained in the present study, showed significant increments across the four-quarters gestation. This is not unrelated with the structural developments of the overall body size and weights.

Keywords: Adult, Dromedary, Foetus, Morphometry, Tongue
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Introduction

Camels belong to the taxonomic order *Artiodactyla* (even toed Ungulates), sub-order *Tylopoda* (Pad-footed), of the *Camelidae* Family. The *Camelidae* is a relatively small family of two genera: *Camelus* (Old world camels) and *Lama* (New world camels). The genus *Camelus* consists of *Camelus dromedarius*, commonly known as the dromedary, one-humped or Arabian camels and *Camelus bactrianus, the* Bactrian or two-humped camels (Burton *et al.,* 1969; Burton, 1972; Wilson, 1984).

Domestication of dromedaries first started in central or southern Arabia. However, they became extinct in the wild about 2,000 later (Kohler-Rollefson *et al*., 1991; Peters, 1997; Pastoret, 1998). About 70% of the world's camels are found within the tropics and over 90% of the African herds are present in the region. African population is thought to be increasing slightly, especially within the tropics. As for some other areas, however, numbers are actually declining, since the camel is being replaced by other domestic species (sheep, cattle and goat) (FAO, 1994). The dromedaries account for about 95 % of the world's 19.4 million camels, 15 million of which are found in Africa (FAO, 2003).

Dromedaries are well known in literatures for their unique features and milk, meat, wool, hair and hide products; serve for riding, and as draft animals for agriculture and short-distance transport (Schwartz & Dioli, 1992; Al-Busadah, 1998).

The tongue is a muscular organ with strong and definite movements. It has free parts (apex and body) and an attached part (the root). It is an important organ in the animal's body. It is a renowned organ of taste owing to its component taste buds, it plays unique role in prehension, lapping, grooming and manipulation of food in the mouth (Igado, 2011). The dromedary belongs to the arid lands, where xerophytes with hard rough thorny stems grow. The dromedary has thus developed special adaptive feature of sturdy rubbery mouth to enable it maintain efficient feeding on these plants without damage from their thorns and stems (Sui *et al*., 1983).

There is scanty information on the morphological features of the tongues of foetal (Salehi *et al.*, 2010) and adult dromedaries (Qayyum *et al*., 1988; Erdunchaolu *et al.*, 2001; Peng *et al*., 2008). This study aims at documenting information on the morphometry of the foetal and adult dromedary tongues with special emphasis on the four prenatal developmental stages of the dromedary (Jaji *et al.,* 2011). Such information will be quite valuable in providing baseline data for academics, livestock practitioners and scientists towards improving veterinary education, research and animal health.

Materials and methods

This study was conducted at the Maiduguri Metropolitan abattoir, Nigeria. Forty foetuses, ten per stage, and ten adult dromedary tongues from both sexes and above 5 years were used in this study. The animals were apparently normal. The body weight (kg) and crown-rump length (cm) of foetuses associated with quarters of gestation were measured using citizen® electronic weighing balance (0.1g – 100Kg precision) and Butterfly® measuring tape (0.1 – 150cm precision), respectively. The data thereby obtained and correlated with developmental horizons, enabled the placement of the foetuses into broadly based groups as adopted from Jaji *et al*. (2011).

Immediately after slaughter, the foetal and adult tongues and their associated structures were dissected out from the animals. The weights of the tongues were measured in grams, using Citizen® electronic weighing balance and their lengths (cm) and breadths (cm) were also measured using the butterfly® measuring tape.

The lingual length was the distance from the root of the tongue, nearest to the pharynx, to the tip of the apex. The lingual body breadth (rostral lingual breadth) was the widest distance between the two lateral limits of the lingual body. The lingual basal breadth (caudal lingual breadth) was the widest distance between the two lateral limits of the lingual base, including the height, of the *Torus linguae*.

Data analysis

The differences between the above dimensions across the developmental stages of the foetal dromedaries were tested using the ANOVA from the computer statistical software, Graph pad Instat®, version 3.06, 32 bits for Windows. The whole variables were recorded in a mean± SD of measurement of errors. Values of $p< 0.001$ to $p<0.05$ were considered significant throughout the measurements of the study.

Results

In the foetal and adult dromedaries studied, the tongue was pale grey in colour and flat (apically) to oval (basally) in shape (Plate I). The apex and body of the tongue were freely movable while the Base was relatively stable and made up of the *Torus linguae* and the root of the tongue. At the first growth phase, a foetus measured 44.00 ± 9.72 cm in crown-rump length (CRL), 3.42 ± 1.36Kg in body weight and its tongue measured 8.33 ± 1.99cm in length, 1.85 ± 0.56cm and 2.72 ± 0.60cm in respective body and basal breadths, and 9.92± 4.61g in weight, 0.31% of the bodyweight (Table 1). These dimensions and weights showed extremely significant increases along the four dromedary growth periods except the basal lingual breadth that showed no significant increase in size at the first growth period (Table 1).The adult dromedary tongue (of both sexes) was very mobile (flexible) and furnished with lots of filiform papillae spanning the dorsum of its apex and body. It was also showed that, in all the stages of development, the camel tongues were elongated, with flat surfaces and rounded apically. There were many Lentiform and conical papillae on the dorsum of the *Torus linguae*. A conspicuous column of five circumvallate papillae was found at each lateral margin of the *Torus linguae* in the adult male tongue (Plate II). In addition, the tongue was observed to be smaller in relation to the overall size of the animal. The animal weighed 546.56 ± 52.22 Kg in body weight, while the tongue weighed 0.72 ± 0.17 Kg, making about 0.16% of the animal weight. The tongue measured 41.33 ± 2.25cm in length, 6.50 ± 0.63cm and 20.00 ± 4.70cm in respective body and basal breadths (Table 1). There were no statistically significant differences observed between sexes in this study.

Plate I: Photograph of the dorsum of the second trimester, 3-6 months gestation female dromedary tongue showing its three major components
Legend: A; apex, Bo; Body and Ba; Base

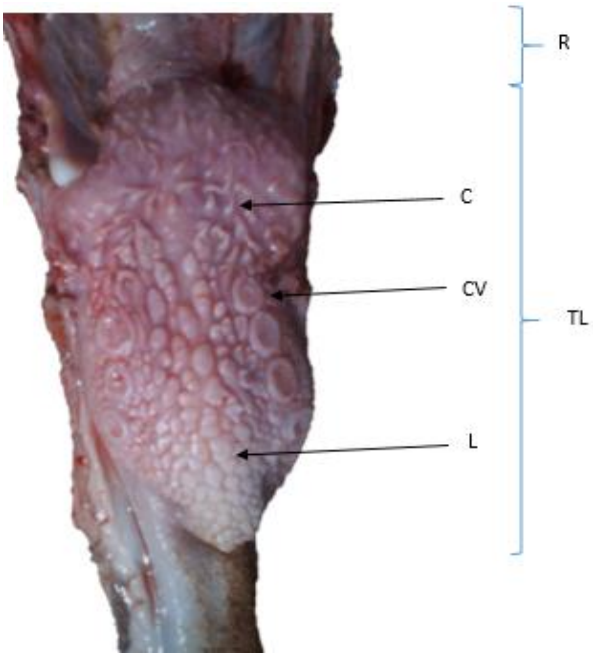

Plate II: Magnified photograph, a closer look at the dorsum of the basal part of the male tongue depicting its rounded part (*Torus linguae*, TL) and root (R) components
Legend: C; Conical papillae, CV; Circumvallate papillae, L; Lentiform papillae, R; Root, TL; papillae of the *Torus linguae*.
There is a row of five CV papillae on either side

Table 1: Mean ± S.D Values of Body and Tongue Morphometry in the Foetal and Adult Dromedary

Measurements	Prenatal phase				Adult dromedary >5years
	Q_1 (2-4 Months)	Q_2 (5–7 Months)	Q_3 (8-10 Months)	Q_4 (11-13 Months)	
Crown-rump length (cm)	44.00 ± 9.72	67.00 ±7.35 ***	85.00 ± 4.04***	100.67±4.89***	-
Body weight (Kg)	3.42 ± 1.36	8.02±2.17***	12.50 ±1.92***	17.50±3.51***	540.56± 52.22
Lingual Weight (g)	9.92 ± 4.61	28.83 ±10.26***	44.83±8.84***	54.82±4.02***	720 ± 170
Relative percentage - Lingual to body weights (%)	0.31	0.39	0.38	0.28	0.16
Lingual Length (cm)	8. 33 ± 1.99	11.33±1.66***	13.25±1.67***	13.92±0.58***	41.33±2.25
Lingual body breadth (cm)	1.85 ± 0.56	1.77 ± 0.26***	2.25±0.60***	2.92±0.38***	6.50±0.65
Lingual basal breadth (cm)	2.72 ± 0.60	3.00 ± 0.55 ^{ns}	4.30 ± 0.68***	4.50 ± 0.45***	20.00 ± 4.70

ns - Not significant
* - Significant (P<0.05)
** - Significant (P<0.005)
*** - Significant (P<0.001)

Discussion

Grossly, it was obdered that, in all the stages of development, the camel tongues were elongated, with flat surfaces and rounded apically. This was in agreement with the observations of Bello *et al*, (2014). According to Doran (1975), the camel tongue belongs to the type I (intra-oral) tongue in domestic animals. The size of the adult dromedary tongue was observed to be relatively smaller than its whole body size, in agreement with Wilson (1984). Although the dromedary is a pseudoruminant, its tongue showed resemblance to those of ruminants; its tongue showed high degree of flexibility and its *Torus linguae* was well furnished with five large diameter circumvallate papillae along its entire surface typical of ruminants (Frandson *et al*., 2009). Different morphological structures of the tongues of ruminants including the pseudoruminant, camels, are specialized to fulfil different anatomical and physiological functions, such as swallowing, water uptake, prehension, grooming,

suckling, vocal modulation and even adaptations to some environmental conditions (Kilinc *et al*., 2010; Mancanares *et al*., 2012). Moreso, the mammalian tongue is known to exhibit various morphological adaptations in different species. The distribution of the different types of papillae on the surfaces of the tongue plays a vital role in taxonomic ranking; to the extent of differentiating one genus characteristics from the other or even among different species (Pastor *et al*., 2011). For instance, one humped camels are adapted to desert environment and to feeding on the thorny structures around. Therefore, morphological differences and variations appearing in the tongue are directly associated with dietary specializations and feed types, as well as various environmental conditions (Iwasaki, 2002). The dromedary has thus developed special adaptive feature of sturdy rubbery mouth to enable it maintain efficient feeding on these plants without damage from their thorns and stems (Sui *et al*., 1983).

The dromedary tongue in this study was observed to consist of a mass of muscle covered by mucous membrane. The muscles comprises of extrinsic parts which were paired and entered the tongue from the sides, and the intrinsic muscles within the tongue, which is in agreement with Chibuzo (2006). The ruminant digestive system uniquely qualifies ruminant animals such as cattle to make efficient use of high roughage feedstuffs such as forages. Anatomy of the ruminant digestive system includes the mouth, tongue, salivary glands, oesophagus, and the four-compartment stomach (rumen, reticulum, omasum, and abomasum), pancreas, gall bladder, small and large intestines (Parish, 2011). This also resembles that of dromedary camel and it agreed with the observation of Bello *et al*. (2012). These extrinsic muscles comprised of the styloglossus, which was observed as a long slender muscle on the ventrolateral surface of the tongue. It originated from the styloid bone and inserted at the middle of the tongue. The hyoglossus muscle was a wide flat muscle observed at the base of the tongue. It originated from the basihyoid bone, lingual process and the thyrohyoid bone and inserted at the root of the tongue; and laid medial to the styloglossus. The genioglossus attached to the symphysis and adjacent body part of the mandible. It inserts in the tongue, in agreement with Chibuzo (2006).

In the prenatal dromedary tongues studied, the salient gross features of the tongue were fully evident right from the first quarter of gestation (first three months of prenatal life), but were relatively small in size. Likewise, the mean dimensions and the weights obtained in the present study showed significant increments across the four-quarters gestation. This is not unrelated to the structural developments of the overall body size and weights. The figures for the overall body weight and CRL showed slight differences with earlier reports (Musa & Abusineina, 1978; Ribadu, 1988; Jaji *et al*., 2011).

It was concluded that the salient gross features of the dromedary tongue were fully evident right from the first quarter of gestation but were relatively small in size. The tongue of the prenatal and adult dromedary, just like those of other ruminants are highly flexible organs and their sizes are relatively small when compared to the overall sizes of the animals. We therefore recommended that, histological studies need to be undertaken to determine the timing for the appearance of taste buds in the gustatory papillae of the foetal dromedary tongue.

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