



Histologic developmental horizons of the prenatal dromedary tongue

AZ Jaji¹, AS Saidu^{2*}, MP Yawulda², N Elelu³, F Da'u⁴ & SM Jajere²

1. Department of Veterinary Anatomy, Faculty of Veterinary Medicine, University of Ilorin, P,M,B., 1515, Ilorin, Kwara State, Nigeria
2. Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, Ahmadu Bello University, PMB, 1013, Kaduna State, Nigeria
3. Department of Veterinary Public Health and Preventive Medicine, Faculty of Veterinary Medicine, University of Ilorin, PMB, 1515, Ilorin, Kwara State, Nigeria
4. Kano State Ministry of Animal and Natural Resources, Kano, Nigeria

*Correspondence: Tel.: +2348039359544, E-mail: adamudvm13@gmail.com

Abstract

We present a study on the histologic developmental horizons of the dromedary tongue using abattoir samples. The 13 month dromedary gestation period was divided into four quarters, giving the dromedary four prenatal growth phases. Foetuses were recovered from slaughtered camels and 1 cm² samples were cut from dorsum and lateral parts of the apex, body and base of tongues of associated foetuses in each growth phase for histological analysis. The dorsal and lateral parts of the apex of the tongue showed variable sizes of underdeveloped filiform and fungiform papillae formed from the folding of non - keratinized stratified squamous epithelium. The filiform papillae were interspersed with fungiform papillae. A brief glandless propria-submucosa of vascularized connective tissue was continuous with their lamina epithelialis. The muscularis showed vertical, longitudinal and transverse (X, Y, Z) directions of skeletal muscles. Same arrangement was found at the lingual body. Under-developed lentiform papillae extended from the terminus of the caudal aspect of the lingual body to the rostral aspect of the lingual base. The lingual base showed underdeveloped fungiform and vallate papillae. The lingual body and base were highly muscularized. The muscularity became more obvious at the second and third quarters. Unique to the third phase was apical keratinization of filiform papillae, marking its full development. The propria-submucosa was highly vascularized. The fourth growth phase marked the stage for full development of most of parts of the tongue except the mucosa of the lingual base, where taste buds were not observed in gustatory papillae, eventhough an earlier study had observed taste buds in gustatory papillae of the adult dromedary. It was concluded that most of the salient features of the postnatal dromedary tongue, such as gustatory and non-gustatory papillae, were already evident as early as the first growth phase.

Keywords: Dromedary, Foetus, Histology, Prenatal development, Tongue

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Introduction

Camels belong to the taxonomic order *Artiodactyla* (even-toed ungulates), sub-order *Tylopoda* (pad-footed) and family *camelidae*. The camelidae family is comparatively small (Burton *et al*, 1969) and contains only two genera: *Camelus* (Old world camels) and *Llama* (New world camels). The genus *Camelus* consists of *Camelus dromedarius*, the dromedary, one-humped or Arabian camels and *Camelus bactrianus*, the Bactrian or two-humped camels (Burton *et al*, 1969; Wilson, 1984).

The dromedary is a tropical animal that feeds on xerophytes with hard rough thorny stems. Thus,

the dromedary has developed sturdy rubbery mouth, a special adaptive feature, to enable it maintain efficient feeding on these plants without damage from their thorns and stems (Sui *et al*. 1983).

Much research has been carried out on the dorsal surface of tongue in different animals: horse (Chamorro *et al.*, 1986), one humped camel (Qayyum *et al.*, 1988), cow (Fernandez, 1988), buffalo (Scala *et al.*, 1993), goat (Igbokwe & Okeoli, 2009), and the lesser mouse deer (Agungpriyono *et al.*, 1995). However, there is still

dearth of information on the histology of the whole of this vital organ of the dromedary, especially the ones relating to its prenatal development. Most of the available histologic information only centered on some aspects of the organ. This present study aims at complementing in filling of this gap through the provision of baseline prenatal histologic information on the four phases of development of the dromedary tongue. This will be vital in studying developmental malformations in this specie.

Materials and Methods

The thirteen months dromedary gestation period was divided into four quarters for the purpose of this study (Jaji *et al.*, 2011), giving the dromedary four prenatal growth phases. Immediately after recovery of foetuses from slaughtered camels at different quarters of gestation, about 2-4mm thick tissues were sampled from dorsum and lateral parts of the apex, body and base of the tongues of the foetuses for histological slide production. These samples were immediately fixed in 10% buffered formal saline, embedded in paraffin, sectioned at 5µm thickness and stained with Haematoxylin and Eosin (Baker & Silver, 1979).

The histological slides so produced were studied under light microscope at ×20 and ×40, magnifications of Olympus VAN-OX research microscope, for prenatal histological changes in the foetal dromedary tongues. Micrographs of relevant sections were then recorded.

Results

The dromedary tongue was grossly observed to be divided in a flat flexible apical part that is connected to a fixed oval basal part by a cylindrical body. However, histologically it is as follows:

First growth phase (2-3 months)

The dorsal and lateral surfaces of the lingual apex showed variable sizes of underdeveloped filiform and fungiform papillae formed by the folding of non - keratinized stratified squamous epithelium (Plate I). A brief glandless propria-submucosa of vascularized connective tissue was continuous with their lamina epithelialis. The muscularis showed vertical, longitudinal and transverse (X, Y, Z) directions of skeletal muscles. Same arrangement of layers extended up to the lingual

body. Under-developed lentiform papillae were seen to extend from the terminus aspect of the caudal aspect of the lingual body to the rostral aspect of the lingual base. The remaining parts of the lingual base except the lingual root showed under-developed fungiform and vallate papillae (Plate II). The lingual body and base were more muscularized than the apex. The vallate and fungiform papillae lacked taste buds.

Second growth phase (3-6 months)

The dorsal and lateral surfaces of the apical part of the tongue showed improvement in number and maturity of filiform (Plate III) and fungiform (Plate IV) papillae. Few lingual glands were found at the propria submucosae, which had also increased in vascularization. The lingual glands (Plate V) were seen to extend to the muscularis at different parts of the tongue. The lateral and dorsal parts of the terminal aspect of the caudal part of the lingual body showed, in addition to the filiform papillae, more developed lentiform papillae. This spanned to the rostral aspect of the tongue. The lingual base still showed under-developed fungiform (Plate V) and vallate papillae without taste buds. The lingual body and base showed increased muscularity.

Third growth phase (6-9 months)

At the mucosal level, the filiform papillae of the lingual apex were fully formed and keratinized. The fungiform and lentiform papillae were also fully developed at their respective locations at this stage. The propria-submucosae of the lingual apex and body had prominent blood vessels (Plate VI). Fungiform (Plate VII), vallate and conical papillae were also in advanced stages of development. Their propria-submucosa and muscularis were typical with those of the earlier growth phases but now developed.

Fourth growth phase (9-13 months)

The apical part of tongue showed filiform papillae with a highly keratinized stratified squamous epithelium. The propria-submucosa and muscularis were also typical of those of the earlier growth phases. Other parts of the tongue showed fully developed components except the lingual base where its gustatory papillae still lacked taste buds to characterize it.

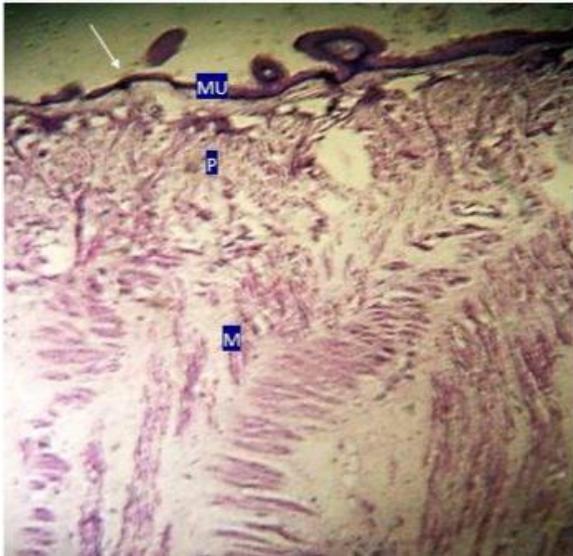


Plate I: Photomicrograph of the apex of a fetal dromedary tongue at first growth phase (2 – 3 months) showing the arrangement of its mucosa (Mu), propria-submucosa (P) and muscularis (M). H and E x40. Legend: F: Filiform papillae, (arrows); had started forming, the propria-submucosa was vascularized and the muscularis had x, y, z directed smooth muscle fibers



Plate II: Photomicrograph of the base of fetal dromedary tongue at first growth phase (2 – 3 months) showing the formation of fungiform papillae (arrow). Legend: Arrow; fungiform papillae, No taste bud was observed on the papillae. The muscularis (M) was made up of thick musculature. H and E x40



Plate III: Photomicrograph of the apex of a fetal dromedary tongue at second growth phase (3 – 6 months) showing the formation of filiform papillae (F). H and E x40. Legend: F; Filiform papillae; the apex of the papillae (arrows) was formed by non – keratinized stratified squamous epithelium and had tapering ends



Plate IV: Photomicrograph showing the formation of fungiform papillae (F) of the apex of a dromedary fetal tongue during the second growth phase (3-6 months). H and E x40

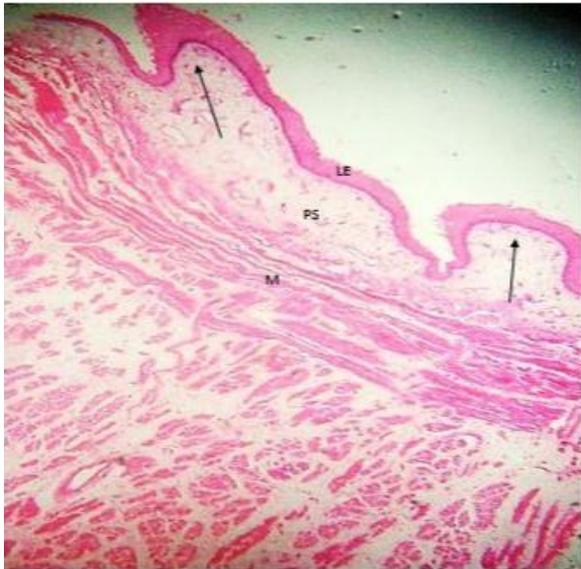


Plate V: Photomicrograph of the base of a fetal dromedary tongue at second growth phase (3 – 6 months) showing the arrangement of its layers into lamina epithelialis (LE), propria-submucosa (PS), and muscularis (M). H and E x 20. Legend: the mucosa had fungiform papillae (arrows), and propria-submucosa and muscularis have lingual glands under formation. The fungiform papillae still had no taste bud

Discussion

In the prenatal tongues studied, almost all the histological features of the lingual mucosae, propria submucosae and muscularis were evident right from the first growth phase (2-3 months approximately). Other phases were, to a larger extent, associated with maturity of components of these structures. At the first growth phase, the apical mucosa showed filiform papillae at variable levels of development. The stratified squamous epithelium has folded to form the filiform and fungiform papillae. The fungiform interspersed the filiform papillae. The filiform papillae were fully developed by the third quarter of gestation. The apical part of the mucosa of the full term dromedary tongue studied, showed numerous fully formed filiform papillae, slender, thread-like structures with highly keratinised stratified squamous epithelium. At this phase, the tongue was observed to have taken the normal shape of the adult dromedary tongue (Bello *et al.*, 2014). Stinson & Calhoun (1993) had described the filiform papillae in some domestic animals thus: the equine filiform papillae have thin cornified threads projecting above the surface; the cat has large papillae with caudally directed keratinised spine supported by more rounded rostral papillae with a thinner stratum corneum, each papilla has two prominences; the filiform papillae of the dog may have two or more apices; the caudal one is



Plate VI: Photomicrograph of the apex of a fetal dromedary tongue at third growth phase (6 – 9 months) depicting the formation of filiform papillae, (arrows). The papillae are now covered with keratinized stratified squamous epithelium and have sharp tapering ends (Arrows), V; the propria sub-mucosa was highly vascularized. H and E x20



Plate VII: Photomicrograph of the apex of a fetal dromedary tongue at third growth phase (6 – 9 months) showing the fully formed filiform papillae (arrows). H and E x20. Legend: the papillae had sharp tapering ends made up keratinized stratified squamous epithelium; the propria sub-mucosa was highly vascularized (V)

larger and has a thicker stratum corneum than the other. Similarly, the filiform papillae were observed, in the present study, to be the dominant and most abundant papillae when compared to

other lingual papillae in some species (Morais & Watanabe, 1988; Estecondo *et al.*, 2001). The mucosae of the lateral and dorsal surfaces of the tongue base showed vallate and fungiform papillae with few filiform. The vallate and fungiform papillae were devoid of taste buds at the first growth phase up to full term in this study. Eurell & Frappier (2006) had described taste buds in gustatory papillae of adult dromedary. Few lingual glands (serous glands) started becoming obvious as from the second quarter, at the propria submucosa. The tunica muscularis showed vertical, longitudinal and transverse (X, Y, Z) arrangement of skeletal muscle directions. These peculiarities were common across the other growth phases with some minor variations in terms of development. The morphology and pattern of distribution of lingual papillae observed in this study conforms to those of previous studies (Morais & Watanabe, 1988; Estecondo *et al.*, 2001). The possession of the vallate, fungiform and filiform papillae by the dromedary tongue is a

peculiarity also observed in the bactrian camel (Peng *et al.*, 2008), ruminants, such as, sheep, goats (Kurtul & Atalgin, 2008), carnivores, such as, raccoon dog and fox (Emura *et al.*, 2006), silver fox (Jackowiak & Godynicki, 2004) and American beaver (Shindo *et al.*, 2006). However, these differ in the structure and pattern showed by the other Xenarthrans.

Propria submucosa of the full term dromedary tongue had vascularised loose connective tissue with prominent collagenous fibres, blood vessels and lingual glands. A similar account was given of the other ruminants (Eurell & Frappier, 2006). Tunica muscularis of the dromedary tongue showed vertical, longitudinal and transverse (X, Y, Z) directions of skeletal muscles.

Conclusively, most of the salient features of the postnatal dromedary tongues are already obvious as early as the first growth phase and fully established by the third quarter of gestation. However, the gustatory papillae are devoid of taste buds up to full term.

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