

# GROSS ANATOMICAL PECULIARITIES OF TONGUE OF INDIAN DROMEDARY CAMEL

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## ABSTRACT

The present study was conducted on tongues obtained from 10 cadavers of adult camels (*Camelus dromedarius*). Gross anatomical features were studied. The tongue of camel was muscular and spatula shaped, comprised of 3 parts - the apex, body and the root. The mean length of tongue was  $41.21 \pm 0.527$  cm. A median groove was present on the dorsal surface of tongue. The caudo-dorsal part had convexity and formed an elliptical dorsal prominence (*torus linguae*), and bounded rostrally by the *fossa linguae*. A median fibrous ridge like structure, "lyssa" was present on the rostral third of its ventral surface. Five types of papillae were identified on the tongue of camel.

**Key words:** Dromedary camel, tongue

The Indian camel breeds have variable behavioural preferences for diet, feed resources because the anatomy and physiological function of the tongue is well adapted to wide range of feed resources (Serkan *et al*, 2016) in camels living in diverse and extreme climate conditions. Although, previous research studies have been performed on the tongue has been reported *viz.* Indian buffalo (Dhingra and Baranwal, 1979), Bactrian camel (Ye *et al*, 2008). The ultrastructural studies using scanning electron microscopy studies on the papillary body of dromedary tongue have been conducted by Saber *et al* (2011). Gross morphology and morphometry of tongue of antenatal and adult dromedaries (Saidu *et al*, 2015), histology of dromedary tongue (Qayyum *et al*, 1991) and morphological study of muscle of camel tongue (Allouch, 2014) have been studied previously. The paucity in the literature on the gross structure of tongue of the Indian dromedary camel evoked interest to carry out the present study.

## Materials and Methods

The tongues were dissected out from 10 cadavers of recently dead adult camels (*Camelus dromedarius*) irrespective of age and sex from clinics of Veterinary Clinical Complex, RAJUVAS, Bikaner. These were free from any pathological condition of tongue and mouth.

Each tongue was then used to study the gross and biometric parameters. The tongue was weighed

on a weighing scale. The width and thickness of each tongue was measured by Vernier caliper. The maximum length measured from the tip of the tongue to the median glosso-epiglottic fold was recorded by a measuring scale. Volume of each tongue was recorded by water displacement method. The number of papillae present on the tongue was counted grossly. The data was analysed using standard statistical methods as described by Kaps and Lamberson (2004).

## Results and Discussion

### Shape and Colour

The tongue of camel was muscular and spatula shaped and comprised of 3 parts - the apex, body and the root (Fig 1). Similar findings were reported by Smuts and Bezuidenhout (1987), Kumar *et al* (1995) and Ramayya *et al* (2012) in dromedary camel, Ye *et al* (2008) in Bactrian camel, Raghavan (1964) in Ox, Parvez and Rahaman (2005) in cow and Mahabady *et al* (2010) in Iranian buffaloes. The apex was free, flattened, wide and rounded as described previously (El Sharaby *et al*, 2012) in camels. It presented dorsal and ventral surfaces and a median groove was present on the dorsal surface (Fig 1). Similar findings were observed by Ye *et al* (2008) in Bactrian camel. Although, Ye *et al* (2008) reported crinkled appearance of the apex of tongue on dorsal surface, but no such observations have been recorded in the present study. The presence of papillated structures on the ventral margin of the apex of tongue (Fig 2) was

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in congruence with the observations of Harłajczuk *et al* (2015) in Alpacas. A median fibrous ridge like structure “lyssa” was observed on the rostral third of the tongue at ventral surface, situated 2 - 3 cm away from the tip and extended caudally to the level of *frenum linguae* (Figs 1 and 2) was in conformity with the findings in camels (Shoeib *et al*, 2014) and in dogs (Eubanks, 2007). However, Besoluk *et al* (2006) reported the helical shaped *lyssa* in cats and more or less J-shaped in the dogs. Shoeib *et al* (2014) reported the *lyssa* as rod-shaped in dog and strip-like structure in cat.

The body of the tongue was wider and thicker caudally than the apex and narrower rostrally (Fig 1). These findings were not in conformity with the Ye *et al* (2008) who reported long and slender body of the tongue in camels. It had 4 surfaces *viz.* dorsal, 2 lateral and ventral surfaces. The rostral part of the dorsal surface of the tongue was flat and the caudal part had convexity and formed an elliptical dorsal prominence - *torus linguae*, which appeared to be more, pronounced in the centre than on its lateral margins (Fig 1). These findings were in close agreement with the reports in Indian buffalo (Dhingra and Barnwal, 1979), cow (Parvez and Rahaman, 2005), Bactrian camel (Ye *et al*, 2008) and Egyptian water buffalo (El-Bakary and Abumandour, 2017). However, Bradley (1971), in ruminants named this elliptical dorsal prominence as intermolar eminence. The *torus linguae* has been found bounded by the *fossa linguae*, rostrally which restricted the torus between 2<sup>nd</sup> and 3<sup>rd</sup> cheek teeth in the middle of the tongue (Fig 1). Similar observations were reported by Gupta *et al* (1989) in tongue of buffalo. Ramayya *et al* (2012) reported the absence of *fossa linguae* in the tongue of camel. The *fossa linguae* was crescent shape (Fig 1) as reported by Dhingra and Barnwal (1979) in Indian buffalo. The lateral surfaces were nearly flat for the most part, but rostrally became rounded and narrower. The rostral part of the ventral surface of the tongue was free and the caudal part was related to the mylohyoid muscle, which was similar to the findings reported in ox (Raghavan, 1964). The root of the tongue was slightly narrower than body and sloped caudo-ventrally. The tongue of the camel had light pink appearance of dorsal surface and grayish pink ventral surface (Figs 1 and 2). Black pigmented patches or spots were occasionally found on the ventral surface of the tip and body (Fig 3). Whereas pigmented spots on the dorsum of mucous membrane of tongue of ox were reported by Sisson and Grossman (1958).

## Size and Weight

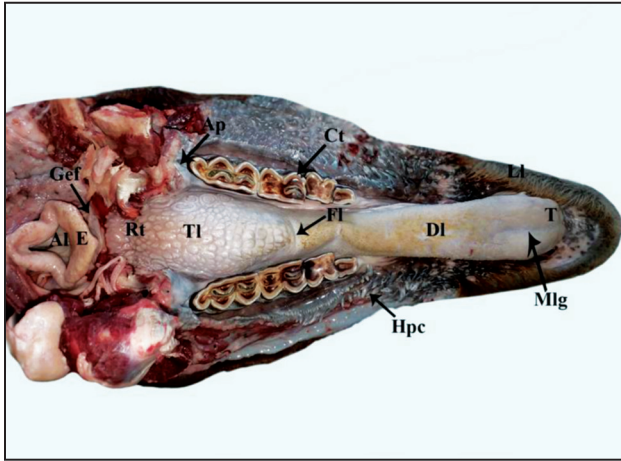
The morphometric studies demonstrated the mean length of the tongue from the tip to the root  $41.21 \pm 0.527$  cm. Similar findings were reported by Kumar *et al* (1995) and Ramayya *et al* (2012) in camels. However, Ye *et al* (2008) reported the length of tongue in a range 25-32 cm in Bactrian camels and El-Bakary and Abumandour (2017) reported  $47 \pm 1.2$  cm in Egyptian water buffalo. The mean length from root to lingual fossa and lingual fossa to tip of tongue was  $16.83 \pm 0.202$  cm and  $24.38 \pm 0.462$  cm, respectively.

The mean thickness of tongue at *torus linguae* was  $6.825 \pm 0.409$  cm, at lingual fossa  $4.362 \pm 0.284$  cm and at tip  $1.235 \pm 0.108$  cm. The mean width of tongue at root was  $8.117 \pm 0.209$  cm, at lingual fossa  $3.916 \pm 0.191$  cm and  $5.479 \pm 0.117$  cm at the tip. Kumar *et al* (1995) reported maximum width at root of tongue  $7.12 \pm 0.94$  cm in camel, however, Ramayya *et al* (2012) noticed maximum width at the level of *torus linguae* in same species. According to El-Bakary and Abumandour (2017), the tongue of Egyptian water buffalo was  $7 \pm 0.51$  cm wide at its middle part. The mean weight of tongue recorded  $0.570 \pm 0.021$  Kg and mean volume  $0.572 \pm 0.021$  litres.

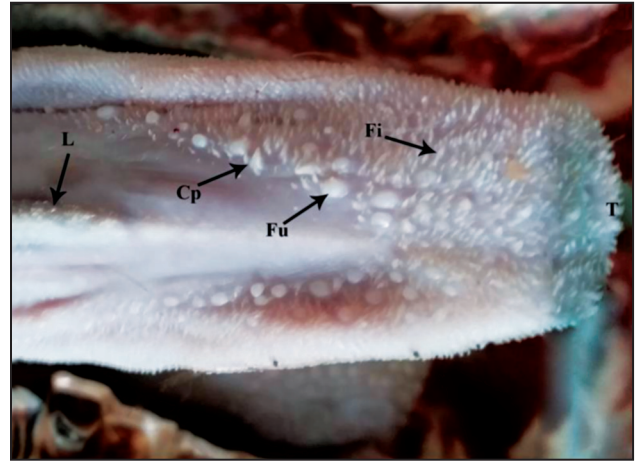
## Topography

The tongue rests on the floor of mouth cavity, between the two horizontal rami of mandible (Figs. 1 and 3). It was in agreement with Raghavan (1964) in ox, Gupta *et al* (1989) in buffalo and Ye *et al* (2008) in Bactrian camel. It extended from glosso-epiglottic fold to the lingual surface of central incisors (Fig 1), whereas, Gupta *et al* (1989) found the tongue extended from the glosso-epiglottic fold to about 1 cm rostral to the level of sublingual caruncle in buffalo. Kumar *et al* (1995) found camel tongue extended from the rostral part of the floor of mouth cavity to the level of the oropharynx.

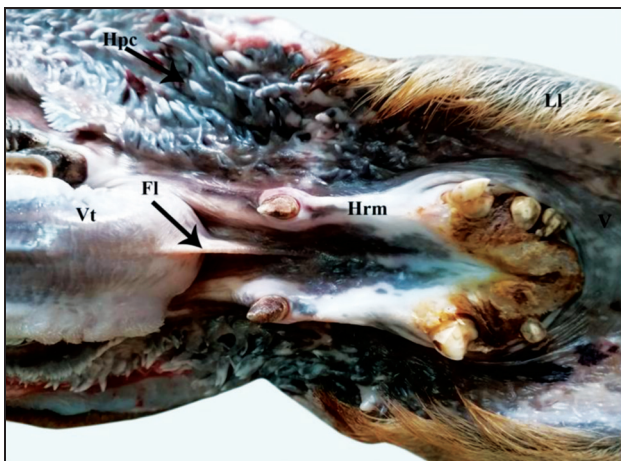
The caudal 3/4<sup>th</sup> portion of the tongue was fixed and rostral 1/4<sup>th</sup> was free which was also reported by Dhingra and Barnwal (1979) in Indian buffalo. On the Contrary, Ye *et al* (2008) reported the caudal 4/5<sup>th</sup> of tongue was fixed while the rostral 1/5<sup>th</sup> was free in Bactrian camel. The ventral surface of fixed part was placed on the mylohyoid muscle and attached to the dorsal surface of basal part of hyoid bone was in partial accordance with the findings of Ye *et al* (2008) in Bactrian camel. The dorsal surface of fixed part was attached with anterior pillars of the soft palate, and the glosso-epiglottic fold (Fig 1). Similar findings were also reported by Raghavan (1964) in ox. The ventral surface of the free part of the tongue was attached to the floor of the oral cavity by a median



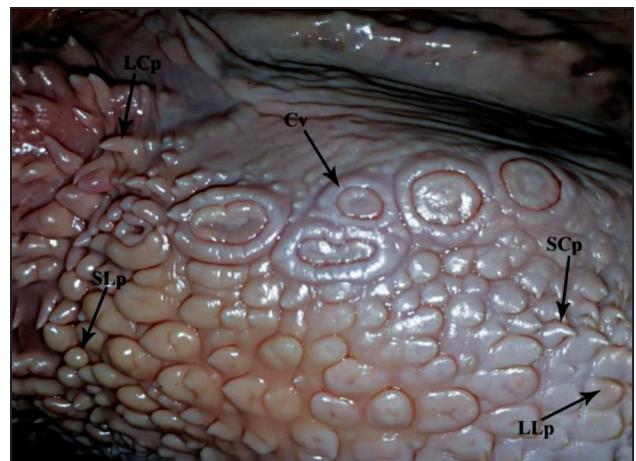
**Fig 1.** Photograph showing mouth cavity and pharynx of camel. Al - Aditus laryngis, E - Epiglottis, Gef - Glosso - epiglottic fold, Tl - *Torus linguae*, Ct - Cheek tooth, Fl - *Fossa linguae*, Dl - *Dorsum linguae*, Hpc - Horny papillae of cheek, T - Tip of tongue, Ll - lower lip, Ap - Anterior pillar, Mlg - Median longitudinal groove, Rt - Root of tongue.



**Fig 2.** Photograph of ventral surface of tongue of camel showing papillae. Fi - filiform papillae, Fu - Fungiform papilla, Cp - Conical papilla, L - Lyssa, T - Tip of tongue.



**Fig 3.** Photograph showing floor of mouth cavity of camel. Vt - Ventral surface of tongue, Fl - Frenulum linguae, Hpc - Horny papillae of cheek, Hr - Horizontal ramus of mandible, V - Vestibule, Ll - Lower lip.



**Fig 4.** Photograph of dorsal surface of tongue of camel showing circumvallate papilla. Cv - Circumvallate papilla, LCp - Large conical papilla, SCp - Small conical, LLP - Large lenticular papilla, SLp - Small lenticular papilla.

fold of mucosa, the *frenulum linguae* which was extended from caudal end of *lyssa* to 1 - 2 cm rostrally to the 1<sup>st</sup> premolar (Fig 3). It was in congruence with the observations of Gupta *et al* (1989) in buffalo, Ye *et al* (2008) in Bactrian camel and El-Bakary and Abumandour (2017) in Egyptian water buffalo.

### Papillae

Five types of papillae identified on the tongue of camel were categorised as mechanical and gustatory papillae. The filiform, conical and lenticular papillae were categorised as mechanical papillae whereas, fungiform and circumvallate were categorised as gustatory papillae. These were in conformity with

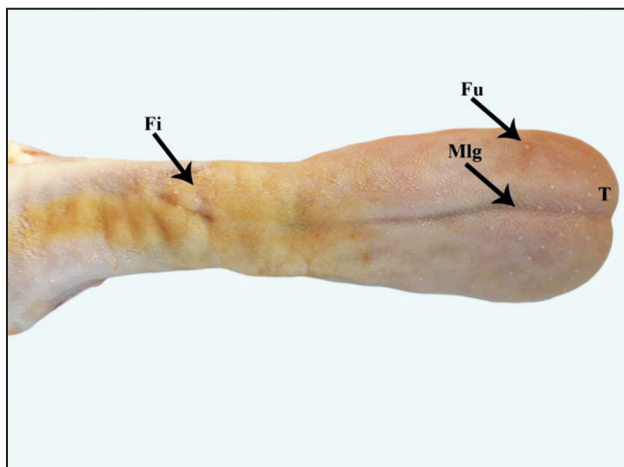
the findings of Smuts and Bezuidenhout (1987) in dromedary camel and Peng *et al* (2008) in Bactrian camel. However, it partially contradicted the statement of Mahabady *et al* (2010), who found filiform, conical, lenticular and fungiform papillae as mechanical papillae and circumvallate papillae as gustatory papillae in Iranian buffaloes.

### Mechanical papillae

#### Filiform Papillae

Filiform papillae were the most numerous papillae randomly distributed approximately on the anterior half of the surface of the tongue (Fig 5). It was



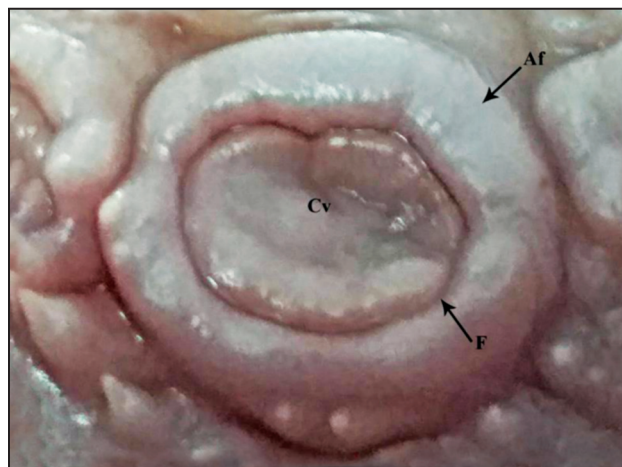


**Fig 5.** Photograph of dorsal surface of tongue of camel showing filiform and fungiform papillae. Fi - Filiform papillae, Fu - Fungiform Papillae, T - Tip, Mlg - Median longitudinal groove.

in agreement with Smuts and Bezuidenhout (1987) in dromedary camel and Ye *et al* (2008) in Bactrian camel. These were thickly populated on the dorsal surface, in front of the *fossa linguae* up to the tip and moderately populated on the ventral surface of the tip (Figs 2 and 5). Similar findings were reported (Parvez and Rahaman, 2005) in cow. No filiform papillae were found on *torus linguae* and root (Fig 4). It was also reported by Ye *et al* (2008) in Bactrian camel however, contradicted with the findings of Mahabady *et al* (2010), according to which filiform papillae were distributed over the entire dorsal surface of the tongue, with the filiform papillae on *torus linguae* shaped as caudally directed pointed spines or conical shape in Iranian buffaloes. The height of the papillae located on the tip of the tongue was low, but increased towards the body of the tongue, which was in conformity with the findings of Ye *et al* (2008) in Bactrian camel. The papillae were triangular or leaf-like shape with a sharp tip pointed backward. It was also reported by Mahabady *et al* (2010) in Iranian buffaloes. The degree of inclination of the filiform papillae increased towards *fossa linguae*.

### Conical Papillae

Two types of conical papillae, i.e. large and small were located only on the *torus linguae*. The larger papillae were located mainly on caudal margin of *torus linguae* and directed caudally, with flat and blunt free end. The small conical papillae were located on lateral margins of torus rostrally to the circumvallate papillae and directed cranially. The free ends of conical papillae were pointed (Fig 4). Few horny conical papillae were also found on the ventral



**Fig 6.** Photograph showing single circumvallate papilla on the tongue of camel. Cv - Circumvallate papillae, F - Furrow, Af - Annular fold.

surface of the tip (Fig 2). Parvez and Rahaman (2005) reported that the large conical papillae were located in the rostral two-thirds of the dorsum of the tongue with a higher concentration in the middle portion of the tongue in cow (*Bos indicus*).

### Lenticular Papillae

Lenticular papillae were largest among the mechanical papillae, limited on the *torus linguae* (Fig 4) as described by Smuts and Bezuidenhout (1987) in camel and Mahabady *et al* (2010) in Iranian buffaloes. These were of two types, i.e. larger and smaller. The larger papillae were arranged in two parallel rows and located in the middle of the anterior two-third of the torus while the smaller papillae were distributed laterally in the posterior third of the torus. Their free surfaces were round or flattened (Fig 4).

### Gustatory papillae

#### Fungiform Papillae

The fungiform papillae were small, round and club shaped (Fig 5) as also reported by Raghavan (1964) in ox. These were irregularly distributed among the filiform papillae in the anterior two-thirds of the dorsal surface and ventro-lateral surface of the tongue (Fig 5), also reported previously in camels (Smuts and Bezuidenhout, 1987). These papillae were maximally distributed on the dorsal and lateral aspects of the tip of the tongue, with few on the ventral surface of the tip (Figs 2 and 5) which were in agreement with Raghavan (1964) in ox and El-Bakary and Abumandour (2017) in Egyptian water buffalo. No fungiform papillae were found on *torus linguae* and root (Fig 4) whereas, it was contrary to

the findings of Mahmoud *et al* (2002) in donkeys. These were slightly elevated from the lingual surface as described by Mahabady *et al* (2010) in Iranian buffaloes. Fungiform papillae decreased in number but increased in size from the tip to lingual fossa which, were in the accordance with the findings of Gupta *et al* (1989) in buffalo. The ventral surface was also papillated. The filiform and fungiform papillae extended for about 5 to 6 mm beyond the tip (Fig 2).

### Circumvallate Papillae

Circumvallate papillae were found arranged in a single row on both rims of the *torus linguae*. These were 12-16 in number, with 6-8 distributed on either side (Figs 1 and 4). These findings were in partial disagreement with Smuts and Bezuidenhout (1987), as the vallate papillae were located on the torus, along its lateral borders, and consisted of a single row of 3 to 6 prominent papillae in same species. Kobayashi *et al* (2005) reported 15 or more vallate papillae at the posterior area of the lingual prominence in cattle although, Parvez and Rahaman (2005) reported 12-20 papillae in number on either side in cattle. Further, El Sharaby *et al* (2012) also reported 4-6 large vallate papillae arranged on each side closer to one another forming two lines almost parallel to the rim of lingual torus in one-humped camel whereas, Ramayya *et al* (2012) reported that circumvallate papillae were 4 on right side and 5 on left side on caudo-lateral aspect of the tongue in camel. The papillae were round in shape with minute elevation from the tongue surface. Each papilla was separated from the surrounding thick annular fold by a prominent furrow (Fig 6). The shape and size of these papillae varied greatly and these were not identical or symmetrical in the lines of either side even in the same specimen (Fig 1 and 4) also reported in camels previously (El Sharaby *et al* 2012). In some specimens, two papillae were found surrounded by a common annular pad and primary grooves (Fig 4).

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