



RESEARCH ARTICLE

Scanning electron microscopic study on the structure of the lingual papillae of the Karacabey Merino sheep

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Karacabey merinosunda dil papillalarının taramalı elektron mikroskopik incelenmesi

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Öz

Amaç: Bu çalışma Karacabey Merinosunda dil papillalarının taramalı elektron mikroskopik incelenmesi amacıyla yapıldı.

Gereç ve Yöntem: Araştırmada on adet genç erkek Karacabey Merinosu kullanıldı. Dokular dilin apex, corpus ve radix bölgelerinin dorsal, ventral ve ventro-lateral bölgelerinden alındı. Alınan dokular Scanning Electron Mikroskopu (SEM) kullanılarak incelendi.

Bulgular: Papilla filiformis, papilla conica ve papilla lentiformis olmak üzere üç tip mekanik papilla ile papilla vallata ve papilla fungiformis olmak üzere iki tip tat papillası gözlemlendi. Papilla filiformis'ler dilin apex ve corpus bölgesinde, ayrıca nadiren dilin apex bölgesinin lateral yüzünde de görüldü. Papilla conica'lar yuvarlak tabanlı ve küt uçluydu. Bu papillalar filiform papillalardan daha büyük oluşları ve sekonder papillalarının olmayışıyla ayrıldı. Fungiform papillalar mantar benzeri ve yuvarlak şekilli, dilin apex, corpus ve radix kesiminde filiform papillaların arasına serpilmiş olarak bulunmaktaydı. İki tip papilla lentiformis belirlendi. Birinci tip piramid şeklinde ve sivri uçlu iken, ikinci tip; yuvarlak şekilli ve küt bir uca sahipti. Papilla vallata'da kalın dairesel pedler ve tat tamurcuğu hendekleri belirlendi.

Öneri: Karacabey Merinos koyunu dilinde farklı morfolojik özelliklere sahip birçok dil papillasının olduğu belirlendi. Karacabey Merinos koyunu dil papillaları koyun, Saanen ve Jamunipari keçisi ile benzer mekanik fonksiyon özelliklerine sahip olduğu gözlemlendi.

Anahtar kelimeler: Dil papillaları, Karacabey merinos koyunu, SEM

Abstract

Aim: It was aimed to determine the scanning electron microscopic structures of the lingual papillae in Karacabey Merino Sheep in this study.

Materials and Methods: Ten male young Karacabey Merino Sheeps were used. Tissues were received from the dorsal, ventral and ventro-lateral surfaces of the apex, body and root of the tongue. Tissues were examined by scanning electron microscopy (SEM).

Results: Filiform, lentiform and conical papillae were observed three types as mechanical papillae and fungiform and vallate papillae were observed two types as gustatory papillae on the tongue in Karacabey Merino Sheep. The filiform papillae were present on the apex and body of the tongue, in addition randomly determined lateral surface of the apex. The conical papillae were round base and had a blunt tip and these papillae differed from the filiform papillae with their larger size and absence of the secondary papillae. The fungiform papillae round in shape and mushroom-like, scattering among the filiform papillae on the dorsal surface of the apex, body and the root of the tongue. The lentiform papillae were determined in two types. While the pyramidal-shaped type I lentiform papilla had a pointed apex, the round-shaped type II lentiform papilla had a blunt apex. The vallate papillae were defined bud ditch and a thick annular pad.

Conclusion: It was determined that Karacabey Merino sheep linguae were equipped with lots of papillae with different morphologic features. Lingual papillae of Karacabey Merino sheep had mechanical function which similar to Jamunapari goat, Saanen Goat, sheep.

Keywords: Karacabey Merino sheep, Lingual papillae, SEM





Introduction

The lingual mucosa of domestic animals is rough due to the presence of structures called 'lingual papillae' (Sonntag 1925, Evans and Cristensen 1979). Substantially, fungiform, foliate and vallate papillae are considered as gustatory and filiform, lenticular and conical papillae are as mechanic type (Doran 1975, Ojima 2001, Dyce et al 2004).

Many studies have been published on the structures of the lingual papillae surface in several herbivorous animals including cattle (Steflik et al 1983, Chamorro et al 1986, De Paz Cabello et al 1988), wild Japanese serow (Funato et al 1985), camel (Qayyum et al 1988, Erdunchaolu et al 2001), buffalo (Scala et al 1993), lesser mouse deer (Agungpriyono et al 1995), formosan serow (Atoji et al 1998, Takayuki et al 2002), Jamonopari goat (Kumar et al 1998), blackbuck (Emura et al 1999), Barbary sheep (Emura et al 2000), Big-horn sheep (Takayuki et al 2002), Mehraban lamb (Tadjalli and Pazhoomand 2004), muntjac (Zheng and Kobayashi 2006), Saanen goat (Kurtul and Atalgın 2008), hippopotamuses (Yoshimura et al 2009), Akkaraman sheep (Şah Harem et al 2009) and roan antelope (Emura et al 2011) using scanning electron microscopy. Scanning electron microscopic studies have determined a lot of level of macroscopic and microscopic structural variation, especially size and shape of the lingual papillae on the surfaces of the tongue (Scala et al 1993, Kumar et al 1998, Erdunchaolu et al 2001, Jackowiak 2006, Jackowiak and Godynicki 2007).

These important variations noticed between in mammals and might also seen among the individuals of the same species (Emura et al 2002, Jackowiak and Godynicki 2004, Jackowiak 2006, Jackowiak and Godynicki 2007). This variation has been based to the type of food intake, modification of species to environmental requirements, and taxonomic peculiarities (Thome 1999, Iwasaki 2002, Jackowiak and Godynicki 2007). Therefore, this study investigated the morpho-structural characteristics of the lingual papillae in the Karacabey Merino Sheep and compared the findings to those of other sheep, goat species and related animals.

Materials and Methods

Tongues were collected from ten male young Karacabey Merino sheeps (approximately 75 days old, 35 kg in weight and with a known pedigree) immediately after slaughter in a local slaughterhouse at Balıkesir.

Tissue samples were taken dorsal, ventral and lateral surface of the apex, body and root of the tongue. The samples were rinsed with phosphate buffer (pH:7.2) and pre-fixed in 2.5% glutaraldehyde solution. After dehydration through a graded ethanol series, were infiltrated by hexamethyldisilazane (HMDS). For the SEM, materials were fixed on aluminum

stubs using double-sided adhesive. The SEM micrographs were taken in a SEM-JEOL, (JCM 5000) at an accelerating voltage of 10–15 kV.

Results

Macroscopically investigated tongue of the Karacabey Merino sheeps were 15.5 cm in length, 3 cm in width anteriorly, 3.5 cm at the level of the lingual torus, and 3.7 cm at the root on average (Figure 1). On the dorsal and ventro-lateral surfaces of the lingual mucosa filiform, lentiform, conical, vallate and fungiform papillae were determined. There were no foliate papilla. There were approximately 43-75 fungiform papillae on the root, 38-65 on the body and 193-311 on the apex of the tongue. The conical papillae number were 23-32 and vallate papillae were 38-52 in the tongue.

Scanning electron microscopy

Numerous filiform papillae were present on the apex and body of the tongue and randomly determined lateral surface of the apex of the tongue (Figures 2 and 3). The basal part emerged from a flat base in the lingual mucosa and presented two main and lots of small secondary papillae. Each filiform papillae had two main secondary papillae emerging from the left and right sides of the papillae (Figure 3). In addition, 3 or 4 small secondary papillae sprung from the secondary papillae. There were no secondary papillae at the lateral surface of the tongue. The height of the filiform papillae varied between 360 and 540 μm and width between 82 and 175 μm . The height of the secondary papillae of the filiform papillae varied between 190 and 231 μm and width varied between 14 and 55 μm . The filiform papillae distributing on the dorsal surface at body of the tongue were bifurcated tips. The surface layer of the epithelium of the filiform papillae was highly keratinized, especially at the rostral aspect of the papillae. The conical papillae were observed on the lingual torus and ventro-lateral surface of the lingual mucosa (Figure 1). These

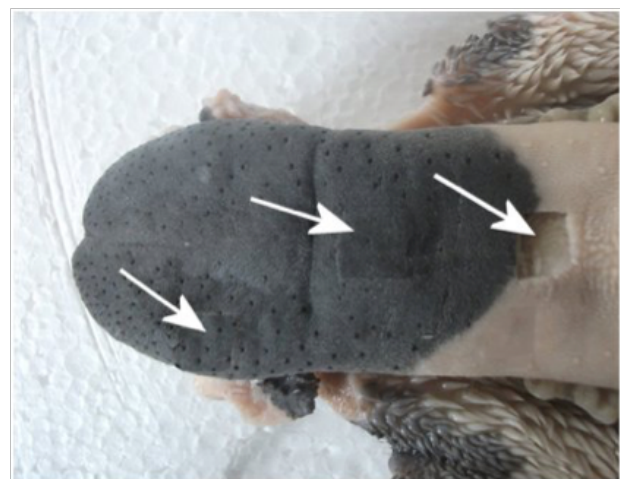


Figure 1. Overview of the dorsal surface of the tongue, displaying sample acquiring pattern.

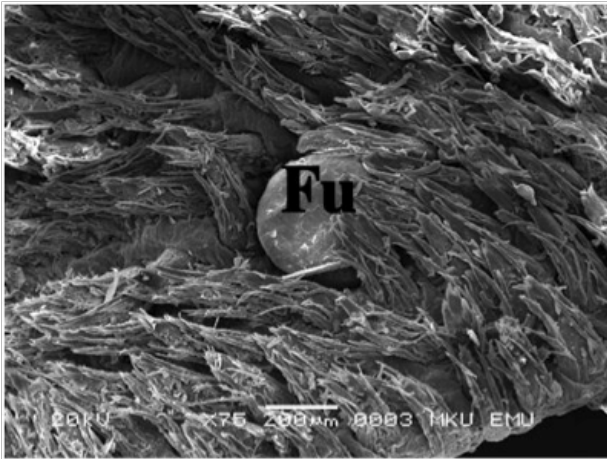


Figure 2. Scanning electron micrograph of the fungiform papilla (Fu) and filiform papillae.

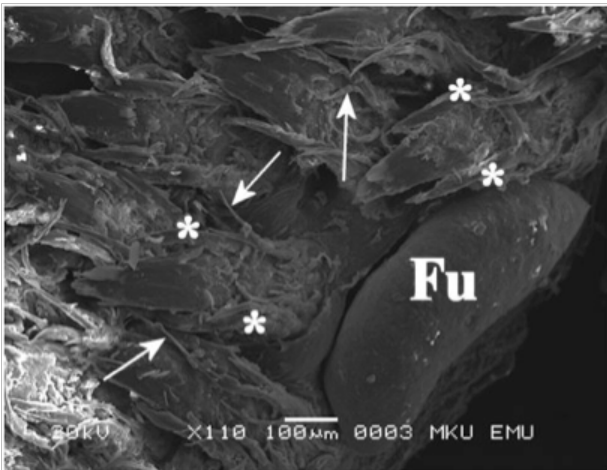


Figure 3. The filiform papillae and its secondary papillae (asterisks) the dorsal surface of the tongue, small secondary papillae of secondary papilla' (arrow), papilla fungiformis (Fu).

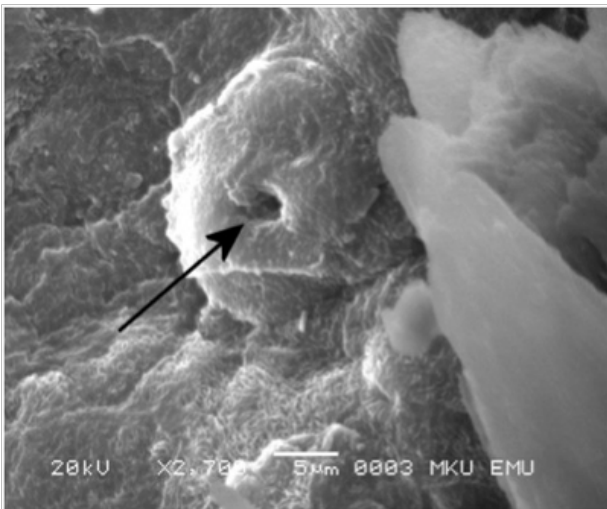


Figure 4. Fungiform papilla, the gustatory bud pore: posterior region of dorsal surface of the tongue.

papillae were round base and a blunt tip. The conical papillae differed from the filiform papillae with their larger size and absence of secondary papillae. Their surface area was

covered with squamous epithelial cells. No taste buds and pores were observed in the epithelium of these papillae.

The fungiform papillae were round in shape and mushroom-like, scattering among the filiform papillae on the dorsal surfaces of the apex, body and the root of the tongue (Figures 2, 3 and 4). The fungiform papillae had a diameter of 58 μm on average. In addition, on average, there were 28 fungiform papilla in per cm^2 area on the root, 38 fungiform papilla in per cm^2 area on the body and 45 fungiform papilla in per cm^2 area on the apex of the tongue. At x900 magnification, desquamated epithelial cells observed at the free surface and at higher magnification (x4500) polygonal cells with micro-pits were observed (Figures 5 and 6). Pores were recognizable on the free surface of the fungiform papillae as a crater-like structure. These pores had a diameter 3 μm on average at x2700 magnification (Figure 4).

The lentiform papillae were irregular lentil-like papillae of different sizes (180 $\mu\text{m}/\text{mm}$) and only observed on the torus linguae. These papillae were determined in two -types. While the pyramidal-shaped type I lentiform papilla had a pointed apex, the round-shaped type II lentiform papilla had a blunt apex (Figure 7). There were no secondary papillae. The cell boundaries were observed clearly at x2000 magnification (Figure 8).

The vallate papillae were located symmetrically on either side of the torus linguae where girdling by a gustatory bud ditch and thick annular pad or vallium of lingual mucosa (Figure 9). The vallium was split into 2-3 portions by small furrows. These round shaped papillae located caudally larger than those lying cranially. The largest vallate papilla was 1520 μm in diameter while the smallest one was 480 μm and the vallate papillae were 960 μm in diameter on average.

Discussion

This study investigated the anatomical characteristics of the lingual papillae in Karacabey Merino Sheep using scanning electron microscopy techniques. Thus, the findings were compared to research conducted previously on the papillae of the tongue in Karacabey Merino Sheep.

The filiform papillae on the dorsal surface of the lingua showed in this study were directed caudally, as informed in the buffalo (Scala et al 1993), Jamunapari goat (Kumar et al 1998), and lamb (Tadjalli and Pazhoomand 2004). The filiform papillae have one sharp pointed tips hereby, as reported in the cow (Chamorro ety al 1986, De Paz Cabello et al 1988), Jamunapari goat (Kumar et al 1998) and lamb (Tadjalli and Pazhoomand 2004). But some filiform papillae have bifurcated tips and each filiform papillae accompanied by only two main secondary papillae were demonstrated and these apices don't reach filiform papillae length.

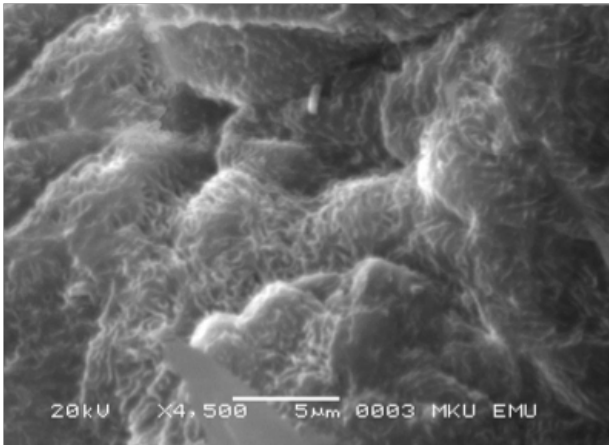


Figure 5. Appearance of the microplcae on the fungiform papilla at x4500 magnification.

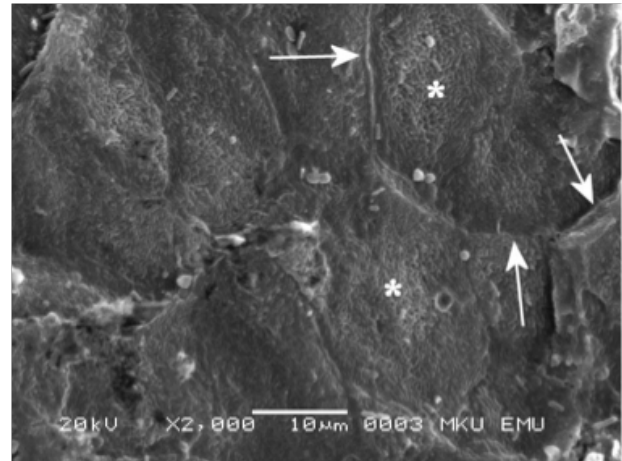


Figure 8. Lentiform papilla, the borders of the cells (arrow) and the micro-ridge patterns (asterisks).

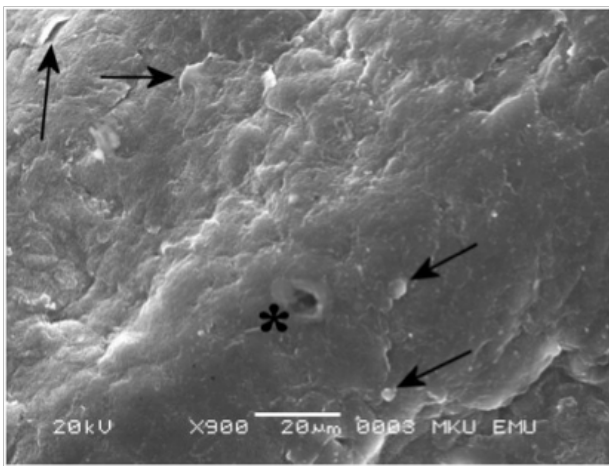


Figure 6. Fungiform papilla, squamous epithelial cells sheddings (arrows), gustatory bud por (asteriks).

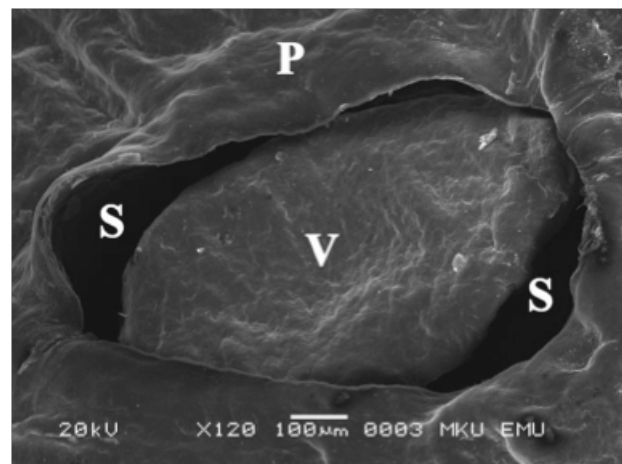


Figure 9. Papilla vallata (V); its sulcus (S) and pads (P).

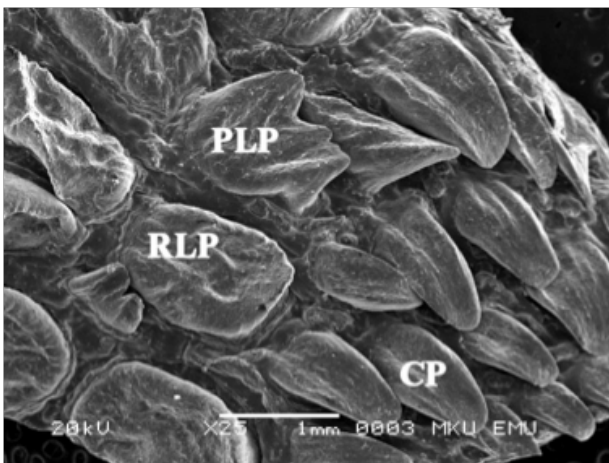


Figure 7. Pyramidal shaped type I lentiform papilla (PLP), round shape type II lentiform papilla (RLP), conical papilla (CP).

Some se-conder papillae have bifurcated tips too, unlike these studies (Chamorro et al 1986, De Paz Cabello et al 1988, Tadjalli and Pazhoomand 2004, Kurtul and Atalgin 2008). The height of the filiform papilla were about 360-540 µm. They seemed to have only one papillary projection at the free tip even though 2-3 sharp projections were reported in the

Jamunapari goat (Kumar et al 1998). Each filiform papillae had two main secondary papillae, emerging from the left and right side of the papilla but it was not found in other studies (Chamorro et al 1986, De Paz Cabello et al 1988, Kumar et al 1998, Tadjalli and Pazhoomand 2004, Kurtul and Atalgin 2008). Seconder papillas had 3-4 small seconder papillae. This was different from the other articles (Agungpriyono et al 1995, Kumar et al 1998, Kurtul and Atalgin 2008). The seconder papillae form a mildly rough surface, which enables careful mastication and handling of food before swallowing.

The basal part emerged from a flat base in the lingual mucosa but not in Jamunapari goats (Kumar et al 1998). The small filiform papillae were showed on the ventro - lateral surface of the lingua were much less dense, had a distinct basal groove, and possessed no secondary papilla at the near and base.

The fungiform papillae showed in this study parallel to those documented in the cow (Chamorro et al 1986, De Paz Cabello et al 1988), Jamunapari goat (Kumar et al 1998) and lamb (Tadjalli and Pazhoomand 2004). Parallel to the statement in



Jamunipari goat (Kumar et al 1998) there were fungiform papillae on the dorsal surface of the lingua and pores were determined at x2700 also were observed x900 magnification in this study. These papillae were spreaded among the filiform papillae, and separated by a marked papillary groove. The stratified scales, which were reported to be present in lambs (Tadjalli and Pazhoomand 2004) were determined on the surface of the fungiform papillae in this study, even though they were not reported in the Jamunapari goat (Kumar et al 1998). The fungiform papillae were more densely distributed on the tip and ventral surface of the lingual apex in Japanese serow (Funato et al 1985), Formosan serow (Atoji et al 1998), blackbuck (Emura et al 1999), Barbary sheep (Emura et al 2000) and the papillae were smaller than that of the body. There were appearance of the Micro-pitted on fungiform papilla at x4500 magnifications. But it was not seen in other studies (Chamorro et al 1986, De Paz Cabello et al 1988, Kumar et al 1998, Tadjalli and Pazhoomand 2004, Kurtul and Atalgın 2008).

The lentiform papillae were located on the dorsal aspect of the lingua as reported in the cow (Scala et al 1993), Jamunapari goat (Kumar et al 1998), and lamb (Tadjalli and Pazhoomand 2004). There were two types of lentiform papillae. Similar to saanen goat (Kurtul and Atalgın 2008), first papilla named pyramidal shaped-I lentiform papilla, had one or two sharp tips, second papilla named round shaped type II lentiform papilla have surrounding annular groove. Micro-pitted image of papillae were found due to the keratinized cells. In human the non-keratinized oral mucosa seem to have surface microplication (Kullaa-Mikkonen and Sorvari 1985), while keratinized surface has a pitted appearance called micro-pits (Mc Millan 1979). On the Karacabey Merino sheep lingua the epithelium of the lentiform papillae, fungiform papilla and filiform papilla were keratinized (pitted). Because the upper surface of papillae, especially fungiform, lenticular papillae, lack the protection of seconder papillae and because that surface comes into contact with foods, epithelium comes keratinized as answer to the environmental stress.

Micro-pits systems, which were reported (Mc Millan 1979, Kullaa-Mikkonen and Sorvari 1985, Kumar et al 1998) in the filiform and lentiform papillae, were determined on the surface of the lentiform papillae the borders of the cells and the micro-pitted patterns in this study at x2000 magnification. We also determined micro-pits on fungiform papilla at x4500 magnifications.

Morphostructure and location of the conical papillae were similar to those in the cow (Chamorro et al 1986), Jamunapari goat (Kumar et al 1998) and lamb (Tadjalli and Pazhoomand 2004). In this study we were not observed secondary papillae near the conical papilla as reported by the literature (Funato et al 1985, Erdunchaolu et al 2001, Dyce et al 2004).

The vallata papillae had surrounding thick annular fold and our findings similar to literature cow (Chamorro et al 1986), Jamunapari goat (Kumar et al 1998), lamb (Tadjalli and Pazhoomand 2004) and wild pig (Ates et al 2013). It is well known that the number and spread of the vallate papillae varied between species from entirely absent, as in single in mouse, rat and hamster (Iwasaki 2002) to numerous as in ruminants (Chamorro et al 1986, Scala et al 1993, Kumar et al 1998, Tadjalli and Pazhoomand 2004, Kurtul and Atalgın 2008).

Conclusion

Results of this study indicated that Karacabey Merino sheeps linguae are equipped with lots of papillae with different morphologic features. These linguae has mechanical function which similar to different kinds of small ruminants.

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