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Electron Microscopic Examination of Anatomical Structure of Tongue Papillae in Turkish Grey^{**}

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Abstract: This study was carried out to determine the surface of the papillae in the dorsal and lateral parts of the tongue surface and the features in the non-papillary parts of Turkish Grey. In the study, 7 male Turkish Grey tongues were used. Materials obtained from the apex, corpus and radix lingua of the upper (dorsal) side of the tongue were taken for scanning electron microscopic examinations. The routine procedure was applied for scanning electron microscopic images. In the study, the presence of large ruminant tongue papillae, papilla filiformis, papilla fungiformis, papilla conica, papilla lentiformis and papilla vallata, was observed. It was determined that the root part of Papilla filiformes had a depression in the form of a ditch. It was observed that the papilla filiformis at the tip of the tongue had very few secondary papillae. Papilla filiformis in the corpus lingua was found to have 2-4 secondary papillae. On the surface of the papilla fungiformis, cell borders were seen at 2000 magnification, taste pores were detected, and the microridge structure was clearly detected at 10000 magnification. A weak annular pad was seen in the papilla vallata. Cell borders were seen at 2500 magnification on surface images. Taste pores were detected at 5000 magnification. In this study, the tongue papillae of Turkish grey, which is very few in Turkey and resistant to harsh conditions, were examined, and it was aimed to contribute and own the missing literature about tongue papillae.

Keywords: Papilla, scanning electron microscopy, tongue, Turkish Grey

Boz İrk Sığırlarda Dil Papillalarının Anatomik Yapısının Elektron Mikroskopik İncelenmesi

Öz: Bu çalışma, boz ırk sığırdaki dil yüzeyinin dorsal ve lateral kısımlarındaki papillaların yüzeyinin ve papillasız kısımlardaki özelliklerin belirlenmesi amacıyla yapılmıştır. Çalışmada, 7 adet erkek Boz İrk sığır dili kullanılmıştır. Dilin üst (dorsal) tarafındaki apeks, korpus ve radiks lingua'dan elde edilen materyaller taramalı elektron mikroskopik incelemeler için alındı. Taramalı elektron mikroskopik görüntüler için rutin prosedür uygulandı. Yapılan çalışmada büyük ruminant dil papillalarından, papilla filiformis, papilla fungiformis, papilla conica, papilla lentiformis ve papilla vallata'nın varlığı gözlemlendi. Papilla filiformes'lerin kök kısmının hendek şeklinde bir çöküntüye sahip olduğu saptandı. Dilin uç kısmındaki papilla filiformis'lerin çok az sekonder papillaya sahip olduğu görüldü. Corpus lingua'daki papilla filiformis'lerin ise 2-4 arası sekonder papilla'ya sahip olduğu saptandı. Papilla fungiformis yüzeyinde 2000 büyütmede hücre sınırları görüldü, tat porları saptandı, 10000 büyütmede ise mikroridge yapısı çok net saptandı. Papilla vallata'da zayıf bir annular pad görüldü. Yüzey görüntülerinde 2500'lük büyütmede hücre sınırları görüldü 5000'lük büyütmede tat porları saptandı. Çalışmamızda zor şartlara dayanıklı, ülkemizde sayısı çok az olan bu ırkın dil papillaları incelenmiş olup, dil papillaları hakkında eksik olan literatüre katkı sağlanması, bu türün gündeme gelmesi ve sahiplenmesi hedeflenmiştir.

Anahtar kelimeler: Boz İrk, dil, papilla, taramalı elektron mikroskop

Introduction

The tongue plays a vital role in nutrition, along with other organs in the oral cavity. In all mammalian species, structural differences in language reflect differences in food sources and the specific habitat of each species. Therefore, the morphological and histological features of the tongue in mammals are indicative of the differences between mammalian lifestyles (Iwasaki, 2002).

In vertebrates, the mucosa of the tongue consists of various papillary systems that perform taste and mechanical functions, and the tongue is covered with multilayered keratinized epithelium (Tadjalli and Pazhoomand, 2004; Kurtul and Atalgın, 2008). Most of the tongue is covered with various papillae concentrated mainly on the dorsal surface, which arise in connection with local modifications of the mucosa and perform mechanical or taste functions. The scattering, volume, number and shape of the papillae differ in each species (König and Liebich, 2015). It has been reported that functionally, some primary and secondary papillae can assist in the transport of food and liquid from the periphery of the tongue to the center and then towards the pharynx (Ojima,

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2001).

Papilla filiformis, which provides a relatively suitable surface for the movement and crushing of nutrients in the mouth towards the esophagus, were detected on the dorsal surface of the tongue, especially in the apex and corpus lingua. It has been reported that the papilla filiformis has significant variations in shape and size in different animals.

Turkish Grey cattle breed, consisting of *Bos taurus primigenus*, is the native breed of Anatolia and Thrace. Turkish Grey cattle, also called steppe and Plevan cattle, are called Anatolian Grey or Turkish Grey in the international literature. In Türkiye, there is a spreading region that starts from Sivrihisar and covers the Aegean and Marmara sides (Alpan and Aksoy, 2012).

Turkish Grey cattle are breeds that can survive in strong living conditions and are relatively resistant to diseases and microorganisms compared to different species. They have the ability to survive without human assistance. In the winter months, except for the very cold periods of the weather, they continue outside in the form of free communities for most of the year. Forages that are not of good quality can be evaluated much better than different breeds. The cost of breeders in the breeding of this species is almost zero (Kök, 1992).

Material and Methods

In the study, 7 adult male Turkish Grey cattle tongues obtained from the slaughterhouse were selected as material. Tongues taken from animals were initially washed with physiological saline. Fragments obtained from the apex, corpus and radix lingua of the upper (dorsal) side of the tongue were taken for scanning electron microscopic examinations. The tongue was fixed with formaldehyde. The samples were kept in 5% glutaraldehyde (0.13 M Sorensen phosphate buffer, pH 7.2) for 2 hours (+4 C refrigerator) for primary fixation. It was washed twice with 0.13 M Sorensen phosphate buffer for 30 min. For secondary fixation, it was incubated in 1% Osmium tetroxide (0.13 M Sorensen phosphate buffer, pH 7.2) for 1 hour (+4 C refrigerator). It was then soaked in HMDS (Hexamethyldisilazane) for 1 hour for drying. It was then left to dry at room temperature. It was covered with gold and viewed under a scanning electron microscope (EVO50, ZEISS, Germany). Since the materials are taken from the slaughterhouse, there is no need for an ethics committee document.

Nomina Anatomica Veterinaria (2017) is used for anatomical terms.

Results

The materials were found to have all the features of a

ruminant language. It was determined that the tongue consisted of apex lingua, corpus lingua and radix lingua. In the measurements, the average length of the tongue was 31.6 cm, the average anterior width was 7.4 cm, the average middle width was 8.3 cm, and the average posterior width was 9.3 cm. It was observed that there were two types of papillae on the tongue. It was observed that the first of these was mechanical papillae and the other was taste papillae. Mechanical papillae were determined as papilla filiformis, papilla lentiformis, papilla conica. Taste papillae were defined as papilla fungiformis and papilla vallata. Papilla foliata was not found.

Macroscopic findings

Papilla filiformis

It was observed that the papilla filiformis (Figure 1) started from the apex of the tongue and spread towards the trunk. An average of 70.5 papilla filiformis was counted in a 1 cm² section. It was determined that the free ends of the papilla filiformis were in the caudodorsal direction in the identified tongues. It was determined that especially the parts at the apex were longer in the first anterior 5 cm and decreased as they went posteriorly. It was determined that their length was minimized in the rostral parts of the fossa lingua (Figure 2) and at the tip of the apex lingua. Papilla filiformis was observed with abundant papilla fungiformis (Figure 1-4) in the ventrolateral part of the apex lingua. When the tongue was viewed from the ventral side, approximately 1 cm from the anterior margins of the tongue down, papilla filiformis and especially abundant papilla fungiformis were found. It was found that this part was separated by a sharp border with the ventral part of the tongue that had no papillae (Figure 5). It was found that the papilla filiformis at the tip of the apex lingua was considerably shortened and even macroscopically not observed (Figure 4). No papillae were observed macroscopically in the ventral part of the tongue (Figure 5).

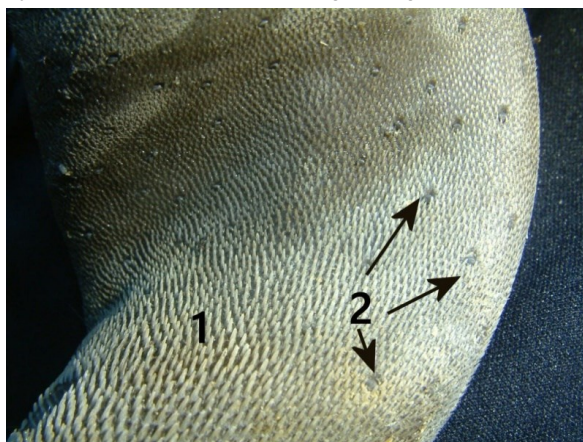


Figure 1. The appearance of the apex lingua in Turkish Grey cattle 1-Papilla filiformis, 2-Papilla fungiformis.

Papilla lentiformis

It was observed that the largest of the mechanical papillae was the papilla lentiformis. Papilla lentiformis (Figure 2-3); observed in the torus lingua in different ways. Papillae, which were not fully evident in the median line, were more prominent in the paramedian part. Papilla lentiformis on average, 223.5 were counted. It was observed that their sizes were different. It was found to be bordered by papilla conica and papilla fungiformis from the sides. They were found to be irregular in shape, pyramidal and round. That's why it was categorized into two different types. The first type was named as pyramidal shaped type 1 because it resembled a pyramid shape, while the other was called round shaped type 2 because it was round shaped.

Papilla conica

Papilla conica; It was observed in the caudal part of the torus lingua of the tongue, especially in the median line, near the radix lingua, and especially in the anterior lateral parts of the torus lingua (Figure 2). On average, 276 papillae were counted. No papilla conica was recorded on the dorsal surface of the corpus lingua. Papilla conicas, which are triangular, conical in shape and relatively thin and small compared to those on the cheek, were found in small amounts in the parts of the torus lingua close to the radix lingua (Figure 2) and in the lateral parts. It was observed that they were of different sizes.

Papilla fungiformis

In the apex lingua, it was observed as mushroom-shaped scattered among abundant papilla filiformis. It was observed less in the median line and more in the lateral line. Papilla fungiformis was also observed in torus lingua. It was observed in the caudal part of the torus lingua, especially in the median line, between the papilla conicas. On the median line was not observed in the parts of the tongue close to the fossa lingua. Small type ones were found in the apex and corpus lingua, while large type ones were found in the torus lingua. It was observed that there was not a complete equality in numbers between the right and left parts of the language. On average, 114.5 papillae on the right and 130.5 on the left were observed. It was determined that there were approximately equal numbers in terms of localization and number only in the part of the fossa close to the tongue. It was detected very rarely in the lateral part of the tongue.

Papilla vallata

Papilla vallata (Figure 2) was detected in the lateral parts behind the torus lingua. It was observed in different sizes. Different numbers of papillae vallata were detected on the right and left sides of the tongue. On average, 20 papillae were counted on the

right and 26 on the left. It was observed that the papilla vallata started from the lateral parts after the papilla lentiformis and progressed towards the caudale.

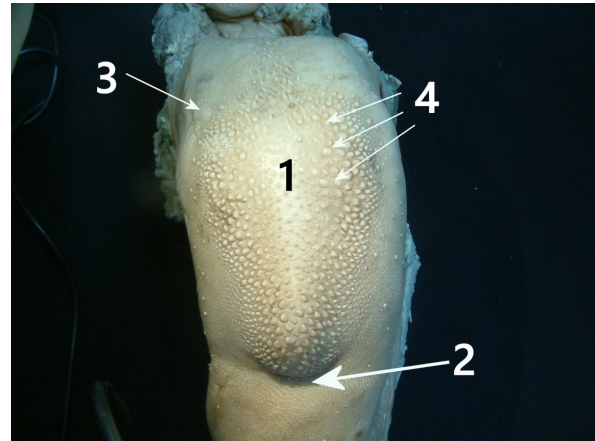


Figure 2. Appearance of the torus lingua of the tongue in Turkish Grey cattle; 1-Torus lingua, 2-Fossa lingua, 3-Papilla vallata, 4-Papilla lentiformis.

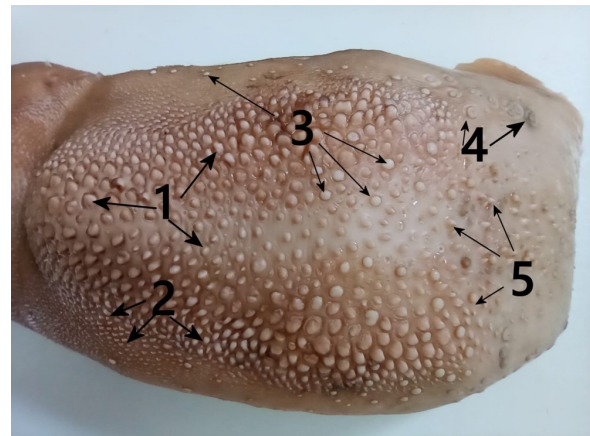


Figure 3. Appearance of papillae on the lingua torus of the tongue in Turkish Grey cattle, 1-Papilla lentiformis, 2-Papilla conica (in the lateral part of the torus lingua), 3-Papilla fungiformis, 4-Papilla vallata, 5-Papilla conica (in the caudal part of the torus lingua).

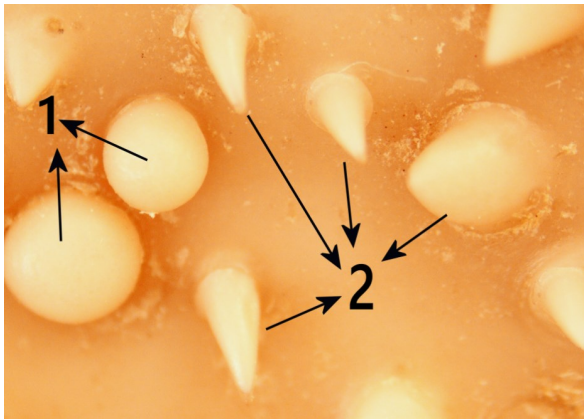


Figure 4. Stereomicroscopy view of some papillae on the torus linguae of the tongue in Turkish Grey cattle, Papilla filiformis was not seen. 1-Papilla fungiformis, 2-Papilla conica.

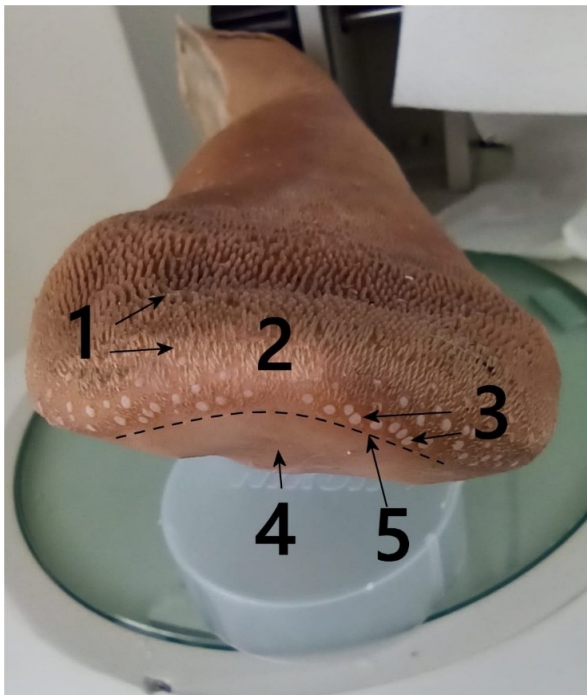


Figure 5. Appearance of papillae on the apex lingua of the tongue in Turkish Grey cattle; 1-Papilla filiformis, 2-Apex lingua, 3-Papilla fungiformis 4-Facies ventralis 5-The part where the tongue has no papillae on its ventral surface and where it is separated by a sharp border with the papillae.

Scanning electron microscopic findings

Papilla filiformis

It was found that the papilla filiformis, which can be seen easily, is quite long and wide in width (Figure 6). Their lengths were measured ranging from 1233 µm

to 1420 µm. When measured in the middle, its width was found to vary between 185 µm and 295 µm. It was determined that the apex of the papilla filiformis ended bluntly, not pointedly (Figure 6-7). Some apices were found to have an unsymmetrical termination as if they were cut unilaterally (Figure 6). A trench-like pit was found in the part where the papilla filiformis attaches to the tongue (Figure 8). It was determined that there were secondary papillae extending from the outer part of this pit towards the body of the papilla filiformis (Figure 8), these papillae were sometimes not seen at all, and some were only one or two. It was found that the width of the secondary papillae ranged from 33 µm to 45 µm when measured from the middle. Its length was determined to be between 86 µm and 115 µm.

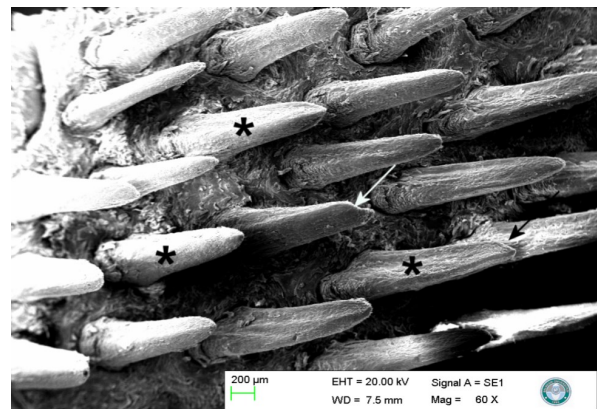


Figure 6. View of the dorsal side of the tongue in Turkish Grey cattle, x60. Asterisks; papilla filiformis, arrow; papilla filiformis with unsymmetrical apex endings.

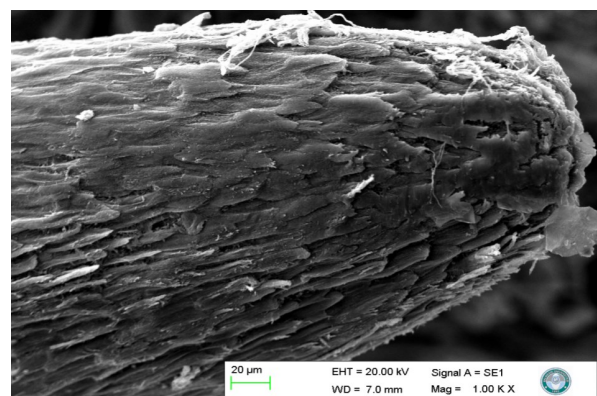


Figure 7. Papilla filiformis tip, x1000.

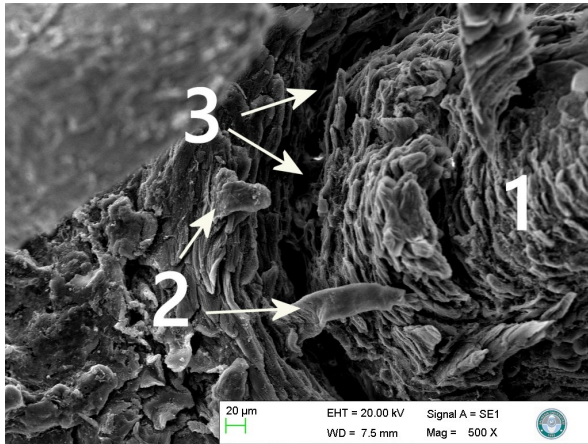


Figure 8. Root part of papilla filiformis x500; 1-Papilla filiformis; 2-Secondary papillae; 3-Trench at the root of papilla filiformis.

It was determined that the papilla filiformis in the middle part of the tongue was smaller than the papilla filiformis in the apex of the tongue. The tips of the papilla filiformis in this section were found to be pointed. It was determined that the length of the trunks of the papilla filiformis ranged from 112 µm to 177 µm. Papilla fungiformis, which provides the sense of taste of the tongue, was seen in this region (Figure 9). These papillae were surrounded by papilla filiformis, heterogeneous and sparsely observed.

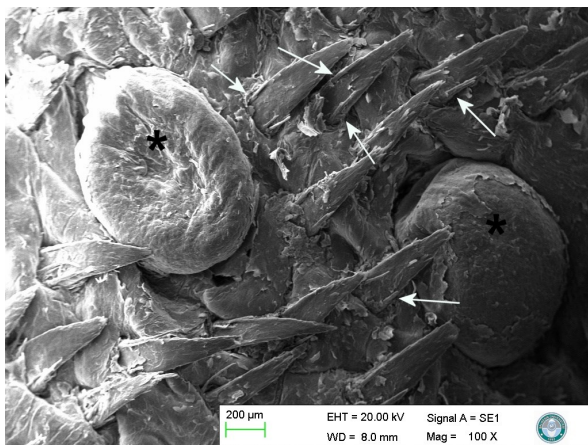


Figure 9. View of the dorsal side of the tongue in gray cattle. Asteriks: Papillafungiformis; Arrows: Secondary papillae of papilla filiformis. x100.

Papilla conica

Conical shaped, triangular shaped papillae conicas, which are relatively thin and small compared to those on the cheek, were found in small amounts in the parts of the torus close to the radix lingua (Figure 3) and in the lateral parts of the torus lingua. Very sparse and small papilla conicas were seen on the

lateral aspect of the torus lingua. The lengths of the sparse papilla conicas were measured to vary between 120 µm and 221 µm. It was observed that the width of these papillae in the middle part varied between 43 and 60 µm. It was observed that they were of different sizes. It was determined that these papillae did not have any secondary papillae or protrusion, and also did not have a ditch in the part where they were separated from the tongue. On the other hand, no taste pore was found in the surface enlargement (Figure 10).

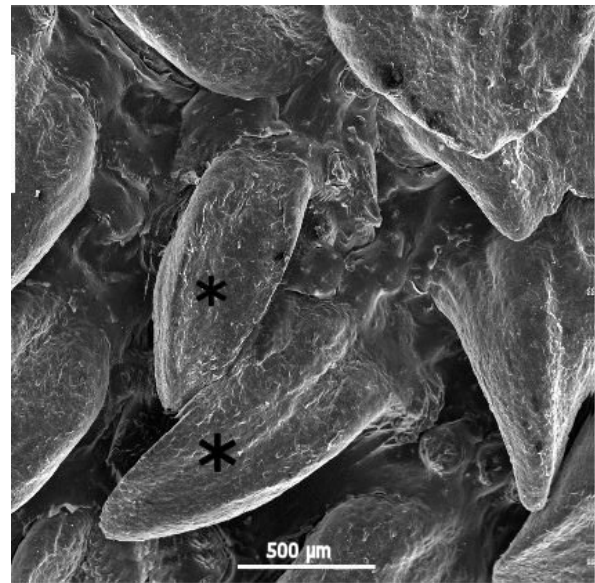


Figure 10. Electron microscopic view of papilla conica, Asteriks: Papillae conicae.

Papilla lentiformis

Papilla lentiformis (Figure 2, 3, 16) was observed in the torus lingua. They were observed to be irregular, round and pyramid-like. No taste pores, ditch or any other formation were found in the surface enlargements.

Papilla fungiformis

The papilla fungiformis was oval and round, and the outer surface was convex. Its diameter was found to be 852 µm on average. It was observed that it was scattered between the papilla filiformis in the anterior and body parts of the tongue. It was seen that there was a groove around it. The surface of the papilla fungiformis was examined. When looking at the surface of the papilla fungiformis at a magnification of 2000, the irregular cell borders were clearly observed (Figure 11). Cell borders were irregularly rectangular, pentagonal and hexagonal (Figure 11). Taste pores were seen at this magnification (Figure 11). The diameter of the taste pores was measured to be 2.3 µm

on average. In the same region, microridges were seen regularly at a magnification of 10000 (Figure 12).

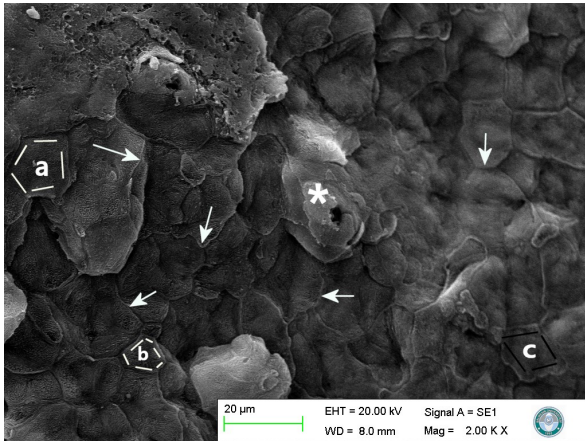


Figure 11. Electron microscopic view of papilla fungiformis, arrows; Cell borders, asterisk: Taste pore. x2000 a. Borders of pentagonal cell: b. Boundaries of the hexagonal cell: c. Borders of a quadrilateral cell.

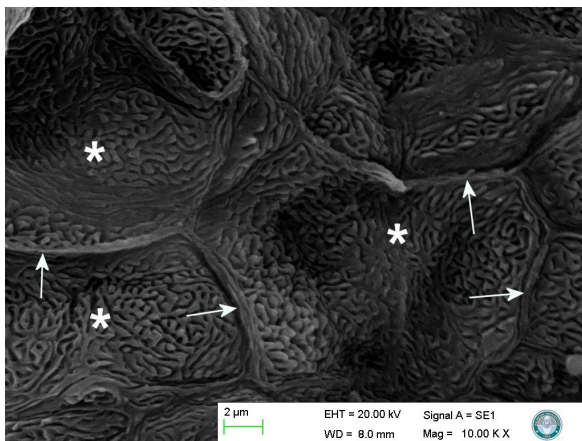


Figure 12. Electron microscopic view of papilla fungiformis; arrows: cell borders; asterisk: microridge. x10000.

Papilla vallata

Papilla vallata were visualized with an electron microscope. This papilla was found to be the largest type of papilla (Figure 13-16). A classic papilla vallata image was observed at 150 times magnification (Figure 13). Its diameter was found to be 879 µm on average. A weak anular pad was visible on the sides of the ditch, surrounding it. Cell borders were detected in 2500 images on the surface of the papilla (Figure 14). Taste pores were found at a magnification of 5000 (Figure 14). It was observed that the diameter of the taste pores was 1.8 µm on average. An average of 10 in the right section and 13 in the left were counted.

It was observed that the papilla vallata was slightly convex and had very sparse papillae in the lateral and caudal parts, and only papilla conica was found in the rostral part.

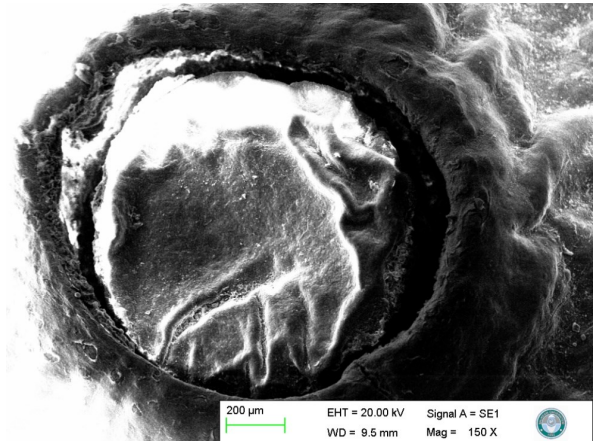


Figure 13. Electron microscopic view of papilla vallata. x150.

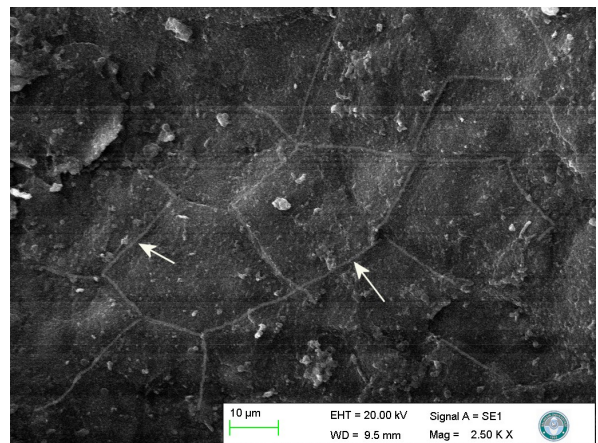


Figure 14. Electron microscopic image of the surface of papilla vallata. Arrows: cell borders, x2500.

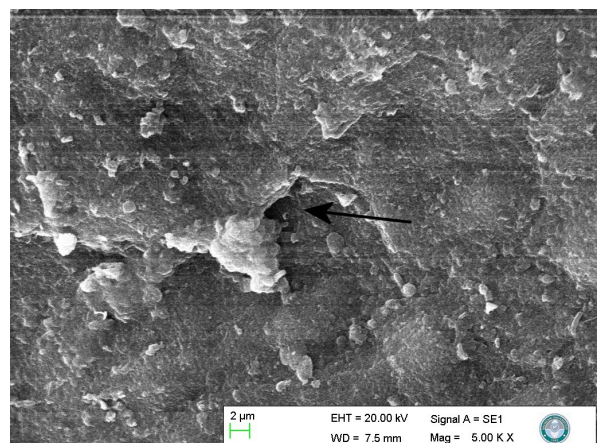


Figure 15. Electron microscopic image of the surface of papilla vallata. Arrow: taste pore, x5000.

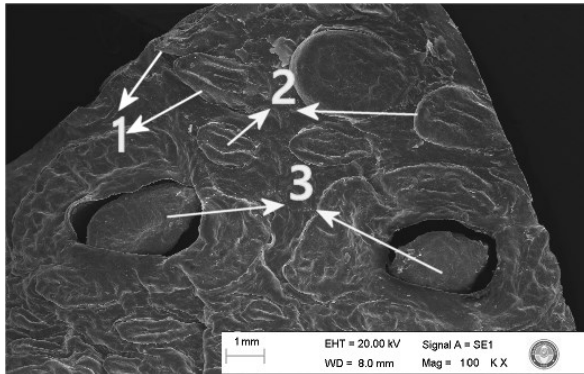


Figure 16. Electron microscopic view of papilla lenti-formis and papilla vallata. x10. 1-Papilla lentiformis (pyramidal shaped, type 1): 2- Papilla lentiformis (round shaped, type 2): 3-Papilla vallata.

Discussion and Conclusion

The most important differences of the ruminant tongue from the others are the anatomical features of the caudal part of the tongue. The fact that the formations on the torus lingua are different from the carnivores, sus and equidea is due to the different diet (Adnyane et al., 2010).

Jamunapari goat (Kumar et al., 1998), Saanen goat (Kurtul and Atalgin, 2008), Mehraban lamb (Tadjalli and Pazhoomand, 2004), Barbary sheep (Emura et al., 2000), and Buffalo (Scala et al., 1993) papilla filiformis is reported to be conical in shape, tongue-like in ox (De Paz Cabello et al., 1988), and rod-shaped in Chinese muntjac (Zheng and Kobayashi, 2006). In this study, papilla filiformis was found to be conical in Turkish Grey cattle.

It has been determined that the number of secondary papillae of papilla filiformis in the apex lingua is quite low. In studies, the number of protrusions, also called secondary papillae, at the free end of the papilla filiformis, in connection with the main body, is 3-6 in Jamunapari goat (Kumar et al., 1998), 6-9 in Saanen goat (Kurtul and Atalgin, 2008), Mehraban lamb has 4-8 (Tadjalli and Pazhoomand, 2004), Karacabey merino has two bases (Can et al., 2016), while dromedary camel (Quayyum et al., 1988) has an extension, Chinese muntjac (Zheng and Kobayashi, 2006), bighorn sheep (Takayuki et al., 2002) and goat antelope (Funato et al., 1985) have been reported to have two thin-long visual extensions attached to the main body. In the study conducted in Anatolian buffalo (Can et al., 2015) and dromedary camel (Quayyum et al., 1988), it was stated that secondary papilla was absent. In this study, it was found that the average number of two. In this respect, it was found to be similar to Chinese muntjac (Zheng and Kobayashi 2006), bighorn sheep (Takayuki et al., 2002), goat antelope (Funato et al., 1985) and Karacabey Merino (Can et al., 2016).

The difference in papilla filiformis sizes between Anatolian buffalo (Can et al., 2015) and Turkish Grey breed was remarkable. The papilla filiformis of the Anatolian buffalo varies between 780 and 920 µm in length and between 312 and 422 µm in width. In this study, it was determined that the lengths of the papilla filiformis ranged from 1233 µm to 1420 µm, while their widths ranged from 185 µm to 295 µm. In this respect, it was determined that Turkish Gray papilla filiformis were relatively long and thin compared to the papilla filiformis found in Anatolian buffalo (Can et al., 2015).

In this study, it was determined that the morphology of the papilla filiformis in Turkish Grey cattle was different in the apex and corpus regions of the tongue. In the apex lingua, it was determined that the body of the papillae was longer and easily recognizable, and the apex part of the papilla was conical in shape, some of them were cut on one side and the ends were not symmetrical. No such definition was found in the scanned articles.

It is reported that the papilla lentiformis, which is the largest of the mechanical papillae, provides complementary protection on the linguae surface (Tadjalli and Pazhoomand, 2004). Presence in many animals such as ox (De Paz Cabello et al., 1988), dwarf deer (Agungpriyono et al., 1995), Bactrian camel (Erdunchaolu et al., 2001), Saanen goat (Kurtul and Atalgin, 2008) which was emphasized to be absent, was found in torus lingua in Turkish Grey cattle (Emura et al., 1999), Berber sheep (Emura et al., 2000) and Formosan goat antelope (Takayuki et al., 2002).

In this study, two different forms of papillae, type 1 (pyramidal shaped papillae) and type 2 (round type papillae), belonging to the papilla lentiformis were detected in accordance with the Saanen goat (Kurtul and Atalgin, 2008). Kurtul (Kurtul and Atalgin, 2008) reported in his study that there were papillae with two ends. In this study, however, it was determined that the pyramidal shaped papillae had only one blunt end.

Although in one study (Scala et al., 1993) the presence of a special papilla called "laminari papillae" similar to it, in the torus lingua of buffalo, next to the papilla conicas was mentioned, such a papilla was not seen in this study.

Papilla conica, which was reported to be absent in camels (Quayyum et al., 1988), was found in Barbary sheep (Emura et al., 2000), Japanese goat antelope (Funato et al., 1985), arctic fox (Jackowiak et al., 2009) and land antelope (Emura et al., 1999), it was determined that it is located especially in the posterior part of the torus lingua, less frequently and in a small size on the radix lingua.

Kurtul and Atalgin, (2008) reported that the papilla conica was triangular in shape, without a taste pore on its surface, and had a distinct groove in goats, unlike this study. In this study, it was stated that the papilla conica did not have a secondary papilla, this finding is consistent with some studies (Kumar et al., 1998; Kurtul and Atalgin, 2008; Can et al., 2015).

Papilla conica is found in ruminants like as this study, because it is more resistant to mechanical effects during chewing, but in non-ruminant animals such as the Savanna monkey (Emura et al., 2002), and in ruminant dromedary camels (Quayyum et al., 1988) have been reported to have no papilla conica. Papilla fungiformis were observed in two types in gray cattle, consistent with Formosan goat antelope (Atoji et al., 1998; Takayuki et al., 2002) and Chinese muntjac (Zheng and Kobayashi, 2006). In this study, the small type was found in the apex and corpus lingua, while the large type was reported in the torus lingua. It has been reported in some studies that the surface of the papilla is limited by many different directional grooves (Kumar and Bate, 2004; Nonaka et al., 2008; Adnyane et al., 2010). In this study, however, this type of groove was not observed.

Taste pore was found in both types of papilla fungiformis in gray cattle, different from Akkaraman sheep (Harem et al., 2009) and Jamunapari goat. The findings of this study were found to be consistent with the view that taste buds were present in both types of papillae fungiformis in the Chinese muntjac (Zheng and Kobayashi, 2006).

The number of papillae of papillae vallata located on both sides along the posterior edge of the tongue differs according to the species. Thirty in Barbary sheep (Emura et al., 2000) and black antelope (Emura et al., 1999), 23 in Formosan goat antelope (Atoji et al., 1998; Takayuki et al., 2002), Japanese goat antelope (Funato et al., 1985) and Bighorn sheep (Takayuki et al., 2002), 20 papillae in Saanen goat (Kurtul and Atalgin, 2008) and 10-30 in deer (Adnyane et al., 2010). It was found that there were 23 of them. It has been reported that papilla vallata is absent in prairie rat (Cape Hyrax) (Emura, 2008).

Although it was observed that many papilla conica oriented towards papilla vallata in the savanna monkey (Emura et al., 2002), and the ditch there somewhat closed the gap, such a situation was not observed in this study.

In this study, the papilla surface was smooth, as in the Jamunapari goat (Kumar et al., 1998), ox (Chamorro et al., 1986) and dromedary (Quayyum et al., 1988). It has been reported that the annular pad located on the edge of the papilla vallata regulates the cleaning function of feed residues and saliva accumulated in the ditch with the help of smooth mus-

cles (Chamorro et al., 1986). The annular pad, which is well developed in ruminant species such as the ox (Chamorro et al., 1986), dromedary (Quayyum et al., 1988) and dromedary camel (Eerdunchaolu et al., 2001), has been found in the Formosan goat antelope (Atoji et al., 1998; Takayuki et al., 2002) are reported to be weakly shaped in some species. It was determined that the annular pad was weakly shaped in gray cattle. It has been reported that the annular pad is absent in horses (Chamorro et al., 1986).

In this study, the diameter of the papilla vallata was measured as 897 µm. Accordingly, it was determined to be smaller (1500 µm) than deer (Adnyane et al., 2010), which is one of the measured species.

Papilla foliata can be found in some animals such as pig (Kumar and Bate, 2004), raccoon dog (Emura et al., 2006), rabbit (Nonaka et al., 2008) and horse (Chamorro et al., 1986; Can and Atalgin, 2016) observed and not observed in this study.

In the study, papilla filiformis was found in the Jamunapari goat (Kumar et al., 1998), the ox (Chamorro et al., 1986), the Hellon lamb (Tadjalli and Pazhoomand, 2004) and the buffalo (Scala et al., 1993), papilla fungiformis, papilla conicae, papilla lentiformis, and papilla vallatae have been demonstrated. It shows that the differences and similarities between animal species, the anatomical conditions and characteristics of the papillae in the dorsal and lateral part of the tongue may depend on many factors.

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