



Morphological Features of Tongue in Domestic Cat *Felis catus*

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Abstract

The current study aimed to identify the morphological description of the domestic cat tongue; thus, for this purpose, five domestic cats were collected from the local markets of Baghdad city, and then the animals were anesthetized and the tongue was removed from them. Fresh tongue samples were fixed and the preserved samples were dyed with methyl blue. The results showed that the tongue is an elongated organ divided into three regions: a somewhat flat, rounded apex; this region contains a central depression called the middle groove. The second region, the lingual body region, represents the largest region of the tongue, whereas the last region, called the root, has a lingual prominence on its dorsal surface. In addition, the dorsal surface of the tongue is covered by five types of lingual papillae, the most common of which are filiform papillae that spread over the entire dorsal surface of the tongue, while the presence of cylindrical papillae is limited to a specific area of the lingual body close to the apex. Moreover, the fungiform papillae spread between the filiform papillae and gradually increase in size towards the lingual root, while the presence of circumvallate papillae is limited to the lingual root and its number is 5 papillae. Finally, the foliate papillae are located on both sides of the lingual root, while the ventral surface of the tongue is smooth without lingual papillae. The results of this study showed that the distribution pattern of the lingual papillae in the domestic cat differs from that of the rest of the mammal species.

Keywords: Morphological, Tongue, lingual papillae, Cat.

1. Introduction

The tongue represents one of the organs of the digestive system, and it not only plays an important role as an organ of taste and touch but also contributes to pronunciation and articulation as well as the transport of food [1]. There are many lingual papillae spread on the surface of the tongue, including the mechanical papillae and gustatory papillae. The mechanical papillae involve filiform and cylindrical papillae, while gustatory papillae include the fungiform, circumvallate, and foliate papillae, and each of these papillae has morphological characteristics and differs in its



shapes and distribution in relation to feeding pattern and behavior [2]. There are many published studies that include the morphological description of the tongue in many animals, for example, in the order of carnivora to which the domestic cat belongs, the subject of the current study. Interestingly, there are many studies on the tongue of the Asian black bear [3], the tongue of the lion [4], and the tongue of the tiger [5]; all these studies revealed the presence of many variations in the distribution of the lingual papillae on the dorsal surface of the tongue. Therefore, the purpose of this study is to examine the distribution pattern of the lingual papillae on the dorsal and ventral surfaces of the tongue in the domestic cat (*Felis Catus*).

2. Materials and Methods

Five domestic cats of both sexes were used in the current study, which were collected from the local markets of Baghdad governorate. These animals were anesthetized using chloroform first, then the mouth was opened and the lower jaw was removed from the upper in order to photograph the tongue in its location to describe its shape and the location of the frenulum. Then, the fresh tongues were removed from the animals and dried using filter paper, fixed with 10% formalin, and stained with methyl blue dye. The tongue was photographed to detect the distribution of lingual papillae on the dorsal and ventral surfaces [6].

3. Results

The results of the current study showed that the tongue in the domestic cat is an elongated, pale pink organ that is located at the lower jaw to settle at the bottom of the oral cavity, as it is connected to it by a long membranous fold called the frenulum (**Figures 1–2**). The tongue in the domestic cat is divided into three parts: its anterior part is rounded, called the apex; the middle part is called the body; and its posterior part represents the root zone. Each part of the tongue has four surfaces: a dorsal surface, a ventral surface, and two lateral surfaces, except for the root, which lacks a ventral surface (**Figure 2**). The apex area appears small and rounded and contains a depression at the center that divides the apex of the tongue into two equal halves; this depression is called the middle groove, while the body region represents the largest region of the tongue and is located between the apex and the root, while an altitude is observed in the middle part of the dorsal surface of the lingual root, representing an atrophied lingual prominence (**Figures 2, 3**). The ventral surface of the tongue in the domestic cat appeared smooth due to the absence of lingual papillae and Lyssa (**Figure 4**).

The dorsal surface of the tongue was very rough due to the fact that it contained five different types of lingual papillae: two mechanical papillae, including filiform and cylindrical papillae; and the rest are gustatory papillae, which include the fungiform, circumvallate, and foliate papillae. The entire dorsal surface of the tongue is covered with filiform papillae, which represent the most common type among the lingual papillae. This type of papillae is characterized by a broad base and a pointed and sharp apex pointing back towards the lingual root area. In general, these papillae are small in size at the apex, and their size increases towards the back as they appear larger at the center of each body and the lingual root (**Figures 5, 6**).



Figure 1. The tongue of cat showing Frenulum (F).

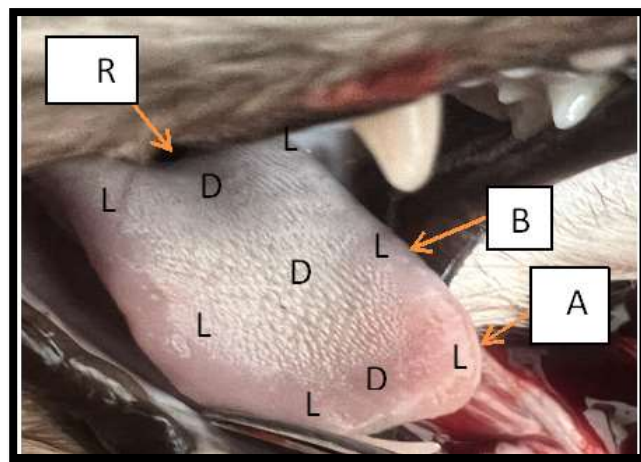


Figure 2. Regions of tongue in cat showing their surface: Apex (A), Body(B), Root(R). Lateral surface (L) & Dorsal surface (D).

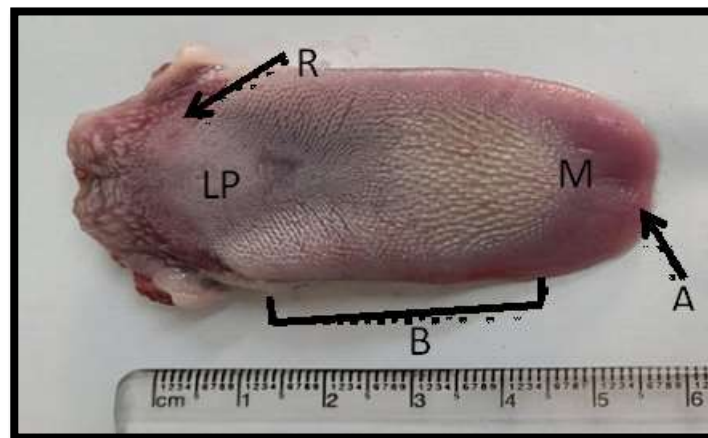


Figure 3. General morphology of tongue in cat Showing: Apex (A), Body (B), Root (R), Middle groove (M) & Lingual prominence (LP).



Figure 4. Ventral surface of tongue in cat showing.

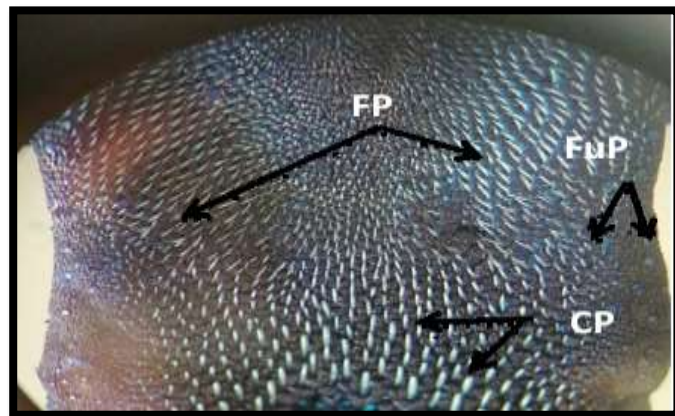


Figure 5. Dorsal surface of tongue in cat showing: Filiform papillae (FP), Cylindrical papillae (CP) & Fungiform papillae (FuP), Methyl Blue stain, 8X.

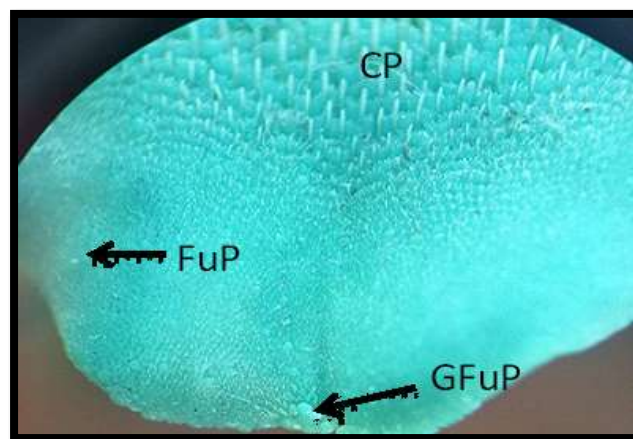


Figure 6. Dorsal surface of apex in tongue of cat showing: Cylindrical papillae (CP), Fungiform papillae (FuP) & Giant Fungiform papillae (GFuP), Methyl blue stain, 8X.

The cylindrical papillae take the form of a half-cylinder, and their presence is limited to a specific area of the lingual body, which is the area near the apex. In addition, they appear small in this area, gradually increase in size, and then return to getting smaller again on the side of the lingual root (**Figures 6, 5**). On the other hand, the fungiform papillae are distributed among the filiform papillae throughout the parts of the tongue; they have a rounded and flat apex and slightly

rise from the dorsal surface. They are small in size, aggregate at the apex, and gradually increase in size towards the lingual root (**Figures 5, 6, and 7**). The giant fungiform papillae are located at the central edge of the lingual apex, specifically at the beginning of the middle groove, giving a sesame-like appearance (6). The dissecting microscopic examination showed the presence of five circumvallate papillae at the lingual root, arranged in an inverted V shape. They represent the largest type among the types of papillae and the least in number, and they appeared recessed within a thick pad that encloses the trench surrounding the papilla from all directions (**Figures 8, 7**). The foliate papillae appeared in the form of a bunch of grapes located on either side of the lingual root and separated from each other by the taste groove (**Figure 9**).

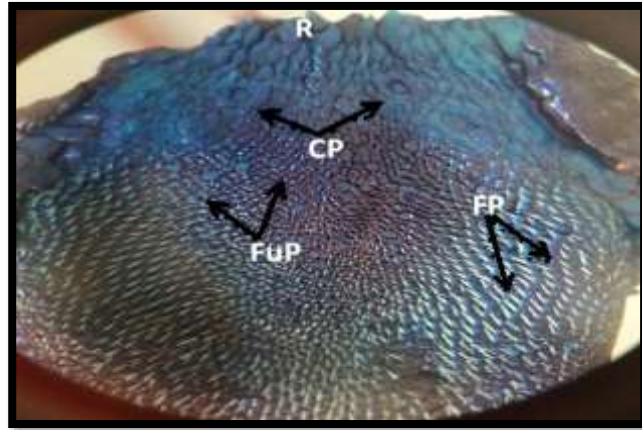


Figure 7. Dorsal surface of apex in tongue of cat showing: Cylindrical papillae (CP), Fungiform papillae (FuP) & Giant Fungiform papillae (GFuP), Methyl blue stain, 8X.

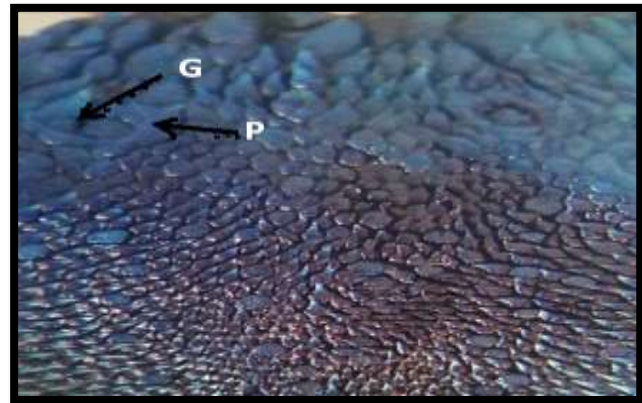


Figure 8. Dorsal surface of root in tongue of cat showing Circumvallate papillae structure (CP): Pad (P) & Groove (G), Methyl Blue, 15X.

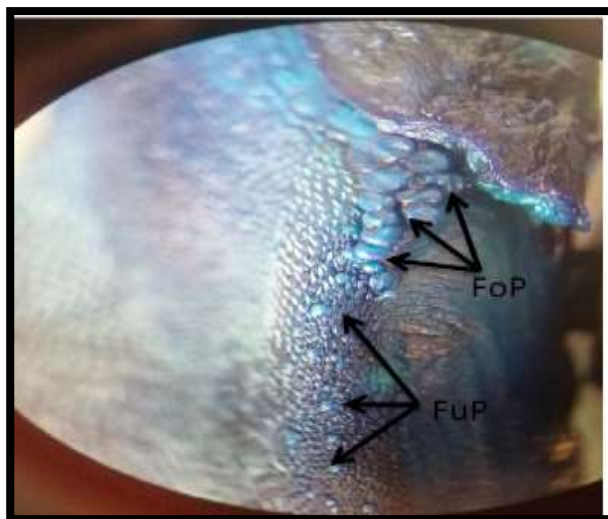


Figure 9. Lateral surface of tongue in cat showing: Foliate papillae(FoP)& Fungiform papillae(FuP),Methylene blue stain,6X.

4. Discussion

The tongue of the domestic cat, the subject of the current study, appeared as an elongated organ located at the lower jaw. On the ventral surface of the tongue, there is an elongated lingual membranous fold that makes the tongue touch the floor of the oral cavity and thus resembles most mammals [7], [8]. The results found that the tongue of the domestic cat is composed of three regions: the rounded apex, a broad lingual body, and a lingual root; this result is in agreement with previous studies [9], [10]. The apex appears to be rounded and contains a medial-central groove that separates it into two equal parts. This result is inconsistent with the findings of [11], who suggested that the middle groove in *Panthera tigris tigris* (Indian tiger) has a middle groove that extends from the apex of the tongue to the root. Furthermore, the current results do not agree with the study of [12], which found that the middle groove in the dog's tongue was shallow in the linear half of the tongue and deep in the caudal half, and perhaps this difference is related to the structural construction based on the requirements of the function and according to the feeding pattern. Additionally, several studies have indicated that the region of the lingual body contains a lingual protrusion on its dorsal surface [13], [14], and the findings of the current study are in agreement with the above study, where it was found that the tongue of the domestic cat has an atrophied lingual protrusion at the lingual root region while it is absent at the lingual body region. These results contradict the findings of [15] and [16] studies, which may be due to the fact that the function of this protrusion is to grind the food to facilitate chewing and then swallowing.

The ventral surface of the tongue in the domestic cat appeared smooth, had no lingual papillae, and did not contain Lyssa. This result is inconsistent with the findings of the [17] study on the Lyssa in the tongue of cats and dogs and also with the [18] study on predators. The reason may be due to the nature of cat food in the Iraqi environment, which is low in animal protein, while the dorsal surface of the tongue of the domestic cat appeared very rough due to the presence of different types of lingual papillae, and this result is consistent with the study [19] in the cat and the study [20] in the Nile fox (*Vulpes vulpes aegyptica*).

The filiform papillae were spread over the entire dorsal surface of the tongue in the domestic cat, which is the most common type; this result is in agreement with [25], [26], and [27] studies that detected the presence of filiform papillae on the entire dorsal surface of predators. This type of papillae is characterized by a broad base and a pointed and sharp apex, directed posteriorly toward the lingual root region. In general, these papillae are small at the apex, and their size and edges gradually increased in both the lingual body and lingual root as they appear larger at their centers. These results were consistent with studies [21] on the Bengal tiger (*Panthera tigris tigris*) and a study [22] on the lion (*Panthera leo*). In contrast, the [23] study indicated that the filiform papillae were lost on the posterior surface of the lion's tongue. The difference seems to suggest that the cat's tongue was specialized for predatory feeding, especially since some of these papillae were thin and curved back, which may be due to their mechanical function that depends on holding on to the pieces of food to prevent them from slipping out of the mouth and to be able to push them into the pharynx.

The cylindrical papillae appeared in the form of a semi-cylinder, and their presence was limited to a specific area of the lingual body close to the apex. They appeared small, gradually increased in size, and appeared small and then gradually increased in size and returned to a smaller size from the side of the lingual root. Many studies tend to consider the cylindrical papillae as one of the types of filiform papillae, as found in the study of [24] in the tongue of the Persian tiger (Persian leopard) (*Panthera pardus saxicolor*), whereas the results of the current study were in agreement with the findings of the [25] study, which showed that the cylindrical papillae in the leopard's tongue were larger in the lingual body; it seems that this difference in the distribution of cylindrical or conical papillae is compatible with their mechanical function. In contrast, the fungiform papillae of the domestic cat tongue overlap with the filiform papillae, and this is in agreement with many previous studies [23], [21], [24]. Moreover, it also agreed with the study of [26], which revealed that the fungiform papillae present in the lingual body are larger than those at the apex. While the results of this study were inconsistent with the findings of [27] and [22] studies, which reported that the fungiform papillae in the lingual body are smaller than those of the lingual apex, The results of the current study detected the presence of giant fungiform papillae located at the central edge of the lingual apex, and it seems that the presence of these papillae may compensate for the absence of the ventral surface of the lingual apex from the lingual papillae.

The domestic cat, the subject of the current study, has five circumvallate papillae whose existence is limited to the lingual root region. They appear to be the largest among other types of papillae and are recessed within a thick pad that encloses the trench surrounding the papilla from all directions.

The structure of the circumvallate papillae in the domestic cat is similar to that of the tiger, raccoon dog, and fox, according to several studies [28], [29]. Although other studies differed about the number of circumvallate papillae in mammals, in the study [5], the number was four in the tiger, five in the Californian Sea Lion [29], six in the Indian Civet Cat [26], and ten in the Tiger [28]. The study by [26] showed that the Bengali tiger tongue has two circumvallate papillae at the edge between the lingual body and the root of the tongue. The difference in the number of these papillae may be due to the function of this type of papillae, which is taste-related to the type and nature of food [30].

The foliate papillae of the domestic cat tongue were bunches of grapes shaped on either side of the lingual root area and separated by taste grooves. This result didn't match up with the study [26], which found that the Indian Civet Cat has two leafy papillae on the sides of its tongue at the level of the circumvallate papillae. It also didn't match up with the study [20], which found that the Nile Fox tongue (*Vulpes vulpes aegyptica*) has five to six papillae that are separated by oval grooves. While the study of [11] observed the absence of these papillae in the Indian tiger's (*Panthera tigris tigris*) tongue, it seems that the presence of these papillae from the absence and variation of their numbers is related to the feeding pattern and behavior of the animals.

5. Conclusions

The present study shows the structure and distribution of lingual papillae in domestic cats at the macroscopic level. It is considered that the findings of the present study may contribute to knowledge in the area of study.

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Conflict of Interest

There are no conflicts of interest.

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References

1. Colville, T.; Bassert, J. *Clinical anatomy and physiology for veterinary technician*. Mosby. Elsevier. 2nd ed. **2008**, 342.
2. Dyce, K.M.; Sack, W.O.; Wensing, C.J. *Textbook of veterinary Anatomy*. Philadelphia. London. New York, **2010**.
3. Emura, S.; Hayakawa, D.; Chen, H. & shoumra, S. Morphology of the dorsal lingual Papillae in the newborn Panther and Asian blackbear. *Okajimas Folia Anat. Jen.*, **2001**; 78, 173-178.
4. Emura, S.; Hayakawa, D.; Chen, H. & shoumra, S. Scanine electron microscopic and gross study on the linguall Surfacc of the lion *Panthera leo* (in Japan). *Mammalian Sci.*, **2003**; 43, 45-50.
5. Emura, S.; Hayakawa, D.; Chen, H.; shoumra, S. Morphology of lingual papillae in the tiger. *Okajimas Folia Anat. Jpn.*, **2004**; 81, 39-44.
6. Mohamed, A.A.M. Three-dimensional study of the lingual papillae and their connective tissue coresin the nile fox (*Vulpes vulpes aegyptica*). *Microscopy Res. Techn.*, **2021**; 84, 11, 2716-2726.
7. Poddar-Sarkar, M.; Raha, P.; Bhar, R.; Charaborty, A.; Brahmachary, R. Ultrastructure and lipid chemistry of specialized epidermal structure of Indian Porcupins and hedgehog. *Acta zoological*, **2011**; 92, 2, 134.
8. Ibrahim, M.K.; Al- Jumaily, I.S. Morphological study of the tongue in Mongoose (*Herprstes javanicus*). *Biochem. Cell. Arch.* **2020**, 20, 2, 5923-5923.

9. El-bably, S.; Tolba A.R. Morpho-metrical studies on the tongue (lingua) of the adult Egyptian domestic cat (*Felis domestica*). *Int. J. Vet.*, **2015**; 4, 2, 69-74.
10. El-Zayate, A.F.; Nawal, A.N. Macro morphological study on the tongue of the Red fox (*Vulpes vulpes*) with special Reference to its arterial supply. *Int. J. Vet. Sci.*, **2017**.
11. Sarma, M.; Devchouchaury, K.B.; Kalita, S.N.; Sarma, K.K.; Chakaborthy, A. Morphology of the tongue of Indian tiger (*Panther tigris tigris*). *Zoos. PRINT J.*, **2004**; 19, 10, 1669.
12. Chibuzo, G.A. *The tongue*. In: Evans, H.E. and G.C. christense (editors). Miller's anatomy of the dog, 2nd ed. W.B. Saunders Company, Philadelphia, **1979**.
13. Abumandour, M.M.A.; El-Bakary, R.M. Anatomic reference of morphological and scanning electron microscopic studies of the new land white rabbit tongue (*Oryctolagus cuniculus*) and their lingual adaptation for feeding habits. *J. Morphol. Sci.*, **2013**; 30, 4, 254-265.
14. Al-Mahmodi, A.M.M. Anatomical and histological study of the tongue of eild adult male rabbit (*Oryctolagus cuniculus F.domestica*) in Al-Najaf province. *Kufa. J. Vet. Med. Sci.*, **2016**; 7, 2, 79-94.
15. Mohammed, A.H.S.; Haider, S.K.; Salman, R.A. Morphological study of the lingual Papillae in the *Mellivora capensis* tongue. *J. Us-China Med. Sci.*, **2016**; 11, 1, 42-46.
16. Goodarzi, N.; Azarhoosh, M. Morphological study of the brandts hedgehog, *Parechinus hypomelas* tongue. *Vest. Zool.*, **2016**; 50, 5, 457-466.
17. Besoluke, K.; Eken, E.; Sur, E. Morphological studies on lyssa in cats and dogs. *Vet. Med.*, **2006**; 51, 10, 485-489.
18. Capellari, H.; Egerbacher M.; Helmreich, M.; Bock, P. Bau und Gewebekom ponenten der lyssa. *Wiener Tierarztliche Monatsschriften*, **2001**; 88, 197-202.
19. Sarma, K.M.; Bhattachary, M.; Charaborthy A. Anatomical studies of the tongue of sloth and Himalayan Blackbear. *Ind. J. Vet. Anat.*, **1994**; 6, 97-100.
20. Munki, K.; chong-Sup, K.; Gon-Sup, K.; chung-kil, W. Scanning electron microscopic observation of lingual Papillae in abengal tiger (*Panthera tigris tigris*). *J. Biochem. Transl. Res.*, **2014**, 3, 135-140.
21. Toprak, B.; Ulusoy, Y. Macroscopic and light microscopic structure of lingual Papillae on the tongue of young lion (*Panthera leo*). *Isr. J. Vet. Med.*; **2011**, 66, 3, 114-117.
22. Bharadwaj, R.; Rajput, L.; Sharma, D.N. Anatomical study on the tongue of the lion (*Felis leo*) with special reference to Papillae distribution. *Indian J. Vet. Anat.*, **2000**; 12, 1, 105-107.
23. Sadeghinezhad, J.; Sheibani, T.; Memarian, I.; Chiocchetti, R. Anatomical study on the tongue of the lion (*Felis leo*). *Ant. Histol. Embriol.*, **2017**; 46, 3, 240-248.
24. Emura, S.; Okumura, T.; Chen, H. Morphology of linguall papilla in the jaguar. *Okajimas Folia Anat. Jpn.*, **2013**; 89, 4, 93-97.
25. Sarma, K.; Sarma, M.; Kalita, S.N. Gross anatomical and biometrical studies on the tongue of an adult small Indian civet cat. *Isr. J. Vet. Med.*, **2009**; 64, 36-38.
26. Robinson, P.P.; winkles, P.A. Quantitative study of fungiform papillae and taste buds on the cat's tongue. *Anat. Rec.*, **1990**; 225, 108-111.
27. Emura, S.; Okumura, T.; Chen, H. & Shoumura, S. Morphology of the lingual papillae in the raccoon dog and fox. *Okajimas Folia Anat. Jpn*, **2006**; 83, 73-76.
28. Emura, S.; Okumura, T.; Chen, H. Morphology of the lingual papillae in the Japancs Marten. *Okajimas Folia Anat. Jpn.*, **2007**, 84, 77-82.
29. Yo Shimura, K.; shindo, J.; Kobayashi, K. Scanning electron microscopy study of the tongue and lingual papillae of the California. Sea lion (*Zalophus californianus californianus*). *Anat. Rec.*, **2002**, 267, 146-153.

30. Khan, A.M.; Ali, S.; Jameela, R.V.; Muhamood, M.; Haqh, M.F. (2019). Impact of fungiform papillae count on taste perception and different methods of taste assessment and their clinical applications: a comprehensive review. *Sultan Qaboos University Med. J.*, **2019**; *19*, 3, e184–e191.