



## Comparative Anatomical and Morphometrical Study of the tongue in local and Sherazi Adult Cats



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### Abstract

**T**HE anatomy of the local cat and the Sherazi cat has been studied in order to understand the various overall differences. These two types of cats, which can be known as (*Felis catus*), belong to the family of felines (*Felidae*) [1]. 10 samples were collected from the tongue of cats that were attracted to veterinary clinics, and they were divided into 5 samples for each type of cat. Our anatomical study has shown that the tongue is a muscular structure located inside the oral cavity and connected to the lower jaw by the lingual frenulum. The results also showed that the tongue is divided into three regions: apex, body, and root. The study also found the presence of four types of lingual papillae on the dorsal surface of the tongue (filiform, fungiform, foliate, and circumvallate papillae). The study also indicated that there is a difference in the relative weight between local cats and the Sherazi cat, and this diversity in weights is attributed to the environmental differences and diversity between the two breeds.

**Keywords:** Anatomical study, Cat, Sherazi cat, Tongue.

### Introduction

Cats, scientifically known as (*Felis catus*), belong to the family of felines (*Felidae*) and the genus of true cats (*Felis*), a family that includes many small species of felines such as the leopard, the small African lion, and the feline [1], [2]. In addition, the cat (*Felis catus*) is the only domesticated animal from the feline family, and it is often referred to as the domestic cat to distinguish it from the rest of its family of wild cats [3]. Cats are similar in anatomy to other types of felines. They have a strong, flexible body, sharp teeth, and retractable claws adapted to killing small prey. They have the ability to see at night and have a well-developed sense of smell [4]. Comparative studies of living organisms are considered one of the most important scientific foundations for understanding biological and evolutionary diversity and physical structure. Among these organisms are cats, as the cat's tongue is considered an important part of the physical structure, which performs multiple functions related to tasting, communicating with each other, eating food, and reducing body temperature [5], [6]. The tongue exists as a muscular structure within the oral

cavity, connected to the lower jaw via the lingual frenulum. The dorsal and lateral surface of the tongue is also characterized by the presence of small protrusions known as "prongs", which facilitate the process of eating and drinking, as well as cleaning the fur and removing dirt from it [7]. The researchers [8] also mentioned that the tongue of cats uses to clean their fur thanks to the small, rough, curved spines it contains called lingual papillae. There are four types of lingual papillae on the dorsal surface of most mammalian tongues, (filiform, fungiform, foliate, circumvallate) and has two main functions: gustatory and mechanical. The gustatory papillae carry taste buds and pores, while the Mechanical papillae have several roles that include surface protection, pre-chewing of food, and swallowing [9]. This study aimed to analyze the shape and standard distribution of the tongue and lingual papillae in adult domestic and Persian cats, while calculating the diameter and height of different types of papillae. This aims to understand the differences and similarities in tongue structure between the two species and their impact on the functions of cats.

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(Received 16 May 2024, accepted 19 July 2024)

DOI: 10.21608/EJVS.2024.290162.2092

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## **Material and Methods**

### **Samples preparation:**

The following devices were used in the study: an anatomical microscope camera type (Omax) made in (China), a two-lens anatomical microscope (Human Scope Stereo) made in (Germany), and a sensitive balance type (EK - I - EW - I) made (Japan). Electronic vernier type (Electric-Nuiley) origin (China). As for chemicals, distilled water and 10% formalin were used.

### **Sample collection:**

(30) cats were collected in this study, and they were divided equally between two groups: a local cat group (15 samples) and an adult Sherazi cat group (15 samples), without regard to gender. The animals included in the study include cats that had been involved in accidents and whose recovery was challenging (Terminally ill animals), and that were brought to veterinary clinics, as shown in Fig. (1) and (2). Each study animal is weighed before being given a high dose of anesthetics to end its life (euthanasia). After the animal dies, the tongue is extracted by dissecting the oral cavity.

### **Anatomical study;**

- After the animal's death, the tongue is extracted directly and completely from its tip to the larynx area and is washed and cleaned of food residues and blood, if any, using physiological saline. After that, its weight is taken [10].
- A complete description of the tongue in terms of its shape and location in the oral cavity, as well as a description of the structures found on it (lingual papillae).
- The tongue is divided with imaginary lines into three main parts: (the apex of the free part, the body and the root), then the apex and the body are secondarily divided into two equal parts for the purpose of studying the distribution of papillae in these parts more precisely, as in Fig. (3) and (4).

\* The three parts of the tongue (the tip, the body, and the root) were determined based on certain constants, as follows:

- The tip of the tongue (the free part): represents the part located between the front of the tongue and the location of the tongue shape.
- The body of the tongue: represents the part located between the forms of the tongue to the end of the last papilla on both sides of the tongue.
- Root of the tongue: represents the part located between the end of the last papilla on both sides of the tongue to the opening of the larynx.

- The number of each type of papillae on the surface and edges of the tongue is calculated in a specific unit of measurement [11].
- The length of each part (apex, body and root) and the total length of the tongue are measured using a vernier.
- The width of each part (apex, body and root) of the tongue is measured using a vernier.
- The thickness of each part (apex, body and root) of the tongue is measured using a vernier.

## **Results**

### **The anatomical study**

The study showed that the average weight of an adult local cat was 5830 g, and the average weight of the tongue was 16.60 g, with a relative weight of 0.28%. For the Sherazi cat, its average weight was 4750 grams, and the average tongue weight was 13.69 grams, with the same percentage as in table (1).

### **The external appearance of the tongue:**

The results of our study of the external shape of the tongue of both the local cat and the adult Sherazi cat showed that it is a muscular organ that fills the oral cavity and is divided into apex, body, and root, and is connected to the lower jaw by means of the frenulum linguae, as shown in Fig. (5) and (6).

Our study showed that the front edge of the tip of the tongue of the local cat is wide and irregular (curvy), while the tip of the tongue of the Sherazi cat was circular in shape, smooth and thin, as in Fig. (7).

Our results showed that on the dorsal surface of the tip of the tongue in both study animals, two types of lingual papillae were spread on it, namely filiform papillae and fungiform papillae, as in Fig. (8), while the ventral surface of the tongue was devoid of any type of lingual papillae, as in Fig. (9).

Our study showed that the body of the tongue in both types of cats contains three types of papillae: filiform, fungiform and foliate papillae. It was noted that the filiform and fungiform papillae are densely spread on the dorsal and lateral surface of the anterior part of the tongue body, and there are no foliate papillae in this part. As for the second part of the body of the tongue, which is close to the root, the spread of filiform and fungiform papillae was observed on the dorsal and lateral surface of the body of the tongue. The presence of fungiform papillae was concentrated in the medial part of the dorsal surface of the tongue, while the presence of filiform and filiform papillae was observed in the posterior lateral part of the body. The tongue, as shown in Fig. (10).

Our study of the tongue root in both animals, the local cat and the Sherazi cat, showed that it contains filiform papillae spread entirely over the dorsal surface of the tongue root, while the circumvallate papillae were represented by (4) papillae located in the anterior part of the root in both animals, as shown in the Fig. (11).

- **Anatomical measurements of the tongue:**

Measurements of the tongue were taken in its three parts (apex, body, and root) in terms of length, thickness, and width, and in both animals, the local cat and the adult Sherazi cat, to note the differences in these parts between the two animals.

From Table No. (2) we note that there is a significant difference in the parts of the tongue between the local cat and the adult Sherazi cat with regard to the length and width of the tip of the tongue in favor of the local cat, while there was no significant difference regarding the thickness of the pieces at the tip of the tongue. Table No. (2) also showed that there were significant differences in measurements of length, width and thickness of the tongue root in favor of the Sherazi cat.

- **Lingual papillae:**

- **filiform papillae:**

Our current study showed the spread of filiform papillae on the dorsal surface of the tongue in its three parts, the apex, the body, and the root. These are flat, filiform-shaped structures whose numbers and density were low in the local cat, while they were long and thin and with high numbers and density in the Sherazi cat, as shown in Fig. (12).

- **Fungiform papillae:**

In the current study, the presence of fungal papillae was detected spread across the apex and body of the tongue in both the local cat and the Sherazi cat. The results showed that these papillae are circular in shape and resemble mushrooms, and vary in size depending on their location on the surface of the tongue. These papillae were dense in number and large in size in the local cat, while their density was less and smaller in size in the Sherazi cat, as shown in Fig. (13).

- **Foliate papillae:**

The results of our study revealed the presence of a single row of papery papillae in the posterolateral part of the body of the tongue, in the form of parallel longitudinal folds, and they were almost similar in size and number in both animals, the local cat and the Sherazi cat, as shown in Fig. (14).

- **Circumvallate papillae:**

Our study showed that the front part of the tongue root area in both types of cats, the local and the Sherazi, contains one row consisting of 4 cupped papillae, circular in shape and surrounded by a groove called the taste groove, and that their dorsal surface is at the same dorsal level as the tongue surface. It is surrounded in front and laterally by the foliate papillae, and surrounded by filiform papillae in all directions. They were larger in size in local cats than in Sherazi cats, as shown in Fig. (15).

### Discussion

The results of our study show that the local cat weighs on average higher than the Sherazi cat, with their weights reaching 5830 and 4750 grams, respectively. The results also showed that the tongue weight of the local cat is heavier than that of the Sherazi cat, with values of 16.60 and 13.69 grams, respectively. Despite this discrepancy, the relative weight of the tongue was similar between the two species, reaching 0.28%, which indicates a balance in the ratio of the tongue to the total weight of cats. This discrepancy in weights is attributed to genetic and environmental differences between the two breeds.

Through our current study of the tongues of the local cat and the Sherazi cat, we were able to identify that the tongue is a muscular organ that fills the oral cavity and is divided into three main parts: the apex, the body, and the root. Our study reached this result, which is consistent with what was reported in previous studies, such as the study of the Nile fox conducted by [12], as well as the study of the tongue of the adult Iraqi domestic cat conducted by [13], in addition to the study of the tongue of the Nile fox Published by [14].

Our study indicates that the tongue of the local cat has a broad, irregular anterior edge, while the tongue of the Sherazi cat is rounded and smooth. This difference is due to genetic and environmental factors, with the local cat adapting to diverse environmental and nutritional conditions, while the Sherazi cat's tongue reflects the genetic differences and functional needs of the species. These results represent agreement with the findings of previous studies, such as the study of the tongue of the Egyptian fruit bat conducted by [15], and the study of the tongue of the adult small Indian civet cat conducted by [16]. It is worth noting that The broad, flat top of the tongue in the local cat matches what was found in a study of the tongue of the silver fox (*Vulpes vulpes fulva*) conducted by [17].

The current study showed significant differences in tongue dimensions between the local cat and the adult Sherazi cat, where the tip of the tongue was larger for the local cat while the root dimensions were larger for the Sherazi cat. This variation reflects

each breed's adaptation to its environment and needs, with the local cat needing a larger, more complex tongue to adapt to changing conditions and diverse diets, while the Sherazi cat's needs can be less complex, which is reflected in the dimensions of its smaller, thinner tongue. This conclusion differs from some previous studies, such as the study of the tongue of the mongoose (*Mustela putorius furo*) conducted by [18] and the study of the tongue of the arctic fox (*Alopex lagopus*) conducted by [19], in which conclusions were reached Different with respect to tongue dimensions. This difference could be due to adaptations that enable cats to obtain food and interact with their environment differently.

Our current study has found that the tongue of the local cat and the Sherazi cat consists of four types of lingual papillae (filiform, fungiform, foliate, and circumvallate) in both animals. These papillae's are spread on the dorsal surface of the tongue, while they are absent on the ventral surface of the tongue. With these results, we agree with the researchers [20] in the tongue of the Persian tiger (*Panthera*), and [21] in the chimpanzee tongue. However, these results differ with the study [14], which indicated the presence of five types of lingual papillae in the tongue of the Nile fox (*Vulpes vulpes aegyptica*), and with a study [18] which indicated the presence of three types of papillae in the tongue of the ferret (*Mustela putorius furo*). This difference may be related to genetic and evolutionary differences between these organisms.

Our current study showed the spread of filiform papillae on the dorsal surface of the tongue in its three parts: the apex, the body, and the root. These filamentous structures are flat, and were high in number and density in the local cat, while they were long and thin, with lower numbers and density in the Sherazi cat. This difference is due to possible factors such as cats being fed coarser foods, needing greater tongue cleaning, and being exposed to more difficult conditions. Therefore, cats that need these processes intensively may need larger and denser papillae to assist in these processes. With these results we agree with [14] in the tongue of the Nile fox (*Vulpes vulpes aegyptica*), and [22] for adult jackals (*Canis mesomelas*).

In the current study, the presence of Fungiform papillae was detected spread across the apex and body of the tongue in both the local cat and the Sherazi cat. The results showed that these papillae are circular in shape and resemble mushrooms, varying in size depending on their location on the surface of the tongue. These papillae were dense in number and large in size in the local cat, while their density was less and smaller in size in the Sherazi cat. This is perhaps due to differences in nutrition and environmental conditions between the two

breeds. With these results, we agree with [14] regarding the tongue of the Nile fox (*Vulpes vulpes aegyptica*), and [23] regarding the tongue of the mongoose (*Herpestes javanicus*), and [24]. In the tongue of the Egyptian cat (*Felis domestica*).

The study discovered the presence of a single row of papillae in the posterior-lateral part of the body of the tongue, taking the form of parallel longitudinal folds. These papillae were approximately similar in size and number in the local cat and the Sherazi cat, indicating a similar function in sensing taste and assisting in digestive processes in both species. With these results, we agree with previous studies, such as the study conducted by [24] in the tongue of the Egyptian cat (*Felis domestica*). However, this finding differs with some other studies, such as the study by [23] in Mongoose (*Herpestes javanicus*), [25] on the tongue of a jungle dog (*Speothos venaticus*).

Our study showed that the root area of the tongue in cats, whether local or Sherazi, contains a single row of circumvallate papillae surrounded by a groove called the taste groove. The papillae in the local cat were larger than those in the Sherazi cat, and this difference in size may be due to factors such as genetics and feeding pattern, as these factors can affect the formation of tissue in the tongue, resulting in differences in the size of the papillae. These results differ with Both [23] in the tongue of the mongoose (*Herpestes javanicus*), where it was mentioned that there are 3 circumvallate papillae, and [20] in the tongue of the Persian tiger (*Panthera*), where it was mentioned that there are 6 circumvallate papillae, and this is attributed The variation in the number of cupped papillae in the tongues of felines is due to differences in feeding style and adaptation to the environment, as diversity in food and environmental pressures can lead to the development of diverse tongue structures for each species.

#### *Acknowledgment*

The author thanks the staff of Anatomy department - College of Veterinary Medicine, University of Mosul, for their assistance.

#### *Conflicts of interest*

None

#### *Funding statement*

Self-supported funding.

**TABLE 1.** Shows the average weights of the cats and the average weights of the tongue, as well as the relative weight and standard error for both the domestic cat and the adult Persian cat using the unit of measurement (g)

| Variable             | local Cats (n = 5)<br>M ± SEM | Sherazi Cats (n = 5)<br>M ± SEM |
|----------------------|-------------------------------|---------------------------------|
| Weight of Cat (g)    | 5830 ± 0.74 *                 | 4750 ± 0.12                     |
| Weight of Tongue (g) | 16.60 ± 0.31 *                | 13.69 ± 0.11                    |
| Relative Weight (%)  | 0.28 ± 0.23                   | 0.28 ± 0.27                     |

Arithmetic mean ± standard error M± SEM in both the local cat and the adult Sherazi cat.

(\*) indicates the presence of statistically significant differences at the significance level ( $P \leq 0.05$ ) between the domestic cat and the adult Persian cat.

The table above shows that there are significant differences in both body weight and tongue weight between the local cat and the Sherazi cat, and the largest difference is in favor of the local cat, while no significant difference was observed in the relative weight between both animals.

**TABLE 2.** Shows the rates of measurements of the parts of the tongue (length, width, and thickness) and the standard error between the local cat and the adult Sherazi cat using the unit of measurement, the millimeter (mm).

| Variable                   | Sherazi Cats (n=5)<br>M ± SEM | local Cats (n=5)<br>M ± SEM |
|----------------------------|-------------------------------|-----------------------------|
| Tongue Tip Length (mm)     | 16.47 ± 0.4                   | 19.48 ± 0.54 *              |
| Tongue Tip Width (mm)      | 18.42 ± 0.30                  | 20.33 ± 0.48 *              |
| Tongue Tip Thickness (mm)  | 6.84 ± 0.19                   | 6.14 ± 0.08                 |
| Tongue Body Length (mm)    | 22.72 ± 0.53                  | 21.49 ± 0.60                |
| Tongue Body Width (mm)     | 18.50 ± 0.32                  | 19.29 ± 0.31                |
| Tongue Body Thickness (mm) | 12.12 ± 0.41                  | 11.49 ± 0.23                |
| Tongue Root Length (mm)    | 14.73 ± 0.42 *                | 12.32 ± 0.17                |
| Tongue Root Width (mm)     | 18.43 ± 0.34 *                | 16.47 ± 0.23                |
| Tongue Root Thickness (mm) | 11.59 ± 30 *                  | 9.17 ± 0.21                 |

Arithmetic mean ± standard error M±SEM in both the domestic cat and the adult Persian cat.

(\*) indicates the presence of statistically significant differences at the level of significance ( $P \leq 0.05$ ) between the local cat and the adult Sherazi cat.

**Fig. 1.** Sherazi cats.



Fig. 2. Local cats.

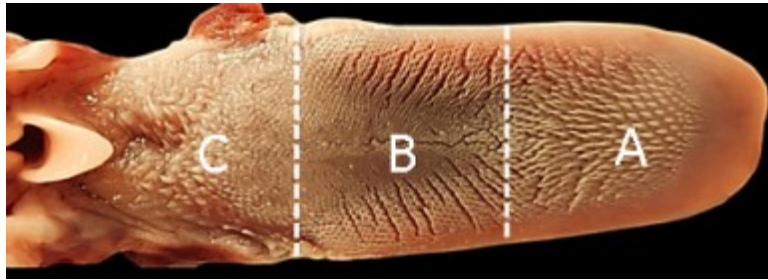


Fig. 3. (a) apex (free part), (b) body, (c) root

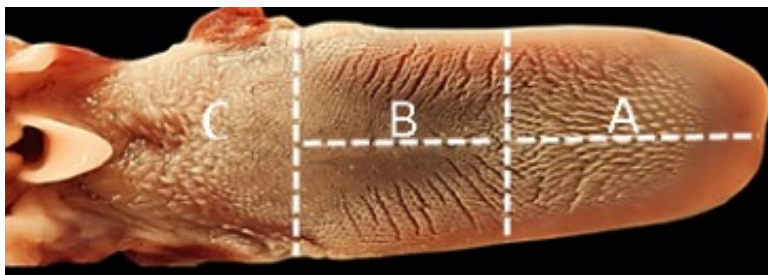


Fig. 4. (A) The apex (free part) is divided into two parts by an imaginary line, (B) The body is divided into two parts by an imaginary line, (C) The root

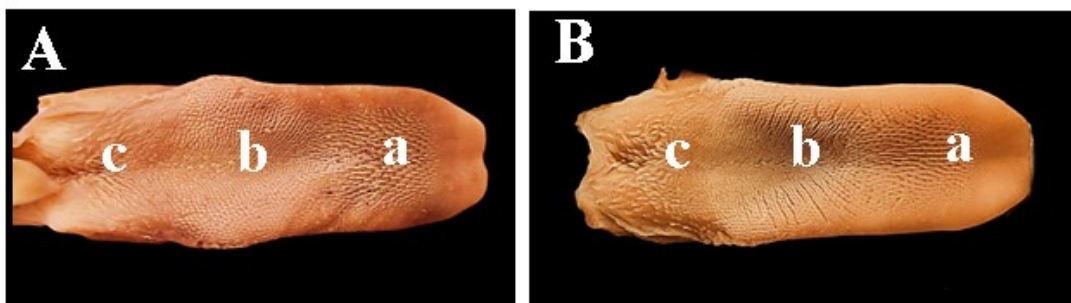


Fig. 5. A macroscopic anatomical image of the tongue, the local cat (A), and the Sherazi cat (B), showing the divisions of the tongue as the front of the tongue (a), the body of the tongue (b), and the root of the tongue (c).



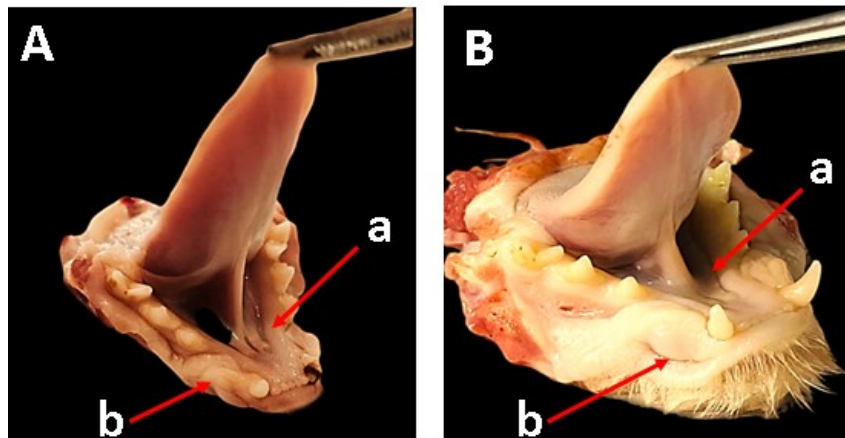


Fig. 6. A macroscopic anatomical image of the tongue showing the connection of the tongue to the lower jaw in the local cat (A), the Sherazi cat (B), where the shape of the tongue (a) represents the lower jaw (b).

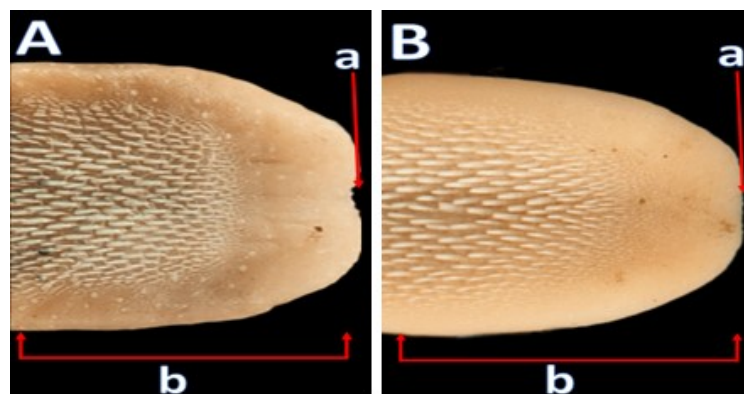


Fig. 7. A macroscopic anatomical image of the tip of the tongue showing the anterior edge of the tongue of the local cat (A), the Sherazi cat (B), where the edge of the tongue (a) and the tip of the tongue (b) are visible.

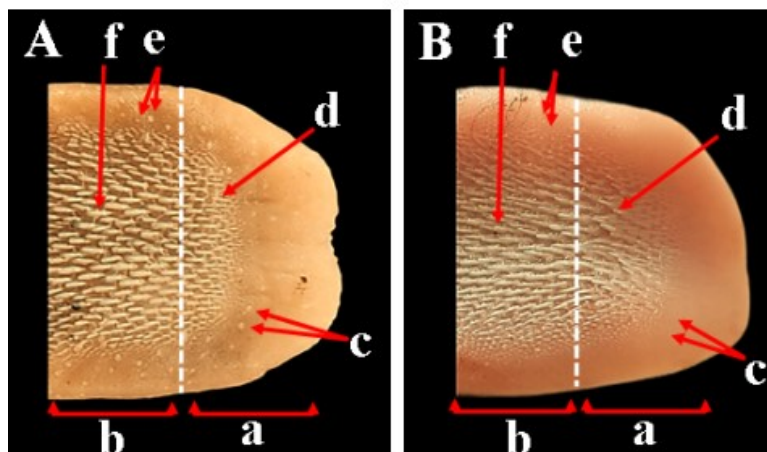


Fig. 8. Macroscopic anatomical image of the dorsal surface of the tip of the tongue, local cat (A), Sherazi cat (B), first part of the tip of the tongue (a), second part of the tip of the tongue (b) in both animals, fungiform papillae in the first part (c) in both animals, filiform papillae in the first part of the tip of the tongue (d) in both animals, fungiform papillae in the second part of the tip of the tongue (e), filiform papillae in the second part of the tip of the tongue (f).

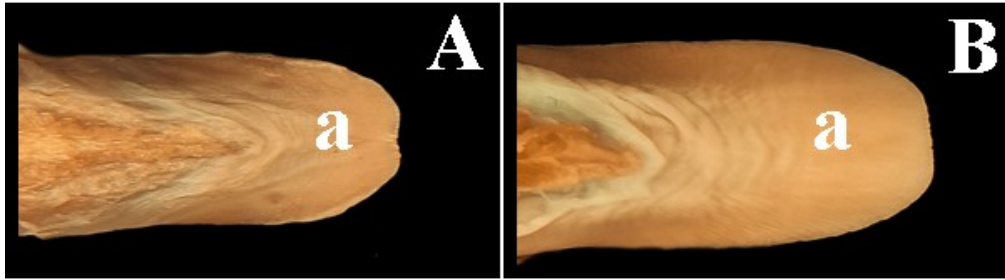


Fig. 9. A macroscopic anatomical image of the ventral surface of the free part of the tongue in a local cat (A), Sherazi cat (B), where the ventral surface of the tongue appears devoid of papillae (a).

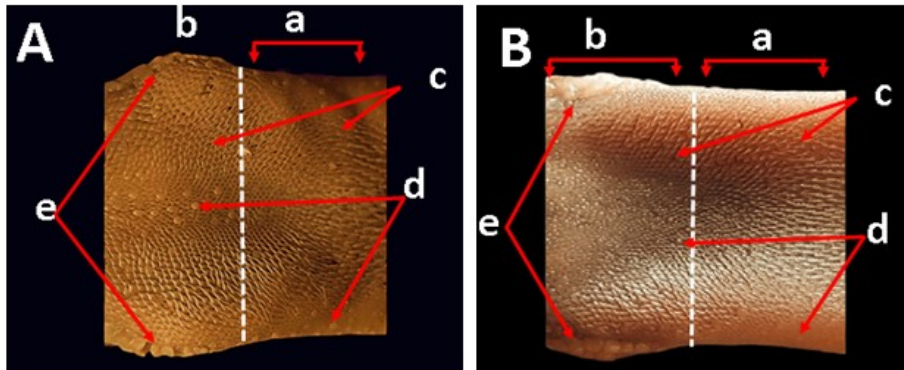


Fig. 10. Macroscopic anatomical image of the dorsal surface of the tongue body, the local cat (A) and the Sherazi cat (B), the first part of the tongue body (a), the second part of the tongue body (b), filiform papillae in both parts (c), fungiform papillae in both parts (d), foliate papillae in the lateral edge of the second part of the tongue (e).

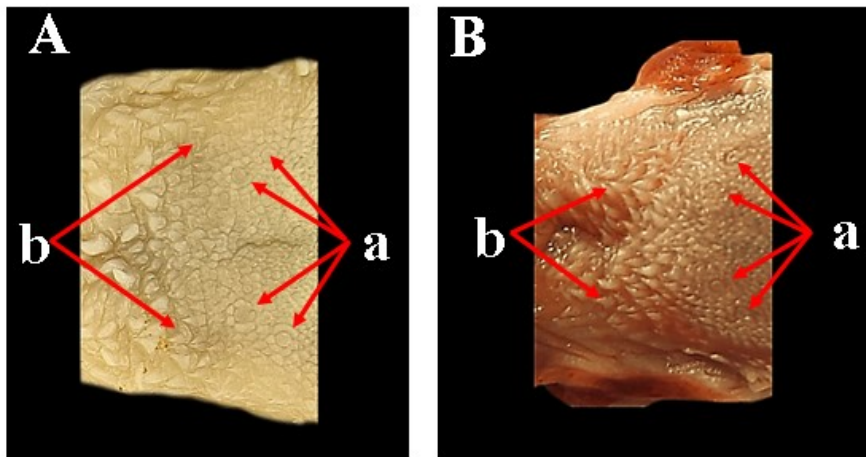


Fig. 11. Macroscopic anatomical image of the dorsal surface of the tongue root, local cat (A), Sherazi cat (B), showing circumvallate papillae (a), filiform papillae (b).

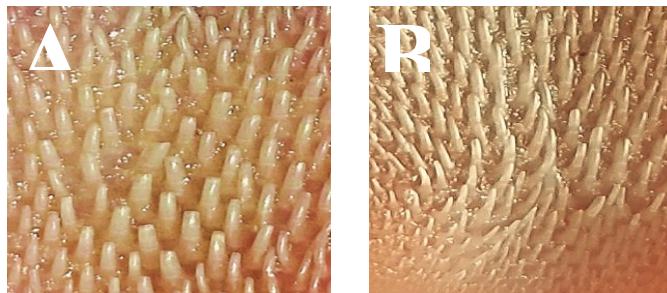
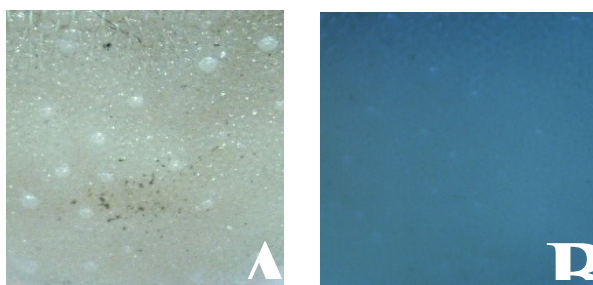
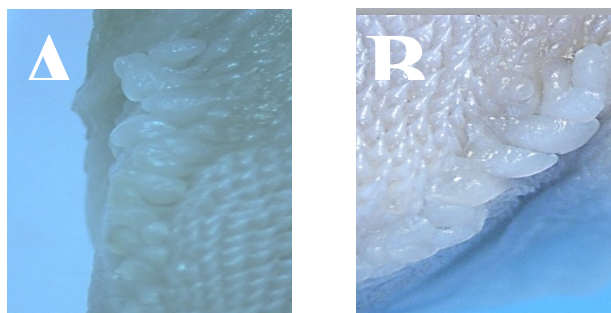


Fig. 12. Macroscopic anatomical image of the dorsal surface of the tongue showing filiform papillae, local cat (A), Sherazi cat (B).

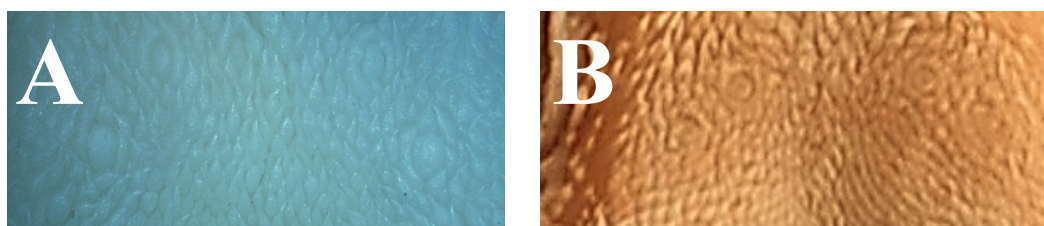




**Fig. 13. Macroscopic anatomical image of the dorsal surface of the tongue showing fungal papillae, local cat (A) and Sherazi cat (B).**



**Fig. 14. Macroscopic anatomical image of the dorsal surface of the back of the body of the tongue showing the papillae, local cat (A) and Sherazi cat (B).**



**Fig. 15. Macroscopic anatomical image of the dorsal surface of the anterior part of the tongue root showing the cassette papillae, the local cat (A) and the Sherazi cat (B).**

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## دراسة تشريحية وقياسية شكلية للسان القط المحلي والقط الشيرازي البالغ

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### الملخص

تمت دراسة تشريح القط المحلي والقط الشيرازي من أجل فهم الاختلافات الكلية المختلفة. وينتمي هذان النوعان من القطط التي يمكن أن تعرف باسم (القطط الشيرازي) إلى فصيلة السنوريات (السنوريات) [1]. تم جمع 10 عينات من السنة القطط التي تم جلبها إلى العيادات البيطرية، وتم تقسيمها إلى 5 عينات لكل نوع من القطط. وقد أظهرت دراستنا التشريحية أن اللسان عبارة عن هيكل عضلي يقع داخل تجويف الفم ويتصل بالفك السفلي بواسطة اللجام اللساني. كما أظهرت النتائج أن اللسان ينقسم إلى ثلاث مناطق: القمة، والجسم، والجذر. كما توصلت الدراسة إلى وجود أربعة أنواع من الحليمات اللسانية على السطح الظهري للسان (الحليمات الخيطية، والفطريات، والحليمات الورقية، والحليمات الحلقية المحيطة). كما أشارت الدراسة إلى وجود اختلاف في الوزن النسبي بين القطط المحلية والقط الشيرازي، ويعزى هذا التنوع في الأوزان إلى الاختلافات البينية والتنوع بين السلالتين.

الكلمات الدالة: دراسة تشريحية، القطط، القط الشيرازي، اللسان.