Archives of Razi Institute, Vol. 77, No. 1 (2022) 129-133

DOI: 10.22092/ARI.2021.356480.1851

Original Article

Anatomical Assessments for Grey Mongoose Tongue by Scanning Electron Microscope (*Herpestes edwardsii*) in Iraq

Mahmood, H. B[1 *], Obead, W. F[1], Al-Arubaye, N[2]

1. College of Veterinary Medical Sciences, Anatomy and Histology Department, University of Karbala, Karbala, Iraq
2. Al Safwa University College, Anatomy and Histology Department, Karbala, Iraq

Received 6 October 2021; Accepted 29 October 2021
Corresponding Author: hussein.mahmmod@uokerbala.edu.iq

Abstract

The grey mongoose is a mongoose species native to the West Asia and Indian subcontinent. It is listed as the Least Concern on the International Union for Conservation of Nature Red List. The main objective of this study was to identify the different categories of papillae found in the tongue of Iraqi grey mongoose to investigate the possible differences with other grey mongoose species. This study investigated the position and shape of the Iraqi grey mongoose tongue papillae. A total of six healthy grey mongooses were examined by Scanning Electron Microscope. The results revealed the existence of five different kinds of papillae on the dorsal surface of the tongue in grey mongooses that included 1) Filiform (sharp and cylindrical shape in the cranial and middle part of the tongue), 2) Multifilament (distributed in the cranial third and caudal part), 3) Circumvallate (positioned caudally in the cranial and rear regions of the tongue), 4) Conical (identified in the proximal to the circumvallate), and 5) Fungiform (located in the middle and caudal portions of the tongue). The present study highlights different shapes and distributions of all types of lingual papillae in the Iraqi grey mongoose.

Keywords: Electron Microscope, Grey Mongoose, Tongue

1. Introduction

Mongooses (Herpestidae) are tiny carnivores that may be found all around the world from Africa to South Asia (1). The species Herpestes comprises 10 species and is the oldest genus in the Carnivora order (2). The Eastern gray mongoose, also known as the ubiquitous grey mongoose, is a mongoose species found mostly in southern Asia. Rats, reptiles, hatchlings, and a diversity of invertebrates are also prey for this omnivorous scavenger (3). Significant anatomical variations exist in animal tongues, which appear to be connected to the type of food and the surrounding environment. Weaning, swallowing, water uptake, food manipulation, cleaning, voice quality, and suckling are all performed by the tongue. It also aids in the production of saliva and the taste of meals (4-6). Many papillae cover the dorsal mucosa, which plays a major role in food consumption and breakdown in many animals. Furthermore, different shapes and concentrations of papillae on the dorsal surface of the sea otter, silver fox mongoose, bush dog, dog, panther, and Asian black bear have been discovered (7). The physical variety of mammalian animals varies depending on their feeding preferences and living habitat (8, 9). Multiple filiform papillae found in carnivores were found along with the fungiform one that ran among them. In the rear part of the tongue, eight vallate papillae with faint circumferential crests were dispersed in a V shape, and many taste buds were visible in the circumferential grooves (10). The tongue, along with several other organs inside and bordering the mucous membranes, has a highly evolved papillary

structure with mechanical and gustatory capacities in animals (11). In tetrapods, it plays a vital role in feed intake functioning (12). The arrangement of papillae on the dorsum of mammalian tongues is an essential component of the tongue's physical features (13, 14). Circumvallate, fungiform, filiform, and foliate papillae are found in nearly all mammalian species; however, there are significant variances in the subtypes of filiform (15). The main objective of this study is to identify the different categories of papillae found in the tongue of Iraqi grey mongoose so that it may be differentiated from other species.

2. Materials and Methods

2.1. Animal and Tongue Sampling

Tongues from six adult grey mongooses were used in this study. The grey mongoose tongues were collected from dead animals found in orchards near Tigris Rivers. After dissecting the tongues, the specimens were mounted for 12 h in the buffer (pH 7.4) with 2% glutaraldehyde. They were then fixed for 2 h in 1% osmium tetroxide, dehydrated in ethanol, and invaded with amyl acetate.

2.2. Scanning Electron Microscope Procedure

The samples were inspected using the Scanning Electron Microscope (SEM) in the Faculty of Veterinary Medical Sciences, Karbala University, Karbala, Iran. The tissues of the tongues were washed twice using 0.1 M (pH 7.4) phosphate buffer solution and were then kept in 2.5% glutaraldehyde solution for two days. After that, the tissues were kept in 1% osmium tetroxide (OsO4) for 1 h. Subsequently, they were passed through a sequential series of a seton and dried using a critical point dryer. They were coated with gold using a Polaron SC7620 sputter coater, and finally, the images were taken using LEICA LEO 440 trade SEM at various magnifications.

3. Results and Discussion

Grossly, the tongue of the grey mongoose appears elongated with its apex pointed moderately. The width of the tongue's apex was significantly wider than the central section of the tongue, and it narrowed towards the back. Figure 1 illustrates that the caudal section of the lingual bulk and the tongue possess a narrow lingual flare. According to SEM analysis, the tongue of the grey mongoose contained five categories of papillae on the dorsum mucous membrane. The threadlike papillae (filiform) were situated and developed on the cranial section of the dorsal aspect in the tongue of the grey mongoose with a reduction in numbers on the caudal area. In the interior part, filiform appeared sharp in the apex and wider in a base with the average length of 103.74 µm, while they are cylindrical, elongated in form, and have varying diameters depending on the location, approximately 151.92 µm in the middle (Table 1). The filiform papillae were decreased in numbers and became shorter than other regions (Figures 2, 3). These results are in line with the findings of a study by Reginato, Bolina (16) who reported that the diameter of a rat's tongue varies depending on its location. The papillae in the cranial area have a rounded apex and are low-cone-shaped. The current study found the presence of dense multi-filamentary papillae distributed in the cranial third and caudal parts of the tongue. Each papilla had two or three conical with short branches, and the average diameter was 165.66 µm (Figure 4). This result is consistent partially with the findings of a study conducted by Reginato, Bolina (16) that showed multi-filamentary papillae (2-4) filaments in the mid and caudal areas.

Figure 1. Cross-section of the tongue in a grey mongoose

Table 1. Length and diameter types of papillae (µm)

Type papi	Filiform cylindrical	Filiform sharp	Multi-form	Circumvallate (Diameter)	Conical	Fungiform (Diameter)
Length of papi	103.74	151.92	165.66	137.17	125.39	120.64

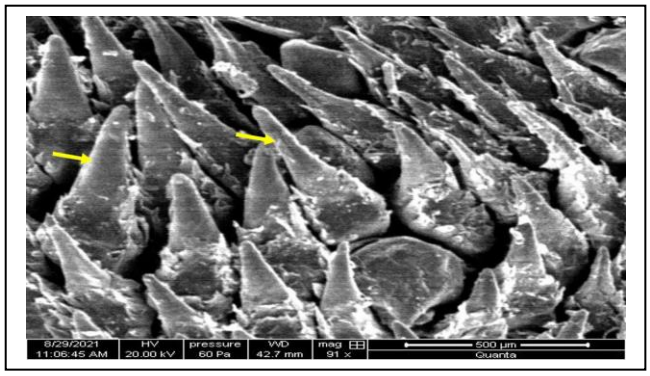

Figure 2. Tongue of the grey mongoose showing the sharp filiform papillae (yellow arrow)

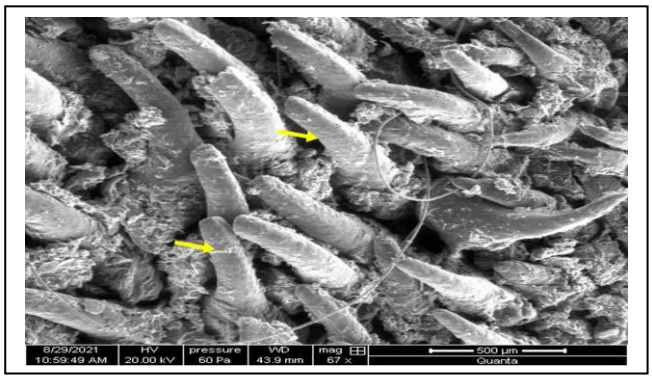

Figure 3. Tongue of the grey mongoose showing the cylindrical form of the filiform papillae (yellow arrow)

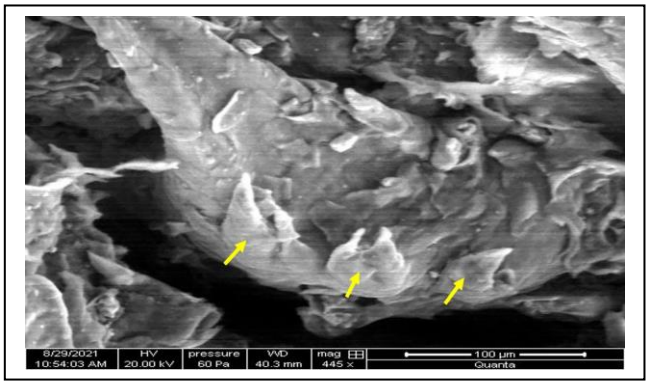

Figure 4. Tongue of the grey mongoose showing the multi-filamentary papillae (yellow arrow)

In grey mongoose, there are two types of circumvallate papillae, two of which are large and located caudally, and one is small that is arranged in a triangular line. These papillae are surrounded by a prominent annular pad and have a deep moat. The diameter of the circumvallate papillae was 137.17 µm (Figure 5). This finding is not consistent with the result of studies performed by Kobayashi (14) and Lima (17) that described the tongue in dogs had two types of papillae (four large and one small) which were arranged in two lines that diverged on each side of the midline. In the caudal part, the rabbits have two circumvallate types.

On the other hand, the number of the circumvallate type differed per species with four papillae observed near the base of the tongue in a study conducted by E. Barbara (18). The total of the circumvallate types in horses can range from 2 to 5 (19). In rodents, the multitude of circumvallate varies greatly, with one large papilla encircled by several tiny papillae in white lab rats (20), one circumvallate in wild-type rat tongues, three papillae in American beavers, and three circumvallate in flying squirrels (4, 21).

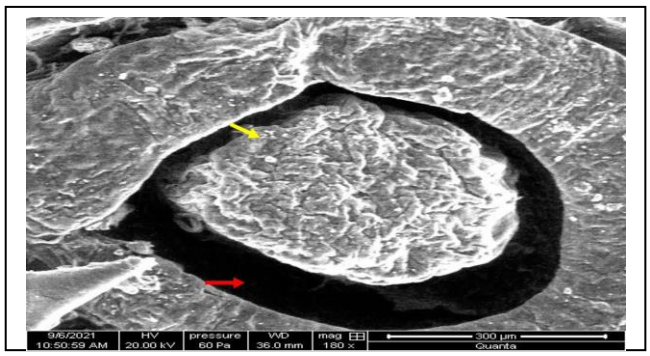

Figure 5. Tongue of the grey mongoose showing the circumvallate papillae (yellow arrow) and deep moat (red

According to the present study, the surface of the grey mongoose tongue had a lot of conical papillae distributed in two regions: at a lateral side of the cranial part of the tongue and caudally at the root of the tongue. The conical papillae in the caudal region are sharp and directed caudally toward the pharynx. The length of these types was 125.39 µm (Figure 6). The conical papillae were identified on the dorsal of the caudal region of the tongue in wild boar, caudally to the vallate papillae, and bent towards the throat similar to a study conducted by Kilinc, Erdogan (4). However, in a study carried out by Dyce, Sack (18), the conical papillae in tayra occurred anteriorly to the circumvallate papillae.

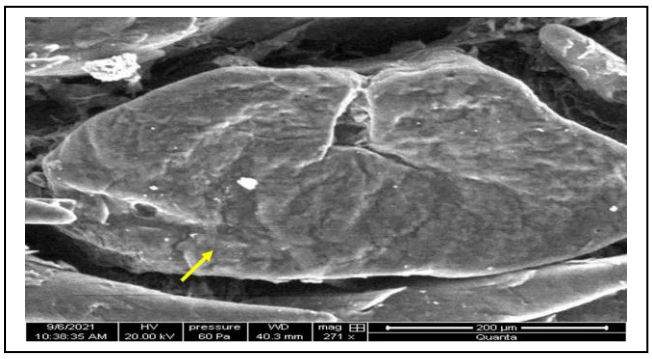

Figure 6. Tongue of the grey mongoose showing the fungiform papillae (yellow arrow)

Fungiform types were found in central and caudal parts of the tongue, anterior to the circumvallate in grey mongooses. This type appeared as a mushroom flattened in shape and surrounded by filiform papillae. These papillae had circular morphology with an approximate diameter (120.64 µm) (Figure 7). These findings contrasted with the location of fungiform type in rats and mice which were found in the cranial and central areas of the dorsal aspect (12) of blind mole rats (8).

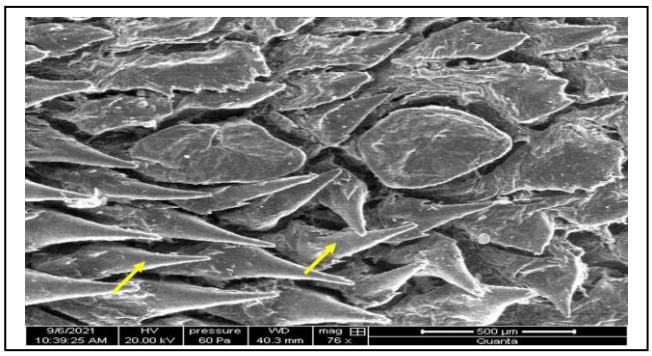

Figure 7. Tongue of the grey mongoose showing the conical papillae (yellow arrow) directed caudally

Authors' Contribution

Study concept and design: H. B. M.
Acquisition of data: H. B. M. and N. A. A.
Analysis and interpretation of data: W. F. O.
Drafting of the manuscript: W. F. O.
Critical revision of the manuscript for important intellectual content: H. B. M.
Statistical analysis: H. B. M.
Administrative, technical, and material support: H. B. M.

Ethics

The experiments on animals were reviewed by the ethical review committee, which uses the guidelines of the University of Karbala, Karbala, Iraq.

Conflict of Interest

The authors declare that they have no conflict of interest.

Acknowledgment

The authors would like to thank the College of Veterinary Medical Sciences of Karbala University, Karbala, Iraq, for their facilities during the research and suggestions to improve the manuscript.

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