

The Morphological Description and Histological Study of Lingual Papillae in the Tongue Bat *Pipistrillus kuhli*

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Abstract: The present study was carried out to investigate the morphological and histological structure as well as some histochemical aspects of tongue bat *Pipistrillus kuhli*. The dorsal surface of the tongue has lateral oblique grooves connected with inter median groove, while the ventral surface, contain long process with deep fissure on its free end. Histologically, the dorsal surface was covered by keratinized stratified squamous epithelium, while the ventral surface covered with non-keratinized stratified squamous epithelium. Three types of lingual papillae (filiform, fungiform and circumvallate) were project and distributed on the dorsal surface. The filiform papillae are the most abundant and characterized by a slender sharp pointed structure, while the fungiform papillae like the mashroom, the wall contain taste buds, but the circumvallate papillae circular in shape and embedded in the epithelium and surrounded by circle grooves which contain taste buds. The lamina propria is consisted of dense connective tissue which is rich in blood vessels and striated muscle fibers that have arranged in different directions. The results of histochemical examination of lingual glands showed positive reaction for PAS stain in this species.

Key words: lingual papillae, tongue, histology, bat.

1. Introduction

Tongue as taste organ has important role in digestion of food in all vertebrates. [1] examined the fundamental importance of morphology in the evolution of the vertebrate tongue, focusing on the origin of the tongue and on the relationship between morphology and environmental conditions. The author examined the tongues of various extant vertebrates, including those of amphibians, reptiles, birds and mammals.

Bats with nearly 1250 species are the second largest group of mammals and play ecological and economic role in our community [2]. The study of the histological and the histochemical aspects on the tongues of the species in different classes of vertebrates, and specifically bats, has attracted the attention of certain investigators.

Earlier anatomical and microscopic on insectivorous species from families of Vespertilionidae and Molossidae [3], Hipposideridae, Rhinolophidae and fruit eating bats such as *Pteropus vampyrus* [4]. There are various types of lingual papillae on the dorsal surface of tongue. These papillae are divided into mechanical (filiform and conical) and gustatory papillae (fungiform, circumvallate). Shape, position and distribution of these lingual papillae play important role in eating habits [5].

[6] study the anatomical differences in the tongue of rat, bat and pangolin, the results showed non papillae of the keratinized stratified epithelium of pangolin tongue unlike the papillae seen in the tongue of the rat and bat, while the filiform papillae seen in the rat was bristle like, the filiform papillae in the bat were crown-like.

The structure of the tongue in the *Millivera capensis* was studied by [7], five types (filiform, conical, fungiform, circumvallate and foliate) papillae were project and distributed on dorsal and lateral surface. The filiform was similarly to threads or like hairs, while conical was cylindrical shaped. The fungiform papillae like the mashroom, the wall contain taste buds, but the circumvallate papillae circular in shape and embedded in the epithelium, the foliate papillae was similar ridges, both circumvallate and foliate papillae were contain taste buds.

The morphological characteristics and histological structure of the tongue and lingual papillae has been study in the Egyptian fruit bat (*Rousettus aegyptiacus*). This study showed that elongated and movable tongue and thin keratinized epithelium especially on ventral surface of tongue, numerous and different types (4 types) of papillae on the dorsal surface of tongue in different locations and orientation were seen in this species, hyaline cartilage was observed in tip of tongue [2].

In the Egyptian bat *Pipistrillus kuhli* the tongue is characterized by the presence of numerous filiform papillae at its dorsal and a small number of circumvallate, while in the Syrian *Pipistrillus kuhli*, the circumvallate papillae absent [8]. The available literature indicated that few studies have carried on the histology and histochemistry of the tongue of this species in Iraq. So, the present study was performed to investigate the histological structure and the histochemical characteristics of the lingual glands.

2. Materials and Methods

Tongue from five *Pipistrillus kuhli* was used in this study. The animals were collected from different agriculture regions around Baghdad.

Each bat was dissected, tissue samples of the tongues were immediately excised, cut into small pieces, fixed rapidly in 10% neutral formalin solution for 18-20 hours and then dehydrated in ascending series of ethyl alcohol, cleared in xylene and embedded in paraffin wax. Sections of 4-6µm thick were stained with hematoxylin and eosin.

For histochemistry processing, sections were stained with Periodic Acid Schiff (PAS) for polysaccharides of the glands and the muscle of the tongue [9]. Histological examination carried out using light microscope Kruss and photographed by using Sony digital camera.

3. Results

Tongue was long, muscular and movable, it lies in the floor of the buccal cavity and is connected posteriorly by means of the frenulum linguae, it was divided into three areas: apex, body and root. The dorsal surface has lateral oblique grooves connected with inter median groove (Fig.1), but in the ventral surface of the tongue there is a long process with deep fissure on its free end (Fig.2).

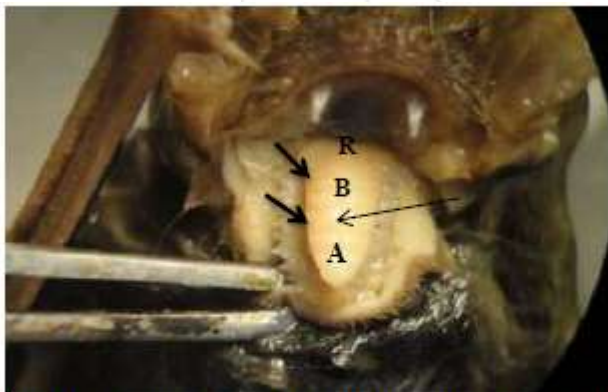


Figure 1: Dorsal surface of the tongue showing three parts: Apex (A), Body (B) and Root (R), Inter median groove (↔), Lateral groove (↘).

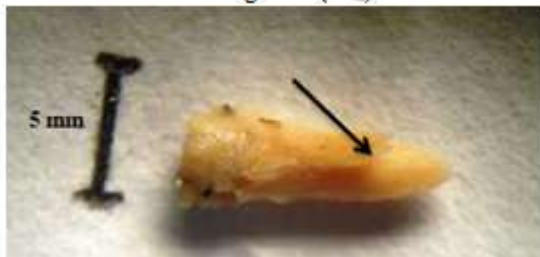


Figure 2: Ventral surface of the tongue showing long process with deep fissure (↘).

Three types of lingual papillae (filiform, fungiform and circumvallate) were found on the dorsal surface of the tongue,

which is covered with thick keratinized stratified squamous epithelium (Fig.3,4), while the ventral surface were lack the lingual papillae which is covered by non keratinized stratified epithelium (Fig.5).

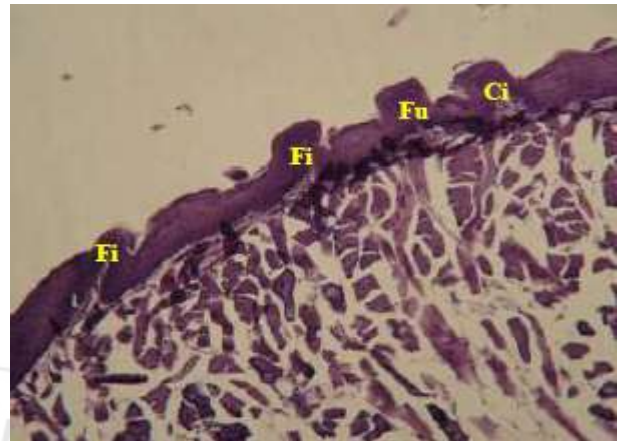


Figure 3: Transverse section of the tongue showing types of lingual papillae, filiform (Fi), fungiform (Fu) and circumvallate papillae (Ci). (10X)(H&E)

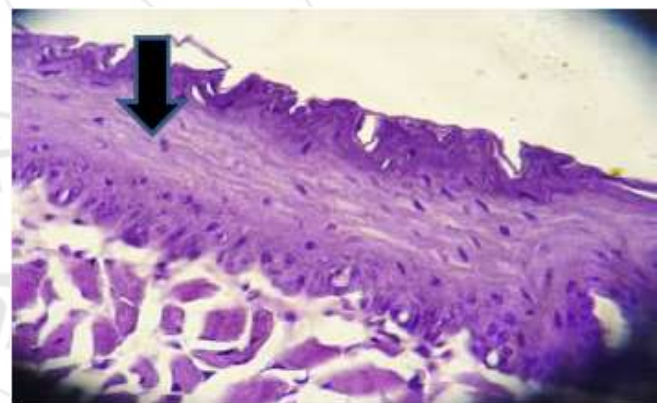


Figure 4: Transverse section of the tongue showing thin keratinized epithelium on the dorsal surface (40X)(H&E)

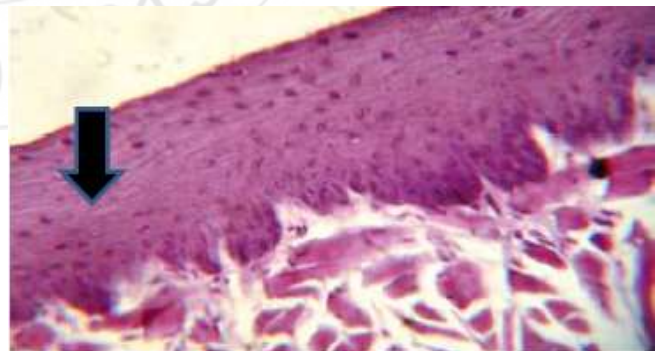


Figure 5: Transverse section of the tongue showing non keratinized epithelium on the surface (40X)(H&E).

The filiform papillae are most numerous and distributed over the dorsal anterior portion of the tongue and consists of conical mass (process) of stratified squamous epithelial cells it is a slender sharp pointed structure and vascular core of connective tissue (Fig.6).



Figure 6: Transverse section of the tongue showing filiform papillae (↘) and lining Epithelium (Le), Lamina propria (Lp)(10X)(H&E).

Fungiform papillae are relatively few in number and are interspersed among the filiform papillae, they were observed on all of surface especially at the tip and lateral margins of tongue. They are large, mushroom form and broader than the base with many taste buds and has a core of connective tissue, it is covered by keratinized epithelium (Fig.7, 8).

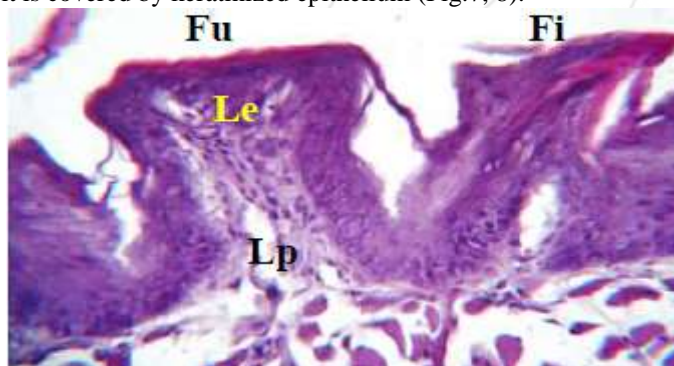


Figure 7: Transverse section of the tongue showing filiform (Fi), fungiform papilla (Fu), lining epithelium (Le) and lamina propria (Lp) (10X)(H&E).

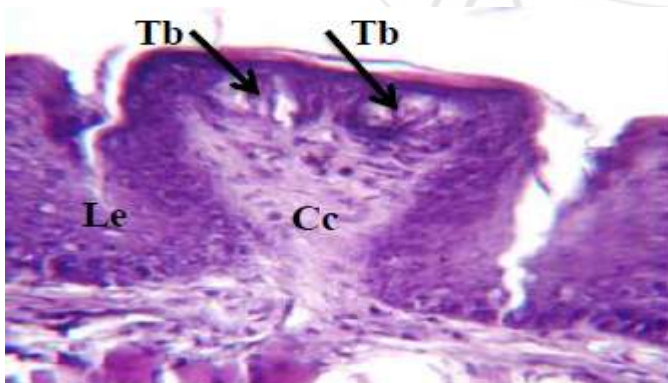


Figure 8: Fungiform papilla showing lining epithelium (Le), connective tissue cone (Cc) and taste buds (Tb) (40X)(H&E).

The circumvallate papillae were less in number, they were located on the behind of mid region of tongue and surrounded by circle grooves which contain many taste buds. The

circumvallate papillae are flattened structure, exhibit a thin keratinized epithelium (Fig.9, 10, 11).



Figure 9: Circumvallate papillae (↘) showing lining epithelium (Le) and lamina propria (Lp) (10X) (H&E).

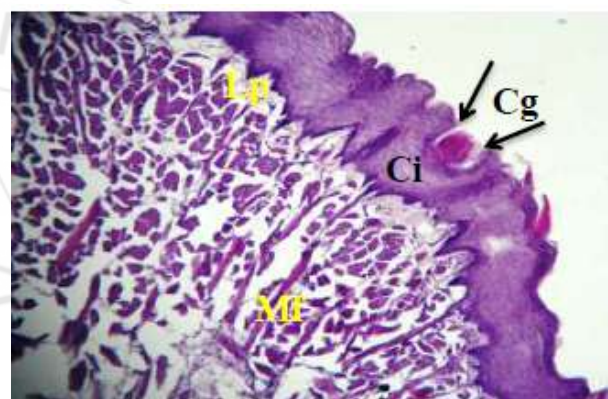


Figure 10: Circumvallate papilla (Ci) showing circular groove (Cg), lamina propria (Lp) and muscle fibers (Mf) (10X)(H&E).



Figure 11: Circumvallate papilla showing circular groove (Cg) and taste buds (Tb) (40X) (H&E)

The lamina propria is built up of connective tissue rich with blood vessels, longitudinal and transverse bundles of muscle fibers were surrounded by collagenous fibers below the connective tissue (Fig.12).

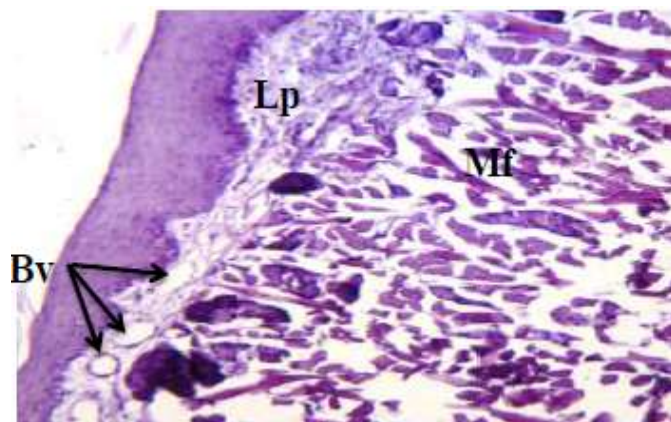


Figure 12: Transverse section of the tongue showing lamina propria(Lp),Blood vessels(Bv)and muscle fibers (Mf) (10X) (H&E)

The histochemical examination showed, the lingual glands are stained with red color with PAS method indicating the presence of mucopolysaccharide secretion. The mucous glandular cells are irregular in shape with basely flattened nuclei (Fig.13,14).

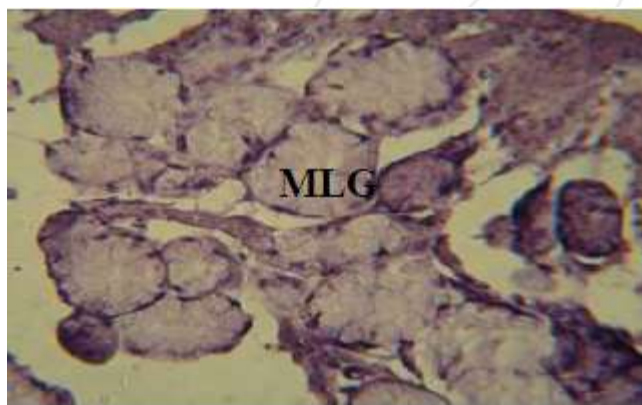


Figure 13: Transverse section of the tongue showing mucous lingual glands (MLG)(40X) (H&E)

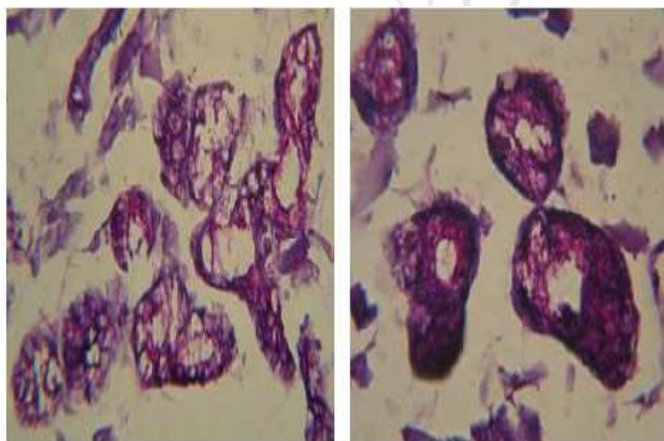


Figure 14: Lingual glands showing positive reaction for PAS stain (10X)(H&E)

4. Discussion

The morphological and histological features of mammalian tongues reflect the differences among the life styles of mammals [1].

The results of the present study showed three parts distinguished in the dorsal surface of the tongue, apex, body and root. This design appeared also in most vertebrates species [10;11; 12].

On the dorsal surface of the tongue of mammals, there are various kinds of lingual papillae including filiform, fungiform, circumvallate and foliate papillae,each having different morphological structure and shape [7].Distribution of these lingual papillae has been considered to be related to species eating habits [13]. The epithelium of the anterior half is more extensively keratinized than that of the posterior ones which provide the tongue with greater rigidity to be efficient for feeding [14]. In the present study the keratin is less in the anterior half, this may be due to the difference of feeding habits, this is similar to the adult Egyptian bats and Syrian bats[8].

In mammals there are some variation in the shape and number of papillae on the dorsal surface of the tongue [6]. Histological observations of insectivorous batof the present study showed that the dorsal surface of the tongue is rough due to the presence of three types of lingual papillae (filiform, fungiform and circumvallate papillae), these observations provided similar results to those of [15; 8],while in the Syrian bat *Pipistrillus kuhli* the circumvallate papillae absent [8], whereas there are four types of lingual papillae (filiform, fungiform conical and circumvallate papillae) in the tongue of fruit eater bats [2].

In the insectivorous bat (*Rhinopama hardwickie*), [16] showed that the filiform papillae are most numerous and distributed over the dorsal anterior portion of the tongue and consists of a slender vascular core of connective tissue covered with cornified stratified squamous epithelium, this finding is contradicting that reported in the present study, and in the study of Egyptian bat (*Pipistrillus kuhli*) and Syrian bat (*Pipistrillus kuhli*) [8] but in the Egyptian fruit bat (*Rousettus aegytiacus*) were reviewed by [2], the authors postulated that the filiform papillae were distributed on the dorsal surface and were divided into three types with different size and position which are: small, giant and bifid filiform papillae.

Fungiform papillae in some mammals such as buffalo[17]hasn't taste buds but in the current study, the fungiform papillae are large ,mushroom form with many taste buds were observed.

Fungiform and circumvallate papillae were covered by a thin keratinized layer because they have taste buds [18],the food particles were exposed to the taste buds and facilitate

absorption of food, this finding is agreement with previous investigators [7; 16].

The circumvallate papillae were circular – shape surrounded by circular groove and embedded in the lingual epithelium these our observations were similar to previous work which done on rodents and ferret [1; 19].

The number of circumvallate papillae in different species of bats was reported by several authors, there are two papillae in the Japanese long-fringed bat [20; 21] and four papillae in the long-nosed bat [21]. The present observations could not detect or arrived to the exact number of the circumvallate papillae in this species of bats.

The bundle of skeletal muscle fibers was occupied the core of *Pipistrellus kuhli* tongue arranged in all direction, these observation came to correspond the previous study on the other vertebrate tongue [1;22]. [2] reported for the first time the presence of cartilage in the front part of the tongue of Egyptian fruit bat (*Rousettus aegyptiacus*) which is important for movement, the results of the present study not agreement with previous study.

Histochemical examination results of the present study showed that the lingual glands are positive with PAS reaction for mucopolysaccharides, this was indicates a considerable activity of this glands in the production of mucous secretion. This observation agree with that of Egyptian bat [16].

In conclusion, the present study showed that the shape and the distribution of lingual papillae depend on the type of diet and location of these papillae on the tongue , in addition histological structure are appropriate to their function.

References

- [1] Iwasaki,S.,“Evolution of the structure and function of the vertebrate tongue”, J.Anat.,201:1-13, 2002.
- [2] Ghassemi,F.,Jahromi,H.K. and Ahmadi,N.,“Macroscopic and light microscopic study of the tongue of the Egyptian fruit bat (*Rousettus aegyptiacus*)”, 2013.
- [3] Azzali,G.;Gabbi,C.;Graandi,D. and Bonomini,D.“Morphological and ultrastructural features of the non sensory papillae ,in tongue of hibernating bats”,Archital.Anat.Embryol.,96:257-280, 1991.
- [4] Emura,S.;Hayakawa,D.;Chen,H;Shoumura,S.;Atoji,Y. and Wijayanto, H., “SEM study on the dorsal lingual surface of the large flying fox, *Pteropus vampy*.Okajimas Folia”, Anat.Jpn., 79:113-120, 2002.
- [5] Hanna,J.;Trzcielinska-Lorych,J. and Gdynicki,S., “The microstructure of lingual papillae in the Egyptian fruit bat(*Rousettus aegyptiacus*) as observed by light microscopy and scanning electron microscopy”, Arch.Histol.Cytol.,72:13-21, 2009.
- [6] Abayomi,T.A.;Ofusori,D.A.;Ayoka,O.A.;Odukoya,S.A.; Omotoso,E.;Amegor,F.O.; Ajaayi,S.A.;Ojo,G.B. and Oluwayinka,O.P.,“A comparative histological study of the tongue of the rat (*Rattus norvegicus*), Bat (*Eidolon helvm*) and pangolin (*Manis tricuspis*)”, Int.J.Morphol.,27(4):1111-1119, 2009.
- [7] Ali,T.G., “Some histological description of lingual papillae in the *Millivora capeneries* tongue”,Biol.J.AL-Kufa Uni.,4(1):290-295, 2012.
- [8] Selim,A.;Nahla,N.E. and Shelfeh,M., “Comparative and anatomical and histological studies of the tongue between the Egyptian bat *Pipistrellus kuli* and the Syrian bat *Pipistrellus kuli*”, 2008.
- [9] Bancroft,J. and Stevens,A.,Theory and practice of histological techniques, Churchill Living stone, London,2nd. 622pp+XIV, 1986.
- [10] Mutlak, B.H.; Dauood, H.A. and ALIDoori,T.Y.,“A study of the anatomy and histology of the tongue of fresh water turtle *Clemmys caspica caspica*.”,J.Diyalla,8(1):115-127., 2000.
- [11] Nasr,E.S.; Gamal,A.M. andElsheikh,E.H.,“Light and scanning electron microscopic study of the dorsal lingual papillae of the rat *Arvicanthis niloticus* (Muridae, Rudentia)”, J.Amer.Sci.,8(4):619-627, 2012.
- [12] Taha, A.M., “Comparative anatomical, histological and histochemical study of tongue in two species of insectivorous vertebrates” Aust. J.Bas.Appl.Sci.,7(1):401-410, 2013.
- [13] Fawcett,D.W., A text book of histology, W.B.Sanuders company,(cited by Taha,2013), 1986.
- [14] Selim,A., Comparative histological, histochemical and physiological studies on the digestive system of the two insectivorous bats *Rhinopoma herdweickei* and *Ase lliatridens*, MSc.Zoology department faculty of science, Tanta Univ. Tanta Egypt (cited by Selim *et al.*, 2008), 1988.
- [15] Pastor,J.F.;Moro,J.A.;Verona,J.A.;Gato,A.;Represa,J. and Barbosae,A.,“Morphological study by scanning electron microscopy bat *Pipistrellus pipistrellus*”,Arch.Oral.Biol.,38(7):597-599, 1993.
- [16] Taki El-Deen, F.M.A.; Samia,M.I. and Shahin,M.A.,“Comparative histological studies on the tongue of three species of Egyptian bats”, Life Sci.J., 10(2): 633-640, 2013.
- [17] Khaksary, M.; Mahababy,H.; Morovvati, K. and Khazaeil, L.,“A microscopic study of lingual papillae in Iranian buffalo (*Bubalus bubalus*)”, Asi. J. Ani., 5(2):154-161, 2010.
- [18] Emura, S.,“SEM study on the lingual papillae and their connective tissue cores of the Japanese common pipstrelle (*Pipistrelle abramus*)”, Okajimas Folia Anat. Jpn., 153:56-62, 2009.
- [19] Mohammed, A., Salih,K. and Dala, K. “Some microscopic and morphologic aspects of the lingual papillae in the tongue of ferret (*Mustela putrius*)”, Scient. conf., 11: 130-138, 2009.
- [20] Kobayashi, K. and Shimamura,S., “Comparative anatomical observations of the tongue of Japanese long-fingered bat, *Miniopterus schreibersi fuliginosus*”, Okajimas Folia Anatomica Japan 58: 923-932, 1982.
- [21] Greenbaum,I.F. and Phillips, C.J.,“Comparative anatomy and general histology of the tongues of long-nosed bats

(*Leptonycteris sanboni*) and (*L. nivalis*) with reference infestation of oral mites”, J.Mammal. , 55:489-504, 1979.

- [22] Igbokwe, C.O. and Okolie, C., “The morphological observations of some lingual papillae in the prenatal and prepuberal stages of red sokoto goats (*Capra hircus*)” Int. J. Morphol., 27(1): 145-150, 2009.

