Surface Morphological Structure Of The Tongue Of The Hedgehog,HemiechinusAuritus (Insectivora:Erinaceidae)

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Abstract: The morphology of the dorsal lingual papillae of the adult hedgehog, *Hemiechinusauritus (insectivora)*was examined by scanning electron and light microscopy. The tongue in the hedgehog was elongated with somewhat symmetrical width. It was about 11–15 mm in length and 3–4 mm width. On the dorsal surface of the lingual mucosa, four types of papillae were observed: filiform, fungiform, vallate and foliate. Numerous filiform papillae covered the entire surface of the apex and body of the tongue. Dome shape fungiform papillae were observed over the entire surface scattered between the filiform ones. They displayed regional variation in number and size. Three vallate papillae, in an inverted triangle form were found on the root of the tongue. Each papilla had an elliptical form with a depression around it .Both fungiform and vallate papillae were carrying taste budes. A pair of crescent- shaped foliate papillae were found in the postero-lateral part of the root .Each had parallel microridges. The lingual mucosa showed keratinization while submucosa housing the lingual muscle and mucous glands.
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Key words: Hedgehog tongue, morphology , SEM.

1. Introduction

Tongues of several species of animals were studied not only for their relation to taste but it is participates in the assessment of palatability of food , sucking , intake of liquid food, mastication and mixing food with saliva, deglutition, and speech (Stevens and Lowe, 2005 ; Kulawik & Zdrojewska, 2006).The tongue is a highly muscular organ covered with squamous epithelium and partly oral and partly pharyngeal in position (Stevens and Lowe, 2005). The dorsal surface of the mammalian tongue is covered by specialized structures called lingual papillae. In humans there are around 4,600 total taste buds in all papillae (Miller and Reedy, 1990 a, b). Morphological and functional studies of various species indicated a close correlation of the lingual form and the histological structure of the lingual epithelium with their feeding habits (Vollmerhaus and Sinowatz, 1992; Koening and Liebig, 2001; Emura, *et.al.,*2008,2009). Furthermore, Yoshimura, *et. al.*, (2009) stated that the morphology of the tongue, the mucosa of the lingual papillae on its dorsal surface and the distribution of these papillae reflects dietary habits and living environment of the vertebrate animals. Scanning electron microscopic studies have identified some level of structural variation in size and shape of the lingual papillae between different species. This study has carried out to clarify the relationship between the morphological features of the tongue by light & scanning electron microscopy and the life style of the hedgehog and compare with the results reported in other vertebrates

2.Material and Methods

Tongues from 12 adult hedgehogs of both sexes, mass of approximately 40 g were used for the study. Animals were anaesthetized with ether and tongues were removed immediately and put into 10% neutral formaldehyde for histological examination. After routine processing 5-7 µm sections were cut and stained with hematoxylin and eosin.

For scanning electron microscopic examination, tongue samples were placed into 3% glutaraldehyde with phosphate buffer (pH 7.3). After rinsing in buffer, tissues were post-fixed in 1% osmium tetroxide (OsO4) at 37C for 1.5 hr. Afterwards, post-fixation tissues were placed in 3 N HCl at 60 C for 20 min. to remove extracellular mucus from the surface of the tissue (Iwasaki *et al.,* 1996, 1997). Tissue samples were passed through alcohol and amyl acetate series and dried with critical-point-dryer. The dried material was coated by gold sputter coater (SPI-Module) and samples examined by JEOL-JSM-5500 LV reflection scanning electron microscopy in the Regional Centre of Mycology, Al-Azhar University- Cairo Egypt. The material was stored over silica gel, so that it remained in perfect condition for many weeks

3.Results

The tongue in the hedgehog was elongated with somewhat symmetrical width rounded anterior end (Fig. 1a). It was about 11–15 mm in length and approx. 3–4 mm width. It could be distinguished into three regions; the apex (tip), the corpus (body) and the radix (root) as shown in figs.1b-e.

Scanning electron microscopy

Four different types of papillae were observed: filiform, fungiform, vallate and foliate .

Filiform papillae were the most numerous, extending over the whole dorsal surface of the tongue up to the root. They were tongue or leaf-like in shape with directed posteriorly pointed tips. They were simple conical (Fig. 2a) or branched, divided into two to four pointed accessory processes (Figs. 2 b,c). Filiform branched papillae lie in rows and were compactly distributed over the tongue. They have two accessory processes from the apex to the anterior third and two to four at the posterior two thirds. The length and number of the accessory processes vary throughout the surface of the tongue. In the posterior third, the length of processes decreased (Fig.2d).

Dome shape fungiform papillae were observed over the entire surface scattered between the filiform ones (Figs.3a-d). They were more abundant on the first third of the tongue where it can be seen in clusters of two or three papillae (Fig.3b). They were shorter in length and larger in diameter when compared with filiform papillae. Several taste pores were observed on the dorsal of the fungiform papillae (Fig.3c).The fungiform papillae located in the front were discoid-shape (Fig.3d) and relatively larger than those found in the posterior.

There were three vallate papillae, in an inverted triangle form (Fig.1e). One of this vallate papilla is located at the central mid-line; the other two are located laterally at both sides of the postro-lateral area (Figs.4a-c). Each papilla had a circular or elliptical form with a depression around it (Fig. 4a). The body of vallate papillae was surrounded by a continuous trench and dense mucosal folds (Fig.4b).The upper surface mucosa was irregular and there were several taste pores (Fig.4c).

A pair of foliate papillae was found in the latero-posterior part of the root of the tongue, each was crescent in shape and had some parallel projections (microridges) separated by grooves (Fig.4d). On their surface there were several taste pores and 4–5 fissures situated bilaterally. The posterior rough surface of tongue was covered with clusters of growing and degenerated papillae with very short processes.

Light microscopy

Each type of lingual papilla was covered by stratified squamous epithelium and had a core of connective tissue (Fig.5). Keratinization of the covering epithelium was markedly observed. The anterior aspect of filiform papillae consisted of clear cells with weakly stained cytoplasm in the dorsal part. On their posterior aspect the predominant epithelial cells form thick keratin spine (Fig. 5a). Taste buds were found in the epithelium of the later parts of the fungiform papillae (Fig.5c) and the lateral parts of the vallate papillae (Fig.5d), but not observed on foliate papillae (Fig.5e). Submucosal and intermuscular serous glands were observed in the ventral part of fungiform papillae. The glands had openings into the depth of the groove (Fig.5c).

4. Discussion

The results of the present study facilitate a description of the topography and the microscopic structure of the dorsal surface of the tongue in the hedgehog

The presence of four types of papillae as revealed by the scanning electron microscopic observations is a morphological pattern basically similar to that described for other mammal species (Emura *et al*., 2006). On the contrary, Ciuccio *et al.* (2008) reported the presence of only three types of papillae in armadillo tongue. The structure of the tongue reveal a variability of morphological features related to the type of food, habit, and taxonomy (Okada & Schraufnagel, 2005). This variability is significant between high systematic units, such as orders or families, although there are interspecies differences (Iwasaki, 2002; Kobayashi *et al*., 2005 and Emura *et al*., 2006).

The morphology of filiform papillae is comparable to that reported by Estecondo *et al.*, 2004 although some differences in the size and in the number of branches were found. Those variations may be due to mastication methods and/or dietary habits, as has been claimed for other mammals (Yoshimura *et al*., 2002). The pattern of filiform papillae covering the entire dorsal surface of the tongue, with the number of branches increasing to the middle third of the organ, seems to be common in insectivores. The absence of taste pores suggests that filiform papillae have only mechanical function during the mastication process, while its abundance and distribution suggests their protection role of the dorsal surface (Emura *et al*., 2001;Emura*et al*., 2006; Pastor *et al.,* 2008 and Karan *et al*.,2010).The fact that filiform papillae are easily bent in the direction of the radix but not in the opposite direction, could be related with the need to secure in place and move the food taken into the mouth (Jackowiak, 2006).

In the present study, almost all fungiform papillae have a dome-shaped appearance while few were discoid shape. The presence of taste pores in fungiform and vallate papillae clearly suggests that they are gustatory papillae, as shown in other species (Unsal *et al..*, 2003; Benetti *et al.,*2009 and Ciuccio *et al.,* 2008, 2010).

In this study, the distribution of mushroom-shaped fungiform papillae was dense especially in the medial

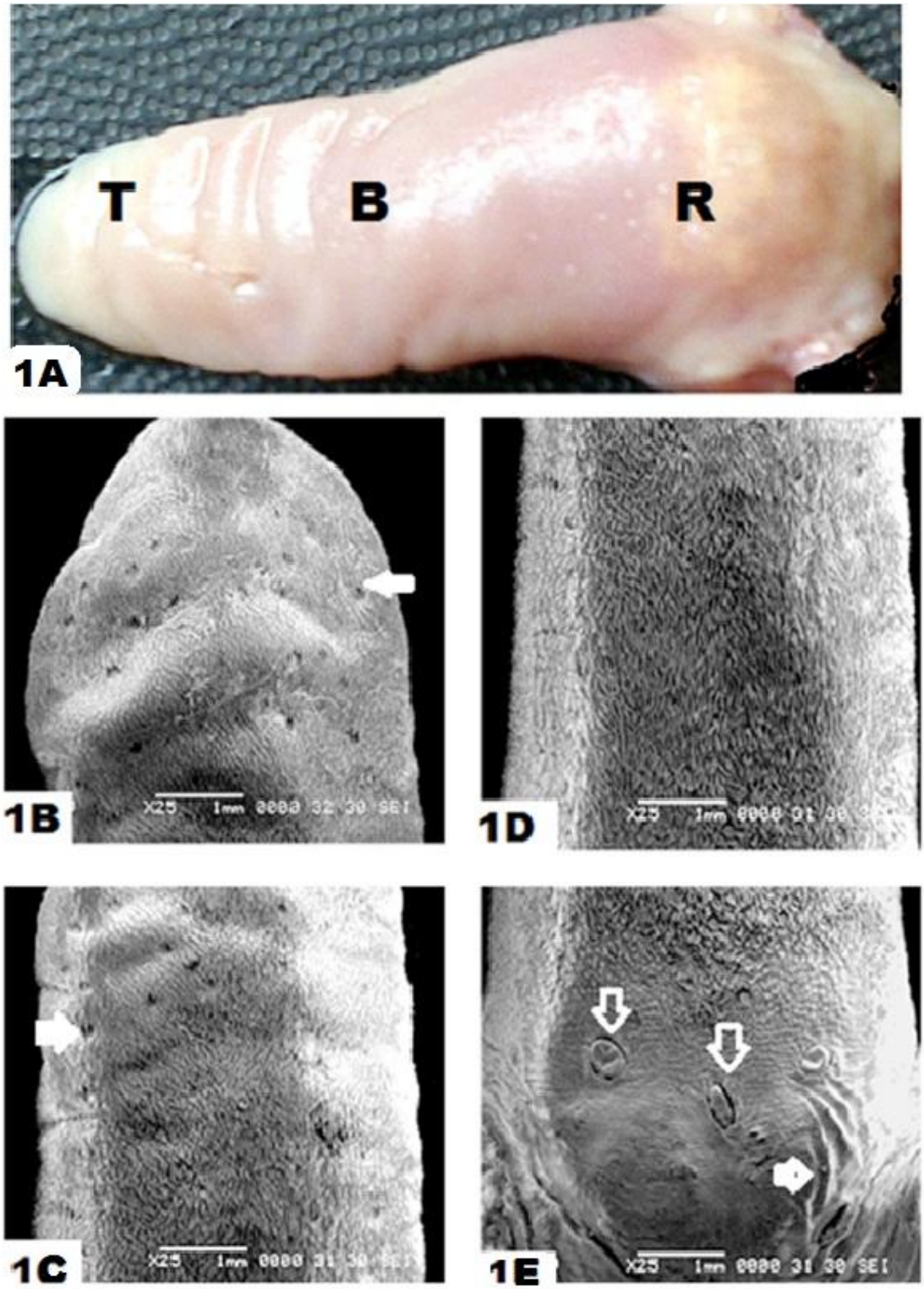


Fig 1: photomicrograph (a), scanning electron micrograph(c-d) of the tongue of hedgehog showing different anatomical regions: **a:**tip(t) , body (b), and root (r). **b**:the anterior convex end of the tongue with fungiform papillae (arrow) scattered between filiformpapillae.Scale bar=1µm.**c**,**d** :the body of the tongue with less dense fungiform papilla (arrow) and more dense longer filiformpaoillae. Scale bar=1µm. **e**:the root with its converted triangle shaped vallate papillae (hollow arrow) and the crescent shape foliate papillae (solid arrow). Scale bar=1µm.

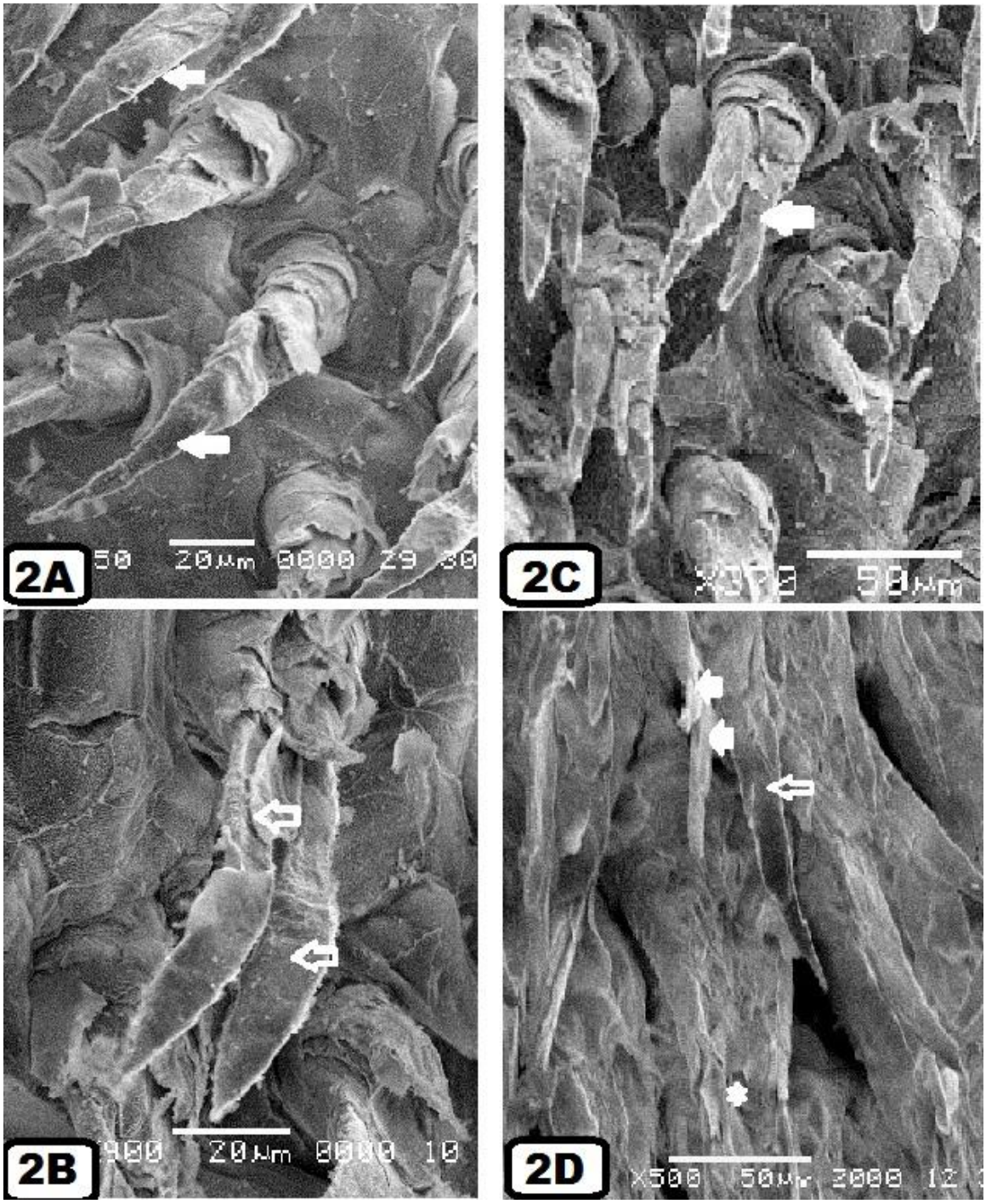


Fig.2: Scanning electron micrograph of different shape filiformpapillae. **a**:simpl conical or leaf-like with pointed tips directed posteriorly (arrow). **b**:branchedfiliform divided into two (hollow arrow). Scale bar=20µm. **d**: three processes filiformpapilla; one principal (solid arrow) and two accessory (solid arrow). Scale bar=20µm.

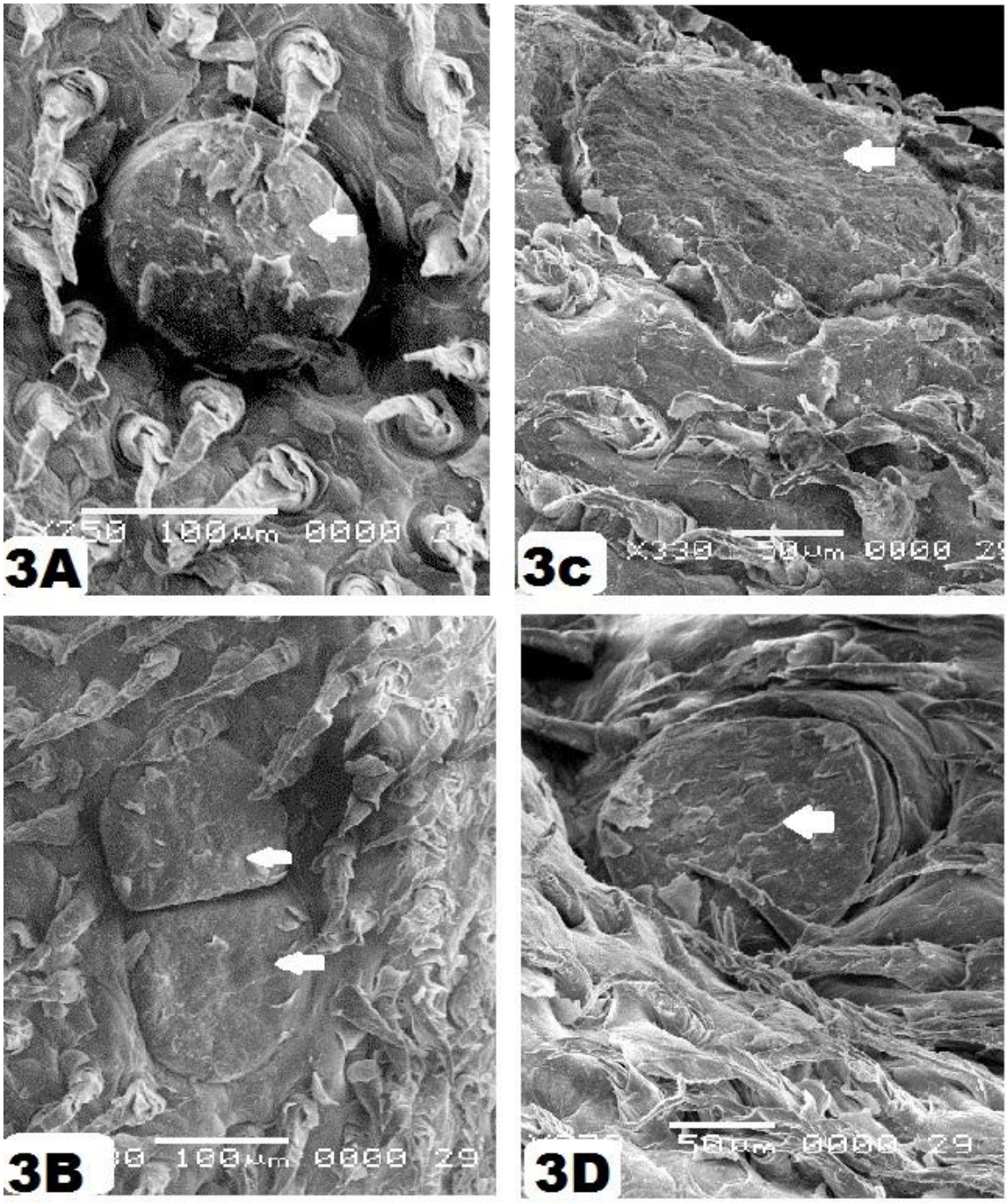


Fig.3: Scanning electron micrograph of fungiform papillae. **a:**mushroom shaped single papilla showing taste pore (arrow). **b:**clusters of two fungiform papillae embedded between the filiform ones. Scale bar=100µm. **c**,**d:**discoid shape papillae with taste pores (arrows). Scale bar=50µm.

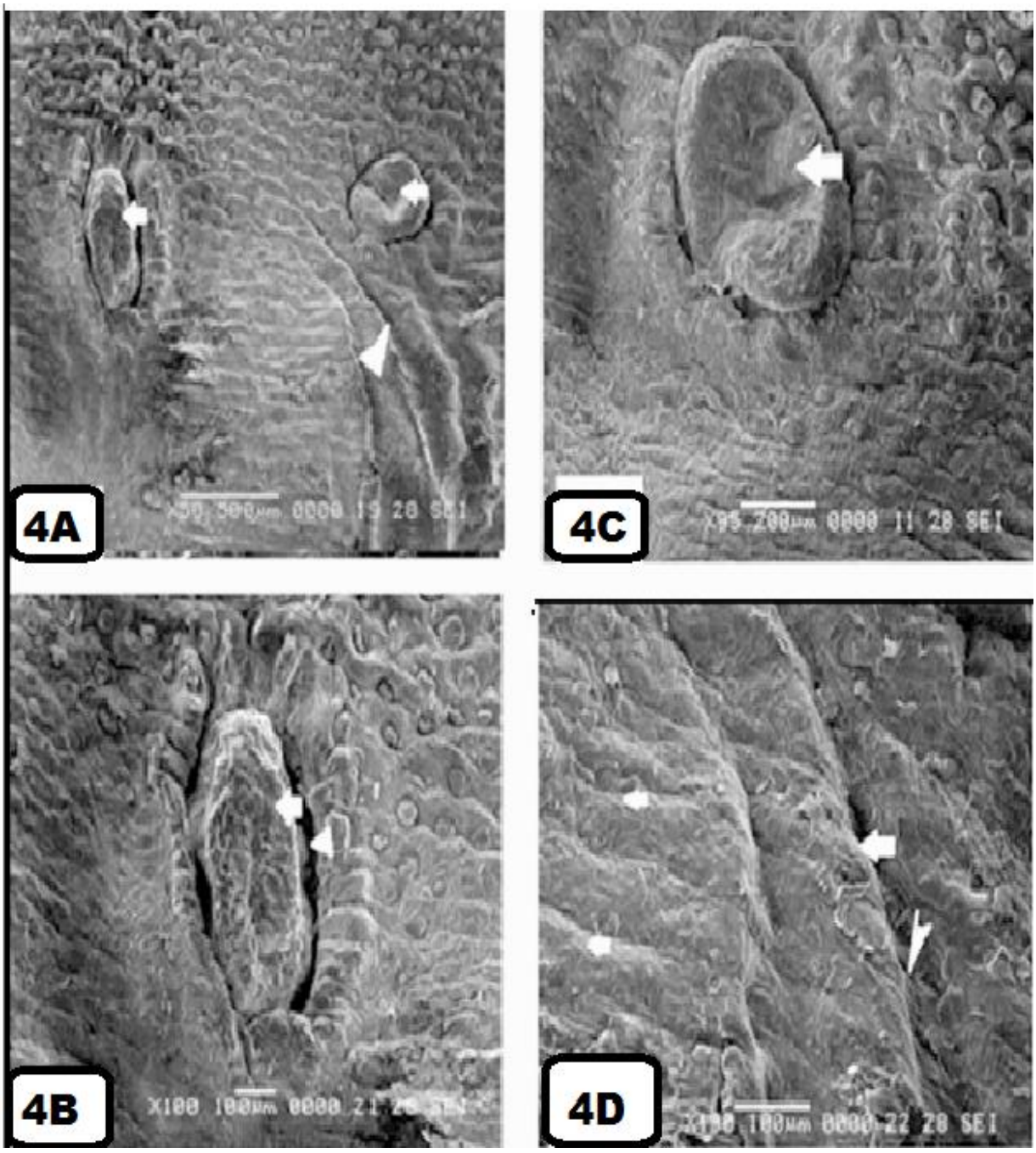
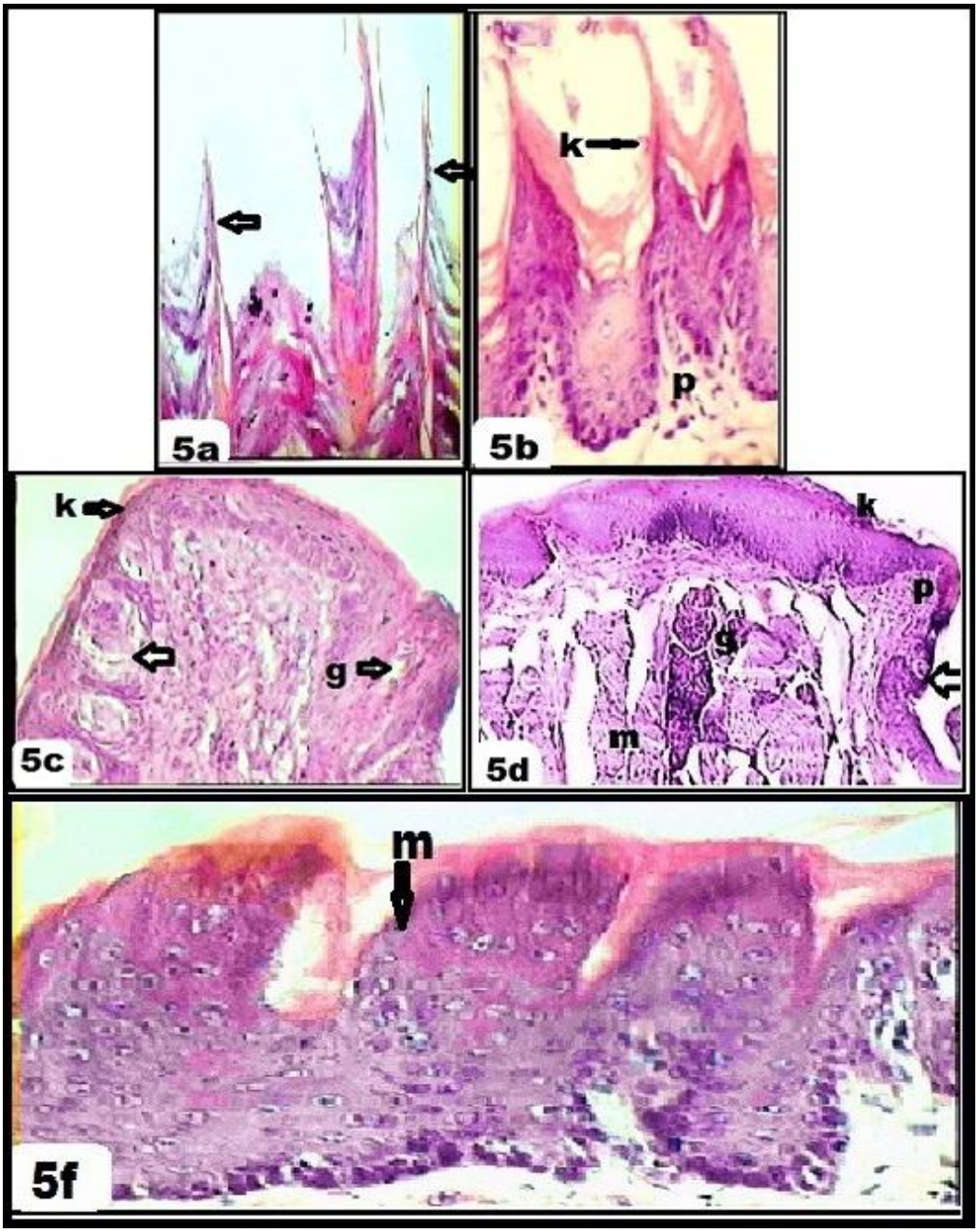


Fig.4 : Scanning electronmicrograph of an elliptical form vallate and foliate papillae.**a**: the median elliptical (arrow) and oval lateral (arrow) vallate papillae on the root of the tongue .See also the foliate papillae(arrow head) Scale bar=50µm.**b**, **c:**magnified elliptical vallate (arrow) surrounded by a trench (arrow head **) ,** oval vallate papilla with mucosal folds. Scale bar=100µm.**d:** A crescent shape.foliate papillae (large arrow) separated with groove(arrow head) and with parallel projections microridges (small arrow). Scale bar=100µm



Figs.5a: H &E photomicrograph of a single branched filiform papillae (arrow) directed backward and covered with a core of connective tissue (p) and thick keratin spine (k).Double branched papilla is seen in fig (5b) X400.
Fig.5 c: H&E photomicrograph of cross section throw mushroom shaped fungiform papilla with taste(arrow) .In the submucosa serous glands(G) open into the depth of the groove. Dorsal surface is covered by thin layer of keratin (k). X400

region among the longer filiform papillae, probably as a means of protection. Fungiform papillae on the anterior region were greater than those in the medial and posterior region. The manner of this distribution had also been reported on the dorsal lingual surface in the Japanese marten (Emura*et al.,* 2007).As reported in the maned sloth (Benetti*et al.,* 2009) fungiform papillae were found on the apex of the tongue and also on its lateral margins. However, fungiform papillae were found only on the corpus of the tongue in the common shrew (Jackowiak*et al.,* 2004). Furthermore, the size and number of fungiform papillae vary

according to animal species (Yoshimura *et al.,* 2008;Takemura*et al.*, 2009).

In the present study, a pair of foliate papillae was located on the postero-lateral margin of the body of the hedgehog tongue. Each papilla composed of 4–5 microridges separated by deep grooves. Although, the number of microridges in the flying squirrel tongue are higher (Emura*, et. al.* 1999),the microridges observed in the hedgehog papillae are similar to those in armadillos (Estecondo, *et. al*., 2001).Both the location and the structure of foliate papillae are similar to those in the bank vole (JackowiakandGodynicki, 2005) , in golden–headed lion(Buirty,*et.al.,*2009).Iwasaki (2002) suggested that, microridges may act as a supporting structure for food-uptake, mastication and swallowing.

The vallate papillae of the hedgehog tongue were round or oval in shape and surrounded by a furrow. The body of the vallate papilla was separated from the wall of the tongue by a continuous deep trench. This large circular trench seems to enhance the accessibility of food to the taste buds present at the papillae's sides. Distribution of the vallate papillae of the hedgehog shows a triangular pattern; one is on the mid-line of the posterior area of the tongue and the other two are situated at the antero-lateral sides. The number of vallate papillae depends on the types of food consumed. A single vallate papilla is located in thethe squirrel monkey (Iwasaki *et al.*, 1988).Two vallate papillae are recorded in the nutria (Emura*et al.*, 2001) while, in the guinea pig vallate papillae are absent and in their place the so-called foliate papillae are observed (Kobayashi, 1990) . Despite of insectivorous bats have two papillae (Gregorin, 2003), the fruit eating bats and the flying squirrel have three vallate papillae (Hwang & Lee ,2007). On the other side, several vallate papillaewere found in dog andcat (Kobayashi, *et.al.,* 1988 a,b).In human up to12 vallate papillae are distributed in front of the terminal grooveas stated byKobayashi, *et.al.*(1994).

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