

Research Article

Comparative Studies of the Tongue of Postnatal (Lactating), Young and Adult Between Two Species of Mammalian Animals of Different Feeding Habit *Rattus Rattus* and *Orcytolagus Cuniculus*

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Abstract

Background: The study of tongue of mammals is important because the different species of animals with different feeding, so the present study was attended to observe the relation between various feeding and the morphological shape of tongue of present stages of both *R. rattus* and *O. cuniculus* using histological, histochemical techniques, ultra structural examination and Statistical analysis.

Results: The Egyptian herbivorous rabbit *O. cuniculus* and the rodent *R. rattus* showed that the tongue is elongated with rounded apex. In both species the thicknesses of the tongue increase gradually toward the pharynx. The tongue length of adult rabbit was large than the adult rat.

In the studied animals, the anterior end of the tongue of the herbivorous rabbit *O. cuniculus* is covered with short horny filiform papillae at the anterior part and giant circumvallate papilla at the posterior part with taste buds, also large enormous numbers of mucus and serous glands but in the rodent *Rattus* is covered with short pointed horny filiform papillae and others small elongated ones. Few numbers of fungiform papillae and numbers of mucus and serous glands are scattered among the skeletal muscles. The Tongue of adult *R. rattus* and *O. cuniculus* have different shapes of filiform papillae, fungiform papillae distributed between the filiform ones, two circumvallate on the surface, number of serrate glands and mucous gland. Give strong reaction with Periodic Acid Schiff (PAS). In young and lactating some undifferentiated and poor developed papillae were observed and serrate and mucous glands less than that in adult stage

Conclusion: The different feeding habit of both rat (rodents and Rabbit (herbivorous) give different shapes of papilla and give different reaction with histochemical stains.

Keywords: Rabbit; Rat; Herbivorous; Tongue; Rodents; Lactating; Young; Adult and Ultra Structure

The Aim of Study

The difference of habits between rodents (rats) and herbivorous (rabbits) were the aim of study, so the research focus on the first part of the alimentary canal, the tongue. The previous researches on the tongue describe it as muscular organ covered with squamous epithelium. It lies between oral cavity and pharynx; it is attached by its muscles to the hyoid bone, mandible, styloid processes, soft plate and the pharyngeal wall describe the specimens of Camelus dromedaries exhibit that the animal has ideal elongated tongue which appear surface [1,2].

Many previous studies had described the foliate papillae which located on the posterior dorsal part of domestic rabbit tongue. In *Oryctolagus cuniculus* fungiform papillae observed on the apex of tongue body [3]. In detecting protein content of papillae of tongue Egyptian insectivorous bats tongue give more dense reaction with bromophenol blue stain than those Syrian ones [4].

Three shapes of papillae (filiform, fungiform and circumvallate) observed on the surface of *Miniopterus schreibersi fuliginosus* and *Pipistrellus savii* tongue [5]. Ultrastructure study on *Dasypus hybrid* tongue detect taste buds carrying on fungiform and circumvallate papillae that both are responsible for taste, while mechanical and protective role carry out by filiform ones [6]. At the first day after birth taste bud were observed on vallate papillae of domestic rabbit tongue [7]. Kulawik, et al., revealed that the filiform papillae are cone or palm shaped with three to seven processes in a study by light and scanning electron microscope of the filiform papillae of the tongue in adult rabbit (*Oryctolagus cuniculus*) [8].

Differences in the stain ability and distribution of neutral and acid muco polysaccharides in the lingual glands were present in comparative histological studies of three species of Egyptian bats the frugivorous ones, the insectivorous bat *Rhinopoma hardwickie* and the tomb-inhabiting bat *Taphozous perforates* [9]. The California sea lion show some morphological adaptations to their aquatic environment however, they possess some structures similar to those of land mammals [10]. Mucous and serous glands were observed especially on posterior ventral surface of insectivore bat (*Rhinopoma hardwickii*) tongue and single circumvallate papilla were situated in dorsal root of tongue [11]. Some authors observed the three vallate papillae in Marsupials [12]. Others observed the shape of the horse tongue and its papillae, they observed that the papillae are present on the dorsal surface of the tongue while the foliate papillae are found in the horse but not found in the goat [13].

Material and Methods

The animals of *Rattus rattus* (Sub order Myomorpha). Family: Muridae and *Oryctolagus cuniculus* (order Lagomorpha). Family Leporidae were brought alive and the specimens were killed by decapitation.

Collected the Animals

The specimens of *Oryctolagus cuniculus* and *Rattus rattus* collected alive and classified as follows: Adult group, young group; (after weaning) and Lactating group.

Histological Examination

Organs of adult, prenatal and postnatal *Oryctolagus cuniculus* and *Rattus rattus* collected. Parts of tongue were immediately fixed. All preparations were microscopically examined for the histological examination.

Histochemical Examination

Periodic Acid Schiff procedure (PAS): The PAS reaction used to: demonstrate the mucous secretion of the mucosa, and muscles in tongue demonstrate the secretion of mucus and serous glands.

Azan Stain: (Gretchen, 1974). Azan stain used to: examine the activity of the tongue (serous and mucous) and to demonstrate keratinization of epithelia, connective tissue.

Scanning Electron Microscopy

The surface lingual papillae and glands were observed using Scanning Electron Microscope (SEM) [14].

Statistics

Standard deviation and chi-square test by SPSS V.20.

1. Mean value $\left(\bar{X}\right): \left(\bar{X}\right) = \frac{\sum x}{n}$ Where $\sum$ = sum and n = number of observations.

2. Standard Deviation [SD]

$$SD = \sqrt{\frac{\sum |x - \bar{x}|^2}{n - 1}}$$

3. Standard student "t test", test of significance of the difference between two means:

$$t = \frac{\bar{X} - \bar{X}_2}{\sqrt{\frac{(SD_1)^2}{n_1} + \frac{(SD_2)^2}{n_2}}}$$

The calculated "t" was compared with tabulated one at different levels of significance at the Degree of Freedom (DF):
DF = (D + n₂) - 2 Where:

$\bar{X}$ = The mean value of group L

$\bar{X}_2$ = The mean value of group II.

SD1 = The standard deviation of group I.

SD2 = The standard deviation of group II.

n1 = The number of observations of group L

n2 = The number of observations of group II.

4. Analysis of Variance [ANOVA] tests (f): According to the computer program SPSS for Windows. ANOVA test was used for comparison among different times in the same group in quantitative data [15].

Results

External Morphology

Examination of the tongue of the two studied species, the Egyptian herbivorous rabbit *O. cuniculus* and the rodent *R. rattus* showed that the tongue is elongated with rounded apex. In both species the thicknesses of the tongue increase gradually toward the pharynx (Fig. 1).

Morphometric Study

The tongue length of rabbit was in lactating 2.08 ± 0.31 cm, in Young 3.09 ± 0.22 cm and in adult 4.24 ± 0.30 cm. The tongue length of rat was in lactating 1.07 ± 0.20 cm, in Young 2.0 ± 0.21 cm and in adult 2.83 ± 0.21 cm.

Adult Tongue

Light Microscopic Observations: In the studied animals, the apex of the tongue of the herbivorous rabbit *O. cuniculus* is covered with short horny filiform papillae at the anterior part and giant circumvallate papilla at the posterior part with taste buds, also large enormous numbers of mucus and serous glands (Fig. 2) the rodent *Rattus rattus* is covered with short pointed horny filiform papillae and others small elongated ones (Fig. 3). Few numbers of fungiform papillae and numbers of mucus and serous glands are scattered among the skeletal muscles (Fig. 3) in the posterior part of the tongue.

Histochemical Investigation

In *Oryctolagus cuniculus* (Fig. 2) showing numerous mucous glands give strong reaction with (PAS) stain. But the mucus gland gives weak reaction with azan stain. (Fig. 2). In *Rattus rattus* by using azan stain, mucous glands (Fig. 3) mucous glands give weak reaction while serous gland give moderate reaction with azan and give very moderate reaction with Schiff reagent of (PAS) Fig. 3. The serous glands more developed in *Rattus rattus* (feed on dry materials) than *Oryctolagus cuniculus*.

Scanning Electron Microscopic Observations: *Oryctolagus cuniculus* showed many different shapes of filiform papillae from elongated to short and horny (Fig. 4), while in *R. rattus* with small, elongate and serrate filiform papillae were observed covering the tongue apex (Fig. 5). In the two bat species studied, the fungiform papillae were few in number and scattered and among the filiform papillae (Fig. 4,5). At the posteriorly of the tongue, the circumvallate papillae and the taste buds were shown in the two studied bats (Fig. 4,5). In addition, the mucous glands were seen in the posteriolylt of the tongue in both species (Fig. 4,5).

Young Tongue

Light Microscopic Observations

The tongue of the young rabbit in the anterior lateral part of *O. cuniculus* showing very short horny filiform papillae than adult, fungiform papillae and muscle, Fig. 6 while in the posterior part of *O. cuniculus* tongue showing filiform papillae, mucous glands and serous gland in a few numbers than adult. In *Rattus rattus* in the anterior part the tongue showing filiform papillae, fungiform papillae, muscles Hand E. in middle line of the anterior part of *R. rattus* tongue showing short filiform papillae, muscles and lamina propria Hand E. but in the posterior part of *R. rattus* tongue showing horny filiform papillae fungiform papillae, mucous glands, Serous Gland (SG), Muscles (M) and Lamina Propria (LP) Hand E (Fig. 7).

Histochemical Investigation

Transverse section in the posterior part of *O. cuniculus* tongue showing Mucous Gland (MG) give negative reaction with azan. G and h- and moderate reaction with PAS (Fig. 7), There is no serous glands developed in the anterior part of *R. rattus* tongue showing Mucous Glands (MG) give weak reaction while Serous Gland (SG) give moderate reaction with azan. E, f- in the posterior part of *R. rattus* tongue showing Mucous Glands (MG) and Serous Glands (SG) give moderate reaction with Schiff reagent of (PAS) stain (Fig. 7).

Scanning Electron Microscopic Observations

Examination of the surface of the tongue apex in the Rabbit showed that the median was curved and the tip of the tongue was round with undifferentiated papillae (Fig. 8). At the posterior part of the tongue, the fungiform papillae were shown and some short horny filiform papillae were observed at this stage (Fig. 8), While in Rat at the posterior part of the tongue the is divided by suture and covered with undifferentiated elongated filiform papillae (Fig. 9). In the middle and the posterior part, the circumvallate, less developed fungiform and the irregular filiform papillae began to develop (Fig. 9).

Lactating Tongue

Light Microscopic Observations

In the studied animals the anterior part of the tongue of Rabbit is covered with short horny filiform papillae and the fungiform papillae (Fig. 10) poor developed, but in the middle and the posterior part the circumvallate papillae poor developed (Fig. 10) and the mucus glands were poor than those of adult, but in rat the anterior part of the tongue with poor developed filiform and fungiform papillae the apex is covered with small filiform and fungiform papillae (Fig. 11).

Histochemical Investigation

In Rabbit mucus glands give moderate PAS reaction (Fig. 10), the serous glands were present and react negatively with PAS (Fig. 10) but in rat there are very small amount of mucus glands which scattered around blood vessels of the tongue and give moderate PAS reaction (Fig. 11).

Scanning Electron Microscopic Observations

The median sulcus on the anterior part of the dorsal surface was distinct in the anterior surface of the tongue but in rabbit curved. The filiform papillae undifferentiated (Fig. 12). At the posterior part of the tongue the circumvallate papillae and the taste buds were shown (Fig. 12). In Rat (Fig. 13) the filiform papillae undifferentiated in the middle of the tongue. At the posterior part of the tongue the circumvallate papillae and the taste buds were poor (Fig. 13).

Musculature

An intricate complex of three types of muscle bundle comprises the bulk of the tongue of both species:

1. Horizontal muscle bundles attach one lateral surface to the other
2. Vertical muscle bundles connect the dorsal and ventral surface
3. Longitudinal muscle bundles extend along the tongue

Results Obtained from This Study

Various changes occur in tongue from lactating too young to adult include: Tongue of adult *O.cuniculus* and *R.rattus* elongated with rounded apex and the thickness of the tongue increase gradually toward the pharynx its length increase gradually from lactating to adult stage . The apex of the tongue of the *O. cuniculus* is covered with short small filiform papillae, but in *R. rattus*, the apex is covered with small horny filiform ones. In both species, few number of fungiform papillae are scattered among the filiform papillae. In the posterior part of the tongue, the circumvallte papillae and the taste buds were observed. Also, two types of glands: mucous and serous were found. In young and lactating *O. cuniculus* and *R. rattus*, developed, poor developed and undifferentiated lingual papillae observed found on the dorsal surface of the tongue. Circumvallte papillae and the taste buds were observed. Also, two types of glands: mucous and serous were found. In young and lactating *O. cuniculus*.

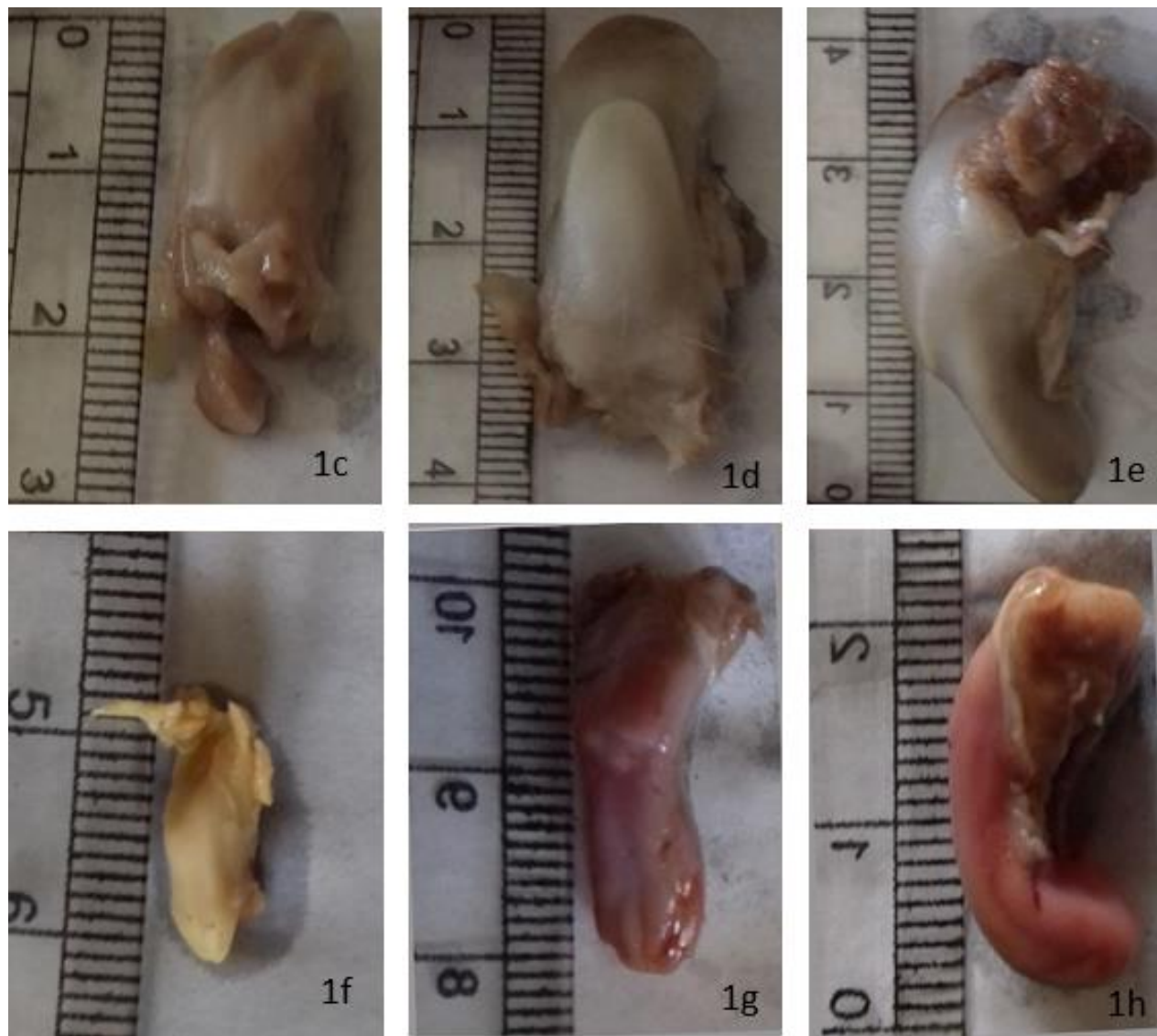


Figure 1: Photographs show external feature of studied animals. (a-b):a- External feature of adult of rabbit *O. cuniculus*. b- External feature of adult rat *R. rattus*; c- External feature of adult tongue of *O. cuniculus*. d- External feature of young tongue of *O. cuniculus*; e- External feature of lactating tongue of *O. cuniculus*; f- External feature of adult tongue of *R. rattus*; g- External feature of young tongue of *R. rattus*; h- External feature of lactating tongue of *R. rattus*.

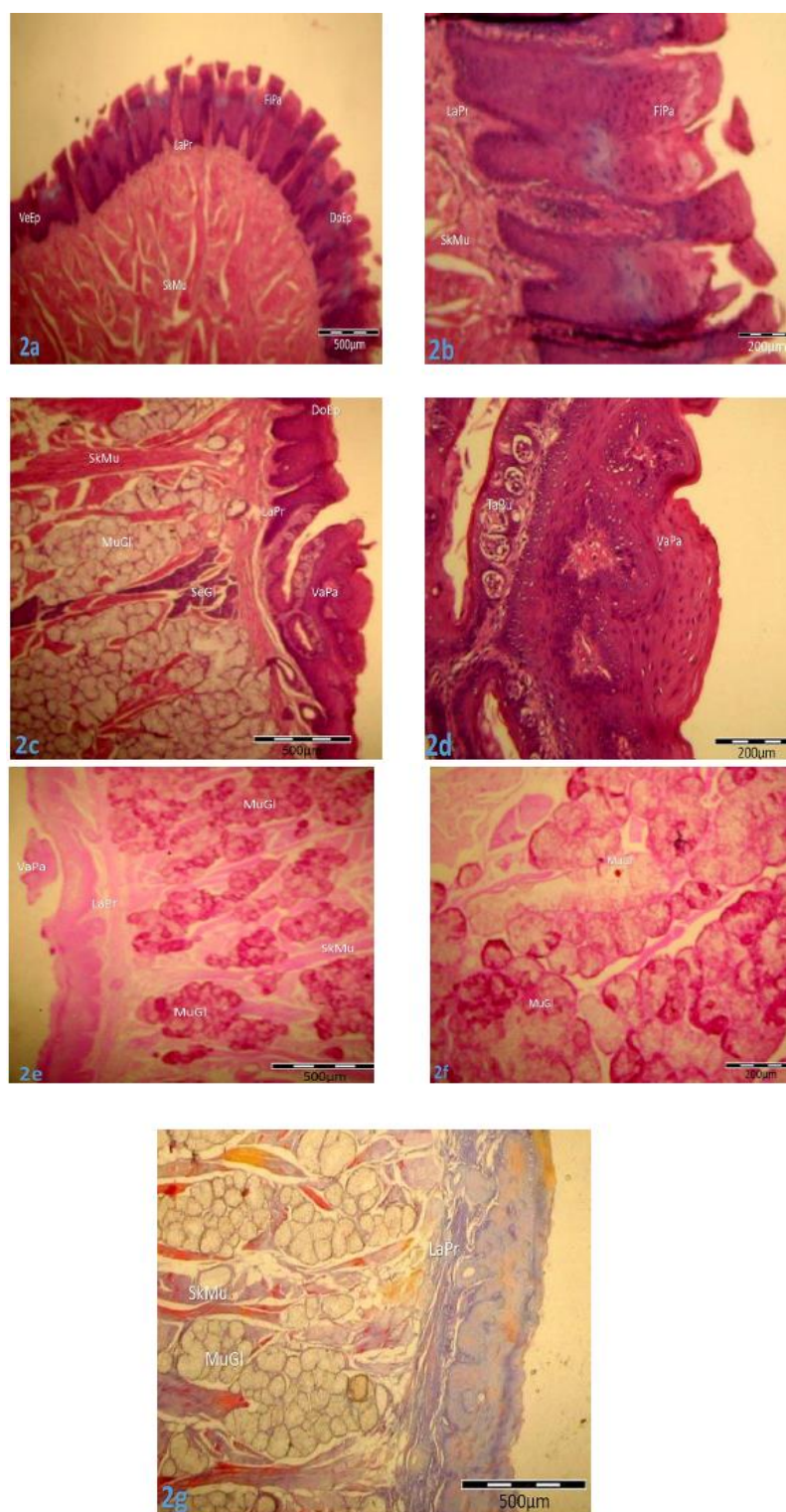


Figure 2: Photomicrographs of adult tongue sections of rabbit *O. cuniculus* to show different type of papillae. (a-g): a, b - Transverse sections in the anterior lateral part of *O. cuniculus* tongue showing filiform papillae (Fi Pa), lamina propria (La Pr) and muscles (Mu) Hand E; c- Transverse section in the posterior part of *O. cuniculus* tongue showing circumvallate papillae (Va Pa), lamina propria (La Pr), mucous gland (Mu Gl) and muscles (Mu) Hand E; d- Transverse section in the posterior part of *O. cuniculus* tongue showing circumvallate papillae (Va Pa), and taste buds (Ta Bu) Hand E; e, f- Transverse sections in the posterior part of *O. cuniculus* tongue showing numerous Mucous Glands (Mu Gl) give strong reaction with (PAS) stain; g- Transverse section in the posterior part of *O. cuniculus* tongue showing the Mucous Gland (Mu Gl) give weak reaction with azan stain.

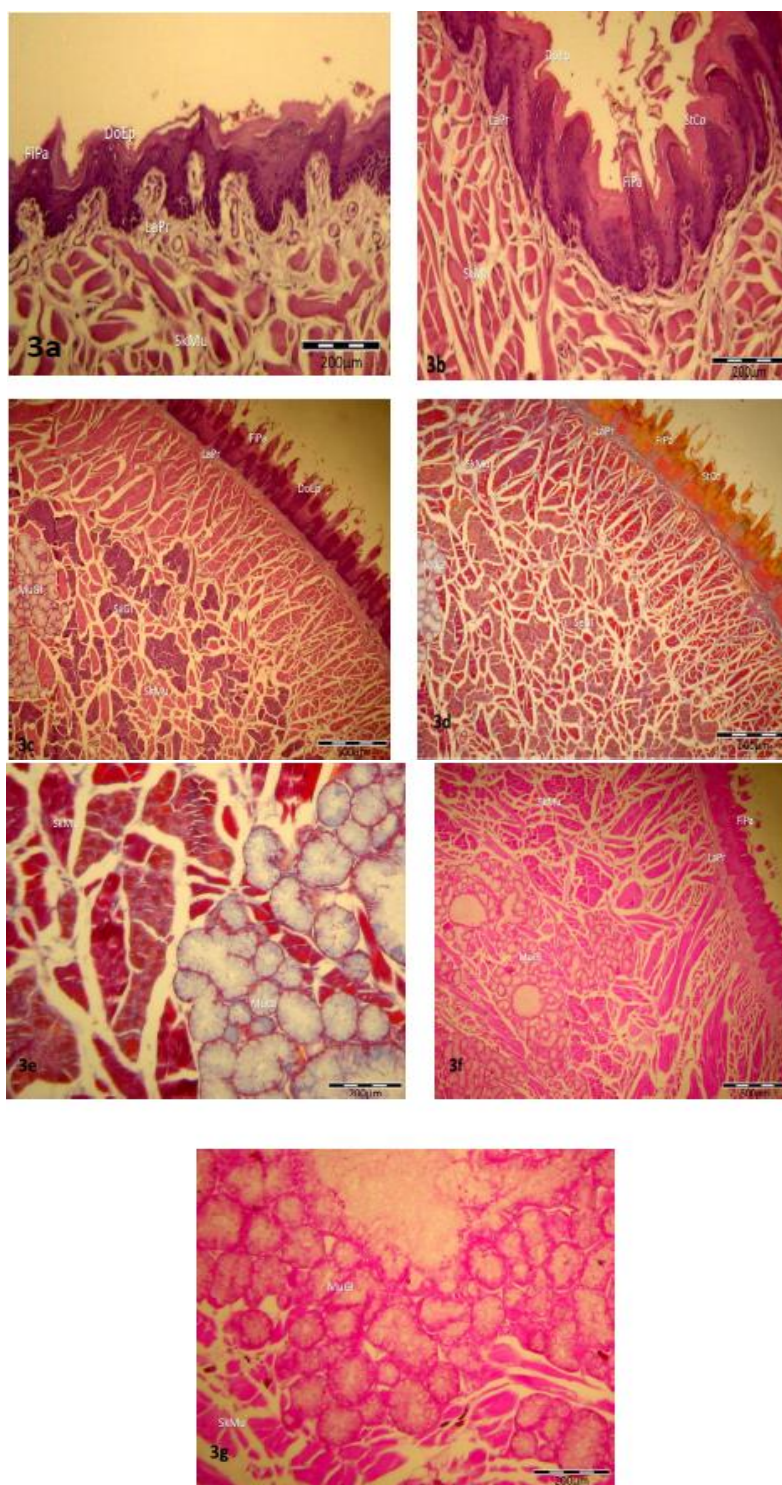


Figure 3: Photomicrographs of adult tongue sections of *R. rattus* to show different type of papillae. (a-j): a- Transverse section in the anterior part of *R. rattus* tongue showing filiform papillae (FiPa), muscles (Mu) and lamina propria (La Pr) Hand E; b- Transverse section in the anterior part of *R. rattus* tongue showing Elongated Horny Filiform Papillae (EHFiPa), Muscles (Mu) and Lamina Propria (LaPr) Hand E; c- Transverse section in the posterior part of *R. rattus* tongue showing Filiform Papillae (FiPa), Mucous Gland (MuGl), Serous Gland(SeGl), Muscles (Mu) and Lamina Propria (LaPr) Hand E; d, e- Transverse section in the posterior part of *R. rattus* tongue showing mucous glands (MuGl) give weak reaction while serous gland give moderate reaction with azan stain .and g- Transverse sections in the posterior part of *R. rattus* tongue showing Mucous Glands (MuGl) and serous glands (SeGl) give very moderate reaction with Schiff reagent of (PAS) stain.

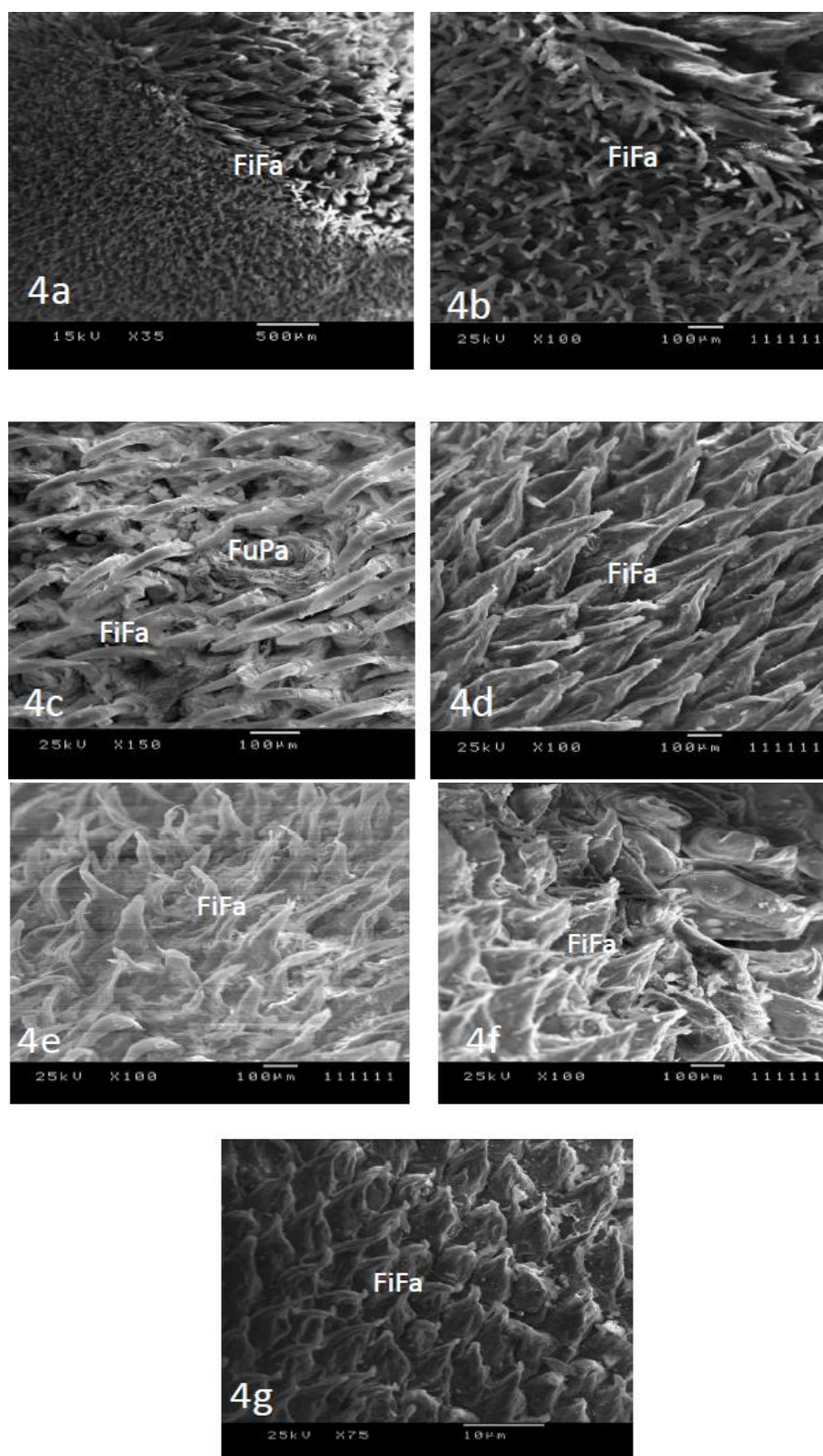


Figure 4: Scanning Electron Micrographs of adult tongue *O. cuniculus* to show different type of papillae. (a-g): a, b- Scanning electron micrographs of anterior part of *O. cuniculus* tongue showing Elongated Filiform Papillae (EFiPa) and short filiform papillae (SFiPa); c- Scanning electron micrograph of anterior part of *O. cuniculus* tongue showing fungiform papillae (FuPa) and filiform papillae (FiPa). d, e- Scanning electron micrograph of middle part of *O. cuniculus* tongue showing filiform papillae (FiPa); f, g- Scanning electron micrograph of posterior part of *R. aegyptiacus* tongue showing filiform papillae (FiPa).

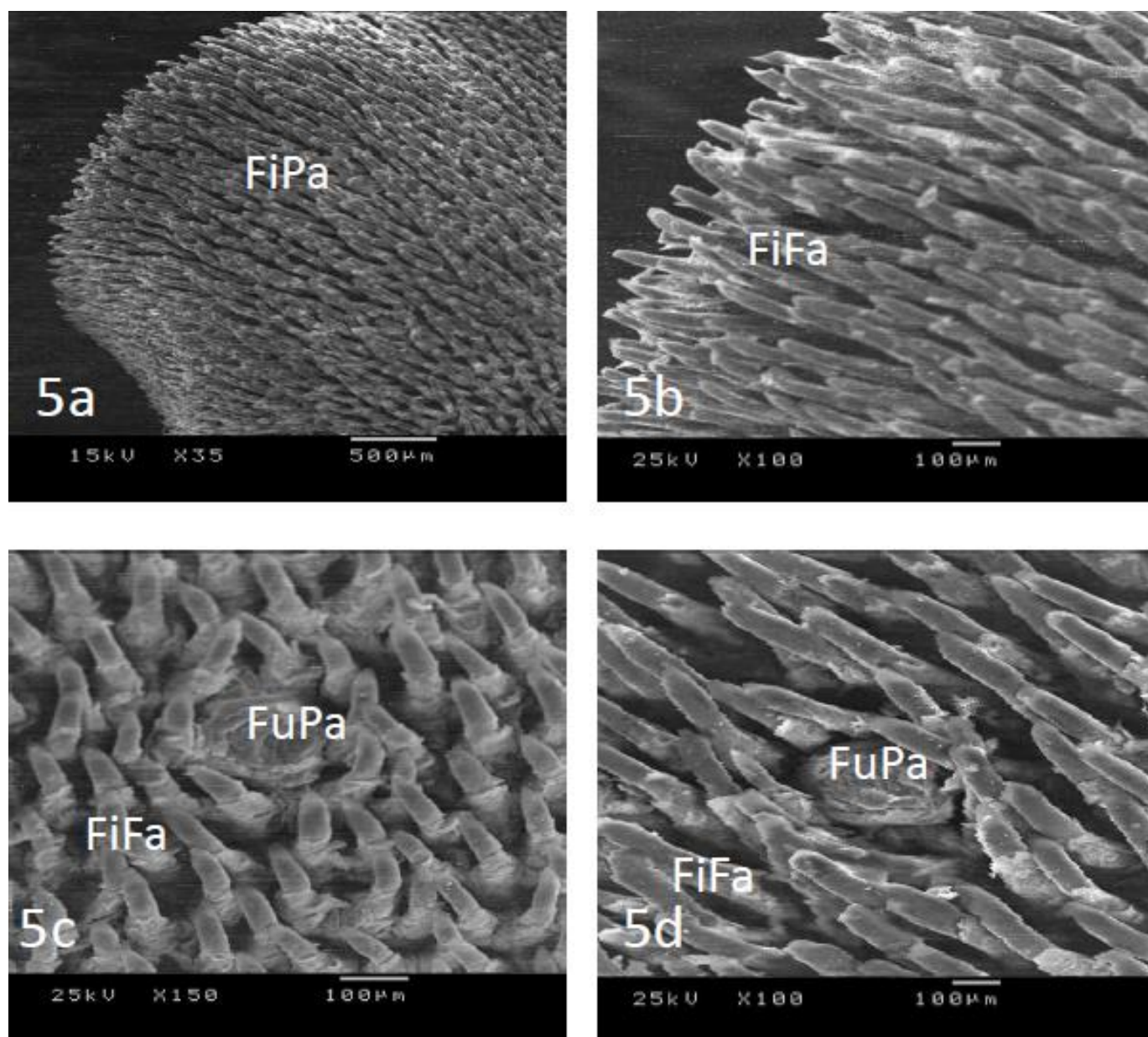


Figure 5: Scanning Electron Micrographs of adult tongue *R. rattus* to show different type of papillae. (a-d): a, b- Scanning electron micrograph of anterior part of *R. rattus* tongue showing serratiform filiform papillae (FP); c, d- Scanning electron micrograph of middle part of *R. rattus* tongue showing fungiform (FuP), filiform papillae (FP) .

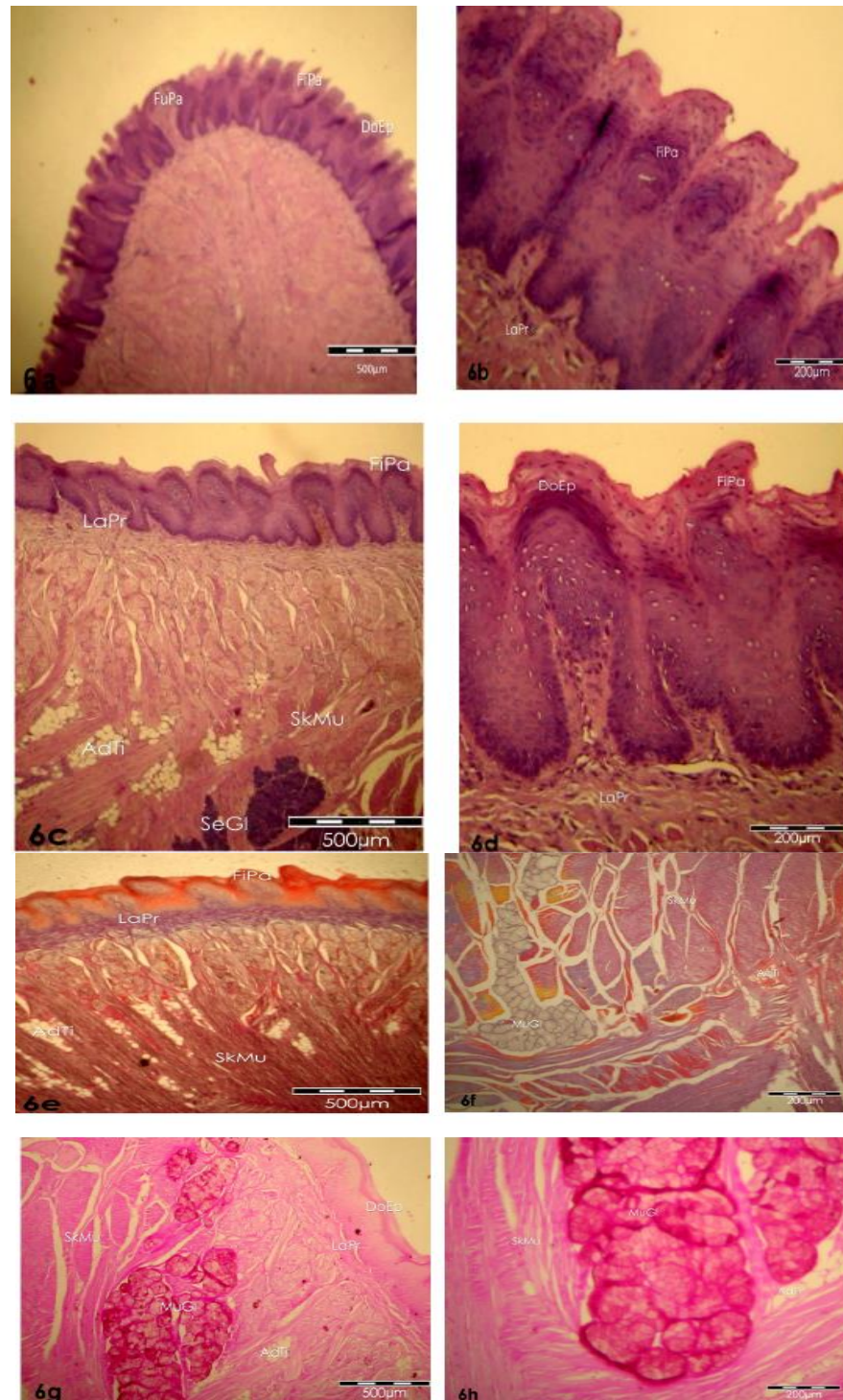


Figure 6: Photomicrographs of young tongue sections of rabbit *O. cuniculus* to show different type of papillae. (a-h): a - Transverse sections in the anterior lateral part of *O. cuniculus* tongue showing Filiform Papillae (FiPa), fungiform papillae (FuPa), Lamina Propria (La Pr) and Muscles (SkMu) Hand E; b- Transverse section in the anterior part of the tongue of *O. cuniculus* showing Filiform Papillae (FiPa), Hand E; c- Transverse section in the posterior part of *O. cuniculus* tongue showing filiform papillae (FiPa), Lamina Propria (LaPr), Mucous Gland (MuGl), Adipose Tissue (AdTi) and muscles (Mu) Hand E; d- Transverse section in the posterior part of *O. cuniculus* tongue showing filiform papillae (FiPa) and lamina propria (LaPr) Hand E; e- showing Filiform Papillae (FiPa), Lamina Propria (LaPr), Mucous Gland (MuGl), Adipose Tissue (AdTi) and muscles (Mu) with azan; f- Transverse section in the posterior part of *O. cuniculus* tongue showing Mucous Gland (MuGl) give negative reaction with azan; g, h- Transverse sections in the posterior part of *O. cuniculus* tongue showing Mucous Glands (MuGl) give moderate reaction with (PAS) stain.

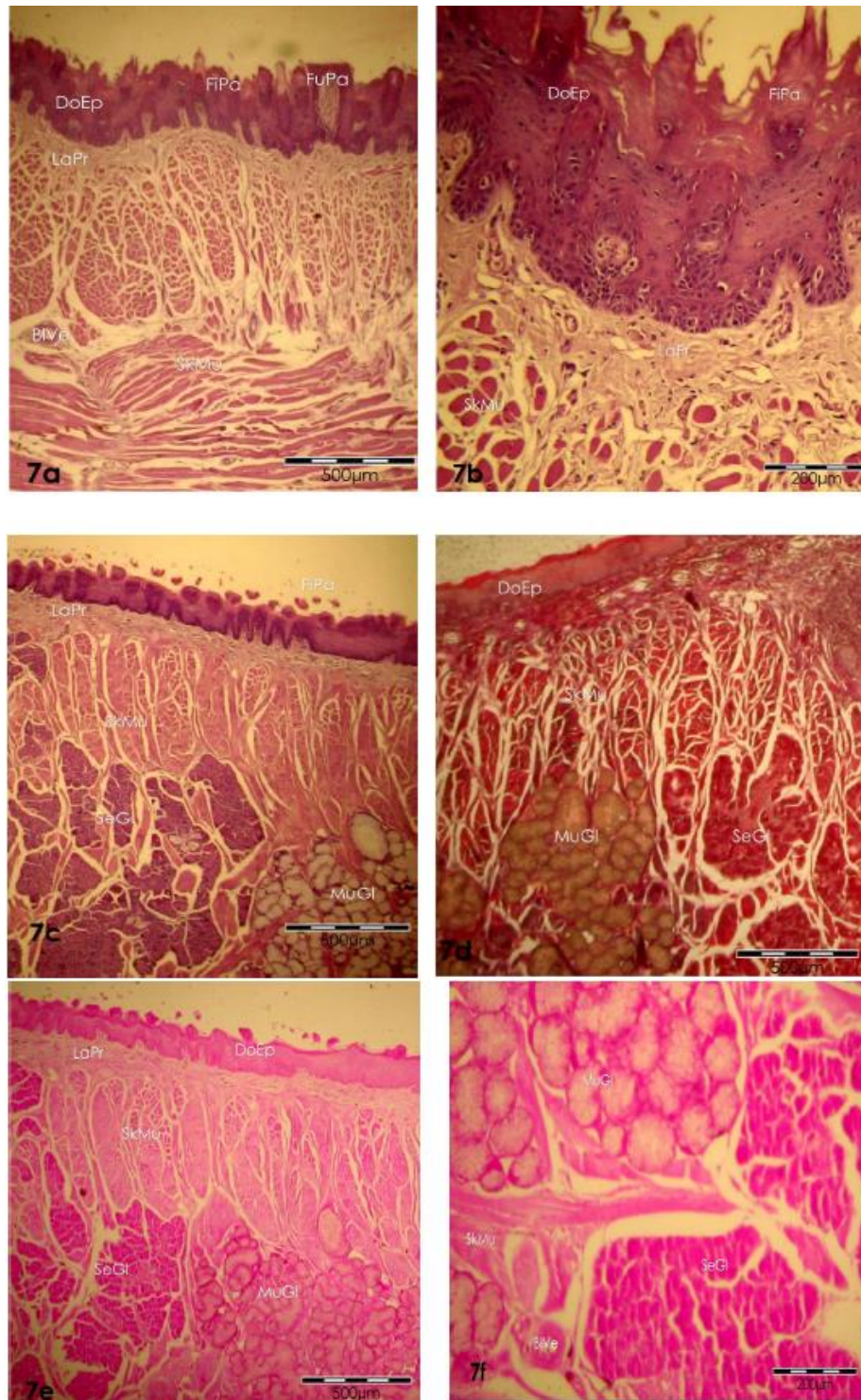


Figure 7: Photomicrographs of young tongue sections of *R. rattus* to show different type of papillae. (a-f): a- Transverse section in the anterior part of *R. rattus* tongue showing Filiform Papillae (FiPa), Fungiform Papillae (FuPa), Muscles (Mu) and Lamina Propria (LaPr) Hand E; b- Transverse section in tongue showing filiform propria (LaPr) Hand E. middle line of the anterior part of *R. rattus* papillae (FiPa), muscles (Mu) and lamina; c- Transverse section in the posterior part of *R. rattus* tongue showing horny Filiform Papillae (FiPa), Fungiform Papillae (FuPa), Mucous Glands (MuGl), Serous Gland (SeGl), Muscles (Mu) and lamina propria (La Pr) Hand E; d- Transverse section in the posterior part of *R. rattus* tongue showing Mucous Glands (MuGl) give weak reaction while serous gland (SeGl) give moderate reaction with azan stain; e, f- Transverse sections in the posterior part of *R. rattus* tongue showing Mucous Glands (MuGl) and Serous Glands (SeGl) give moderate reaction with Schiff reagent of (PAS) stain.

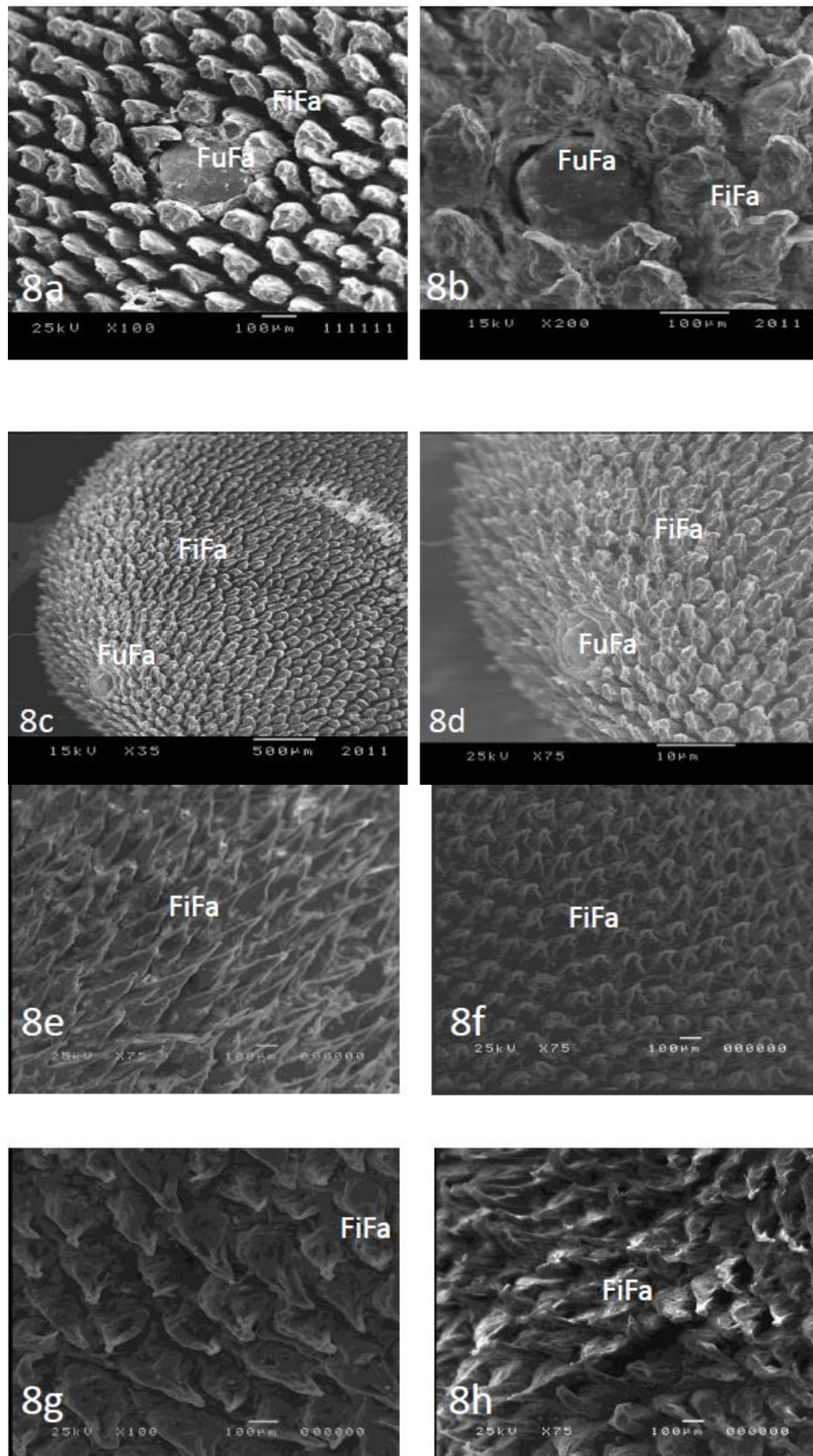


Figure 8: Scanning Electron Micrographs of adult tongue *O. cuniculus* to show different type of papillae. (a-h): a, b, c, d- Scanning electron micrographs of anterior part of *O. cuniculus* tongue showing Filiform Papillae (FiPa) and Fungiform Papillae (FuPa); e, f- Scanning electron micrograph of middle part of *O. cuniculus* tongue showing Filiform Papillae (FiPa); g, h - Scanning electron micrograph of posterior part of *R. aegyptiacus* tongue showing Filiform Papillae (FiPa).

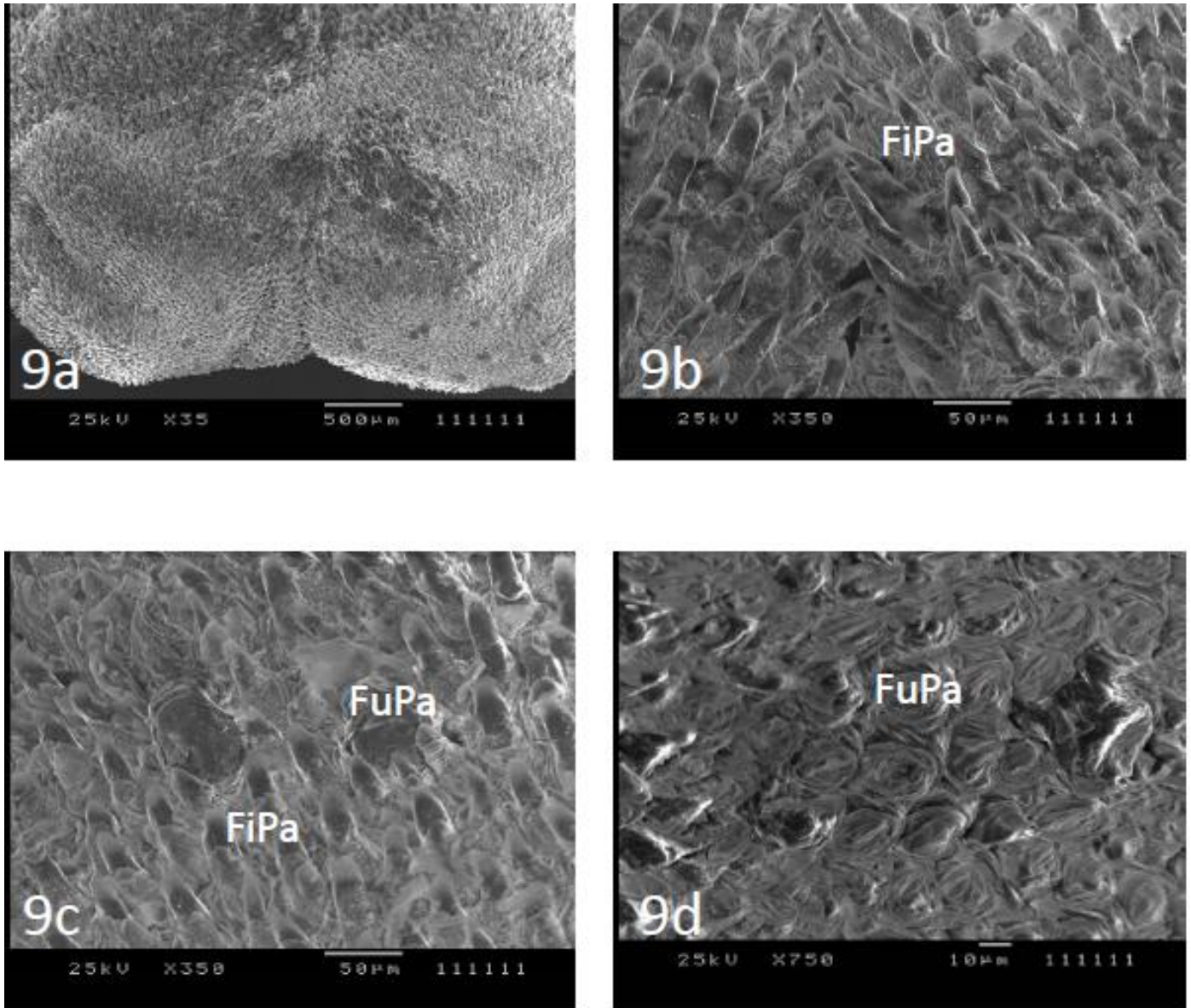


Figure 9: Scanning Electron Micrographs of young tongue *R. rattus* to show different type of papillae. (a-d): A- Scanning electron micrograph of anterior part of *R.rattus* tongue showing Filiform Papillae (FiPa), Fungiform Papillae(FiPa); b- Scanning electron micrograph in middle line of anterior part of *R.rattus* tongue showing Filiform Papillae (FiPa); c- Scanning electron micrograph of middle part of *R. rattus* tongue showing Filiform Papillae (FiPa), Fungiform Papillae(FuPa); d- Scanning electron micrograph of posterior part of *R. rattus* tongue showing Fungiform (FuPa).

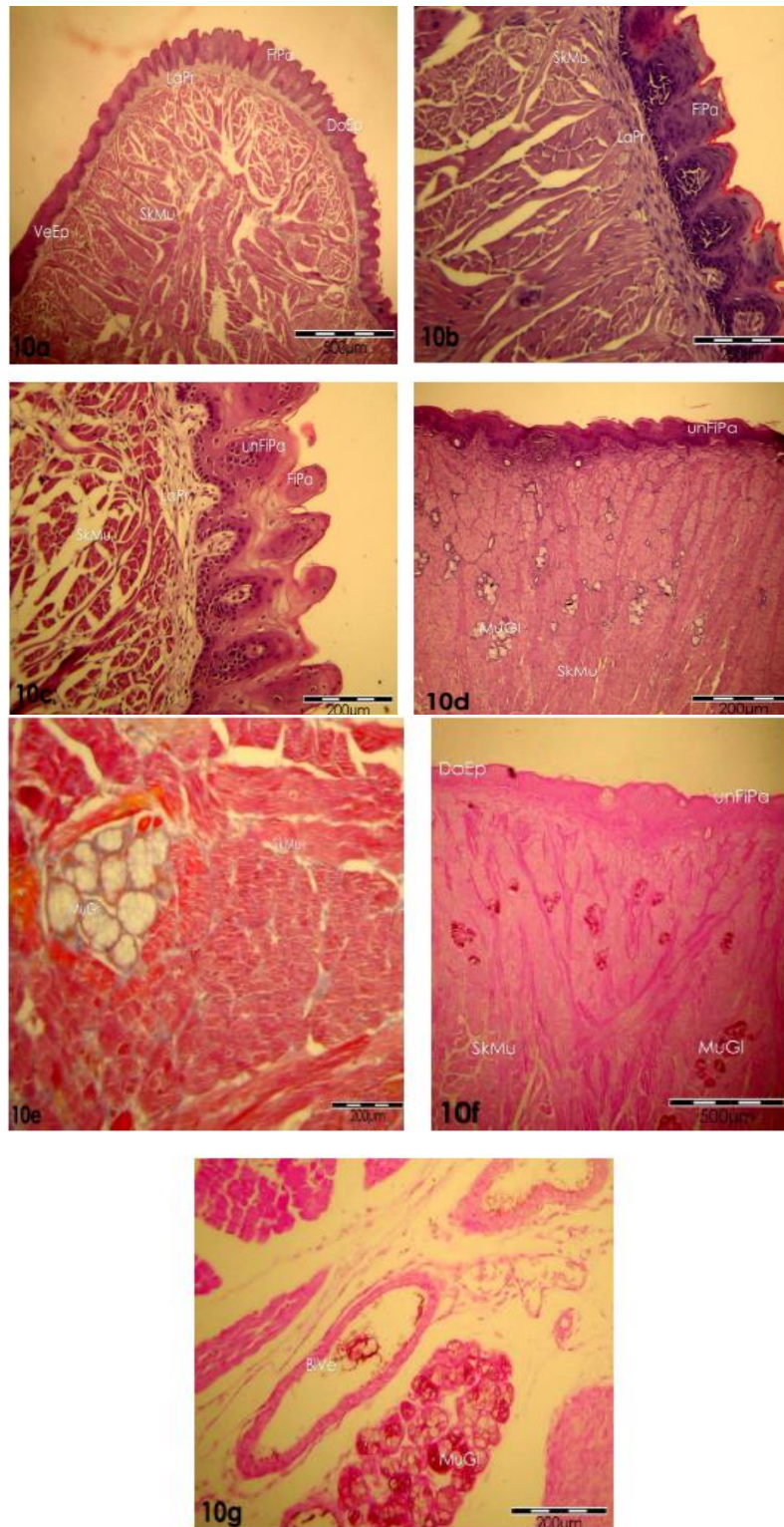


Figure 10: Photomicrographs of lactating tongue sections of rabbit *O. cuniculus* to show different type of papillae. (a-g): a - Transverse sections in the anterior lateral part of *O. cuniculus* tongue showing Filiform Papillae (FiPa), Lamina Propria (LaPr) and Muscles (Mu) Hand E; b, c- Transverse section in the anterior part of the tongue of *O. cuniculus* showing filiform papillae (FiPa), Undifferentiated Filiform Papillae (unFiPa), Hand E; d- Transverse section in the posterior part of *O. cuniculus* tongue showing Undifferentiated Filiform Papillae (unFiPa), Lamina Propria (LaPa), Mucous Gland (MuGl) and muscles (Mu) Hand E; e- Transverse section in the posterior part of *O. cuniculus* tongue showing Mucous Gland (MuGl) give negative reaction with azan stain; f, g- Transverse sections in the posterior part of *O. cuniculus* tongue showing Mucous Glands (MuGl) give weak reaction with (PAS) stain.

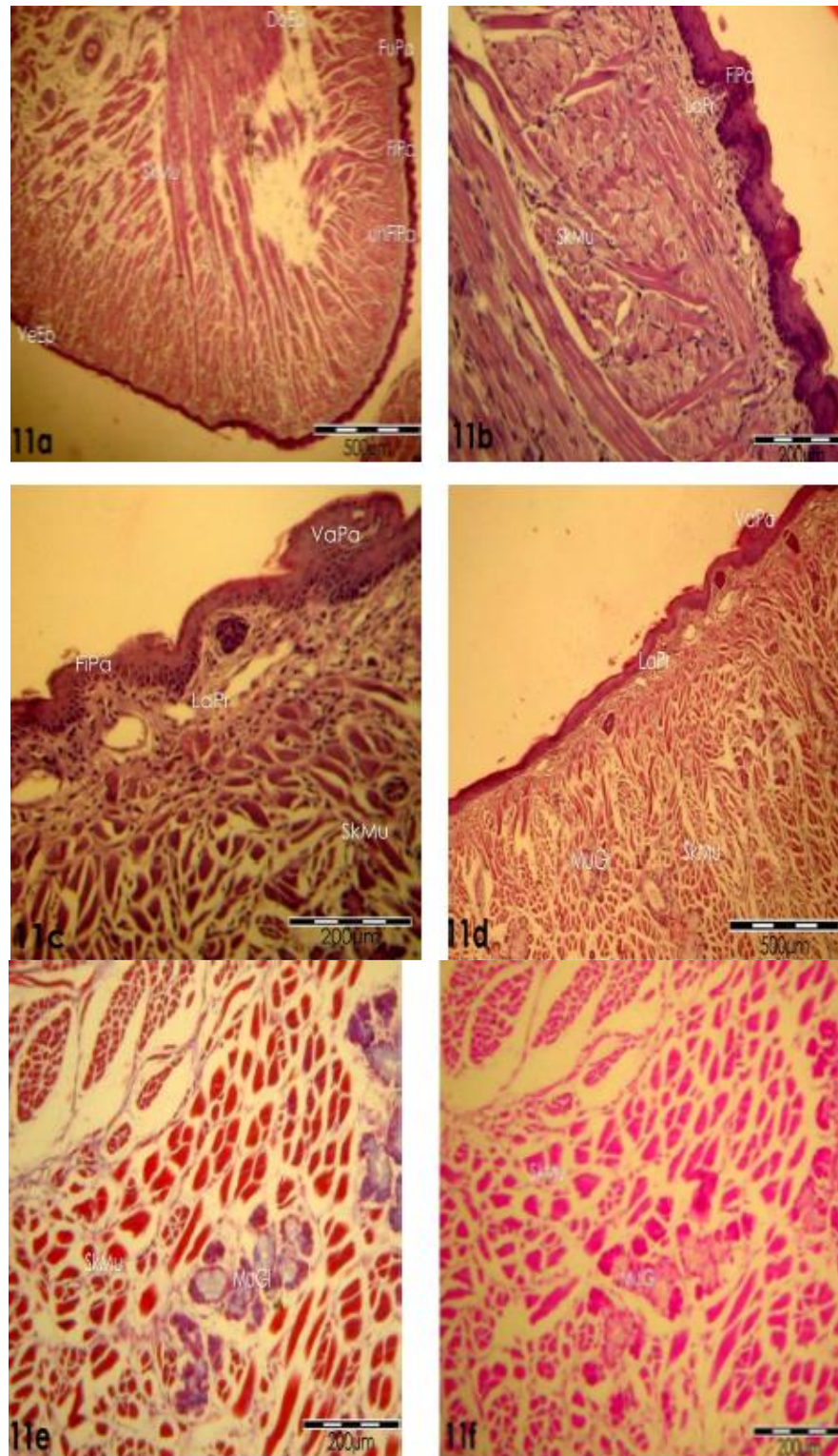


Figure 11: Photomicrographs of lactating tongue sections of *R. rattus* to show different type of papillae. (a-f): a- Transverse section in the anterior lateral part of *R. rattus* tongue showing Filiform Papillae (FiPa), Fungiform Papillae (FuPa), Muscles (Mu) and Lamina Propria (LaPr) Hand E; b- Transverse section in the anterior part of *R. rattus* tongue showing Filiform Papillae (FiP), Muscles (Mu) and Lamina Propria (LaPr) Hand E; c, d- Transverse section in the posterior part of *R. rattus* tongue showing Vallate Papillae (VP), Fungiform Papillae (FuPa), Muscles (Mu) and Lamina Propria (LaPr) Hand E; e- Transverse section in the posterior part of *R. rattus* tongue showing Mucous Glands (MuGl) give weak reaction with azan; f - Transverse section in the posterior part of *R. rattus* tongue showing Mucous Glands (MuGl) give very weak reaction with Schiff reagent of (PAS) stain.

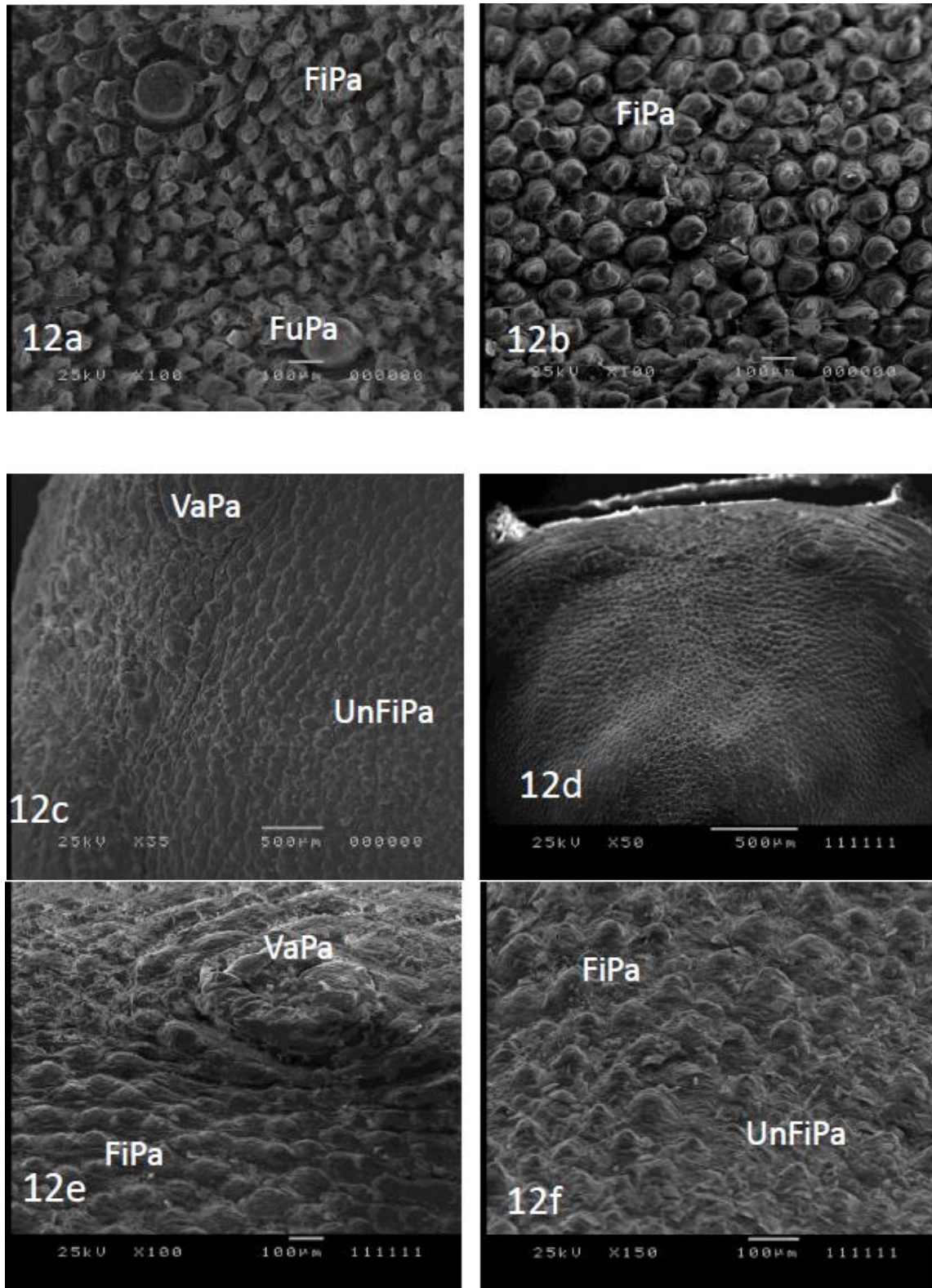


Figure 12: Scanning Electron Micrographs of lactating tongue *O. cuniculus* to show different type of papillae. (a-f): a- Scanning electron micrographs of anterior part of *O. cuniculus* tongue showing Filiform Papillae (FiPa) and fungiform papillae (FuPa); b- Scanning electron micrograph of middle part of *O. cuniculus* tongue showing Filiform Papillae (FiPa); c, d, e- Scanning electron micrograph of posterior part of *R. aegyptiacus* tongue showing Filiform Papillae (FiPa) and Vallate Papillae (VaPa); f- Scanning electron micrograph of posterior part of *R. aegyptiacus* tongue showing filiform papillae (FiPa) and undifferentiated Filiform Papillae (un FiPa).

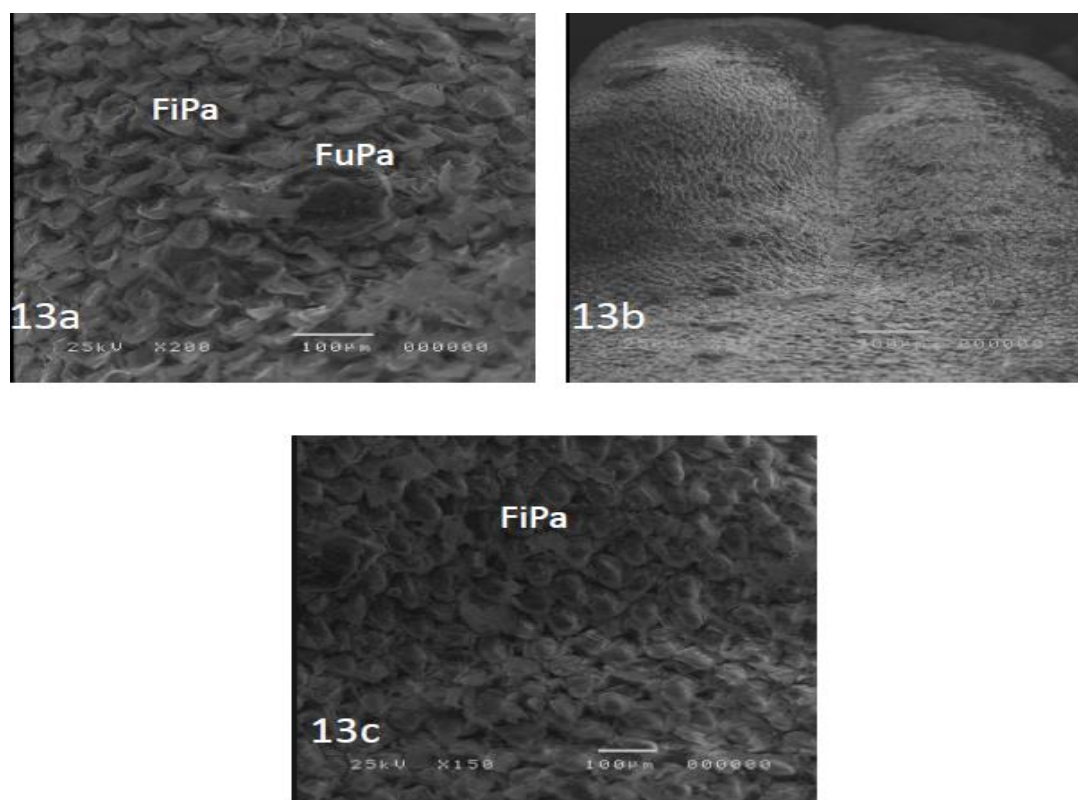


Figure 13: Scanning Electron Micrographs of lactating tongue *R. rattus* to show different type of papillae. (a-d): a- Scanning electron micrograph of anterior part of *R. rattus* tongue showing Filiform Papillae (FiPa), Fungiform Papillae (FuPa); b- Scanning electron micrograph in middle line of anterior part of *R. rattus* tongue showing Filiform Papillae (FiPa); c- Scanning electron micrograph of middle part of *R. rattus* tongue showing Filiform Papillae (FiPa), Fungiform Papillae (FuPa); d- Scanning electron micrograph of posterior part of *R. rattus* tongue showing Fungiform (FuPa).

Discussion

Adult Tongue

The muscular part of the tongue of *Oryctolagus cuniculus* and *Rattus rattus* is complicated as in *R. aegyptiacus* and *T. nudiventris* because of difference of food habit [15]. Also, in adult Egyptian and Syrian *Pipistrellus kuhli* [4]. In the current study, the tongue is thick and elongated in Rabbit but moderate in rat with around apex. Iwasaki, et al., revealed that the shape of the tongue affects the feeding habit as it is responsible for the transformation of food to the mouth [16].

In the present study, anteriorly the epithelium is more keratinized than the posterior that make the tongue rigidity to become more efficient for feeding. Keratinization was also described in mammals [17,18]. The filiform papillae observed distributed mainly at the apex on the surface of the tongue of *Oryctolagus Cuniculus* where the filiform are long and collected together in large groups, also the fungiform papillae are scattered mainly on the dorsal and lateral surface rounded [3]. This observation different from Egyptian bats *Rousettus aegyptiacus* and *Taphozous nudiventris* in which the fungiform papillae distributed laterally and also different from that found in Egyptian and Syrian *P. Kuhli* [4]. Different from a finding that the tongue is elongated and free anterior part to facilitate the movement of the tongue while swiping the extracts of fruit pulp or licking nectar in fruit bats similar to the case with that of Kunz, et al., but different from the present herbivorous Rabbit and rodent rats [19]. The arrangement of the filiform papillae in the Poznan Poland Egyptian fruit eating bat are different from the studied animals in which there are two subtypes of filiform papillae [20]. The presence of fungiform papillae between the filiform in Posteriorly of the tongue may focus to the taste sense of the food accumulation in this part before swallowing. The presence and the distribution of the circumvallate papillae with their triangle shape observed in the blood drinking bat "*Desmodus rotundus*" recorded [15]. There were amount of mucus glands give strong reaction with PAS reaction of Rabbit than rat in the present study.

Lactating and Young Tongue

In the development and growth of the tongue at the histological and cytological level must be control by various factors, such as nerves, hormones and many kinds of growth factors. The outline of the tongue in the rat fetus appeared at day 12, only two rows of hemisphere dump shaped eminence which were identified as the rudiment of fungiform papillae were arranged at these stages on either side of the median sulcus on the dorsally of the tongue [21]. At the lactating stage of Rat there were a median sulcus at the posterioly without differentiation of papillae at the anterior part different from the case of *R. aegyptiacus* about three months, there were a median sulcus without differentiation of papillae at the anterior part of the tongue. But in the tongue of *T. nudiventris* there is no median sulcus at this lactating stage. Histochemically, at the posterior region of the lactating stage of Rabbit there are few numbers of mucus glands that give strong PAS reaction than those of rat as happen in *R. aegyptiacus*. In the young the mucus glands were very large in Rabbit than those of rat.

Many studies demonstrate that the dorsal epithelium at the middle or late period of gestation (E15) did not include any rudiments of filiform papillae and no signs of keratinization were observed. By contrast, rudiments of the filiform papillae were clearly recognized in the dorsal epithelium of the tongues of newborn mice just after birth [22]. Thus, morphogenesis of the filiform papillae of mice occurs rapidly during days 2 or 3 just before birth. Significant numbers of keratohyalin granules and keratinized cells are present in new-born mice at P0 as presented by scanning electron microscopy. Paulson, et al., and Iwasaki, et al., showed that filiform papillae at P0 are distributed in the same patterns as those observed in the mature adult, however, their shapes are clearly differed from those of the corresponding papillae in the adult [22,23]. In the fruit and nectar eating bats, the micro structure of the tongue has been investigated in the large flying fox (pteropus vampyrus), short-nosed fruit bat (cynopterus brachyotis), and other species belonging to phllostomidae [24,25]. The findings of these studies showed the presence of two types of mechanical papillae (filiform and conical papillae) for food manipulation and two types of gustatory papillae (fungiform and vallate papillae) for taste preception. In the dentition fruit –eating bats, the characteristic traits of the tongue include pronounced canines for cutting the surface of fruit and flattened post canines for delete food particles [24].

In the insectivorous *R hardwickei* and *A tridens*, the tongue is complex and the epithelium anteriorly of the tongue is keratinized if compared with the posterior which make the tongue with greater rigidity to be help for feeding [26]. The surface of the tongue has four types of lingual papillae: two types of mechanical papillae – filiform and conical papillae and two types of gustatory papillae-fungiform and vallate papillae. Most numerous are the filiform papillae with well-developed keratinized processes. These papillae are represented by four morphological subtypes: small, giant, elongated, and bifid papillae. Iwasaki, et al., studied the morphogenesis of three types of lingual papilla in the mouse by scanning electron microscope after collecting of different stages of development from day 15 of gestation to day 7 after birth [23].

In the fetuses at E15, rudiments of fungiform papillae with a relatively regular, lattice-like pattern were visible on the anterior half of the dorsal surface of the tongue, the rudiments of each of the three different kinds of lingual papilla appeared at different respective stages of development. In the rats, the rudiments of the fungiform and circumvallate papillae, which are related to the sense of taste, were visible earlier than those of the filiform papillae, which are not involved in this property [23]. In the Egyptian and Syrian bats P Kuhli the dorsal surface of the former specimen showed numerous filiform papillae, moderate number of fungiform papillae and small number of circumvallate, while in the latter specimen no circumvallate papillae were observed. The fungiform papillae are scattered mainly on the lateral surface and are mostly rounded in shape and are found in both species [4]. In the Egyptian fruit-eating bat Poznan Poland, the surface of the tongue has four types of lingual papillae, two mechanical and two gustatory [20]. In other mammals, three vallate papillae were distributed in a v-shaped structure each papilla was surrounded by a deep sulcus and an external pad. The filiform papillae exhibited crown or finger like shape structure [27]. In the present work, the filiform papillae are distributed mainly at the apex on the dorsal of the tongue, while the fungiform papillae are mainly scattered on the lateral surface and are rounded in shape. These structures are similar to the case found in the adult Egyptian P. kuhli [4]. In other mammals such as the rabbit *O. Cuniculus* the filiform papillae are long and gathered together in large groups. The elongated tongue in the Egyptian fruit bat has a flat surface and free anterior part which facilitate the movement of the tongue while swiping the extracts of fruit pulp or licking nectar [3]. The types and the arrangement of the filiform papillae in the Poznan Poland Egyptian fruit eating bat were different from both the fruit eating bat and the insectivorous bat in which there are only two subtypes of filiform papillae [20]. The occurrence of fungiform papillae among the filiform ones in the posterior part of the tongue may contribute to the taste perception of the food accumulation in this part before swallowing.

The distribution of few numbers of circumvallate papillae in the form of triangle observed in the blood drinking bats *D. rotundus* [28-32].

Summary and Conclusion

Our studies comprised; histological and histochemical observations, ultra structural examination and bio analysis to find the effect of different feeding habit on the structure of tongue of adult, young and lactating of both *O. cuniculus* and *R. rattus*.

Conflict of Interest

The authors have no conflict of interest to declare.

Availability of Data and Materials

The data set analyzed during the current study are available from the corresponding author and the main author with facilities in our department.

Contributions

The authors developed the study design, The laboratory analyses of faculty of medicine provide the electron microscope for scanning sections of tongue. The statistical analyses results data was performed by faculty of medicine.

Ethics Approval and Consent to Participate

This research was done in compliance with the ethical standard set by the faculty of science -Tanta University, Egypt.

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