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Research Article

HISTOLOGICAL STUDY OF TONGUE IN MALE AND FEMALE *RATTUS NORVEGICUS*

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ABSTRACT
The *Rattus norvegicus* carry a number of pathogens and causes or carries disease in humans and domestic animal and crop pest The purpose of this study was to investigate the microscopic and macroscopic structure of the its tongue and its relation to diet. In present research, the tongue of 8 adult male and 8 female rats was dissected from the root. Macroscopic features of tongue as weight, length and wide were measured. Then, they were fixed in formalin (10%) and prepared by tissue processing. The sections (5 μ) were subjected to Haematoxylin and Eosin stain. Morphometric analyses were performed by light microscopy and progress capture soft ware. Results showed that the keratinized stratified squamous epithelium covered dorsal part of tongue especially on apex and the lingual torus was on the posterior third. The numerous filiform papillae as mechanical papillae and a few fungiform and one circumvallate papillae as gustatory papillae with varied in distribution were observed on dorsum of tongue. Lingual glands were found spatially on posterior of ventral surface. According to these results, the structures of tongue in both sexes are similar and show morphological adaptations for variety of diet.

Key Words: *Papillae, Taste bud, Diet*

INTRODUCTION
Rodents With at least 4,000 species, are the largest group of mammals in the world (Vaughan *et al.*, 2000). True rats are members of the genus *Rattus*, the most important of which to humans are as Brown rat or *Rattus norvegicus* (Fragaszy *et al.*, 2003). They adapt to life in most any habitat especially wherever that is an abundance of food. Although Brown rats (*Rattus norvegicus*) are originally native to northern China but they occurred in every country (Nowak and Paradiso, 1983) and they found in Iran especially southern parts. They carry a number of pathogens and causes or carries disease in humans and domestic animal and crop pest (Meerburg *et al.*, 2009).
The selective ingestion or rejection of nutrients are related to anatomical structure of tongue and importance lingual papillae in this is very much. The brown rat is a true omnivore and will consume almost anything, but cereals form a substantial part of its diet.
Histological structure of the tongue was investigated on light microscope and scanning on EM in many vertebrates as reptiles (Cízek *et al.*, 2011), birds (Parchami *et al.*, 2010) and mammals (Ebura *et al.*, 2004; Jackowiak *et al.*, 2009). Tongue, Teeth and other parts of mouth cavity in rodents as rabbit (Nonaka *et al.*, 2008), mouse (Carrard *et al.*, 2008) and wistar rat (Taiwo *et al.*, 2007; Nasr *et al.*, 2012) was studied previously.
The tongue of mammals is muscular organ with three layers including mucosa, submocosa and muscularis. Mucosa is covered by psudostratified squamous epithelium with variation in the keratinization. Six types of the lingual papillae with different density and distribution were known in mammals (Jackowiak and Godynicki, 2007). These papillae are divided to mechanical (filiform.P, fugiform.P, conical.P) and gustatory papillae (vallate.P, foliate P, lentiform.P).
Filiform papillae are needle shape and they were oriented to pharynx. They were divided to three distinct types as type I, II and III that are varied in process (Jwasakis, 2002). In some vertebrate, fungiform
Papillae has both mechanical and gustatory role (Topark, 2006).
According to previous study, the foliate papillae are in almost rodent (Miller & Chaudhry, 1976) and horse but don't developed in carnivorous animals (Kobayashi *et al.*, 2003) and absent in Ruminants

(Kobayashi *et al.,* 2004). In this study, structure of tongue especially lingual papillae in relation with diet were investigated in *Rat (norvegicus*) on light microscopy and compared in both sexes of them.

MATERIALS AND METHODS

The tongue of 8 adult male and female rats (*norvegicus*) was dissected from the root. Their weight, length and wide in apex, body and root, were measured. Then, they were fixed in neutral buffered formalin (10%) for 48 hours and prepared by tissue processing (dehydrated with alcohol 70–100%, clearing by xylol and paraffin impregnation). The serial sections (5 μm) were obtained by microtome and subjected to Haematoxylin and Eosin stains. The morphometric features of the tongue were studied by light microscope and progress capture soft ware.

RESULTS AND DISCUSSION

Three parts (apex, body and root) were distinguished on the tongue of norvegicus rat in both sexes (Table 1) and are mammal's like composed of three layers as follows:

Mucosa was covered by keratinized stratified squamous epithelium, thick submucosa with blood vessels and glands (almost serous) and thick muscularis layer in dorsal surface (Figure 1, 2). The gustatory papillae include fungiform (Figure6) and Vallate papilla (Figure7) and mechanical type include filiform papilla (Figure 2) with different density and distribution, were observed on dorsum of tongue (Table 2).

Table1: Comparatives characteristic of tongue in *Rattus norvegicus*

Parameter	Female (8 N)	Male (8 N)
Mean± S.E of length	2.85±0.16 Cm	2.69±0.14 Cm
Mean± S.E of width(Apex)	.0.42±0.12 Cm	.0.58 ±0.11Cm
Mean± S.E of width(Body)	0.60±0.10 Cm	0.65 ±0.00Cm
Mean± S.E of width(Root)	1.15±0.02 Cm	1.20±0.02 Cm
Mean± S.E of weight	1.013±0.12	0.98±0.02

Table2: Comparatives characteristic of lingual papillae in *Rattus norvegicus*

Male (8 N) Size (mm)	Female (8 N) Size(mm)	location	Density	Papillae
A:0.201 W:0.132	A:0.204 W:0.139	Apex and lateral sides	A few	Fungiform
A:1.01 W:3.87	A:0.90 W:3.50	Anterior of root	one (N)	Vallate
A: 0.286 W: 0.068	A:0.280 W:0.073	over entire surface (anteriolateral)	numerous	Filiform

**A: (attitude), W: (width)*

The epithelium of fungiform papillae had one taste bud on dorsal surface (Figure 6) and one circumvallate papillae with macroscopic size were observed on front of the root (Figure 9). There is less keratinisation on the ventral surface and many glands (serous, mix and mucous gland), thick lamina propria and more muscular mass (circular and longitudinal) was observed in this surface (Figure 3, 4). The most of muscle were transverse bundle and longitudinal bundle were between them (Figure 1, 2). The Colagenous fiber And cartilage was in anterior (Figure 1, 8).

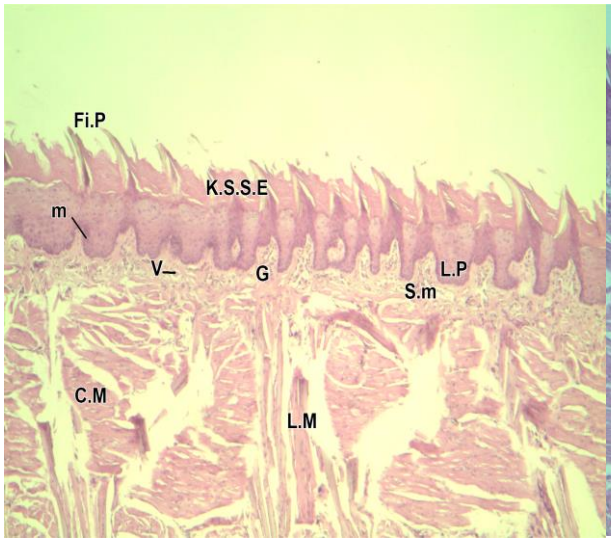

Figure 1: Apex of tongue in male *(Rattus norvegicus)* - (10x- H&E)
Keratiized stratified squmose epithelium (K.S.S.E) lamina propria (L.P); mucosa (m); vessel(V) submucosa(Sm); longitudinal muscle (L.M) circular muscle (C.M); filiform papilla (Fi.P)

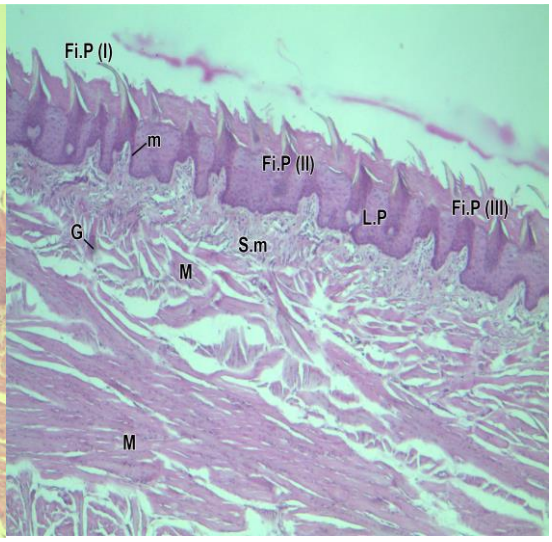

Figure 2: Apex of tongue in female *(Rattus norvegicus)* - (10x- H&E)
Stratified squamous; filiform papilla (Fi.PI, II, III); lamina propria (L.P); mucosa (m) submucosa(S.m); muscle (M); gland (G)

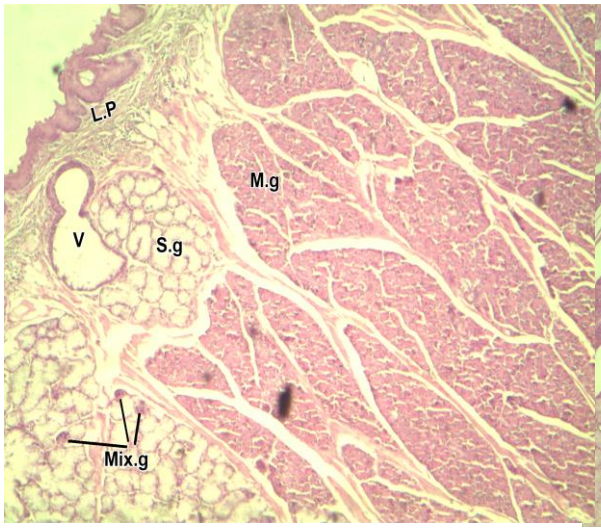

Figure 3: Body of tongue in male *(Rattus norvegicus)* - (10x- H&E)
Lamina propria (L.P); vessel (V); mucus gland (M.g); serous gland (S.g); mix gland

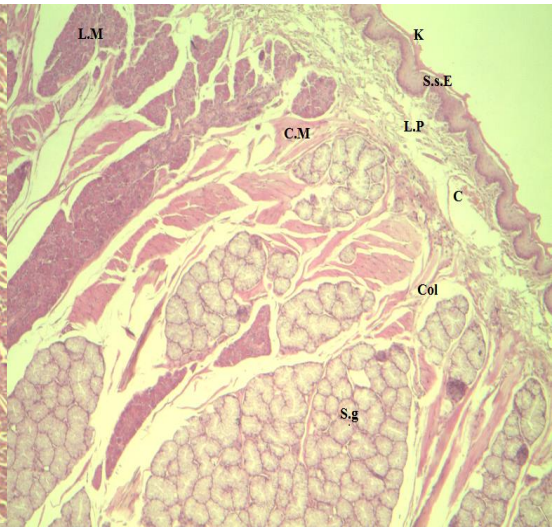

Figure 4: Body of tongue in Female *(Rattus norvegicus)* - (10x- H&E)
Lamina propria (L.P); connective tissue (C); keratin(K); longitudinal muscle (L.M); circular muscle (C.M)

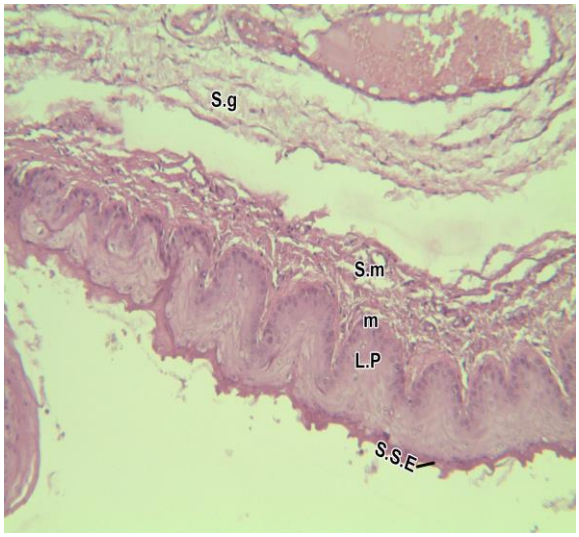

Figure 5: Posterior of tongue in male *(Rattus norvegicus)* - (10x- H&E) Lamina propria (L.P); mucosa(m) submucosa(Sm); serous gland (S.g)

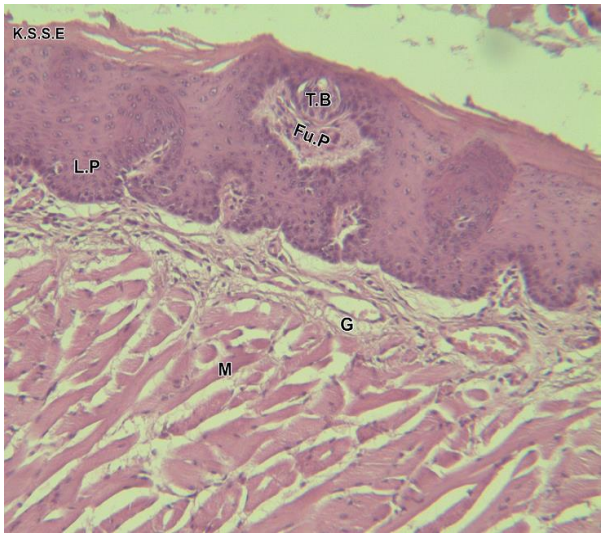

Figure 6: Posterior of tongue in female *(Rattus norvegicus)* - (10x- H&E) Keratinized strat. Squ. epith (K.S.S.E); lamina propria(L.P); muscle (M); gland (G); Fungiform. P(Fu.P); taste bud(T.B)

Figure 7. Circumvallate papilla on tongue in *(Rattus norvegicus)* - (10x- H&E) Psudostratified squamous (Ps.S.E); blood vessel(b); circumvallate . P(ci.P); taste bud (T.b); cleft (cl)

Figure 8. Cartilage in anterior of tongue in *(Rattus norvegicus)* - (10x- H&E) Cartilage (Car)

Discussion

In present study, anatomy of tongue especially lingual papillae was observed with light microscope and compared in female and male *Rattus norvegicus.*

The tongue is a strong muscle that is covered by the lingual membrane. The surface of the tongue is very bumpy. The keratinization on epithelium of its dorsum aid to protection of tongue spatially on apex so the risk of food's collision is higher. According previous study (Iwasaki *et al.,* 1999; Nonaka *et al.,* 2008), stratified squamous epithelium and thick keratin on filiform.P was necessary for protection against damage due to taking hard food.

The filiform papilla due to consisting of some processes, divided to two types include type I & II which the type I almost were on apex (Benetti *et al.,* 2009). This type were needle shape that is suitable for taking particle and type II with thick connective tissue in own process, is suitable for most contiguity and crushing. The density and distribution of papillae were different and decreased from the apex to root of tongue. Thick keratinized epithelium of filiform.P related to its mechanical role and high density on apex and its orientation to pharynx, facilitate to taking food particles and swallow them (Jackowiak & Godinicki, 2007; Ebru *et al.,* 2010).

Presence of the taste buds were in the epithelium of the fungiform, vallate and foliate papillae referred to gustatory role for them. Although fungiform.P is mechanical papillae in most of mammals (Benetti *et al.,* 2009) but thin keratin and one taste buds on conical surface of it, referred to its gustatory function. On the contrary finding of Taiwo et al (2009), most of the fungiform.P were on side of body of tongue. Present result may be related to the feeding habits and varied diet in this species.

The foliate papillae were observed on tongue in some vertebrates (Jackowiak, 2006) and the most of rodent have this papillae with different number from 34 rows in flying squirrels (Emura et al. 1999), 15–20 rows by in rabbits (Kobayashi, 1992) and four to six rows in mice (Toprak, 2007). On the contrary above findings, in this study wasn't seen the foliate papillae (Adeniyi *et al.,* 2010).

The one circumvallate papillae (Figure 9) is suited front of root (Kobayashi *et al.,* 2004). Its location may be related to its role for helping in taste reception. This papillae is oval and big as seen without microscope, has many taste buds in lateral walls epithelium (Figure 7) and tubular canal is around it (Miller and Chaudhry, 1976). The number of this papillae from noting to 14 is varies with species in mammals (Kobayashi *et al.,* 2005). Brown rats are omnivorous and eat a huge variety of foods as milk to meat, vegetables, poultry, all grains and fruits (Meerburg & Singleton, 2009). The serous, mucous and mix glands which were in submocusa and related to taste buds via its canal and aid to gustatory (Figure 3). The most of glands were serous especially in ventral surface (Figure 4).

Thick epithelium and keratin in dorsal surface especially on apex and presence of three types filliform papillae (Figure 2) are useful for contacting hard food. Although the oral epithelium covered by keratin in all of mammals but keratinization is variable and related to their diets (Kobayashi *et al.,* 2004).

Thick lamina propria with blood vessel and collagenous fiber supported the mucosa well (Figure 3). The muscles and collagenous bundle like in all mammals, allows a range of complex movements for mastication (Ofusori *et al.,* 2008). Furthermore, collagenous fibres are seen surrounding the most transverse muscle bundle in the anterior portion of the tongue. It is believed to confer on the tongue, tensile strength needed for protraction and retraction which in association with the complex muscular allows considerable and complex tongue extensions. On the other presence of taste buds in fungiform and vallate papillae confirm to begging of food digestion. The (one) taste bud on conical surface of fungiform papillae (Figure 6) were exposed to food, masticated and facilitated to swallow food particles (Taiwo *et al.,* 2009).

Conclusion

Obtained results showed that morphology and microscopic anatomy of tongue are similar in both sexes of this species (Kobayashi *et al.,* 2003). Their structural specifications are taxonomic and adaptations to their feeding patterns.

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