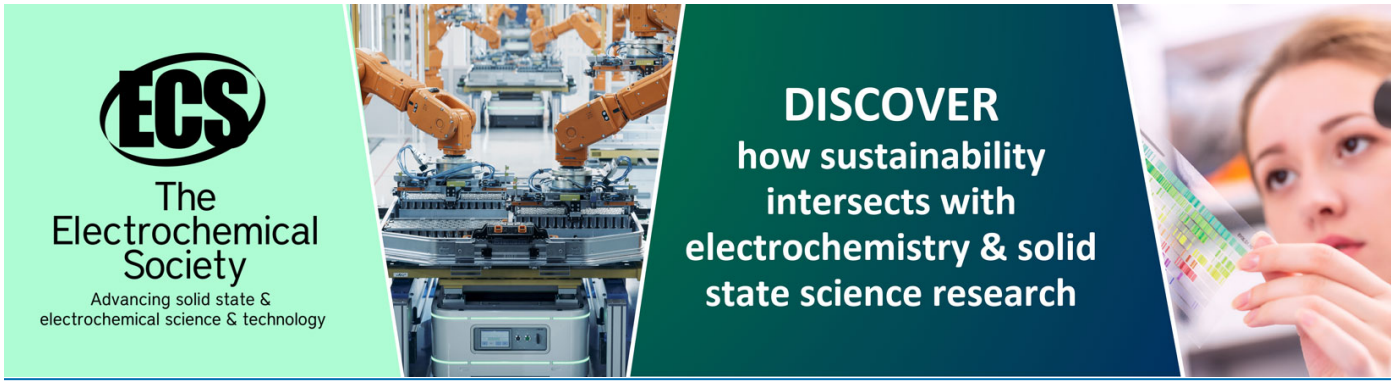
Histological structure of the Tongue in Mongoose (*Herpestes javanicus*)



Histological structure of the Tongue in Mongoose (*Herpestes javanicus*)

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Abstract. The aim of the present study was to investigate the histological structure of the tongue in Mongoose (*Herpestes javanicus*) and its related to the feeding pattern. Five adult animals were used in this study . The tongues were dissected and fixed in 10% formalin, then prepared by following stages (dehydration, clearing, and embedding).The serial section(5µ) were stained with(H&E) and some special stains.The histological examination showed that the tongue consists of three tunicae (mucosa, submucosa and musclaris) and the lining epithelium of the filiform papillae is composed of keratinized stratified squamous epithelial tissue. The cylindrical papillae are covered with a highly keratinized stratified squamous epithelial tissue, whereas the keratinized stratified squamous epithelium tissue is weakly keratinized at fungiform papillae, whilst circumvallate papillae are non-keratinized. The medullary of the papillae consists of a loose connective tissue which is considered as the lamina propria of the tongue, while the tunica submucosa consists of dense connective tissue. The muscularis is composed of skeletal muscle fibres arranged in three direction longitudinal, transverse and obliquate. The lingual glands(Von-Ebner and Weber) placed on both sides of the lingual root at the tunica submucosa and extend to the tunica muscularis .This study pointed out that the secretion of glands is mixed and the mucin is more neutral than acid.

Keywords. Mongoose , Histology, Tongue, Mucin histochemistry.

1. Introduction

The mongoose (*Herpestes javanicus*) is a mammal that belongs to the order carnivora from family of Herpstidae [1].The tongue as taste organ has important role in digestion and swallowing of food in all vertebrates [2, 3, 4]. Tongue's has been studied in different mammals, such as hedgehog (*Hemiechinus auritus*) [5] ,local mice (*Mus musculus*) [6],wild rabbit (*Oryctolagus cunculus*) [7], bat (*Pipistrillus kuhli*) [8] and Lesser hedgehog tenrec (*Echinops telfari*) [9]. The scarcity of studies in endangered wild Iraqi mammals have been a stimulant suggestion of the current study involving mongoose that no data investigated. There is no information on the structures of histological and histochemical features of the tongue in this species of wild animal in Iraq. The present study was designed to describe the microstructure of the tongue and histochemical structure of the lingual glands in mongoose and this results were compared with those of other mammals.

2. Materials and Methods

Five adult mongoose were used in this study .The animals were dissected and removed the tongues. The specimens were fixed in 10% formalin for 72 hours and processed routinely by following stages (dehydration, clearing and embedding).Serial sections(Transverse and Longitudinal) were obtained at 5µ thickness for a rotary microtome. The section were stained in haematoxylin and eosin for general histological examination and some special stains such as shiffs reaction periodic acid (PAS) for demonstrate neutral mucins, Alcian Blue (AB) (pH 2.5) for acidic mucins, PAS/AB to assess the neutral from acidic mucins and Masson's trichrome for detect collagenous fibers [10]. The slides (sections) were mounted and examined with light microscope and photomicrograph by (MEIJI TECHNO) microscope with Omax camera.

3. Results and Discussion

The histological study of the mongoose the subject of the current study showed that the tongue consists of the three tunicae ,the tunica mucosa, which consists of two layers (lining epithelium and lamina propria), tunica submucosa and tunica muscularis (Fig. 1) and this result agree with [11] while the current results contradict some studies [7, 12, 13] because their study described connective tissue as a single layer placed within the tunica submucosa- lamina propria. This difference seems to be related to the structural composition based on functional requirements. The lining epithelium consists of keratinized stratified squamous epithelial tissue and contains lingual papillae and unlike the ventral surface which is non- keratinized and free of papillae (Fig. 2) and this result corresponds to previous studies [13, 14].

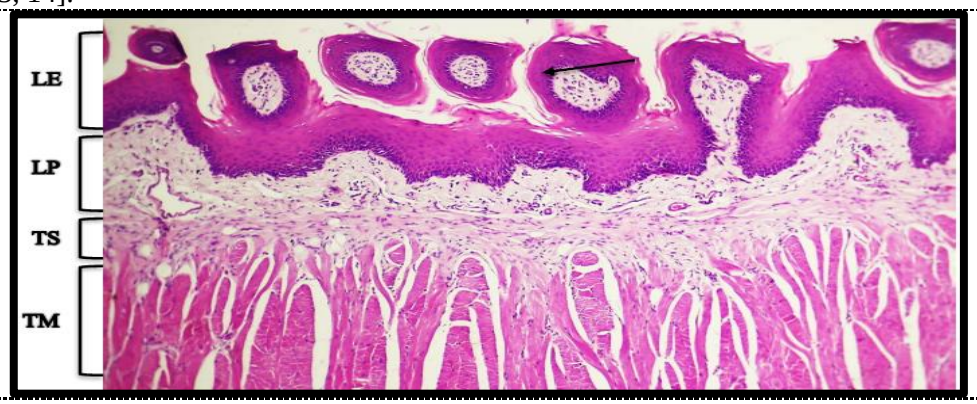

Figure 1. Cross section of lingual root in mongoose showing their components, lining epithelium (LE), lamina propria (LP), tunica submucosa (TS), tunica muscularis (TM). (H&E, 10x).

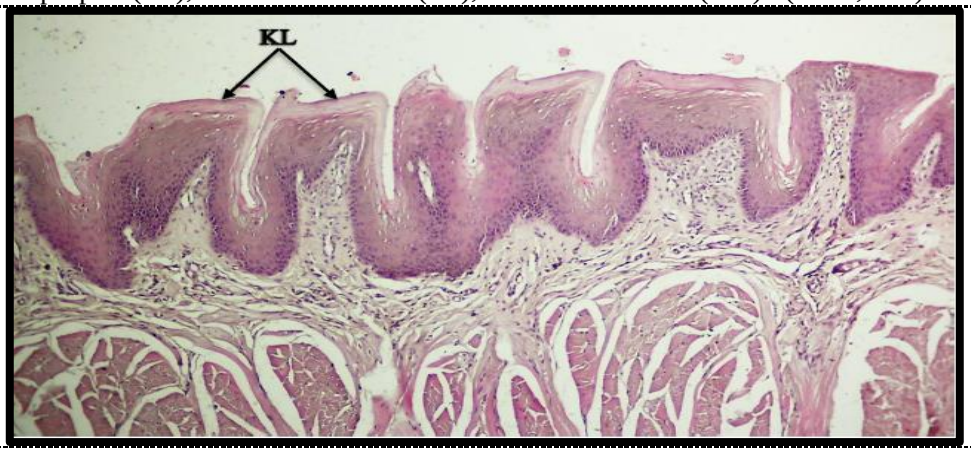

Figure 2. Cross section of lingual body in mongoose showing keratinized layer (KL). (H&E, 10x).

While lamina propria consists of loose connective tissue (Fig. 1) and this result corresponds to some studies [7] and contradict other studies which have shown that the lamina propria is composed of dense connective tissue [12, 15]. This variation is due to the pattern in the histological composition that based on function. The submucosa consists of dense connective tissue (Fig. 1) and this result is consistent with some studies [11, 16]. The presence of lingual glands in this tunica, which extends to the tunica muscularis (Fig. 3) was noted and this result is contrary to the study conducted on two species of wild rats (*Rattus wistar* and *Rattus norvegicus*) [11] because this result showed the position of the lingual glands in the lamina propria and perhaps the reason for the discrepancy is due to the fact that the animal in current study belong to carnivora order, while the mentioned study belongs to the rodents order, which vary in the pattern of nutrition. The tunica muscularis consists of skeletal muscle fibers arranged in three direction longitudinal, transvers and obliquate (Fig. 4) and this result corresponds to previous studies [5, 6, 17, 18]. This may be due to increased efficiency of the tongue in flipping and chewing food. The current study showed that the arrangement of muscle fibers varies between the three areas of the tongue, at the apex the arrangement of fiber takes an occasional direction at the medullary of the tongue and it is surrounded entirely by muscle fibers that take a longitudinal and transverse arrangement alternately (Fig. 5).

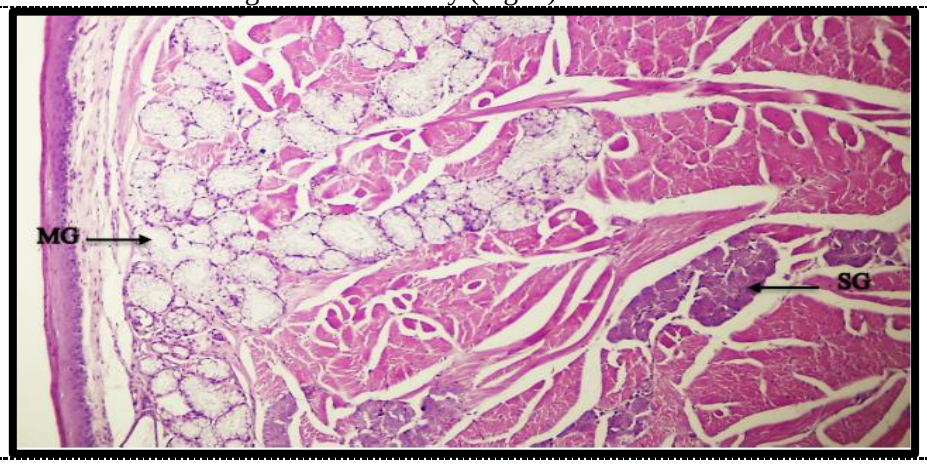

Figure 3. Lateral-cross section of lingual root in mongoose showing located of lingual glands within tunica submucosa and extened into tunica muscularis, mucous glands (MG), serous glands (SG). (H&E, 10x).

Figure 4. Cross section of lingual root in mongoose showing the tunica muscularis components and arrangement of longitudinal fibers (LF), transverse fibers (TF), obliquate fibers (OF). (H&E, 4x).

Figure 5. Cross section of lingual apex in mongoose showing the arrangement of muscle fibers (*) (H&E, 4x).

It was also noted that the surface layer of tunica muscularis at the dorsal and lateral surface in each body and root of the tongue is the arrangement of the fiber with a longitudinal and transverse exchange, while the muscular fibers at the core of the tongue are transverse as they take a radial form adjacent to the both sides the transverse fiber arrangement form in the shape of V letter (Fig. 6). While surface layer's fiber of tunica muscularis in the ventral side of tongue takes a longitudinal arrangement and there are blood vessels and nerves (Fig. 7). These results are in line with the results of [17] and this complexity in the arrangement of fiber is due to this animal depends on tongue largely during feeding as well as the fact that the muscle fibers form a basic mechanics to achieve different and precise movements of the tongue during chewing.

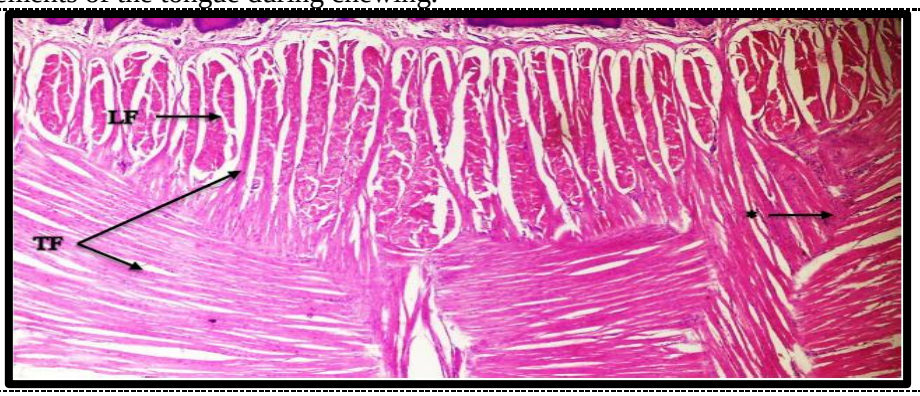

Figure 6. Cross section of lingual body in mongoose showing longitudinal fibers (LF), transverse fibers (TF) alternately, muscle fibers in form of V letter (*). (H&E, 10x).

Figure 7. Cross section of lingual body in mongoose showing keratinized layer (KL). (H&E, 10x).

This study showed that the lingual glands are positioned on both sides of the lingual root in the tunica submucosa and extend to the tunica muscularis (Fig. 3) and this result is contrary to the result of Lesser hedgehog tenrec (*Echinops telfairi*) [9] because the lingual glands are placed between the skeletal muscle fibers of tunica muscularis. The current study showed the presence of two types of glands first is the serous glands (von-Ebners) that fall forward (Fig. 8), the other type is mucous gland and seromucous gland (Weber's) which are positioned backwards (Fig 9), and this result is in line with many studies [5, 13, 18, 20]. Moreover, at the current study used some special stains to detect the type of secretions resulting from these glands. It was noted that the mucous glands give a positive result when stained with PAS, as they appear in a reddish purple color and this indicates that neutral mucin (Fig.10) and also give a positive result when stained with AB, pH: 2.5 and appear in a blue color, this indicated that the resulting secretion is acidic mucin material (Fig. 11) and these results correspond to some studies [13, 20]. But when stained in (PAS/AB, pH: 2.5) it is noted that many cells appear in a reddish purple color (implying that the secreted mucins are neutral) with a small number of cells in blue color (evidence of acidic mucins). We can conclude that the secretion of the glands is mixed mucins that are more neutral than acidic (Fig. 12) and these results are relatively consistent with the result of [13] and that this variation in the type of glandular secretions depends on the nature of the food eaten by the animal as mucous secretions of Weber's glands help to swallow food as well as facilitate the movement of the tongue, but the serous secretions of von-Ebners glands are centered in the partial digestion of food because it contains digestive enzymes.

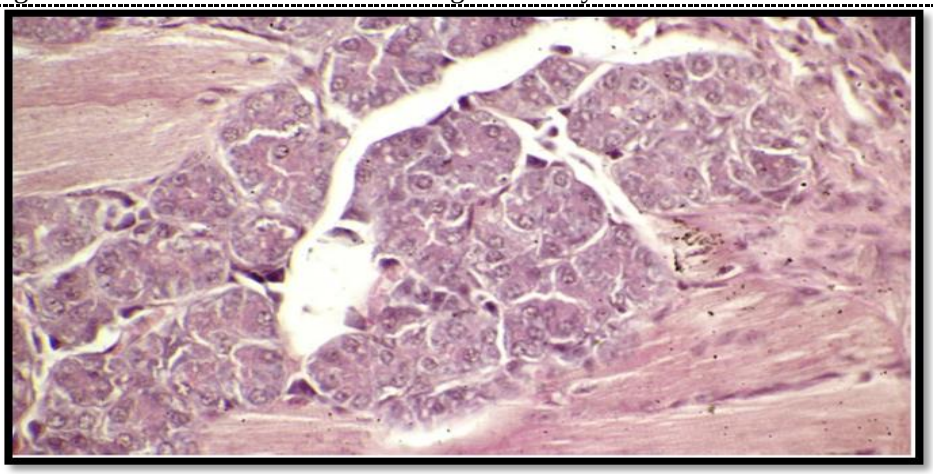

Figure 8. Cross section of lingual root in mongoose showing serous glands (von-Ebners). (H&E, 40x).

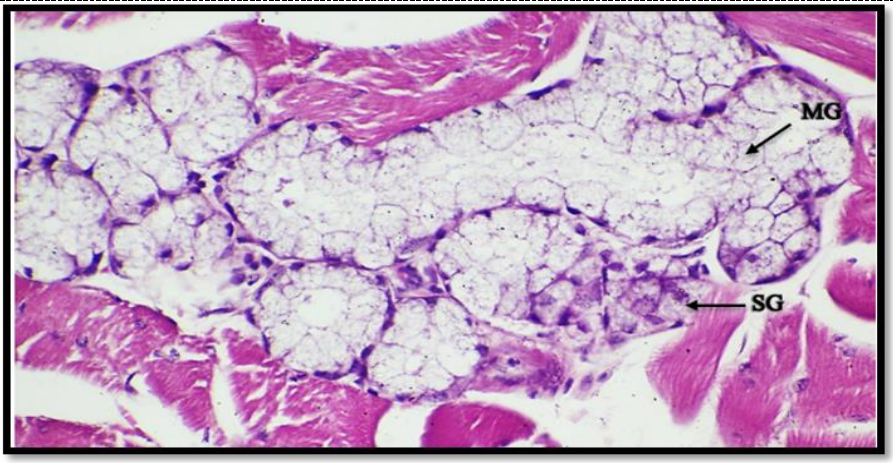

Figure 9. Cross section of lingual root in mongoose showing mucous glands (MG), serous glands (SG) (H&E, 40x).

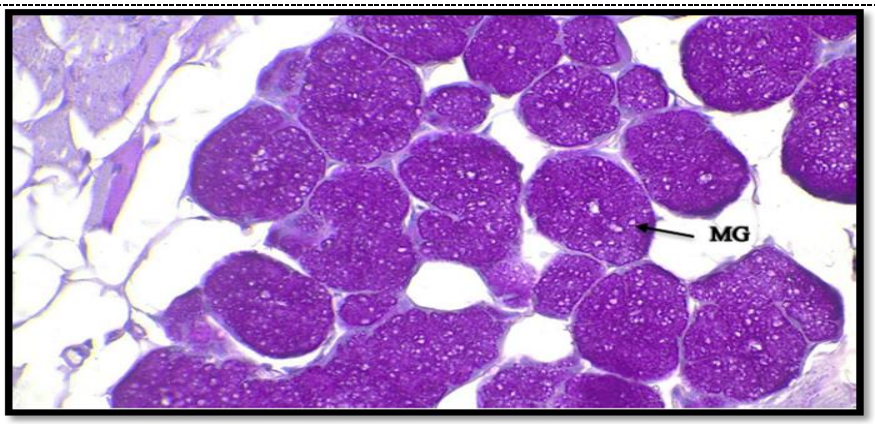

Figure 10. Cross section of lingual root in mongoose showing the positive reaction of mucin with PAS stain, mucous glands (MG). (PAS stain, 40x).

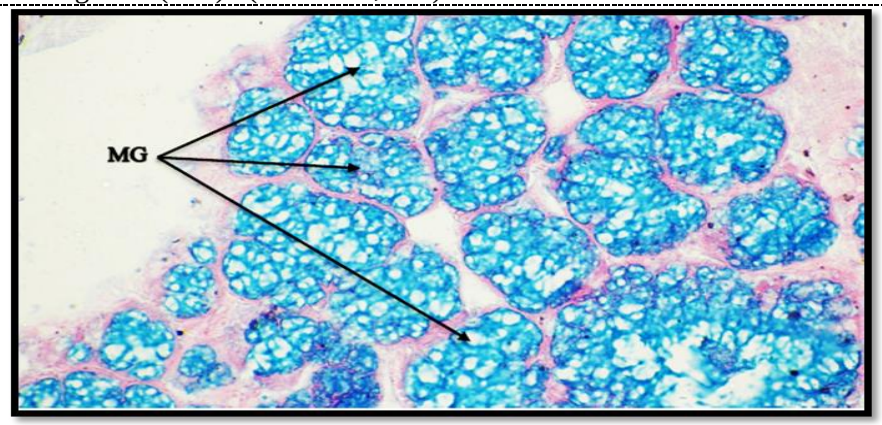

Figure 11. Cross section of lingual root in mongoose showing the positive reaction with AB stain, mucous glands (MG). (AB stain, 40x).

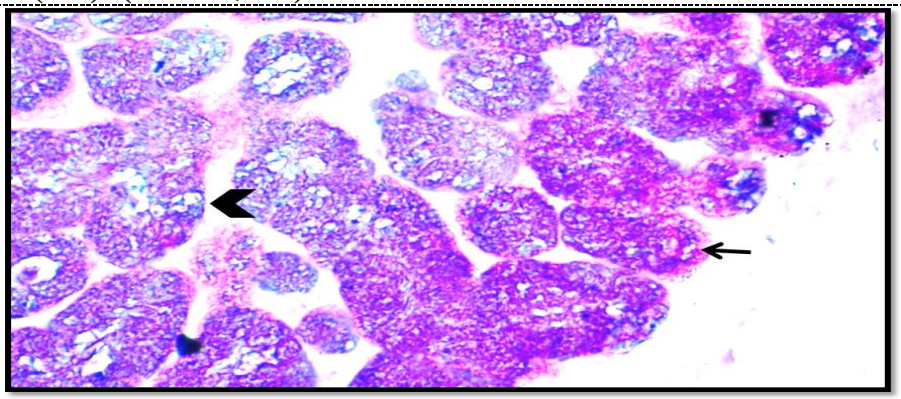

Figure 12. Cross section of lingual root in mongooe showing mucous glands and the positive reaction with PAS/AB stain, the purple color is dominant (arrow) while a little blue color (arrow head) is observed which means that the mucin is a mixed type (PAS/AB stain, 40x).

The dorsal surface of tongue's mongoose differs from the ventral surface as it contains lingual papillae, while the ventral surface is devoid of papillae, but it is characterized by the presence of rod like structure a called Lyssa [21] that consisting of skeletal muscle fibers penetrating between them the connective tissue to form bundles (Fig. 13) and this result is consistent with some studies that indicated the presence of this structure in their study animals [18, 22, 23]. While some studies are contrary in terms of the histological composition of Lyssa, the study of [24] showed that the

composition of Lyssa in the tongue of both the cat and the dog consists of a dense connective tissue, while the study of [18] stated that this composition in persian leopard consists of hyaline cartilage surrounded by connective tissue, and Lyssa's function may be that increases the efficiency of tongue movement, making it easier to flip and swallow the bite. The dorsal surface of tongue's mongoose is characterized by presence of lingual papillae that divided into mechanical papillae (filiform, cylindrical) and gustatory (fungiform, circumvallate) [21],who described the morphology of the tongue in general and , in addition, that shape, situated and distribution of papillae. The histological examination showed that the filiform papillae are covered with keratinized stratified squamous epithelial tissue and medullary of papillae composed of a loose connective tissue (Fig. 14). This result is consistent with other studies [12, 18, 20]. But it was noted that cylindrical papillae is covered with highly keratinized stratified squamous epithelial tissue and papillae's medulary composed of loose connective tissue (Fig. 15) and this result is consistent with previous references [2, 4, 18] and the role of these two types of lingual papillae (filiform and cylindrical) revolves around their mechanical function that represented by holding food and preventing it from slipping because the food of the mongoose is soft. Where the fungiform papillae is covered with a narrowly keratinized stratified squamous epithelial tissue and the dorsal surface of the papilla contains taste buds, while the medullary of papillae consists of a loose connective tissue (Fig. 14). This result is consistent with other studies [9, 12, 13, 25], while disagreement with the study of local mouse (*Mus musculus*) [6] because of their fungiform papillae lacks taste buds.

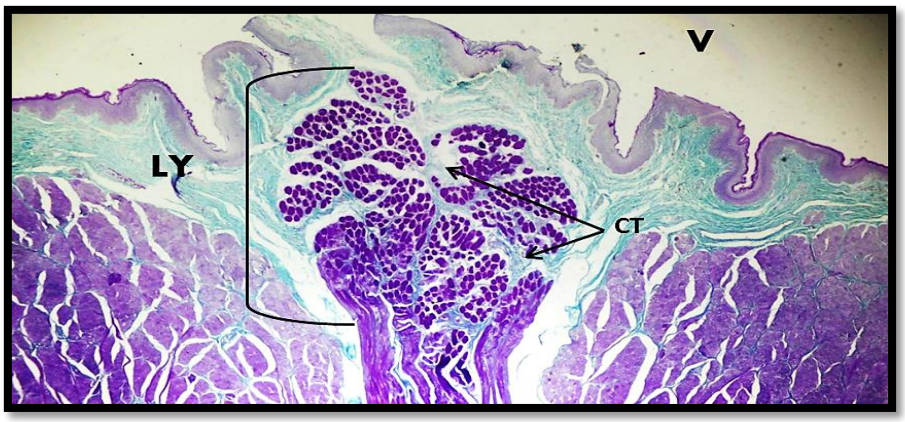

Figure 13. Cross section of lingual body in mongoose from ventral side showing: Lyssa (Ly), ventral side (V) ,Connective Tissue(CT). (Masson's trichrome, 4x).

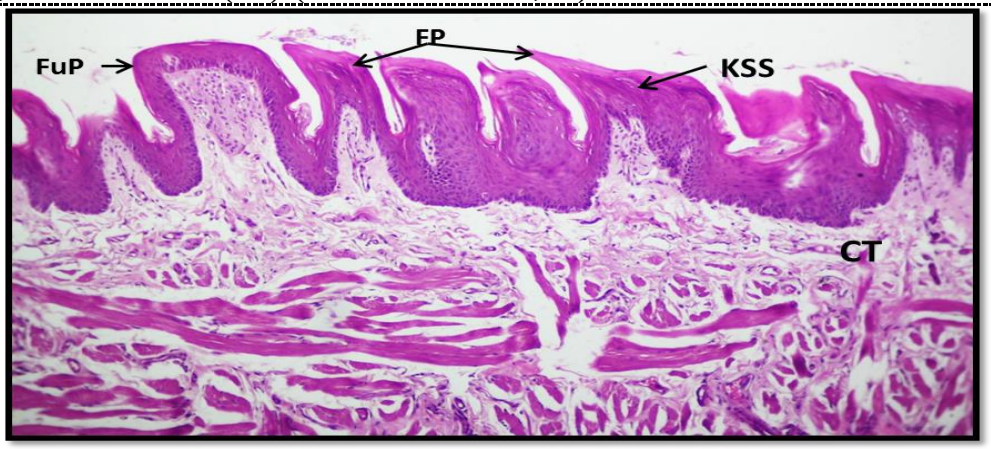

Figure 14. Cross section in tongue of mongoose showing: filiform papillae (FP), fungiform papillae (FuP), Keratinized Stratifed Squamous (KSS), Connective Tissue(CT) (H&E 10x).

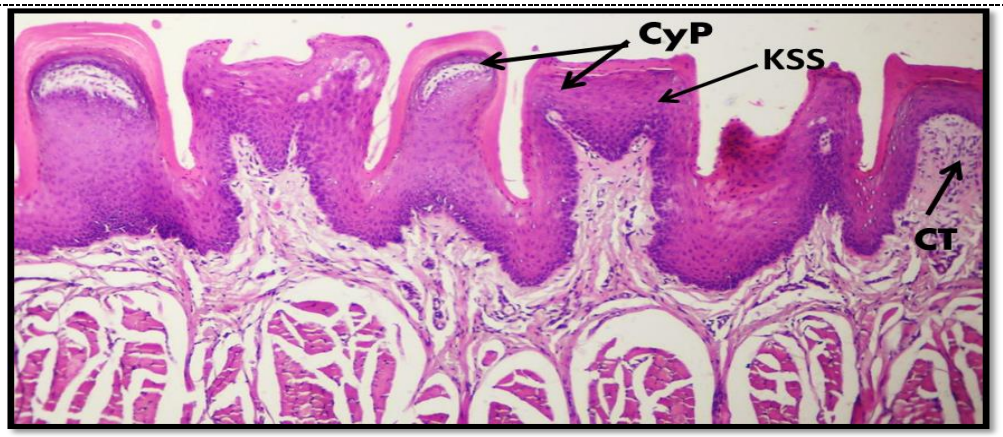

Figure 15. Cross section of lingual body in mongoose showing: cylindrical papillae (CyP) , Keratinized Stratifed Squamous (KSS), Connective Tissue(CT) (H&E, 10x).

The circumvallate papillae are covered with non-keratinized stratified squamous epithelium tissue and contain taste buds on the dorsal and lateral surface of the papillae, the medullary consisting of loose connective tissue, and surrounded by a groove and pad (Fig. 16) and this result corresponds to other studies [6, 18, 26, 27] and the reason of free these papillae from keratinized are allow the growth of taste buds and the performance of their function. The histological study showed that taste buds look like barrels in shape and consist of gustatory-sensory cells and are immersed in the epithelial tissue of gustatory papillaes (fungiform, circumvallate) and this result is agree with previous studies [5, 13]. Many references also showed that the cells of the taste bud consist of three types represented by gustatory cells, supporting cells and basal cells (Fig. 17) and this results is a compatibility with some studies [6, 12, 26]. The histological structure of these buds is associated with their taste function by receiving nutrients through their openings after the dissolving food elements are melted by the digesting enzymes of the serous glands (von-Ebners) to be distributing them over the surface of the tongue in general, including taste buds.

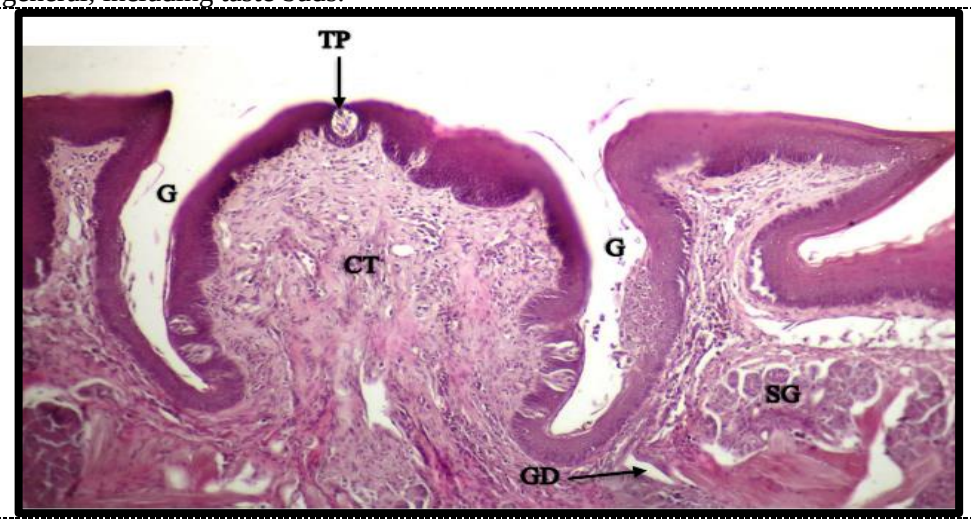

Figure 16. Longitudinal section of lingual root in mongoose showing circumvallate papillae components (CP), taste buds (TB), glosbe (G), serous glands (SG), gland duct (GD), connective tissue (CT). (H&E, 10x).

Figure 17. Longitudinal section of circumvallate papillae of lingual root in mongoose showing components of taste buds, gustatory cells (GC), supporting cells (SC), basal cells (BC), taste pore (TP). (H&E, 100x).

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