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ANATOMICAL AND HISTOLOGICAL STUDY OF THE TONGUE IN GOAT

(*Capra hircus*)

A SEMINAR SUBMITTED TO THE CONCIL OF THE VETERINARY MEDICINE COLLEGE OF DIYALA UNIVERSITY IN PARTIAL FULFILMENT OF REQUIRMENT FOR THE DEGREE OF BACHELOR IN SURGERY AND VETERINARY MEDICINE

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Summary

The current study conducted in the College of Veterinary Medicine-Diyala University for the period from November/2013 to April/2014. The mean weights, length, width, and thickness of tongue in goat (Capra hircus) were recorded. The location, distributions and shape of lingual papillae as well as lingual glands were well described anatomically. Specimens from the tongue of goat selected for histological were fixed in the 10% formalin processed and staining with: Hematoxylin and eosin and PAS. Grossly observations reveled, shallow median longitudinal groove notice on the dorsal surface of apex of tongue. torus linguae which limited rostrally by a shallow transverse depression called lingual fossa. Filiform, conical and lentiform papillae exert mechanical function whereas fungiform and vallate papillae have gustatory function.

Filiform and fungiform papillae were distributed all over the lateral and dorsal surfaces, also ventral surface and rarely extend caudally at level of circumvallate papillae, The conical papillae were elongated, conical in shape and found in several sizes (small, middle, and large), The largest mechanical papillae is lenticular papillae, convex lens in shape, few and different in size, located as a zone on the middle part of the torus linguae.

The vallate papillae were arranged in two rows on both side of tongue dorso-lateral surface of caudal part of the torus linguae, a lingual artery is supplied the tongue .

Histological examination of the tongue revealed abundant keratinized tissue of dorsal surface. two type of filiform papillae, curved spine –like process and connective tissue core is scarce while the second type blunt curved variety and connective tissue core penetrated the general epithelial, conical papilla showed heavy keratinized epithelial, The dorsal surface of the lenticular papilla is slightly convex, and covered by moderately keratin layer , The fungiform papilla is dome shape has numerous taste buds in the epithelium of dorsal and lateral of papilla, large flattened circumscribed –shape papillae surrounding by deep trenches and covered by a slightly cornified layer are seen. Serous and mucous lingual salivary glands are present among the muscle bundls and submucosa.

List of Contents

جمهورية العراق

وزارة التعليم العالي والبحث العلمي

جامعة ديالى

كلية الطب البيطري

دراسة تشريحية ونسجية للسان الماعز

(*Capra hircus*)

بحث مقدم الى مجلس كلية الطب البيطري – جامعة ديالى كجزء من متطلبات نيل شهادة البكالوريوس في الطب والجراحة البيطرية

اعداد

هبة قيس يونس

اشراف

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Dedication

To

-MY dearest country.

-MY darling family .

-MY close friends in the veterinary medicine .

-MY dearest master.

-ALL Iraqi who sacrifice by soul, money and children for peace and freedom.

Hiba

1.1. Introduction:

The goats(*Capra hircus*) were among the first farm animals to be domesticated. As indicated by the archaeological evidence, they have been associated with man in a symbiotic relationship for up to 10000 years (1). Goats disseminated all over the world because their great adaptability to varying environmental conditions and the different nutritional regimes under which they were evolved .Diary goat is considered the cow of the poor, also the goat mainly kept it to produce meat or fibers(mohair) and (cashmere) (2). Goat are popular with small holders because of their source of food of goats forages for hay and pasture are most inexpensive feed source and consider as a poor quality, and have efficient conversion of feed into edible and high-quality meat, milk, hide(skin) (3).Goat are able to survive and reproduce under a wide variety of environmental conditions, however some breeds are better suited in certain climatic conditions than other (4).

The tongue is a movable musclomembranes organ, occupies the greater part of the oral cavity. It has an attached root, body and free apex, capable of both vigorous and precise movements as in prehension, lapping, grooming and manipulation the food with in the mouth on the one hand and speech articulation on the other. In the dog the tongue is participate in heat loss by panting (5).The middle portion of tongue joined to the oral floor by mucosal fold or frenulum, mucosal reflections (palatoglossal arches) also pass from each side of root to join the soft palate. The tongue mucosa is tough and tightly adherence where repeated contact with abrasive food occurs, but looser and less heavily keratinized where a softer diet, much of the surface is covered by a variety of papillae, mechanical like filiform, conical, lenticular, or gustatory like, fungiform, vallate, foliate. A few small salivary glands lie below the

epithelium which associated with this papillae. In domestic ruminants the transverse ridges on the hard palate and the projections on the tongue (papillae) help in the back ward movement of ingesta. The tongue and dental pad help in prehension of food in ruminants(5 ,6).

1.2. Aim of the study:

The main first point of our aims of this study are:

1. The present work was designed to describe anatomical structure of the tongue , and blood supply of the tongue in goat(*Capra hircus*).
2. .To study the histological structure of the tongue , and type of lingual salivary glands of the tongue in goat.
3. To study the types and distribution of gustatory and mechanical lingual papillae of the tongue in goat.

2.1.Anatomical review:

The tongue adult Rams was consisting from three parts apex ,body ,root .The total length of the tongue in ram(19,77 ± 0,334)cm. the wider and thicker area in the middle part of the apex was (3,33 ± 0,083)and (1,32 ± 0,097)cm. respectively ,while the widest and thickest part of the body in the middle of the torus linguae was (3,17 ± 0,097)cm. and the thickness was (1,33 ± 0,053) cm in the first part of root . The apex of the tongue nearly rounded in shape. Shallow median groove notice on the dorsal surface of apex which across for short distance in ventral surface. (7). The apex of the tongue of the Indian goat has notched in center(8)

The tongue of the lesser mouse deer measured ~5,5 cm in length .It showed a median dorsal groove but no torus Linguae , the four different types of papillae were observed filiform ,fungiform vallate and foliate (9).

The apex of tongue in Sambar deer was flat with rounded border. The caudal part of the body presented an elliptical dorsal prominence the torus linguae was demarcated anteriorly by transverse fossa linguae and the torus Linguae was lesser prominent (10).

The tongue of the Reeves muntjac deer has a lingual prominence on which large conical papillae are distributed (11). Also both the Rocky mountain goats and cattle have a well developed Lingual prominence on the dorsal surface of the posterior area of the tongue (12). But the zavot cattle tongue was not median groove on the apex of the tongue, about 30-35 cm in length, the tours lingua and fossa linguae were at the anterior of the root, there (13)

In both yak and cattle the lingual body prominence was observable on the lingual body. The transverse fossa of the yak tongue was visible at the anterior of the lingual prominence but no median sulcus was

observed in the midline of the tongue .However neither sulci were observed in the tongues of cattle . the yak tongue on average measured 28,0cm in the length. In both species. papillae were distributed not only on the dorsal surface of the tongue .but also on the anterior and ventral surfaces(14).

The lingual body of Iranian buffalo had a prominence at the inter molar region half may dorsum of the tongue . five different of lingual papillae were identified filiform, conical ,Lenticular ,cicumvallate and fungiform(15).

The tongue in the Hippoptamus appears elongated with rounded apex, had a narrow lingual prominence situated on the posterior part of the lingual body, the fungioform papillae distributed widely from apex to this lingual prominence (16). The tongue in the donkey spatula-shape(17).

The tongue of chinchilla and agouti are triangular in shape and presented 3,2cm of length, surface of the have numerous types of papillae .filiform .fungiform .vallate and foliate papillae (18 ,19).

The mucous membrane of the tongue presented different types of papillae such as filiform, Lenticular, coniocal, fungiform, vallate and foliate. In adult Rams the filiform papillae were soft horny thread like, densely distributed on the dorsal and ventral surfaces of the apex and of tongue(7),while these papillae in Indian goat are the most common and divided in to three types, the simple, giant and true filiform papillae which are most developed of the a types (8). In the lesser mouse deer, the first type of filiform papillae were tongue or Leaf-like in shape with pointed tips, the secondary papillae were well distributed over the anterior two-thirds of the tongue but were very rare or absent in the posterior third.(9).

The filiform papillae of sambar deer , appear in apical half of the dorsum ,rostral to torus they numerous fine ,soft and thread like(10). in Reeves muntjac deer on the dorsal surface of the anterior tongue numerous filiform papillae were found externally each filiform papillae consist of a rod-shape main process and several small accessory processes (11). In Iranian buffalo the filiform papillae appeared in conical shape with a sharp tip that was directed caudally(15). The horse filiform papillae had a long and slender external form ,while in goat and cattle the external form consisted of a long thick main process (12). But in the donkey, being thin and relatively short at the apex conical and scaly in main part of the body and thin and longer at caudal part of the body(17). In common Raccoon, numerous filiform papillae were distributed along the anterior two-third of the tongue(20)

The fungiform papillae in Indian goat are large and could easily be seen with the naked eye, they are scattered over the entire dorsum being in abundance at the tip (8).

While in adult Rams the fungiform papillae were round convex ,mushroom like papillae little elevated from the lingual surface distributed on the dorsal ,ventral surfaces of the apical free part from the apex ,dorsal, dorso lateral surface of the tongue body among the filiform papillae were decreased in number and increased in size when directed toward the body (7).

In Reeves muntjac deer, fungiform papillae are distributed among filiform papillae on the anterior portion of the tongue large fungiform papillae were also sparsely distributed on the lingual prominence (11).

In zavot cattle , on two third of the dorsal surface and especially on the lateral margins of the tongue (13). While in cow *(Bos indcus*)variably pigmented and club-shaped fungiform papillae were irregularly

distributed all over the dorsum and along the margins of the tongue these papillae decreased in number and increased in size from the tip to the dorsum (21).

In yak the distribution of the fungiform papillae in cattle was similar to that of the yak the number of papillae gradually diminished from the lingual body to the apex .in yak there were 2types of fungiform papillae bud shaped and dam shaped(14). While these papillae was round and convex mushroom like, scattered among filiform papillae In Iranian buffalo (15).

In donkey fungiform papillae appeared scattered mainly on the lateral surfaces ,they mostly rounded but lobulated forms were also observed (17).

In one humped camel fungiform papillae are distributed as small rounded bodies all over the anterior two third of the dorsum ,especially on the lateral sides also at the tip of the ventral surface (22). The distributed of the fungiform papillae on one of the adult cat tongues is shown were absent fungiform papillae from the mid region of the tongue (23).

The vallate papillae also describe in small ruminants like Indian goat there are 13-14 circum vallate papillae arranged in two rows in V shaped pattern (8), but in Adult Rams the total number in the right side (18,3 ±1,044),total number in left side (20,8 ±1,404) (7). .While In saanan goat the vallate papillae were present on both rims of the torus linguae (24), and in Reeves muntjac deer as a ten or more vallate papillae distributed at the posterior lateral area of the lingual prominence (11), also in lesser mouse deer appear a pair of long –flat vallate papillae located on both sides of the midline in the caudal part just rostral to the root of the tongue (9), but

in sambar deer were indistinct unlike in other ruminants and were distributed along the lateral sides of the torus linguae (10).

The vallate papillae in large ruminant were described like in cow *(Bos indicus*) . were 13 -19 on either side dispersed in 2-3 irregular rows (25-38 in total) along the caudal lateral two third of the dorsum (21), and in Zavot cattle were round to oval shaped circum vallate papillae were protruded toward the surface of the tongue about 26 papillae in two lines these papillae were encircle by a papillary groove (13), however, in the yak the vallate papillae were arranged in a V pattern on the posterior-lateral surface of the lingual prominence, each papillae was a cylindrical central body surrounded by a deep groove and circular raised area of tough epithelial tissue (14). also in Iranian buffalo the oval shape circum vallate papillae were located on the lateral and caudal part of torus linguae (15).

In donkey the vallate papillae were 2-3in number .located at the most caudal part as large as the fungiform papillae .each with a wide circular groove around the central bulbous projection (17). The horse had two large vallate while goat and cattle had 15 or more vallate papillae at the posterior area of the lingual prominence (12).

In Hippopotamus typically vallate papillae with a circumferential furrow were not observable (16).

In raccoon ,eight vallate papillae that had a weak circumferential ridge were distributed in a V-shape in the posterior part of the tongue (20).

In humped camel 9-12 circum vallate papillae are found at the junction of the anterior two thirds and posterior one third of the tongue and are encircled by a papillary groove and annular pad of the surrounding lingual mucosa(22). In opossum ,the tongue had two vallate papillae on the posterior dorsum of the tongue(25).

In saanen goat two types of lenticular papillae the pyramidal shaped type I lenticular papillae and had a pointed apex. while the round shape type II lenticular papillae possessed blunt apex and had a large conical papillae were hallow structure (24). In Adult Rams the lenticular papillae were, convex lens in shape situated on the middle part of the torus linguae ,while the conical papillae were elongated conical in shape and found in several size (small , middle , large) (7). In lesser mouse deer the lenticular papillae and conical papillae are absent. Several foliate papillae were observed on both posterior- lateral sides ventral to vallate papillae(9).

In sambar deer the conical and lenticular papillae were present over the torus linguae, conical papillae were larger and directed anteriorly laterally and caudo laterally. lenticular papillae were round ,flat and sessile both papillae decreased in number towards the root. foliate papillae were noticed on the border of the tongue rostral to palatoglossal arches (10).

In zavot cattle lenticular papillae were round or conical –like lenticular papillae were limited to the torus linguae . the largest of these papillae were localized medially at the anterior region of the torus linguae. The distribution of the conical papillae started from the root of the tongue and extended caudally ,the papillae had a smooth surface (13).

In cow *(Bos indicus*) the lenticular papillae were broad ,horny of lentil or mustard seed size spread on either side of the mid-line in the rostral two-third of the dorsum .The large conical papillae occurred in the rostral two–thirds of the dorsum with a higher concentration in its middle portion but the small conical ones occurred throughout the dorsum with a relatively thinner population in its rostral central third and caudal lateral segments (21).

The lenticular papillae in both yak and cattle were distributed on the dorsal surface of the lingual prominence and were circular to oval in shape the conical papillae in the yak were distributed on the dorsal surface of the lingual prominence and there were 2 subtype of these papillae present at the prominence and directed centro-caudally . one type of conical papillae had abroad base and a tapering apex, where as the other had a blunt apex(14).

In Iranian buffalo the lenticular papillae were distributed on the torus linguae and conical papillae are blunt pointed cone shape(15).

the foliate papillae were absent on the dorsal surface of the zavot cattle tongue (13). In Indian goat the foliate papillae are absent (8).

in donkey tongue well developed sets of foliate papillae close to the basis of the palatoglossal arch (17). The foliat papillae were found in the horse studied but not found in goat or in cattle (12).

In Hippopotamus the long and slender conical papillae were distributed on the lingual prominence and were similar to non ruminant ,herbivore that in the donkey the larger conical papillae were not seen among ruminant and seen on the lingual root of omnivores and carnivores and also has the foliate papillae (16).

In raccoon weak fold-like foliate papillae were observable at the lateral edge in the posterior part of the tongue(20). In chinchilla and agouti the tongue in both species has foliate papillae (18 , 19). Ventrally the frenulum linguae fixed its caudal three-fourth leaving the rostral one –fourth free the frenulum linguae extended from the root of the tongue to appoint 4-5 cm caudal to the level of caruncula sublingualis and 3-4cm rostral to the level of the first cheek tooth in cow (21).

In sambar deer the frenulum linguae extended to floor of the mouth cavity was wide (10).

2.2.Histological review:

The dorsal epithelium of the tongue is stratified squamous epithelium with varying degree of keratinization, while ventral epithelium is thin and non-keratinized (26).The keratinization of covering epithelium was only weak in lesser mouse deer (9), While in Sambar deer the dorsal surface is thick cornified epithelium(10).The epithelium with underlying connective tissue forms projections on the dorsal surface of the tongue known as lingual papillae. Three types of the mechanical papillae (filiform, lenticular,and conical) and two types of gustatory papillae (vallate and fungiform) were observed in the tongue of the saanen goat (24). In Red sokoto goats, the filiform papillae in the lingual epithelium showed heavy keratinization (27).

The tongue of Jamunapari goats had a conical-shaped filiform papillae with 3-6 pointed projections and 6-8 secondary papillae at the free tip and the base of dorsal surface of the tongue (28). The filiform papillae in Big horn sheep consisted of numerous protrusions arranged in a U-shape posterior protrusions fused with each other (29). In Reeves muntjac deers, each filiform papillae consist of a rod –shaped main process and several small accessory processes ,their connective tissue core consist of 10 or more rod-shaped processes arranged in a horse shoe pattern and several posterior processes forming a small circular pattern (11). In zavot cattle it was seen that filiform papillae were lined with thick keratinized stratified squamous epithelium supported with a connective tissue core (13). The tongue of the yak had two type of filiform papillae also pseudo-papillae are present (14). In Iranian buffalo the filiform papillae appeared in conical shape with sharp tip was directed caudally (15). In donkey filiform papillae are mainly distributed on the dorsum of the tongue being thin and relatively short, conical and scaly (17).

In the horse the filiform papillae was long and slender. While in the goat and

cattle the external form consisted of a large thick main process and the connective tissue core consisted of a bundle of numerous rod-shape protrusions (12). In agouti tongue ,the filiform papillae were conical and multi filament (19), In common raccoon the filiform papillae were appeared to beathum or cone –like main core and associating finger-like short accessory cores (20). Also in the rat tongue was bristle like ,while the filiform papillae in bat were crown like(30), and of chinchilla consisted of two or three rod-like protrusions (18).

The fungiform papillae distributed among filliform papillae In Jamunapari goats the convex surfaced fungiform papillae raised above the lingual mucosa (28). In Iraqi seep Observed that the fungiform papillae were covering with squamous non keratinized epithelium cells consisting of 3-4 layers, in generally fungiform papillae were rounded in shape and have connective tissue (31).

In lesser mouse deer the taste buds were found in the epithelium of the dorsal parts in the fungiform papillae (9). In Reeves muntjac deer the fungiform papillae have several taste buds in the epithelium on the surface (11). In zavot cattle the fungiform papillae were surrounded by thick cornified epithelial cells with the presence of a few taste buds on their tops (13), while in yak the surface of the bud shaped fungiform papillae was convex .the surface of which were covered by thin keratinized epithelium although in cattle the epithelium was not keratinized (14). In Iranian buffalo the fungiform papillae was round and convex, mushroom- like and no taste buds nor pores were recognizable on the free surface of the papillae (15). In one humped camel the fungiform papillae desquamation of the epithelial cell can be noted in most of the papillae a shallow surrounding groove separates them from the filiform papillae taste pores can be observed on the surface of

the some of the papillae (22). In hippopotamus the fungiform papillae were dome like, a thin layer of stratum corneum was seen on the most superficial

epithelium on these fungiform papillae, however, a few taste buds were seen in the epithelium of the fungiform tops some vascular loops and nerve fibers were seen inside of the lamina propria of these papillae (16). In cats tongue, the number of taste buds per fungiform papillae increased progressively toward the back of the tongue (23).In chinchilla .the fungiform papillae showed round shape and convex and were surrounded by filiform papillae (18).

The vallate papillae of Jamnnapari goats were characterized by a papillary groove and an annular pad, the taste pores were oriented on the dorso-lateral surface of the vallate papillae (28). There are 13-14 circumvallate papillae in indian goat, thick nerve fibers are seen across the numerous glands and their duct ,muscle fibers and connective tissue are also richly innervated (8). The number of vallate papillae was about 20 in Japanese serow with several in big horn sheep and showed a U-shape arrangement in the lingual prominence .numerous taste buds were distributed in the grooved side epithelium of the central vallate papillae and numerous ducts opened to the base of the groove in both species (29). A pair of long-flat vallate papillae in lesser mouse deer were observed, and taste buds were found in the epithelium of the lateral parts of the vallate papillae (9).While these papillae in Sambar deer were indistinct unlike other ruminants and were distributed along the lateral sides of the torus linguae (10). But ten or more vallate papillae were distributed at the postero-lateral area of lingual prominence In Reeves muntjac deer (11) . In yak and cattle the vallate papillae was cylindrical central body surrounded by a deep groove and a circular raised area of tough epithelial tissue (14). These papillae in Iranian buffalo were round to oval in shape with minute

elevation from the tongue surface ,the majority of the taste pores were positioned along the lateral surface of central papillae opening in the papillary groove (15).

In one humped camel the circumvallated papillae are encircled by a papillary groove and an annular pad of the surrounding lingual mucosa several taste pores open in to the primary and secondary grooves(22). In donkey the vallate contained many taste buds with taste pores opening deeply in to the papillary groove (17). In common raccoon numerous taste buds were observable in the circumferential furrows of vallate papillae (20). In opossum these papillae were keratinized stratified squamous type with associated taste buds and small vallum ,these gustatory structures showed circular or oval shapes (25). In chinchilla two elongated vallate papillae are situated at the posterior third of tongue (18). In agouti tongue ,the vallate papillae were arranged in a V-shape in the caudal region and their connective tissue core ranged in shape from elongate to ovoid (19).

The Lenticular papillae are flattened projections found in the ruminant tongue like in Jamunapari goats Two types of lenticular papillae could be distinguished (28). In the saanen goat two types of lenticular papillae both possessing a prominent surrounding groove .the pyramidal-shaped type I Lenticular papillae had a pointed apex while the round –shaped type II Lenticular papillae possessed a blunt apex (24). Large conical papillae were hallow structures differing structurally from the filiform papillae with their large size a tip without projections and lack of the secondary papillae (24). In korean native goats the lentiform papillae had a typical round lens-like shape and its surface was being keratinized (32). In zavat cattle the lenticular papillae round or conical-like lenticular papillae were observed to be covered with thick keratinized stratified squamous

epithelium. Conical papillae differed from lenticular papillae in shape and size the tips of the papillae were covered with a thick layer of keratin (13).

Lenticular papillae in cattle and yak were circular to oval in shape similar in both species, in yak the tops of the lenticular papillae were covered by thin keratinized epithelium .unlike those of cattle .which were not keratinized no taste buds, taste buds were identified in the epithelium of the lenticular papillae of yak (14). In Iranian buffalo lenticular papillae as biconvex projection and elevated beyond as the surface of tongue and were formed keratinized stratified squamous epithelium (15).

In yak and cattle the surface of the conical papillae showed scales of cornified epithelial cells and the taste pores lie at the bottom of erater-like depression surrounded by squamous epithelial cell .However, the taste pores was not found on the yak conical papillae (14).

The conical papillae of Iranian buffalo were elongated with abroad round base and ablunt tip(15).

Foliate papillae in cattle presence .these were absent on the dorsal surface of the zavot cattle tongue (13). While the foliate papillae in Hippopotamus that were observed in this specimen were consisted 7 to 8 ridges and sulci most superficial part of the foliate ridges was covered by thin stratum corneum .mixed salivary glands were distributed in the lamina propria and their ducts opened in to the deepest part of the grooves and some bundles of nerve fiber were seen (16).

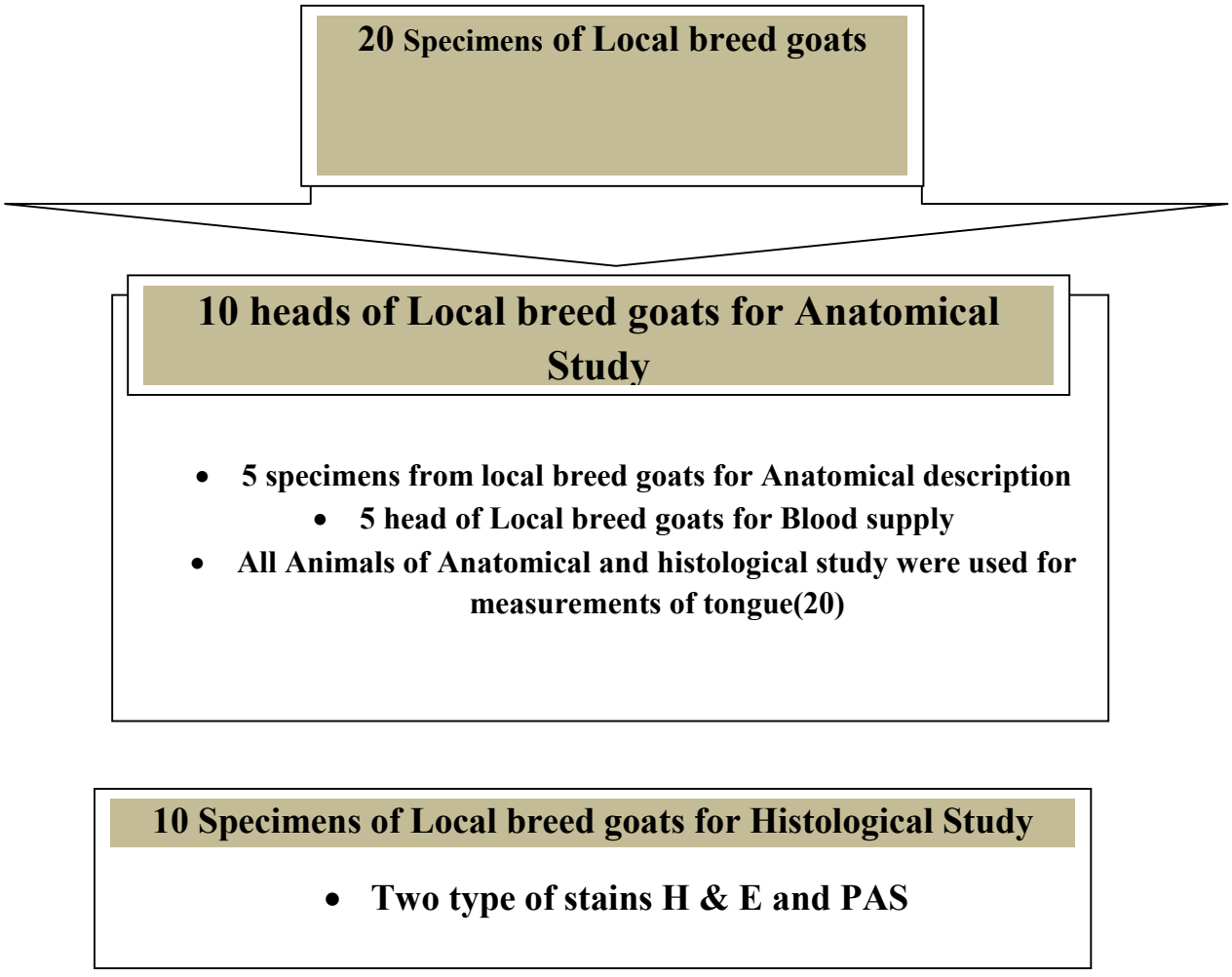
In common Raccoon ,had large conical weak fold-like foliate papillae were observable and a few salivary duct orifices were observable beneath the foliate papillae. An islet-like structure with numerous taste buds was observable on the deep part of the salivary duct of foliate papillae (20).

Skeletal muscle and connective tissue forms the central core of tongue. The skeletal muscle fibers are organized longitudinally, transversely and vertically to give the tongue extensive mobility. Sub mucosal and inter muscular serous glands were observed in the ventral part of vallate (von Ebners glands) and foliate papillae the glands had opening in to the depth of the groove In lesser mouse deer (9). In Hippopotamus no lingual glands were observable in the lamina properia of the anterior part of the tongue (16). Excretory channels of serous type Ebner glands opened to the papillary groove (13) rich mixed lingual glands and their ducts as in other ungulates were observed in the lamina propria of yak and cattle (14).

3. Materials and methods:

The experimental Design:

The present study done on local breed goats:



3. 1. Anatomical Study:

Gross anatomy:

Five Tongues of healthy mature Goats of both sexes were collected from a local commercial market in Baquba city. They used for gross observations includes shape, location, and the distribution of tongue papillae. The samples were collected immediately after animal slaughter and separation of heads from the carcasses. Each sample was washed after removing from the mouth cavity, and kept in clean plastic container to perform the required measurement.

Blood supply and innervation:

Five heads of goat were used of blood supply tongue after injecting of latex colored with red Carmen, the injection was done by syringe directly from the common carotid artery. After the setting of latex, the specimens were dissected carefully for the blood vessels supply the tongue.

The biometric study:

Dissecting of tongues and remove of the extrinsic muscles (styloglossal, hypoglossal and genioglossal) from the tongue were done and then used to study and record biometrical parameters. The weight was measured after removed the surrounding connective tissue and fat by using a sensitive electronic balance. The length, width and thick were measured with the help of electrical digital vernier and a centimeter scale. All data were analyzed using SPSS version 17 (SPSS Inc., Chicago, IL, USA) for Windows. One-way analysis of variance was used to detect age-related variations. The results are expressed as means ± SEM. The results were regarded as significant when $P < 0.05$.

3.2. Histological Study

Ten tongues of goats were used for histological study. The sample were collected as soon as possible from the regions of tongue Apex, Body, Root and fixed in 10% formalin and the solution must be 10:1of the size of specimen and left for 48 hours .

Formalin solution 10% prepared as following:

- 37% - 40% formalin 100 ml

- Distilled water 900 ml

After fixation, the tissue was trimmed and the specimens were washed by tap water for 4 -6 hours to remove the formalin solution and transfer to the following steps:

First Step (Dehydration)

This process is done to remove the extractable water. Dehydration was achieved by passing the samples through ascending grades of ethanol(70%, 80%, 90%, 100% twice) for two hours in each concentration to remove water from the tissue.

Second Step (Clearing)

Two solution of xylene were used as clearing agent. Each change spent one hour to remove the fats and to give the transparency to the sample, and the xylene is miscible with the embedding agent (paraffin).

Third Steps (Embedding)

It is also called the saturation with paraffin wax. The specimens are embedded in two changes of paraffin (at melting point 58 C˚) , each change takes two hours.

Fourth Step (Blocking)

The specimen is poured in blocks of pure wax to be prepared for cutting. It is left for 24 hours in refrigerator to give the paraffin time to solidity.

Fifth Step (Cutting)

Blocks were cuts by using microtome in thickness (6 μm). Then, the sections were transferred into a water bath (45-48 C˚) to adjust the wrinkles before putting them into the slides. The sections were fixed on glass slide which contain a light smear of mixture which consists of egg albumin and glycerin at ratio (1:1) added to a few amount of thymol crystals which play role in preventing the growth of fungi then the slides were dried by thermo oven at (40 C˚) for 24 hours.

Sixth Step (Staining)

The slides were stained with the following stains:

1- Harris Hematoxylin & Eosin

It is a routine stain in histological work. It is prepared as following (33):

A – Harris Hematoxylin stain:

a- Hematoxylin crystals 5 gm

b- Ethyl alcohol 100% 50 ml

c- Ammonium or potassium alum 100 gm

d- Distilled water 1000 ml

e- Mercuric oxide (red) 2.5 gm

B –Eosin stain:

a- Eosin Y, water soluble 20 gm

b- Distilled water 1000 ml

c- Glacial acetic acid 10 drops

2. Periodic Acid Schiff (PAS):

It is used for staining neutral mucopolysaccarides in tissues. The reaction of periodic acid selective oxidizes the glucose residues, creates aldehydes that react with the Schiff reagent and creates a purple-magenta color. PAS also used to stain basement membranes, glycogen and neutral mucosbstances which appear pink. It is prepared as following :

A –Schiff Reagent solution, it composed of:

a- Basic fuchsin 1 gm

b- Distilled water 100 ml

c- Normal hydrochloric acid 20 ml

d- Anhydrous sodium bisulfate 1 gm

B -0.5% Periodic Acid Solution:

a- 10% aqueous periodic acid 0.5 ml

b- Distilled water 100 ml

C –Harris Hematoxylin Solution

According to (33) and (34)

Photographs of examined slides were carried out with Olympus microscope supplied with digital camera (Win joe)with resolution of 2 mega pixel.

4.1.Anatomical Results:

4.1.1.Anatomy:

The tongue of the goat is long consisting from three parts: apex, body and root. The total length of the tongue in goat is (13.48 ± 0.24 cm). The width and thickness of the apex is (31.36 ±1.04 mm), and (9.63 ± 0.28 mm) respectively, while the widest and thickest part of the body in the middle of the torus linguae was (34.21 ± 0.57 mm), and (20.7 ± 0.55 mm) respectively whereas in the root, the width was (30.93 ± 0.55 mm) and thickness was (18.6 ± 0.24 mm) in first part of root (Table 1) (Fig. 1). This results is similar to the results of (7) and disagree with the result of (9) in lesser mouse deer this may be due to the difference in animals size and type of grassing.

The apex of the tongue was nearly rounded in shape which formed by meeting of the dorsal and the ventral surfaces, with rounded margin, shallow median longitudinal groove length (3.75 ± 0.260 cm) notice on the dorsal surface of apex which across for short distance in ventral surface cranially. This observation is in agreement with the observations of (9), and disagree with (13) in zavot cattle, in Yak (14). The apex of the tongue of the goat has not notched in center disagree with(8) in Indian goat. The apex increased gradually in width, thickness and then narrowest in the beginning of the body. The body was the largest and the longer part of the tongue located between the apex and root, quadrilateral shape, has four surfaces ventral, dorsal, two lateral surfaces. It has elliptical dorsal prominence, called torus linguae which limited rostrally by a shallow transverse depression called lingual fossa (Fig. 1). This result is coincided with results of (10) in Sambar deer, Rocky mountain goats(12), Reeves muntjac deer (11) this may be due to similarity with this animals as a grass eating artiodactylas and in contrast to (9) in lesser mouse deer ,this

lingual prominence plays an important role when animals masticate food in the mouth ,pressing it between the palate and the lingual prominence they also stated that this prominence is characteristic for mammals eating fibrous vegetation such as grass .

The body begins narrow and gradually increased in width and thickness until reach to the beginning of root, then return narrow (Table 1). The root was the last and the shorter part of the tongue lies caudally to body of the tongue and slopes ventrally and caudally toward the base of the epiglottis, and has papillae on the dorsal surface (Fig. 1). This result disagree with the result of (7) in ram who mention that the dorsal surface of root devoid from papillae. The width and thickness of the root nearly of that of apex (Table 1).

Gross anatomical studies revealed that five types of papillae were present on the tongue of goat included mechanical and gustatory papillae, filiform , fungiform, conical, lenticular and circumvallate papillae (Fig. 1).The filiform papillae were soft horny thread like structure, inclined toward the posterior of the tongue smallest in size and the most numerous of all lingual papillae which distributed on dorsal surface, ventral surface and rarely extend caudally at level of circumvallate papillae. Filiform papillae which found on lateral margin and at tip of tongue were highly cornified Fig.(2).This resent result is in agreement with the result of (9, 10, 13, 14, 21).

Fungiform papillae were round, convex, mushroom-like papillae distributed among filiform papillae and are more concentrated around the tip of the tongue and on lateral cranial edges Fig.(2).This result is agree with the results of (9,10 ,35) in sambar deer, lesser mouse deer and in Akkaraman sheep. And disagree with the results of (7) in adult ram and(22) in camel, whom the reported that the distribution of the

fungiform papillae is extended to the ventral surface of the tip of tongue. The fungiform papillae in this study extend to the transverse fossa of the torus linguae but don't extend to the torus linguae this in contrast with the result of (11) in Reeves muntjac deer.

The conical papillae were elongated, conical in shape and found in several sizes (small, middle, and large) conical papillae, observed rostral to the torus lingua which are very large and continuous caudally on dorsolateral to the torus lingua with decreased in number, also on both side of tongue root can be observed Fig.(3).This result in disagreement with the results of (13) who mentioned that the distribution of the conical papillae started from the root of the tongue and extended caudally In zavot cattle, and disagree with the (9) in lesser mouse deer which were absent. And in agreement with (21) cow, this difference due to the species different and due to differ in eating habit.

The lenticular papillae is convex lens in shape, It is largest mechanical papillae, few and different in size, located as a zone of papillae on the middle part of the torus lingua Fig.(3) This result agrees with (10) in sambar deer.

The circumvallate papillae were located on dorso-lateral surface of caudal part of the torus lingua, arranged in two rows on both side of tongue in (V) shape similar with other small ruminant (8, 11, 24) and disagree with (9, 25). their number on the left side (13.6 ± 0.24) while on the right side (13.0 ± 0.32). The circumvallate papillae were round to oval in shape, with minute elevation from the lingual surface. It was surrounded by deep papillary groove. the outer row was more in number than inner row, also the number of this papillae in the left side more than that at right side (Table 2). Fig(3) . This result in agreement with the results of (7) in adult ram.

The foliate papillae disappear in the tongue of goat at this study, this result in agree with most ruminant, and disagree with (12) in horse(16)in Hippopotamus, raccoon(20) In chinchilla(18) and agouti (19).

4.1.2. Blood supply and innervation:

The study of blood supply of tongue in goat has been revealed that the common carotid artery terminated by dividing into external carotid artery and occipital artery, the external carotid artery give transverse facial artery and continuous deeply as a lingual artery which supplied the tongue Fig. (4).

The goat tongue is innervation by cranial nerves hypoglossal and glossopharengeal nerves Fig.(5).This result is in agreement with (36)

4.2.Histological Results:

The epithelium of mucosa of tongue is, thick dorsally, rough and cornified, stratified squamous whereas the mucosa of the ventral and lateral surfaces was thin and delicate. This result is in agree with the result of (26) an (10), and disagree with (9).The degree of keratinization in different animals may be influenced by the type of food. The mucous membrane of the dorsum tongue presented highly papillated such as filiform, fungiform, lenticular, conical, and vallate papillae Fig. (6), while the ventral surface of the tongue apex has numerous filiform and fungiform papillae, Fig (7).

The histological study reveled two type of filiform papillae, the epithelium of the first type tapered into curved spine –like process and connective tissue core is scarce while the second type blunt curved variety and connective tissue core penetrated the general epithelial surface. The caudally directed, pointed filiform papillae were distributed

throughout the dorsum, showed heavy keratinization, Fig (6). This result is in agree with result of (27) in Red Sokoto Goats .There are two type of filliform papillae large chief papilla and secondary papilla. This result in agreement with the result of (14) in yak ,(37) in barbary sheep and (18) in chinchilla and disagree with the results of (11) In Reeves muntjac deers (28) in Jamunapari goats (29) in Big horn sheep.

The conical papillae of the goat tongue are distributed on the dorsal surface of the torus lingua but the central type is larger than the peripheral type, and the surface of the papilla showed heavy keratinized epithelial cells Fig (8).like the result of (14) and (15).

The lenticular papillae which located on the middle part of the torus lingua, are round to oval and larger than this located peripherally. The dorsal surface of the papilla is slightly convex, and covered by moderately keratin layer Fig. (9).this result in agree with (14) , (15) and (32) and disagree with (13) who mention that this papillae were covered with a thick layer of keratin.

In the present study, the fungiform papillae are more densely distributed on the dorsal and ventral surface of lingual apex. The fungiform papilla is dome shape has numerous taste bud in the epithelium of dorsal and lateral of papilla. This results in agreement with the result of (9, 11). The top of the papilla is covered by thin keratinized epithelium .This result is coincided with the result of (14) in yak and (22) in camel and in contrast with the result of (31) Iraqi seep The ducts of lingual gland is present in the lamina propria, Fig. (10).

The circumvallate papillae are similar to that in other Ruminants, they were large flattened circumscribed –shape papillae surrounding by deep trenches and covered by a slightly cornified layer, this result disagree with the result of (25) In opossum, the epithelium containing taste buds on lateral wall similar to that in (9, 15, 29) connective tissue core

revealed a dense irregular connective tissue with profuse blood vessels and different cells, also the ducts of lingual gland are present opened to the groove which surrounded this papillae Fig. (11) .

Both serous and mucous (PAS+) lingual salivary gland are present among muscle bundles and also in the submucosa. The presence of mixed gland may be due to consuming mixed food. The duct of this gland are seen opened into the area of vallum of papillae Fig.(12).This result in agreement with (14) in Yak, (9) in lesser mouse deer. The skeletal muscle bundles arranged in different direction to give this organ highly motility Fig.(10) This appearance like in most animals (9, 10, 11, 24, 28, 29) .

Table (1) showing the parameters of Tongue in goat.

Tongue weight	**154.2 ± 2.1 gm**	
Tongue length	**13.48 ± 0.24 cm**	
Median groove length	**3.1 ± 0.18 cm**	
Tongue width	**Apex**	**31.36 ±1.04 mm**
	Body	**34.21 ± 0.57 mm**
	Root	**30.93 ± 0.55 mm**
Tongue thickness	**Apex**	**9.63 ± 0.28 mm**
	Body	**20.7 ± 0.55 mm**
	Root	**18.6 ± 0.24 mm**
Number of circumvallate papillae	**Left**	**13.6 ± 0.24**
	Right	**13.0 ± 0.32**

Values represent mean ± S.E **(P≤0.05)**

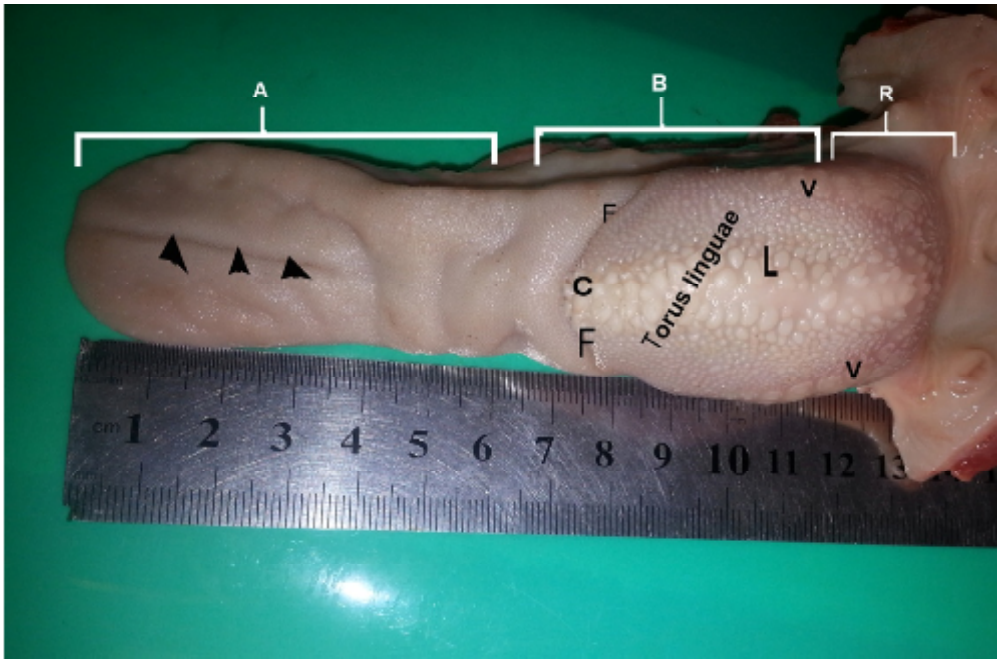


Fig.1: Photograph of dorsal surface of the tongue in the goat, shows: A – Apex B-Body R -Root torus linguae, F- lingual fossa, arrow head- median groove , V- vallate papillae, L-lenticular papillae , C-conical papillae .

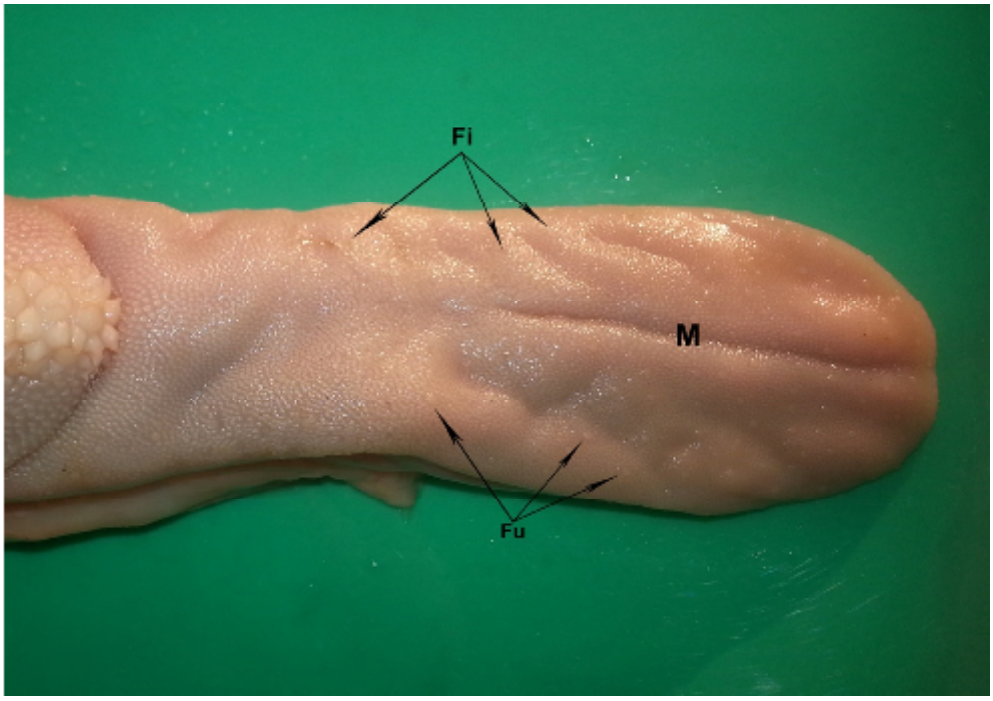


Fig.2: Photograph of dorsal surface of the tongue in the goat, show: A –Apex B-Body M-median groove ,Fu- fungiform papillae, Fi- filiform papillae ,

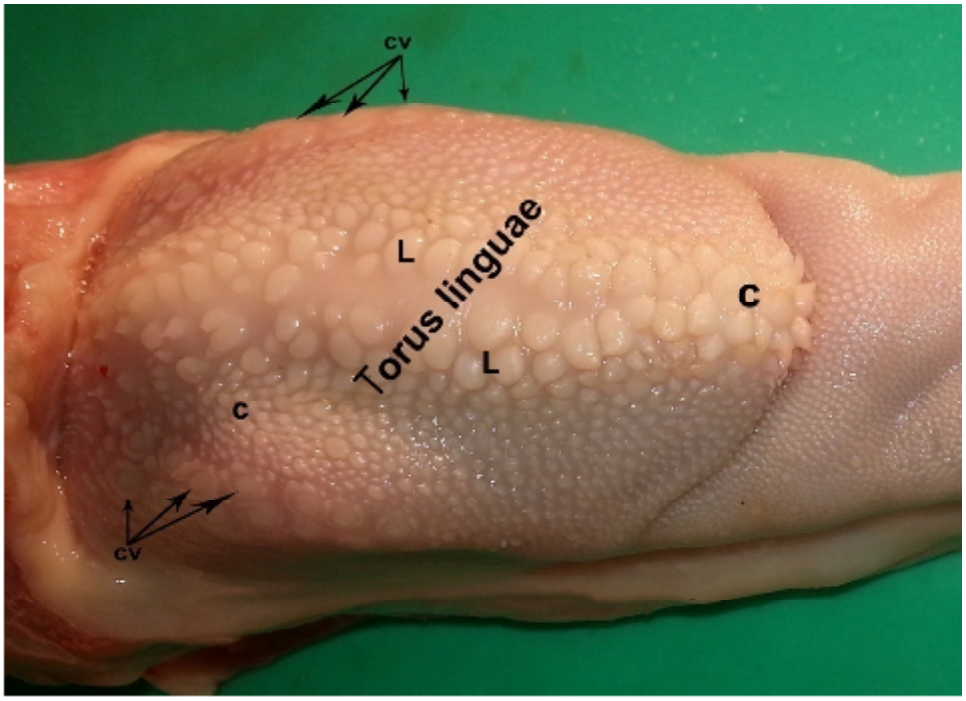


Fig.3: Photograph of dorsal surface of the tongue in the goat, show: Torus linguae CV- vallate papillae, L-lenticular papillae , C-conical papillae.

Fig.4: Photograph of head of the goat, illustrated the blood and nerve supply of the tongue: C-common carotid artery, E-External carotid artery, La- Lingual artery, H- Hypoglossal nerve, G- glossopharangeal nerve, T- Tongue

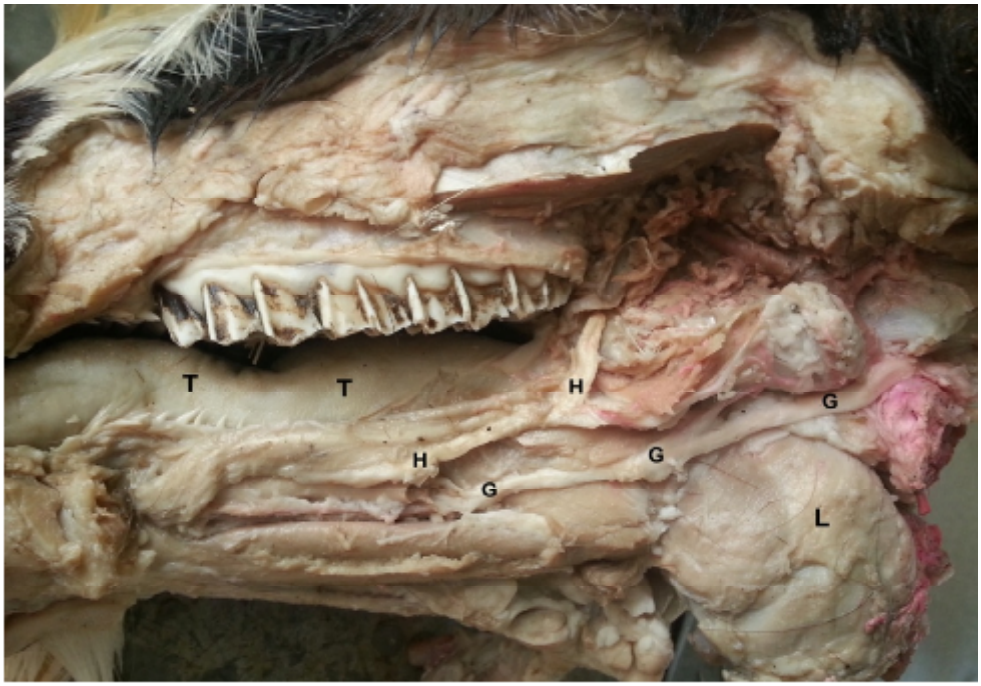


Fig.5: Photograph of head of the goat, illustrated the nerve supply of the tongue: T- tongue H- Hypoglossal nerve, G- glossopharangeal nerve,

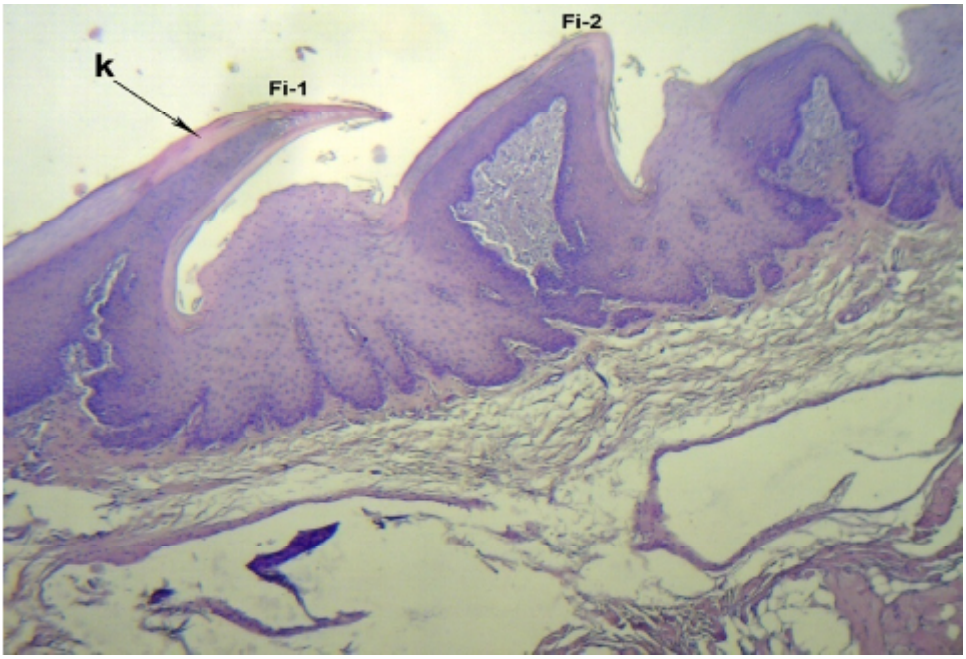


Fig.6: Photomicrograph of dorsal surface of tongue of the goat, illustrated k-thick keratinized stratified squamous epithelium, Fi-1: type one filiform papillae, Fi-2: type two filiform papillae.(40X,H&E stain).

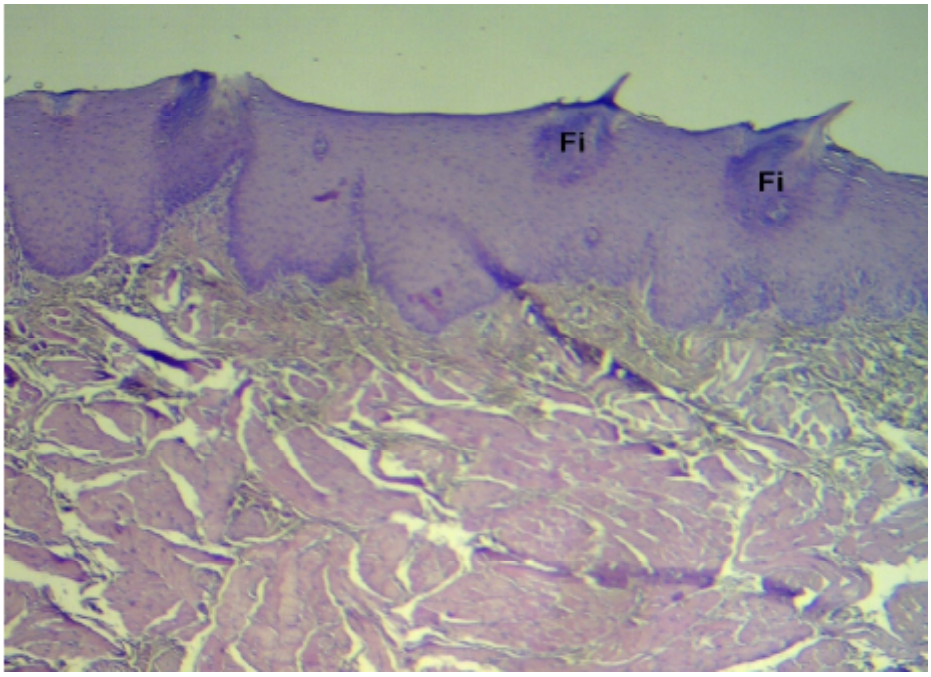


Fig.7: Photomicrograph of ventral surface of tongue of the goat, illustrated presence of Fi-filiform papillae, (40X,H&E stain).

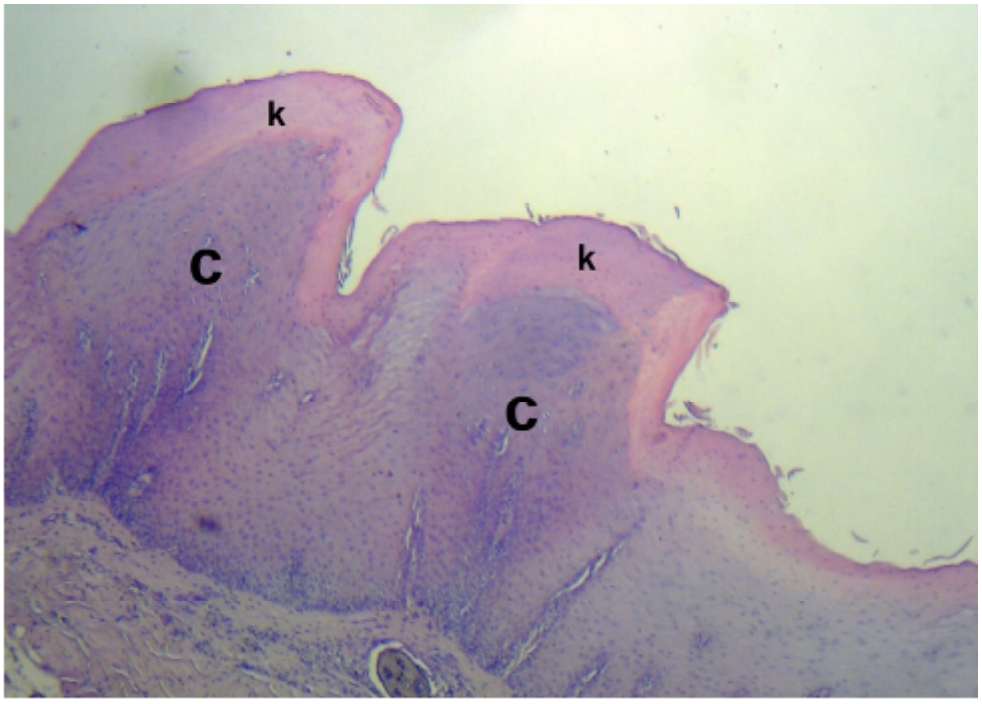


Fig.8: Photomicrograph of dorsal surface of tongue of the goat, illustrated k-heavy keratinized stratified squamous epithelium, C- conical papillae, (40X H&E stain)

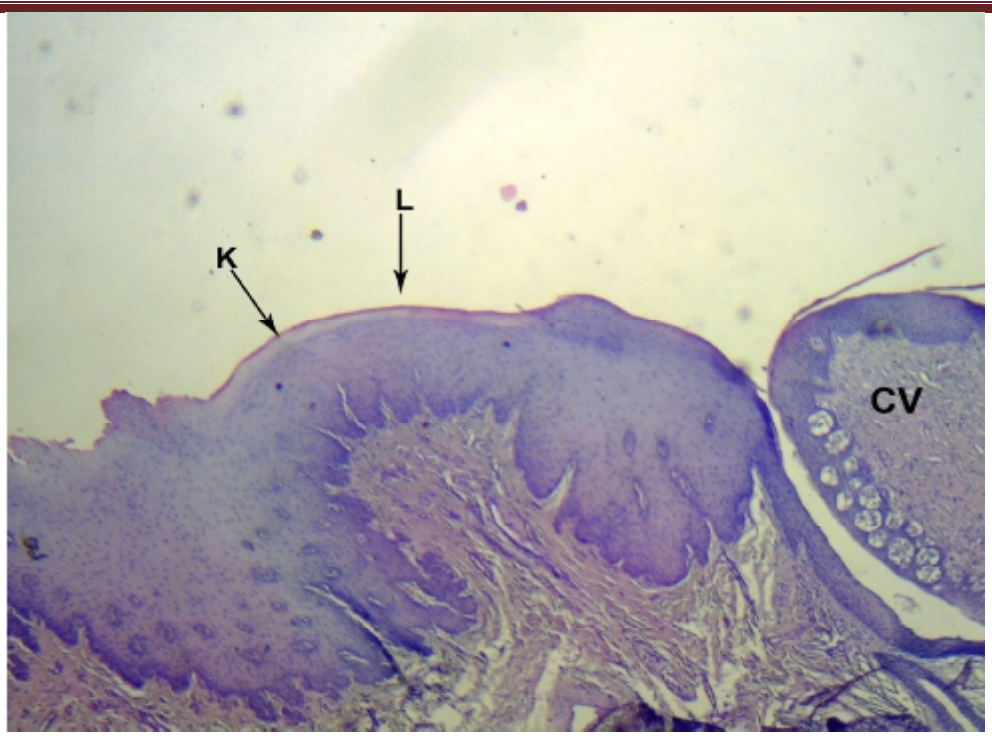


Fig.9: Photomicrograph of dorsal surface of tongue of the goat, illustrated, k-keratinized stratified squamous epithelium, L-lenticular papilla, CV- Circumvallate papilla.(40X,H&E stain).

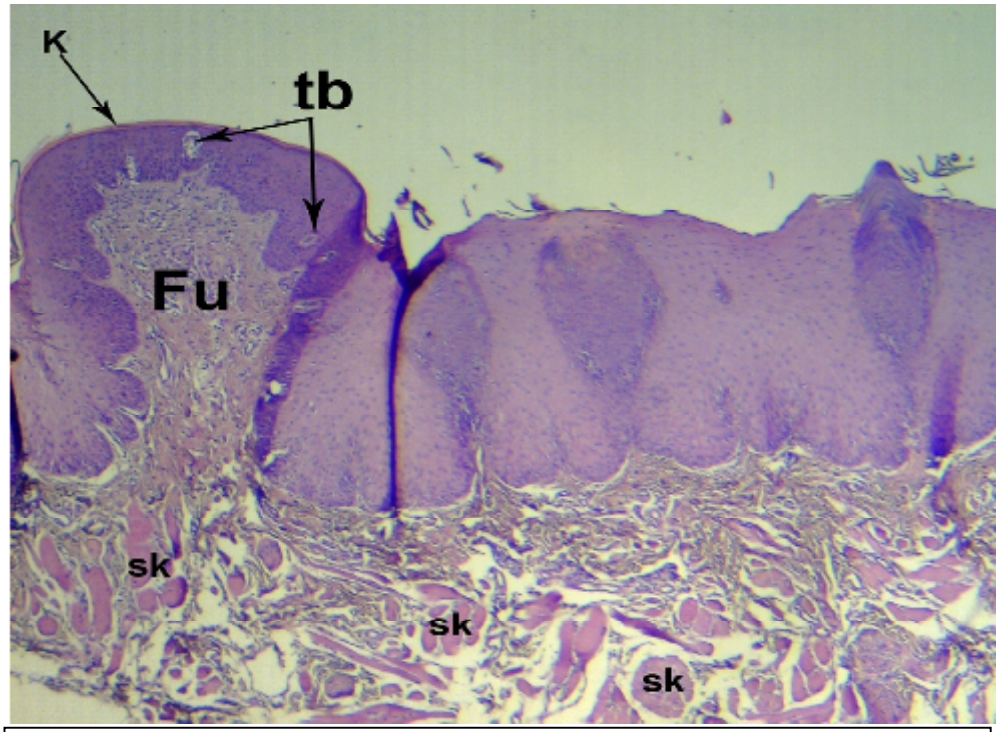


Fig.10: Photomicrograph of dorsal surface of tongue of the goat, illustrated, k-keratinized stratified squamous epithelium, Fu-Fungiform, tb- taste buds, sk- skeletal muscle bundles.(40X,H&E stain).

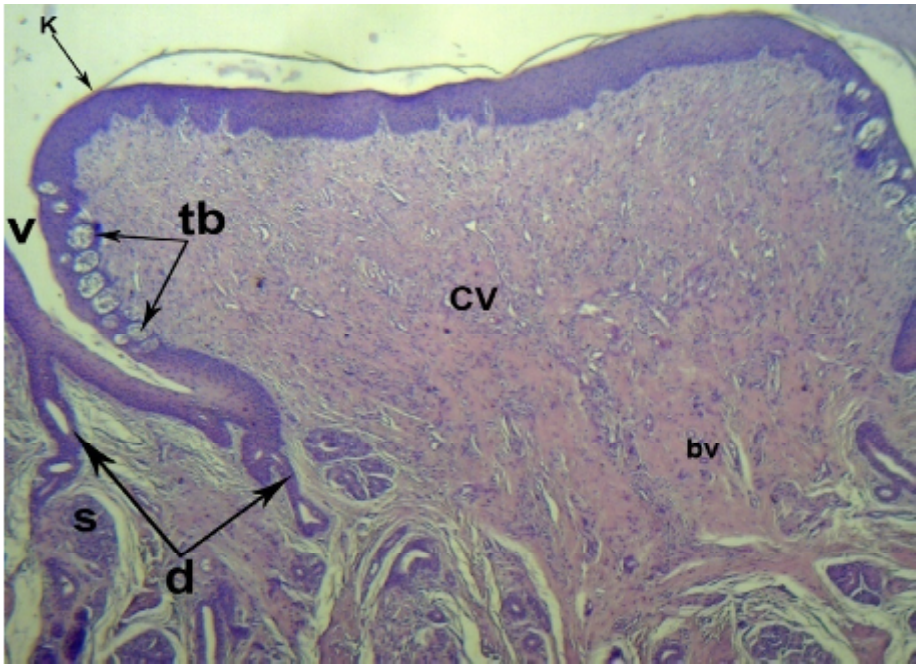


Fig.11: Photomicrograph of dorsal surface of tongue of the goat, illustrated, k-keratinized stratified squamous epithelium, L-lenticular papilla, CV- Circumvallate papilla.(40X,H&E stain).

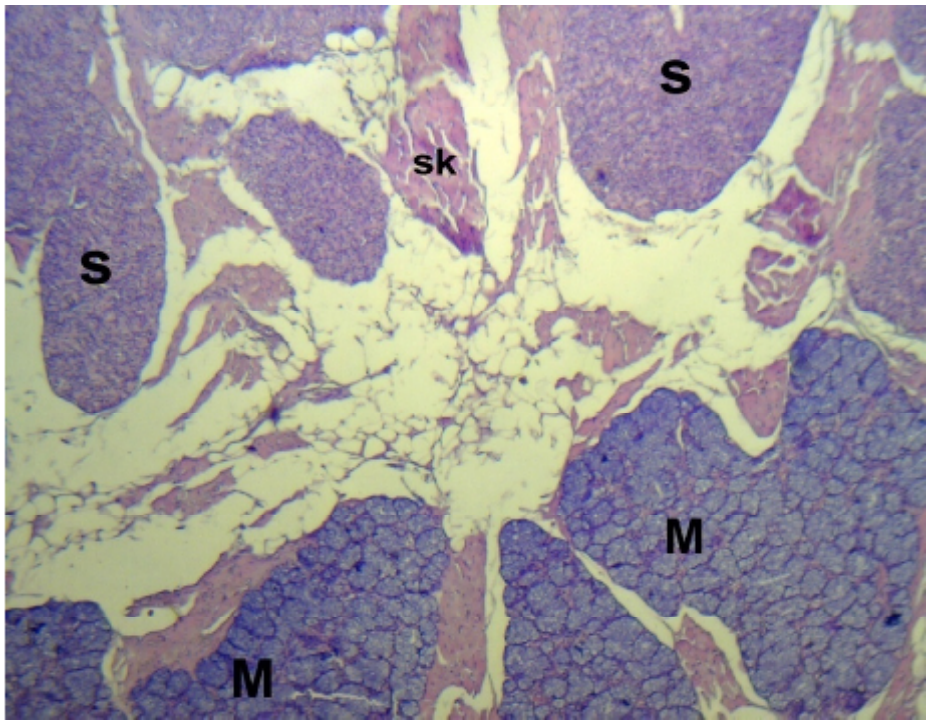


Fig.12: Photomicrograph of cross section in the tongue of the goat, illustrated, sk- skeletal muscle bundles, S-Serous lingual salivary gland, mucous salivary gland among muscle bundles.(40X, PAS)

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Summary

The current study conducted in the College of Veterinary Medicine-Diyala University for the period from November/2013 to April/2014. The mean weights, length, width, and thickness of tongue in goat (Capra hircus) were recorded. The location, distributions and shape of lingual papillae as well as lingual glands were well described anatomically. Specimens from the tongue of goat selected for histological were fixed in the 10% formalin processed and staining with: Hematoxylin and eosin and PAS. Grossly observations reveled, shallow median longitudinal groove notice on the dorsal surface of apex of tongue. torus linguae which limited rostrally by a shallow transverse depression called lingual fossa. Filiform, conical and lentiform papillae exert mechanical function whereas fungiform and vallate papillae have gustatory function.

Filiform and fungiform papillae were distributed all over the lateral and dorsal surfaces, also ventral surface and rarely extend caudally at level of circumvallate papillae, The conical papillae were elongated, conical in shape and found in several sizes (small, middle, and large), The largest mechanical papillae is lenticular papillae, convex lens in shape, few and different in size, located as a zone on the middle part of the torus linguae.

The vallate papillae were arranged in two rows on both side of tongue dorso-lateral surface of caudal part of the torus linguae, a lingual artery is supplied the tongue .

Histological examination of the tongue revealed abundant keratinized tissue of dorsal surface. two type of filiform papillae, curved spine –like process and connective tissue core is scarce while the second type blunt curved variety and connective tissue core penetrated the general epithelial, conical papilla showed heavy keratinized epithelial, The dorsal surface of the lenticular papilla is slightly convex, and covered by moderately keratin layer , The fungiform papilla is dome shape has numerous taste buds in the epithelium of dorsal and lateral of papilla, large flattened circumscribed –shape papillae surrounding by deep trenches and covered by a slightly cornified layer are seen. Serous and mucous lingual salivary glands are present among the muscle bundls and submucosa.