**Republic of Iraq**
**Ministry of Higher Education**
**& Scientific Research**
**University of Al-Qadissiya**
**College of Veterinary Medicine**

# Comparative Anatomical , Histological and Histochemical study of Oropharynx and tongue of three birds with different feeding habits

A Graduation Project Submitted to the Department Council of the Internal and Preventive Medicine-College of Veterinary Medicine/ University of Al-Qadisiyah in a partial fulfillment of the requirements for the Degree of Bachelor of Science in Veterinary Medicine and Surgery.

**Intisar muhamad murad**

By
Supervised by
**Lect.Dr. Fatimah Swadi Zghair**

2021 A.D. 1442 A.H.

فَتَعَٰلَى ٱللَّهُ ٱلْمَلِكُ ٱلْحَقُّ ۗ وَلَا تَعْجَلْ بِٱلْقُرْءَانِ مِن قَبْلِ أَن يُقْضَىٰٓ
إِلَيْكَ وَحْيُهُۥ ۖ وَقُل رَّبِّ زِدْنِى عِلْمًا ﴿١١٤﴾

صَدَقَ اللهُ العَظِيمُ

**من سورة طه**

# Certificate of Supervisor

I certify that the project entitled (Comparative Anatomical , Histological and Histochemical study of Oropharynx and tongue of three birds with different feeding habits ) was prepared by Intisar Muhamad Murad under my supervision at the College of Veterinary Medicine / University of Al-Qadissiya.

Supervisor

**Lect.Dr. Fatimah Swadi Zghair**

Dept. of anatomy and histology

Coll. Of Vet.Med./ Univ. of Al-Qadissiya.

/ 5 / 2021

# Certificate of Department

We certify that Intisar Muhamad Murad has finished her Graduation Project entitled (Comparative Anatomical , Histological and Histochemical study of Oropharynx and tongue of three birds with different feeding habits) and candidate it for debating.

Instructor

**Dr. Muthanna H. Hussain**

30 / 5 / 2021

Assist. Prof. Saad AL-Husseiny

Head of Dept of Int. and Prev. Med.

30 / 5 / 2021

# Dedication

*To ……. the prophet Mohammed and the*

*family of the prophet (Ahl al-Bayt).*

*To ……. My homeland.*

*To…… my beloved father and mother (Allah, please save them from all harm)*

*To…… my family with love*

*Intisar*

# Summary

The morphology of the oropharynx and tongue of male local duck, Partridges and ostrich were studies with a view to identifying structural features that may influence nutrition, food intake and ingestion as well as to provide a foundation for the recognition of pathology of the bird in this region. The results illustrated that the roof of the oropharyngeal cavity was formed by a cartilaginous hard palate that lacked papillae on its mucosal surface except partidage, but exhibited a prominent median longitudinal mucosal fold, the median palatine ridge. Orderly arranged rows of notches the lamellae, formed the lateral boundaries of both the roof and floor of the oropharynx. The tongue, which was located on the floor of the oropharyngeal cavity, was characterized by a prominent dorsal median sulcus, numerous lateral brush- like horny lingual papillae and a bell- shaped dorsal surface elevation, that formed the base of the organ excepted the ostrich was absent of papillae. This bell shaped variation depend on birds were uesd. Histologically, the features of tongue include a non- keratinized stratified squamous epithelial lining on both its dorsal and ventral surface, a wide connective tissue layer, containing lingual glands, blood vessels and nerves and a core of paraglossum and associated striated muscles. In conclusion, the oropharynx and tongue of the male duck, partidage and ostrich exhibits certain anatomical features that are unique to this species and the morphological modifications of this region of the digestive tract may be adaptations to the bird's habitat and mode of feeding.

## Introduction

Most birds can fly (Partridges) but some cannot (duck and ostrich), and all are adapted to their different environments with respect to food sources, the seashore, ponds, small rivers, fields, or mountains. Reflecting their different life styles, birds have different feeding habits, with corresponding differences in the structures of their bills and tongues.

Ducks are mini- livestock whose nutritional benefits may be useful to supplement the protein requirements of rural communities in Iraq and other developing countries. Ducks are hardy and resistant to most common diseases and environmental hazards. In Iraq, local ducks are raised either in a free system alongside domestic fowl or in a semi-enclosed system. They are highly adapted to scavenging conditions, and feed by foraging for a diet of grasses, seeds, invertebrates and water fleas.( Hanna et al., 2011). According to the most economic importance to the leat, the birds are classified as fowl, goose, duck, turkey, pigeon and guinea ( Igweubike and Eze 2010).

Knowledge of the anatomy of the oropharynx and tongue is important to identify structural features that may influence nutrition, food intake and ingestion as well as to provide a foundation for recognition of pathology in this region. Some attention has been devoted to the study of the morphology of the avian oropharynx and tongue (Jackowiak and Godynicki, 2005; Crole and soley, 2008; Igebuike and eze, 2010; Tivane et al., 2011; Erdogan and Alan, 2012). However, specific information on anatomy of the oropharynx and tongue of the duck, partidage and ostrich are still very scant. The present study seeks to investigate the morphology of the oropharynx and tongue of the duck, partridge and ostrich using gross anatomical and light microscope techniques.

## Material and methods

The current study was conducted on ten male, apparently healthy domestic ducks, Partridges and ostrich of different ages. Five of each bird out of ten were used to describe the oral cavity grossly. The morphometric study was measured by aid of a Dazor Magnifier and a Vernier Caliber. The obtained results were photographed using **Sony®** digital camera 12.1mp, 4x. The birds were euthanized by intraperitoneal administration of sodium pentobarbitone (80)mg/kg (REILLY, 2001). All the heads of birds were dissected immediately. The study was approved by the Local Ethical Commity at Faculty of Veterinary Medicine/al-qadisiyah University. The tongues and oral cavity were washed with normal saline solution and then kept in 10% neutral buffered formalin. The shape of the tongue as well as oral cavity and dimensions include the length from the tip to the body base junction and the width at this point of the tongues was studied in details under stereomicroscope image analysis (SMZ 1500 digital camera). The hard palate and tongues were cut off transversally. Paraffin sections (6 μm) were obtained from the tongue. Staining with routine haematoxylin eosin and masons trichrome for studying of general microstructures and collagen fiber, alcian blue(pH-2.5) -PAS for acid and neutral mucin (Totty, 2002). The sections were documented in Olympus microscope; model BX 50, provided by digital camera (MEM 1300).

**Literature review**

Struthio is a genus of birds in the order Struthioniformes, whose members are the ostriches. It is part of the infra-class Palaeognathae, a diverse group of flightless birds also known as ratites that includes the emus, rheas, and kiwis (Freitag, et al., 1993). There are two living species of ostrich, the common ostrich and the Somali ostrich. They are large flightless birds of Africa who lay the largest eggs of any living land animal. With the ability to run at 70 km/h (43.5 mph), they are the fastest birds on land. It is farmed worldwide, particularly for its feathers as they are used as decoration and feather dusters. Its skin is also used for leather products.( Buffetaut and Angst, 2014)

| | |
|---|---|
| Kingdom: | Animalia |
| Phylum: | Chordata |
| Class: | Aves |
| Order: | Struthioniformes |
| Family: | Struthionidae |
| Genus: | *Struthio* |

Partridges are medium-sized non-migratory birds, with a wide native distribution throughout Europe, Asia, and parts of Africa. They are sometimes grouped in the Perdicinae subfamily of the Phasianidae (pheasants, quail, etc.). However, molecular research suggests that partridges are not a distinct taxon within the family Phasianidae, but that some species are closer to the pheasants, while others are closer to the jungle fowl.

| | |
|---|---|
| Kingdom: | Animalia |
| Phylum: | Chordata |
| Class: | Aves |
| Order: | Galliformes |
| Family: | Phasianidae |
| Subfamily: | Perdicinae |

Partridges are native to Europe, Asia, Africa and the Middle East. Some species are found nesting on steppes or agricultural land, while others species prefer more forested areas. They nest on the ground and have a diet consisting of seeds, grapes and insects (Kurman and Sherk ,2014).

Duck is the common name for numerous species in the waterfowl family Anatidae which also includes swans and geese. Ducks are divided among several subfamilies in the family Anatidae; they do not represent a monophyletic group (the group of all descendants of a single common ancestral species) but a form taxon, since swans and geese are not considered ducks. Ducks are mostly aquatic birds, mostly smaller than the swans and geese, and may be found in both fresh water and sea water.

Ducks eat a variety of food sources such as grasses, aquatic plants, fish, insects, small amphibians, worms, and small molluscs. Dabbling ducks feed on the surface of water or on land, or as deep as they can reach by up-ending without completely submerging.

Along the edge of the beak, there is a comb-like structure called a pecten. (Young, 2019).

| | |
|---|---|
| Kingdom: | Animalia |
| Phylum: | Chordata |
| Class: | Aves |
| Order: | Anseriformes |
| Superfamily: | Anatoidea |
| Family: | Anatidae |

## Results

**Gross morphology of the oral cavity and dissecting microscope study**:

**The roof of the cavum oris is formed from the Palatum:**

The palate length (fig.1A,B,C) is about 6.2 cm in male duck, 4.2 cm in ptridage and 8 cm in ostrich, deeply concave centrally and fades caudally. From its mucous membrane the median palatine ridge (fig.1 A,B,C) arises as median longitudinal ridge which measures about 4 cm in ostrich 1.5 cm in ptridage 3.6 cm in duck. It extended rostrally till about 0.3 in ostrich, 0.5 in ptridage 0.6 cm in duck beyond the hard keratin tip and terminates caudally forming four based papillae (fig.1A,B,C). On both sides of the rostral part of the ridge there are 4-5 short, smooth transverse palatine ridge absent in ostrich and partridge (Fig.1A,B,C), in duck another row of 38 – 40 long blades-like pigmented lamellae (fig.1A) that lie on the lateral margins of the palate, absent in ostrich and patridage. On the lateral margins of the palate on the ventromedial sides of the bill there is a row of 22- 24 distinct thick lamellae which are about 0.3 cm rostrally and gradually increase caudally till reach 0.6 cm while in ostrich 6-10 plate in lower jaw about 0.4cm rostrally and decrease in number toward caudally. these lamellae absent in patridage. The choanal cleft (sulcus palatinus) (fig.1 A,B,C) measures about 2.6 cm in duck, 2 cm in patridage , 3cm in ostrich and divides into short narrow rostral and long wide caudal parts. The edges of its mucous membrane possess several irregular rows of caudally directed papillae (fig.1A,B). Caudal to the choanal cleft there is an infundibular slit (fig.1A,B,C) which represents the common narrow opening of the two auditory tubes.in ostrich the choana cleft as V-shape depression subdivided along the midline by a prominent mucosal ridge (asterisk). The openings of the internal nares are demarcated dorso-medially by low mucosal ridges. The infundibular cleft (black arrow) extends from a crater-like

depression (white arrow) to subdivide the caudal portion of the pharynx into two overlapping mucosal. The free borders of the folds are rounded and form a deep retropharyngeal recess (grey arrows) before becoming continuous with the mucosa of the proximal oesophagus

**The floor of the cavum oris consists of Lingua**, The tongue **(**Lingua) (figs. 2and 3A,B,C) in duck is thick, fleshy, elongated while in partridge appear has an elongated triangular shape with a pointed hardened texture tip and flat dorsal surface. In ostrich appear as conical in shape with bifid tip, these completely fills the floor of the oral cavity and measures about 5.2 cm length in duck, 4cm in partridge, 1cm in ostrich: 1.5 cm in duck, 1cm in partridge, 1.75cm in ostrich width and 1 cm in duck, 0.5cm in partridge, 0.75cm in ostrich in thickness. It consists of three parts; the apex, the body and the root. The apex of the duck tongue (Apex linguae) is narrow, smooth, free from the papillae and reaches to the tip of the lower bill while partridge the apex of tongue has a pointed hardened texture tip(figs.2 and 3A,B), in ostrich The triangular interramal region was accommodated between the rami of the mandible and formed the floor of the oral cavity rostral to the tongue. It extended bilaterally around both the tongue and the laryngeal mound, eventually merging with the oesophageal mucosa. The mucosa of this region displayed two components based on differences in color. The largest component was a pale color and occupied the rostral and rostro-lateral aspects of the oral cavity (fig.3C).

The body of the tongue (Corpus linguae) (fig.3A and 4) is thick and has dorsal, ventral and two lateral surfaces; the dorsum linguae is marked by the sulcus linguae (figs.2,3 and 4) as a deep median longitudinal groove that is extended from the apex till the torus linguae in duck, partridge while in ostrich was absent(figs.3A,B,C). The

measures about 2cm, and 1cm in to adapt the median ridge of the hard palate during closure of the oral cavity in duck and partridge. From the ventrum linguae arises a sickle shaped fold of mucous membrane representing the frenulum linguae (fig.4 A,B,C) which extends 1 – 2 cm from the middle of the ventral surface of the body of the tongue to the floor of the oropharyngeal cavity and this fold measures about 1.6 cm,1.3cm and 1cm in duck, partridge and ostrich. The margo linguae are fringed with large conical papillae (fig.4A,B) in duck and partridge and in between them there are numerous fine thread-like papillae that intermingled with the bill lamellae of the palate (figs. 3A,B&4A,B). The root of the tongue (Radix linguae) (fig.3A,B,C) bears rostrally the triangular wide ridge of mucous membrane, the torus linguae (figs.3A,B); its base directed caudally. The lateral sides of the torus linguae are marked rostrally by two parallel curved rows of fine papillae and the caudal basal side of the torus is divided by the sulcus linguae into two parts each one contain transverse caudally directed papillae (fig. 4A,B). On the floor of the pharynx caudal to the root of the tongue, there is a laryngeal prominence (mound) (figs.3,4,A,B) as a median mucosal elevation which contains the laryngeal inlet (glottis), it is bounded rostrally by small papillae as well as numerous fine pointed caudomedially directed papillae which are distributed on the terminal part of the laryngeal mound in front of the esophageal inlet. Bill whilst the keratin covering most of bill in the doft and leathery, at rostral end there is a hard plate, the nail (Fig.3A,B,C).

In ostrich three regions are distinguished in the dorsal surface of the tongue; the lingual apex, the lingual body, and the lingual radix. There is wide area between the lingual apex and lingual base, that situated at the end of the lingual body and are inclined toward the posterior end of the tongue. A median groove is found along the dorsal surface of the tongue and gradually expands backwardly. This median groove

divides the body of the tongue into two symmetrical parts which are characterized by their convex folded surface. The tongue is connected with the bottom of the bill with a short frenulum in the posterior part of the lingual body at the level of the crest of the conical papillae(Fig.3C, 4C).

Hard conical papillae were directed backward and arrange transversely between tongue body and its base. The larger one located at each side of the body-base junction. However, there were additional one or two papillae just behind this transverse row on each side (Fig. 3A,B &4A,B). Numerous lingual glands were opened on the dorsal surface of the tongue base. The ventrolateral surfaces of the tongue had hard plate (Fig. 3A,B&4A,B). One row of pharyngeal conical papillae were directed backward and arrange transversely behind the laryngeal cleft, however, there were another rudimentary conical papillae that arranged transversally behind the first row (Fig. 3A,B)

**Histological and Histochemical Result :**

The microscopic study of the tongue of the ducks, partridge and ostrich under investigation indicated that there was epithelial lining that covering the lamina propria (LP) containing lingual mucous glands, lymphoid nodules, blood vessels, and nerves, as well as a core of paraglossum and associated striated muscles. On the ventral surface of the rostral part of the tongue, the epithelium lining appeared orthokeratinized and was covered by many layers of cornified squamous cells; the basal, intermediate, and keratinized layers forming a lingual nail (Fig. 5A,B,C). Also, parakeratinized epithelium with the same three layers was seen on the dorsum of the tongue. The dorsal and ventral surfaces of the root of the tongue and some areas on the lingual prominence were lined by non-keratinized stratified squamous epithelium. The dorsal marginal epithelium appears thicker than the ventral one. A dense irregular

richly vascularized fibrous connective tissue (CT) was found underneath the epithelium of the dorsal and ventral surfaces of the tongue body which penetrated the layers of the epithelium in the form of connective tissue papillae, The tip and the ventral surface of the tongue were devoid of any glandular structure except in ostrich have lingual salivary glands. (Fig.5A,B,C).

The tongue contained anterior and posterior lingual salivary glands, located ventrolatrally and at the base of the tongue respectively. The mucous glands were simple tubulo-alveolar. The columnar cells with basal located nuclei were represents the secretory cells of these secretory units (Fig. 5A,B,C). The anterior group of the lingual salivary glands was smaller than that at the base of the tongue. However, after the histochemical stain, the amount of mucin in the anterior salivary glands showed differences; the medial group had more mucin quantity than the lateral group as appeared after PAS stain (Fig. 6A,B,C). The section at the base of the tongue showed similar appearance of the posterior lingual glands with that of the medial group. It has been observed that the lateral group of the anterior lingual glands had weak acid mucin reaction compared with the medial group or with the posterior lingual glands after alcian blue stain. Meanwhile, the granules of the mucin in the cytoplasm of the secretory cells contained both neutral and acid mucin in the medial group of the anterior lingual glands and the posterior lingual glands, but it seemed mostly neutral reaction in the lateral group .

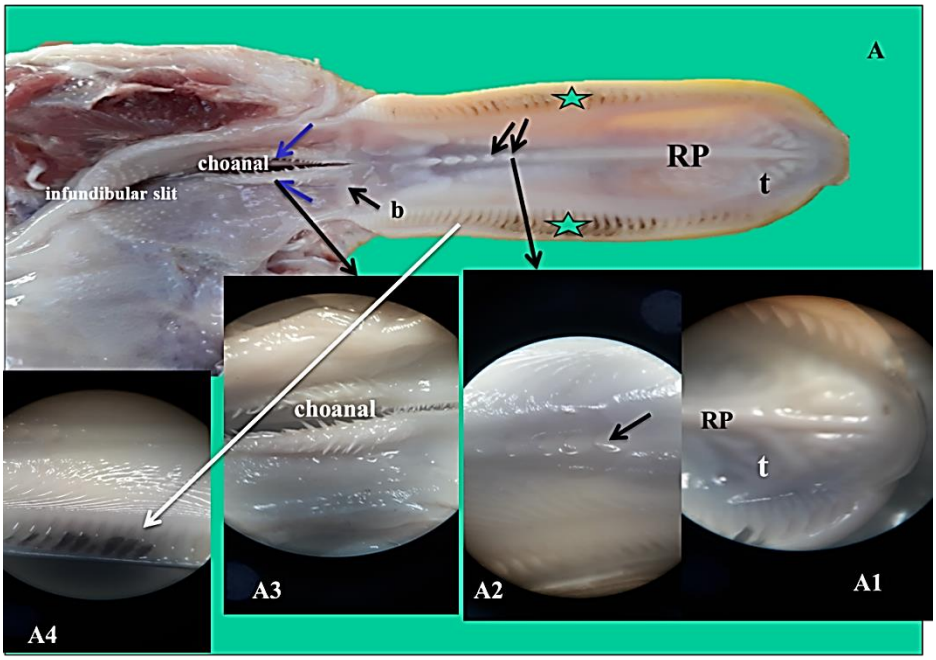


Fig. (1A): A photograph showing the roof of oral cavity of the duck (hard palate) : the median palatine ridge (Rp), mucosal transverse folds(t), bilateral ridge(b), Based papillae (black arrows), Bill lamellae( green star), Papillae(blue arrows), choanal , Infundibular slit.A1,A2,A3,A4: under dissecting microscope X10.

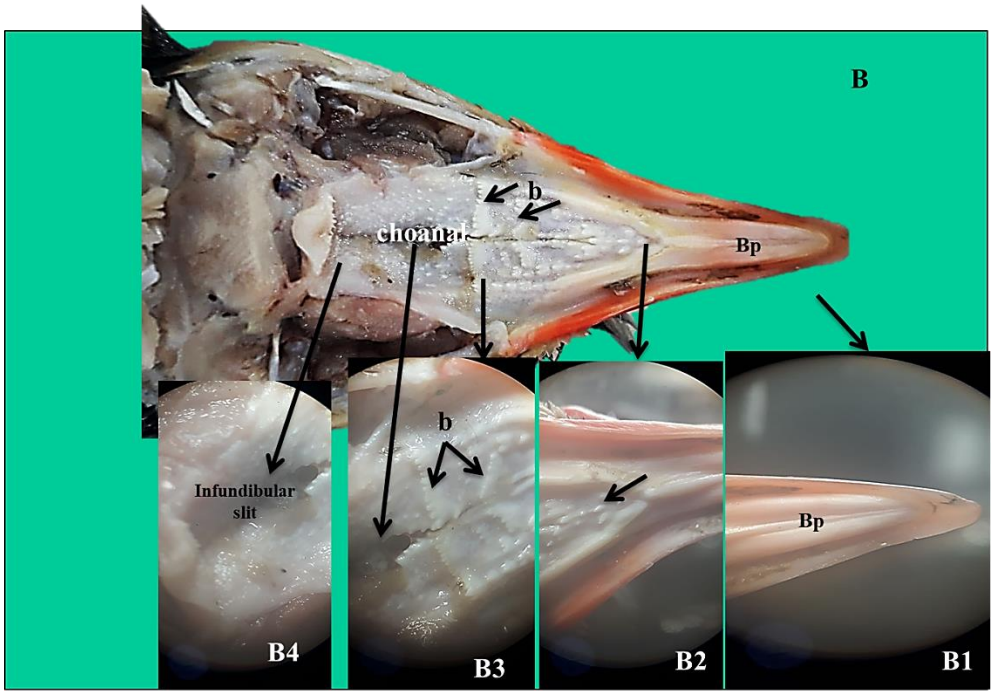


Fig. (1B): A photograph showing the roof of oral cavity of the ptridage (hard palate) : the median palatine ridge (Rp), bilateral ridge(b), Based papillae (b), Papillae(blue arrows), choanal , Infundibular slit.B1,B2,B3,B4: under dissecting microscope X10.

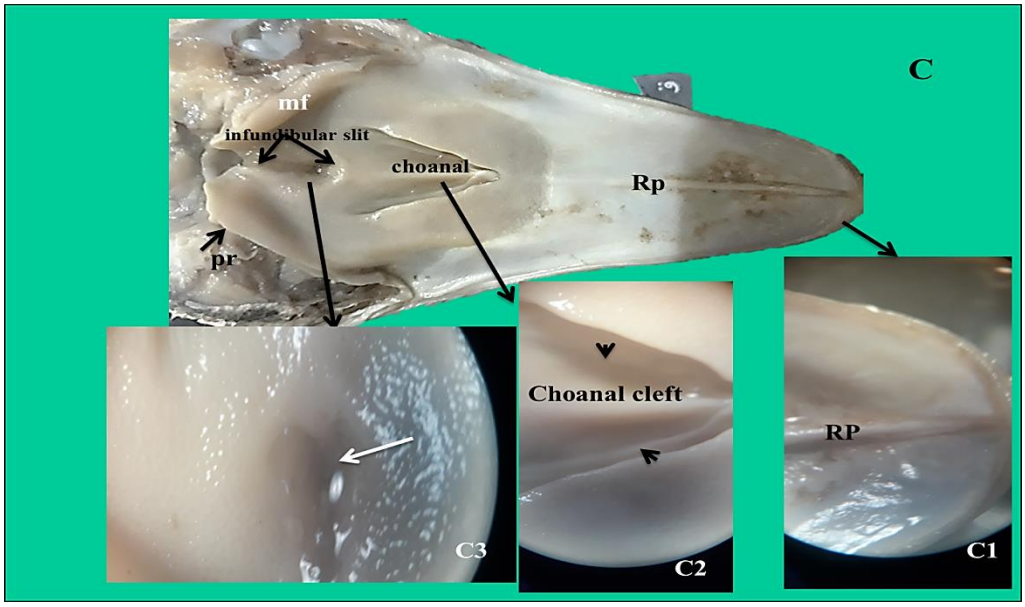


Fig. (1C): A photograph showing the roof of oral cavity of the ostrich (hard palate) : the median palatine ridge (Rp), choanal cleft , Infundibular slit., a crater-like depression (white arrow), pharyngeal folds (mf), two small caudally directed papillae at the base of the tongue (arrowheads), retropharyngeal recess (pr). C1,C2,C3: under dissecting microscope X10.

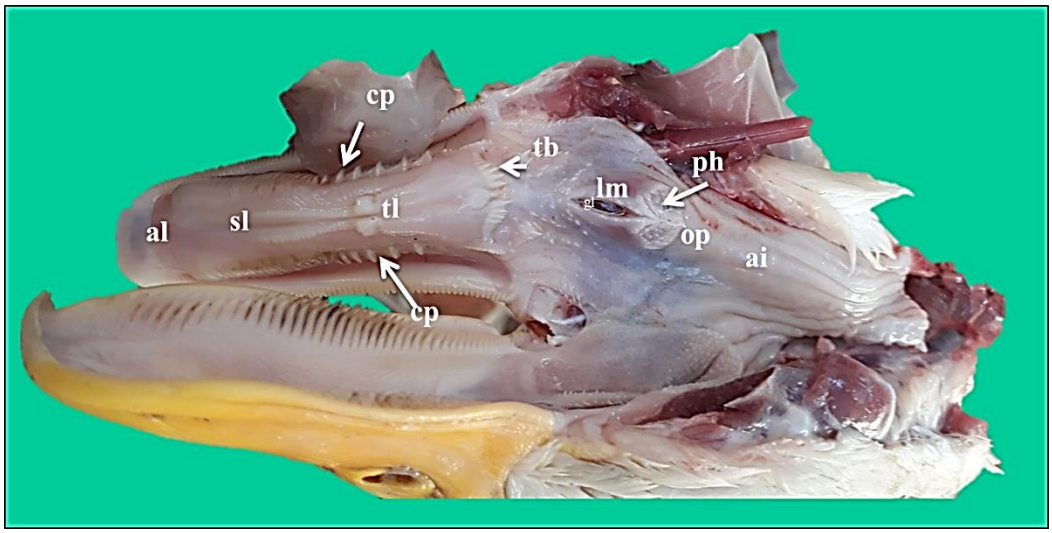


**Fig. (2): A photograph showing the floor of oral cavity of the duck.**

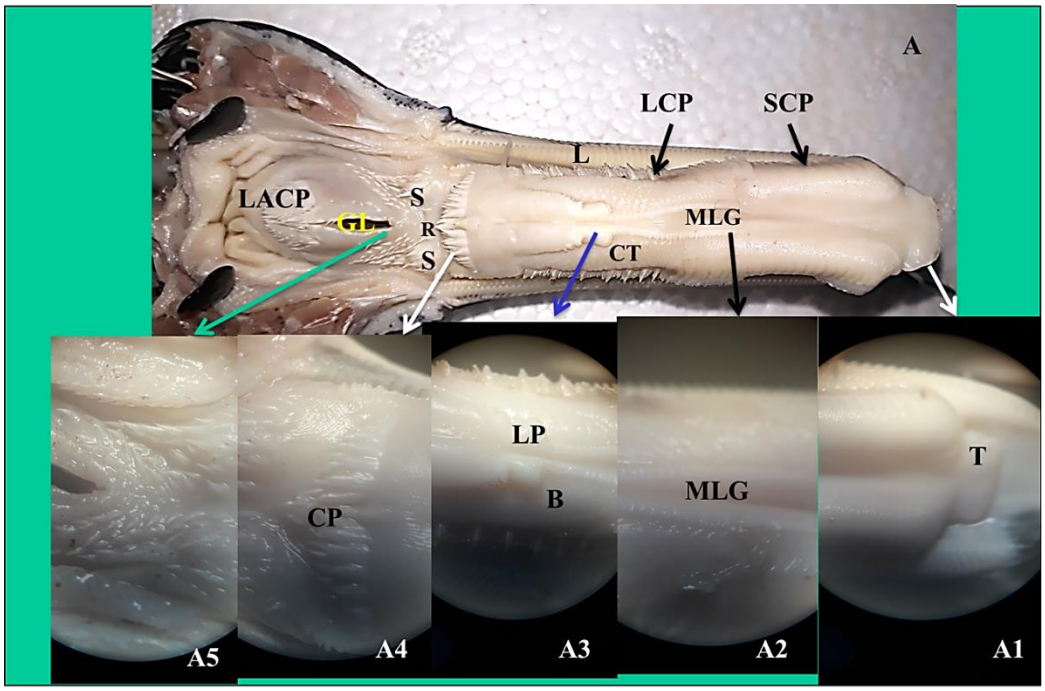


Fig.3A: Photograph showing the floor of the oropharynx in the duck. Note the tip of the tongue (T), body of the tongue (B), lamellae of the bill (L), lingual prominence (LP), mucosal swellings (S), median ridge (R), glottis (GL), median lingual sulcus (MLG), conical papillae on the caudal border of the lingual prominence (CP), small conical papillae (SCP), laryngeal conical papillae(LACP) and large conical papillae (LCP).A1,2,3,4,5,under dissecting microscope X10.

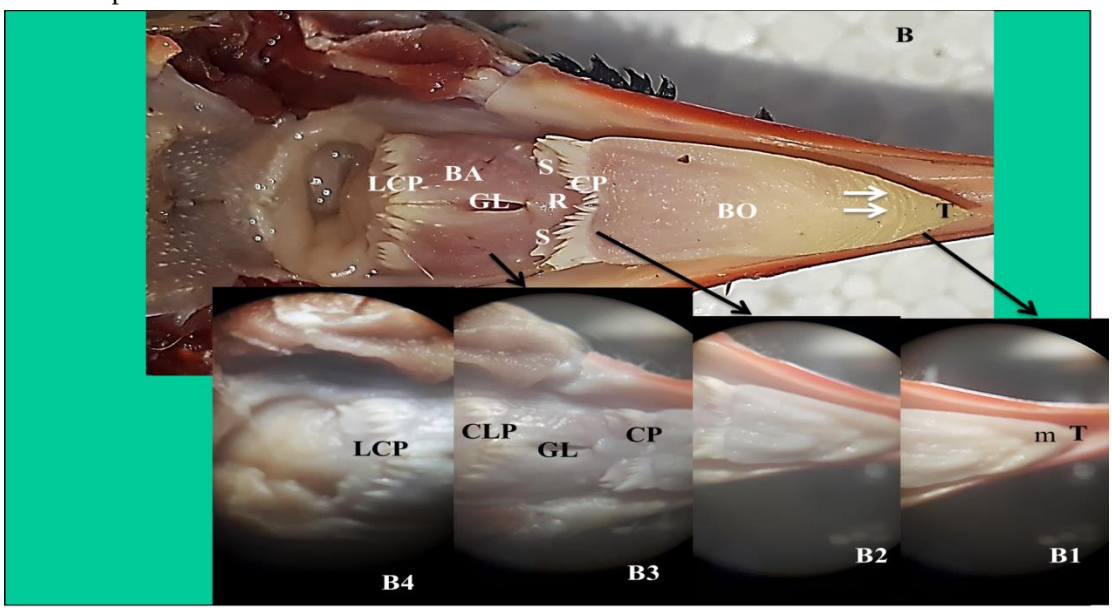


Fig.3B: Photograph showing the floor of the oropharynx and tongue in the partidage. Note the tip of the tongue (T), body of the tongue (BO), mucosal swellings (S), median ridge (R), glottis (GL), conical papillae on the caudal border of the body (CP), transverse line of the conical papillae (white arrow), median longitudinal groove (m) and the openings of the lingual salivary glands (white arrows), laryngeal conical papillae(LACP), B1,2,3,4 under dissecting microscope X10.

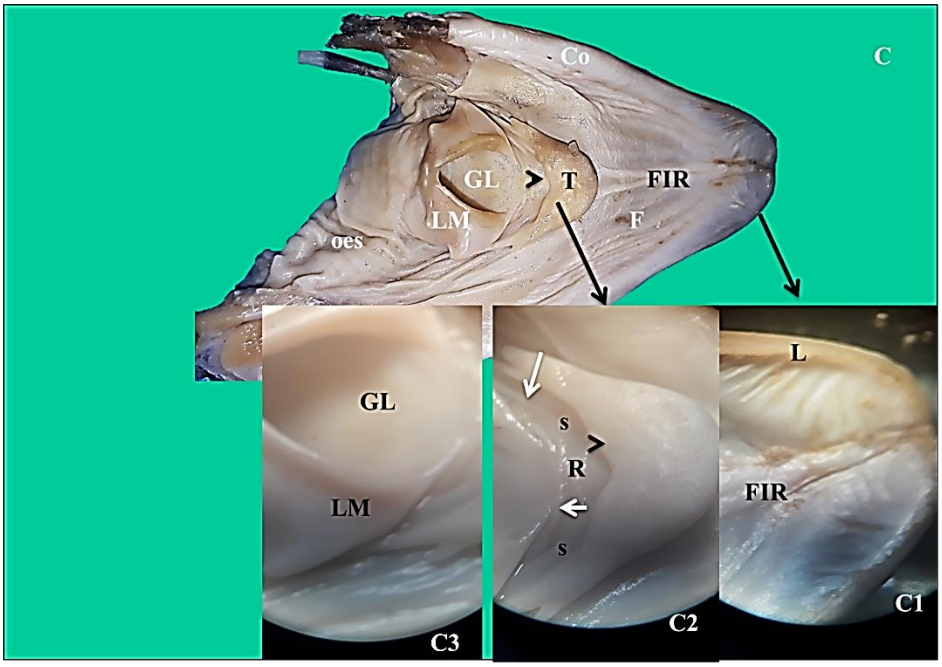


Fig.3C: Photograph showing the floor of the oropharynx and tongue in the ostrich. Note the tip of the tongue (T), body of the tongue (C2), mucosal swellings (S), median ridge (R), glottis (GL), laryngeal mound (LM), high folded internal region(FIR) , transverse line of the pharyngeal papillae (white arrow) and the openings of the lingual salivary glands (white arrows), secondary tongue folds (head arrow)and oesphagus(Oes), C1,2,3 under dissecting microscope X10.

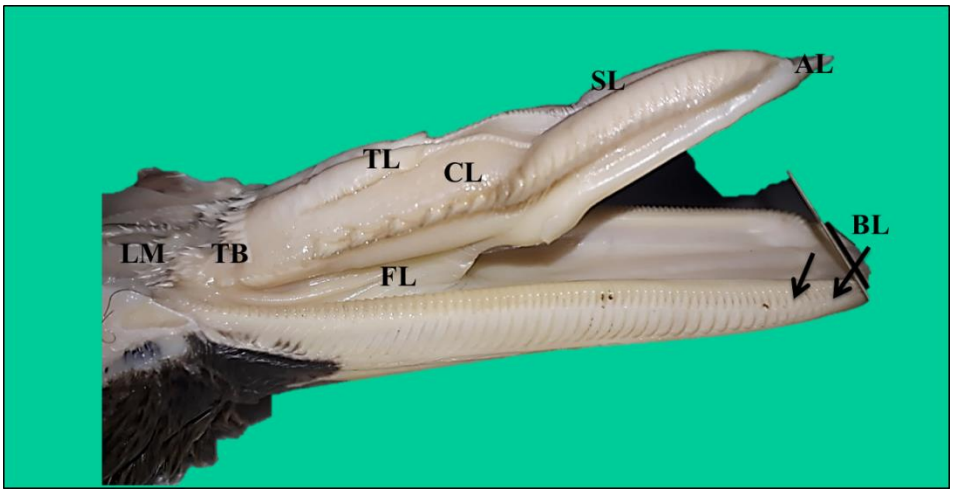


Fig. (4A): A photograph showing the tongue and the floor of the oral cavity in the duck. (Lateral view), Corpus linguae(CL), apex linguae(AL), Sulcus linguae(SL), Torus linguae (TL), Frenulum linguae(FL), Bill lamellae(BL), Transverse papillae(TB) and Laryngeal mound(LM) .

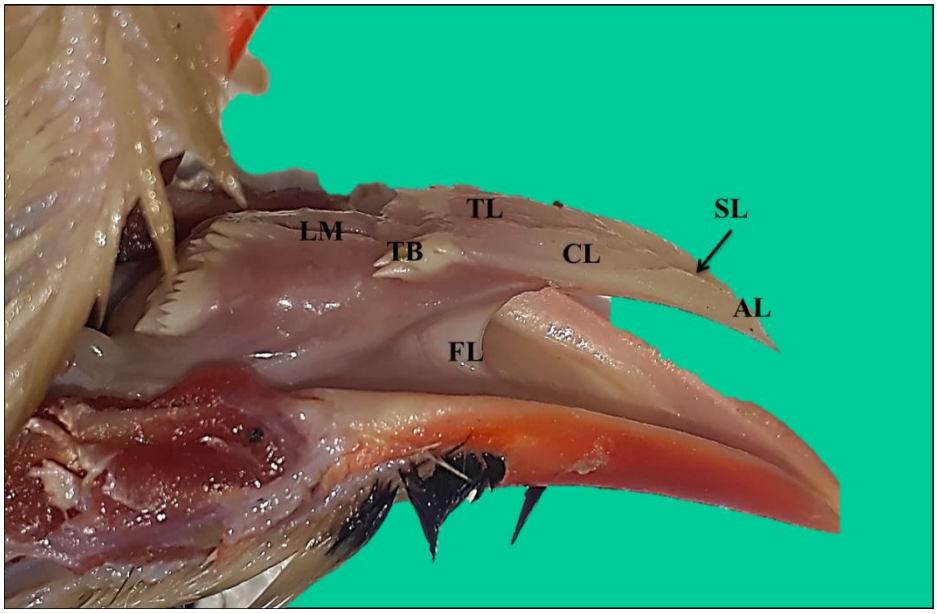


Fig. (4B): A photograph showing the tongue and the floor of the oral cavity in the partidage. (Lateral view), Corpus linguae(CL), apex linguae(AL), Sulcus linguae(SL), Torus linguae (TL), Frenulum linguae(FL), Transverse papillae(TB) and Laryngeal mound(LM)

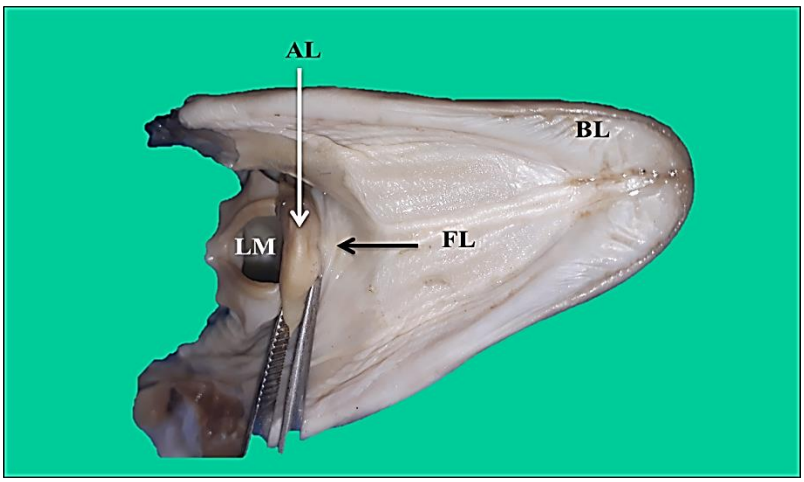


Fig. (4C): A photograph showing the tongue and the floor of the oral cavity in the ostrich. (anterior view), apex linguae(AL), Frenulum linguae(FL) and Laryngeal mound(LM)

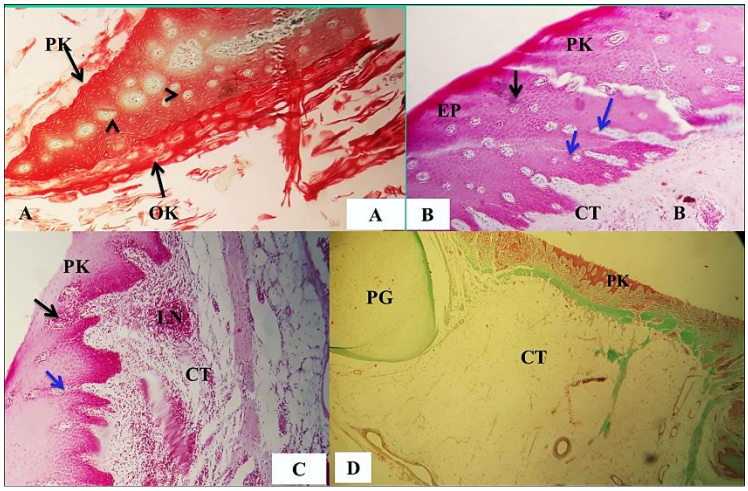


**Fig.5A:** Microphotograph of the duck tongue tip showing thick stratified squamous epithelium (EP),connective tissue (CT),parakeratinized layer (PK), intraepithelial taste buds (Black arrowheads and black arrow), CT papillae (Blue arrowheads), hyaline cartilage (PG), lymphatic nodule (LN), orthokeratinized(OK). (A&D: Masson trichrome stain, X40),(B&C: Combined alcian blue and PAS stain , X100).

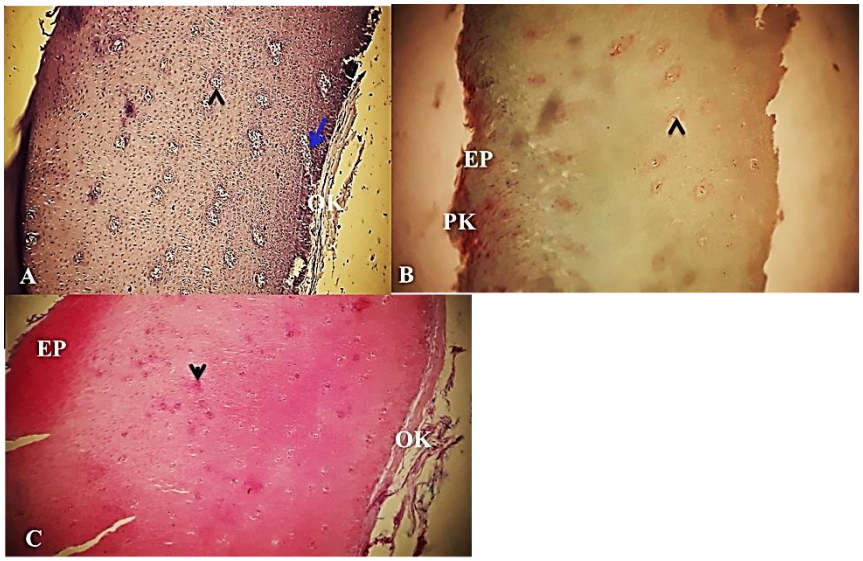


**Fig.5B:** Microphotograph of the partidage tongue tip showing thick stratified squamous epithelium (EP), parakeratinized layer (PK), intraepithelial taste buds (Black arrowheads), CT papillae (Blue arrowheads), orthokeratinized(OK). (A&B: H&E and Masson trichrome stain, X40),( C: Combined alcian blue and PAS stain , X100).

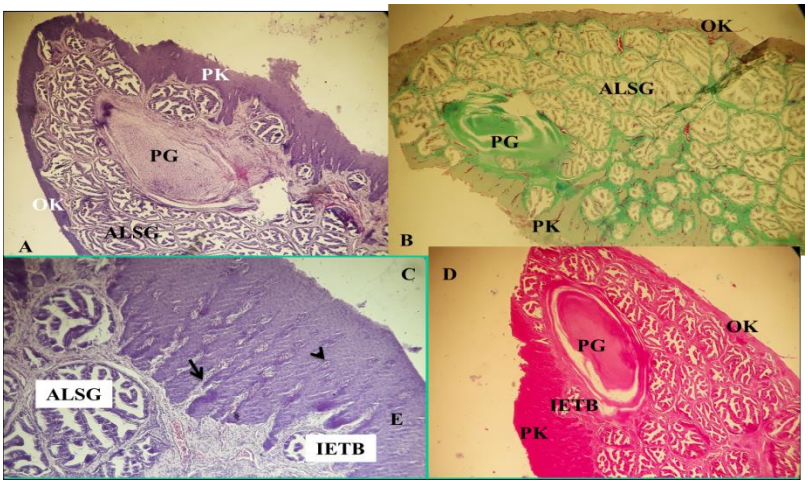


**Fig.5C:** Microphotograph of the ostrich tongue tip showing thick stratified squamous epithelium (EP), parakeratinized layer (PK), intraepithelial taste buds (Black arrowheads and black arrow), orthokeratinized(OK). (A&B&DX40)(C,X100) (H&E , Masson trichrome stain, Combined alcian blue and PAS stain).

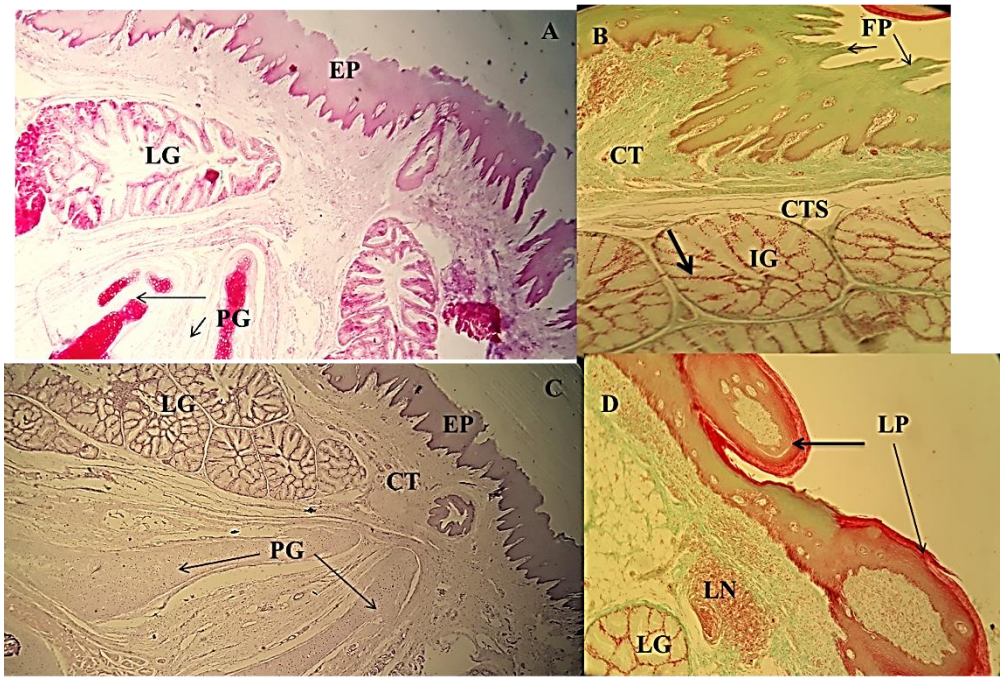


**Fig.6A:** Microphotograph of the duck tongue base showing thick stratified squamous epithelium (EP), simple columnar epithelium lined lingual salivary gland(black arrow), lingual papillae(LP), hyaline cartilage(PG), connective tissue (CT),dense connective tissue sheath (CTS). (A&CX40)(B&D,X100) (H&E , Masson trichrome stain, Combined alcian blue and PAS stain).

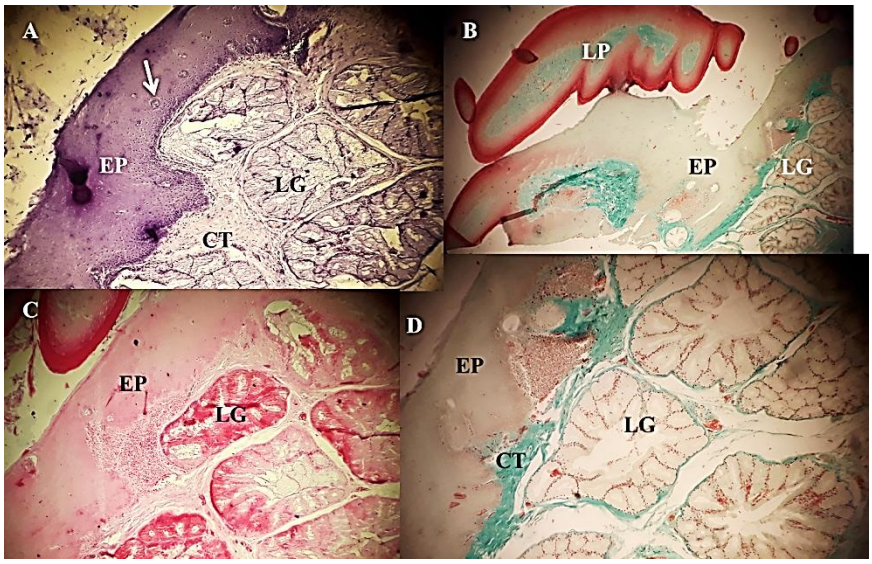


**Fig.6B:** Microphotograph of the partidage tongue base showing thick stratified squamous epithelium (EP), lingual papillae(LP), connective tissue (CT), intraepithelial taste bud (white arrow). (A,B&C,D:X40) (H&E , Masson trichrome stain, Combined alcian blue and PAS stain).

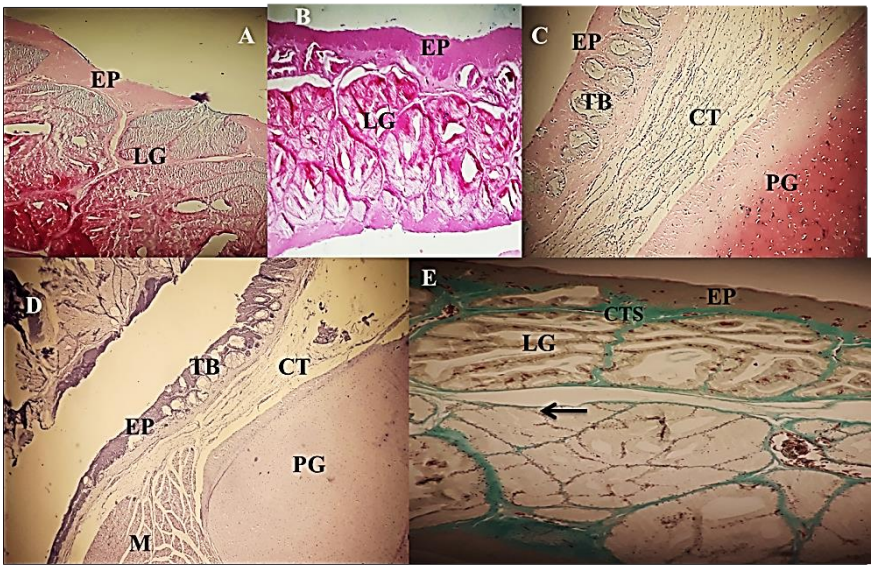


**Fig.6C:** Microphotograph of the ostrich tongue base showing thick stratified squamous epithelium (EP), simple columnar epithelium lined lingual salivary gland(black arrow), hyaline cartilage(PG), connective tissue (CT),dense connective tissue sheath (CTS). (A,B,C,D&EX100) (H&E , Masson trichrome stain, Combined alcian blue and PAS stain).

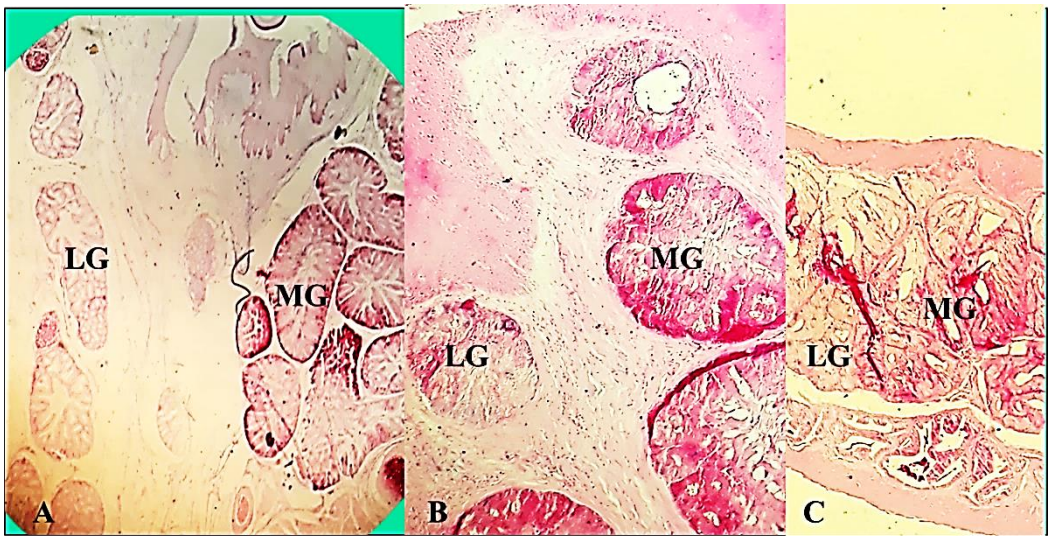


**Fig.7A,B,C:** Microphotograph of the duck, partridage and ostrich tongue base as follow showing lateral glands group (LG) and medial gland group(MG) (A,B&CX100) (Combined alcian blue and PAS stain).

## Discussion

### Regarding the gross morphology of the oral cavity:

Our findings have a similar opinion to that seduced by some available literatures where the soft palate was absent , consequently, there was a common oropharyngeal cavity , its roof formed by the hard palate which oriented by the choanal cleft followed by the infundibular slit and the vicinity of its floor occupied by the tongue.

In agreement with our study, Hanna et al (2011) in domestic goose, Igweubike and Eze (2010) in African pied crow, Dursun (2002) in domestic fowls, Nickel etal (1977) in fowls and pigeons and Mc Lelland (1968) in chicken have the opinion that the tongue was divided into three parts; apex, body and root. Concerning the torus linguae of the examined ducks, it was a triangular wide ridge of mucous membrane where its base directed caudally and its lateral sides were marked rostrally by two parallel curved rows of fine papillae and the caudal basal side of the torus linguae was divided by the sulcus linguae into two parts; each one contained caudally directed papillae. On the other hand, Hanna et al (2011) in domestic goose said that the body of the tongue ended by a lingual prominence, Mally (2005) and McLelland (1990) in ducks, geese and swans asserted that the tongue had the fleshy caudal eminence that was called the torus linguae and Mc Lelland (1968) in duck and goose observed that the terminal part of the tongue contained a wide ridge of the mucous membrane in duck while in ostrich and partidage it was replaced by the caudal raised part. The tongue of ducks in our study was thick, fleshy, elongated and completely fills the floor of the oral cavity with narrow, smooth apex free from any mechanical papillae. The tongue of the partridge is long in the antero-posterior direction and is triangular in shape, with a pointed apex. This description of the tongue agrees with that of many granivorous birds; Salem (1978) in the pigeon, Iwasaki and Kobayashi (1986) in chicken, Iwasaki

et al. (1997) in Middendorffs bean goose,. However, Homberger and Brush (1986) recorded that the tongue of the African gray parrot (granivorous) is relatively rounded profile as present result. On the other hand, Hanna et al (2011) in goose defined that the tongue was narrow elongated, Igweubike and Eze (2010) in African pied crow said that it was arrow shaped , Dyce, sack and wensing (2010) in birds revealed that the tongue was triangular in its outline, in ostrich observed that it was a small, stubby and u-shaped structure with a blunt apex as result Catarina (2008), Mally (2005) and Mc Lelland (1990) in geese and swans mentioned that the tongue was thick and fleshy with the rostral border modified into a scoop while in flamingo it was piston-like. In the bartidage the tongue was short, blunt and fleshy as Nickel et al (1977) in pigeon cited that the tongue was narrow and in fowl it was broad, lancet-shaped. Moreover, in duck asserted that the long free part of the tongue was narrow at the rostral extremity as result with Mc Lelland (1968) in goose that it was spatula shaped with rounded rostral extremity and the latter author in chicken added that the tongue was relatively rigid triangular. The frenulum lingua of the examined birds was insinuated between the ventral surface of the body of tongue and the floor of the oral cavity, this statement was similar to that described by Hanna etal (2011) in goose , Igweubike and Eze (2010) in African pied crow , Catarina (2008) in ostrich , Nickel etal (1977) in birds and Mc Lelland (1968) in chicken. In the present the dorsum linguae of the tongue was marked by a deep median sulcus linguae which extended from its apex to the base. This result was agreed with that given by Hanna et al (2011) in goose, Hassan et al (2010) in the Egyptian geese and Mally (2005) and Mc Lelland (1990) in ducks, geese and swans. in ostrich observed that the dorsal surface of the tongue was folded back on itself to form a deep blind pocket as result Catarina (2008).

In the investigated ducks, it was revealed that the margo linguae are fringed with large conical papillae and in between them there are numerous fine thread like papillae that intermingled with the bill lamellae of the palate. These results were nearly similar to that asserted by Hanna et al (2011) and Hassan et al (2010) in geese, Dyce etal., (2010) in ducks and geese, Mally (2005) and Mc Lelland (1990) in ducks, geese and swans and Mc Lelland (1968) in duck. The current study confirmed that the mucous membrane of the palate was oriented by a ruga palatine mediana as median longitudinal ridge. It extended rostrally till beyond the hard keratin tip and terminates caudally to form four based papillae. In ostrich, reported that the roof of the oropharynx divided into two halves by a prominent median palatine ridge as Catarina (2008). Furthermore, Nickel et al (1977) in fowl and pigeon and Mc Lelland (1968) in chicken that described that the hard palate had a median and two lateral palatine ridges. Moreover, the latter author in goose observed that the rosral part of the hard palate had a longitudinal median ridge. In the studied, the rostral part of the ridge was formed by smooth rugae palatinae laterales. On the lateral margins of the palate close to the ventromedial edge of the upper bill there is a row of long blade like lamellae. On the lateral margins of the palate on the ventromedial sides of the bill there is a row of distinct thick lamellae which are rostrally and gradually increase caudally till. These statements nearly similar to that concluded by Nickel et al(1977) in lamellirostres and Mc Lelland (1968) in duck and goose. The results under discussion achieved that the choanal cleft in the examined divided into short narrow rostral and long wide caudal parts. The edges of the mucous membrane of the cleft were covered with several irregular rows of caudally directed papillae and caudal to the preceeding cleft there was the infundibular slit as a narrow common opening of the two auditory tubes. These statements might be attributed to that noted by Mc Lelland (1968) in

duck and goose. In partridge midline of the hard plate there was choana which was characterized by a longitudinal fissure and divided into a narrow rostral and an enlarged caudal portions similar with Igweubike and Eze (2010) in the African pied crow. The mucous membrane of the hard palate exhibited many caudally directed papillae that were prominent on the palatine ridges and on the edges of the enlarged portion of the choanal slit. However, Dyce et al (2010) in birds said that the palate presented a long median choanal cleft which was connected with the nasal cavity. Moreover, in ostrich reported that the roof of the oropharynx had inverted V shaped depressed choana which bounded caudally by a shallow crescent that demarcated the median infundibular cleft as Catarina (2008). Furthermore, Mc Lelland (1968) in chicken stated that the roof of the oral cavity contained papillae that directed caudally and arranged in transverse rows. Two rows arranged immediately rostral to the choanal slit and two rows on each sides of this slit. The roof of the pharynx was divided by a short median longitudinal infundibular slit.

In present study it has been shown that the tongue of birds is adapted to the route and type of food intake (Pasand et al., 2010). The conical papillae arrange in a transverse row. However, these papillae are restricted in the midline between the body and the base of the tongue in duck and partridge as (Iwasaki et al., 1997; Hassan et al ,(2010,. There are no papillae in the ostrich tongue similar as (Pasand et al., 2010). Emura et al (2008).has been reported that the caudal direction of papillae is to facilitate the prehension and swallowing of food. Similar to the present study, the pharyngeal papillae of the appear as double rows as (Iwasaki and Kobayashi, 1986) in chicken. But it is a single row in red jungle fowl tongue (Khalid et al., 2011) The tongue of the duck and partridge was covered by parakeratinized stratified squamous epithelium, except the hard keratinization of the conical papillae and on the ventrolateral surface

of the tongue. Similar to these results were detected in some species of birds. However, the keratinization of the tongue epithelium depends mainly on the type of food intake, Jackowiak and Ludwing (2008) had reported that it's appeared heavily cornified in herbivorous and granivorous birds. But in water habitats birds, lesser degree of keratinization occur as (Iwasaki, 2002; Jackowiak et al,2006) The location of the lingual gland seems different than that mention in ostrich, that the lingual salivary glands occupied most of the dorsal and ventral surfaces of the tongue (Pasand et al., 2010). According to our results, the salivary glands of the tongue had exclusively mucous secretion. This result was in line with Rossi et al. (2005) in partrige. In contrast, no lingual salivary glands are found in cormorants tongue (Jackowiak et al., 2006). In present study, we did not find any explanation to the histological differences that found between the medial and lateral groups of the anterior lingual salivary gland, despite these differences were mention previously in some species of birds too. Like in red jungle fowl (Khalid et al., 2011) that shown that the anterior and the posterior lingual glands have some difference after histological stain. However, our suggestion that the lateral group may be exposed to more external pressure than that for the medial group as its located more superficially, thus the former group had changed according to this influential factor. For this reason, the mucous granules that detected by (PAS stain )glycoconjugates containing vicinal diol group) in the cytoplasm of the secretory cells of the medial group and lateral group or in the posterior lingual glands this result similar the tongue of the little egret is free of neutral mucin (Al-Mansour and Jarrar, 2007). The lateral group of the anterior lingual glands contained mostly neutral mucin, while the medial group and the posterior lingual gland had both neutral and weak acid mucin. These results were similar to that founded in chicken (Suprasert and Fujioka1987). However, Olmedo et al. (2000)

reported that differences in substructure were found even within the same acinus and the same cell of the avian tongue. The medial group of the anterior lingual gland no reaction acid mucin reaction after alcian blue (pH2) and the posterior gland tend to the weak reaction acid mucin reaction after alcian blue (pH2) and containing corboxylated group. However, these data were in line with Gargiulo et al. (1991) in chicken, Al-Mansour and Jarrar (2007) in the little egret. It is known that neutral mucin act as lubricant of food to facilitate swallowing and preserves hydration by providing a hydrophilic environment. In addition, the acid mucin play a role in the modulation of the oral calcium channel activity (Slomiany et al., 1996). It was concluded that the unique features of the duck and partridge tongue were the arrangement of the lingual conical papillae and the presence of double rows of the laryngeal papillae, while papillae absent in ostrich . In addition there is different histochemical reaction in salivary glands component. However, there is no difference between duck, partridge and ostrich.

## Conclusion

1- Morphological and histochemical observations were done on the duck, partidage and ostrich anterior and posterior lingual glands.

2. In the anterior lingual glands there are lateral and medial zones showing different morphological and tinctorial features. The secretory cells are typical mucous cells.

3. Histochemical reactions revealed the presence of acidic glycoconjugates with terminal CHO residues, and glycoconjugates vicinal diol groupings in the secretory granules.

4. It is suggested that the main functions of lingual glands are the lubrication of boli and protection from micro-organisms.

5- The study showed that the tongue of the had specific features such as a lingual nail and mechanical papillae which were covered by the orthokeratinized and parakeratinized epithelium specialized for pecking, filtration, and transportation of the food to the esophagus, as well as prohibit waste of the food from the oral cavity.

**Recommendation**

1- ultrastructure and glycoconjugate histochemistry study were investigated by means of light and electron microscopy using staining specific for complex carbohydrates.

2- immunohistochemically study for endocrine cells.

3- pre-hatching and post-haching study of oral cavity and tongue.

**References**

Baumel, J. J. (1968): Coraço evasossanguneos das aves. In: GETTY, R. Sisson/ Grossman anatomia dos animais domésticos. 5. ed. Rio de Janeiro: Guanabara Koogan, v. 2, p. 1842-1880.

Baumel, J.J. (1975) : Aves Heart and Blood Vessels. In Sisson and Grossman's the Anatomy of the Domestic Animals. Getty R (Eds.), Vol. II, 5th ed. Saunders Company, Philadelphia, 1990-1991.

Buffetaut, E.; Angst, D. (2014). "Stratigraphic distribution of large flightless birds in the Palaeogene of Europe and its palaeobiological and palaeogeographical implications".*EarthScienceReviews*. **138**:394408. doi:10.1016/j.earscirev.2014.07.001

Baumel, J.J., King, S.A., Breasile, J.E., Evans, H.E. and Berge, J.C.V. (1993) : Nomina Anatomica Avium. Published by the Nuttall Ornithological Club. No: 23, Cambridge, Massachusets.

Catarina, T. (2008) : The morphology of the oral cavity, pharynx and esophagus of the ostrich (struthio camelus). (Mvsc degree) anatomy and physiology department faculty of vet. Science of pretoria university.

Dursun, N. (2002) : Anatomy of Domestic Birds. Medisan Publishing,Ankara. 140–141.

Dyce, K.M., Sack, W.O. and wensing, C.J.G (2010) : Text book of veterinary anatomy (4th edition).El Sevier Saunders, 350-355.

Freitag, Stephanie & Robinson, Terence J. (1993). "Phylogeographic patterns in mitochondrial DNA of the Ostrich (Struthio camelus)". The Auk. 110 (3): 614–622. doi:10.2307/4088425. JSTOR 4088425

Hanna, J., Kinga, Godynicki, S.S., Iwasaki, S.I. and Meyer (2011). Functional Morphology of the tongue in the Domestic Goose (Anser Anser f. Domestica). The anatomical record 294:1574–1584.

Hassan, M.S., Moussa, E.M. and Cartwright, E.L. (2010) : Variations by Sex in Anatomical and Morphological Features of the Tongue of Egyptian Goose (Alopochen aegyptiacus). Cells Tissues Organs (DOI: 10.1159/000223231) Published Research Articles in International Journals 2009-2010.

Holliday, C.M., Ridgely, R. C., Balanoff, A. M. and Witmer, L. M. (2006) : Cephalic vascular anatomy in flamingos (phoenicopterus ruber) based on novel vascular injection and computed tomographic imaging analyses, the anatomical record part A 288A:1031–1041.

Kurman j. and Sherk o. (2014). "The Roots of Modern Kurdish Nationalism". In Bengio, Ofra (ed.). Kurdish Awakening: Nation Building in a Fragmented Homeland. University of Texas Press. p. 96.

Igweubike, u.M. and Eze, U.U.(2010) : Anatomy of oropharynx and tongue of the African pied crow(corvus albus). Vet. arhiv 80,523-531.

Mally, B.O. (2005). Clinical anatomy and physiology of exotic species (structure and function of mammals, birds, reptiles and amphibians. El Sevier Saunders; Edinburg London newyork Oxford Phiadelphia Tt Louis Sydney Toronto 2005.

Mc Lelland, J. (1968) : Anatomy of the avian cecum. Journ. Exp.Zool. Suppl. 1989; 3:2-9.

Mc Lelland, J. (1990) : A color atlas of avian anatomy. W.B.philadelphia, London, Toronto, montreal, Sydney, Tokyo.

Nickel, R., Schummer, A. and Seiferle, E. (1977) : Anatomy of the Domestic Birds. Berlin:Verlag Paul Parey. 96-99 and 101-103.

Al-Mansour, M.I. and B.M. Jarrar, (2007.)Morphological, histological and histochemical study of the lingual salivary glands of the little egret, Egretta garzetta. Saudi J. Biol. Sci., 14.81-75:Bashir, A., 1960. Iraqi Birds. Alribat Press, Baghdad, Iraq.

Emura, S., T. Okumura and H. Chen, 2008. Scanning electron microscopic study of the tongue in the peregrine falcon and common kestrel. Okajimas Folia Anatomica Japonica, 85(1): 11-15.

Gargiulo, A.M., S. Lorvik, P. Ceccarelli and V. Pedini, .1991Histological and histochemical studies on the chicken lingual glands. Br. Poult. Sci., 32: 693 .702-

Hassan, S.M., E.A. Moussa and A.L. Cartwright, 2010. Variations by sex in anatomical and morphological features of the tongue of Egyptian goose )Alopochen aegyptiacus). Cells Tissues Organs, .165-161 :191

Humason, G.L., 1972. Animal Tissue Techniques. 3rd Edn., W.H. Freeman and Co., San Francisco, pp.182-180:

Iwasaki, S., 2002. Evolusion of the structure and function of the vertebrate tongue. J. Anat., 201: .13-1

Iwasaki, S. and K. Kobayashi, 1986. Scanning and transmission electron microscopical studies on the lingual dorsal epithelium of chickens. Acta Anat -83 :61 .96

Iwasaki, S., A. Tomoichiro and A. Chiba, 1997.Ultrastructureal study of the keratinization of the dorsal epithelium of the tongue of middendorff's bean goose, Anser fabalis middendorffii (Anseres, Antidae). Anat. Rec., 247: 149-163.

Jackowiak, H. and S. Godynicki, 2005. Light and scanning electron microscopic study of the tongue in the white tailed eagle (Haliaeetus albicilla, Accipitridae, Aves). Anat. Anzeiger, 187: 251-259.

Jackowiak, H., W. Andrzejewski and S. Godynicki, .2006Light and scanning electron microscopic study of the tongue in the cormorant Phalacrocorax carbo (Phalacrocoracidae, Aves). Zool. Sci., 23(2:( .167-161

Jackowiak, H. and M. Ludwing, 2008. Light and scanning electron microscopic study of the structure of the Ostrich (Strutio camelus) tongue. Zool. Sci., 25: 188-194.

Khalid, K.K., A.B.Z. Zuki, S.M.A. Babjee, M.M. Noordin and M. Zamri-Saad, 2011. Morphological and histochemical observations of the red jungle fowl tongue Gallus gallus. Afr. J. Biotechnol.9977-9969 :(48)10,.

Olmedo, L.A., M.E. Samar, R.E. Avila, M.G. de Crosa and L. Dettin, 2000. Avian minor salivary glands: An ultrastructural study of the secretory granules in mucous and seromucous cells. Acta Odontol. Latinoam, 13: 87-99

Pasand, A.P., M. Tadjalli and H. Mansouri, 2010. Microscopic study on the tongue of male ostrich. Eur. J. Biol. Sci., 2(2): 24-31.

Rossi, J.R., S.M. Baraldi-Artoni, D. Oliveira, C. Cruz, V.S. Franzo and A. Sagula, 2005. Morphology of beak and tongue of partridge Rhynchotus rufescens. Cienc. Rural, 35: 1-7.

Slomiany, B.L., V.L. Murty, J. Piotrowski and A. Slomiany, 1996. Salivary mucins in oral mucosal defense. Gen. Pharmacol-Vasc. S., 27(5): 761-771.

Suprasert, A. and I. Fujioka, 1987. Lectin histochemistry of glycoconjugates in esophageal mucous gland of the chicken. Jpn. J. Vet. Sci., 49: 555 .557

Young, E.( 2019). "World's funniest joke revealed". New Scientist. Retrieved 7.

Totty, B.A., 2002. Mucins. In: Bancroft, J.D. and M. Gamble (Eds.), Theory and Practice of Histological Techniques. 5th Edn., Churchill Livingstone, New York, pp: 163-200.