Al-Qadisiyah J. Vet. Med. Sci. 2025; 24 (1): 95-103. doi.org/10.29079/qjvms.2024.155444.1051

ISSN P: 1818-5746
E: 2313-4429
qjvms.qu.edu.iq

Comparative morphohistological study of the tongue of domestic goose (*Anser anser* domesticus) and domestic turkey (*Meleagris gallopavo* domesticus)

Hawzheen Jamal Mahmood ✉ Hadia Karim Zorab ✉
Department of Anatomy and Pathology, College of Veterinary Medicine, University of Sulaimani, Iraq

Submitted: November 26, 2024
Revised: December 29, 2024
Accepted: December 30, 2024

Abstract This study was designed to compare the morphohistological features of the tongue between domestic goose and turkey. Ten tongues of adult healthy both the birds were used. Six tongues of both birds for macroscopic inspections and the four tongues for microscopic examinations were prepared. The gross observations showed that shape of the tongues was fit to the shape of the lower beaks, and they occupied lower beak only small space of rostral region remained. Goose tongue was elongated with rounded tip, but turkey tongue was triangular with pointed tip. Lingual apex carried a lingual nail plays a major role in food collecting. In turkey lingual nail was longer than it in goose. The conical papillae were observed on the body and root in goose and turkey. Filiform papillae only observed in goose located between conical papillae in body. Microscopically, tongues covered by parakeratinized, orthokeratinized and non-keratinized mucosa according to the tongue regions. The lamina propria contained lingual glands that divided into anterior glands in body and posterior glands in root of the tongues. The lingual glands excrete mucous secretion via their opening on the ventrolateral and dorsal surfaces of tongue. The findings in this study conclude that tongue is a modified and essential organ; it has different morphology and performances according to the feeding habit and food type in birds.

Keywords: Goose, Lingual nail, Lingual papillae, Lingual salivary glands, Turkey

Introduction The feeding habits and types of food are different between goose and turkey. Goose is belonging to the herbivorous birds that eats grain and grass. In addition, goose can dip head in water to feed on aquatic plants (1). However, turkey is belonging to the omnivorous birds that eats grain, grass, leaves, nut, berries, and insects (2). Variations in bird feeding habits are related to the different lifestyle and variety of available food resource. As a result, these variations affect the morphological adaptation of the tongue and beak (3). Tongue is an essential organ in the oropharynx cavity which has a significant role in food taking, transportation and swallowing toward the esophagus due to the presence of various structures such as muscles, salivary glands, cartilage, and bone (4). The different kinds of tongues observed in birds according to the adaptations of tongue structures which related to their performance. Tongue that used to catch and food intake, tongue that covered with papillae used to grasp and manipulation of food and tongue that retain the food in the oral cavity before swallowing (5). Previous anatomical observations revealed that the characteristic features of tongue represented shape of the lower beak as identified in peregrine falcon and common kestrel, domesticated goose, domesticated duck, and laughing dove (6-9). Numerous studies have been done on the structures of the tongue in different birds of Galliformes including chicken (10), common quail (11), red jungle fowl (12), Japanese quail (13), chukar partridge (3), guinea fowl (14), and turkey (15). Also, few studies focused on the anatomical and histological structures of the tongue in Anseriformes birds for example domestic goose (7) and domestic duck (5, 8). But the comparative morphohistological study between Galliformes and Anseriformes birds is less available and this point provides a good reason to design the current study to make a comparison the anatomy and histology structures of tongue between domestic goose (Anser anser domesticus) and domestic turkey

Al-Qadisiyah J. Vet. Med. Sci. 2025; 24 (1): 95-103. doi.org/10.29079/qjvms.2024.155444.1051
ISSN P: 1818-5746
E: 2313-4429
qjvms.qu.edu.iq

(Meleagris gallopavo domesticus). The results of this study are useful to understand the relationship of feeding habit and adaptions of tongue in studied birds.

Materials and methods

Ethical approval

The study was approved (VET 0237) in 13/11/2024 issued by the College of Veterinary Medicine, University of Sulaimani, Iraq.

Birds

To perform this study ten heads of healthy mature geese and ten heads of turkeys (both sexes) were obtained from local slaughterhouse in Sulaimani province/ Iraq. The average weight and age of studied birds were 5.5±5kg and 10 months, respectively. The tongues were divided into two groups. First group prepared for macroscopic examination composed of six tongues of geese and six tongues of turkeys. Second group prepared for microscopic examination composed of four tongues of geese and four tongues of turkeys.

Macroscopic examination

The collected heads immediately washed by the tap water to remove blood, food and dirty materials. The heads were dissected at the left and right corners of the beak, the oropharynx cavity completely opened by retracting the mandible ventrally and disarticulating quadratomandibular joints to observe shape of rostral space of the lower beak. The tongues were removed from the oropharynx cavities by cutting the frenulum at the base of the tongues and additional washing has been done by using of normal saline. Each region of tongues which including apex, body and root examined grossly and under stereomicroscope (Optica, BG-Italy) to observe the lingual nail, lingual papillae and lingual salivary glands openings. The digital camera was used to take the photos. Also, the total length of each region was measured by using Vernier caliper; following mean and standard deviation were calculated by using (IBM SPSS statistic 22).

Microscopic examination

The samples were taken from the apex, body and root of tongues preserved for 24hrs in 10% formalin. The samples processed by the general histotechniques method to make paraffin blocks which cut into (4 µm) sections by using rotary microtome (16). Finally, sections were stained with eosin and hematoxylin stains. The microscopic sections were inspected under the light microscope (Motic/ China) to examine the histologic structures of the lingual mucosa, lingual papillae and lingual salivary glands of each bird and to make a comparison between them. A digital camera (Am scope/ China) was used to capture the photomicrographs.

Results

Macroscopic findings

Grossly, tongues of the domestic goose and domestic turkey divided into the apex, body and base (root). The tongue was connected to the lower beak floor by the lingual frenulum.

Shape and total length of tongues

Tongue of domestic goose was adapted to the lower beak shape that completely occupied the space of the lower beak except small space of rostral part remained. It was elongated and flat shape. The average length was (65±1.41 mm). Also, tongue of domestic turkey was adapted to the lower beak shape, but free space in the rostral part of lower beak was greater than in goose. It was tapering and triangular shape. The average length of tongue was (43±1.41mm) (Figure 1).

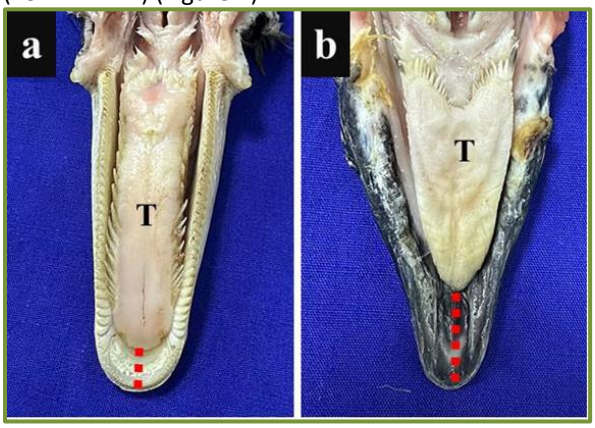


Figure 1: Morphological appearance of the lower beak and tongue of domestic goose (a) and domestic turkey (b). Tongues (T) of both birds fit to the shape of the lower beak and fill the lower beak except free rostral spaces remain (red dash lines).

Apex of tongue

In both birds, dorsal surface of this region was smooth due to absence of the lingual papillae. The ventral surface carried a white hard plate called lingual nail that represented the lingual apex shape. Lingual apex and lingual nail were round in goose (Figures 2a, 2b) but, in turkey they were triangular and pointed (Figures 2a, 2c). In goose lingual apex had a total length of (11.66±0.81 mm) and lingual nail had a total length of (11.33±0.52 mm). In turkey the total length

Al-Qadisiyah J. Vet. Med. Sci. 2025; 24 (1): 95-103. doi.org/10.29079/qjvms.2024.155444.1051

ISSN P: 1818-5746
E: 2313-4429
qjvms.qu.edu.iq

of lingual apex was (10.16±0.75 mm) and the total length of lingual nail was (12 ± 0.89 mm).

Body of tongue

In goose and turkey dorsal surface of body divided by shallow median groove called median lingual sulcus into two symmetrical parts. The total length of the lingual body in goose was (43.5 ± 0.83mm), while in turkey was (24 ± 0.83mm). In goose three types of lingual papillae founded on the lateral margins of body including spiny conical papillae, cornified conical papillae (tooth like papillae) and filiform papillae (Figures 3a, 3b). In turkey there were no papillae on rostral portion of body, but 3-5 small conical papillae exhibited on the lateral margins of the caudal portion of body (Figure 3d). In both species, caudal portion of body was elevated called lingual prominence that consisted of the apex and base. A lingual prominence apex was directed toward the lingual apex and the base was directed toward the lingual root. In goose lingual prominence was triangular shape, more elevated than it in turkey and a row of conical papillae directed toward the root observed in V- shape on the lingual prominence base (Figure 3a). However, in turkey lingual prominence was heart shape, flat and expanded into middle part of body region (Figure 3c). In turkey two rows of conical papillae directed caudally toward the root were observed. First row located on the caudal border of the lingual prominence and second row extended into the lingual root. In first row, conical papillae that located in medial part were thinner and shorter than the lateral part papillae (Figure 3c, 3d). In goose the anterior lingual salivary gland openings were observed on the ventrolateral surface of body region. But, in turkey these openings observed only in the caudal part of the body that emerged with the openings of the posterior salivary glands. The openings of lingual glands were linearly and circularly arranged in goose and turkey, respectively (Figures 3b, 3d).

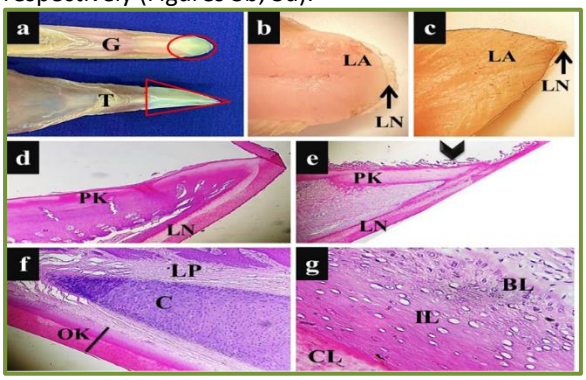


Figure 2: Histomorphological appearance of the lingual apex and lingual nail. (a) Ventral surface of the tongue showed lingual nail in goose (G) which was round and in turkey (T) which was triangular. (b) Dorsal surface of the lingual apex (LA) in goose was smooth and round. (c) Dorsal surface of the lingual apex (LA) in turkey was smooth and pointed. (d) Microscopic image of section (b) in goose showed rounded lingual apex covered by parakeratinized mucosa (PK) and ventral surface covered by orthokeratinized mucosa called lingual nail (LN). (e) Microscopic image of section (c) in turkey showed tapered lingual apex covered by parakeratinized mucosa (PK) and ventral surface covered by orthokeratinized mucosa called lingual nail (LN), superficial cells of parakeratinized mucosa exfoliated as a single scale (black arrowhead). (f) Lamina propria (LP), initial part of the paraglossal cartilage (C), orthokeratinized mucosa (OK). (g) Basal (BL), intermediate (IL) and cornify (CL) layers of orthokeratinized mucosa. H&E stain, (d, e. f) X40, (g) X100.

Base of tongue

Lingual root (base) occupied a small area between body and laryngeal mound. The average length of lingual root in domestic goose was (9.66 ± 0.51mm) and in turkey was (8.33 ± 0.5mm). In goose two mucosal folds existed on the dorsal surface of lingual root; each of them carried 3-4 conical papillae (Figure 3a). In turkey 3-5 conical papillae located on the lateral borders of the end of root with those papillae of the body extended to the root (Figure 3c). In goose and turkey, the openings of posterior lingual salivary glands were observed on the lateral and dorsal surfaces of the lingual root.

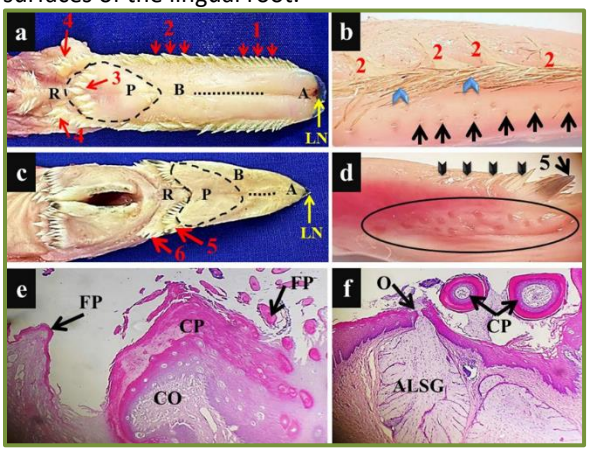


Figure 3: Histomorphological appearance of body and root regions in goose (a) and in turkey (c) Apex (A),

Al-Qadisiyah J. Vet. Med. Sci. 2025; 24 (1): 95-103. doi.org/10.29079/qjvms.2024.155444.1051

ISSN P: 1818-5746
E: 2313-4429
qjvms.qu.edu.iq

Body (B), Lingual prominence (P) marked by dash line, Root (R), Lingual nail (LN), Spiny conical papillae (1), Cornified conical papillae (2), V-shape conical papillae on the caudal border of the lingual prominence (3), Two mucosal folds carried 3-5 conical papillae (4), Two rows of conical papillae on the caudal border of the lingual prominence (5), Conical papillae on the lateral borders of the root (6), Median lingual sulcus (dot line). (b) Higher magnification of section (a) in goose showed filiform papillae (blue arrowheads) between conical papillae (2), openings of the anterior lingual salivary glands linearly arranged (black arrows) along the body. (d) Higher magnification of section (c) in turkey showed small conical papillae on the lateral margins of the caudal portion of body (black arrowheads) with conical papillae on the base of lingual prominence that they extended into root (5), openings of the anterior lingual salivary glands circularly arranged (black circle). (e) Microscopic image of section (b) in goose showed conical papillae (CP) with connective tissue core (CO), Filiform papillae (FP) without core. (f) Microscopic image of section (d) in turkey showed conical papillae (CP), opening (O) of anterior lingual salivary glands (ALSG). H&E stain, (e, f) X100.

Microscopic findings

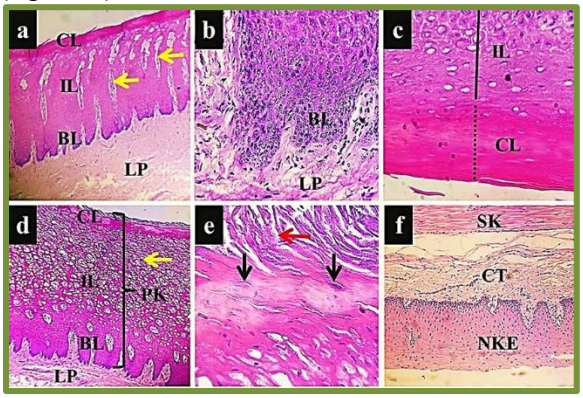
Lingual apex

In goose and turkey, the dorsal surface of apex was covered by parakeratinized epithelium but, the ventral surface covered by orthokeratinized epithelium (Figures 2d, 2e). The parakeratinized and orthokeratinized epithelium were consisted of the basal, intermediate and cornify layers (Figure 2g). In both birds, ventral surface of the apex modified to hard keratinized structure called lingual nail. A lingual nail was elongated ladle-like structure composed of orthokeratinized epithelium and protruded from ventral surface of the apex which essential for pecking (Figures 2d, 2e). Lamina propria located beneath parakeratinized epithelium and penetrated the lingual mucosa called connective tissue core. The amount of connective tissue increased toward the end of the apex. The initial part of the paraglossal cartilage located at the apex surrounded by lamina propria (Figure 2f), and toward the end of the apex surrounded by fat tissue. In both species, the dorsal surface of the apex was smooth and lingual papillae not existed. In turkey, the superficial cells of parakeratinized mucosa of the apex and cranial portion of the body exfoliated in form of slim single elongated scale, but this histologic feature not observed in goose (Figures 2e, 4e).

Lingual body

Body of tongue was the largest region located between apex and root. In goose and turkey, the conical papillae that covered by orthokeratinized epithelium exhibited on the dorsal and lateral surfaces of body. In goose different sizes of the conical papillae existed with filiform papillae that located between conical papillae. The conical papillae had connective tissue core but, filiform papillae did not have connective tissue core and constituted only by the projection of orthokeratinized epithelium of the lingual body (Figure 3e). In turkey conical papillae were observed without any filiform papillae (Figure 3f).

In both birds, the dorsal surface of the body covered by parakeratinized epithelium. The parakeratinized epithelium of body was similar to the apex epithelium that consisted of three layers (Figures 4a, 4d). The basal layer cells were cylindrical, contained elliptical nucleus and rested on the basement membrane (Figure 4b). The intermediate layer cells were round or oval with variable sizes. The intermediate layer composed of the upper and lower regions. The cells in upper region toward the superficial become more flattened. The cells of cornify layer were small elliptic contained condensed flat nucleus (Figure 4e). In both birds, the ventral surface of body covered by the orthokeratinized epithelium. The basal and intermediate layers of the orthokeratinized epithelium were similar to those described in the parakeratinized epithelium but, the cornified cells in orthokeratinized epithelium contained no nucleus (Figure 4c). Toward the end of the body in both species the ventral surface epithelium changed from orthokeratinized to non-keratinized epithelium (Figure 4f).



Al-Qadisiyah J. Vet. Med. Sci. 2025; 24 (1): 95-103. doi.org/10.29079/qjvms.2024.155444.1051

ISSN P: 1818-5746
E: 2313-4429
qjvms.qu.edu.iq

Figure 4: Microscopic structures of the lingual body epithelium in goose (a, b, c) and in turkey (d, e, f). (a) Basal (BL), intermediate (IL) and cornify (CL) layers of parakeratinized epithelium covered dorsal surface of body in goose, lamina propria (LP) penetrated the parakeratinized epithelium called connective tissue core (yellow arrows) that they perpendicular to the lingual body surface. (b) Higher magnification of section (a) showed basal layer (BL) and lamina propria (LP). (c) Cornify layer (CL) of the orthokeratinized epithelium of the ventral surface of body that cells in this layer did not contain nucleus. (d) Basal (BL), intermediate (IL) and cornify (CL) layers of parakeratinized epithelium (PK) covered dorsal surface of body in turkey; lamina propria (LP) penetrated the parakeratinized epithelium called connective tissue core (yellow arrow). (e) Higher magnification of section (d) showed cornify cells layer with flat nuclei (black arrows), cornify cells in superficial layer of parakeratinized epithelium exfoliated as single scale (red arrow). (f) The covering epithelium of the ventral surface of body in goose and turkey toward the root changed to non-keratinized epithelium (NKE), connective tissue (CT), skeletal muscles (SK). H&E stain, (a, d, f) X40, (b, c, e) X400.

In both species, the following subepithelial structures can be observed beneath parakeratinized epithelium that covered the dorsal surface of the body such as lamina propria contained blood vessels, nerves, mechanoreceptor (herbs corpuscle only in goose), and lymphatic tissues. The connective tissue core penetrated parakeratinized epithelium perpendicular to dorsal surface of the body region (Figure 4a). A great amount of fat tissue existed particularly at the caudal end of the body, in goose the amount of fat tissue that presented was more than in turkey. The hyaline paraglossal cartilage plate also existed that separated from adjacent tissues by perichondrium and surrounded by fat tissues. In addition, skeletal muscles appeared in different directions which helpful in tongue movement. In goose the anterior lingual salivary glands located beneath parakeratinized epithelium embedded in the lamina propria in the caudal part of the body and lingual prominence. Their saliva secretions excreted via their openings on the ventrolateral surfaces of body. In turkey the anterior lingual salivary glands located in the dorsal surface over whole area of lingual body and surrounding of hyaline paraglossal cartilage plate in lateral sides of body (Figure 5a).

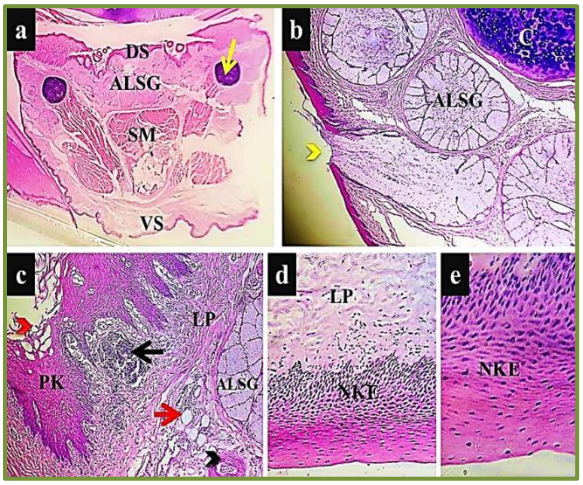


Figure 5: Photomicrograph of the sagittal section of the caudal portion of the body in turkey showed (a) the anterior lingual salivary glands (ALSG) located beneath dorsal surface (DS) embedded in lamina propria also surrounded the paraglossal cartilage (yellow arrow) in both sides of the body, skeletal muscles (SM). (b) Higher magnification of section (a) showed the opening (yellow arrowhead) of the anterior lingual salivary glands (ALSG), paraglossal cartilage (C). (c) Higher magnification of section (a) showed the dorsal surface of the body covered by parakeratinized epithelium (PK) with cornify cells in superficial layer of parakeratinized epithelium exfoliated as single scale (red arrowheads), aggregation of the lymphoid tissue (black arrow), fat cells (red arrow) and blood vessel (black arrowheads) observed in the lamina propria (LP). (d) Higher magnification of section (a) showed the ventral surface (VS) of the body covered by non-keratinized epithelium (NKE). (e) Higher magnification of section (d) showed non-keratinized epithelium (NKE). H&E stain, (a) X20, (b, c, d) X100, (e) X 400.

Lingual root

The lingual root covered by non-keratinized mucosa dorsally and ventrally in goose and turkey. This mucosa consisted of basal, intermediate and superficial layers. The basal and intermediate layer cells were the same histologically as described in parakeratinized epithelium of the body. The cells in superficial layer were flat and the cell nuclei were heavily flattened. In goose and turkey conical papillae observed without filiform papillae. In goose the posterior lingual salivary glands located in the lamina propria beneath conical papillae on the lateral surfaces and close to the ventral surfaces of the lingual root. Their openings were located on the

Al-Qadisiyah J. Vet. Med. Sci. 2025; 24 (1): 95-103. doi.org/10.29079/qjvms.2024.155444.1051
ISSN P: 1818-5746
E: 2313-4429
qjvms.qu.edu.iq

dorsal and lateral surfaces (Figure 6). In turkey, the posterior salivary glands located in the lamina propria of mucosa just below the conical papillae and on the entire dorsal surface of the root and their openings were located on the dorsal and lateral surfaces. Posterior and anterior salivary glands composed of simple branched tubular mucus secreting cells enclosed by a delicate connective tissue capsule in goose and turkey.

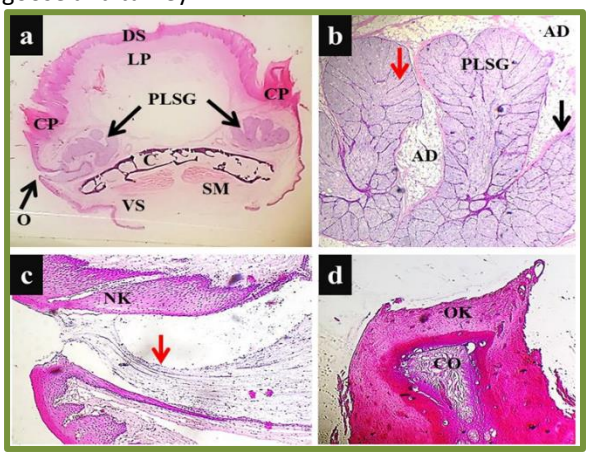


Figure 6: Photomicrograph of the sagittal section of lingual root in goose showed (a) the posterior lingual salivary glands (PLSG) in the lamina propria (LP) beneath conical papillae (CP) on the lateral surfaces and close to the ventral surfaces (VS), dorsal surface (DS), opening of salivary glands (O), skeletal muscles (SM), paraglossal cartilage (C). (b) Higher magnification of section (a) showed posterior lingual salivary glands (PLSG) composed of simple branched tubular mucus secreting cells enclosed by a delicate connective tissue capsule (black arrow) embedded in adipose tissue (AD). (c) Higher magnification of section (a) showed the opening (red arrow) of posterior lingual salivary glands in the lateral surface of lingual root that covered by non-keratinized epithelium (NKE). (d) Higher magnification of section (a) showed large conical papilla covered by orthokeratinized epithelium (OK) with connective tissue core (CO). H&E stain, (a) X20, (b) X100, (c, d) X 400.

Discussion

Tongue is one of the most adapted organs in relation to food type and feeding habit in birds. The functional performances of the tongue are link to the morphologic structures of it (17), in view of these points; three types of tongues exist in birds. First type is narrow elongated tongue due to strong and developed hyoid apparatus it can extract and move out from the oropharynx cavity to catch food. Second type is wide elongated tongue that different numbers and sizes of lingual papillae located on dorsal surface and lateral borders. Last type is fix and less movable tongue that place deep in the oropharynx cavity (18). By analyzing structures of the tongues in current study, we can state that tongue of domestic goose as Anseriformes member is belongs to the second type. Goose feed on grains and vegetable parts of plants therefore, pecking and grazing are methods of food collecting. During pecking domestic goose starts with grabbing the grain by tip of the beak and lingual nail acts as a shovel to take grain into the oropharynx cavity, but during grazing goose uses small and large conical papillae on the lateral margins of lingual body that fit to lateral horny lamellae on the lateral sides of lower beak that they are directly linked to the process of cutting plants and manipulating food effectively. Our observations are very similar to those in goose stated by (7). Finally, by pressing the lingual prominence against hard palate and presence of conical papillae on the root surface that directed towards esophagus food transport into the esophagus, in accordance with the results of (1). Another method of collecting food in Anseriformes is filter feeding. The presence of filiform papillae in goose that they fill space between conical papillae along lateral borders of lingual body facilitates filter-feeding process when goose dip head into water these papillae filter food particles from water. But goose lives mainly in land and adapted to the terrestrial life; as a result goose regarded as non-specialist filter-feeder. According to studies, in goose grazing is the first method of food intake but, filter-feeding is the first method of food intake in duck (19, 20).

Based on our findings we conclude that tongue of domestic turkey is classifying to third type which less movable and set deeply in floor of lower beak by lingual frenulum in accordance with general features of tongue in turkey stated by Harrison (1964) (18). The only mechanism of food collecting is pecking in turkey as a member of Galliformes that feed on tiny and large grains. Lingual apex and lingual nail are main structures responsible for food collection. A median lingual sulcus groove on the dorsal surface of tongue assists in food transportation toward esophagus. The conical papillae on lateral edges of the root prevent food from dropping into the oropharynx cavity. The conical papillae extended from caudal end of the body

Al-Qadisiyah J. Vet. Med. Sci. 2025; 24 (1): 95-103. doi.org/10.29079/qjvms.2024.155444.1051
ISSN P: 1818-5746
E: 2313-4429
qjvms.qu.edu.iq

toward root prevent food regurgitation, finally food is swallowed successfully. Similar observations showed in domestic turkey by (15). Lingual nail is a hard white plate covered the ventral surface of lingual apex in goose but, in turkey extend to the cranial portion of the body, based on our morphometric analysis the length of lingual nail in turkey was greater than it in goose, as a result turkey can grab grains properly during pecking. This morphological structure is associated with the fact that in goose grazing is the first method of food collecting and pecking is the method for food collecting in turkey. The shape of the tongue in birds is a species-specific feature that closely fits the shape of the lower beak space. Extreme cases also occurred such as the tongue of the Eurasian hoopoe captured from Egypt where the length of the tongue is drastically reduced to one quarter length of the bill cavity (21), and the elongated tongue in the Japanese pygmy woodpecker (22). The shape of tongue observed in this study in goose was similar to that of domestic goose (7) and Egyptian goose (23). Also, the shape of tongue observed in this study in turkey was similar to that of domestic turkey (15).

The current microscopic observations of lingual mucosa showed that three kinds of mucosa covered tongue of goose and turkey including parakeratinized, orthokeratinized and non-keratinized mucosa. In both species the dorsal surface of lingual apex and body covered by parakeratinized mucosa where food transport toward caudal end of the oral cavity and esophagus. However, the orthokeratinized mucosa exhibited in the lingual nail (ventral surface of the apex) that essential for food collecting and it was covered conical papillae on the lateral margins of the lingual body that help in cutting green plants in goose. In addition, it covered conical papillae on the base of the lingual prominence and lingual root that prevent food from moving backward. Similar results reported in goose (7), turkey (15) and domesticated duck (8).

Based on our findings the parakeratinized and orthokeratinized mucosa were composed of the same histologic layers including basal, intermediate and cornify (superficial) layers. The parakeratinized and orthokeratinized mucosa differentiated by the microscopic features of cornify cells layer. The cornified cells in parakeratinized mucosa contained flattened nucleus but the cornified cells in orthokeratinized mucosa contained no nucleus in agreement with (24). The current study revealed that in turkey, superficial cells of cornify layer of the apex and body mucosa desquamate as single scale in contrast this microscopic feature not observed in goose in agreement with the recent study showed that superficial cells of cornify layer of the parakeratinized mucosa exfoliated as individual scale in turkey but, in goose and duck not shown (25).

In the current study the light microscopic investigations showed that the lingual root was protected by non-keratinized mucosa in goose and turkey, because this region has minimum contact during food transportation toward the esophagus and incidence of conical papillae on the lingual root directed toward root facilities food swallowing. The filiform papillae were detected among conical papillae on the lateral borders of lingual body only in goose, but in turkey not observed. Microscopically, filiform papillae formed by projection of lingual mucosa (orthokeratinized epithelium) without connective tissue core; however, the conical papillae contained connective core. These microscopic observations are similar to those defined by (15) stated that there were no filiform papillae in domestic turkey but, the presence of filiform papillae revealed in domesticated goose (7) and in duck (8).

Based on the our microscopic findings in goose the adipose tissues located mainly in caudal region of the lingual body and root which act as a cushion to protect the underlying tissue structures by decreasing the pressure on the tongue during grazing and filter-feeding, where pressure is applied to the lingual prominence's surface as a result of the lingual prominence being elevated and pressed up against the hard palate region of the oropharynx roof in agreement with (7).

The current examinations of the lamina propria in goose and turkey revealed two groups of lingual salivary glands. The first group was anterior glands that they located in lingual body and the second group was posterior glands that they located in lingual root. The openings of these glands located on the ventral surface and lateral borders of lingual body and dorsal surface of lingual root. But the number of openings was much higher in goose than in turkey. A mucus secretion plays an important role in decreasing friction during food collection and moistens the tongue during food transport. The present observations in domesticated goose and turkey support the findings of formerly authors (7, 15). The absence of salivary glands in the apex of the tongue

Al-Qadisiyah J. Vet. Med. Sci. 2025; 24 (1): 95-103. doi.org/10.29079/qjvms.2024.155444.1051
ISSN P: 1818-5746
E: 2313-4429
qjvms.qu.edu.iq

and the intense clustering of lingual salivary glands with numerous channel openings at the lingual body and root suggest that the primary function of the tongue in both birds is to allow contact of the food with saliva and to rapidly move the food bolus backwards (14). Microscopically the lingual salivary glands consisted of simple branched tubular mucous secreting cells enclosed by a delicate connective tissue capsule in accordance with the results founded in other birds such as (3, 5, 7, 15).

Conclusion

The findings in this study conclude that tongue is a modified and essential organ; it has different morphology and performances according to the feeding habit and food type in birds.

Acknowledgments

The authors would like to thank the College of Veterinary Medicine, University of Sulaymani for providing facilities during this research.

Conflicts of Interest

The authors declare there is no conflict of interest.

Funding source

This research had no specific fund; however, it was self-funded by the authors.

References

1.Van der Leeuw A, Kurk K, Snelderwaard P, Bout R, Berkhoudt H. Conflicting demands on the trophic system of Anseriformes and their evolutionary implications. Animal biology, (2003); 53:259-301. DOI: 10.1163/157075603322539453.

2.Klasing KC. Poultry nutrition: a comparative approach. Journal of Applied Poultry Research, (2005); 14:426-36. DOI: 10.1093/japr/14.2.426.

3.Erdoğan S, Sağsöz H, Akbalik ME. Anatomical and histological structure of the tongue and histochemical characteristics of the lingual salivary glands in the Chukar partridge (Alectoris chukar, Gray 1830). British Poultry Science, (2012); 53:307-315. DOI: 10.1080/00071668.2012.700507.

4.Erdoğan S, Iwasaki SI. Function-related morphological characteristics and specialized structures of the avian tongue. Annals of Anatomy-Anatomischer Anzeiger, (2014); 196:75-87. DOI: 10.1016/j.aanat.2013.09.005

5.Mohamed R. Histomorphological study on the tongue of the duck in the Caribbean with relation to feeding habit. Journal of advanced veterinary and animal research, (2019); 6:74-81. DOI: 10.5455/javar.2019.f315.

6.Emura S, Okumura T, Chen H. Scanning electron microscopic study of the tongue in the peregrine falcon and common kestrel. Okajimas Folia Anatomica Japonica, (2008); 85:11-5. DOI: 10.2535/ofaj.85.11.

7.Jackowiak H, Skieresz-Szewczyk K, Godynicki S, Iwasaki SI, Meyer W. Functional morphology of the tongue in the domestic goose (Anser anser f. domestica). The Anatomical Record: Advances in Integrative Anatomy and Evolutionary Biology, (2011); 294:1574-1584. DOI: 10.1002/ar.21447.

8.Skieresz-Szewczyk K, Jackowiak H. Morphofunctional study of the tongue in the domestic duck (Anas platyrhynchos f. domestica, Anatidae): LM and SEM study. Zoomorphology, (2016); 135:255-268. DOI: 10.1007/s00435-016-0302-2.

9.Abumandour MM, El-Bakary NE. Anatomical investigations of the tongue and laryngeal entrance of the Egyptian laughing dove Spilopelia senegalensis aegyptiaca in Egypt. Anatomical Science International, (2019); 94:67-74. DOI:10.1007/s12565-018-0451-0.

10.Iwasaki SI, Kobayashi K. on the Lingual Dorsal Epithelium of Chickens. Acta anat. Nippon, (1986); 61:83-96. DOI: 10.1155/2013/980465.

11.Attaallah A, Fouda Y, El-Beltagy AE, Saleh AM. Comparative studies on the tongue of the Egyptian fruit bat (Rousettus aegyptiacus) and the common quail (Coturnix coturnix). Egyptian Journal of Basic and Applied Sciences, (2023); 10:476-492. DOI:10.1080/2314808X.2023.2231197.

12.Kadhim KK, Zuki AB, Babjee SM, Noordin MM, Zamri-Saad M. Morphological and histochemical observations of the red jungle fowl tongue Gallus gallus. African Journal of Biotechnology, (2011); 10: 9969-9977. DOI : 10.5897/AJB11.955.

13.Pourlis AF. Morphological features of the tongue in the quail (Coturnix coturnix japonica). Journal of Morphological sciences, (2014); 31:177-181. DOI: 10.4322/jms.061113.

14.İlgün R, Kuru N, Bölükbaş F, Gür FM. Histological and electron microscopical structure of tongue and lingual papillae of guinea fowl (Numida meleagris). Pakistan J. Zool., (2020); 52:949-956. DOI: 10.17582/journal.pjz/20190621210615.

15.Skieresz-Szewczyk K, Plewa B, Jackowiak H. Functional morphology of the tongue in the domestic turkey (Meleagris gallopavo gallopavo var. domesticus). Poultry Science, (2021); 100:101038. DOI: 10.1016/j.psj.2021.101038.

16.Bancroft JD, Cook HC. (1984). Manual of Histological Techniques. Churchill Livingstone, Edinburgh, London, Melbourne and New York.

17.Glatz PC, Miao ZH, Ru YJ. Feeding Free-range Poultry and Pigs. In: Bels V. Feeding in Domestic Vertebrates. From Structure to Behaviour, CAB International, Wallingford. Oxfordshire, UK: CABI Publishing, 2006; 326–348. DOI: 10.1079/9781845930639.0326.

18.Harrison JG. Tongue. A new dictionary of birds. 1st ed. Publishing A.L. Thomson. Nelson, London, United Kingdom, 1964: 928. https://lccn.loc.gov/64018267.

19.Skieresz-Szewczyk K, Jackowiak H. Scanning electron microscopy investigation of the filter-feeding apparatus in the domestic goose (Anser anser f. domestica) and the domestic duck (Anas platyrhynchos f. domestica). In: A. Méndez-Vilas, Ed. Microscopy: advances in scientific research and education, 2014ed, FORMATEX, 2014; 84-88. url={https://api.semanticscholar.org/CorpusID:62884485.

Al-Qadisiyah J. Vet. Med. Sci. 2025; 24 (1): 95-103. doi.org/10.29079/qjvms.2024.155444.1051

ISSN P: 1818-5746
E: 2313-4429
qjvms.qu.edu.iq

20.Alhasso A, Alzebari BS. Anatomical study and measurements on the tongue of mature local breed ducks (Anas Platyrhynchos) and geese (Anserinae). NTU Journal of Agriculture and Veterinary Science, (2023); 3:164-170. DOI: 10.56286/ntujavs.v2i2.

21.Abumandour MM, Gewaily MS. Gross morphological and ultrastructural characterization of the oropharyngeal cavity of the Eurasian hoopoe captured from Egypt. Anatomical science international, (2019); 5:172-179. DOI: 10.1007/s12565-018-0463-9.

22.Emura S, Okumura T, Chen H. Scanning electron microscopic study of the tongue in the Japanese pygmy woodpecker (Dendrocopos kizuki). Okajimas folia anatomica Japonica, (2009); 86:31-35. DOI: 10.2535/ofaj.86.31

23.Hassan SM, Moussa EA, Cartwright AL. Variations by sex in anatomical and morphological features of the tongue of Egyptian goose (Alopochen aegyptiacus). Cells Tissues Organs, (2010); 191:161-165. DOI: https:10.1159/000223231.

24.Skieresz-Szewczyk K, Jackowiak H, Ratajczak M. LM and TEM study of the orthokeratinized and parakeratinized epithelium of the tongue in the domestic duck (Anas platyrhynchos f. domestica). Micron, 2014; 67:117-24. DOI: 10.1016/j.micron.2014.07.004.

25.Skieresz-Szewczyk K, Jackowiak H, Skrzypski M. Alpha-keratin, keratin-associated proteins and transglutaminase 1 are present in the ortho-and parakeratinized epithelium of the avian tongue. Cells, (2022) ; 11:1899. DOI: 10.3390/cells11121899.