TRADITION AND MODERNITY IN VETERINARY MEDICINE, 2020, vol. 5, No 2(9): 31–45

AGE RELATED SCANNING ELECTRON-MICROSCOPIC STUDIES ON TONGUE AND ANTERIOR LARYNX OF THE BROILER CHICKS

Shailja Bansal, Pawan Kumar

Department of Veterinary Anatomy, College of Veterinary Sciences,
Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar, India
E-mail: pkumar@luvas.edu.in; pawanrajoria2000@rediffmail.com

ABSTRACT

The aim of present study was to investigate the scanning electron microscopic structure of the tongue and anterior larynx of thirty Cubb broiler chicks of one week to one month (7-32 days) age.

The tongue was triangular in shape having an apex, a body, and a root. The dorsal surface of the apex and body was having a large number of filiform-like papillae whereas; the root was smooth devoid of papillae. A papillary crest and a transverse row of caudal lingual papillae were present at the junction of the body and the root. The papillae at higher magnification presented microplicae of varying patterns. Gustatory papillae or taste buds were not observed in any portion of the tongue.

The anterior larynx was having centrally placed laryngeal cleft, laryngeal mound on both sides, 4 rows of medial papillae, a transverse row of pharyngeal papillae, and a row of giant papillae. The floor of the laryngeal cleft presented a meshwork like structure along with some ciliated cells and openings of glandular ducts. The dorsal surface of the different structures of the larynx showed epithelial cells having varying patterns of microplicae.

A few structural differences were observed in the tongue and the anterior larynx of birds of different age groups.

Key words: tongue, cranial larynx, papillae, scanning electron-microscopy, Cobb broiler chicks.

Introduction

The Cobb broiler belongs to the genus *Gallus gallus domesticus,* which is preferred for experimental research models because its meat is a rich source of protein and low cholesterol whereas the bones are used as a mineral supplement for animals and humans. The tongue is involved in the process of collection, manipulation, and swallowing of food. Different types of nutrients in the diet and their digestion led to morphological changes in the structures present on the tongue of birds (Jackowiak et al., 2011) and directly related to their dietary habits and living conditions (Erdogan & Perez, 2015). The anterior larynx is a structural component involved in respiration, vocalization, and swallowing of the food. The laryngeal associated lymphoid tissue is responsible for maintaining the immune system of the body. The morphological differences in the tongue and anterior larynx of different species might be due to anatomical structure of lower beak, their diet, feeding habits, lifestyle, environmental conditions, and immune system (Erdogan & Iwasaki, 2014; Onuk et al., 2013; Erdogan & Alan, 2012; Parchami et al., 2010b). A detailed histological and histochemical study has been conducted on tongue and anterior larynx of broiler chicks (Bansal et al., 2018, 2019). The light and electron microscopy studies of the tongue have been reported in birds such as the Golden eagle (Parchami et al., 2010a), woodpecker (Emura et al. 2009), ostrich (Jackowiak & Ludwig, 2008), owl (Emura & Chen, 2008) and penguin (Kobayashi et al., 1998). The aim of the present study was to explore surface features of the tongue and anterior larynx of the broiler chickens of different age groups and to compare with those of other species.

Materials and methods

The present study was conducted on 30 healthy broiler chicks of one week to one month (7–32 days) of age which were divided into 5 groups having 6 birds in each group. The head of dead birds were collected after a post-mortem examination at 7, 11, 18, 25 and 32 days of age.

The fresh tissues were collected from apex, body, caudal lingual papillae and root of the tongue and anterior, middle, and posterior portions along with pharyngeal papillae of the anterior larynx and associated glands. The tissues were fixed in 2% glutaraldehyde solution for 6–8 hours after thorough washing in chilled 0.1M phosphate buffer (pH 7.4) for scanning electron microscopy. The tissues were again washed twice with chilled 0.1M phosphate buffer and the rest of the procedure was carried out at EM Lab., AIRF, JNU, New Delhi, India. The tissues were dehydrated in ascending grades of ethanol, critical point dried and sputter-coated with gold. The processed tissues were viewed under a scanning electron microscope (SEM) to record observations and photographs.

Results

Tongue:

The tongue was triangular in shape and subdivided into an apex, a body and a root in birds of all the age groups. The apex had a small concave depression which was followed caudally towards the anterior part of the body (Figures 1a, b). The longitudinally oriented grooves were 2–3 in birds of 18 days onwards but did not reach the caudal most part of the body of the tongue (Figure 1b). The apex showed a large number of filiform-like papillae which were densely arranged toward the lateral border as compared to the central concave portion (Figure 1a). These papillae of varying shapes and size were mainly leaf-like and their surface presented irregularly oriented folds (Figure 1c). The free tips of papillae were either spatula or pointed type. The higher magnification of these papillae showed microplicae of different patterns (Figure 1d). The dorso-lateral portion of the tip was smooth without any papillae except a few desquamated cells (Figures 1b, 2a). A higher magnification of this surface presented flat squamous cells without presence of microplicae (Figure 2b). The apex of the tongue of birds of 18 days onwards was smooth and did not possess the filiform papillae (Figure 1b).

The occurrence of grooves on the dorsal surface of the body was not a regular feature however; small additional longitudinal grooves were laterally placed towards the caudal portion of the body (Figure 2c). The dorsal surface of the body presented papillae in terms of shapes, size and microplicae similar to those of the apex (Figures 1a, b, 2c, d). The density of the papillae was comparatively lesser toward the caudal most part of the body. The mucous secretions were also observed in between the clusters of the papillae on the surface of the body indicating the presence of the opening of the ducts of the lingual glands. A transversely oriented fold of the lingual mucosa in the form of a papillary crest present at the junction of the root and the body of the tongue was separated from the later by a transverse groove (Figures 3a, b, c). The crest was broader towards the lateral margin. The shape of the groove was an arc shaped in birds of 7 days (Figure 3a), "V" shaped in birds of 11 and 18 days (Figures 2c, 3b) and serpentine pattern in birds of 25 and 32 days (Figure 3c). The groove always corresponded to the shape of the crest. A small papilla was observed on either side towards lateral side of this groove.

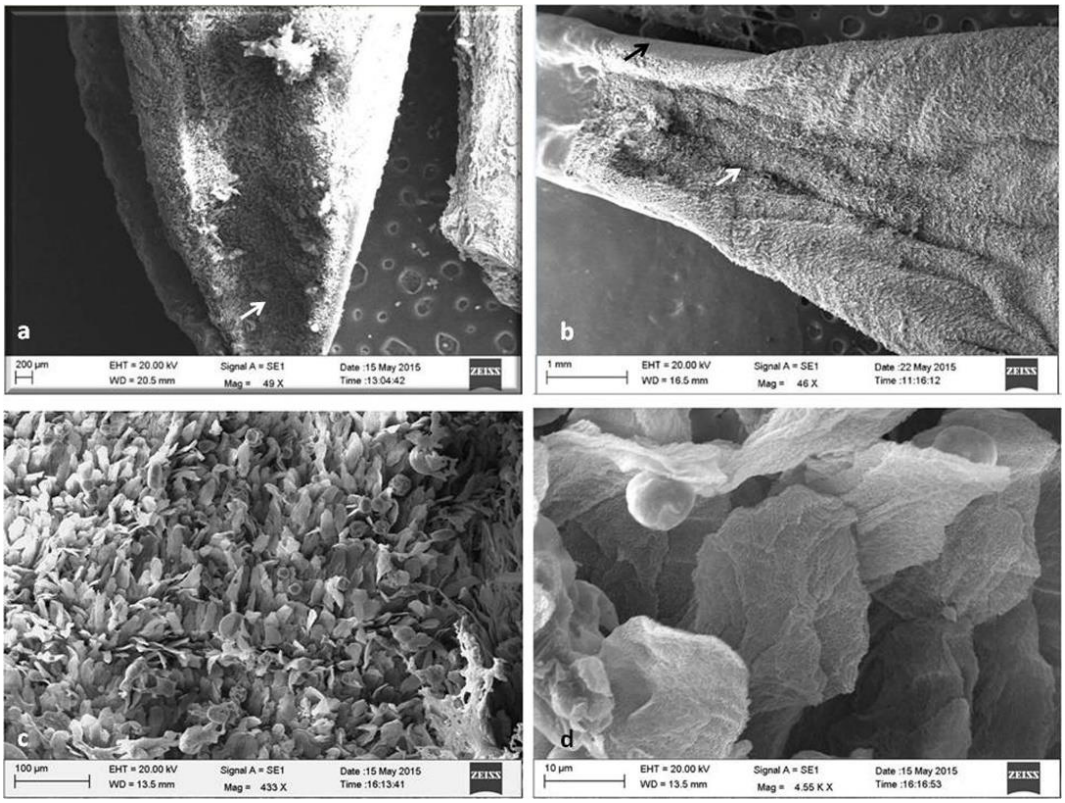

Figure 1: Scanning electron-micrograph of (a) Apex and the body of the tongue of 07 days old chick showing concave depression toward anterior part (arrow); Increase- 49X (Bar 200 µm). (b) Apex and body of the tongue of 18 days old chick showing different types of grooves (white arrow). Note smooth surface toward ventro-lateral portion of the apex (black arrow); Increase- 46X (Bar 1 mm). (c) Filiform-like papillae present at the apex of the tongue of 07 days old chick; Increase- 633X (Bar 100 µm). (d) Filiform-like papillae of 07 days old chick showing presence of microplicae; Increase- 4550X (Bar 10 µm).

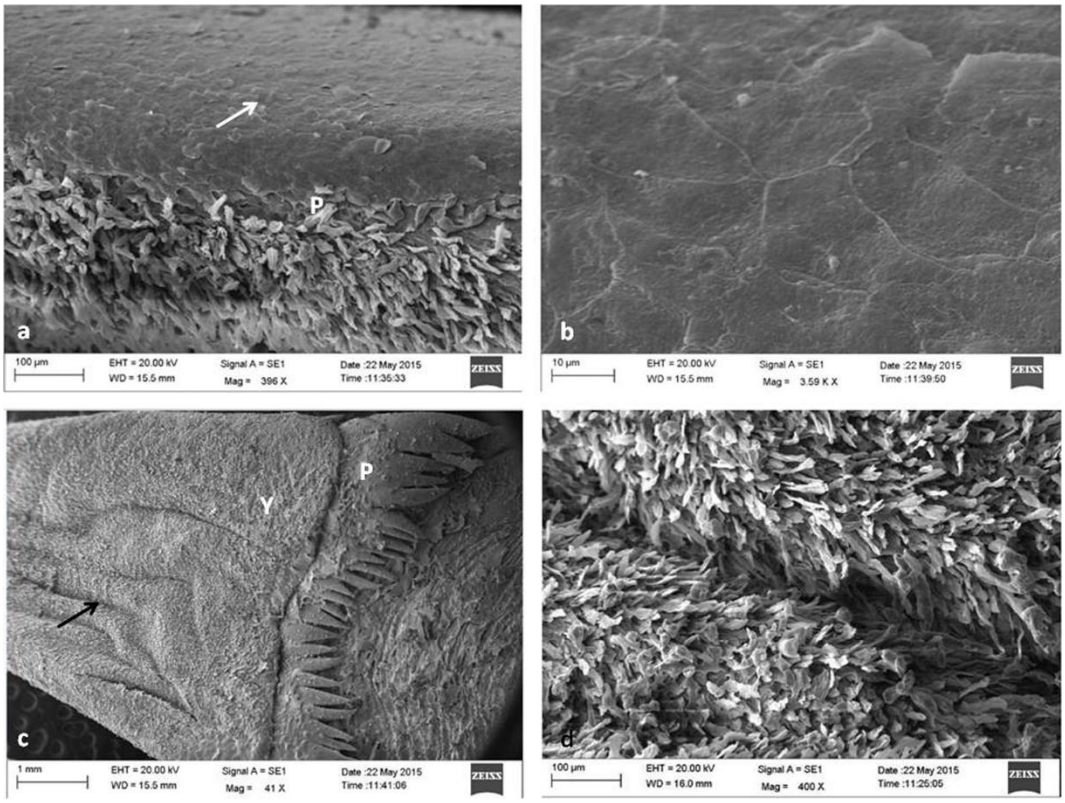

Figure 2: Scanning electron-micrograph of (a) Apex of the tongue of 25 days old chick showing its ventro-lateral smooth surface (arrow); Increase- 396X (Bar 100 µm). (b) Higher magnification of A showing flat squamous cells; Increase- 3590X (Bar 10 µm). (c) Body (Y) and papillary crest (P) with caudal lingual papillae present on the tongue of 25 days old chick. Note longitudinal groove toward caudal part of the body (arrow); Increase- 41X (Bar 1 mm). (d) Filiform-like papillae present at the body of the tongue of 18 days old chick; Increase- 400X (Bar 100 µm).

The caudal border of the papillary crest presented irregular surface because of the presence of large-sized caudal lingual papillae. These papillae showing an increase in size from medial to lateral portion were divided into medial and lateral papillae. The medial papillae were approximately 12–14 in number and their bases reached up to the transverse groove and were separated from each other by shallow groves (Figures 3a-c). However, the lateral papillae were 5–6 on each side and their pointed tips were caudally directed having single projection and were separated by narrow clefts whereas; their bases joined to form a regular structure which was sloping down towards the center (Figures 3a-d, 4a). Some of the papillae presented bifid tips. Only a few papillae possessed small secondary papillae like structures towards the base. The surface of these caudal lingual papillae presented exfoliated scale-like cells (Figures 3d, 4a). The higher magnification of these papillae presented squamous cells which were delineated by micro elevations and were studded with microplicae of varying shapes and patterns (Figure 4b). The microplicae appeared as if filled with some material. A row of 3-4 large giant papillae were present towards lateral part of the papillary crest and were closely associated with the caudal lingual papillae (Figure 4c).

These linearly arranged giant papillae separated from each other by small clefts and the grooves showed their tips directing backward. These papillae also had a smooth surface except a few desquamated cells and microplicae similar to those of the caudal lingual papillae. No secondary papillae were observed. Sometimes, a few giant papillae fused with each other to form a large papilla, a feature observed in birds of last two groups (Figure 4c). The root of the tongue was having an uneven structure due to presence of transversely and obliquely oriented folds and grooves without any type of papillae (Figure 4c). However, small openings of ducts of lingual glands were present irregularly especially towards its lateral portion (Figure 4d). The grooves were more prominent in birds of 25 and 32 days of age. Gustatory papillae or taste buds were not observed in any portion of the tongue in the birds of the present study.

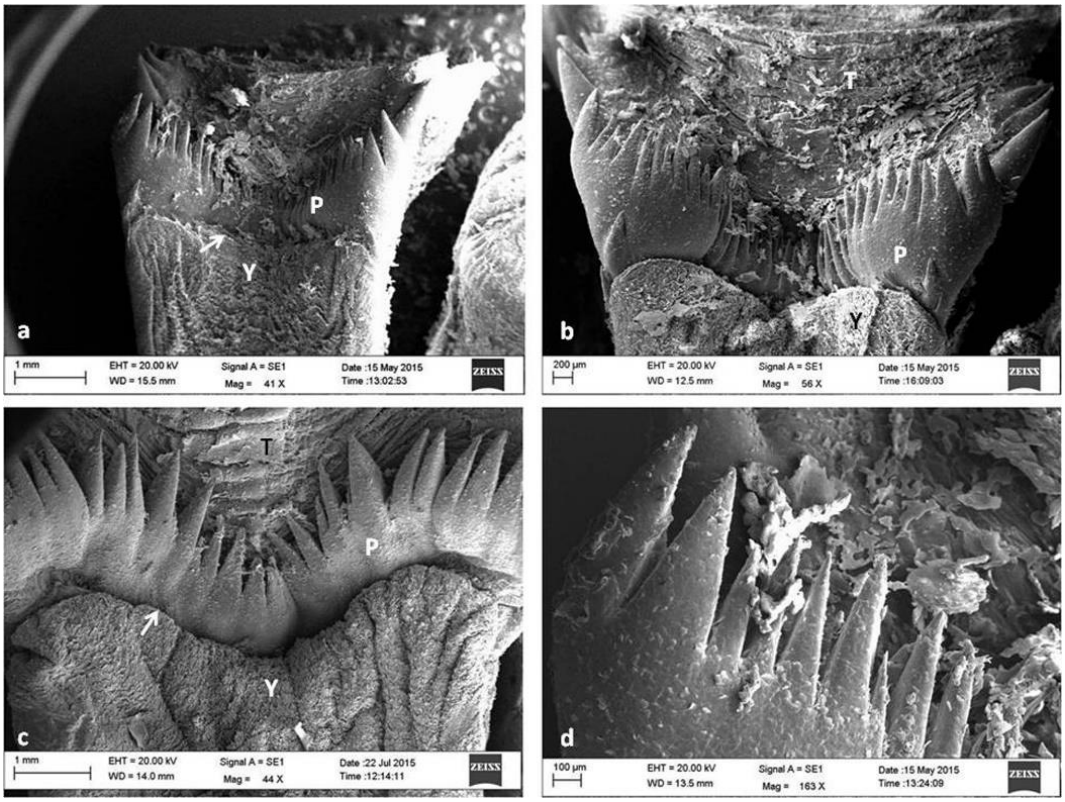

Figure 3: Scanning electron-micrograph of (a) Tongue of 11 days old chick showing a transverse groove (arrow) separating the body (Y) and papillary crest (P) with caudal lingual papillae; Increase- 41X (Bar 1 mm). (b) Caudal part of the body (Y), papillary crest (P) and root (T) of the tongue of 18 days old chick; Increase- 56X (Bar 200 µm). (c) Caudal part of the body (Y), a transverse groove (arrow), a serpentine papillary crest (P) and root (T) of the tongue of 32 days old chick; Increase- 44X (Bar 1 mm). (d) Higher magnification of the caudal lingual papillae of the tongue of 11 days old chick; Increase- 163X (Bar 100 µm).

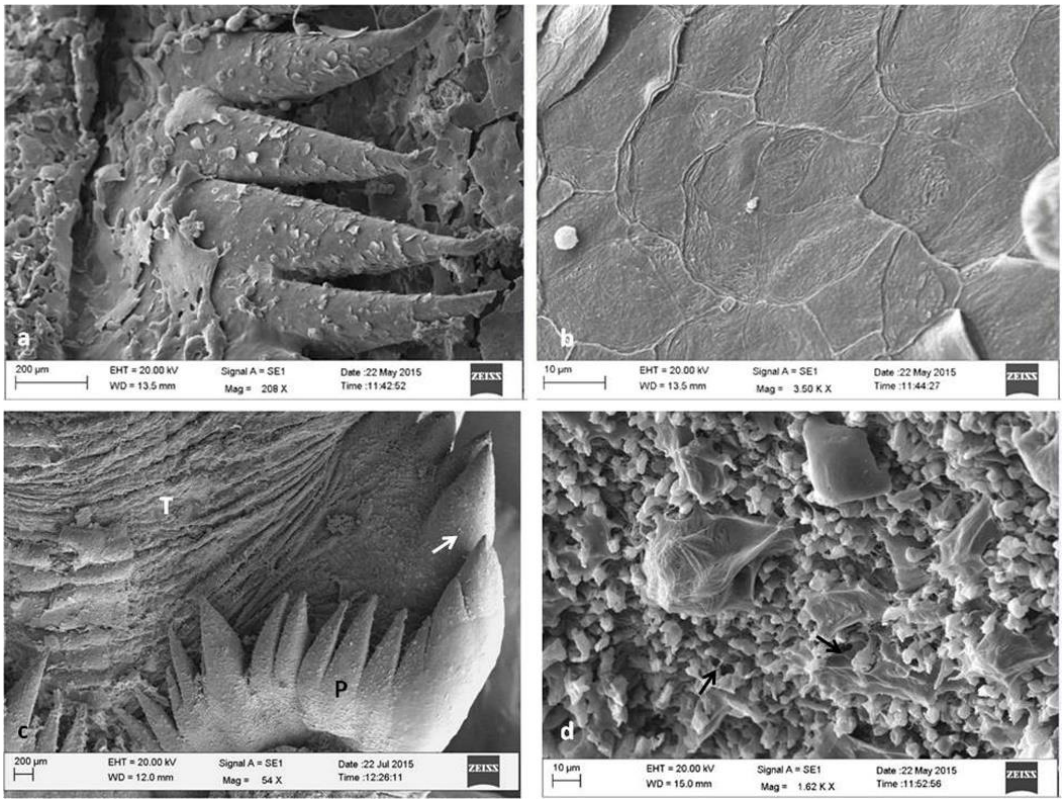

Figure 4: Scanning electron-micrograph of (a) Caudal lingual papillae of the tongue of 25 days old chick; Increase- 208X (Bar 200 µm). (b) Higher magnification of a portion of A showing microplicae; Increase- 3500X (Bar 10 µm). (c) Caudal lingual papillae of the papillary crest (P), lateral giant papillae (arrow) and the root of the tongue of 32 days old chick; Increase- 54X (Bar 200 µm). (d) Root of the tongue of 18 days old chick showing mucous secretions and opening of glandular ducts (arrow); Increase- 1620X (Bar 10 µm).

Larynx:

The anterior larynx was having a centrally placed laryngeal cleft, laryngeal mound on both sides and transversely oriented pharyngeal papillae in the birds of all age groups (Figures 5a-c). The laryngeal cleft was oval-shaped present only towards the anterior part of the larynx. The anterior border of the cleft was in the form of a straight line whereas the posterior border was pointed to U-shaped (Figure 5d). The cleft on either side was bound by a rim like laryngeal mound having two parts. Its lateral portion was flat and broader whereas the small medial portion was inclined downward and inward. The medial portions of either side united with each other to form the posterior oval boundary of the laryngeal cleft. The laryngeal mound presented irregular rough surface due to presence of scales like structures. The laryngeal fissure was the caudal continuation of the laryngeal cleft. On either side of the fissure, a variety of conical papillae were generally oriented in four rows as longitudinally arranged median papillae. The first row was comprised of one small papilla present on each lateral side of the laryngeal cleft (Figure 5a). The second row was comprised of four papillae, two on either side of the laryngeal fissure (Figures 5b, c).

These papillae were larger than those of the first row. The third row was constituted by five large-sized papillae on each side of the laryngeal fissure, of which three larger papillae were having finger-like arrangement (Figures 6a, b). Their posterior pointed parts were separated from each other. The other two comparatively smaller papillae were obliquely placed. All these papillae were conical shaped with pointed tips directed posteriorly. The fourth row of median papillae was constituted by four horn-like papillae on each side just caudal to the third row of papillae (Figure 5c). The surface of all types of papillae covered with scales like flat polyangular cells and contained varying patterns of the microplicae (Figure 6c).

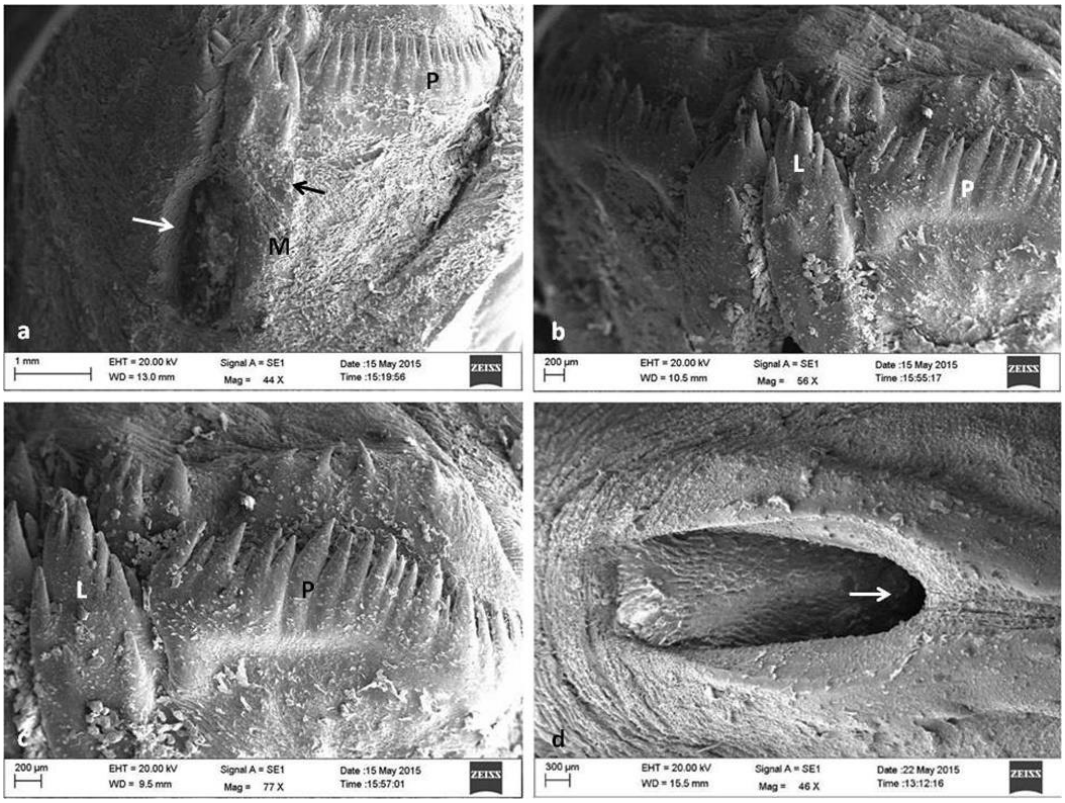

Figure 5: Scanning electron-micrograph of (a) Anterior larynx of 07 days old chick showing laryngeal cleft (white arrow), laryngeal mound (M), first row of medial (black arrow) and pharyngeal papillae (P); Increase- 44X (Bar 1 mm). (b) Anterior larynx of 11 days old chick showing medial (L) and pharyngeal papillae (P); Increase- 56X (Bar 200 µm). (c) Higher magnification of B showing different rows of medial (L) and pharyngeal papillae (P); Increase- 77X (Bar 200 µm). (d) Anterior larynx of 18 days old chick showing oval shaped posterior boundary of the laryngeal cleft (arrow); Increase- 46X (Bar 300 µm).

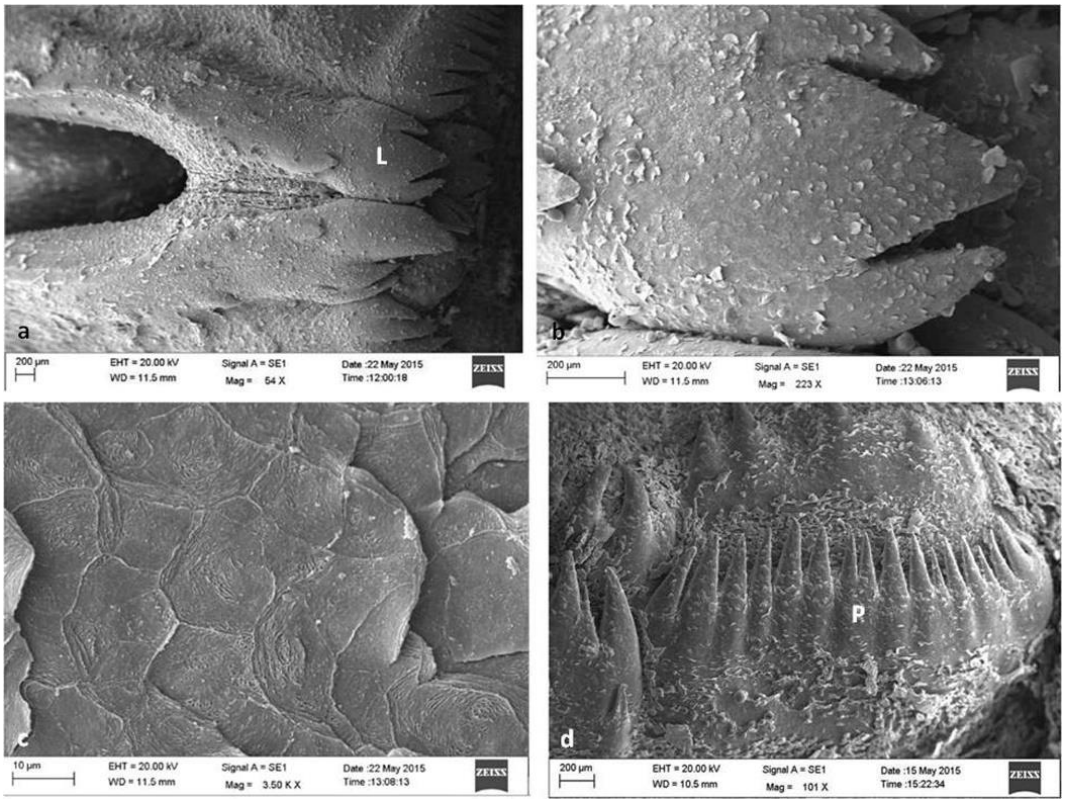

Figure 6: Scanning electron-micrograph of (a) Anterior larynx of 18 days old chick showing laryngeal cleft and medial papillae (L); Increase- 54X (Bar 200 µm). (b) Higher magnification of A showing medial papillae; Increase- 223X (Bar 200 µm). (c) Anterior larynx of 18 days old chick showing microplicae of medial papillae at higher magnification; Increase- 3500X (Bar 10 µm). (d) Anterior larynx of 07 days old chick showing pharyngeal papillae (P); Increase- 101X (Bar 200 µm).

The pharyngeal papillae of the anterior larynx were also categorized into two rows. The anterior row was comprised of generally 17–18 papillae on each side of the laryngeal fissure in a transverse manner (Figures 6d, 7a, b). These papillae observed lateral to the third and fourth rows of median papillae were conical-shaped having pointed tips similar to teeth of a saw and were directed downward and backward (Figures 7c, d). The bases of these papillae were joined with those of adjacent ones. However, shallow grooves demarcated their junctions. The size of these papillae did not exhibit any definite order as large and small papillae were irregularly observed. These papillae presented the rough surface because of desquamated epithelial cells. The adjacent epithelial cells were separating from each other by the microridges (Figure 8a) showed different arrangements and patterns of microplicae of filled nature. The small-sized four pharyngeal papillae of second-row were conical shaped and widely placed just caudal to the first row on each side (Figures 7a, b). These papillae also contained microplicae similar to the first row of pharyngeal papillae (Figure 8b).

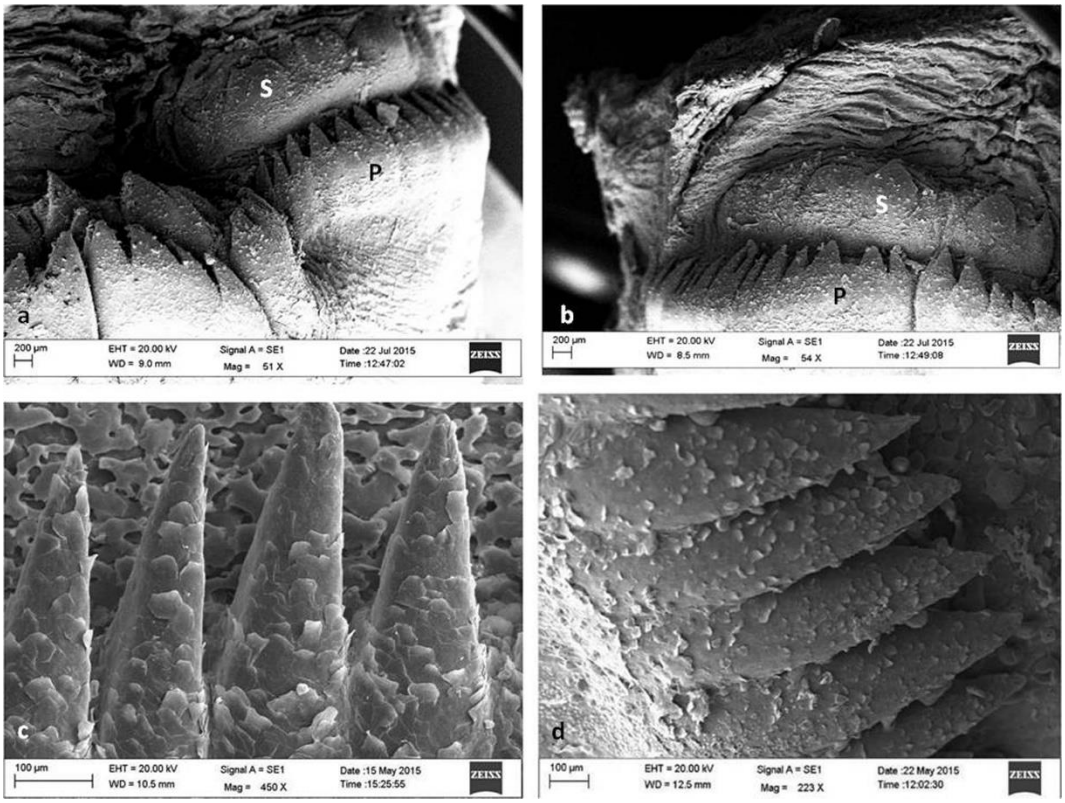

Figure 7: Scanning electron-micrograph of (a) Anterior larynx of 25 days old chick showing transverse row of pharyngeal papillae (P) and second row of papillae; Increase- 51X (Bar 200 µm). (b) Anterior larynx of 25 days old chick showing pharyngeal papillae (P) and second row of papillae (S); Increase- 54X (Bar 200 µm). (c) Anterior larynx of 7 days old chick showing transverse row of pharyngeal papillae at higher magnification; Increase- 450X (Bar 100 µm). (d) Anterior larynx of 18 days old chick showing transverse row of pharyngeal papillae at higher magnification; Increase- 223X (Bar 100 µm).

The rest birds of the groups (11, 18, 25 and 32 days of age) showed similar structural features of the larynx except the progressive developmental changes. Some of the birds also possessed additional papilla present irregularly in relation to the laryngeal cleft and some of the papillae presented bifid appearance. The laryngeal mound, floor of the laryngeal cleft and the caudal row of the pharyngeal papillae were more prominent in the birds of 25 and 32 days of age. The laryngeal mound showed the specific arrangement of bundles of fibers separated by the grooves. These fibers were directed obliquely outward and forward (Figure 8c). The laryngeal cleft presented a meshwork like structure along with ciliated cells and mucous secretions indicating the openings of underlying glandular ducts (Figure 8d).

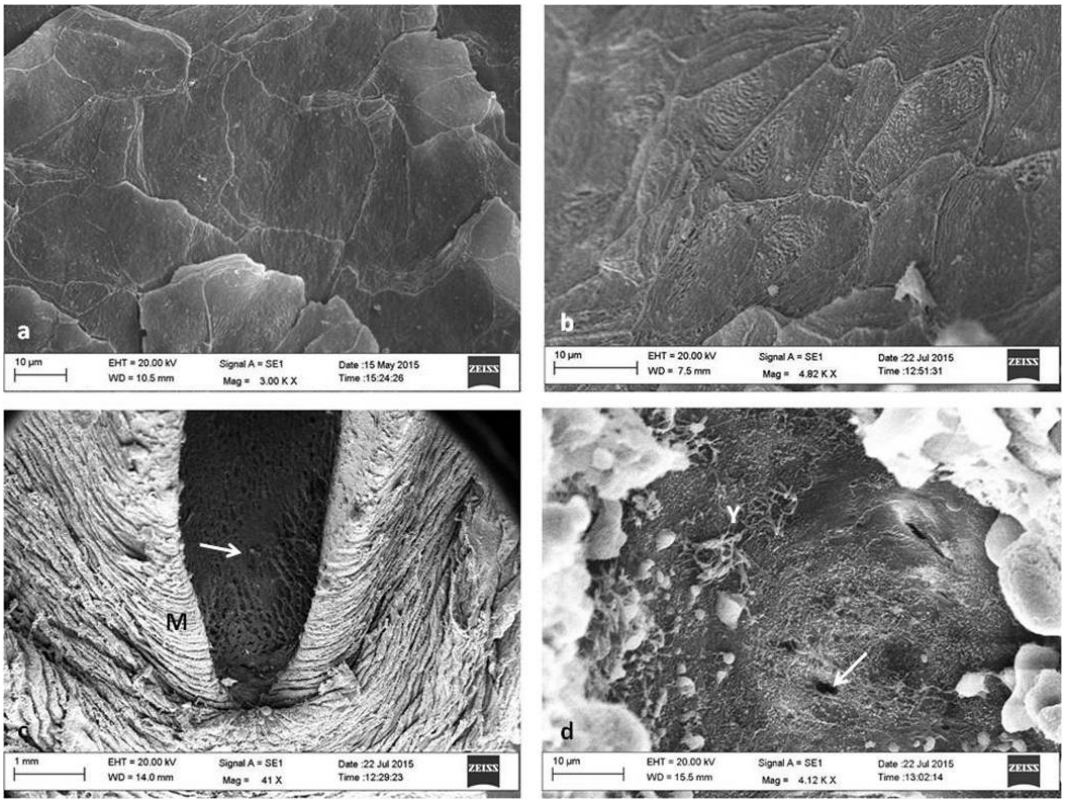

Figure 8: Scanning electron-micrograph of (a) Anterior larynx of 7 days old chick showing microplicae of transverse row of pharyngeal papillae; Increase- 3000X (Bar 10 µm). (b) Anterior larynx of 25 days old chick showing microplicae of second row of pharyngeal papillae; Increase- 4820X (Bar 10 µm). (c) Anterior larynx of 25 days old chick showing laryngeal cleft (arrow) and mound (M); Increase- 41X (Bar 1 mm). (d) Anterior larynx of 32 days old chick showing presence of ciliated cells (Y) and openings of the glandular ducts at the floor of laryngeal cleft; Increase- 4120X (Bar 10 µm).

Discussion

The tongue of domestic fowl was triangular shaped as observed earlier in chicken (Ertas & Erdogan, 2019). In contrast, the tongue has been reported spade-like with oval tip in quails (Parchami *et al*., 2010b), eagle and hawk (Jackowiak & Godynicki, 2005; Emura et al., 2008), and bifid with an oval tip in owl (Abou-Zaid, 2008). A triangular tongue with slightly rounded apex has also been reported in quails (Pourlis, 2014). The variations in the shape of tongue might be attributed due to feeding habits of the birds. The tongue of chicken was divided into an apex, a body and a root as reported earlier (Bansal et al., 2018; Ertas & Erdogan, 2019; Abou-Zaid, 2008), and nutcracker (Jackowiak et al., 2010; Erdogan & Perez, 2015; Erdogan & Iwasaki, 2014). The dorsal surface of the apex had a small concave depression which was followed caudally into the anterior part of the body as reported in quails (Pourlis, 2014), European magpie and common raven (Erdogan &Alan, 2012) and owl (Emura & Chen, 2008). This grove was reported absent in previous studies on fowl (Iwasaki & Kabayashi, 1986). The apex showed a large number of filiform papillae which were densely arranged toward the lateral border of the tongue as reported earlier in chicken (Ertas & Erdogan, 2019; Abou-Zaid, 2008), seagull (Onuk et al., 2015) and laughing dove (Farouk & Hassan,

2015). However, these filiform like papillae were lacking towards anterior part of the apex of the tongue of chickens of 18 days onwards. Similar observations have been recorded in owl without mention of age (Ertas & Erdogan, 2019; Abou-Zaid, 2008) and quails (Pourlis, 2014). This area devoid of papillae has been called as a lingual nail (Ertas & Erdogan, 2019). The antero-lateral portion of the apex having scales like structure presented flat cells which at higher magnification showed microplicae of different patterns. Similar type of superficially exfoliated cells and micro-ridges has been reported earlier (Ertas & Erdogan, 2019; Pourlis, 2014, Jackowiak & Godynicki, 2005; Parchami et al., 2010). In contrast, in golden eagle many processes were densely distributed on the dorsal surface of lingual apex (Parchami et al., 2010a). These papillae of varying shapes and size showed leaves like structure as reported earlier (Abou-Zaid, 2008), in golden eagle and quail (Parchami et al., 2010a, b). In contrast, many thread like papillae were observed in owl (Abou-Zaid, 2008). The surface of papillae presented some longitudinal folds which at higher magnification showed different arrangements of microplicae however, some of the papillae presented a smooth appearance. The microridges were arranged as parallel rows on the cellular surface in the vicinity of openings of glandular ducts in quails (Pourlis, 2014). The microridges could be associated with the friction and may be involved in the increase of the surface area, adherence and spreading of mucus to maintain moisture on the free surface (Croley & Soley, 2010).

The dorsal surface of the body of tongue in chicken also presented additional oblique grooves. However, only one medial groove was reported in the domestic pigeon (Parchami & Dehkordi, 2011), quail (Pourlis, 2014) and laughing dove (Farouk & Hassan, 2015). The caudal portion of the body presented small longitudinal folds irregularly towards the lateral portion on either side. The filiform papillae present throughout the surface of the body in the fowl were mainly localized between the wings of the body in the quails (Pourlis, 2014). Small openings of the glandular ducts of lingual glands observed earlier on the dorsal surface of the body of tongue in fowl (Abou-Zaid, 2008) and quails (Pourlis, 2014) could not be demonstrated during the present study because of the high density of the papillae, however, presence of mucous secretions in between the papillae indirectly indicates their presence.

At the junction of the body and the root of the tongue, a transversely oriented fold of the lingual mucosa called as the papillary crest (Ertas and Erdogan, 2019) was separated from the body by a shallow transverse groove as reported in quails (Pourlis 2014). The groove reported "V" shaped (Ertas & Erdogan, 2019; Jackowiak et al., 2011, Parchami et al., 2010b) presented different shapes with the advancement of age during the present study. The papillary crest was studded with 2 transverse rows of papillae in goose (Jackowiak et al., 2011). Generally, 2 small-sized papillae present close to the anterolateral border of the lingual fold have not been reported in previous studies on fowl. The posterior border of the crest had conical shaped caudal lingual papillae as reported earlier in the fowl (Abou-Zaid, 2008; Ertas & Erdogan, 2019), quails (Pourlis, 2014), white-eared bulbul (Parchami et al., 2013), and laughing dove (Madkour, 2018, Farouk & Hassan, 2015). These papillae were reported to be cactus leaf-like in Japanese quails (Madkour, 2018). In contrast, these papillae were absent in ostrich (Jackowiak & Ludwig, 2008). The number of these papillae varied in different birds. There papillae were categorized into 12–14 medial, 5–6 lateral and 3–4 giant papillae during the present study. Similarly, 25 medial conical papillae and 2–6 very large-sized papillae have been reported caudo-lateral to large conical papillae (Ertas & Erdogan, 2019). The crest showed a row of 24-26 main conical papillae along with two sets of 2–3 giant papillae towards its lateral ends on each side in quails (Pourlis, 2014). The size of the conical papillae increased as moved from central to

the lateral portion and their surface presented exfoliated cells as reported earlier in the fowl (Abou-Zaid, 2008). Only a few papillae presented small papillae which were comparable to the secondary papillae and these were observed towards the base of the papillae. The presence of scales might be due to interaction of these papillae and the feed particles during ingestion and indicated their mechanical nature. The higher magnification of surface of these papillae presented the microplicae which were of varying shapes and size as reported earlier (Abou-Zaid, 2008). The papillae comparable to giant papillae were called as second row formed by two large papillae in European magpie and common raven (Erdogan & Alan, 2012). In contrast, these types of papillae were not reported in seagull (Onuk et al., 2015). These papillae also presented the smooth surface except few desquamated cells and microplicae similar to caudal lingual papillae. The outline of each cell was polygonal and their margins were slightly thickened between adjacent cells. Slight-elevated microridges adorned the surfaces of the cells. No secondary papillae were observed. Relative smooth cellular surfaces were seen mainly on and around the conical papillae. Variations of the surface of the epithelial lingual cells have also been observed in the chicken (Iwasaki & Kobayashi, 1986). These variations probably represent adaptations of the tongue to the feeding mechanisms and to the environmental habitats (Iwasaki, 2002). The conical papillae present in owl (Abou-Zaid, 2008) have been reported to play a role in swallowing of ingested food and to prevent regurgitation.

The root of the tongue devoid of any type of papillae presented an uneven structure having transversely oriented folds along with the presence of a few small openings of the glandular ducts as reported earlier (Ertas & Erdogan, 2019), in quails (Pourlis, 2014) and Japanese quails (Madkour, 2018). The openings of ducts of anterior lingual glands were localized towards the lateral surface of the posterior part of the lingual body, whereas those of the posterior lingual glands were reported towards the root in the white-tailed eagle (Jackowiak & Godynicki, 2005). Similar types of openings of varying shapes were present throughout the surface of the body and root of the tongue in falcon (Emura et al., 2008). The secretions of the glands might have protective role by acting as a barrier for entry of the pathogens in the oral cavity (Gargiulo et al., 1991; Sagsoz et al., 2013). Taste buds could not be localized in any portion of the tongue during the present and previous detailed study by light microscopy (Bansal et al., 2018). However, more taste buds have been reported in the stratified squamous epithelium of the anterior part of the body than the root of the tongue in fowl (Abou-Zaid, 2008).

The anterior larynx of birds was constituted by a centrally placed laryngeal cleft, laryngeal mound on both sides, medial and transversely arranged pharyngeal papillae as reported in long-legged buzzard (Erdogan et al., 2012) and southern lapwing (Erdogan and Perez, 2015). The laryngeal mound was divided into medial and lateral parts. The medial portions bound the laryngeal cleft which caudally led to the laryngeal fissure as reported in southern lapwing (Erdogan and Perez, 2015). The dorsal surface of the mound showed large conical papillae in the nutcracker (Jackowiak et al., 2010). The papillae categorized as median type during the present study were generally arranged in 4 rows in relation to the laryngeal cleft and the fissure. However, 16–18 papillae were located medially and continued from the caudal border of the glottic fissure to backward in long-legged buzzard (Erdogan et al., 2012). The caudally directed conical papillae were observed besides the rims of glottis in Japanese quails (Madkour, 2018).

The pharyngeal papillae of the anterior larynx were transversely arranged on lateral side similar to those of Southern lapwing (Erdogan & Perez, 2015). These papillae were generally 17–18 on each side of the mid plane. However, in long-legged buzzard the rostral row of pharyngeal papillae

was composed of 28–30 conical papillae (Erdogan et al., 2012). The caudal row of pharyngeal papillae was constituted by 4 papillae on each side. In contrast, the caudal row of pharyngeal conical papillae was formed by 22–25 conical papillae in the long-legged buzzard (Erdogan et al., 2012). These papillae were also conical shaped and were widely placed from each other especially in birds of 25–32 age groups. These pharyngeal papillae have been reported to be arranged in 3 transverse rows in Japanese quails (Madkour, 2018). The various patterns of microplicae were observed with a predominance of filled nature in all the types of papillae during the present study.

The floor of the laryngeal cleft was more prominent and it presented a meshwork like structure, where the openings of underlying glandular ducts were observed as reported in laughing dove and Japanese quails (Madkour, 2018). However, in seagull, the openings of salivary glands were observed at the rostral edge of the larynx (Onuk et al., 2015). The structural components of the anterior larynx of the Cubb chicks of different age groups were identical during the present study except the laryngeal mound and caudal row of the pharyngeal papillae which were comparatively more pronounced in the birds of 25 and 32 days of age.

Conclusion

The present study on the tongue and the anterior larynx was conducted in a systematic manner in the Cubb broiler chicks of different age groups. The triangular shaped tongue was studded with filiform-like papillae except the apex (dorso-lateral portion) and the root. The papillae presented microplicae of varying patterns. A transverse groove and the papillary crest sandwiched in between the body and the root of the tongue varied in shape in the birds of different age groups. The papillary crest was comprised of medial and lateral papillae being supported by an additional row of giant papillae towards lateral side. Taste buds were not observed in any type of the lingual papillae. The laryngeal mound of anterior larynx presented different rows of conical papillae. The anterior row of pharyngeal papillae was comprised of 17–18 papillae on either side of pharyngeal fissure whereas the second row was having only 4 small sized papillae. The laryngeal mound and the caudal row of the pharyngeal papillae of the anterior larynx were comparatively more pronounced in the birds of 25 and 32 days of age.

Disclosure statement

There was no potential conflict of interest by the authors.

Ethics statement

The tissues were collected from birds of different age groups after post-mortem examination. Permission was granted by Institutional Animal Ethics Committee, LUVAS, Hisar, India to work on these birds.

Funding

The present research work did not receive financial assistance by any funding agency.

References

1. Abou-Zaid DFA. (2008). *Comparative anatomical study on the dorsal surface structure of the tongue of two birds with different feeding habits*. Egyptian Journal of Experimental Biology (Zool): Vol. 4: 65–72.
2. Bansal Shailja, Kumar S., Mamta, Kumar Pawan. (2019). *Age related histological and histochemical studies on cranial larynx and associated glands in broiler chicks*. Indian Journal of Veterinary Anatomy: Vol. 31(1): 33–36.
3. Bansal Shailja, Kumar Satish, Mamta, Kumar, Pawan. (2018). *Age related histological and histochemical studies on tongue and associated glands in broiler chicks*. Veterinary Research International: Vol. 6(3): 52–59.
4. Croley M.R., Soley J.T. (2010). *Surface morphology of the emu (Dromaius novaehollandiae) tongue*. Anatomia Histologia Embryologia: Vol. 39: 355–365.
5. Emura S., Chen H. (2008). *Scanning electron microscopic study of the tongue in the owl (Strix uralensis)*. Anatomia Histologia Embryologia: Vol.37: 475–478.
6. Emura S., Okumura T., Chen, H. (2009). *Scanning electron microscopic study of the tongue in the Japanese pygmy woodpecker (Dendrocopos kizuki)*. Okajimas Folia Anatomica Japonica: Vol. 86: 31–35.
7. Emura, S, Okumura, T and Chen, H. (2008). *SEM studies on the connective tissue cores of the lingual papillae of the Northern gos–hawk (Accpiter gentilis)*. Acta Anat Nippon 2008; 83: 77–80.
8. Erdogan S., Iwasaki S. (2014). *Fuunctional related morphological characteristics and specialized structures of the avian tongue*. Annals of Anatomy: Vol. 196: 75–87.
9. Erdogan S., Perez W. (2015). *Anatomical and scanning electron microscopic characteristics of the oropharyngeal cavity (tongue, palate and laryngeal entrance) in the southern lapwing*. Acta Zoologica: Vol. 96: 264–272.
10. Erdogan S., Alan A. (2012). *Gross anatomical and scanning electron microscopic studies of the oropharyngeal cavity in the European magpie (Pica pica) and the common raven (Corvus corax)*. Microscopy Research Technique: Vol. 75: 379–387.
11. Erdogan S., Perez W., Alan A. (2012). *Anatomical and scanning electron microscopic investigations of the tongue and laryngeal entrance in the long-legged buzzard (Buteo rufinus, cretzschmar)*. Microscopy Research Technique: Vol. 75: 1245–1252.
12. Ertas T.D., Erdogan S. (2019). *Investigation of chicken (Gallus domesticus) tongue by morphometric and scanning electron microscopic methods*. Dicle Universitesi Veteriner Fakultesi Dergisi: Vol. 12: 8–12.
13. Farouk S.M., Hassan S.A. (2015). *Histochemical and ultrastructural characteristics of tongue of laughing dove (Stigmatopelia senegalensis)*. Journal of Cytology and Histology: Vol. 6: 363–368.
14. Gargiulo A.M., Lorvik S., Ceccarelli, P., Pedini V. (1991). *Histological and histochemical studies on the chicken lingual glands*. British Poultry Science: Vol. 32: 693–702.
15. Iwasaki S., Kobayashi, K. (1986). *Scanning and transmission electron microscopical studies on the lingual dorsal epithelium of chickens*. Acta Anatomica Nippon: Vol. 61: 83–96.
16. Iwasaki S. (2002). *Evolution of the structure and function of the vertebrate tongue*. Journal of Anatomy: Vol. 201: 1–13.
17. Jackowiak H., Godynicki S. (2005). *Light and scanning electron microscopic study of the tongue in the white tailed eagle (Haliaeetus albicilla, Accipitridae, Aves)*. Annals of Anatomy: Vol. 187: 251–259.
18. Jackowiak H., Ludwig M. (2008). *Light and scanning electron microscopic study of the ostrich (Struthio camelus) tongue*. Zoological Science: Vol. 25: 188–194.
19. Jackowiak H., Skieresz-Szewczyk K., Godynicki S., Iwasaki S., Meyer W. (2011). *Functional morphology of the tongue in the domestic goose (Anser anser f. domestica)*. Anatomical Record: Vol. 294: 1574–1584.

20. Jackowiak H., Skieresz–Szewczyk K., Kwiecinski Z., Trzcielinska–Lorych J., Godynicki S. (2010). *Functional morphology of the tongue in the nutcracker (Nucifraga caryocatactes)*. Zoological Science: Vol. 27: 589–594.
21. Kobayashi K., Kumakura M., Yoshimura K., Intomi M., Asami T. (1998). *Fine structure of the tongue lingual papillae of the penguin*. Archives of Histology and Cytology: Vol. 62: 37–46.
22. Madkour F.A. (2018). *Characteristic features of the pharyngeal cavity of the laughing dove (Streptopelia senegalensis aegyptiaca) and Japanese quail (Coturnix coturnix)*. Assiut Veterinary Medical Journal: Vol. 64: 52–59.
23. Onuk B., Tutuncu S., Kabak., M., Alan A. (2015). *Macroanatomic, light microscopic, and scanning electron microscopic studies of the tongue in the seagull (Larus fuscus) and common buzzard (Buteo buteo)*. Acta Zool 2015; 96: 60–66.
24. Parchami A., Dehkordi R.A. (2013). *Light and electron microscopic study of the tongue in the White–eared bulbul (Pycnonotus leucotis)*. Iranian Journal of Veterinary Research Vol. 14: 9–14.
25. Parchami A., Dehkordi R.F. (2011). *Lingual structure in the domestic pigeon (Columba livia domestica): A light and scanning electron microscopic study*. World Applied Science Journal: Vol.; 12: 1517–1522.
26. Parchami A., Dehkordi R.F., Bahadoran S. (2010). *Fine structure of the dorsal lingual epithelium of the common quail (Coturnix coturnix)*. World Applied Science Journal: Vol. 10: 1185–1189.
27. Parchami A., Dehkordi R.F., Bahadoran S. (2010). *Scanning electron microscopy of the tongue in the golden eagle Aquila chrysaetos (Aves: Falconiformes)*. World Journal of Zoology: Vol. 5: 257–263.
28. Pourlis A.F. (2014). *Morphological features of the tongue in the quail (Coturnix coturnix japonica)*. Journal of Morphology: Vol. 31: 177–181.
29. Sağsöz H., Erdoğan S., Akbalik M.E. (2013). *Histomorphological structure of the palate and histochemical profiles of the salivary palatine glands in the Chukar partridge (Alectoris chukar, Gray 1830)*. Acta Zoologica: Vol. 94: 382–391.