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Research Article

ANATOMY OF THE ORO-PHARYNGEAL CAVITY OF TURKEY (*MELEAGRIS GALLOPAVO*)

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ABSTRACT

The study was conducted on 12 turkey birds of 8 weeks of age. The mouth cavity was guarded by convex and curved upper beak which extended over the lower beak. The roof of oropharynx was formed by hard palate cranially and pharynx caudally. The anterior two thirds of the hard palate was divided into right and left halves by a median palatine ridge (2.232 ± 0.032 cm long) and posterior one third was formed by 1.619 ± 0.051 cm long choanal cleft. The margin of the choanal cleft was serrated. The pharyngeal roof was occupied by the infundibular slit. A transverse row of papillae separated the oropharyngeal cavity from the oesophagus. The floor of the oropharynx lodged a triangular shaped tongue (1.896 ± 0.023 cm long), pharynx and laryngeal mound (1.003 ± 0.030 cm long). The laryngeal mound was marked by an elongated median slit, glottis in the centre which communicated with the larynx. The length and width of the glottis was 0.609 ± 0.009 and 0.193 ± 0.007 cm, respectively. Two rows of caudally directed papillae were present at the terminal part of laryngeal mound.

Key words: Cavity, Glottis, Oro pharynx**,** Turkey

Turkey is a large bird of the genus Meleagris. *Meleagris gallopavo*, species commonly known as the wild turkey, is native to the forests of North America. In birds, the relation between the pharynx, oral and nasal cavities is different from that in mammals. The anatomy of this region was previously reported in ostrich (Tadjalli *et al.*, 2008; Tivane *et al.*, 2011), emu (Crole and Soley, 2010), Guinea fowl (Jayachitra *et al.*, 2015) and fowl (Gupta *et al.,* 2016). Relatively scant scientific information on the gross morphology of oro pharyngeal cavity in Turkey prompted the present study.

MATERIALS AND METHODS

The study was conducted on 12 normal healthy 8 weeks old turkey heads obtained after slaughter from an organized poultry farm of U.P. Pandit Deen Dayal Upadhyaya Pashu Chikitsa Vigyan Vishwavidyalaya Evam Go-Anusandhan Sansthan, Mathura. The heads were thoroughly washed in normal saline and fixed in 10% formalin. After fixation, the heads were washed in running tap water to remove excess of formalin and incised along the commissures of mouth to expose the oropharyngeal cavity. The anatomical position and shape of all the structures located in the oropharyngeal cavity were studied in detail and recorded. Biometrical parameters were recorded with the help of non-stretchable thread, meteric scale and digital Vernier Callipers. The data were statistically analysed.

RESULTS AND DISCUSSION

The mouth cavity of turkey was guarded by upper and lower beaks (Fig. 1 and 2). The beak was a hard, keratinized structure which covered the rostral part of upper and lower jaws. The upper horny beak was narrow and pointed. It covered the fused incisive bone and extended caudo-laterally on the maxillary bones as described by Tadjalli *et al.* (2008), Getty (2012) and Gupta *et al.* (2016) in various avian species. The lower beak was formed by rostral part of mandible. The upper beak was convex and curved, and its width increased caudally (Fig. 1). The lower beak was concave and adapted to the tongue (Fig. 2). The upper beak extended beyond the lower beak forming a small hook as also reported by Nickel *et al.*(1977), Jaychitra *et al.* (2015) and Gupta *et al.* (2016) in fowls. The length of upper and lower beak of turkey was 1.732±0.037 and 1.23±0.021 cm, respectively as compared to ostrich where it measured 6.3±0.4 cm and 2.5±0.3 cm (Tadjalli *et al.*, 2008) and fowl 3.61±0.08 cm and 3.34±0.04 cm (Gupta *et al.*, 2016). In turkey, the beak was triangular shaped with a pointed apex as also in guinea fowl (Jaychitra *et al.,* 2015). The beak varies tremendously in form among various avian species depending on their type of food and manner of prehension. Iwasaki (2002) also reported that the wide variation in the morphology of the beak and structures of the avian feeding apparatus is related to their adaptational strategies for obtaining food, feeding methods, and kinds of food and climatic conditions.

There was no clear line of demarcation between the oral and pharyngeal cavities in turkey due to absence of soft palate and hence they have a common oropharyngeal cavity. This cavity extended from the beak to the oesophagus as mentioned by the Igwebuike and Anagor (2013) in Muscovy duck and Jaychitra *et al.* (2015) in guinea fowl. McLelland (1975) marked it at the last caudal transverse row of papillae on the hard palate dorsally and a row of papillae on the base of the tongue ventrally. However, Hodge (1974) marked it at the opening of the glottis. The pharyngeal roof in turkey extended from the rostral end of the choanal cleft to the pharyngeoesophageal junction as in ducks (Hassouna, 2002). Nickel *et al.* (1977) described the boundary between the oral and pharyngeal

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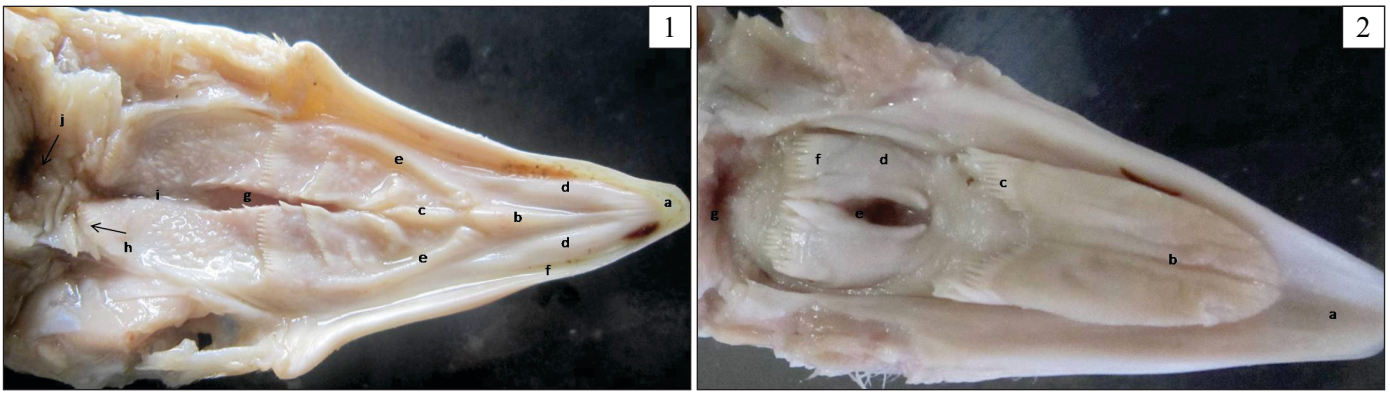

Fig. 1. Photograph of upper jaw of turkey; a. Upper beak, b. Rostral part of median palatine ridge, c. Caudal part of median palatine ridge, d. Rostral part of lateral palatine ridge, e. Caudal part of lateral palatine ridge, f. Lateral palatine groove, g. Choanal cleft, h. Last transverse row of papillae on hard palate, i. Infundibular cleft and j. Oesopahagus.2: Photograph of lower jaw of turkey; a. Lower beak, b. Tongue palatine ridge, c. Row of lingual papillae, d. Laryngeal mound, e. Glottis, f. Row of pharyngeal papillae on laryngeal mound, and g . Oesopahagus.

cavities at the junction of the narrow and wide parts of the choanal slit. Ali (2004) observed that the oropharyngeal roof in ostrich was separated from the oesophagus by a transverse mucosal ridge. The roof of oropharynx in turkey was deeply concave along its longitudinal axis and only slightly so along the transverse axis (Fig. 1). It was triangular in shape with an anterior apex, confined to the shape of the beak. The roof was formed by the hard palate cranially and the pharynx caudally (Fig. 1). The floor was occupied by tongue cranially and laryngeal mound caudally (Fig. 2). The lips and teeth were absent. These findings are similar to the observations of Mohamed and Zayed (2003), Abumandour (2014) and Jaychitra *et al.* (2015). The palate (Palatum) can be divided into two parts; rostral and caudal. The line of demarcation between the two parts lay at the junction of the rostral narrow and caudal wide parts of the choanal slit. The length of the roof of oral cavity in the turkey was 2.886±0.156 cm which constituted 71.26 % of the total length of the roof of the oropharynx. It forms about 78% of the oropharynx in the pigeon and goose, and only 67% in chicken (Mohamed and Zayed, 2003). The length of the palate in the chicken, pigeon and goose is 4.3, 3.2 and 8.5 cm, respectively (Mohamed and Zayed, 2003), while that in the European magpie is 3.144 cm and in Common raven it is 4.00 cm (Erdogan and Alan, 2012). These differences might be due to species characteristics.

In turkey, the rostral two thirds of the hard palate was divided into right and left halves by a median palatine ridge (*Ruga palatine mediana*) and the caudal one third by the choanal cleft (Fig. 1). The median palatine ridge started caudal to the tip of the upper beak and became more prominent in its caudal part. It began behind the upper beak by 0.6 cm in the chicken and 0.5 cm in goose; but just caudal to the tip of the upper beak in the pigeon (Mohamed and Zayed, 2003). In the ostrich, it started from the tip of the beak (Ali, 2004), while in 60 days old duck, it began behind the upper nail by 0.454 cm (Madkour, 2011). In turkey the length of median palatine ridge was 2.232±0.032 cm and it consisted of two parts *viz*. the rostral continuous and the caudal interrupted parts (Fig. 1). The rostral part measured 1.58±0.076 cm long and terminated caudally at the level of rostral end of the caudal lateral palatine ridges (Fig. 1). It continued caudally with the interrupted part which measured 0.623±0.039 cm (long) and bore 2-3 projections in the form of caudally directed papillae. Ali (2004) made similar observations in ostrich. On either side of the median ridge a prominent papilla presented opening of maxillary gland, as reported by Sisson and Grossman (1974) in chicken. On either side of the median ridge, two lateral palatine ridges ran parallel to the margin of the beak in dorso-caudal direction all along the length of the palate. These ridges ran at first caudally in close relation to the median ridge and then diverged caudo-laterally parallel to the free edge of the upper beak and terminated onto the corresponding caudo lateral palatine ridge. The two rostro- lateral palatine ridges in turkey began directly in front of the median palatine ridge as in emu (Crole and Soley, 2010), ostrich (Tivane *et al.*, 2011), guinea fowl (Jayachitra *et al.*, 2015) and fowl (Gupta *et al.*, 2016). Rostrally, the lateral palatine ridges joined the median ridge at an acute angle. The length of rostro-lateral palatine ridge measured 1.873±0.020 cm. It was thicker rostrally and thinner caudally. The two caudo- lateral palatine ridges (7.081±0.098 cm long) began from both sides of the caudal end of the continuous part of the median palatine ridge opposite the level of the medial angle of the nostril. They were curved with the convexity directed laterally. Each ridge began from the corresponding side of the median ridge and extended caudo-laterally to terminate at the lateral end of the last caudal transverse row of the palatine papillae at the angle of mouth, opposite the junction of narrow and wide parts of the choanal slit. Both the ridges were thick rostrally and thin caudally. Between the edges of the upper beak laterally and the rostro- lateral

as well as the caudo-lateral palatine ridges there was a longitudinal lateral palatine groove (Sulcus palatinus lateralis) (Fig. 1). This groove was narrow rostrally (0.114 ± 0.008 cm) and deeper and wider caudally (0.368 ± 0.014 cm).

The palate of the turkey was characterized by the presence of a triangular area lying between the caudo-lateral palatine ridges laterally and the most caudal transverse row of the palatine papillae. The apex of this area was directed rostrally and demarcated by the rostral ends of the caudo-lateral palatine ridges. This area contained the narrow part of the choanal slit and was characterized by the presence of three to four rows of transverse ridges whose margins were occupied by papillae as in fowls (Sisson and Grossman, 1974; Nickel *et al.* 1977 and Gupta *et al.*, 2016). The apices of the papillae were directed caudally as in fowl (Jayachitra *et al.,* 2015). A complete absence or only traces of papillae on the hard palate have been reported by Igwebuike and Anagor (2013) in Muscovy duck, Gussekloo and Bout (2005) in rhea and Tivane *et al.* (2011) in ostrich. The palate of goose had a median and 2-3 paramedian longitudinal rows of blunt papillae. In the duck, these papillae were confined only to the apical region (Nickel *et al.*, 1977*).* These papillae on the hard palate, around the choanal cleft might have a mechanical function to obstruct the escape of food into the cleft and thus facilitate its movement into the esophagus.

The choanal cleft was present as a longitudinal fissure (median slit) along the mid line of the hard palate (Fig. 1). It was 1.619 ± 0.051cm long, narrow rostrally and broad caudally. It formed a permanent communication between the oral and nasal cavities and continued into a narrow closely placed groove in the pharyngeal region as reported by Igwebuike and Eze (2010) in African pied crow, Jayachitra *et al.* (2015) in guinea fowl and Gupta *et al.* (2016) in fowl. The cleft is very long in fowl and pigeon, short in duck and goose (Nickel *et al.,* 1977) and bell-shaped in ostrich (Catarina *et al.,* 2011). The length of rostral and caudal part of choanal cleft was 0.842 ± 0.038 and 0.760 ± 0.043 cm, respectively. The cleft was wider caudally (0.203±0.012 cm) than rostrally (0.113±0.004 cm). The margin of the choanal cleft was serrated showing papillae whose apices were caudally directed.

The pharyngeal roof was occupied by the infundibular slit which was a median longitudinal fissure representing common opening of the two auditory tubes (Fig. 1). The infundibular slit was 0.770±0.022 cm long and was smaller than the choanal cleft. It was located against the base of skull, limited by the pharyngeal folds. It divided the roof of the pharynx into two equal parts. The infundibular slit in adult turkey measured 6.93 mm long and constituted 68.34% of the total length of the pharyngeal roof (Sayad *et al.*, 2016). This variation might be due to age and variation in climate, vegetation and feeding regimen. This slit measured 0.804 cm in the 60 days old duck (Madkour, 2011) 1.97 cm and 1.8-2.2 cm in ostrich (Tadjalli *et al.*, 2008 and Ali, 2004, respectively), 0.141 cm in the European magpie and 3.69 cm in Common raven (Erdogan and Alan, 2012). Madkour (2011) in the duck, Tadjalli *et al.* (2008), and Tivane *et al.* (2011) in the ostrich stated that, this slit was located caudal to the choanae. Erdogan and Alan (2011) observed this slit in European magpie and Common raven at the rear of the palate, separated from the choanal cleft by a transverse fold. It is concluded that the length of the infundibular slit in the turkey was nearly equal to the infundibular slit of duck, but shorter than the ostrich.

The pharyngeal roof of turkey measured 0.511±0.040 cm in length and constituted 28.73 % of the total oropharyngeal roof. It was wider rostrally (1.36±0.123 cm) but narrower (0.691±0.114 cm) caudally. In 60 days old duck, the length of the pharyngeal roof was 1.515 cm forming 15.19% of oropharangeal roof (Madkour, 2011). Fine scattered papillae on the surface of the pharyngeal roof, more concentrated on either sides of the choanal and infundibular clefts (Fig. 1), were the openings of salivary glands. The pharynx was limited caudally by a transverse row of papillae, oesophagus (Fig. 1). This is in agreement with the findings of Erdogan and Perez (2014) in Southern lapwing, Jayachitra *et al.* (2015) in guinea fowl and Gupta *et al.* (2016) in fowl. In contrast the transverse rows of papillae are absent in ostrich (Tadjalli *et al.,* 2008). In turkey the length of the upper and lower parts of the pharynx was 1.511±0.040 and 1.821±0.080 cm, respectively, which is lesser than fowl (Gupta *et al.,* 2016). The width of rostral and caudal regions of upper part of the pharynx was 1.360 ± 0.124 and 0.698±0.114 cm, respectively, while the same parameters for lower part of pharynx were 0.244±0.030 cm and 1.098 ± 0.070 cm, respectively. The floor of the oropharynx contained a concave triangular depression between the rami of mandible and lodged a triangular shaped tongue, pharynx and laryngeal mound as also reported by Nickel *et al.* (1977) in domestic birds, Rodrigues *et al.* (2012) in rhea and Gupta *et al.* (2016) in fowl, Bailey *et al. (*1977) in captive bustards and (Tadjalli *et al.,* 2008) in ostrich.

The tongue of turkey was demarcated from the pharynx by a transverse row of caudally directed papillae (Fig. 2) as reported in ostrich (Tadjalli *et al.,* 2008) and fowl (Gupta *et al.,* 2016). It was wide and triangular in shape. The triangular form of the tongue is commonest among the avian species as also noted by Rossi *et al.* (2005) in partridge and quail, but it is elongated shaped in Eurasian Hobby (Abumandour, 2014). An elongated and

oval tongue is also a characteristic of water birds such as duck and goose (Iwasaki *et al.,* 2002) narrowed in pigeon and lancet shaped in fowl (Nickel *et al.*, 1977). These morphological differences in the tongue of various avian species might be associated with the morphology of beak, dietary specialization, food type and adaptation to their eco- environmental conditions. In turkey the length of the tongue was 1.896±0.023 cm whereas, it was 1.94±0.06 cm in ostrich (Tadjalli *et al.*, 2008) and 1.92±0.15 cm in fowl (Gupta *et al.*, 2016). The width of the tongue of turkey was 0.213±0.010, 0.914±0.010 and 0.137±0.010 cm at the tip, body and root, respectively. The width of the tongue of ostrich was 2.92±0.29 cm (Tadjalli *et al.,* 2008) and fowl was 1.17±0.03 cm (Gupta *et al.*, 2016). The variation in the dimensions is due to species and genetic differences of the bird.

The tongue of turkey was divisible into root, body and tip. The root was fixed at the junction of mouth cavity and pharynx. The rounded tip (0.086 ± 0.006 cm thick) laid 1.113 ± 0.059 cm away from the tip of the lower beak. The rostral two thirds of the tongue was free. It was attached to the floor of the mouth cavity by means of the frenum linguae. Ventrally a prominent ridge was present in the median part of the tongue as also reported by Kadhim *et al.,* (2011) in Red jungle fowl and Gupta *et al.* (2016) in fowl. Corresponding to the ventral ridge a median groove was present on dorsal surface. The dorsal surface of the tongue was marked by several transverse ridges which might be the impressions of rughae palatine. At the root of the tongue a single row of caudally directed papillae were present. These were small in the centre and increased in height laterally, forming a "V" shaped structure. The caudally directed papillae were also reported in fowls and pigeons (Nickel *et al.,*1977), bustards (Bailey *et al.,* 1977), African pied crow (Igwebuike and Eze, 2010), Eurasian Hobby (Abumandour, 2014), guinea fowl (Jayachitra *et al.*, 2015) and fowl (Gupta *et al.*, 2016). However, in duck and goose, there were two rows of upright, horny papillae situated at the edges of the tongue (Getty, 2012). The papillae played major role in directing food to the esophagus and prevented the regurgitation of small and large food pellets (Erdrogan and Perez, 2014). Caudal to the row of the lingual papillae another row of papillae was present, restricted at the periphery of the pharynx.

In turkey, the laryngeal mound prominently projected in the caudal part of the floor of the pharyngeal cavity reaching up-to the first tracheal ring and entrance to the oesophagus (Fig. 2) as reported in African pied crow (Igwebuike and Eze, 2010), guinea fowl (Jaychitra *et al.*, 2015) and fowl (Gupta *et al.*, 2016). It consisted of two adjoining, raised, quadrilateral plates as also observed by Kabak *et al.* (2007) in long-legged buzzard and AL-Mussawy *et al.* (2011) in turkey. Lbe *et al.* (2008) in the West African guinea fowl described the laryngeal mound as roughly triangular shaped structure. In turkey the length of laryngeal mound was 1.003±0.030 cm as compared to fowl 1.09±0.03 cm (Gupta *et al.,* 2016). The laryngeal mound was marked by an elongated median slit, glottis in the centre which communicated with the larynx. Epiglottis was absent in turkey as also in other avian species (Nickel *et al.*, 1977). The length and width of the glottis was 0.609±0.009 and 0.193±0.007 cm, respectively. In fowl it is 0.56±0.02 cm long (Gupta *et al.,* 2016), in chicken 1.1 cm, in turkey 1.5 cm and in duck and goose 1.3 cm (White, 1975) and it was 0.9 cm long in long legged buzzard (Kabak *et al.,* 2007). The width of the glottis turkey was 0.32 cm. White (1975) measured it 0.50, 0.30, and 0.40 cm in turkey, duck, and goose, respectively. In long legged buzzard it was 0.186 cm (Kabak *et al.,* 2007).

At the terminal part of laryngeal mound two rows of caudally directed overlapping papillae were observed (Fig. 2). The rostral row consisted of long spinous conical papillae with numerous thin thorny papillae at their bases and two large giant papillae on the midline. Sisson and Grossman (1974) in chicken, Abumandour (2014) in Eurasian Hobby and Gupta *et al.* (2016) in fowl reported similar papillae. A single row of pharyngeal papillae occurred behind the laryngeal mound in red jungle fowl (Kadhim *et al.* 2011), raven and magpie species (Erdogan and Alan 2012) and guinea fowl (Jayachitra *et al.*, 2015). Hassouna, (2002) described 5-7 transverse rows of thin, medium-sized caudally directed papillae in ducks. Kabak *et al.* (2007) described two sagittal rows of 5-6 small papillae running parallel with the rims of the inlet and dorsal furrow in chicken and long legged buzzard. In cage and aviary birds Evans (1996) described a few filiform papillae on the laryngeal prominence. In ostrich the papillae are not seen on the larynx (Tadjalli *et al.*, 2008). The caudally directed pointed cornified papillae on the mound might be helpful in the ingestion of solid food particles and pellets and in raking movement of the larynx during swallowing (White, 1975; Fitch, 1994).

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