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**SOME MORPHOLOGICAL STUDIES ON THE
TONGUE OF THE TURKEY**
(With 23 Figures)

By

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بعض الدراسات المورفولوجية على اللسان في الرومي

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أظهرت الدراسة أن الشكل اللساني للسان الرومي طويل نسبياً ويقع 1,4 سم خلف زاوية الفم . الجزء الأمامي للعظمة اللسانية الداخلية يمثل بغضروف ويمتد أماماً إلى قمة اللسان ، بينما ينتهي قرني هذه العظمة خلفاً عند مستوى الصف المستعرض للحلمات اللسانية . هذه الحلمات مخروطية الشكل ومغطاة بحلمات ثانوية ذات شكل حرسفي . كما أوضحت الدراسة أن الحلمات الخيطية تغطي ظهر جسم اللسان ولم تلاحظ هذه الحلمات على الجزء الأمامي لقمة وكذلك جذر اللسان . يوجد من الحلمات الخيطية الصغير والكبير ، وبعض الحلمات يتكون من جزئين قاعدي وقمي . ومن الجدير بالذكر وجود العديد من الحلمات كرنبية الشكل محاطة بحلمات خيطية أمام جذر اللسان . ومن المقترح أن تؤدي هذه الحلمات وظيفة ميكانيكية لعدم إمكانية رؤية البراعم التنويرية بها . يغطي اللسان طلائية حرشفية مصففة كيراتينية ، سمك الطلائية وكذلك الطبقة الكيراتينية يتوقف على منطقة اللسان . الغدد اللعابية الأنبوبية المركبة تقع وحشياً للعظمة اللسانية الداخلية في منطقة الجسم ، بينما تكون هذه الغدد كتل مخروطية الشكل على الجانب الظهري الوحشي للعظمة الخيشومية الأساسية الأمامية . وقد تبين من البحث وجود حزم من العضلات الهيكلية في منطقة الجذر حيث تمتد هذه العضلات أماماً إلى منطقة الجسم . أوضحت الدراسة أيضاً أن قمة اللسان لا تحتوي على عضلات أو عدد .

SUMMARY

The present study shows that the frenulum linguae in the tongue of turkey is relatively long and lies 1.4 cm caudal to the angle of the mouth. The rostral part of the entoglossal bone is represented by cartilage which extends to the apex, while its cornua are V shaped and terminate caudally at the level of the transverse row of the lingual papillae. The latter papillae are conical in shape and covered with secondary scale-shaped papillae. Three to four large papillae lie ventrolateral and caudal to the lingual papillae. The filiform papillae cover the dorsal aspect of the body and do not observed in the tip and root of the tongue. Small and large filiform papillae are demonstrated, some papillae consist of basal and apical parts. Many cabbage-shaped papillae surrounded by filiform papillae are found in front of the root. The taste buds could not be observed in these papillae, therefore it is suggested that they serve mechanical function. The tongue is covered with keratinized stratified squamous epithelium. The thickness of the epithelium and keratin layer vary in the different regions of the tongue. The compound tubular salivary glands lie lateral to entoglossal bone in the body and form a pyramidal shape masses dorsolateral to the rostral basibranchial bone in the root region. Bundles of the skeletal muscles are found in the root and extend rostrally to the body of the tongue. The apex does not contain either muscles or glands.

Key words: Morphological studies on the tongue of the turkey

INTRODUCTION

Since birds have no teeth, the functions of the mouth organs are confined to the prehension and incomplete breaking up of the food. The tongue and pharynx transport and swallow the food (Nickel, Schummer and Seiferle, 1977). The tongue in birds is widely modified according to diet and habits of birds and varies in shape and motility (Arnall and Keymer, 1975). The tongue plays an important role in the physiology of the mouth (Smith, Paterson, Scratchered and Read, 1988). For these reasons the morphology of the tongue of some birds has received a considerable interest of many investigators. The knowledges about the tongue of the turkey are lacking in the available literature, therefore, the present work has

been performed to clarify the morphological structure of the tongue in this bird.

MATERIAL and METHODS

The present work was carried out on broad-breasted turkey (*Meleagris gallopavo*). For the macroscopical study, eight birds were bled, then the heads were separated. The tongues were measured, photographed and the anatomical features were investigated carefully.

The scanning electron microscopical study was carried out on four tongues which washed in 0.2 phosphate buffer. Small pieces from the apex, body and root of the tongue were fixed in formaldehyde glutaraldehyde solution, then the specimens were washed in 0.1 M cacodylate buffer at PH 7.3, dehydrated in ascending graded ethanol followed by amyl acetate. They were dried by the critical point drying using liquid Co₂, then coated with gold and examined by a Jeol 5400 LV scanning electron microscope.

The light microscopical observation was carried out on eight turkeys. Several parts were taken from the different regions of the tongue and fixed in Bouin's fluid and prepared for paraffin embedding. Sections of 5 microns were cut and stained with haematoxylin and eosin, Masson's trichrome, Verhoeff's elastic stain and periodic acid schiff's reagent (Bancroft and Stevens, 1996).

RESULTS

The tongue in the turkey is triangular in shape with pointed apex and sharp lateral borders. It measures about 4.4 cm in length and 1.3 cm in breadth at the root. The tongue is adapted to the shape of the lower beak within which it lies, it does not fill the oral floor completely (Fig. 1). Its apex terminates about 1.5 cm caudal to the rostral limit of the lower beak, and its lateral border is separated from the edge of this beak by about 0.4 cm.

The tongue has a concave dorsal surface which contains a shallow median longitudinal groove extending from the apex rostrally to the beginning of the root caudally. In addition the tongue has two ventrolateral surfaces which meet together ventrally on the free part of the tongue to form a distinct ventral border.

The tongue is fixed by relatively long median mucous fold; frenulum linguae, which is reflected from the oral floor to the

ventral aspect of the tongue. It lies rostral to the angle of the mouth by about 1.4 cm. The tongue as a whole is supported by the hyobranchial apparatus.

The dorsal surface has a curved transverse row of well developed caudally directed lingual papillae which lie at the beginning of the root region. The convexity of this row is directed rostrally. The papillae are 34-36 in number.

Scanning electron microscopical study reveals that the lingual papillae are conical in shape with pointed free ends (Fig. 2). The longest and the thickest papillae are present in the periphery, then they decrease in both length and thickness medialwards. These papillae are covered with small secondary scale-shaped papillae (Fig. 3), which are directed toward the apical ends of the lingual papillae. Moreover, 3-4 large papillae are situated ventrolateral and caudal to the previous row of papillae.

The dorsum of the tongue; as shown by scanning electron microscope, contains filiform papillae (Fig. 4). They are dorsocaudally slender structures. Small and large papillae can be observed, but the latter are numerous than the former ones. Some of the filiform papillae consist of basal and apical parts which are telescoped with each other (Fig. 5). The apical part is longer than the basal one, its free end is blunt and show cup-shaped invagination (Fig. 5). The distribution of the filiform papillae differs according to the region of the tongue, they are numerous in the body and could not be observed in the root region. The caudal part of the apex contains filiform papillae, while its rostral part (tip) is devoid from papillae and contains instead of these papillae scale-shaped structures (Fig. 6). The root region demonstrates few grooves and some scale-shaped structures.

Infront of the root of the tongue there are many cabbage-shaped papillae which are arranged mainly in rows (Fig. 7). They are surrounded by relatively large filiform papillae. The latter papillae surround one or sometimes two cabbage-shaped papillae (Fig.8).

The scanning electron microscopical study indicates that at the rostral part of the body region, the salivary glands lie lateral to the entoglossal bone (Figs. 9, 10). The glands are separated from the bone by bundles of skeletal muscle fibers (Fig. 11). At the caudal part of this region, the glands lie dorsolateral to the rostral basibranchial bone. The masses of the salivary glands appear

pyramidal in shape in cross section with its base directed ventromedially (Fig. 12).

The V shaped structure (Fig. 9) representing the caudolaterally directed paired cornua of the entoglossal bone lies within the texture of the body. The cornua terminate caudally at the level of the transverse row of the lingual papillae. These cornua are surrounded from the outside by oblique bundles of the skeletal muscle fibers which separate the bone from the adjacent salivary glands (Fig. 11). The rostral part of the entoglossal bone is represented by central cartilagenous plate which extends to the apex of the tongue.

The tongue of the turkey is covered generally with keratinized stratified squamous epithelium. The epithelium of the dorsal surface is thicker than that of the ventral surface, while the keratin layer is thinner (Fig. 13). The thickness of the epithelium of the dorsal surface decreases caudalwards, on the other hand it increases in the same direction in case of the ventral surface. The cells of the upper layers of the dorsal epithelium show acid fuchsin positive granules (Fig. 13).

At the beginning of the root region, the dorsal epithelium is developed into lingual papillae, which consist of highly keratinized stratified epithelium and supported by connective tissue core (Fig. 14). Rostral to the foregoing papillae a well developed cabbage-shaped papillae with distinct neck (Fig. 15) are demonstrated. Taste buds could not be observed in these papillae. In addition, numerous dorsocaudally directed filiform papillae are observed on the dorsal surface (Fig. 16).

The apex of the tongue is characterized by the presence of scanty dense irregular connective tissue between the dorsal and ventral surfaces. The muscles and glands could not be observed in this region (Fig. 13). The body contains numerous salivary glands (Fig. 16), which decrease in amount towards the root region. Bundles of striated muscle fibers are demonstrated in the root region (Fig. 17), which decrease in thickness towards the body region. Lymphoid nodules aggregate around the invaginations of the dorsal surface of the root to form lingual tonsils (Fig. 18).

The salivary glands are composed of masses of mucous compound tubular glands embedding in connective tissue and open in the dorsal and ventrolateral surfaces of the body and root of the

tongue (Figs. 19, 20). The secretory end pieces of the gland are lined by columnar sometimes pyramidal cells with flat and basally located nuclei (Fig. 20). The apical parts of their cytoplasm appear foamy and vacuolated. The cytoplasm gives positive reaction with PAS technique.

The connective tissue of the tongue is formed mainly of collagen fibers and elastic fibers. The latter fibers are distributed all over the connective tissue and increase at the ventral part of the tongue.

A central cartilagenous plate (Fig. 21) is observed in the caudal part of the apex. It is represented the rostral extension of the entoglossal bone. The rostral part rich in collagen fibers, in addition to some elastic fibers (Fig. 22). Before this plate continues caudally with the bony tissue, it changes into hyaline cartilage (Fig. 23).

DISCUSSION

Corresponding to Arnall and Keymer (1975) the tongue in birds have been adapted to probe, sieve, brush or rasp, they vary in shape and may be cylindrical, rectangular, spoon-shaped, left-shaped, flat, cupped, grooved, tubular, or forked. Petrak (1982) reported that the tongue in birds is narrow, pointed and protrusible. Sturkie (1976) mentioned that in birds in which the tongue adapted for manipulating food, it is non protrusible, short, thick, fleshy specially in the seed and nut eaters. The tongue in the examined turkey is triangular in shape with pointed free end similar to that recorded in chicken by Mclelland (1975). While the tongue in hawk is roughly spatula-shaped as stated by Abd Elmohdy (1993), and narrow in pigeon whereas broad and lancet-shaped in chicken as reported by Nickel *et al.* (1977), and may be split, fringed or tubular in flower-frequenting species as mentioned by Gardner (1926).

The present study indicates that the dorsal surface of the tongue contains a shallow median groove extending from the apex rostrally till the beginning of the root caudally. In this respect, Abdalla (1993) pointed up that this groove terminates in front of the transverse row of lingual papillae in chicken and pigeon, whereas in duck it reaches this row. But Mclelland (1975) mentioned that the groove presents on the rostral part of the dorsal surface of chicken and duck.

The frenulum linguae of the investigated turkey is represented by relatively long median fold of mucous membrane. similar finding is obtained by Mclelland (1975). This fold lies about 1.4 cm rostral to the angle of the mouth.

The present work shows that the dorsum of the tongue contains dorsocaudally directed slender filiform papillae. Small and large papillae can be observed, some papillae consist of basal and apical parts. The filiform papillae are observed in the body of the tongue, but in the tip and root of the tongue the filiform papillae could not be observed. Abdalla (1994) stated that the filiform papillae are distributed all over the dorsum of the free part of the tongue in chicken, but present only in the mid-line of this part in pigeon. These papillae impart the velvety appearance to the dorsal surface of the tongue as mentioned by Gartner and Hiatt (1997). Also, Banks (1993) clarified that the filiform papillae serve mechanical functions.

It is worthy to state that many cabbage-shaped papillae surrounded by filiform papillae are found in front of the root of the tongue in the investigated turkey. The taste buds could not be observed in these papillae, therefore it is suggested that they serve mechanical function. The cabbage-shaped papillae were not described in the available literature.

The present study indicates that the tip of the tongue in the turkey is hard, because the dorsal and ventral epithelium of this part undergoes a process of heavily keratinization. However, Susi (1969) observed the hard keratinization on the ventrolateral surfaces of the tongue, and King and Mclelland (1984) on the dorsum of the tip of the tongue of the fowl. Tucker (1964 c, 1966) described the keratinized epithelium only on the papillae and the rostral parts of the ventrolateral surfaces. According to Nickel *et al.* (1977) the heavily keratinization is observed on the dorsum of the tongue, however, the stratum corneum has only moderate thickness in the lower and lateral surfaces and at the base of the tongue.

In agreement to that recorded by Chodnick (1948); Calhoun (1954) and Hodges (1974) the salivary glands are compound tubular glands. The secretory end pieces of these glands are lined in the investigated turkey by columnar sometimes pyramidal cells. But they are lined by tall columnar cells as stated in fowl by Hodges (1974) and in hawk by Abd Elmohdy (1993). The present work shows that the cytoplasm of these cells gives positive reaction with

the PAS technique. This is due to that the organic constituent of the secretion of the salivary glands (saliva) is mainly amylase and glycoprotein (Smith *et al.*, 1988). The saliva facilitates the swallowing and deglutition (White, 1968; Andrews and Hickman, 1974).

The rostral part of the tongue in the turkey under investigation is free entirely from muscles. This result was also obtained by Nickel *et al.* (1977), but they added that the muscles of the extralingual system spread into the remaining parts of the tongue. In the examined turkey bundles of skeletal muscles are also observed in the body and root regions. In this concern, Hodges (1974) explained that the tongue itself is mobile organ but, because of the poorly developed intrinsic musculature anteriorly and the thick epidermal epithelium, it is comparatively rigid.

The root of the tongue in the present work is characterized by the presence of few grooves and some scale-shaped structures. Abdalla (1993) stated that this region is characterized by the presence of longitudinal folds separated by grooves in chicken and pigeon, and by numerous scale-shaped papillae in duck. In agreement with Telford and Bridgman (1995) the lymphoid nodules aggregate around the invaginations (crypts) of the dorsal mucous membrane of the root of the tongue. The previous authors clarified that the lingual tonsils are seldom infected because of the excellent flushing action of the underlying mucous glands.

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LEGENDS

- Fig. (1):** A photograph of the dorsal surface of the tongue. Apex (A), body (B), root (R), and a transverse row of lingual papillae (L).
- Fig. (2):** Scanning electronmicrograph of part of the transverse row of lingual papillae (X 15).
- Fig. (3):** Scanning electronmicrograph of the lingual papillae showing secondary scale-shaped papillae, (X 350).
- Fig. (4):** Scanning electronmicrograph of filiform papillae on the dorsal surface of the body of the tongue. (X 200).
- Fig. (5):** Scanning electronmicrograph of the filiform papillae showing the basal and apical parts of the papillae and the cup-shaped invagination. (X 2000).
- Fig. (6):** Scanning electronmicrograph of the tip of the tongue showing scale-shaped structure. (X 1000).
- Fig. (7):** Scanning electronmicrograph showing cabbage-shaped papillae arranged in rows. (X 75).
- Fig. (8):** Scanning electronmicrograph showing the filiform papillae surround one sometimes two cabbage-shaped papillae. (X 200).
- Fig. (9):** Scanning electronmicrograph showing the paired cornua of the entoglossal bone. Notice the salivary glands lie lateral to the bone. (X 15).
- Fig. (10):** Scanning electronmicrograph showing the salivary glands. (X 75).
- Fig. (11):** Scanning electronmicrograph showing bundles of skeletal muscles separate the entoglossal bone from the salivary glands. (X 200).
- Fig. (12):** Scanning electronmicrograph showing the salivary glands dorolateral to the rostral basibranchial bone (X 15).

- Fig. (13):** Longitudinal paraffin section in the apex of the tongue showing acid fuchsin positive granules in dorsal epithelium (arrows), thick keratin layer in ventral surface (two arrows). Masson's trichrome stain, X 100.
- Fig. (14):** Longitudinal paraffin section at the beginning of the root of the tongue showing the lingual papillae (two arrows). H & E. stain, X 100.
- Fig. (15):** Longitudinal paraffin section in front of the root of the tongue showing cabbage-shaped papillae (arrow). Masson's trichrome stain, X 40.
- Fig. (16):** Longitudinal paraffin section in the body of the tongue showing dorsal surface (d), ventral surface (n), lingual glands (u) and spongy bone (s). H & E. stain, X 100.
- Fig. (17):** Longitudinal paraffin section in the root of the tongue showing lingual glands (u), skeletal muscles (m) and adipose tissue (arrow). H & E. stain, X 100.
- Fig. (18):** Longitudinal paraffin section in the root of the tongue showing lingual tonsils around the invagination of the dorsal surface (arrow). H & E. stain, X 100.
- Fig. (19):** Longitudinal paraffin section in the body of the tongue showing salivary glands (arrow) open in the dorsal surface (d) by a duct (two arrows). PAS-H stain, X 100.
- Fig. (20):** Paraffin section in the root of the tongue showing end pieces of salivary glands and their lining epithelium. H & E stain, X 400.
- Fig. (21):** Cross paraffin section in the apex of the tongue showing central cartilagenous plate (c). Masson's trichrome stain, X 40.
- Fig. (22):** Longitudinal paraffin section in the apex of the tongue showing cartilagenous plate contained chondrocyte (two arrows) collagen fibers, and elastic fibers (arrow). Verhoef's elastic stain, X 400.
- Fig. (23):** Longitudinal paraffin section in the body of the tongue showing hyaline cartilage (h), spongy bone (s) and skeletal muscle (m). Verhoef's elastic stain, X 100.









