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Anatomical Study of the Trachea In Indigenous Male Turkey (*Meleagris gallopava*)

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Abstract

The present study was used five healthy male turkeys (*Meleagris gallopava*) at the first year of their age (4715 ± 43.3 gm) was the mean live weight, collected from the center of Diwanyia city for making use in the study of the respiratory physiology, histopathology, the respiratory diseases diagnoses, surgery and anaesthesia.. After well bleeding the trachea identified then the shape, position, dimensions of each specimen were recorded. The trachea appeared as empty cartilaginous tube confined between cricoid cartilage of the larynx (rostrally) and the first tracheosyringeal cartilage (caudally), and composed of overlapping complete circular cartilages, each ring contained broad and narrow parts. There were two paired of skeletal muscles associated with the trachea (Sternotrachealis and Trachiolateralis muscles).

Introduction

The respiratory system of avian is more complex than that in the mammalian counterpart, and described as non-tidal (1; 2; and 3).The trachea in birds appears as cylindrical tube-like flexible cartilaginous structure with an empty interior arranged in loops or coils so that the length of the trachea is much longer than the length of the neck and variable dimension in deferent bird species (4; 5; 6;and 7). In *Anatidae* (ducks, swans and their allies), black swan (*Cygnus atratus),* whooping crane (*Grus americana*), trumpet bird (*Phonygammus keraudrenii),* and birds of Paradise, tracheal length up to four times than that of comparably sized birds, the redundant loops or coils lie in an excavations of the sternum or thorax (1; 8; and 9). Whereas in a passerine species (*Manucodia keraudrenii), Platalea, Anseranae, Crax,* and *Aramus)* the trachea coils lie in the space between the skin and the outer chest walls, allowing it to undergo unrestricted elongation to an extreme not seen in any other species (10).In *Sphenisciforms* (some penguins) and petrels (*Procellariidae*), the trachea is fragmented into left and right channels by a median septum contain cartilaginous bars. In Casuarius species this septum is incomplete, whereas in males of many *Anseriform* species there is tracheal bulb that occurs a short distance rostral to the syrinx, but in *(Melaritta fusca*) just caudal to the larynx there is second tracheal bulb (11).The trachea in birds lies in the midline ventral to the esophagus and extends from the cricoid cartilage of larynx to the tympanum of the syrinx. It passes from the right side of the neck ventral to the esophagus and ventro-lateral to the cervical vertebrae as it extends caudally, therefore, most of the trachea lies on the right side of the neck and can easily be palpated in the live bird. As it approaches the thoracic inlet returns to the midline-ventral position, the crop being on its right side, entered the thoracic cavity between the two arms of furculae and underwent a modification at the cranial of heart's basis in the form of the syrinx. There is no demarcation line between the trachea and the syrinx therefore decided to incorporate under the heading of 'trachea series', all the complete rings as far caudally as the tracheal bifurcation including the three or four tracheal syringeal cartilages which form the tympanum, after syrinx, the trachea bifurcate into two parts, left and right primary bronchi, which enters the hilus of the lung on the septal surface (1; 12; 5; 14; and 15).Tracheal rings in most birds consists of complete hyaline cartilaginous rings (O-shaped), but occasionally incomplete rings

are encountered and in other cases a partial bifurcation of a ring was observed its commonly ossified held together by narrow membranous ligaments. (16; 4; 17; 2; 18; 19; and 20). In Chicken, Turkey, and Goose tracheal rings consist of broad and narrow parts, the broad part of one cartilage ring overlaps the narrow parts of two adjacent rings. The craniocaudal diameter of the rings progressively increase throughout the cranial third of the trachea and then progressively decrease throughout the caudal third of the trachea. The rings in the cranial third of the trachea are transversely oval while the rest of the trachea is circular, the most caudal few millimeters where they become vertically oval (21; 22; and 9). In West african guinea fowl cartilaginous rings of trachea are irregular sizes and each of the larger rings bifurcates at the ventral aspect into two small rings (15); whereas, in Long-legged buzzard the tracheal rings are narrowed dorsally and ventrally (14); while in Murres (*Uria aalge*) tracheal rings are notched dorsally and ventrally, and successive rings partly overlapped (6)The number of the tracheal rings differs according to the length of the neck of the birds and ranges from about 30 in small passerines to about 350 in long neck Flamingos and Cranes (20; 14; and 15).In Chicken there are three pairs of the tracheal muscles associated with the caudal end of the trachea:-

1-Sternotrachealis muscles (*Sternolaryngeus*) are extend from the costal process of the sternum (craniolateral process) to the caudal rings of trachea to contribute to ascends the caudal part of the trachea.

2- Tracheolaryngeodorsalis muscles are arise on dorsolateral aspect of the trachea.

3- Tracheolaryngeoventralis muscles are arise on ventrolatral aspect of the trachea.

4- Composite median muscle (Sternotracheolaryngus medial muscle) forms by fused all preceding three tracheal muscles at twenty-fifth ring cranial to the syrinx, rostral in direction, near the larynx divided into left and right parts which attached with the body of cricoid laryngeal cartilage. It is constitute the (caudomedial extrinsic muscle of the larynx) (21; and 6).In the Chicken, Pigeons, Duck (*Anser anser*) and Scaup *(Aythyamarila)* the Tracheolaryngeoventralis and Tracheolaryngeodorsalis considered as Tracheolateralis muscle. In addition, another muscle is called Cliedohyoid muscle which is a pair, right and left, they extend from the symphysis of the furculae to cranial of the larynx or hyoid bone. It is attached to the trachea by loose fascia and they act to pull the trachea caudally (11; and 23).In Pigeon, the left sternotrachealis muscle crosses over the trachea and fuses with the right part, and the tracheolateral muscle attach to the lateral tympaniform membrane of the syrinx (22).Whereas in Ring doves (*Streptopelia risoria*) tracheal muscle are composed of tracheolateral and sternotracheal muscles only (24), in the Brown thrashers *(Toxostoma rufum)* tracheal muscles are composed of tracheolateral dorsalis, tracheolateralis, sternotrachealis, and tracheobronchialis ventralis (25).In birds like Long-legged buzzard, tracheal muscles are composed of pairs of the sternotrachealis muscles, which start from the craniolateral process of the sternum and connect between the 26th and 30th tracheal ring cranial to the syrinx. Trachiolateralis muscle extends from the caudolateral aspect of the body of the cricoid cartilage to the first bronchial cartilage of the syrinx (bronchiosyringeal cartilages) (11; and 14).

Materials and methods

Specimens were prepared by bleeding of birds with the cutting of the major neck blood vessels after making a skin incision in the neck and separation of trachea away from the site of cutting to avoid aspiration of blood and spoiling of the respiratory system.Each specimens of trachea observed immediately after prepared, described the position in situ and shape registered, then carefully removed, fine dissections immediately, divided into two parts (proximal parts extend from the cricoid cartilage of the larynx to the thoracic inlet and distal part extend from the thoracic inlet to the first tracheosyringeal cartilage), and by using the subsequently instruments (high sensitive electrical balance*, vernier, ruler, amplifier lens (X12, X6), registered the following data:

3- Weights of proximal trachea, distal trachea, and total trachea.

4- Length and number of the tracheal rings of proximal trachea, distal trachea, and total trachea.

5- Thickness, and diameter of proximal, and distal tracheal rings.

And for purposes of photography use Sony W230 digital camera 12.1 Mega pixels and colored of tracheal rings by used watery paints.

Results

The trachea appeared as empty cartilaginous pipe, it was long comparably the neck. The mean total length was (26 ± 1.23 cm). It restricted between the caudal border of cricoid cartilage of the larynx (rostrally) and the first tracheosyringeal cartilage (caudally) (Fig.1). The proximal part (palpable part). It was situated in the midline ventrally to the esophagus, inclined to the right side in the middle of the neck, and closed to thoracic inlet regressed to first position (Fig. 2). The mean length and ratio of weight of the proximal trachea to the weight of life birds were (21 ± 0.92 cm) and (0.206 %) respectively.The distal part of the trachea (non palpable part) located ventral to the esophagus, the mean length and ratio of weight of the distal trachea to the weight of life birds were (5 ± 0.71 cm) and (0.03 %) respectively.Tracheal cartilages were composed of overlapping complete circular cartilages linked together by annular ligaments, each ring contained broad and narrow parts (broad part overlapped on narrow parts of two adjacent rings) (Fig. 3). These features of overlapping disappeared in the last some millimeters of the distal trachea as, none overlapping, and thick circular rings (Fig. 4). The mean number of tracheal rings in the proximal part, and in the distal part were (126 ± 6) and (25 ± 6) respectively.The tracheal rings in proximal part appeared as transverse oval rings, the mean diameter (1.01 ± 0.03 cm), whereas in the distal part was vertical oval rings, the mean diameter (0.73 ± 0.05 cm), and the mean thickness of the proximal and distal tracheal rings were (0.05 ± 0.00 cm).Near the base of heart the trachea modification to (syrinx) and then divided to two primary bronchi (Fig. 4). There were two muscles associated with the trachea:

1- Sternotrachealis muscle (sternotracheolaryngeus muscles):-

Paired large skeletal muscles good obvious, craniomedial in orientation, arose from the craniolateral process of the sternum, and firmly attached with the trachea at, the tenth ring of the distal part, and the mean distance (2.5 ± 0.1 cm) cranial to the pessulus cartilage of the syrinx (Fig. 4) then, it runs cranially and firmly attached with the lateral aspect of the trachea and inserted on the lateral aspect of the larynx, it acted as the main origin of caudolateral and caudomedial extrinsic muscles of the larynx.

2- Trachiolateralis muscles:- Paired small skeletal muscles little obvious, transparent, arose from the lateral aspect of the trachea at the 24th rings of distal part, and the mean

distance (4.2 ± 0.2 cm) cranial to the pessulus cartilage of the syrinx (Fig. 4), then, it runs cranially and loosely attached with the trachea, it was ending at the lateral aspect of the cricoid body of the larynx.

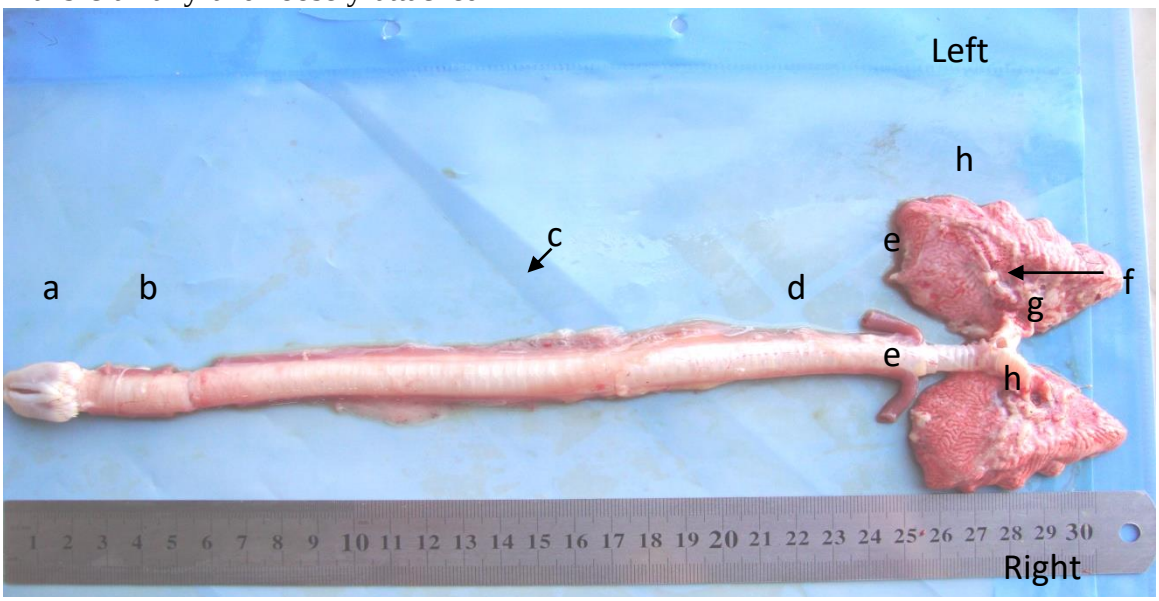

Fig. (1): Dorsal view of the major respiratory organs of male Turkey showing: larynx (a), proximal trachea (b), trachealateralis muscle (c), distal trachea (d), sternotrachealis muscles (e), syrinx (f), extrapulmonary primary bronchus (g), lung (h).

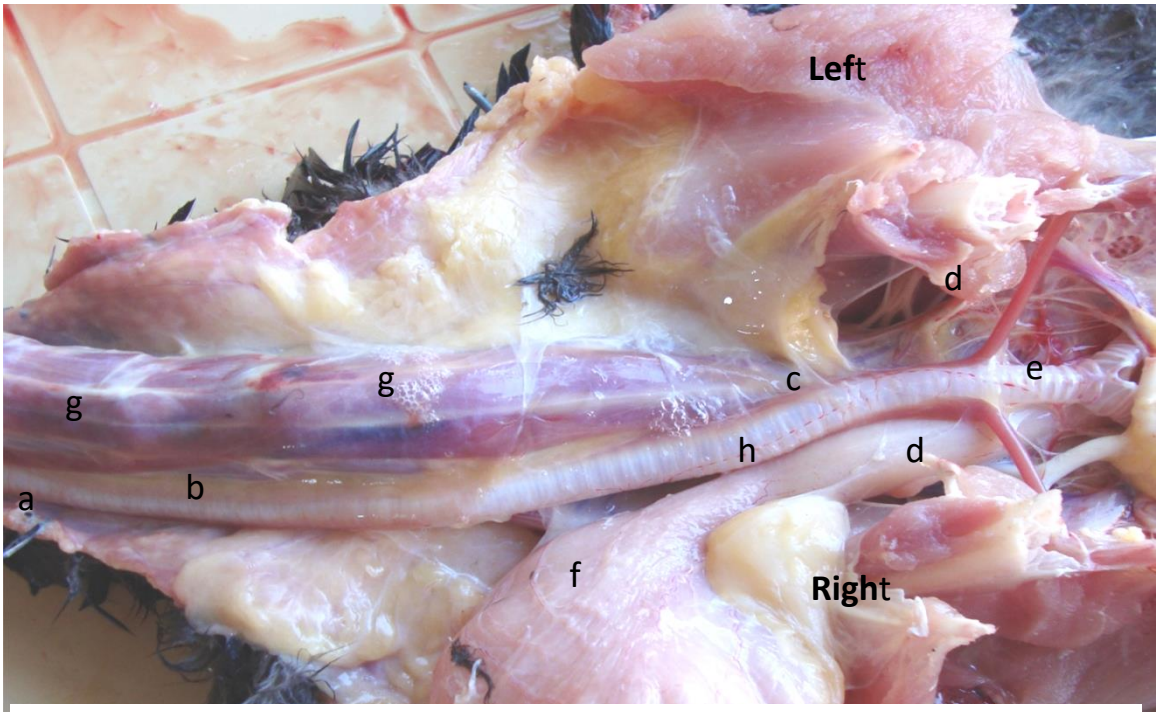

Fig (2): Ventral view of the neck and thoracic inlet of the male turkey demonstrating: the trachea and syrinx insitue: proximal trachea (a), tracheaolateralis muscle (b), distal trachea (c), Sternotrachealis muscle (d), syrinx (e), crop (f), esophagus (g), cervical vertebrae (h).

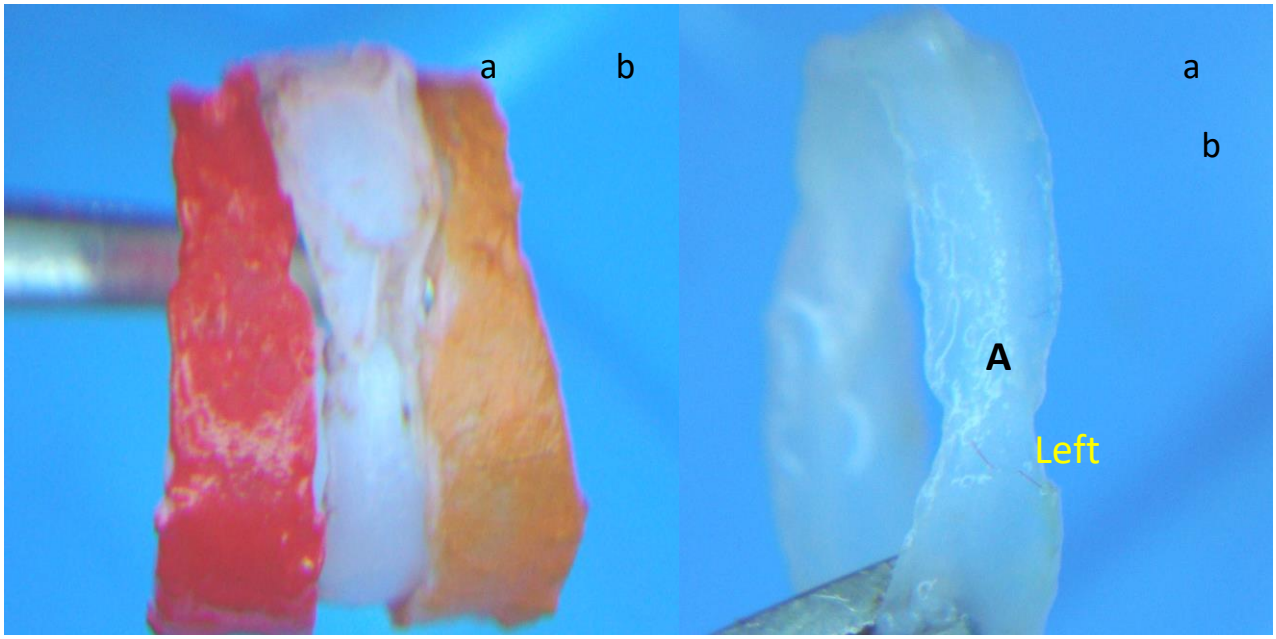

Fig. (3): Magnified tracheal rings of the male Turkey (lateral (A), and arrangement (B) view) showing: broad part of the tracheal ring (a), overlapped on the two narrow parts (b), of adjacent tracheal rings. **(X 24 A, B)**

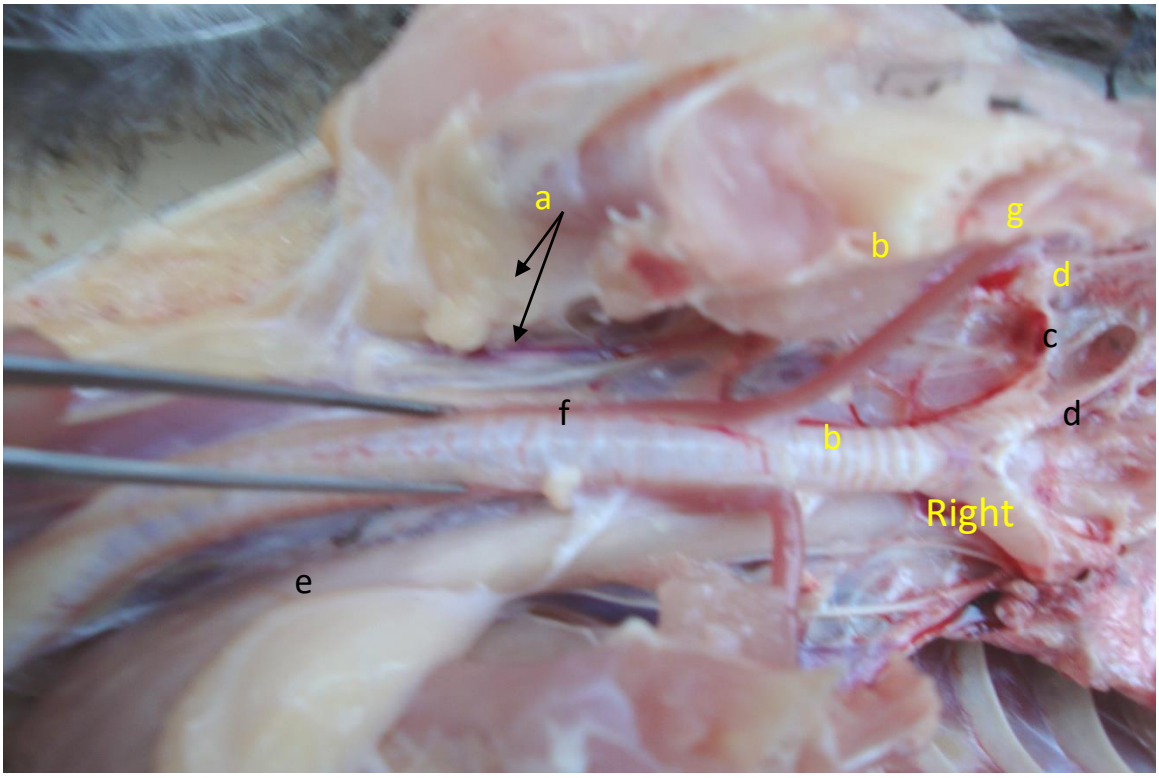

Fig. (4): Ventral view of thoracic cavity of male turkey demonstrating the tracheal muscles: the origin of the tracheolateralis muscles (a), sternotrachealis muscle attachment with the distal part of trachea (b) syrinx (c) extrapulmonary primary bronchi (d), crop (e), esophagus (f), hilus of lung (g).

Discussion

The present anatomical outcomes of the trachea exposed that this respiratory part came into sight as cartilaginous empty pipe structure; it was long comparably with the neck. These consequences coordinated with previous studies offered by (21; 20; 22; 10; 15; and 26) in birds generally, but uncoincided with, (22); (11); (1); and (8) in *Anatidae* (ducks, swans and their allies), Cygnus, Gruids, American species of cranes, and birds of paradise, (10) in a passerine species (*Manucodia keraudrenii*), Platalea, Anseranae, Crax, and Aramus, and (11) in Sphenisciforms (some penguins) and petrels (*Procellariidae*), Casuarius species, males of many Anseriform species, in *Melaritta fusca*. The mean length of the total trachea and distal part of trachea was (26 ± 1.23 cm) and (5 ± 0.71 cm) respectively. These results corresponding to (15) who said the mean total length of trachea was (26.363 ± 0.383 cm) in West African guinea fowl. But uncorresponding with him in the same species the mean length of the distal part of trachea was (3.26 ± 0.27 cm), also disagree with (27) who said the tracheal measures in budgerigars (*Melopsittacus undulates*) approximately (5 cm) from the glottis to the bottom of the syrinx, (28) noted the total length of the trachea in ostriches was (78 cm). Sounds produced in the avian vocal organ (syrinx) may be modified by filter properties of the upper vocal tract. Filter characteristics include movements of the beak, tongue, and larynx and adjustments of tracheal length (29; 30; 8; 31; and 23) these clarification supported by the recent study of (32) who said the length changes of the trachea were a probably mechanism for altering upper vocal tract filter properties during song. Tracheal shortening occurred at the onset of song bouts, and during each motif the tracheal length decreased during expiratory pressure pulses and increased during the short inspirations in the zebra finch (*Taeniopygia guttata*). But (27) said the tracheal resonances, in budgerigars, don't have a slight effect but don't normally play a very large role in determining the spectral content of contact call.The mean diameter of proximal tracheal rings was (1.01 ± 0.03 cm). This result disagreement with (15) who said that the mean diameter of proximal tracheal rings was (0.0875 ± 0.0031 cm) in West African guinea fowl and (28 who said the diameter of the trachea in ostriches was (2 cm). Tracheal cartilages composed of overlapping complete circler cartilages, each rings contain broad and narrow parts these consequences coordinated with previous studies (21); (22); (11); (1); (4); (14); and (19) in most birds, and disagreement with, (20) in domestic fowl, (15) in west african guinea fowl, and (14) in long-legged buzzard.The mean total number of the tracheal rings were (151 ± 12) this result under range (21); (20); (14); and (15) who said the number of the tracheal rings ranges from about 30 in small passerines to about 350 in long neck flamingos and cranes.The complete circle of the tracheal rings and its bony stature important in prevention the tracheal collapse. This explanation supported by recent study of (19) who assumed that these trachea was made up of cartilaginous rings that prevent its collapse from the negative pressure caused by inspiration of air.There were two tracheal muscles associated with the caudal part of the trachea caudally and cricoid laryngeal cartilage cranially (sternotrachealis and trachiolateralis muscles) these consequence harmonized with (22); (11); (24); and (14) in pigeon, ring doves, long-legged buzzard, and inconsistence, (21) in chicken, (22); (11); and (23) who showed there were another tracheal muscles called (Cliedohyoid muscle), and (33) who said tracheal muscles were composed of tracheolateral dorsalis, tracheolateralis, sternotrachealis, and tracheobronchialis ventralis in the brown thrashers These

features of tracheal (complete rings, easily moved overlapping rings, length, and strong tracheal muscles) can be attributed to its responsibility for some characteristic adaptation of sounds and assist in mucus secretion movement toward the larynx (22); (11); (1); (8); and (30). And the sternotrachealis muscles were thought to adjust, the length of the trachea during inspiration and/or expiration and control rigidity of the cartilages of the vocal organ (syrinx) during phonation these muscles are heavier in males than females (34).

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الخلاصة

استخدم في الدراسة الحالية خمس من الديك الرومي (*Meleagris gallopava*) سليمة بعمر سنة واحدة ومتوسط وزن جمعت من مركز مدينة الديوانية (4715 ± 43.3 gm). للاستفادة منها في دراسة فسلجة التنفس والأمراض النسجية والتشخيص المبكر للأمراض التنفسية وفي الجراحة والتخدير بعد النزف الكامل شخص ألرغامي ثم سجل شكله وموقعه وقياساته. أظهرت النتائج أن ألرغامي ظهر بهيئة أنبوب مجوف يقع بين الغضروف الحنجري الحلقي أماميا و الغضروف ألرغامي الأول لعضو التغريد خلفيا و مكون من حلقات غضروفية كاملة متداخلة كل حلقة تحتوي على جزئ عريض وجزئ ضيق ، وهنالك وزوجين من العضلات الهيكلية (القصية ألرغامية و ألرغامية الوحشية) ذات العلاقة المباشرة مع ألرغامي.