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RESEARCH ARTICLE

The Gross Anatomy of Larynx, Trachae and Syrinx in Goose *(Anser anser domesticus)* [1]

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Summary

In this study, larynx, trachea and syrinx of eight domestic mature geese *(Anser anser domesticus*) weighing 4500-5000g were examined. The larynx was formed by single cartilago (cart.) cricoidea and cart. procricoidea, and a paired cart. arytenoidea. Cartilagines trachea numbered 137-140 and variations in their diameters were detected along their courses. The cartilage rings localized near the middle of the trachea were in contact with the previous or following rings and formed "H" letter shape. Some rings were dorsally and some were ventrally forked. The syrinx was tracheobronchial type and formed by cartilagines (cartt.) tracheosyringeales and cartt. bronchosyringeales. Cartilagines tracheosyringeales were tube shaped and fused in both directions. Rings were completely ossified except the first two. Cartilagines bronchosyringeales were made up of six 'C' shaped cartilage rings. The open medial faces of the last four cartt. bronchosyringeales came closer to each other and facing left and right parts were tightly attached to each other by connective tissue smooth muscle. The membrane tympaniformes lateralis and medialis were observed. The membrane tympaniformes lateralis was between the tympanum and the first cart. bronchosyringealis, and the membrane tympaniformes medialis was between the pessulus and the second cart. bronchosyringealis. In conclusion, the cartilage rings in middle parts of trachea which seem to be "H"-shaped forked and also the tympanum which is completely fused and ossified characteristic for the goose.

Keywords: *Goose, Larynx, Morphology, Syrinx, Trachea*

Kazda *(Anser anser domesticus)* Larynx, Trachae and Syrinx'in Makroskobik Anatomisi

Özet

Bu çalışmada 4000-5000 g ağırlığında 8 adet evcil olgun kaz *(Anser anser domesticus)*'a ait larynx, trachea ve syrinx incelendi. Larynx'in tek olan cartilago (cart.) cricoidea, cart. procricoidea ve çift olan cart. arytenoidea'dan oluştuğu belirlendi. Seyri boyunca çaplarında değişiklik görünen trachea halkalarının sayısı 137-140 arasındaydı. Trachea'nın orta bölgesinde yer alan halkalar bir önceki ya da sonraki halka ile temas ederek ''H'' harfine benzer bir şekil almaktaydı. Bazı halkalar dorsal'de bazıları ise ventral'de iki'ye çatallanmaktaydı. Cartilagines tracheosyringeales ve cartt. bronchosyringeales'den meydana gelen syrinx'in tracheobronchial tip olduğu belirlendi. Tracheosyringeal kıkırdaklar birbirleriyle kaynaşmış tüp şeklindeydi. İlk ikisi hariç halkaların tamamı kemikleşmişti. Cartilagines bronchosyringeales altı adet 'C' şeklindeki kıkırdak halkalardan meydana gelmişti. Son dört cartt. bronchosyringeales'in açık olan median yüzlerinin birbirlerine, içerisinde düz kas hücreleri bulunduran bir bağ doku ile sıkıca bağlanmaktaydı. Membrana tympaniformis lateralis ve membrana tympaniformis medialis'in varlığı gözlendi. Membrana tympaniformis lateralis tympanum ve birinci cart. bronchosyringealis arasında, membrana tympaniformis medialis ise pessulus ve ikinci cart. bronchosyringealis arasındaydı. Sonuç olarak, trachea'nın orta bölgesinde yer alan kıkırdakların ''H'' harfine benzer çatallanması ve aynı zamanda tympanum'un tamamen kaynaşıp kemikleşmesi kaz için karakteristikti.

Anahtar sözcükler: *Kaz, Larynx, Morfoloji, Syrinx, Trachea*

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INTRODUCTION

Major functions of the avian respiratory system are oxygen and carbon dioxide exchange, balance of body temperature and contribution to sound production. Air inspired during respiration passes from the nasal cavity to the larynx and continues via the trachea and enters the syrinx and bronchi [1-4]. In avian species, the laryngeal skeleton is composed of four partially ossified cartilages: cart. cricoidea, cart. procricoidea and paired cart. arytenoidea [3,5-7]. Movements of larynx are carried out by its intrinsic dilatator and constrictor muscles of glottis [3,5,8]. The trachea follows the larynx and is made up of the tracheal cartilage ring [7,9], which, unlike those of mammals, possess m. tracheales and lig. anulare [10-12]. In birds, the number of cartilage rings in the trachea varies due to the length of the neck. The trachea is usually made up of 108-126 cartilages [2,3,13,14].

Some birds vocalize all year long while others call only during the mating season or during migration [15]. The syrinx is the sound producing organ in birds [2,4,15-17]. Last portion of trachea or beginning of bronchus, or both (especially in domestic chicken) participate in the formation of the syrinx [16-21]. Thus, the syrinx is classified as tracheobronchial, bronchial and tracheal [2,7,8,15]. Two membranes in the syrinx, the membrane tympaniformes lateralis and medialis, produce sound [2,22,23]. These membranes are activated by the intrinsic and extrinsic muscles [22]. Birds that vocalize possess both the intrinsic and extrinsic syringeal muscles. There is much variation among species [21,24-28] the vast majority of nonsinging birds possess m. sternotrachealis and m. tracheolateralis which are extrinsic syringeal muscles [5,8] .

Larynx, trachea and syrinx have been morphologically and physiologically studied in numerous species [5,14,23,29-31]. The role of these structures in vocalization [32] and neuro-musculer control of voice and function of syringeal muscles [22] have been investigated. Sexual dimorphism was observed in mallards and the differences for it were investigated in detail [19].

To date, the anatomical structure of goose has not been described in detail, so that the determination of the structure of the larynx, trachea and syrinx in goose are the aims of the present study.

MATERIAL and METHODS

The larynx, trachea and syrinx of 4 males and 4 females domestic mature geese weighing 4500-5000 g were examined. Birds were killed by the intramuscular injection of a combination of diazepam (Diazem-Deva) (2-4 mg/kg) and ketamine HCl (Alfamine-Alsafan International, Holland) (20-60 mg/kg) [33]. The guideline of the ethical committee of Ondokuz Mayıs University was strictly followed during the procedure.

Dissections were performed using an Olympus SZ61 TRC stereomicroscope and photographs were taken with Olympus C-5060 digital camera. The larynx, trachea and syrinx of the eight birds were fixed in 10% formalin for anatomical examination.

Larynx, trachea and syrinx of 5 geese were left in 70% alcohol for two hours and then in 1% methylene blue solution prepared with distilled water for 15 min for the cartilages to become more evident. At the end of this time, tissues were left in 50% and 70% alcohol for an hour, respectively. The tissue of the remaining three geese was prepared for paraffin histology using established procedures. Six-µm transverse sections were stained with Crossmon's trichrome [34]. In addition, alpha smooth muscle actin (Labvision neomarkers, Fremont, CA, USA) was demonstrated by immunohistochemical methods.

Nomina Anatomica Avium [8] was used for nomenclature.

RESULTS

The larynx, trachea and syrinx were examined in detail and differences among closely related species as well as macro anatomic structures only peculiar to goose were noted.

Larynx

A protuberance called the mons laryngealis *(Fig. 1A)* was visible at the caudal side of the larynx when base of pharynx was inspected in the oral cavity. The mons laryngealis was divided in half by the sulcus laryngealis *(Fig. 1A),* approximately 9.05±0.58 mm long. In the sulcus laryngealis, 4-5 papilla rows extending in cranio-caudal direction were determined. There were cone shaped papillae *(Fig. 1A)* with tips facing the caudal direction in each half of the mons laryngealis. These were not in systematic rows as in the sulcus laryngealis, but were localised randomly and their numbers varied approximately between 25 and 28.

The glottis *(Fig. 1A),* which was the entrance of the larynx, was split, and circumscribed by the cart. arytenoidea *(Fig. 1B)* from both sides in the cranio-caudal direction. There were 6-7 rows of papillae on each side of the glottis, which was approximately 15.32±2.04 mm long and was 3.07±0.05 mm wide at the median part *(Fig. 1A).*

The cartt. laryngeales were formed by paired cart.

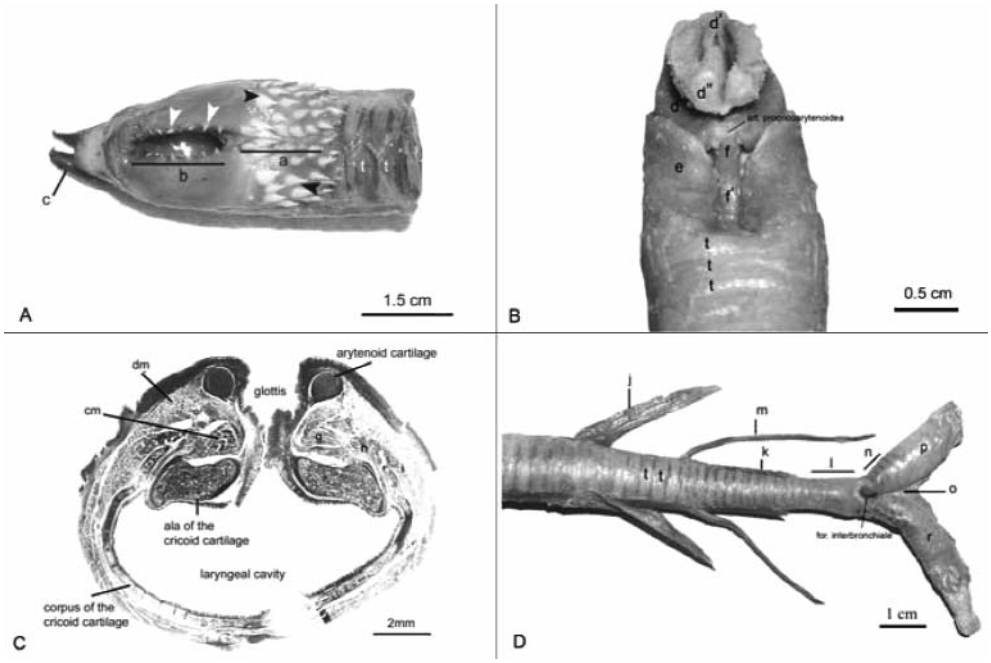

Fig 1. Dorsal view of the mons laryngealis **(A)** and the larynx cartilages **(B),** Transversal cross-section of the larynx **(C),** Ventral view of trachea and syrinx **(D). a:** sulcus laryngealis. **b:** glottis. **c:** m. cricohyoideus. **d:** corpus of arytenoid cartilage **d':** rostral process of arytenoid cartilage. **d":** caudal process of arytenoid cartilage. **e:** corpus of cricoid cartilage. **f:** caput of procricoid cartilage. **f':** corpus of procricoid cartilage. **dm:** dilatator muscle of glottis. **cm:** constrictor muscle of glottis. **cm-g:** lateral portion. **cm-h:** middle portion. **cm-i:** medial portion. **j:** m. cleidotrachealis **k:** m.tracheolateralis. **l:** tympanum. **m:** m. sternotrachealis. **n:** cartt. bronchosyringeales. **o:** lig. interbronchiale **p:** right primary bronchi. **r:** left primary bronchi. **t:** tracheal cartilage. Black arrow head: irregular papillae row. White arrow head: papillae row around the glottis

Şekil 1. Mons laryngealis **(A)** ve Larynx kıkırdaklarının **(B)** dorsal görünümü, Larynx'in transversal kesiti **(C),** Trachea ve syrinx'in ventral görünümü **(D). a:** sulcus laryngealis. **b:** glottis. **c:** m. cricohyoideus. **d:** arytenoid kıkırdağın corpus'u **d':** arytenoid kıkırdağın proc. rostralis'i. **d":** arytenoid kıkırdağın proc. caudalis'i. **e:** cricoid kıkırdağın corpus'u. **f:** procricoid kıkırdağın caput'u. **f':** procricoid kıkırdağın corpus'u. **dm:** m.dilatator glottis. **cm:** m. constrictor glottis. **cm-g:** lateral kısım. **cm-h:** orta kısım. **cm-i:** medial kısım. **j:** m. cleidotrachealis **k:** m.tracheolateralis. **l:** tympanum. **m:** m. sternotrachealis. **n:** cartt. bronchosyringeales. **o:** lig. interbronchiale **p:** sağ primer bronchi. **r:** sol primer bronchi. **t:** tracheal kıkırdak. Siyah ok başı: düzensiz papilla sırası. Beyaz ok başı: glottis'in etrafındaki papilla sırası

arytenoidea, single cart. cricoidea and cart. procricoidea as shown in *Fig. 1B*. The largest cartilage of the larynx was cricoide which forms the entire ventral and caudo-dorsal roof of the larynx and was ossified in the mature goose *(Fig. 1C)*. The cart. cricoidea was approximately 17.22±0.23 mm long, 6.24±0.02 mm wide cranially and 11.38±0.32 mm wide caudally and forms thin and flat dorsal cart. cricoidea by curling toward the dorsal direction. The cart. procricoidea was the smallest cartilage of the larynx and was hammer shaped. The cart. procricoidea and the cart. arytenoidea which the glottis formed delimit the art. procricoarytenoidea and had a convex articular surface *(Fig. 1B)*. In adults, the cart. procricoidea was completely ossified. The dorso-ventral length of the cartilage was approximately 6.22±0.02 mm, rostral width 1.83±0.03 mm and caudal width 1.63±0.02 mm. Each half of the paired cart. arytenoidea possessed a corpus, proc.rostralis and proc. caudalis. In adults, only the corpus of the cart. arytenoidea was ossified. Intrinsic dilator *(Fig. 1C)* and consrictor muscles of the glottis *(Fig. 1C)* lied between the cart. cricoidea and cart. arytenoidea. The dilator muscle of the glottis lied just under the larynx mucosa and gives a puffy appearance to the mons laryngeales. The origin of the dilator muscle of the glottis was on the lateral side of the corpus of the cart. cricoidea and the dilator muscle connected to the lateral side of the proc. caudalis of the cart. arytenoidea.

The constrictor muscle of the glottis exiting in the ventral of dilator muscle of the glottis was made up of lateral *(Fig. 1C)*, middle *(Fig. 1C)* and medial *(Fig. 1C)* parts according to the course of muscle fibers. The lateral, middle and medial part of the constrictor muscle connected to the corpus of the cart. cricoidea, to the wings of the cart. cricoidea, and to the corpus and proc. caudalis of the cart. arytenoidea, respectively.

The larynx had three pairs of extrinsic muscles; m. cricohyoideus *(Fig. 1A),* m. cleidotrachealis and m. tracheolateralis *(Fig. 1D).* From these muscles, m. cricohyoideus originated on the hyoid bone and connected to the ventral portion of cart. cricoidea as two muscle bands coursing on the right and left sides.

Trachea

The trachea was formed by cartilage rings starting at the caudal margin of the larynx. The trachea was observed in the ventro-medial ingluves and enters the thoracic cavity. Its final cartt. tracheales constituted a tube the tympanum *(Fig. 1D)* before seperating to two main bronchi. There were 137-140 cartt. tracheales in the trachea. The rings in the anterior half of trachea could nest into each other in dorsal and ventral directions. In particular, laterally the cartilage rings in middle of trachea contacted the previous or following rings and were "H"-shaped *(Fig. 2A).* Some rings were dorsally and some rings were ventrally forked *(Fig. 2A).*

Up to the 90-95th trachea ring, the approximate dorso-ventral (dv) and latero-medial (lm) diameters were 7.1±0.38 mm, and was 8.5±0.15 mm, respectively. While the diameter of trachea widened from these rings (dv: 8.4±0.4 mm, lm: 10.88±0.51 mm), after 117-118th rings the diameter of trachea narrows (dv: 6.95±0.28 mm, lm: 7.79±0.32 mm).

The m. sternotrachealis *(Fig. 2),* m.cleidotrachealis and m. tracheolateralis allowed movement of the trachea. The m. sternotrachealis was a very narrow, thin structure, approximately 2.21±0.03 mm wide. It originated on the sternum and connected with fibers of the m. tracheolateralis on the ventral side of 120th tracheal ring. The m. tracheolateralis coursed laterally along both sides of trachea and was approximately 4.28±0.07 mm wide. Its origin was the cart. cricoidea of the larynx and it ends with a narrow tendon at both sides at the beginning of the tympanum. The m. cleidotrachealis was approximately 4.20±0.05 mm wide. It originated on the clavicula and attached to the right and left lateral faces of the 110th ring at the ventral aspect of the trachea, where it connected to the ventral side of the cart. cricoidea and with m.tracheolateralis, cranially. During the course of these two muscles, they united at the beginning of trachea right and left, and completely closed the ventral side of the trachea. The mentioned muscles of trachea were extrinsic muscles of the syrinx and, supply the movement of the syrinx.

Syrinx

The syrinx, at the base of the heart, was located between the last portion of the trachea and the first part of the left and right primary bronchi and was of the tracheobranchial type. In the goose it was composed of the cartt. tracheosyringeales and the cartt. bronchosyringeales *(Fig. 2B).* The first two rings of cartt. tracheosyringeales form a circle and their borders were clear. However, the rest of the cart.tracheosyringealis completely fused and ossified for forming the tympanum. The tympanum was approximately 10.77±0.06 mm long. It had right and left processed at the dorsal and ventral aspects of caudal and with these processed, the membrana tympaniformes lateralis *(Fig. 2B)* were attached to the caudo-lateral aspect of the tympanum. The dorsal and ventral ends of the pessulus, located at the caudo-medial of the tympanum form a column in lateral view, were widened and connected to the right and left process at the caudal end of the tympanum. Dorso-ventral length of the pessulus was approximately 9.66±0.05 mm, width at the middle was 1.88±0.12 mm, width at the ventral connection point was 4.64±0.13 mm and dorsal width was 6.77±0.15 mm. The cartt. bronchosyringeales were formed from six pairs of 'C' shaped components contributing to the syrinx skeleton. Except for the first two bronchial half rings, the cartilaginous ended of the last four 'C' shaped rings lie very close to one another. Connective tissue tightly joined the bronchial rings, the tips of which approach each other medially *(Fig. 2C).* This connective tissue included collagen fibers in the regions near the cartilages and adipose tissue in the median portion. Few smooth muscle cells were observed between adipose tissue and collagen fibers *(Fig. 2D).* The foramen (for.) interbronchiale was limited by the pessulus cranially, the membrane tympaniformes medialis laterally and connective tissue caudally *(Fig. 2C).* In the species used in this study, a rudimentary cartilage *(Fig. 2C)* at the cranial aspect of the first right ring was observed.

A paired membrana tympaniformes, to the lateral tympanum, was located between the convexity of tympanum's caudo-lateral wall and the first ring of the cartt. bronchosyringeales. This membrane attached to the caudal process of dorsal and ventral tympanum. In addition, the membrane tympaniformes medialis, the second membrane of syrinx, connected the pessulus and the 2nd cart. bronchosyringealis. This sound-producing organ was rather short. The two sides of the membrane tympaniformes medialis join tightly at the middle zone of caudal part.

Following the cartt. bronchosyringeales, 14 cartilage rings forming primary bronchi were observed to fork into two or to give branches connected to each other similar to the rings in the middle region of trachea. Between these rings, lig. interbrochiale was observed as thin and membraneous *(Fig. 1D-2C).*

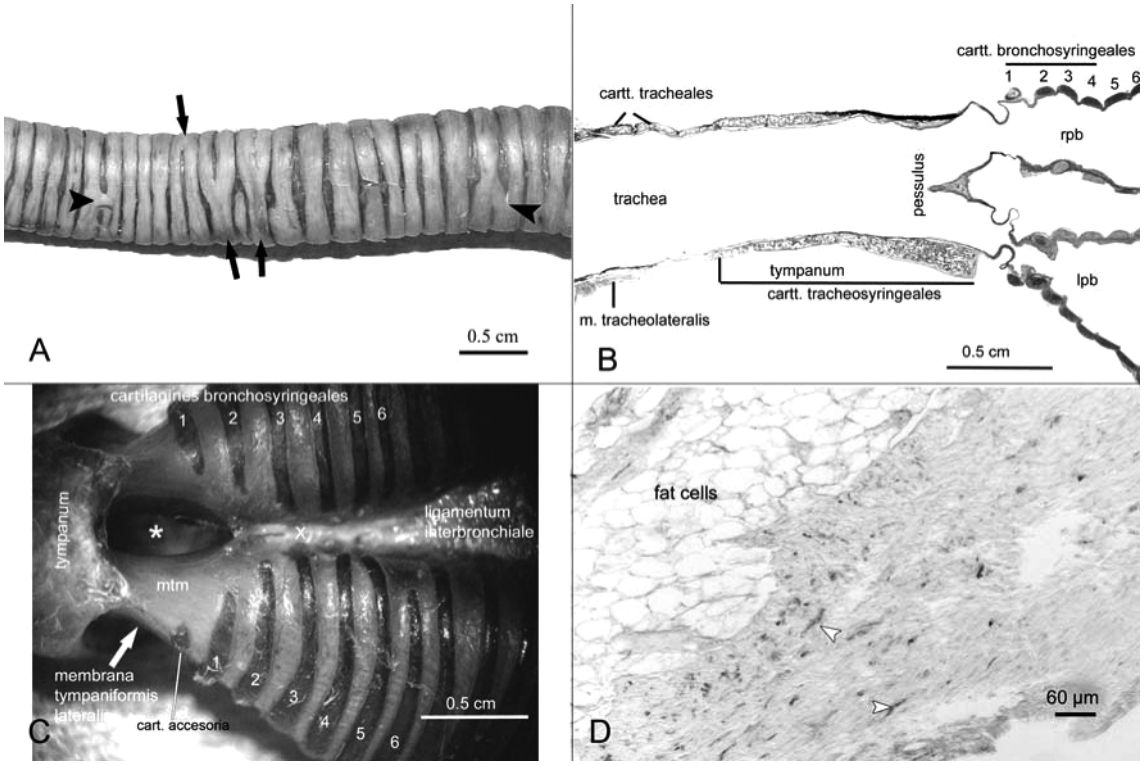

Fig 2. Dorsal view of the trachea **(A),** Horizontal cross-section of the syrinx **(B),** Ventral view of the syrinx **(C),** α-smooth muscle actin immunoreactive cells (White arrow head) are observed at the last four inter bronchosyringeal cartilages area Streptavidin peroxidase staining. Bar=60 µm. **(D).** Black arrow: Divergence zones of tracheal cartilages. Black arrow heads: Unification zones of tracheal cartilages. **mtm:** membrana tympaniformis medialis. **mtl:** membrana tympaniformis lateralis. **lpb:** left primary bronchi. **rpb:** right primary bronchi. **X:** tight connective tissue between bronchosyringeal cartilage. *For. interbronchiale

Şekil 2. Trachea'nın dorsal görünümü **(A),** Syrinx'in horizontal kesiti **(B),** Syrinx'in ventral görünümü **(C),** Son dört cartt. bronchosyringeales arasındaki doku'da kollagen iplikler arasına serpilmiş düz kas aktin immunoreaktif hücreler (beyaz okbaşları) (streptavidin peroksidaz boyama metodu). Bar=60 µm. **(D).** Siyah ok: cartt. trachealis'in ayrılma yerleri. Siyah ok başı: cartt. trachealis'in birleşme yerleri. **mtm:** membrana tympaniformis medialis. **mtl:** membrana tympaniformis lateralis. **lpb:** sol primer bronchi. **rpb:** sağ primer bronchi. **X:** cartt. bronchosyringeales arası sıkı bağ doku. *For. interbronchiale

DISCUSSION

Although the larynx, trachea and syrinx had been investigated in many bird species, [3,4,8,29,35] only the trachea has been studied in goose [1]. The present study included extensive gross anatomic information about the all extrapulmonary airways in the goose. We found, at the caudal of mons laryngealis, rostral and caudal transversal papillae row progressing in caudal direction did not display a uniform arrangement but that the numbers of papillae were similar to literature values [2,3,5,29,31]. Apart from the mentioned papillae, 6-7 papillae rows were present at both sides of the glottis with tips directed in dorsal direction, as also observed in the penguin [14], but the papillae formed a double row arrangement in the penguin.

Although a cart. procricoidea had not been mentioned in chicken [4], turkey [13], and penguin [14], the larynx cartilage of goose was observed to be formed by single cart. cricoidea and cart. procricoidea plus paired cart. arytenoidea as in other studies [2,3,5,6,8]. While the partial ossification of the larynx cartilage in adult birds was generally similar to that in other species [3,5,8,31], the rostral and caudal processes of the cart. arytenoidea were the completely cartilaginous in the goose. It was suggested that the ossification rate of the larynx cartilages which increased with age may be an important criterion to distinguish between young and adult birds. While crista ventralis located at the interior and median side of the body of cart. cricoidea had been described in other species [7,8,31], such a structure was not encountered in goose.

In birds, the larynx muscles were divided into two as intrinsic and extrinsic muscles, but there were differences in number and naming of extrinsic muscles [3-5,7,31]. In this study, the extrinsic muscles of the larynx were named m. cleidotrachealis, m. tracheolateralis and m. cricohyoideus similar to Baumel et al.[8]. The m. cricohyoideus had the

same origin and insertion as the m. basibronchialis laryngeus and the m. hyolaryngialis reported by Getty [3], Nickel et al.[4] and Taşbaş et al.[31]. The m. cleidotrachealis was the same as the m. ypsilotrachealis of Nickel et al.[4] and Humphrey [30]. In generally, the naming of the m. tracheolateralis was similar to that in the literature [5,8,23,30], but there were differences among bird species for regarding the insertion of muscle. Kabak et al.[5] and Baumel et al.[8] reported that the m. tracheolateralis attached to the first cart. bronchosyringealis in long legged buzzard and seagull, Humphrey [30] and Taşbaş et al.[31] mentioned that it had attached to the tympanum in Hawaii goose and Denizli rooster. In the present study, it was observed that the m. tracheolateralis did not connect to the last part of the tympanum as described by Griffiths [23] for bitterns and herons, but it connected to the beginning of the tympanum as described by Humphrey [30] for Hawaii goose and Taşbaş et al.[31] for Denizli rooster.

The number of tracheal rings in birds of different species lied between 108 and 126 [2,3,13,14], but it was 137-140 due to the body size of the goose in the present study.

The structure and shape of the trachea rings were generally similar to that of described in the literature [3,10-13]. However, both the cartilage rings in middle parts of trachea which connected to the previous or following rings appeared to be “H”-shaped and some rings were dorsally and some rings were ventrally forked were represented firstly in the present study.

Although Daley and Goller [36] suggested that changes in the trachea length might be effective in phonation, it was considered that these connections or seperations, preventing imbrication of the trachea cartilages, may be reason for the inability of goose to produce a melodious song voice. The m. sternotrachealis, m. cleidotrachealis and m. tracheolateralis in the study were responsible for tracheal movement, which was in agreement with Humphrey [30] in the Hawaii goose. Because these muscles connected to the larynx, they were also indirectly responsible for the syrinx movement.

The syrinx of goose was the tracheobronchial type which was similar to many birds including domestic fowl [3,4], long legged buzzard [5], Japanese quail [29], Denizli rooster [31] and ostrich [37]. The syrinx of the goose was similar to that described of Baumel et al.[8] who noted the syrinx was formed by the cartt. tracheosyringeales and cartt. bronchosyringeales. However, the borders of first two cartilage rings of the cartt. tracheosyringeales were separate, but the other rings’ borders of the cartt. tracheosyringeales completely fused, ossified and formed the tympanum. Therefore, the finding obtained from the present study was different from the result of Baumel et al.[8]. While the number of the tracheal rings forming the tympanum were reported as 3-4 in the domestic chicken [3], as 4 in the Denizli rooster [31] as 3 in the long legged buzzard [5] and in ostrich [37], the number of tracheal rings could not be determined certainly in goose. As mentioned above, the pessulus -located at the caudo-medial side of the tympanum- was made up of connective tissue in some species such as pigeons [2,38] and the ostrich [37], whereas this structure was absent in penguins [14,23], larks [2,17], pelicans, cormorants, grebes and the kiwi [23]. The pessulus was reported to be cartilaginous in chickens [2-4,18] and owls [23]. If the pessulus is composed of bone tissue, the membrana tympaniformes medialis will be more stuff, vibrate more strongely and after all the more rotund sound will be made. If the pessulus is composed of cartilage tissue, the membrane mentioned above couldn’t be stretched adequately and after all the weaker sound will be made. If the pessulus is composed of connective tissue, as a result of the failures in stretching and vibrating the undistinguished voices will be made. Especially in songbirds, the well developed and ossified structure of the pessulus [19,28,29,31] was similar to that observed in the present study. It is thought that the ossified pessulus reaching the trachea can allow to be heard the different voices by way of isolation of the voices in the generation of sound in singing birds. It has been reported that the shape of the pessulus differs among birds. While it was the dagger shaped in domestic fowls [2,3,31] half prism shaped in Japanese quail [29] and lengthwise oval shaped in male duck [19], it was columnar in the present study.

Although ‘C’ shaped cartilage rings composing the bronchosyringeal cartilages part of syrinx were reported to be formed by the first cartilage in the turkey [13], the first three cartilages in domestic fowls [2,3], songbirds [28], Japanese quail [29], Denizli rooster [31] and ostrich [37], and the first four cartilages in long legged buzzard [5] and crow [16], the bronchosyringeal-cartilage part of syrinx was formed by the first six cartilages in the present study.

Foramen interbronchiale, which helps the membrana tympaniformes medialis to vibrate and produce sound, was observed in the goose as was reported in some singing birds [4,28,31].

The membran tympaniformis medialis, which had a role in sound production, was not located between the pessulus and lig. interbronchiale as described for other species [3,5,23,31], but extended between the pessulus and connective tissue, attaching to the last four cartt. bronchosyringeales. The presence of smooth muscle cells in these connective tissue were confirmed by means of

immunohistochemistry. This result was similar to Warner's [28] report for the starling and male mallard [39]. It is belived that these smooth muscle cells may be a remnant of the intrinsic syringeal muscles and that may play role in the syringeal sound generation by influencing the tension of the membrana tympaniformes medialis. Origins and insertion of the membrana tympaniformes lateralis lay between the tympanum and the 1st cart. bronchosyringealis as stated in the literature [3,4,8,29,37]. However, there was not a connection between the membrana tympaniformes lateralis and the pessulus and this finding was different from the results of Getty [3] and Chamberlain et al.[16]. Intrinsic syringeal muscles, which moved the lateral and membrane tympaniformes medialis especially in songbirds [21,24-27,32] were not encountered in the goose.

In conclusion, some structural differences and similarities of the larynx, trachea and syrinx were determined between the goose and other bird species in the study. In the present study the cartilage rings in middle parts of trachea seemed to be "H"-shaped because of forks in some ring, which were characteristic for the goose. Moreover, the tympanum was completely fused and ossified in the goose, and the presence of smooth muscle cells in the connective tissue of the last four bronchosyreangeal cartilages was determined.

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