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Research Paper

SEXUAL DIMORPHISM IN THE ANATOMICAL FEATURES OF THE SYRINX IN THE WHITE PEKIN DUCKS (ANAS PLATYRHYNCHOS)

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The main purpose of this study to investigate the position and normal anatomical features of the syrinx in adult male and female white pekin ducks. Eight (5 females and 3 males) adult white pekins ducks weighting 1500-2000 gram were examined. Anatomical examination revealed the syrinx was located in the thoracic cavity at the bifurcation of the trachea. The syrinx was tracheobronchial type formed by syringeal cartilages, pessulus, tympaniform membranes, interbronchial ligament and foramen as well as and extrinsic muscles of the syrinx. The syrinx was a symmetrical in the male forming bulla tympaniformis but in the female duck had no tympanic bulla.

Keywords: White pekin ducks, Syrinx, Anatomy

INTRODUCTION

Commercial duck meat farms are intensive operations similar to chicken meat farms. Pekins are the most common domestic duck which the adults are pure white and the ducklings are a cute yellow. They are a large breed used for meat production. As with the mammalian larynx, sound is produced by the vibration of air flowing through the voice organ in birds, the syrinx. Some birds vocalize all year long while others call only during the mating or during migration (Al-Badri *et al.,* 2014). The German anatomist classified bird species by their syringeal anatomy already in 1878 (Muller, 1878). Three different types of syrinx, namely tracheobronchial, tracheal and bronchial, can be found according to distinction between tracheal and bronchial elements of syrinx and topographical position of the main sound producing mechanism (Nickel *et al.,* 1977; King and Mclelland, 1984; and Baumel *et al.,* 1993). Morphological structure of syrinx has been described in many bird's species such as guinea fowl (Al-Bishtue, 2014), Iraqian Duck (Ali *et al.,* 2015), Japaneses quail (Cevik-Dermirkan *et al.,* 2007), long legged buzzard (Kabak *et al.,* 2007), turkey (Khaksar *et al.,* 2012), goose (Onk *et al.,* 2010), jungel crow (Tsukara *et al.,* 2008), ostrich (Yildiz *et al.,* 2003), bursa roller pigeon (Yildiz

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et al., 2005) and mallard duck (Yilmaz *et al.,* 2012), The present investigation aimed to investigate the anatomical features of the syrinx in male and female white pekins ducks as detailed information on the sexual differences in the anatomical structure of the syrinx of White Pekins ducks has generally been lacking.

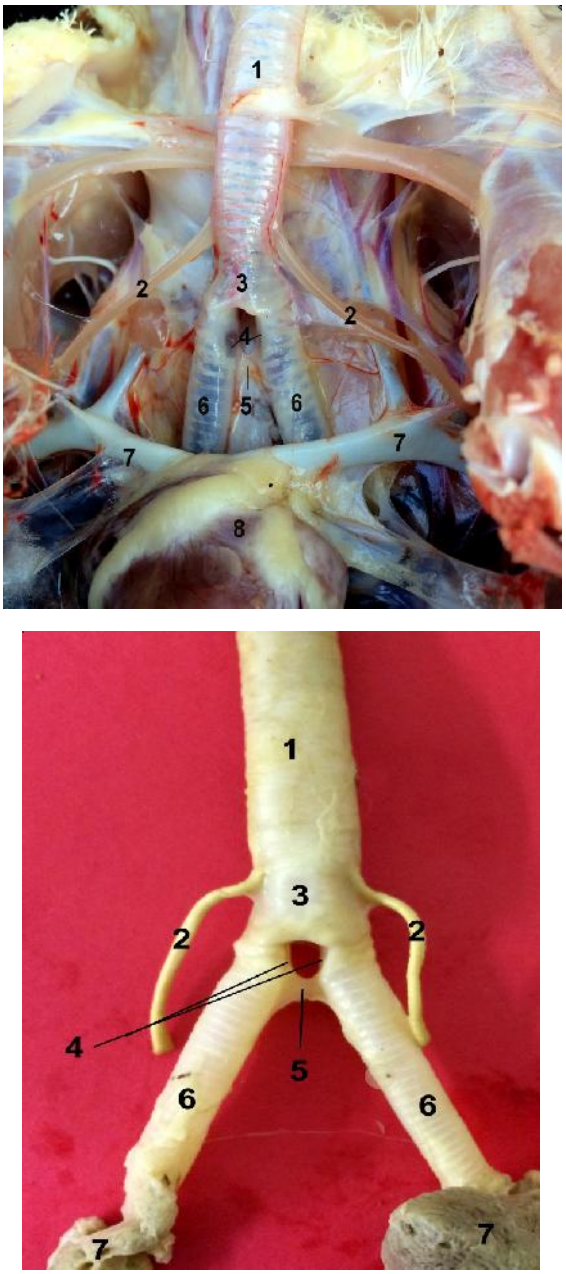
MATERIAL AND METHODS

A total of eight (5 females and 3 males) adult white pekins ducks weighting 1500-2000 gram were obtained from local farms to be used in this study. The birds were anaesthetized with an IM injection of ketamine (50 mg/kg) and xylazine (20 mg/kg), and then the specimens were prepared by bleeding of birds by cutting the major neck blood vessels. After opening the body cavity the topographic position of syrinx was observed at the terminal end of the trachea. The terminal part of the trachea and syrinx were left in 70% alcohol for two hours to acquire a clear vision of the cartilages. The syrinx was dissected by remaining fat and connective tissue. The gross anatomy of the syrinx was investigated and documented by photos using a codak digital camera (12 mega pixels). Nomina Anatomia Avium (1993) was used for nomenclature.

RESULTS

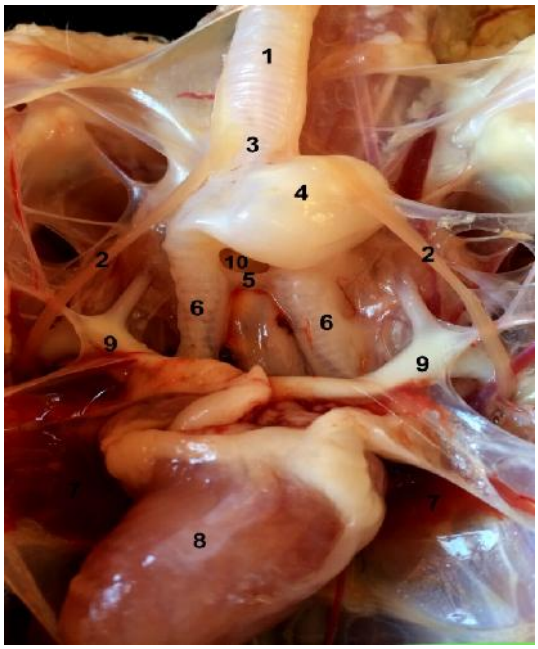
The Syrinxes were observed in male and female white pekins ducks inside the thoracic cavity lies ventral to esophagus between the caudal portion of the trachea and the beginning of the primary bronchi at the base of the heart. It was tracheobronchial type. The syrinx was composed of three groups of modified cartilagenous rings known as syringeal cartilages which were tracheosyringeal, tympanum, and bronchosyringeal cartilages; the pessulus at the tracheal bifurcation; two pairs of vibrating tympaniform membranes;interbronchial ligament and extrinsic muscles (Figures 1 and 2).

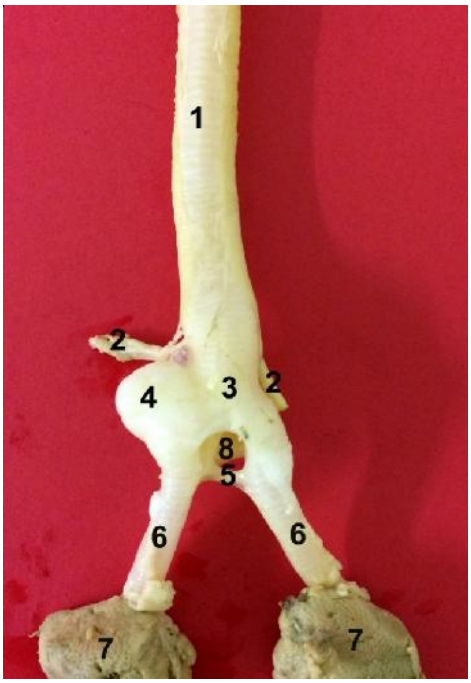
Figure 1: Ventral View of the Syrinx in the Female White Pekin Duck Insitu and in a Fresh State (A) and Isolated Fixed Syrinx (B)



Note: 1. Trachea, 2. Sternotracheal muscles, 3. Pessulus, 4. Right and left medial tympaniform membranes, 5. Interbronchial ligament, 6. Right and left primary bronchi, 7. Right and left brachiocephalic trunks (A) & Lungs (B), 8. Heart.

Figure 2: Ventral View of the Syrinx in the Male White Pekin Duck in Situ and in a Fresh State (A) and Isolated Fixed Syrinx (B)





Note: 1. Trachea, 2. Sternotracheal muscles, 3. Pessulus, 4. Syringeal bulla, 5. Interbronchial ligament, 6. Right and left primary bronchi, 7. Lungs, 8(B) & 10(A). Interbronchial foramen, 8(A). Heart, 9. Right and left brachiocephalic.

Syringeal Cartilages

Tracheosyringeal and Tympanum Cartilages

The tracheosyringeal cartilages were eight to ten rings and they were found to participate informing the tympanum by four C-shaped cartilage rings. The last tracheosyringeal rings formed the syringeal bulla in male white pekin ducks.

Bronchosyringeal Cartilages

The bronchial rings were smaller than the tracheal rings and incomplete medially. They were placed ventrolaterally, while their free ends directed dorsomedially and supported by the medial vibrating membranes.

The Pessulus

The Pessulus was observed as wedge-shaped ossified plate extending dorsoventrally and it was formed at the level of tracheal bifurcation by the fusion of the medial walls of the right and left bronchi. The primary right and left bronchi were connected by a strong interbronchial ligament or bronchidesmus. Also, there was interbronchial foramen or subpessular air space between the pessulus and interbronchial ligament which was filled by fat and connective tissue.

The Vibrating Structure

The syrinx was composed of two medial and two lateral tympaniform membranes. The medial tympaniform membrane covered the medial parts of the first and third bronchosyringeal cartilages and it extended from caudal aspect of the pessulus up to the level of the third bronchosyringeal cartilage. The lateral tympaniform membrane lied on the lateral aspect of the syrinx, which stretched between the last tympanum ring and the first bronchosyringeal cartilage and supported from lateral sides by the tracheosyringeal cartilage.

Extrensic Muscles of the Syrinx

There are no intrinsic muscles in the syrinx but there were two pairs of the extrinsic muscles; the tracheolateral and the sternotracheal muscles. The former muscles were originated from the larynx and located laterally in both sides of the lower part of the trachea. While the sternotracheal muscles were originated from the sternum and inserted above the syrinx on the ventrolateral portion of the tympanum.

Sexual Dimorphism

A considerable differentiation in the shape of the syrinx due to the sexual dimorphism was observed. The syrinx of the male duck was found to be a symmetrical and had a large osseous expansion on the left side and extended laterally called bulla tympaniformis or syringeal bulla which was divided into a left major and a right minor chamber by a double-walled, semilunar and opaque septum. The major chamber of the syringeal bulla connected with the left main bronchus, while the right minor chamber did not show any connection neither to the left nor to the right main bronchus. On the left hand side of the proximal part of the tympanum an osseous partition wall projected into the lumen which separated the syringeal bulla from the tympanum. The syrinx of the female white pekin duck was small, symmetrical and simpler than that of the male (Figure 3).

DISCUSSION

The current investigation revealed that the syrinx in the white pekin ducks could be classified to be tracheobronchial type simulated that reportedin guinea fowl (Al-Bishtue, 2014), mallard (Frank *et al.,* 2007 and Yilmaz *et al.,* 2012), hen (Nickel *et al.,* 1977), ostrich (Yildiz *et al.,* 2003), Bursa roller pigeon (Yildiz *et al.,* 2005), white turkey (Arican *et al.,* 2007 and Khaksar *et al.,* 2012), goose (Onuk *et al.,* 2010), long-legged buzzard (Kabak *et al.,* 2007) and quails (Bayram and Liman, 2000 and Çevik *et al.* 2007).

The obtained results were parallel to those described in mallard (Yilmaz *et al.,* 2012), bursa roller pigeon (Yildiz *et al.,* 2005), white turkey (Arican *et al.,* 2007), denizli rooster (Tasbas *et al.,* 1994) and goose (Onuk *et al.,* 2010) that the syrinx was located inside the thoracic cavity lies ventral to esophagus between the caudal portion of the trachea and the beginning of the primary bronchi at the base of the heart.

The obtained results reported that the number of tracheosyringeal cartilages and tympanum could be 8 as mentioned by Warner (1971) in passerine birds, Lockner and Youngner (1976) and Yilmaz *et al.* (2012) in mallard and or 10 as mentioned in mallard (Frank *et al*., 2007; and Yilmaz *et al.,* 2012). This variability to be normal in our study due to the sexual difference as mentioned by mallard (Yilmaz *et al.,* 2012).

The obtained results were parallel to those described in in goose (Onuk *et al.,* 2010) and mallard (Yilmaz *et al.,* 2012) that the number of tracheosyringeal cartilages were 6 in number. While they are 3 in guinea fowl (Al-Bishtue, 2014), 4 in long-legged buzzard and turkey (Kabak *et al.,* 2007; and Khaksar *et al.,* 2012), 5 in pigeon (Yildiz *et al.,* 2005) and 7 in seagull (Ince *et al.,* 2012).

The findings in mallard (Yilmaz *et al.,* 2012) affirmed our results where the tympanum was composed of four tracheal cartilage rings. However our results were different from those described in Japanese quails (Çevik *et al.,* 2007), sea gulls (Ince *et al.,* 2012), long-legged buzzard (Kabak *et al.,* 2007), goose (Onuk *et al.,* 2010) and bursa roller pigeon (Yildiz *et al.,* 2005).

It was recorded in our study that the pessulus in the white pekin ducks was composed of bone tissue; the same findings were also in guinea fowl (Al-Bishtue, 2014), avian (Baumel *et al.*, 2003), mallard (Warner, 1971; Frank *et al.,* 2007; and Yilmaz *et al.,* 2012), indigenous male turkey (AL-Mussawy, 2011), goose (Onuk *et al.,* 2010) and singing birds (Warner, 1972b). However (Baumel *et al.,* 2003) in oscine, Warner (1972a) in ostriches and Yildiz *et al.* (2005) in pigeon and who elucidated that the pessulus formed by a double-folded mucous membrane.

Our results achieved that the male white pekin ducks have pear-shaped syringeal bulla in their left primary bronchus, a result which was in a line with that obtained by (Frank *et al.,* 2007) and Yilmaz *et al*. (2012) in male mallard and (Nickel *et al.,* 1992; and Konig and Liebich, 2001) in male anatidae.Whereas ostriches do not have syringeal bulla (Yildiz *et al.,* 2003).

The current work under discussion revealed that the lateral and medial tympaniform membranes were in the same location as of mallard (Yilmaz *et al.,* 2012),Japanese quails (Çevik *et al.,* 2007), denizli roosters (Tasbas *et al.,* 1994) and ostriches (Yildiz *et al.,* 2003). Moreover, the medial tympanic membrane covers the open ends of the bronchosyringeal cartilage as reported in mallard (Yilmaz *et al.,* 2012) and in song birds (Larsen and Goller, 2002).

In the present findings, there were two extrinsic muscles, sternotracheal and tracheolateral were located at the side of the trachea simulated that given by Kabak *et al* (2007) in long-legged buzzard, Tasbas *et al.* (1994) in denizli cock, Yilmaz *et al.* (2012) in mallard, Yildiz *et al.* (2005) in Bursa roller pigeon and Yilmaz *et al.* (2012) in mallard. While the syringeal muscles were absent in the guinea fowl (Al-Bishtue, 2014).

There was interbronchial foramen between bronchidesmus and pessulus, similar result was mentioned in guinea fowl (Al-Bishtue, 2014), indigenous male turkey (AL-Mussawy, 2011), sea gulls (Ince *et al.,* 2012), mallard (Frank *et al.,* 2007; and Yilmaz *et al.,* 2012), turkey (Khaksar *et al.*, 2012) and goose (Kobak *et al.,* 2007).

The present investigation asserted that syringeal bulla is composed of a major and minor chamber, separated by a partition a septum, a result that passed parallel to that in Warner (1971), Lockner and Youngren (1976), King and McLelland (1989) and Frank *et al.* (2007) in different birds.

In accordance with that given in mallard (Frank *et al.,* 2007), our finding achieved that there was a connection between the major chamber of the syringeal bulla and the left main bronchus. However, Warner (1971) and King and McLelland (1989) mentioned a connection between the syringeal bulla and right main bronchus. Moreover the right minor chamber did not show any connection neither to the left nor to the right main bronchus as mentioned by Frank *et al.* (2007) in mallard

In agreement with that in Aubrecht and Holzer (2000) and Warner (1971) in birds, mallard (Ballintijn and Ten Cate, 1997; and Frank *et al.,* 2007) in collared dove and Prince *et al.* (2011) in European starlings and the differences in the anatomical structure of the syrinx in male and female birds cause a variable vocalization. Female white pekin ducks have a loud *quak* voice while the male white pekin ducks have a little higher, *araeb* voice moreover, during the mating season the male white pekin ducks have *fihbib* voice. These vocal differences could be due the medial tympaniform membranes which acts as a sound generator were thicker in male than female.

CONCLUSION

The syrinxes of the male and female white pekin ducks were examined. The topographical of the syrinx of the white pekin ducks showed close resemblance to that of other bird species. Some structural differences and similarities of the syrinx were determined between the white pekin ducks and other bird species in the study. The sexual dimorphism in syringeal structures and vocalizations was marked and the syrinx in male adult white pekin ducks showed some notable specific anatomical features.

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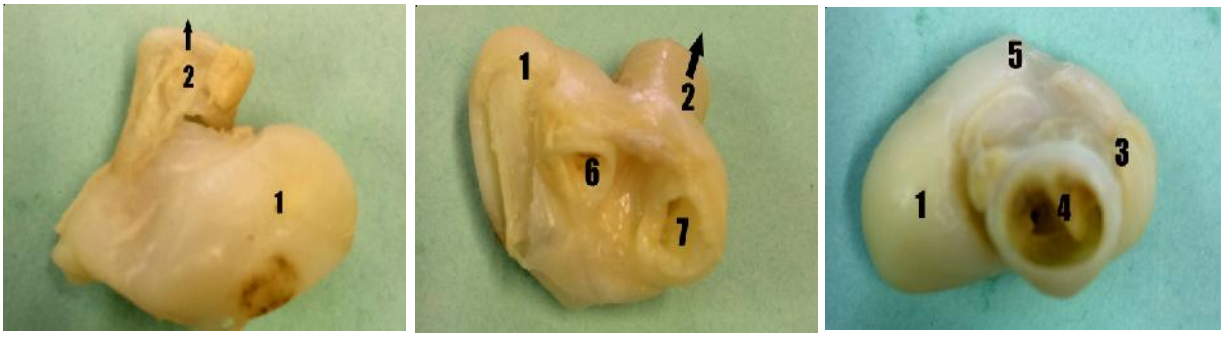
APPENDIX

Figure 1: Ventral (A & B) and Cranial (C) Views of the Syringeal Bulla in a Male White Pekin Ducks



(a) (b) (c)

Note: 1. Syringeal bulla (major chamber), 2. Direction to the trachea, 3. Tympanum, 4. Pessulus, 5. Minor chamber of syringeal bulla, 6. Left main bronchus, 7. Right main bronchus.