

Macro and Micro Anatomy of the Respiratory System of Male and Female Muscovy Duck (*Cairina moschata*)



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A Clinical Report Submitted as per approved styles and Contents

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List of Abbreviation

Abbreviation	Elaboration
H & E	Hematoxylin & Eosin
Et al	Et alia (all others)
SM	Sliding Microtome
DM	Digital Microscopy

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Abstract

Muscovy duck (China Hash) is one of the most popular breeds of duck in Bangladesh. Currently, there is a huge demand in the country. The purpose of this study was to distinguish the features of respiratory systems of both male and female Muscovy duck in gross and microscopic samples and to compare them with other avian species. Two adult Muscovy ducks (one male & one female) of one year age were collected from the local poultry market of Chattogram, Bangladesh, and were brought into the Anatomy lab of Chattogram Veterinary and Animal Sciences University (CVASU). The ducks were sacrificed by avoiding pain and distress according to animal welfare standard guidelines and procedures and systematic dissection was performed. Different respiratory organs i.e. larynx, trachea, syrinx, and lungs were observed in situ and isolated. Sections were cut and stained with Hematoxylin and Eosin (H&E) to observe microscopic structures. The study showed that the length of the larynx of male and female ducks was 2.5 cm and 2.3 cm, respectively. The length of the trachea of male and female ducks was 18 cm and 13.8 cm, respectively. The number of tracheal rings in the male Muscovy was 103 and the female Muscovy was 87. At the bifurcation of the trachea, there was a laterally swollen structure called the syringeal bulla in the male Muscovy duck. The syringeal bulla was a large bony swelling projecting from the left side of the trachea in male with 1.6 cm length and 1.4 cm width, while in female, it was not projected beyond the tracheal walls. The right and left lungs of both male and female Muscovy were symmetrical in size. The male lungs were larger than the female lungs. Research related to this species is few in number. Thus, this research will help the people of management and clinicians for disease diagnosis, treatment, increased production and monitor for the conservation of this species.

Keywords: Muscovy duck, male, female, respiratory system and syrinx.

Introduction

Bangladesh is a country in South Asia and one of the most populous countries in the world (Schendel. W.V., 2020). The economy of this country mainly depends on agriculture (Ferdous et al., 2020). To satisfy the hunger and nutritional demand of the huge population, poultry meat plays a significant role. Chicken, duck, quail, turkey, goose, pigeon, etc., are reared and consumed in Bangladesh.

Among the aquatic poultry species of Bangladesh, Muscovy duck (*Cairina moschata*) is now becoming very popular, especially in rural areas. This type of duck is commonly known as 'China Hash' or 'China Duck' in Bangladesh. Muscovy duck is a large species of waterfowl. They are larger than most domestic ducks. They are well-known for their adaptability in this climatic condition, and they thrive in this warm climate. They are also good egg layer and produce a large number of eggs. Due to these reasons, Muscovy ducks in Bangladesh is becoming more popular day by day and their unit price is also higher than other ducks.

As like other birds, the respiratory system of Muscovy duck consists of larynx, trachea, syrinx, lungs and air sacs. Muscovy duck contains larynx, trachea, lungs structurally similar to other avian species. But as Muscovy ducks are larger, they tend to have larger lungs and air sacs than other ducks. The pessulus, which is present at the end of the syrinx, of this type of birds are non-ossified, cartilaginous, in contrast to completely ossified pessulus of other vocal-natured birds.

There are also quite some differences in respiratory system between male and female Muscovy ducks. Male Muscovy ducks generally is larger than female Muscovy ducks and therefore, contains larger respiratory organs such as larynx, trachea, syrinx and lungs. Though both genders of this duck do not contain vocal cords as other birds (Suthers et al., 2006), the male birds contain a completely ossified bulging structure called syringeal bulla on one side of syrinx at the bifurcation of the trachea. The female birds do not have this structure. The presence of syringeal bulla enables the male to have distinct hissing sound.

The males produce a hissing sound whereas females produce croaking or quacking sounds in general. The males are more territorial and aggressive than the females, especially in the

breeding season. Inversely females are more docile and quieter than males. In general, Muscovy ducks are quieter than other ducks as they don't typically quack like other ducks (Baldassarre, 2014). They are often called near-mute ducks for this reason.

Though there are a lot of research papers available for other types of ducks such as Pekin, research papers are scarce in the case of Muscovy, especially about their respiratory system. One of the more prominent types of research is from Nigeria (Oguntunji et al., 2014) which described the sexual size dimorphism and sex determination in Muscovy ducks. Another research described the pulmonary anatomy of this type of duck (Vidyadaran et al., 1991). Still, further research is necessary to understand the anatomy of these ducks as well as for their better management and disease prevention.

Therefore, the purpose of the study is to understand the macro and microanatomy of the respiratory system of both male and female Muscovy ducks.

Materials and Methods

Ethical Statement

The birds were sacrificed, and samples were collected from the carcasses, avoiding and minimizing the conditions affecting animal welfare according to standard guidelines and procedures of the Florida International University (FIU, 2003).

Collection of Birds

Two adult Muscovy ducks of similar ages (one male & one female) were obtained from the famous Reazuddin Bazar of Chittagong and were brought into the Anatomy lab of Chattogram Veterinary and Animal Sciences University (CVASU). The male weighed 2.4 kg and the female bird weighed 1.65 kg. The male had a body length of 72.3 cm with a neck length of 10.5 cm. The female had a body length of 57.7 cm with a neck length of 8.1 cm.



Figure 1: The female(A) and male(B) Muscovy duck

Sacrificing of chicken for collection of samples & Biometry

The birds were then humanely slaughtered by following appropriate guidelines without causing any unnecessary pain. After opening the body cavity, the topographical location of different respiratory organs was observed. Biometry of different organs was performed in situ and ex-situ by using a measuring scale. The samples were washed with normal saline for histomorphological study.

Fixation of samples

Samples were immersed in neutral buffered formalin for a period of 72 hours for complete fixation.

Tissue processing and staining for microscopic examination

After washing fixed tissue, dehydration was performed through the passing of tissue samples into successive ascending concentrations of alcohol. After the completion of dehydration, the tissue specimens were passed through successive changes of xylene for cleaning until the alcohol from the tissue was replaced. When the tissue samples were clearly transparent, i.e., cleaning was completed by xylene. The specimen was to be placed into melted paraffin in the oven at 58-60°C to evaporate the xylene and the tissue space was infiltrated with melted paraffin. After completion of infiltration, the tissue samples were placed in between two L-shaped angles and then filled with melted paraffin to make a paraffin block. Then microscopic section was cut at 6µm thickness using a sliding microtome machine (Leica SM2010R V1.2 English-09/2008 Sliding Microtome Machine, Germany) with the help of a disposable Carbon blade. The water bath was set at 60°C temperature. The slide was then labeled by a diamond pencil as marked with a tag. Gelatin was used as an adhesive to attach the section to a glass slide. Then the slide was dried in air for 12 hours before staining. The tissues were stained with hematoxylin and eosin according to standard protocol (Cardiff et al., 2014) for visualization under the light microscope.

Histomorphometry

To obtain histomorphometric data, a microscopic study of different respiratory organs (trachea, syrinx and lung) of both male and female Muscovy duck was performed and photomicrographs were taken using a photomicroscope (LEICA MC170 HD 5 MP HD Microscope Camera, Microscope Model LEICA DM 1000LED) and LAS EZ software 3.4.0 version).

Results

The male bird had both black and white colored stripes on its wings and the female one had mostly white stripes. The male had more prominent caruncles on its face than the female. The male had a beak length of 7 cm with a beak width of 4 cm compared to 5.5 cm and 3.5 cm respectively for the female. From the point of beak to the tip of the tail, the male bird was 72 cm, and the female bird was 57 cm. The male also had larger wings of 30 cm compared to the female wings of 23 cm. The lengths of the necks of male and female birds were 10 cm and 8 cm, respectively.

Larynx: The larynx was situated at the top of the trachea. The larynx of the male and female Muscovy was almost similar in size with the male larynx is of 2.5 cm and the female larynx is of 2.3 cm (Table 1). The larynx of the ducks didn't contain any vocal cords.

Trachea: The trachea started at the larynx at the base of the tongue and extended down through the neck into the chest cavity. The length of the male trachea was 18cm and the female trachea was 13.8cm long. (Table 1). The number of tracheal rings in the male Muscovy was 103 and the female Muscovy 87 (Table 1). In histophotometry, lamina epithelia, perichondrium layer, and lamina adventitia were found (Figure 5).

Syrinx: The syrinx was at the base of the trachea and it branched into two primary bronchi leading to the lungs. The male syrinx was 2.7cm and the female syrinx was 1.8cm long. (Table 1). Both male and female Muscovy syrinx contained pessulus but the male syrinx also contained a completely ossified syringeal bulla of 1.6cm length and 1.8cm width (Table 1), while the female syrinx didn't. In histophotometry, lamina epithelia, lamina propria, submucosa and muscular layer were found in both syrinx (Figure 5).

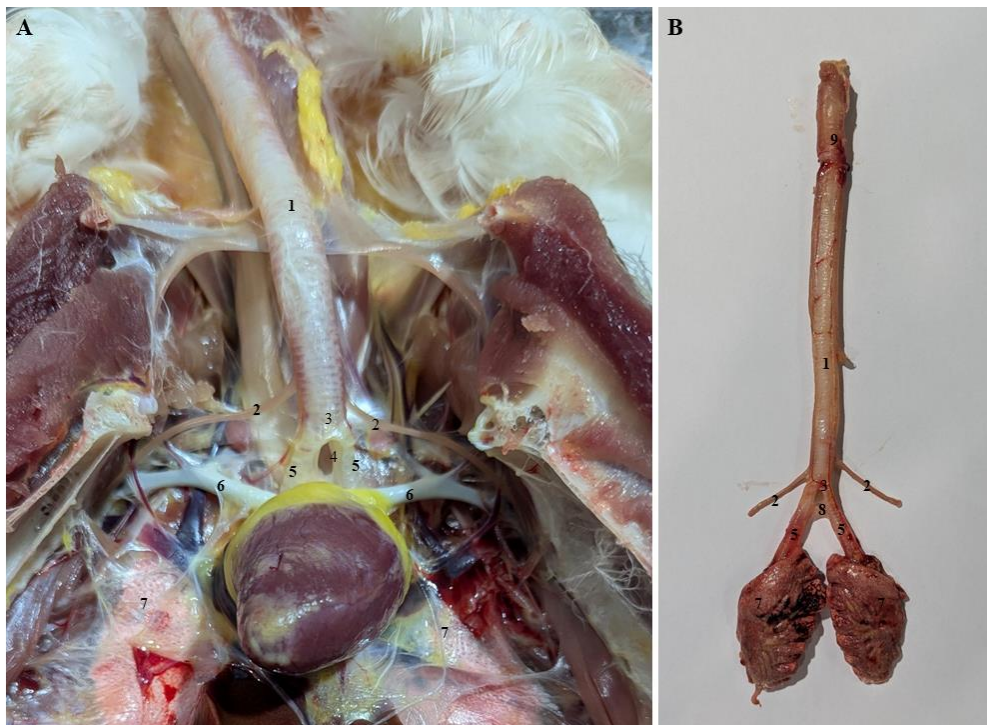


Figure 2: Organs of the respiratory system of the female Muscovy duck

Figure 2: Organs of the respiratory system of the female Muscovy Duck: A) Ventral view of the Respiratory System in situ and in a fresh state & B) Isolated Respiratory Syetem: 1. Trachea, 2. Sternotracheal Muscles, 3. Pessulus, 4. Tympaniform Membrane, 5. Right and Left Primary Bronchi, 6. Right and Left Brachiocephalic Trunks, 7 Lungs, 8. Interbronchial Ligament, 9. Larynx

Lung: The right and left lungs of both male and female Muscovy were almost symmetrical in size. The male lungs were larger than the female lungs (Table 1). In histophotometry, both lungs contained typical parabronchi (Figure 5).

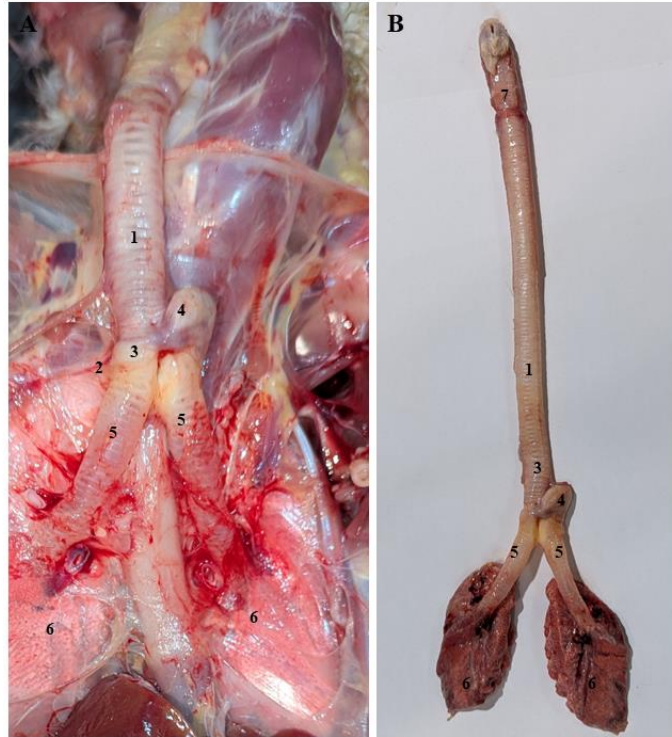


Figure 3: Organs of the respiratory system of the male Muscovy duck

Figure 3: Organs of the Respiratory system in the Male Muscovy duck. A) Ventral view of the Respiratory system in situ and in a fresh state. B) Isolated Respiratory system. 1.Trachea, 2. Sternotracheal muscle, 3. Pessulus 4. Syringeal Bulla, 5. Right and Left Primary Bronchi, 6. Lungs, 7. Larynx

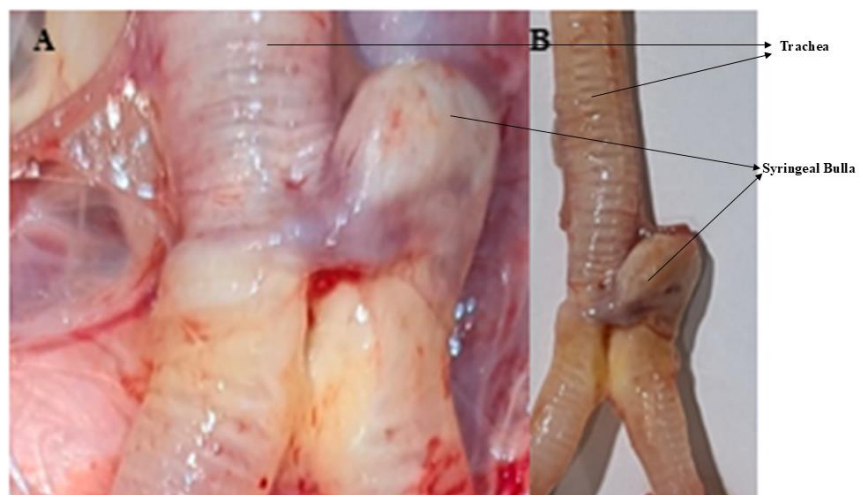


Figure 4: Syringeal bulla in the male Muscovy duck

Figure 4: Syringeal bulla with trachea in the male Muscovy duck. A) In situ and in a fresh state. B) Isolated Syringeal bulla with trachea.

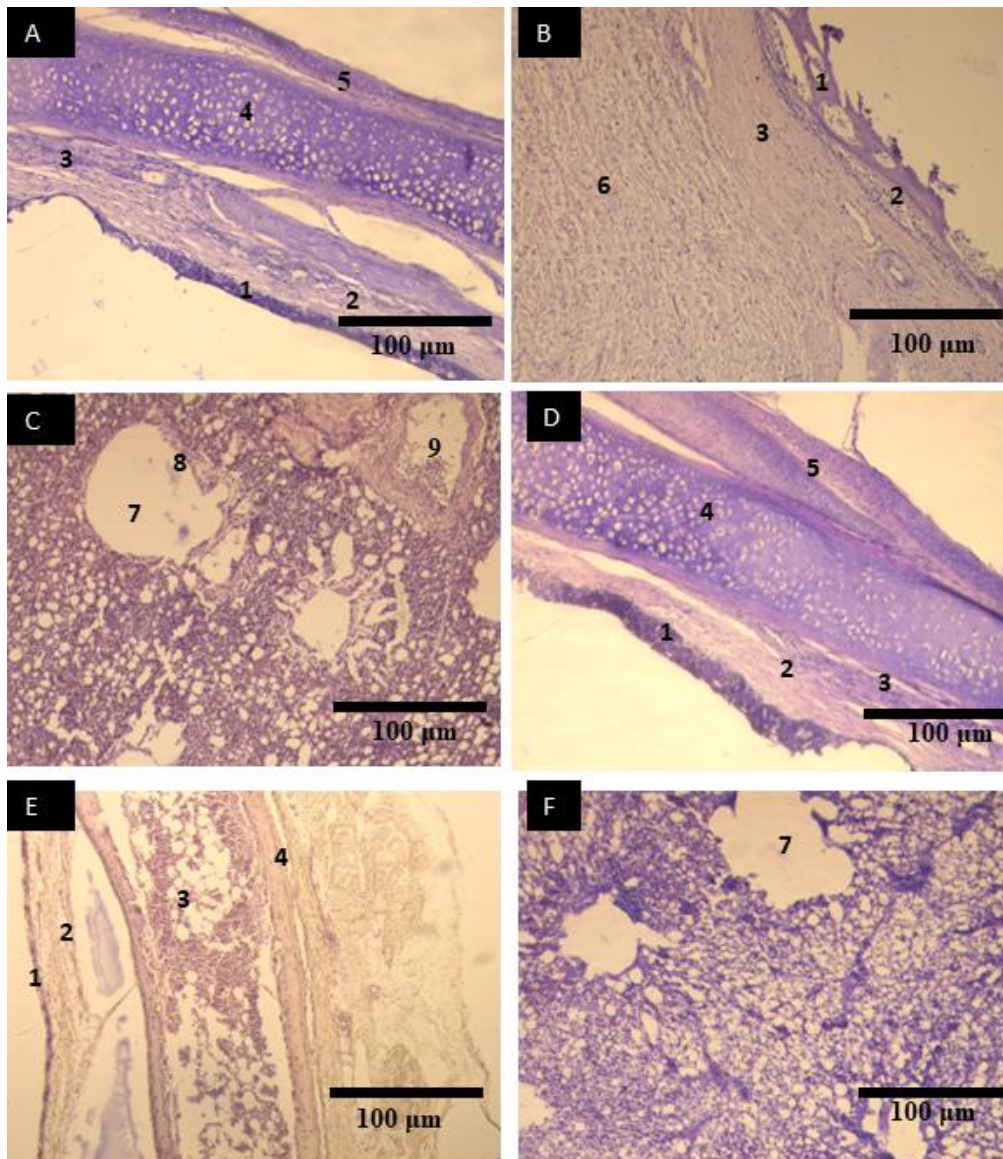


Figure 5: H&E staining of the different organs of the respiratory system

Figure 5: Hematoxylin and Eosin staining of the (A)Male Trachea, (B)Male Syrinx, (C)Male Lung, (D)Female Trachea, (E)Female Syrinx & (F)Female Lung. 1.Lamina epithelia; 2. Lamina propria; 3. Submucosa; 4. Perichondrium; 5. Tunica adventitia; 6. Skeletal Muscle; 7. Parabronchial lumen; 8. Parabronchial wall; 9. Blood vessel.

Table 1: Comparative measurements of various organs of the respiratory system of male and female Muscovy ducks

Name of the Organs	Male Muscovy		Female Muscovy	
	Length	Width	Length	Width
Larynx	2.5 cm	0.8 cm	2.3 cm	0.6 cm
Trachea	18 cm	0.9 cm	13.8cm	0.7 cm
Bronchus	4.1 cm	0.8 cm	3.2 cm	0.7 cm
Left lung	6.5 cm	3.2 cm	5.2 cm	2.9 cm
Right lung	6.7 cm	3.4 cm	5.4 cm	3.1 cm
Syrinx	2.7 cm	1.4 cm	1.6 cm	1.1 cm
Syringeal bulla	1.6 cm	1.4 cm	Absent	Absent

Table 2: Comparative studies of the respiratory system of male and female Muscovy duck

Point	Male Muscovy	Female Muscovy
Larynx	Longer and wider	Shorter and narrower
Trachea	Longer and wider	Shorter and narrower
No. of tracheal rings	103	87
Bronchus	Longer and wider	Shorter and narrower
Left lung	Larger	Smaller
Right lung	Larger	Smaller
Syrinx	Longer and more developed	Shorter and less developed
Syringeal bulla	Present	Absent
Respiratory muscles	More prominent and developed	Less prominent

Discussions

The structure of the different organs of the respiratory system of the Muscovy ducks indicates some similarities and dissimilarities with other avian species. The study indicated that the larynx of the Muscovy duck does not contain vocal cords which is similar to other studies (Wild. J.M., 1994, Suthers. R.A & Zollinger. S.A., 2006, and Casteleyn, et al., 2018 etc). The laryngeal cartilages were not ossified and that is also reported in white Pekin ducks (Mohammed R, 2017), quails (ÇEvik-Demirkan et al. 2007), mallards (Yilmaz et al., 2012 and Frank et al.,2007), white turkey(Arican et al.,2007 and Khaksar et al.,2012 and) and goose (Onuk et al.,2010).

The study found that the length of the trachea in the Male Muscovy (18cm) and the female Muscovy (13.8cm) is similar to local ducks (*Anas Platyrhnhos*) (18.8 ± 0.7 cm: (Al-Ahmed. S.A & Sadoon A.H., 2020) but is much shorter than Swan Goose (*Anser cygnoides*) (49.38 ± 3.585 and 42.68 ± 1.765 cm, in males and females, respectively: Ali.H.J., Zghair.F.S., 2022,). The length of the syrinx in the male and female were 2.7cm and 1.6 cm, respectively while in local ducks it was 1.5 ± 0.24 cm (Al-ahmed. S. A. & Sadoon A.H., 2020)

The study revealed that the syrinx of the Muscovy ducks is the tracheobronchial type which is also found in white Pekin ducks (Mohammed R, 2017), mallards (Frank et al., 2007 and Yilmaz et al., 2012), white turkey (Arican et al.,2007 and Khaksar et al.,2012), goose (Onuk et al.,2010), ostrich (Yildiz et al., 2003) and hen (Nickel et al., 1977).

The study found that the cartilages of the trachea are simple and tubular and completely closed like other types of ducks i.e. local ducks (*Anas platyrhnhos*) (Al-Ahmed. S.A & Sadoon A.H., 2020). But “H” shaped and forked cartilages were found in geese in another study (Onuk B et al., 2010). The number of tracheal rings (Male Muscovy: 103, female Muscovy: 87) also supported previous studies. (Swan goose: Ali. H.J & Zghair. F.S., 2022, local duck: (Al-Ahmed. S.A & Sadoon A.H., 2020).

The more-vocal ducks such as Mallard (Yilmiz. B et al, 2012), Pekin (Mohammed. R, 2017), etc. have ossified pessulus, as they produce more sounds for different reasons i.e. territory marking, courtship, etc. But that is not the case in Muscovy ducks as they are

less vocal in nature. They have cartilaginous non-ossified pessulus.

Presence of syringeal bulla in the male bird is similar to other studies in other birds i.e. male Mallard (Frank et al,2006), West-African Guinea Fowl (Al-Bishtue.A.A.H,2013), White Pekin (Mohammed R, 2017), Common Bulbul (Al-Badri et al., 2014) etc.

Histological examination of the lung indicated presence of parabronchus in both male and female Muscovy duck which is similar to other avian species. (Mynah & Starling: Alsaedi et al.,2024), (Quail, Fowl, Pigeon & Barn Owl: Scheuermann et al., 1998). Findings of perichondrium layers in both male & female trachea also supports other studies on other avian species. (Geese, Cattle Egret, Sparrow: Sakr et al., 2022), (Turkey: AL-Mussawy et al., 2012), (Mallard: Mokhtar. D. M. & Hussien. M. M., 2019) and many others.

Conclusion

For the first time, this study described the anatomical and histological features of respiratory system of male and female Muscovy duck. This study could be used as a basis for future researches on this specific species. Moreover, this data may contribute to improve the production, management and disease prevention of the Muscovy duck.

References

- Ali, H. J., & Zghair, F. S. (2022). Histological study of the syrinx in swan goose (*Anser cygnoides*). *Al-Qadisiyah Journal of Veterinary Medicine Sciences*, 21(2).
- AL-Bishtue, A. A. H. (2014). Anatomical investigations of the syrinx (voice box) of the adult male West African guinea fowl (*Numida meleagris galeata*) in the Al-Najaf Al-Ashraf province. *Al-Qadisiya J Vet Med Sci*, 13, 100-105.
- Al-Ahmed, A. S., & Sadoon, A. H. (2020). Comparative Anatomical, Histological and Histochemical Study of (Larynx, Trachea and Syrinx) Between Mature And Immature Males Of Local Duck (*Anas Platyrhynchos*). *Basrah Journal of Veterinary Research*, 19(1).
- Alsaedi, S. A., & Waad, S. K. (2024, June). Comparative Histological, Histochemical and Scanning Microscopy Study of The Lung in Male Mynah Birds (*Acridotheres Tristis*) And Starling Birds (*Sturns Vulgaris*). In *Obstetrics and Gynaecology Forum* (Vol. 34, No. 3s, pp. 2010-2021).
- Al-Mussawy, A. M., Al-Mehanna, N. H., & Al-Baghdady, E. F. (2012). Histological study of the trachea in indigenous male turkey (*Meleagris gallopava*). *Al-Qadisiyah Journal of Veterinary Medicine Sciences*, 11(2), 47-53.
- Al-Badri, A. M. S., Jassim, B. A., & Abbas, J. G. (2014). Macroscopic study of syrinx in the common bulbul (*Pycnonotus barbatus*) and indigenous pigeon (*Columba domestica*). *Med. Sci*, 13(1).
- Cardiff, R. D., Miller, C. H., & Munn, R. J. (2014). Manual hematoxylin and eosin staining of mouse tissue sections. *Cold Spring Harbor Protocols*, 2014(6), pdb-prot073411.

Casteleyn, C., Cornillie, P., Van Cruchten, S., Van den Broeck, W., Van Ginneken, C., & Simoens, P. (2018). Anatomy of the upper respiratory tract in domestic birds, with emphasis on vocalization. *Anatomia, histologia, embryologia*, 47(2), 100-109.

Çevik-Demirkan, A., Haziroğlu, R. M., & Kürtül, I. (2007). Gross morphological and histological features of larynx, trachea and syrinx in Japanese quail. *Anatomia, Histologia, Embryologia*, 36(3), 215-219.

FIU. (2003). FIU Guidelines for Use of Birds in Research. *Animal Welfare*, 1973, 1–10.

Ferdous, Z., Zulfiqar, F., Datta, A., Hasan, A. K., & Sarker, A. (2021). Potential and challenges of organic agriculture in Bangladesh: a review. *Journal of Crop Improvement*, 35(3), 403-426.

Frank, T., Probst, A., König, H. E., & Walter, I. (2007). The syrinx of the male mallard (*Anas platyrhynchos*): special anatomical features. *Anatomia, Histologia, Embryologia*, 36(2), 121-126.

Kear, J. (Ed.). (2005). *Ducks, Geese, and Swans: Species accounts (Cairina to Mergus)* (Vol. 2). Oxford University Press.

Klika, E., Scheuermann, D. W., De Groodt-Lasseel, M. H. A., Bazantova, I., & Switka, A. (1996). Pulmonary macrophages in birds (barn owl, *Tyto tyto alba*), domestic fowl (*Gallus gallus f. domestica*), quail (*Coturnix coturnix*), and pigeons (*Columbia livia*). *The Anatomical Record: An Official Publication of the American Association of Anatomists*, 246(1), 87-97

Khaksar, Z., Kookhdan, E. T., & Parto, P. (2012). A study on anatomy and histological structure of larynx in adult male and female turkeys. *World Journal of Zoology*, 7(3), 245-250.

Mohamed, R. (2017). Sexual dimorphism in the anatomical features of the Syrinx in the White Pekin ducks (*Anas platyrhynchos*). *Int J Agricult Sci Vet Med*, 5(5), 78-85.

Mokhtar, D. M., & Hussien, M. M. (2020). Cellular elements organization in the trachea of mallard (*Anas platyrhynchos*) with a special reference to its local immunological role. *Protoplasma*, 257(2), 407-420.

Oguntunji, A. O., & Ayorinde, K. L. (2014). Multivariate analysis of morphological traits of the Nigerian Muscovy ducks (*Cairina moschata*). *Archivos de zootechnia*, 63(243), 483-493.

Oguntunji, A. O., & Ayorinde, K. L. (2015). Phenotypic characterization of the Nigerian Muscovy ducks (*Cairina moschata*). *Animal Genetic Resources/Resources génétiques animales/Recursos genéticos animales*, 56, 37-45.

Onuk, B., RM, H., & Kabak, M. (2010). The gross anatomy of larynx, trachae and syrinx in goose (*Anser anser domesticus*). *Kafkas Üniversitesi Veteriner Fakültesi Dergisi*, 16(3).

Richard (Photograph) Nickel, Schummer, A., & Seiferle, E. (1977). *The anatomy of the domestic animals: Anatomy of the domestic birds*/R. Nickel; A. Schummer; E. Seiferle. Transl. by WG Siller... Parey.

Sakr, A. A., Elsayed, S. A., & Ismaeil, S. A. (2022). The macroscopical and microscopical characters of the trachea in different avian species: A comparative study. *Iraqi Journal of Veterinary Sciences*, 36(3), 781-789

Schendel, W.V.(2020). A History of Bangladesh: 2nd Edition

Vidyadaran, M. K., King, A. S., & Kassim, H. (1991). Quantitative observations on the pulmonary anatomy of the domestic Muscovy duck (*Cairina moschata*). *Journal of Zoology*, 224(1), 113-119.

Wójcik, E., & Smalec, E. (2008). Description of the Muscovy duck (*Cairina moschata*) karyotype. *Folia biologica (Kraków)*, 56(3-4), 243-248.

Wild, J. M. (1994). The auditory-vocal-respiratory axis in birds. *Brain, Behavior and Evolution*, 44(4-5), 192-209.

Yilmaz, B., Yilmaz, R., Arican, I., & Yildiz, H. (2012). Anatomical structure of the syrinx in the mallard (*Anas platyrhynchos*). *Harran Univ Vet Fak Derg*, 1(2), 111-116.