

## Some Histological Characteristics and Histochemical features of the Esophagus in Indigenous Adult Male Eurasian Collared Dove (*Streptopelia decaocto*)

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### Abstract:

**Background:** The glands were more expanded in the thoracic region compared to those in the cervical region.

**Aims:** This study aimed to investigate the histological and histochemical characteristics of the esophagus of Eurasian collared doves to provide basic data for physiological and pharmacological investigation.

**Results:** Histologically, the esophagus was comprised of the following layers: mucosa, submucosa, muscularis, and serosa. The mucosa was formed by non-keratinized stratified squamous epithelium, then lamina propria, loose connective tissue with glands. The muscularis mucosa was formed of thin longitudinal bundles of the smooth muscles and longitudinal folds in the cervical region of the esophagus. The submucosa was made of a thin layer of loose connective tissue. The muscularis was made of circular and longitudinal smooth muscle layers. The mean thickness of the muscularis in the thoracic region was greater than the cervical one. The mucosal folds in the cervical region were longitudinal and greatly deeper than those present in the thoracic region of the esophagus. The submucosa was made of a thin layer of loose connective tissue. In the cervical region, the mean mucosal and submucosal thicknesses were thicker than those detected in the thoracic region. The muscularis was made of circular and longitudinal smooth muscle layers. The mean thickness of the muscularis in the thoracic region was greater than the cervical one. The mean thickness of connective tissue in the tunica was thicker than that in the thoracic one.

**Conclusions:** The esophagus of these birds was histologically similar to those recorded in mammalian esophagus, and the mucous glands were prominently detected in both cervical and thoracic esophageal regions.

**Keyword:** Esophagus, digestive system, Histochemistry, avian, collared dove



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## Introduction

The Eurasian collared dove, *Streptopelia decaocto*, is an invasive avian species that breeds close to human habitation, typically wherever food resources are abundant and there are trees available for nesting (Beckett, 2007). Birds have a special type of digestive system unlike other species to accommodate chemical and physical features of a wide variety of food types (Klassing, 1999). The birds have a single body cavity and do not have a diaphragm. In addition, birds have beaks and gizzards instead of heavy bones and muscular and dental structures that are characteristics of mammals and reptiles (Dyce, 2010). In fact, the morphology of an organ system is different according to the feeding, habitat, and nature of lifestyle; such a phenomenon is called adaptation (Tomar et al., 2015). The digestive system in birds is composed of the buccal cavity, pharynx, esophagus, proventriculus, gizzard, small intestine, large intestine, and cloaca (Dyce, 2010). The bird's foregut is comprised of the esophagus and stomach (Shehan, 2012). The long esophagus leads into the short proventriculus (Rus et al., 2000). The esophagus is a hollow organ that lies on the right side of the neck, running dorsally to the trachea and cranially to the thoracic entrance. It returns to the median line and expands ventrally to form the crop (Rodrigues et al., 2012); only in the captive bustards does the esophagus not form the crop (Bailey, 1997). The esophagus is conveying food into the simple muscular stomach and then subsequently into the intestines (Szczezan, 2008). The stomach in birds is highly distensible; in the proventriculus, chemical digestion commences, and the food is passed as a yellowish chyme through the pyloric sphincter into the small intestine. The avian esophagus consists of two regions that are cervical and thoracic (Yovchey et al., 2012 & Shiina et al., 2005). The aim of this study was to describe the histological phenomenon called adaptation (Tomar et al., 2015). The digestive system in birds is composed of the buccal cavity, pharynx, esophagus, proventriculus, gizzard, small intestine, large intestine, and cloaca (Klassing 1999). The bird's foregut is comprised of the esophagus and stomach. The long esophagus leads into the short proventriculus (Rus et al., 2000). The esophagus is a hollow organ that lies on the right side of the neck, running dorsally to the trachea and cranially to the thoracic entrance. It returns to the median line and expands ventrally to form the crop (Rodrigues

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## **Materials and Methods:**

### **Sample Collection**

The present study was carried out on fifteen specimens of the esophagus of adult healthy local male Eurasian Collared Dove *Streptopelia decaocto*. The birds were euthanized by intramuscular injection of a mixture of ketamine and diazepam at doses of 25 and 5 mg/kg of body weight, respectively (Shindala, 1990 & Farhan et al., 2024). Then birds were slaughtered, and specimens of their esophagus were washed with the normal saline solution (0.9%). five specimens from different regions of each of the cervical and thoracic regions of the esophagus. Subsequently, they were fixed by 10% formalin for 24 hours at room temperature, then treated by the routine histological processing (Almayahi M.S., 2024 & Luna, 1968), and embedded with the paraffin wax (58-60°C) and sectioned to 5-7 µm. The provided tissue slides were stained by Harris Hematoxylin and Eosin (H&E) for demonstrating the general histological components of the esophagus and Periodic Acid Schiff (PAS) for the histochemical aspect. The tunicae thicknesses of the esophageal wall of each of the cervical and thoracic regions of the esophagus were measured. Ten areas in each section were chosen to conduct such measurements. The mean (X-) and the standard error (S.E.) were calculated for 5 slides for cervical and thoracic regions of the esophagus (Almayahi, 2024). Light microscopic examination showed that the wall of each of the cervical and thoracic regions of the esophagus was composed of four tunicae (mucosa, submucosa, muscularis, and serosa) (Fig. 1-4). The tunica mucosa was the innermost layer that directly surrounded the lumen of the esophagus and was composed of three coats: lining propria, epithelium, and lamina muscularis mucosa (Fig. 2). The cervical and thoracic regions of the esophagus were lined by non-keratinized stratified squamous epithelium (Figs. 3 & 4).

### **Ethics approval:**

All experimental procedures were conducted following ethical guidelines for animal care and use, with approval from the Institutional Animal Care and Use Committee (IACUC) of the University of Baghdad (Approval No. VET2025/03).

**Results:**

**Table (1): Measurement of thicknesses of the wall tunicae of the esophagus of the male Eurasian Collared Dove ( $\mu\text{m}$ ) ( $m \pm SE$ ).**

Regions	Tunica mucosa				Tunica submucosa	Tunica muscularis			Tunica serosa
	Total	epithelium	Lamina propria	Muscularis mucosa		Total	inner	Outer	
<b>Cervical region</b>	611.2 $\pm$ 6.1	55.6 $\pm$ 1.6	327.1 $\pm$ 6.2	288.6 $\pm$ 3.3	70.2 $\pm$ 1.5	442.2 $\pm$ 1.6	260 .1 $\pm$ 4.5	181.2 $\pm$ 1.6	41.2 $\pm$ 0.4
	<b>Thoracic region</b>	440.3 $\pm$ 5.6	43.6 $\pm$ 1.2	291.1 $\pm$ 4.1	109.7 $\pm$ 1.4	52.6 $\pm$ 0.6	621.2 $\pm$ 7.1	396 .2 $\pm$ 2.3	223.6 $\pm$ 1.4



**Figure (1):** Cross section of the esophagus thoracic region showed lumen (A), mucosa (B), submucosa (C), muscularis (D) and serosa (E) (arrow). H&E, X40.



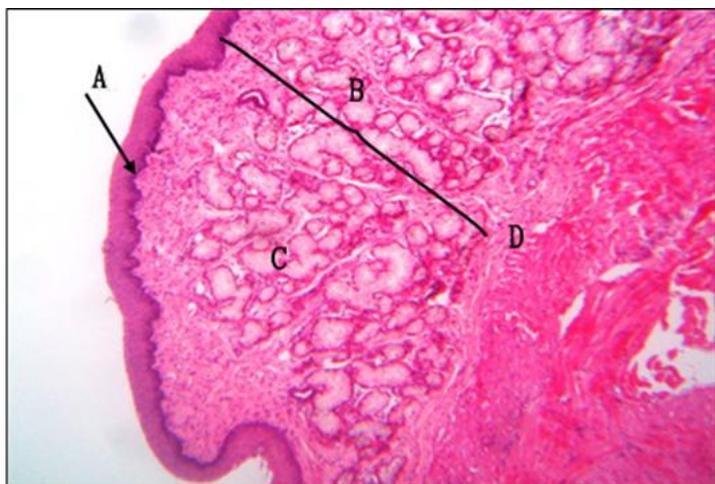
**Figure (2):** Cross section of the thoracic region showed lumen (A), mucosa (B), submucosa (C), muscularis (D) and serosa (E) (arrow). H&E, X100



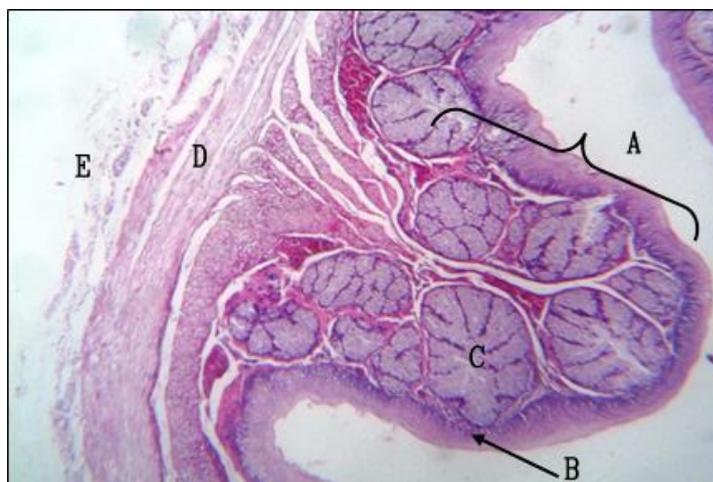
**Figure (3):** Cross section of the cervical region showed lumen (A), submucosa (B) , muscularis (C), no glands. H&E, X40.



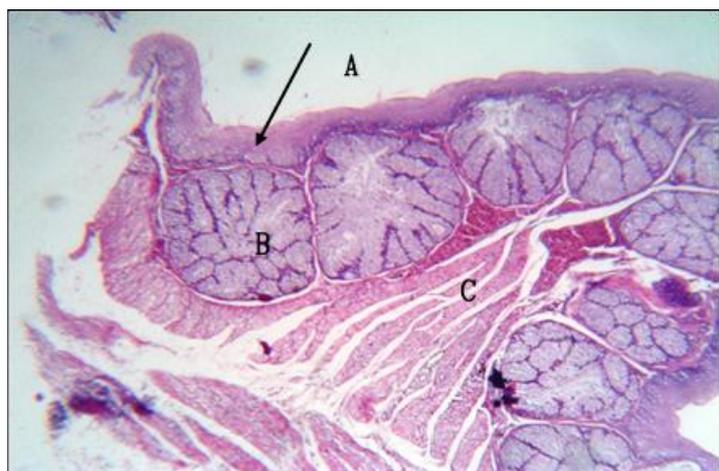
**Figure (4):** Cross section of the cervical region showed folds (A), epithelium (B), muscularis mucosa (C), glands (D). H&E, X40.



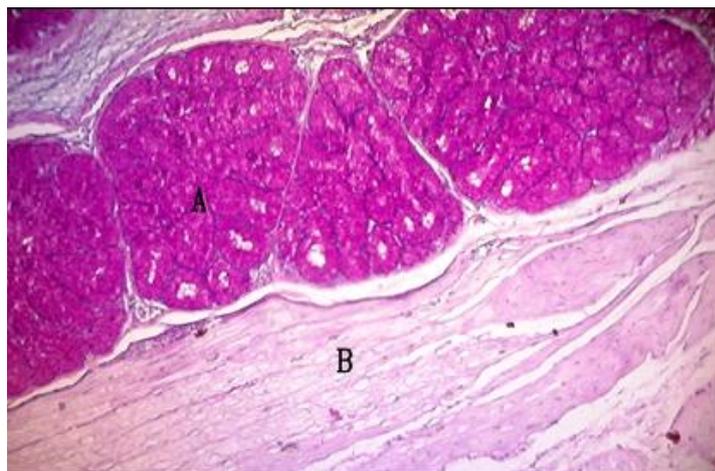
**Figure (5):** Cross section of the thoracic region showed epithelium (A), lamina propria (B), glands (C) and muscularis mucosa (D). H&E, X 100..



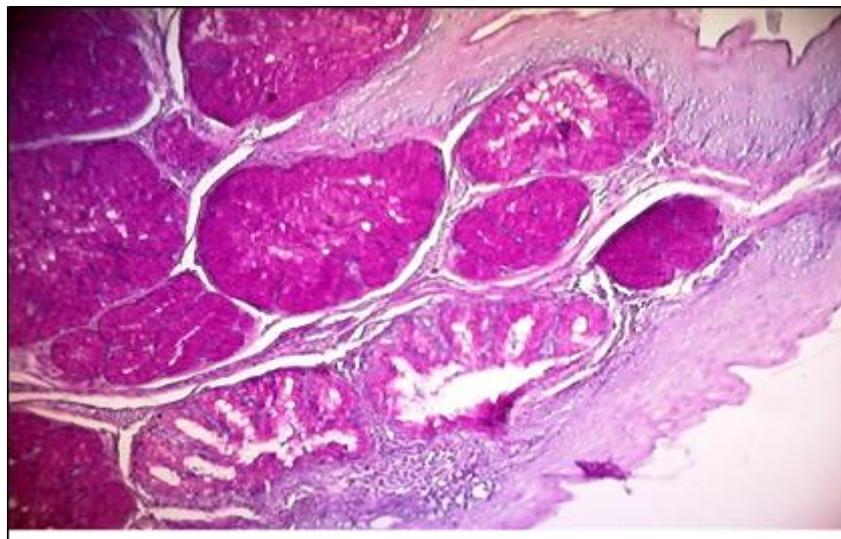
**Figure (6):** Cross section of the cervical region showed longitudinal fold (A), epithelium (B), glands (C), muscularis (D) and serosa (E), H&E, X100.



**Figure (7):** Cross section of the thoracic region showed epithelium (A), glands (B) and muscularis mucosa (C), H&E, X100.



**Figure (8):** Longitudinal section of the cervical region showed mucous glands (A) and muscularis (B). PAS, X100.



**Figure (9):** Longitudinal section of the thoracic region showed mucous glands (A) and lymphatic tissue (B). PAS, X100.

## Discussion

Present findings showed tunica mucosa formed by non-keratinized stratified squamous epithelium, lamina propria, and muscularis mucosa, and such observations were in accordance with previous records in the esophagus of both emu and chicken (Al-Rawi, 1980; Crole, 2009), but it appeared differently to the epithelium of the esophagus in white stork and wild birds, where it was found to be keratinized stratified squamous (RusV2000 & Sisson, 1985). Regarding the estimated thicknesses, the mean of the thickness of tunica mucosa was decreased in the direction toward the last parts of the thoracic region of the esophagus; a result appeared in good agreement with previous findings (Parchami, 2011) in common quail. This characteristic feature reflects a relationship between mucous glands and the esophageal longitudinal folds in parts of the esophagus. This feature may reflect the importance of lubrication and protecting of the mucosa for the passage of food particles, so that a greater height of epithelium in the cervical region will enhance the protective mucosal response (Aughey 2001 & Ali MA 2014). These results may have resulted from the decreased mean of the height of the folds and cells of mammals (Ebrahim, R., 2009). Currently, the tunica muscularis showed two sublayers: an inner circular and an outer longitudinal, which was similar to records of Battah (2009) but different from Rossi (2006), who mentioned that the cervical region of the esophagus in the Partridge raynchotus enclosed three layers: inner longitudinal, medium circular, and outer longitudinal. The tunica muscularis at the thoracic region of the esophagus of the avian esophagus is formed of smooth fibers and not striated as in mammals (Aughey, 2001). The mean thickness of the tunica muscularis in the cervical region was thinner than that in the thoracic region of the esophagus, a result that appeared in good agreement with Parchami (2011). Previous records (Crole, 2009; Szczepanczyk et al., 2000) found the thickness of the tunica muscularis of the quail and goose esophagus in the thoracic region to be thicker than that in the cervical region, and in males, it is thinner than that in female quail. In fact, the contractions of the muscularis can push the food to the gizzard (classing 1999). Similarly to wild birds (Szczepan, 2004; Atiyah, 2025), the tunica muscularis is surrounded by

the tunica adventitia at some sites of the cervical region of the esophagus and by the tunica serosa at all thoracic regions of the esophagus (Atiyah, 2025; Khalaf, 2025).

**Conclusions:** Esophagus parts are composed of four layers: mucosa, submucosa, muscularis, and adventitia or serosa. The mucosal layer was arranged in folds, which were longer in the cervical part and constituted by non-keratinized stratified squamous epithelium. The lamina propria had esophageal glands in the cervical and thoracic regions. The mucoid secretion lubricates the oral cavity and the esophagus; hence, it facilitates the moistening.

**Recommendations:** It is recommended to study the esophagus using an electron microscope to investigate the layers of this organ.

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**Authors Contributions:** The researchers contributed equally in this research.

#### References:

- Beckett, S. M. Komar, N. and Doherty, P. F. (2007): Population estimates for Eurasian collared-dove in northeastern Colorado, The Wilson Journal of Ornithology, 119 (3): 471-475. DOI: <https://doi.org/10.1676/05-064>.
- Klasing, K. C. (1999): Avian gastrointestinal anatomy and physiology. Semin. Avian Exotic. Pet. Med., 8:42-50.
- Dyce, K. M. , Sack, W. O. and Wensing, C. J. G. (2010): Textbook of veterinary anatomy.4<sup>th</sup> ed. The anatomy of birds. W B. Saunders company. Philadelphia. Pp:794-796. DOI: [https://doi.org/10.1016/S1055-937X\(99\)80036-X](https://doi.org/10.1016/S1055-937X(99)80036-X)
- Tomar, M.P.S.; Joshi, H.R.; Ramayya, P.J.; Vaish, R. and Shrivastav, A.B. (2015). Avian Esophagus: A comparative Microscopic Study In Birds With different Feeding Habitats. International journal of Medical and Health sciences, 9(8): 5-6.
- Shehan. N. A. (2012): Anatomical and histological study of esophagus in geese (*Anser anser demesticus*). Bas. J. Vet. Res. 11(1):13-22.
- Rus, V.; Miclaus, V.; Nadas, G.C and Cadar, D. (2000): Structural particularities of the White stork (*Ciconia ciconia*) esophagus. Annals of RSCB , V14(1) Pp:177-179. DOI: <https://dx.doi.org/10.24193/subbbiol.2021.2.02>

- Rodrigues, M.N.;Oliveira, G.B.; Silva R. ;Tivane C.T.;Albuquerque J.F.G.;Mi-gliano M.A.and Oliveira, M.F. (2012): Gross morphology and topography of the digestive apparatus in rheas (*Rhea americana americana*). *Pesquisa Veterinaria Brasileira*, 32(7): 681-686 <http://dx.doi.org/10.1590/S0100-736X2012000700018>
- Bailey,T.A.; Mensah,E.P.; Samour, J.H.; Naldo, J.; Lawrence,P.and Garner, A.(1997): Comparative morphology of the alimentary tract and its glandular derivatives of captive bustards. *J. Anat, Cambridge*, 191: 387-DOI: [10.1046/j.1469-7580.1997.19130387.x](https://doi.org/10.1046/j.1469-7580.1997.19130387.x).
- Szczepan,D.E.and Wesolowska,I.(2008):Morphometric characteristics of esophagus and intestine in tufted ducks (*Aythya fuligula*),wintering on the Baltic coastal areas in North –Western Poland, *Electronic J.of Polish Agricultural uni*.11(4):35-39.
- Yovchev, D.; Dimitrov,R.; Kostov and Vladova,D.(2012): Age morphometry of some internal organs in common pheasant (*Phasianus colchicus*), *Trakia J.of Sci.*,10(3) : 48-52.
- Shiina, T.; Shimizu, Y.; Izumi, N.;Suzuki, Y.; Asano, M.; Atoji, Y.; Nikami, H.and Takewaki, T. (2005): A comparative histological study on the distribution of striated and smooth muscles and glands in esophagus of wild birds and mammals. *J. Vet. Med. Sci.* 67(1): 115–117. DOI: <https://doi.org/10.1292/jvms.67.115>
- Shindala ,M.K.(1990): Anesthetic effects of ketamine, ketamine with diazepam in chicken . *Iraqi Vet.J.Sci.*12:261-265. [https://vetmedmosul.com/article\\_167931.html](https://vetmedmosul.com/article_167931.html)
- Farhan, N. A., & Hussein, A. A. (2024). Morphometric comparative study of the pancreas between the owl bird and the moorhen bird. *Diyala Journal for Veterinary Sciences*, 2(3), 75-83-<https://doi.org/10.71375/djvs.2024.02308>
- Almayahi, M.S.(2024).Histologicaland Histochemical study of Lungs in Domestic Rabbits (*Oryctolagus Cuniculus*). *Diyala Journal for Veterinary Sciences*,2(4) 1-14.DOI: <https://doi.org/10.71375/djvs.2024.02401>
- Luna, I. G. (1968) : Manual of histology staining methods of the armed force institute of pathology. 3P<sup>rd</sup>P ed. *McGraw. Hill book company. New York*, Pp :33 ,76 -168
- Al-Rawi, K.M. and Kalaf-Allah, I.S. (1980) : Design and Analysis Agriculture Experiments. *Dar- Al Kutub-Mosul, Iraq*, Pp: 65, 95-107. DOI: <https://doi.org/10.3390/molecules29153495>
- Crole, M. R.(2009): A gross anatomical and histological study of the oropharynx and proximal esophagus of the emu (*Dromaius novaehollandiae*). MSc dissertation, *Unive.of Pretoria*.Pp: 30-110.
- Sisson, S. and Grossman, J.D.(1986): Anatomia dos animais domestic.5ed,Rio de Janeiro:*Guanabara Koogan*.Pp:100-200.
- Ebrahim,R. and Abolghasem,N.(2009): Histological study on the esophagus and crop in various species of wild bird .*Avian Biology Research*, 2(3): 161-164. DOI:<https://doi.org/10.3184/175815509X12474789336122>

- Parchami,A. and Dehkordi,R.A.F.(2011): Histological characteristics of the esophageal wall of the common quail (*Coturnix coturnix*).*World applied sciences j.* 14(3):414-419.
- Aughey , E. and Frye, F.L.(2001) : Comparative veterinary histology with clinical correlates, *Manson publishing Ltd*, Pp : 105-113. DOI; <https://doi.org/10.1201/b15184>
- Ali, M.A. (2014). Anatomical and histological study of esophagus in (*Lorasmelono cephalus*) at Basra city. *AL-Qadisiya Journal of Vet. Med. Sci.* 13 (1): 100-104. DOI; <http://dx.doi.org/10.29079/vol13iss1art291>
- Lei Zhu. (2015). Histological Study of the Oesophagus and Stomach in Grey-Backed Shrike (*Lanius tephronotus*). *Int. J. Morphol*,33(2):459- 464.
- Nagy, N.;Magyar, A.; Gazadag, E. and Palya,V.(2005) : Esophageal tonsil of the chicken. *Acta vet hung*.53(2):88-173. DOI: <https://doi.org/10.1556/avet.53.2005.2.3>
- Battah,A.L.(2009): Histological and histochemical study of the digestive tract in homing pigeon (*Columba livia domestica*), MSc dissertation, *University of Basra ,Collage of vete. med.***Pp: 10-100.**
- Rossi, J. R.; Baraldi, S.M. and Oliveria, D.(2006): Morphology of esophagus and crop of partaide *Rhynchotus rufescens*. *Maringa* ,28(2):165-168
- Szczepanczyk,E. Kalisinska, E.;Ligocki,M. and Bartyzel,B.(2000): Morphometry of esophagus and gut in bean goose (*Anser fabalis*).*Zoologica Poloniae* 45(1-4):37-46.
- Szczepan,D.E.(2004): Mophometric characteristic of esophagus and intestine in black scoter, *Melanitta nigra (Anseriformes)*,wintering in the Polish Baltic coast , *Vestnik zoo.*, 38(4): 31–37.
- Atiyah, A.J.,Effects Dietary of ArginineandN-carbamylglutamateon Heamatological and Performance Traits of Female Rabbits,Vol.3,No.1,pp142-154. DOI: <https://doi.org/10.71375/djvs.2025.031010>
- Khalaf,A.S.(2025),Histomorphological Study of Tongue in Moorhen (*Gallinulla chloropus*), *Diyala Journal for Veterinary Sciences*,3(1),pp 89-104. DOI; <https://doi.org/10.71375/djvs.2025.03107>