

Morphological Study of the Esophagus in the Domestic Fowl *Gallus Gallus Domesticus* (Linnaeus 1758)

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Abstract

The esophageal morphology of domestic fowl (*Gallus gallus domesticus*) was investigated to fill the dearth of information on the morphology of esophagus from available literature and help in understanding its digestive tract biology. The esophagus is under study as musculomembranous tubular shape, it began from oropharyngeal cavity and terminated on the proventriculus. The esophagus was divided into three regions are represented by cervical part, crop, and Thoracic part. Internal lining of the esophagus consisted of un-branched straight longitudinal folds The length of the cervical part, crop and thoracic part were 11.5 cm, 3.5 cm, 6 cm respectively.

Key words: Avian, chicken, esophagus, *Gallus gallus domesticus*.

Introduction

The avian digestive tract is a continuous tube that opens at either end (beak and vent) to the outside world and consists of a mouth, esophagus, crop, proventriculus, ventriculus or gizzard, intestine, ceca, rectum, and cloaca. As food progresses The oesophagus is a narrow, muscular, highly- distensible tube extends from the pharynx and joins with the stomach¹. Sisson et al (1986) ² observed that the avian esophagus is on the right side of neck (mammal present it was on left side) and it was placed between the pharynx and stomach glandular portion, it was thin and dilatable walls with a diameter relatively larger than of mammals. According to ³ the avian esophagus consist of two parts, cervical and thoracic, while in mammals through these organs, a specific sequence of digestive events occurs, including grinding, acidifying, hydrolyzing, emulsifying and transporting of the end products ⁴.

There was three parts, cervical, thoracic and abdominal. At the thoractical part of the avian

alimentary tract, oesophagus enlarge to form the crop, so that, the cervical part functionally acts to lubricate the food and contact it into the thoractical part in which the food is stored and released into the other parts of the alimentary tract ¹. The distensibility of the avian oesophagus, however, comes from the longitudinal folds in the inner layer of it. Unlike mammals, the avian oesophagus don't have any sphincter in both upper and lower regions of it ⁵. Crop structure and function vary according to the species and the diet, the crop is absent in the gulls and penguin so food passe directly or it is stored in the tubular esophagus ⁶. The crop in duck and goose as in most birds is merely a fusiform enlargement of the esophagus ⁷, crop takes a simple spindle shape while in pigeon as an herbivorous, it took a more complicated structure, whereas some granivorous species have no true crop and can store their food in a very distensible oesophagus ⁸. Crop may provide a type of protection for birds by its storage function that allows the ingestion of the stored food in the evening providing the overnight energy needs, in the other hand, it also allows the birds to ingest their

food rapidly and softly by swallow the water giving the important security for them⁹. The digestive system of birds has adaptations to facilitate flight. Many birds operate on a thin margin of metabolic safety and may require a constant source of feed to sustain activity. Birds cannot afford to store heavy food materials for long periods and digest their food rather quickly relative to mammals¹⁰.

Materials and Method

Twenty adult specimens of species domestic fowl (*Gallus gallus domesticus*) were obtained from different localities at Baghdad city, Iraq. They were collected during December 2020 until February 2021, the animals were brought to the laboratory alive the animals were anesthetized and decapitated according to the international protocol for biomedical investigation with human being and animals, then dissected carefully by making at longitudinal incision at the middle line of skin from ventral surface starts from first cervical vertebrae access to pelvic region, then the skin separated from muscles, which under it. The thoracic region mad transverse incision, then the skin was drawn from muscles. The peripheral muscles were removed within ventral wall, then to cut right part of ventral wall, followed by cut left part of ventral wall and to complete incision across to thoracic girdle. The gastrointestinal tract was extirpated and esophagus was remove and measurement related to formation study were taken which are length of cervical crop thoracic parts.

Results

The esophagus of domestic fowl (*Gallus gallus domesticus*) (Fig. 1) was muscular membranous, tubular shape, which began from oropharyngeal cavity and terminated on the proventriculus (Fig. 2). The esophagus divided into the three regions represented by cervical part, crop and thoracic part (Fig. 3). The cervical part of esophagus was located in the right

side of neck and began with the end of the oropharynx and intertwined on the trachea, the length of cervical part of the esophagus was 11.5 cm. The crop was sac-like structure protruded in the upper part of the body of birds began before the entering of the thoratical cavity, it had a thin wall and very low inner folds (Fig.4), crop length was 3 cm and thoracic part where the crop returned to narrow was length 6 cm . The lining of esophagus in chicken seems white color in three part (cervical, crop, thoracic), and cervical part of esophagus was composed of about 5 un- branched high straight longitudinal fold, but the thoracic part have contains about 7 un-branched straight lower longitudinal folds (Fig.4).



Figure 1: Class: Aves Order: Galliformes Family: Phasianidae Genus: *Gallus* Species: *gallus*.

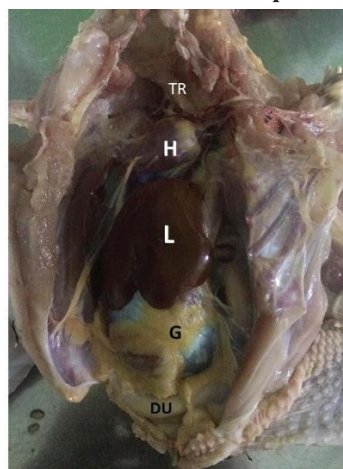


Figure 2: Ventral view of thoracoabdominal cavity. L, liver; H, heart; G, gizzard; Du, duodenum; TR, trachea .



Figure 3: Forms,location of esophaous in *Gallus gallus domesticus*. CER, cervical part; C, crop; THO, thoracic part; L, liver; GB, gall bladder; G, gizzard; DU, duodenum; CO, Colon; CL, cloaca; P, pancreas ; SI , small intestine.



Figure 4: Inner view of esophagus showing LF, Longitudinal folds; CER, cervical part; THO, thoracic part; C, crop.

Discussion

Results of the present study showed that the oesophagus in the domestic fowl under investigation was an organ located in right side of neck and situated between the pharynx and stomach glandular this result agree with ^{2, 11}.

Peristaltic contraction of inner circular and outer longitudinal muscles in the tunica muscularis propels food posteriorly through the esophagus, Esophagus

was divided into three anatomical regions these are cervical oesophagus, crop and thoracic oesophagus as it was found by ¹². Cervical part longer than thoraces, This result in agreement with Samuelson (2007) who study the esophagus in partied *Rhynchotus rufescens*, also in similar with Das *et al.* (1967) during his study on goose esophagus. To aid in swallowing large food items, the esophagus is expandable as a result of a series of longitudinal folds, This accordion-like arrangement is enriched with mucous glands to provide lubrication that result agree with Rasha *et al.* (2015) in wood pigeon (*Columba palumbus*) and The barn owl *Tyto alba*, also agree with Al Kinany (2017) in Breasted Kingfisher (*Halcyon symernensis*).

The esophagus widens into a crop just before entering the thoracic cavity, It appears primarily in the esophagus Grain- eating birds (Granivorous) Where is a place To store and hydrate food (Parachami and Dehkordi, 2011) while being lost in Others, such as gulls (*Larus melanocephalus*) (Ali, 2014) and Bustards(Bailey *et al.*, 1997) .

The crop is a sac-like enlargement on the esophagus. This description similar with Rasha *et al.* (2015) who studied esophagous of wood pigeon and Shehan (2012) but different with Al Kinany (2017) and Al-Jumaily and Al-Borzng (2016) who studied Esophagus in White Breasted Kingfisher (*Halcyon symernensis*) (Piscivorous) who founded that the bird don't had crop, Similar with Rodrigues *et al.* (2012) and Bailey *et al.* (1997) on his study on in rheas and captive bustards respectively. Some granivorous species (eg. Cardueline Finches) do not have a true crop, but they usually have a very expandable esophageal pouch that can store food items ⁴. The presence of large folds of mucosa in crop allows considerable expansion and shrinkage, depending on the amount of contents. Immediately cranial to the thoracic inlet, the crop narrows to reform an esophageal tube and passes between the coracoid bones to the right of the syrinx and dorsal to the heart (Evans, 1996). Within the crop, food softens as a result of hydration by saliva added to food during

swallowing, mucus secreted into the crop, and water consumed after a meal. More significant digestion may occur because of the presence of enzymes in the food itself or from microbial action in the warm moist environment of the crop, the crop also provides a temporary storage area that permits a bird to rapidly forage for large amounts of food and then fly off to digest the meal in safe cover. A crop also permits “tanking up” in the evening, so that food can be slowly released to supply nutrients during the nighttime (Soedarmo *et al.*, 1961 and Hainsworth *et al.*, 1972). The crop and the esophagus play an important role in nourishing the young by permitting the storage and softening of food, which is later regurgitated into the beak of the nestlings. The nutritional and immunologic contribution of the hen to the regurgitated food is not known for most species, but is important in pigeons⁹. The crop represents the first major defence against poultry pathogens and zoonotic organisms with well-established adaptive and innate immune function, and a lactobacilli dominated microbiota capable of reducing the passage of these organisms further along the digestive tract (Classen *et al.*, 2016).

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Conflict of Interest: None to declare.

Ethical Clearance: “All experimental protocols were approved under the Department of Biology and carried out in accordance with approved guidelines”.

References

- Hodges R. The histology of the fowl . Academic press, London. 1974.
- Sisson S, Grossman J. Anatomia dos animais domestic.5ed,Rio de Janeiro:Guanabara Koogan. 1986.
- Levin, R. Absorption from the alimentary tract ,in physiology and chemistry of domestic fowl .(Ed) B. M. Freman. Academic press,London. 1984; 5:1-9.
- Kirk C, Klasing, B. Avian Gastrointestinal Anatomy and Physiology. Seminars in Avian and Exotic Pet Medicine. 1999; 8(2): 42-50.
- Parachami, A, Dehkordi R . Histological characteristics of the esophageal wall of the common quail *Coturnix coturnix*. World applied sciences journal. 2011; 14(3): 414-419.
- Nickel R, Schumer A, Serterele, E. Anatomy of domestic birds ,Berlin: verlag paul parey. 1977.
- Dyce K, Sack, W, Wensing C. Text book of veterinary anatomy, W.B. sounders, CO, Philadelphia London . 2002; 780 -781.
- Gelis S. Evaluation and treating the gastrointestinal system. Clinical Avian Medicine. 2013; 1(14): 412-416.
- Horseman, N, Buntin, J. Regulation of pigeon crop-milk secretion and parental behaviors by prolactine. Annu. Rev. Nautr. 1995; 15: 213-238.
- Rob DV. Avian Digestive System . Minnesota Veterinary Diagnostic Laboratory. 2012: 612-624.
- Hamdi H, El-Cehareeb, A, Zaher, M, Abu Amod F. Anatomical, histological and histochemical adaptation of the avian alimentary canal to their food habits: II *Elanus caeruleus*. J. Sci. Engin. Res. 2013; 4(10) :1355-1367
- Ivey W, Edger S . The histogenesis of the esophagus and crop of chicken, turkey, guinea fowl and pigeon, with special reference to ciliated. The anatomical record. Article first published online. 2005.
- Al Kinany, M. Histological Study of Esophagus in White Breasted Kingfisher (*Halcyon symmerensis*). Wasit Journal for Science & Medicine. 2017; 10(1): (33-42).
- Ali, M.A. (2014). Anatomical and histological study of esophagus in *Larus melanocephalus* at Basra city. Al-Qadisiya J. Vet.Med.Sci.,13(1):120-123.
- Al-Jumaily, I, Al-Borzng, I. Histological study of oesophagus in white breasted kingfisher *Halcyon smyrnensis*. Journal of Madenat Alelem University College. 2016; 8(2): 29-39.
- Bailey, T, Mensah, E, Samour, J. Comparative morphology of the alimentary tract and its glandular derivatives of captive bustards. J. Anat, Cambridge. 1997; 191: 387-398.
- CLASSEN, H, APAJALAHTI, J.; SVIHUS, B. The role of the crop in poultry production . World’s Poultry Science Journal. 2016; 72 .

18. Das L, Biswal, G. Microscopic anatomy of esophagus, proventriculus and domestic duck (*Anas boscuca*), India Vet. J. Chennai. 1967; 42: 320- 326.
19. Evans H. Anatomy of the budgerigar and other birds, in Rosskopf WJ, Woerpel RW (eds): Diseases of Cage and Aviary Birds (ed 3). London, UK, Williams & Wilkins. 1996; 79-162.
20. Hainsworth F, Wolf, L. Crop volume, nectar concentration and hummingbird energetics. Comp Biochem Physiol A Physio. 1972; 142A: 359 366.
21. Mule, F. The avian esophagi molor function and it nervous control. some physiology pharmacological and comparative aspect. Comparative Biological Physiology. 1991; 99: 491-498.
22. Nickle R, Schummer A, Seiferle, E . Alimentary tract of the head. In Anatomy of the Domestic Birds (translated by Siller, WG, Wright PAL). 1977; 41–72.
23. Rasha W, Hussein A. Comparative anatomical, histological and histochemical studies of the oesophagus in two different Iraqi birds (*Columba palumbus* and *Tyto alba*). Int. J. Adv. Res. Biol. Sci. 2015; 2(12): 188–199.
24. Rodrigues, M, Oliveira, G. Gross morphology and topography of the digestive apparatus in rheas (*Rhea americana americana*). Pesquisa Veterin RIA Brasileira. 2012; 32(7): 681-686.
25. Rossi JR, Baraldi-Artoni, S, Oliveria D. Morphology of oesophagus and crop of the partridge *Rhynchotus refescens* (Tiramidae). Acta sci. boil. Sci. 2006; 28(2):165-168.
26. Samuelson D. Textbook of veterinary histology saunders Elsevier,China 2007; 348-352.
27. Shehan, N. Anatomical and histological study of the oesophagous in geese (*Anser anser demesticus*). Bas. J. Vet. Res. 2012; 11(1): 13-22.
28. Soedarmo D, Kate M, Wasserman, R. Observations on the removal of sugar from the mouth and crop of the chicken. Pouh Sci. 1961; 40: 123-141.