



## Study of the esophagus in wild ducks and comparing it structurally and anatomically with the esophagus of cogen chickens

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### ABSTRACT

This study examined an anatomical and histological comparison of the esophagus for two types of poultry birds, the Wild ducks and the cogen chicken, the anatomical results showed that the esophagus in both birds is a relatively long, straight, tubular structure with a high capacity for expansion that connects the oral cavity to the stomach, and in ducks it is relatively long and extends on the dorsal side of the trachea. The airway is on the right side of the neck. It has a thin wall and has a high ability to expand because it contains many longitudinal folds, which contribute to absorbing large amounts of food. These folds make it difficult to identify the gizzard. The esophagus consists of two parts, a cervical esophagus and a thoracic esophagus.

As for the cogen chicken, the esophagus expands in the middle, forming a part known as the gizzard. It divides the esophagus into two parts, the upper part is called the cervical esophagus. The cervical part, or upper esophagus, represents the upper esophagus part of the esophagus, and the lower esophagus, which is called the thoracic part, is shorter than the upper esophagus. The esophagus is a bulge in the form of a thin-walled sac, consisting of two bilobed lobes, and its wall contains small, prominent folds. In its beginning.

Histologically, the esophagus of both birds consists of four tunics: mucous, submucosal, muscular and serous, and the epithelial layer contains stratified squamous epithelium. It is wide, and in the Cogen chicken it was almost keratinized, with the presence of simple tubular esophageal glands in both birds in the basic lamina of the wall, and their number was less in ducks than in chickens, and the muscular mucosal layer is not present in ducks, and its presence is limited only to the upper part of the esophagus, which is thin and longitudinal in arrangement.

As for the muscular and serous layers, they were in the same tissue arrangement, except for the difference in layer thickness. In ducks, it was thicker.

## 1. Introduction

Among the vertebrate animals, the digestive system in birds shows great variation depending on the emergence and development, type of diet, size of the animal, feeding habits, and various environmental pressures, as it shows a clear difference due to the structural and functional adaptation to their nutrition from different sources. The digestive system represents a functional link between the activity of searching for energy and conserving energy. By distributing energy to different activities [1]

The esophagus in birds is a relatively long, straight, tubular structure with a high ability to expand [2] It connects the end of the pharynx to the true stomach (glandular). In orchard birds, it extends along the neck, passing through the thoracic cavity, and is located on the right side of the neck and the dorsal side of the trachea [3], which allows the birds to swallow large amounts of food [4]. It contains a thin wall that can swell and expand, and contains many and larger longitudinal folds. Relatively in diameter compared to what is found in the milk, and the function of these folds is to increase the ability of the esophagus to expand and swell [5].

As for ducks and other birds, such as those that eat grass, meat, fish, and fruits, the diameter of the esophagus is relatively larger than that of birds that eat grains, insects, and birds that crush their food, such as parrots.[6].

The esophagus in birds is divided into four sections: the cervical esophagus, vesicular esophagus Crop Esophagus And Thoracic Esophagus[7] The thoracic esophagus is more abundant in blood than the cervical esophagus and appears darker in color[8].

From a histological standpoint, the esophagus consists of four basic layers: the mucosa, Submucosa, muscular The last layer is the serous layer Serosa Other times it is called the adventitia[9] The mucous layer is composed of an epithelial layer covered by non-keratinized stratified squamous epithelium. This has been indicated [10] To the presence of three layers and the absence of the submucosal layer.

It contains compound tubular glands called esophageal glands, which are columnar in shape with transparent cytoplasm and compact basal nuclei found in the mucous layer.[11] In the Psittacine bird (a species of parrot), the cervical and thoracic esophagus are lined with relatively thick stratified squamous epithelium.[3]. This

structure is commonly observed in many bird species, e. partridge house.[12] And inbird (kite)The black-shoulder kite has a mucous layer lined along its length with keratinized stratified squamous epithelium [13]. It has also been indicated [14] In their study on waterfowl; The non-keratinized stratified squamous mucus layer has been found in Kingfisher [10] and Common pheasants [15].

Numerous mucous esophageal glands are found in the basal lamina with simple columnar epithelium, in the white owl. barn owl The esophageal glands are complex alveolar glands located within the basic lamina of the mucous layer [16], while in ostriches, the glands are simple, straight tubular glands with loose to dense connective tissue in the basic lamina [17].

The tunica submucosae is found in the goose. Goose shaped fibrous tissue [18], In barn owls, it consists of dense connective tissue rich in blood vessels [16], it is absent in the kingfisher due to the difficulty of distinguishing it from the basic plate [10].

The tunica muscularis consists of two layers of smooth muscle, an internal circular and an external longitudinal layer[15]In his study on the common kite, this structure is commonly observed in other species of birds, but in the kite the inner part is longitudinal and the outer part is circular.[13].

The outer serous layer consists of connective tissue interspersed with distinct blood vessels and nerve endings [16], The serous layer in waterfowl is made of connective tissue interspersed with elastic collagen fibers [14]. And The serosa is covered by a thin layer of simple squamous epithelium. In the barn owl, the cervical part of the esophagus and the crop are surrounded by the serosa, and the thoracic part of the esophagus is surrounded by the serosa[16].

## Materials and methods : -

The birds under study were obtained during September of the year 2023 until December in different areas of the governorates in Iraq, Salah al-Din and Baghdad. Wild ducks were obtained from wild bird hunters in Baghdad, while cogen chickens were obtained from bird breeders / Tikrit University, where six bird was taken for each species after ensuring that they were free of diseases. The birds were transferred to the animal house at Tikrit University. First, the birds of both types were anesthetized with chloroform, and then

the two birds were dissected one after the other using dissection tools.

The dissection was done from the ventral side, from the beginning of the exit hole to the lower end of the beak. Then, the thoracoabdominal region was opened and the digestive system was completely removed from the upper esophagus to the end of the outlet opening and its accessory glands, the liver and the pancreas. The parts of the digestive system were washed with physiological solution (sodium chloride solution 0.75%) [19] 3-5 times in order to get rid of Food residues and intestinal secretions with caution.

After the clean parts were obtained, measurements were taken for the parts of the canal and its accessories, and then the parts were cut into small pieces and preserved in a 0.75% alcohol solution. They were transferred directly to the fixation medium, which is diluted 10% saline formalin, as the samples were preserved in the above-mentioned medium for 48 hours. It was then washed with running tap water for a quarter of an hour to remove any residue of the stabilizer. Then the samples were passed through an increasing series of concentrations of ethyl alcohol (Ethanol 70%, 80%, 90%, 100%, 100%) in order to gradually remove water from the tissues. After the process of removing water from them, the samples were transferred to pure xylene medium in two stages, for half an hour for each stage, in order to withdraw the alcohol. of the samples permanently and make them more transparent.

The samples were placed in a mixture of molten paraffin wax with a melting point of 58°C. The samples were impregnated in three transfers, at a rate of half an hour to an hour for each transfer. The samples were buried with the same type of wax used for impregnation using crystalline paraffin wax that was melted using a 420MElektro electric furnace. mag, with a melting point of 58 °C. The wax was poured into L-shaped metal molds measuring 2.5 x 1.5 cm. The wax molds containing the samples were cut after trimming them well using a Rotary microtom type 1508AKEDEE rotary cutting device, of Chinese origin, with a thickness of (6) micrometers. Transverse and sometimes longitudinal sections of all parts of the digestive tract were obtained, starting from the tongue to the rectum.

The sections were then transferred onto glass slides using egg whites to which glycerol (Ah-Meyer) was added, in equal sizes for both types. The two equal sizes were mixed in a small baker

and then It was dissected several times using several layers of medical gauze, and the slices were collected in a tightly sealed bottle and placed in the refrigerator until use, with the addition of (1) gram of Thymol crystals to prevent rotting.

The sections were loaded in order to eliminate the folds that occur during tissue cutting. Then, the glass slides were wiped with the aforementioned loading medium, and then the sections were placed on the glass slides, wiped and dried at laboratory temperature for 24 hours. The tissue sections were stained using Harris's hematoxylin and alcoholic eosin. The stained tissue sections were covered by placing a slide cover on them, which contains the covering medium used, which is Distrene Plasticizer Xylene (DPX), then the slides were left on a hot surface at a temperature of 37°C. For the purpose of drying it. Tissue sections taken from parts of the digestive system of both species were examined using an optical microscope (Miotic) under different magnification powers, and then the parts required for the tissue sections were measured using an ocular micrometer.

Anatomical and histological sections taken from different areas of the parts of the digestive system were photographed using Digital Camera Sony Cyber-Shot 12.1 M Pixel for anatomical sections and E-PWIMicroscopy Camera Eyepiece for PC 0.3M Pixel DC for histological sections and connected to an electronic computer such as a Laptop ASUS U50F. After that, the images were printed in color on color photographic papers using a color printer from Canon G 2000 type.

## **Results and discussion:-**

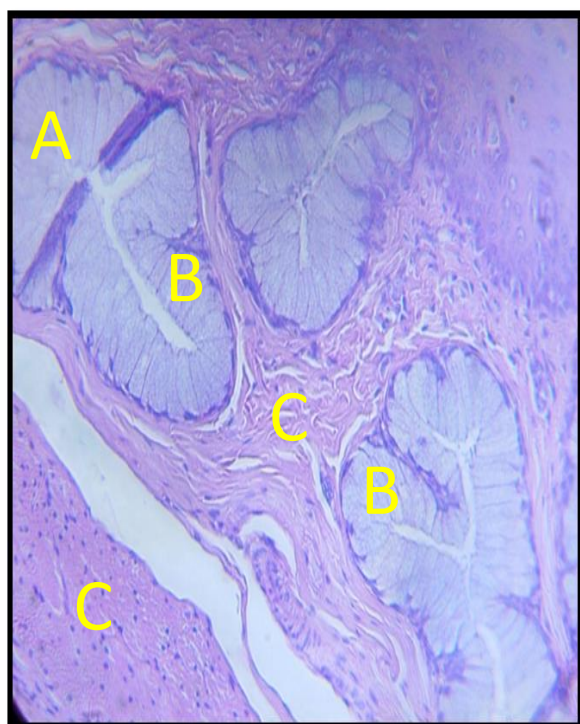
### **Esophagus of ducks**

The esophagus in ducks is relatively long and extends on the dorsal side of the trachea on the right side of the neck. It has a thin wall and has a high ability to expand because it contains many longitudinal folds, which contribute to absorbing large quantities of food. These folds make it difficult to identify the gizzard. The esophagus consists of two parts, the cervical esophagus and the thoracic esophagus.

Histologically, the esophagus consists of four tunica: mucosa, submucosal, muscular and serous, and the epithelial layer contains stratified squamous cells. Striated squamous epithelium Wide, continuous with the mucous glands on the primary page. These glands are lined with mucous cells with pale-pigmented cytoplasm and dark-

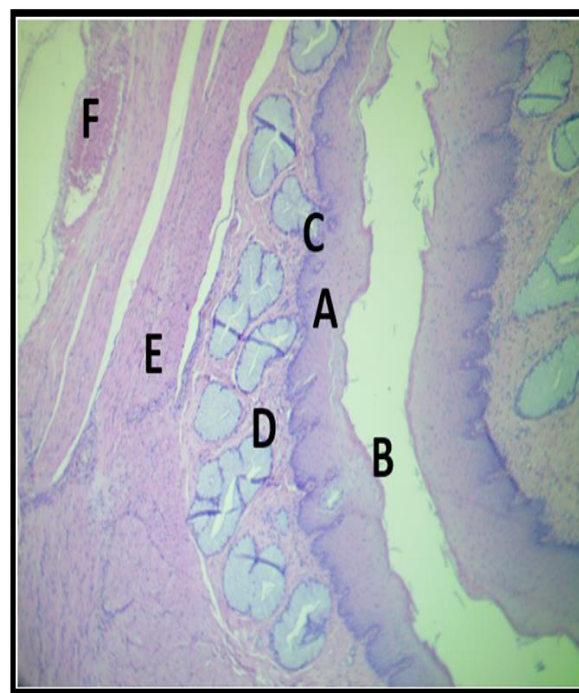


pigmented nuclei arranged together adjacent to the basement membrane of each gland. A thin band of keratin is found. Keratin On the surface of the epithelium facing the esophageal lumen, the row of basal cells of the epithelium appeared dark in pigment. The basic lamina contained mucous glandular units found in groups with pale cytoplasm and dark nuclei adjacent to the basement membrane of each gland. The cavities of the glands were continuous with the surface of the epithelium, and the basic lamina between the glands contained connective tissue composed of bundles of colloidal fibers and some white blood cells, as in Image (1).



**(Fig1)** Duck esophagus/extensive stratified squamous esophageal epithelium (A) Mucous glands in the basal (B) Colloid fiber bundles and white blood cells in the basal (C) (H & EX 40)

There was also a connection between the underlying lamina and the submucosal layersubmucosaThe muscularis mucosae layer was absent in ducks, as for the tunica muscularismuscularisIt contains two layers of smooth, longitudinally oriented muscle bundles, the outer part of which is circularly oriented, and contains blood vessels and soft fibrous tissue. As in the picture (2)



**(Fig2)** Duck esophagus contains stratified squamous epithelium (A), thin band of keratin (B), dark-colored basal layer of epithelium (C), mucous esophageal glands in the basal layer (D), smooth muscle layer wall (E), blood vessel (F) (H&EX 10).

And the adventitious layerTunica adventitia, which surrounds the upper esophagus, contains loose connective tissue covered with simple squamous cells, interspersed with blood vessels and nerves, and surrounded by fatty tissue. As for the thoracic esophagus, it is surrounded by the serous layer surrounded by mesothelium cells.

The esophagus is located on the right side of the neck, dorsal to the trachea. The esophagus consists of two parts, and this result is similar to[9] In her study to compare some of the digestive system organs between birdsparrot*Psittaculakrameri*And the kite*Elanus caeruleus*, And[18], who studied the esophagus of geese*Anserini*It contains wide longitudinal folds that help it expand easily, and thus compensate for the crop, and these results are consistent with what was reported.[9] in her studies, and [20] in the fish bird, and the results differ[21]inHis study on the esophagus*Coturnixcotarnix*And also[22], in their study comparing the digestive system between the Cochin chicken and the Coturnix quail, where they indicated the presence of a sac between the two parts of the esophagus for each of these types of birds. Carnivorous birds need a long esophagus in order to be able to swallow their food (prey), while carnivorous birds need

Grains lead to the presence of a large storehouse represented by the crop [23].

Anatomically, the esophagus and other parts of the digestive tract consist of four basic layers, and this is consistent with what other researchers reported[9], and this study is not similar to the results of [20] in her study on the esophagus of the white-breasted fish *Halcyonsmyrnenensis*, which indicated the presence of only three tunica and does not contain the submucosal tunica, and extending along the wall of the esophagus is a stratified keratinous squamous epithelial layer, as they noted.[14] In their study, this layer is also present in the esophagus of some other species of water birds, including the aquaticus Rallus, the common water chicken, *Gallinulachloropus*, the spotted marshmallow, *Porzanaporzana*, the Eurasian coot, *Fulicaatra*, and the small marsh, *Zaporniaparva*, which are considered small to medium-sized swamp birds or widespread water birds in the area. The ground confirmed this [24]. It is not consistent with the study [20] which indicated the absence of a keratin layer in the whitefish bird, noting that this bird feeds on fish, and this discrepancy is attributed to the close relationship between the tissue structure and the type of nutrition. The muscular mucosal layer is absent in the white-breasted fish *Halcyonsmyrnenensis*, as well as in domestic ducks [18] Lost the musculoskeletal layer.

The presence of esophageal glands and tubular mucous glands in the base plate, but the glands he found [14] In the wall of the esophagus, it is of the tubular-alveolar type of the birds he studied and is located in the basic lamina, while in the fish bird it is of the simple tubular type located within the epithelial lining. This discrepancy in the type and location of the glands is due to functional requirements and their relationship to the nature of nutrition. The cytoplasm of the esophageal gland cell showed a pale color, and this indicates the activity of the cell in producing mucus, because the presence of large droplets of mucus makes the cell pale in color in tissue dyes.

And the tunica muscularis found similar results with the results [14], as he indicated that the smooth contraction of the internal longitudinal and external circular muscles pushes food back through the esophagus, and the results are similar to [15]. In his studies on the pheasant, but in the white-breasted fish, he found that the inner layer was longitudinal and thin, and the outer layer was thick and circular. [20] In domestic ducks, similar results were found to our study [18].

As for the tunica serosa, its histological results are consistent with what you mentioned [20] in the white-breasted fish, as well as in the esophagus of some wild bird species in a study [24], with some differences with the results [14] in some aquatic birds.

The gizzard is not present in wild ducks. Instead, numerous longitudinal folds were found, which expand greatly when eating food. This result is similar to the result. [20] in her study on the fish bird, as well as [25] who pointed out Birds without gizzards store their food along the esophagus. The presence of mucous glands along the esophagus and the absence of the crop helps the prey pass easily from it to the stomach.

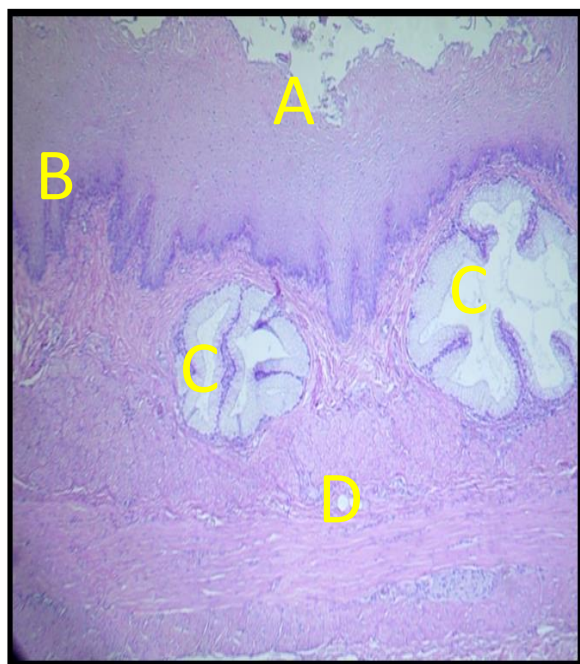
However [8] He pointed out the presence of the gizzard in birds, which is a sac located below the thoracic esophagus and before the true stomach, and lined with a glandular mucous membrane with a secretory function.

#### Chicken esophagus:-

The anatomical results in the cogen chicken showed that the esophagus is a muscular tube that connects the oropharyngeal cavity to the true stomach. It is characterized by its ability to expand and stretch because it contains many longitudinal folds in the inner layer of the esophagus wall. The esophagus expands in its middle, forming a part known as the gizzard. The esophagus is divided into two parts, the upper part is called the cervical esophagus The cervical part, or upper esophagus, represents the upper part of the esophagus, and the lower esophagus, which is called the thoracic part, is shorter than the upper esophagus. The crop is a swelling in the form of a thin-walled sac, consisting of two bilobed lobes, and its wall contains small, prominent folds at its beginning.

The relevant histological study of the part showed that The esophageal wall contained stratified squamous epithelial cells Stratified squamous epithelial tissue Wide In which Basal row cells Dr The dye is based on the basement membrane Basement membrane Then several rows of squamous cells Squamous cells Flat in shape and the presence of rows of sloughed off cells on the surface of the epithelial cells as in the (fig 3).



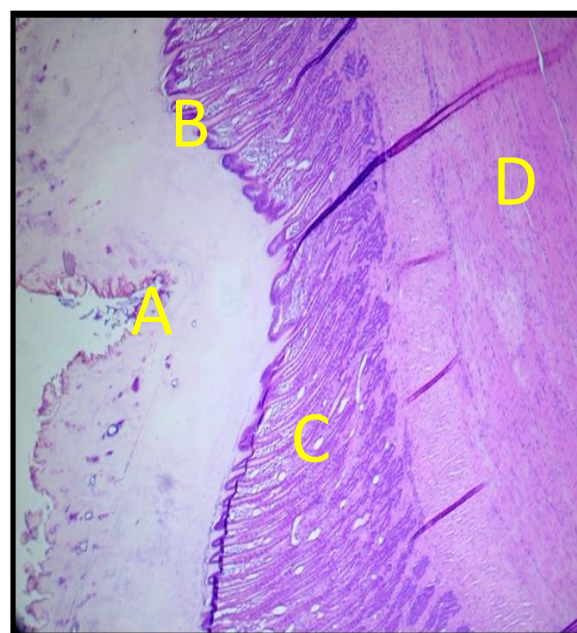


**(Fig3)** Chicken esophagus Esophageal epithelium consisting of rows of squamous cells (A), a row of basal cells (B), the main page containing mucus glands in the form of lobules (C) and capillaries (D) (H & EX 40).

The wall of the esophagus contains a stratified squamous epithelial layer with a row of zigzag basal cells overlapping the basal lamina, which contains mucous glands in the form of lobules, and each lobule contains branching glandular units lined with simple mucus columnar cells, then the basal lamina consisting of dense colloidal connective tissue and fibroblasts with the presence of glands. The mucus is widespread, as these glands contain pale-pigmented mucus-secreting cells with basally located nuclei based on the basement membrane of the glands and the basal lamina. Lamina Propria The chicken esophagus contains bundles of colloidal fibers. White fiber Nerve fibers were also found. Nerve fibers In a bundle form, the bundles of colloidal fibers extend into the submucosa. Submucosa It contains mucous glands located in the form of lobules with wide cavities, with the presence of a smooth muscle layer, which is covered by the serous layer, which is composed of connective tissue.

The epithelium of the follicle is dark in color and appears in the form of a zigzag strip with pointed edges covered by a wide, transparent layer of cuticles. On its surface are keratinized cells that also appear in the form of a zigzag line for some of these cells. The basic lamina contains many numbers of tubular glands lined with cubic cells,

and the glands are oriented vertically towards the stratified squamous epithelium. The submucosal layer contained capillary blood vessels devoid of blood and surrounded on the outside by thick smooth muscle layers, as in the (Fig 4)



**(Fig 4)** Chicken giblets The wide, transparent cuticle layer (A) The rows of keratinized squamous cells (B) The basal layer containing the tubular glands (C) The thick smooth muscle layer (D) (H & EX 10).

The sheets of smooth muscle fibers are extended vertically, with dislocation in some of them, and are surrounded on the outside by the fascia of the tunica serous tissue, which consists of loose, crescent connective tissue in which there is fatty tissue that contains thin blood capillaries, as in the figure (5).



(fig 5) Chicken giblets Smooth muscle fiber sheets (A) Tunica serosa fascia made up of loose connective tissue containing fine capillaries and adipose tissue (B) (H & EX 10).

The results of our study show, anatomically, that the esophagus of the cogen chicken is a muscular tube that connects the oropharyngeal cavity to the true stomach. The most important characteristic of the esophagus is its ability to expand and expand because it contains a number of longitudinal folds in the inner layer of the esophagus, and this is consistent with what was stated in it.[26] In his study on the passenger pigeon (*Columba livia domestica*). However, the esophagus of the Cogun chicken is shorter than that of the mallard, and this indicates the difference between the two birds in terms of size and total external length, as mentioned by Al-Hamdani.[27]

In his study on three types of birds, the longer the esophagus, the greater its ability to expand and absorb large masses of food during eating.

In most birds, the esophagus expands in the middle, forming a part known as the crop. It divides the esophagus into two parts, an upper part and a lower part. This gizzard is a thin-walled, two-lobed membranous sac, which is consistent with the results of researchers including [28] In broiler chickens And[22] In her study on two types of birds, one of which was the cogen chicken. The importance of this crop is to contribute to the process of moisturizing the ingested food, and it is also considered a warehouse for storing food [29]As for birds that eat wet food, they do not have crops, and this is what he confirmed[27] In his study of the digestive tract of the seagull, because it eats fish, which is considered a wet food, and the bird does not have it, which is the reason for this [30].As he pointed out, the bird eats rotting food and insects [31]

The shape of the crop in birds that eat grains and domestic ones is of the type with two lobes, which are anatomically similar.

Histologically, the wall of the esophagus consists of the four layers mentioned previously, and this is consistent with what was mentioned[26]And[32]However, the submucosal layer in the kingfisher is absent due to the difficulty of distinguishing it from the basic lamina[10]The wall of the esophagus also contains longitudinal folds found in the mucous layer of the wall, and the size of the folds in the

chicken's esophagus is shorter than that of the wild duck, and this can be explained by the fact that the food material that the chicken eats is smaller in size, so the benefit of the folds helps in expanding and stretching in the esophagus, which is It agrees with what was mentioned[22]And[30]

As for the original lamina of the mucous layer, it contains other esophageal glands of a simple tubular type, which is consistent with what was mentioned.[33]In the peacock and also confirmed it[34] in her histological study compared the glands in the digestive tract in two types of birds, the Turanian pigeon and the sparrow sparrow, where they were found to be of a dull color. This is due to the secretion of mucus, which gives them a pale color. Food in chickens requires a large amount of hydration while swallowing it.

As for the outer muscle layer surrounding the wall of the esophagus, it was found to consist of two layers of skeletal muscle fibers with an external longitudinal shape and an internal transverse shape, and this is consistent with what was stated.[35].

The outer serous layer is composed of connective tissue interspersed with blood vessels and distinct nerve endings, and this is consistent with[16] in his study on the owl, the white bird *Tyto alba*, and the forest pigeon *Colum aplomb's*, as well as [32] in his study Some of Waterfowl.

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## دراسة المريء في البط البري ومقارنته تركيبيا وتشريحيا مع مريء دجاج الكوجن

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## الملخص

تناولت هذه الدراسة مقارنة تشريحية ونسجية للمريء Esophagus لنوعين من الطيور الداجنة، هما طائر البط البري، ودجاج الكوجن، وأظهرت النتائج التشريحية إن المريء في كلا الطائرين يكون عبارة عن تركيب مستقيم أنبوبي الشكل طويل نسبياً له قابلية عالية للتمدد يربط التجويف ألفمي بالمعدة، ويكون في طائر البط طويلاً نسبياً ويمتد على الجهة الظهرية للقصب الهوائية في الجهة اليمنى من الرقبة، يحتوي على جدار رقيق، له قابلية عالية على التمدد بسبب احتوائه على طيات طويلة كثيرة مما تساهم في استيعاب كميات كبيرة من الطعام وهذه الطيات صعبت التعرف على الحوصلة، ويتكون المريء من جزأين مريء عنقي ومريء صدري.

أما في دجاج الكوجن يتوسع المريء في منتصفه مكون جزء يعرف بالحوصلة، فهي تقسم المريء إلى قسمين قسم علوي ويسمى بالمريء العنقي cervical part أو المريء العلوي upper esophagus ويمثل جزء أعلى الحوصلة من المريء، وآخر سفلي lower esophagus ويسمى بالمريء الصدري thoracic part وهو أقصر من الجزء أو المريء العلوي، والحوصلة عبارة عن انتفاخ بهيئة كيس رقيق الجدران، تتكون من فصين Bilobed ويحتوي جدارها على طيات صغيرة وبارزة في بدايتها.

ونسيجياً يتكون المريء لكلا الطائرين من الغلات الأربعة: المخاطية، تحت المخاطية، العضلية والمصلية والطبقة الظهارية تحتوي على خلايا مطبقة حرشفية واسعة، وفي دجاج الكوجن كانت شبه متقرنة، مع وجود الغدد المرئية الأنبوبية البسيطة لكلا الطائرين في الصفيحة الأساسية للجدار وكان عددها أقل في البط مما في الدجاج، ولاتوجد الطبقة العضلية المخاطية في البط، ويحصر وجودها فقط في الجزء العلوي من المريء رقيقة وطولية الترتيب. أما الطبقتين العضلية والمصلية فكانتا بنفس الترتيب النسيجي غير الاختلاف في سمك الطبقة في طائر البط كانت أكثر سمكاً.

الكلمات المفتاحية: البط البري، دجاج الكوجن، المريء.