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ORIGINAL ARTICLE

MORPHOLOGICAL, HISTOLOGICAL, AND HISTOCHEMICAL STUDIES OF STOMACH, PROVENTRICULUS, AND GIZZARD IN SLENDER-BILLED GULL *CHROICOCEPHALUS GENEI* (BRÈME, 1839) (AVES, CHARADRIIFORMES, LARIDAE)

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ABSTRACT

The current study aimed to identify the morphological, histological, and histochemical composition of the proventriculus and the gizzard of the slender-billed gull *Chroicocephalus genei* (Breme, 1839) (Aves, Charadriiformes, Laridae) using a light microscope. Morphological analysis revealed that the stomach of the bird is divided into proventriculus and gizzard. The proventriculus is situated to the left of the body's midline and is completely encompassed by the liver's left lobe, and appears pear-shaped or elongated oval and has smooth walls. The gizzard has a pear-shaped muscular organ and is located to the left of the midline in the lower quarter of the abdominal cavity. The results of histological examination show that there are four major layers that make up the proventriculus and gizzard walls consist of: mucosa, submucosa, muscularis, and serosa, as well as the presence of the koilin layer covering the tunica mucosa of the gizzard. The lining epithelium of the wall of the proventriculus is covered with simple columnar epithelial tissue, but the lamina properia has simple tubular glands and is made mostly of loose connective tissue, and the submucosa is composed of loose connective tissue and deep gastric glands. The muscularis which consist of three layers of smooth muscle fibers, while loose connective tissue makes up the tunica serosa. In the gizzard, the lining epithelium is lined by simple columnar epithelium; the lamina properia consists of simple tubular glands. The gizzard's submucosa is lined with dense connective tissue, the muscularis is made up of smooth muscle fibers, and the tunica serosa is coated with loose connective tissue. According to the histochemical analysis, the proventriculus and gizzard contain a significant amount of mucopolysaccharides which exhibited a positive reaction to Periodic Acid Schiff (PAS) stains.

Keywords: *Chroicocephalus genei*, Histochemical, Histological, Morphological, Stomach.

Morphological, histological, and histochemical studies

INTRODUCTION

The Slender-billed Gull, *Chroicocephalus genei* (Breme, 1839) belongs to the family Laridae (Aves, Charadriiformes). It is medium-sized, grey and white, and has a thin red bill (Allose, 1961). The composition of the digestive system is subject to morphological and histological changes and modifications depending on the type of food ingested, and the methods used to obtain it (Kardong, 2002). The digestive system carries out a number of tasks, including breaking down and absorbing nutrients and secreting different types of digestive enzymes (Denbow, 2000).

The vertebrate digestive system includes the alimentary canal and the digestive glands, namely the liver and pancreas (Dibner and Richards, 2004). The avian stomach is anatomically composed of two chambers, the first stomach or cranial-chamber, called the proventriculus, which is connected to the esophagus, and the second or caudal chamber, called the ventriculus or gizzard, which is connected to the duodenum (Abumandour, 2013). The stomach wall in birds composed of four general layers, namely the tunica mucosa, submucosa, muscular layer and serosa (Selvan *et al.*, 2008). Gastric secretions, including pepsin and hydrochloric acid, are secreted by a glandular mucus layer lining the proventriculus. Food particles are broken down into tiny pieces in the gizzard, where they are swiftly absorbed by the gut after additional digestion and absorption, along with their fluids (Saleem, 2012).

The purpose of the study is to identify the morphological, histological, and histochemical structure of the proventriculus and the gizzard in the slender-billed gull *Chroicocephalus genei* (Breme, 1839) (Aves, Charadriiformes, Laridae) and compare the results with previous studies in different geographical area.

MATERIALS AND METHODS

Ethical approve The committee of the College of Dentistry at Al- Iraqia University in Iraq gave us official approval for the research design in accordance with the institutional regulations regarding the handling and use of animals in the study. No. ESAER-03-26-062-24. June 2024.

Samples Collection: For this study, eight adult live slender-billed gull samples ranging in length from 37– 40 cm and body weight from 250-280 g were to be obtained and purchased at the Al-Gazal market in Baghdad (Pl.1). The studied birds were anaesthetized with chloroform, The animals were sacrificed after they died, The animal was placed in a dissecting kit on the dorsal side, and the feathers were removed from the neck area to the cloaca; a longitudinal incision was made in the skin from the cloaca to the neck, the skin was separated from the muscles and a medial longitudinal incision was made in the muscles, the clavicle was cut, the digestive tract was extracted, the morphological study was performed to know the general appearance of the stomach and to determine the location in the body, finally, the procedures for histological and histochemical staining were carried out according to (Bancroft and Stevens, 2013).

Plate (1): An image showing the external appearance of the studied bird.

Histological and histochemical preparations: For histological examination, the *Chroicocephalus genei* were preserved in a 10% formalin solution for 48 hours. They were washed to remove the residues of the fixative and placed in an increasing sequence of 70, 80, 90, and 100% ethyl alcohol for one hour in each step to draw out the samples' water content, The samples were placed in xylene, then embedded in paraffin wax, cut into 6 micron thick blocks and stained with Harris Haematoxylin and Eosin (H&E) stains are frequently employed to differentiate the cell types, a compound microscope equipped with a canon digital camera was used to take pictures of the chosen sections after they had been viewed under a light microscope. For histochemistry aspect was performed by using periodic acid Schiff (PAS) to detect neutral mucopolysaccharides and Van Giesons stain to detect collagen fibers (Bancroft and Stevens, 2013).

RESULTS AND DISCUSSION

Morphology

The stomach is situated on the left side of the body cavity's midline (Pl. 2). This result is consistent with (Aizawa *et al*., 2013) in blue-and-yellow macaws *Ara ararauna*, and *Falco berigora* (Linnaeus, 1758) (Al-Taee, 2017). However, it does not agree with Al-Taee (2019) in *Francolinus francolinus* (Linnaeus, 1766) who showed that the stomach is located in the centre of the first third of the thoraco-abdominal cavity and extends to the middle of the last third. The stomach is divided into proventriculus and gizzard (Pl. 3). This result agrees with Al-Taai (2022) in *Sturnus vulgaris* (Linnaeus, 1758), and *Columba livia* (Gmelin, 1789). However, this result contradicts (Taki-El-Deen, 2017) in *Vanellus spinosus* (Linnaeus, 1758), who divides the stomach into a cardiac and a muscular part. The stomach extends between the esophagus and the duodenum, with the esophagus is connected to the proventriculus, while the duodenum is connected to the gizzard via the pylorus (Pl. 3). This finding is consistent with a number of studies (Abumandour, 2013; Al-Saffar and Al-Samawy, 2015). Recent

observations revealed that the proventriculus is located to the left of the midline of the body and is completely covered by the liver's left lobe (Pls. 2, 3). This result is consistent with Al-Taee (2019) in *Francolinus francolinus* (Linnaeus, 1766) and *Ceryle rudis* (Linnaeus, 1758).

However, this result does not agree with Jassem *et al*. (2016) in *Gallinula chloropus* (Linnaeus, 1758), he indicated that the proventriculus is situated between the left lobe of the liver and the spleen on the right side. The proventriculus is connected to the esophagus at the front and appears more spacious, while its posterior part is connected to the gizzard (Pl. 3). This result is consistent with Al-Saffar and Al-Samawy (2015) in *Anas platyrhynchos* (Linnaeus, 1758), *Sturnus vulgaris* (Linnaeus, 1758) and *Columba livia* (Gmelin, 1789) (Al - Taai, 2022). The proventriculus is pear-shaped or elongated oval and has smooth walls (Pls. 3, 4). This result agrees with Hassan and Moussa (2012) in *Columba livia domestica*, (Gmelin, 1789) and results of Al-Juboury (2016) on *Columba palumbus* (Linnaeus, 1758) and *Tyto alba* (Scopoli, 1769). However, this result is in contradiction with Al-Saffar and Al-Samawy (2015) in *Columba livia domestica* (Gmelin, 1789) who stated that the proventriculus is tubular. The result of the study showed the presence of a short tubular intermediate part located between the proventriculus and gizzard called isthmus (Pls. 3, 4). This result agrees with Al-Taee (2019) in *Ceryle rudies* (Linnaeus, 1758), and *Gallinula chloropus* (Linnaeus, 1758) (Abdellatif *et al*., 2022). The gizzard is located to the left of the midline in the lower quarter of the abdominal cavity and is partially covered by the liver's left lobe; the cranial part of the gizzard is connected to the duodenum (Pls. 2-4). The result is agreed to Al-Aaraji (2007) in *Coturnix coturnix* (Linnaeus, 1758), and *Psittracula cuvier* (Cuvier, 1800). However, this result contradicts the study by Al-Aaraji (2007) in *Falco tinnunculus* (Linnaeus, 1758), which showed that the gizzard occupies a central position in the body cavity and is partially covered by the liver.

The study results shows that the gizzard has the shape of a pear-shaped muscular organ (Pls. 3, 4). This result is consistent with Al-Saffar and Al-Samawy (2015) in *Anas platyrhynchos* (Linnaeus, 1758), *Columba palumbus* (Linnaeus, 1758) and *Tyto alba* (Scopoli, 1769) (Al-Juboury, 2016). However, this result contradicts the study by Al-Taee (2019) in *Francolinus francolinus* (Linnaeus, 1766), who stated that the gizzard appears in the form of a biconvex lens. The result of the study shows that the central part of the gizzard shows thickness in the middle and a light colour, which is called the tendinous aponeurosis, in addition to the muscles (Pl. 4). This result is consistent with in Falcon *Francolinus francolinus* (Linnaeus, 1766) (Abumandour, 2013) and *Ceryle rudis* (Linnaeus, 1758) (Al-Taee, 2019).

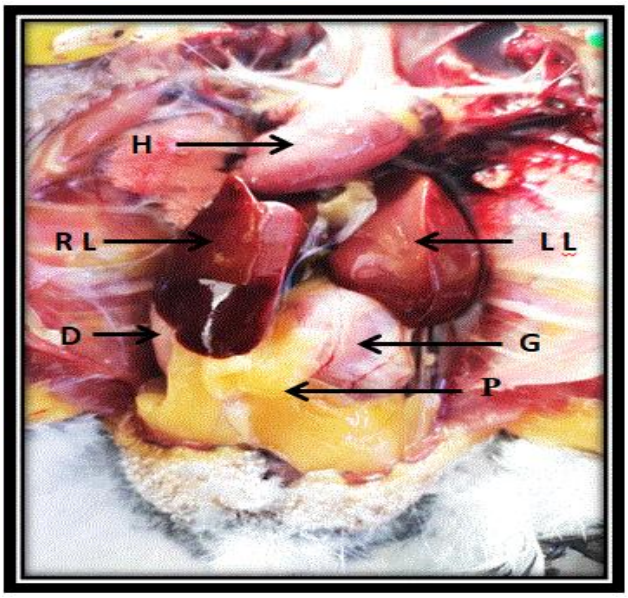

Plate (2): The position of the stomach in *Chroicocephalus genei*. [Duodenum (D), Gizzard (G), Heart (H), peritoneal adipose tissue (P), Right lobe of liver (RL), Left lobe (LL)].

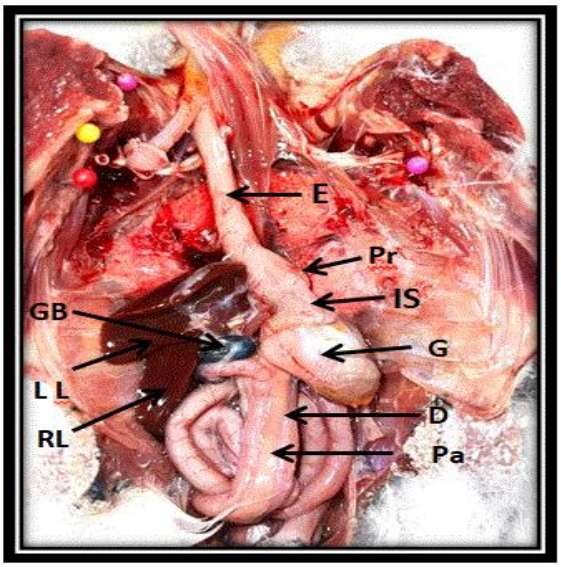

Plate (3): Viscera in *Chroicocephalus genei*. [Duodenum (D), Esophagus (E), Gall bladder (GB), Gizzard (G), Isthmus (IS), Pancreas (P), Proventriculus (Pr), Right and Left lobe (RL), (LL)].

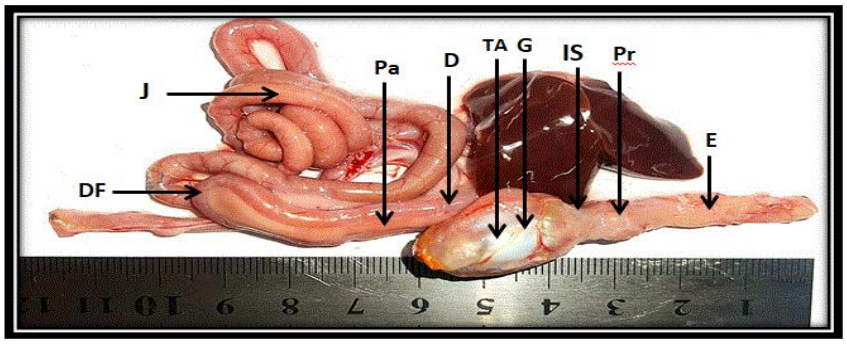

Plate (4): Digestive system in *Chroicocephalus genei*. [Duodenum (D), Duodenal flexure (DF), Esophagus (E), Gizzard (G), Isthmus (IS), Jejunum (J), Pancreas (Pa), Proventriculus (Pr), Tendinous aponeurosis (TA)].

Histological and Histochemical studies

The proventriculus wall of the slender-billed gull has four major tunicae that are divided from the inside out, based on histological findings: mucosa, submucosa, muscularis, and serosa (Pl. 5) (Ahmed and Kamel, 2011; Jassem *et al*., 2016; Al-Taee, 2017). However, it does not agree with the results of Zhu (2015a), who studied *Porzana bicolor* (Walden, 1872), and demonstrated that the proventriculus wall is composed of three layers: the mucosa, muscularis, and serosa.

Histologically, the lining epithelium, lamina properia, and muscularis mucosa are the three secondary layers that make up the proventriculus' tunica mucosa (Pl. 6) (Hassan, 2012; Zhang *et al*., 2014; Al-Taee, 2017). However, this result contradicts some studies that have demonstrated the presence of two layers in the tunica mucosa: the lamina properia and the lining epithelium (Albideri *et al*., 2011).

The lining epithelium of the proventriculus wall appears as finger-shaped folds extending into the stomach cavity, called plicae, which are bounded by the sulcus. These folds are covered with a simple columnar epithelial tissue with a basal oval nucleus (Pl. 6). This result is in agreement with (Ahmed and Kamil, 2011; Al-Nakeeb *et al*., 2019). However, it contradicts the results of the study by Albideri *et al*. (2011) in *Ardeola ralloides* (Scopoli, 1769), which showed that the lining epithelium consists of simple cuboidal epithelial tissue.

The lamina propria is made up of many blood vessels and loose connective tissue. Irregularly arranged collagenous fibers and simple tubular glands called superficial gastric glands. These glands have simple cuboidal epithelium lining them and are open in the lumen (Pls. 6, 7) (Al-Taee, 2019; Al-Nakeeb *et al*., 2019), but contradicts the results of Udoumoh and Ikejiobi (2017) in *Corvus albus* (Muller, 1776).

The muscularis mucosa consists of smooth muscle fibers surrounding the apex of the deep gastric glands (Pl. 6). This result is consistent with (Rodrigues *et al*., 2012) in yellow and blue macaws *Ara ararana* (Linnaeus, 1758), and *Falco berigora* (Linnaeus, 1758), (Al-Taee,

2017). However, it contradicts Zhu (2015a) in *Porzana bicolor* (Walden, 1872), who discovered that there are two layers of smooth muscle fibers in the muscularis mucosa.

The majority of the loose connective tissue that makes up the tunica submucosa contains collagen fibers and blood arteries (Pls. 6, 7). This result is similar with the results of some studies (Batah *et al*., 2012; Al-Saffar and Al-Samawy, 2014). But this result is not consistent with the study of Al-Helali *et al*. (2011) in *Anas platyrhynchos* (Linnaeus, 1758), which showed that the tunica submucosa is reduced and consists of white fibrous connective tissue. The tunica submucosa also contains a number of branching alveolar glands and deep proventriculus glands surrounded by a connective tissue capsule. All glands differ in shape, including oval, circular or pear-shaped, and these glands contain a number of secretory units lined by cuboidal cells with central nuclei (Pls. 6, 7). This result agrees with Al-Juboury (2016) in *Columba palmbus* (Linnaeus, 1758), and *Pica pica* (Linnaeus, 1758), (Al-Nakeeb *et al*., 2019).

Each gland consists of a duct that collects the excretory materials from the secretory units, called tertiary duct, which transports the secretion into the cavity of each gland and conveys the secretory mucins and pepsinogen through a main collecting duct into the stomach cavity (Pls. 6, 7) (Zhu, 2015a ; Udoumoh and Ikejiobi, 2017).

Three layers of smooth muscle fibers make up the tunica muscularis: the central layer is circular, the outer and inner layers are organized longitudinally, and there is collagen and connective tissue fibers between the two layers (Pls. 5, 7) this result is consistent with a number of studies (Al-Nakeeb *et al*., 2019; Al-Taee, 2019). However, the result contradicts Al-Saffar and Al-Samawy (2014) in *Scors brucei* (Plimmer & Bradford, 1899) who demonstrated the two smooth muscle fibers layers that make up this layer.

The tunica serosa is the last tunica and also consists of loose connective tissue in which there are many blood vessels, adipose tissue, collagen fibers and nerve plexuses. It is covered with a mesothelial layer (Pls. 5, 7). This finding was similarly observed in *Lanius tephronotus* (Vigros, 1831) (Zhu, 2015b).

The histological structure of the gizzard revealed four tunicae, just like the wall of the proventriculus, tunica mucosa, submucosa, muscularis and serosa (Pl. 8) (Rodrigues *et al*., 2012; Abumandour, 2013; Kausar *et al*., 2019).

The koilin layer appears to be composed of two types of koilin, the horizontal koilin covering the tunica mucosa and the vertical koilin located between the mucosal folds (Pls. 8, 9). This result agrees with Al-Nakeeb *et al*. (2019) in the magpie *Pica pica* (Linnaeus, 1758), peahens *Pavo cristatus* (Linnaeus, 1758) (Khaleel, 2022), but contradicts the results of a study Al-Aredhi (2013) in *Elanus caeruleus* (Desfontaines, 1789), which explains the loss of the koilin layer.

Morphological, histological, and histochemical studies

The tunica mucosa compose of three areas: lining epithelium, lamina properia and muscularis mucosa (Pl. 10) (Banasal *et al*., 2023). But does not agree with Al-Taee (2019) in *Francolinus francolinus* (Linnaeus, 1766), who showed that the tunica mucosa consists of two layers (lining epithelium and lamina properia).

Numerous folds in the lining epithelium are bordered by simple columnar epithelium with an oval to round nucleus (Pls. 9, 10). This result agrees with Batah *et al*. (2012) in *Fulica atra* (Linnaeus, 1758), and *Columba livia domestica* (Gmelin, 1789) (Al-Saffar and Al-Samawy, 2016), but disagrees with the result of Kadhim *et al.* (2011) in *Gallus gallus spadiceus* (Linnaeus, 1758), who showed that the lining epithelium consists of simple prismatic epithelial tissue.

The lamina propria is made up of loose, collagen-rich connective tissue that is dotted with many simple tubular glands, or gizzard glands, that are bordered by basic cuboidal cells. The vertical koilin fills the gastric pits, and the gizzard glands open between the folds at their base (Pls. 10, 11). This result is consistent with Al-Taee (2019) in *FrancoiInus francoiInus* (Linnaeus, 1766), Broiler (Nasrin *et al*., 2012). However, it contradicts the finding of Zhu (2015a) in *Porzana bicolor* (Walden, 1872), who demonstrates that white fibrous connective tissue makes up the lamina properia.

The muscularis mucosa is a layer of circular smooth muscle fibers that lies between the lamina properia and the tunica submucosa (Pl. 10). This result corresponds to Taki-El-Deen (2017) in *Vanellus spinosus* (Linnaeus, 1758), and *Coturinx coturinx* (Linnaeus, 1758) (Zaher *et al*., 2012). The tunica submucosa of the gizzard consists of dense connective tissue containing collagenous fibers, blood vessels and nerves (Pls. 10, 11), which is consistent with Zhu (2015b) in *Lanius tephronotus* (Vigros, 1831), in *Sturnus vulgaris* (Linnaeus, 1758) (Al-Taai and Hasan, 2020).

The inner longitudinal and outer circular layers of smooth muscle fibers make up the tunica muscularis interspersed between them connective tissue rich with collagen fibers (Pls. 10, 11). This result agrees with Taki-El-Deen (2017) in *Vanellus spinosus* (Linnaeus, 1758), and Khaleel (2022) on *Pavo cristatus* (Linnaeus, 1758). But this result contrary to Rodrigues *et al*. (2012) in *Ara araranu* (Linnaeus, 1758), who mentioned that tunica muscularis consist of thick layer of smooth muscle fibers.

The tunica serosa is covered in mesothelium and is made up of loose connective tissue, nerves, adipose cells, and blood vessels (Pls. 8, 11). This result is consistent with Al-Saffar and Al-Samawy (2014) in *Columba livia domestica* (Gmelin, 1789).

Histochemical analysis of the slender-billed gull's proventriculus under a microscope showed that the supranuclear region of the mucosal epithelial cells showed a strong positive reaction when stained with PAS, so that these cells appeared purple, indicating the presence of neutral mucin (Pl. 12). This result is in agreement with Al-Saffar and Al-Samawy (2014) in *Columba livia domestica* (Gmelin, 1789), in *Anase platyrhchos* (Linnaeus, 1758), (Sultan *et*

al., 2023). The lamina properia and simple tubular gland show a strong positive reaction when stained with PAS, indicating the presence of neutral mucopolysaccharides (Pl. 12) (Cooper and Mahroze, 2004; Al-Hamdany and Al duleemy, 2019). However, this result does not agree with Zhu (2015b) in his study on *Lanius tephronotus* (Vigros, 1831), who showed that the lamina properia reacted only weakly with PAS staining.

Neutral mucins and pepsinogen are released into the stomach cavity as a result of the histochemical analysis of the luminal gland epithelium, which revealed a moderate positive reaction with PAS (Pl. 12). This result is consistent with in *Otus scors brucei* (Plimmer & Bradford, 1899) (Al-Saffar and Al-Samawy, 2014) and *Anas platyrhchos* (Linnaeus, 1758) (Sultan *et al*., 2023). However, it contradicts the results of Selvan *et al*. (2008) in *Numida meleagris* (Linnaeus, 1758), so that the submucosal glands show a weak reaction for mucins with PAS stain. The lamina propria shows positive reactions with PAS stains (Pl.12) this result is consistent with Khaleel (2022) in Peahens *Pavo cristatus* (Linnaeus, 1758).

In the ventriculus (Gizzard), the results of the histochemical in gizzard area showed that the koilin layer located above the epithelial lining reacted positively with PAS stain (Pl. 13).this results is agree with Khaleel (2022) in peahens *Pavo cristatus* (Linnaeus, 1758), in *Anas Platyrhynchos* (Linnaeus, 1758) (Sultan *et al*., 2023). The mucosa is covered in an abrasion-resistant lining membrane called the cuticle layer (Karasov and Douglas, 2013). The cells of lining epithelium were positively reacted with the PAS, this indicated into presence neutral mucin (Pl. 13). This result is agreed with Kausar *et al*. (2019) in *Columba liva* (Gmelin, 1789), and *Anas platyrhchos* (Linnaeus, 1758) (Sultan *et al*., 2023). The connective tissue in submucosa showed PAS positive reaction in ventriculus of slender billed gull (Pl. 13). This result agrees with *Lanius tephronotus* (Vigros, 1831) (Zhu, 2015b).

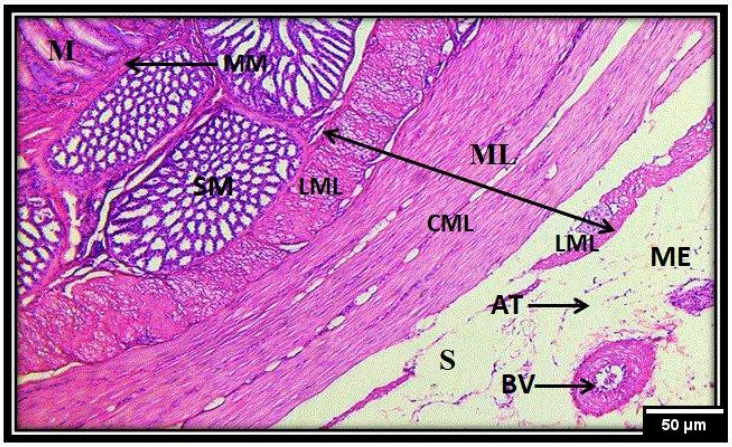

Plate (5): Transverse section in pro-ventrrculus wall showing four tunicae. [Adipose tissue (AT), Blood vessels (BV), Circular median layers (CML), Mucosa (M), Submucosa (SM), Muscularis (ML), Serosa (S), Muscularis mucosa (MM), Internal and external muscularis (LML), Mesothelium (ME)], (H & E).

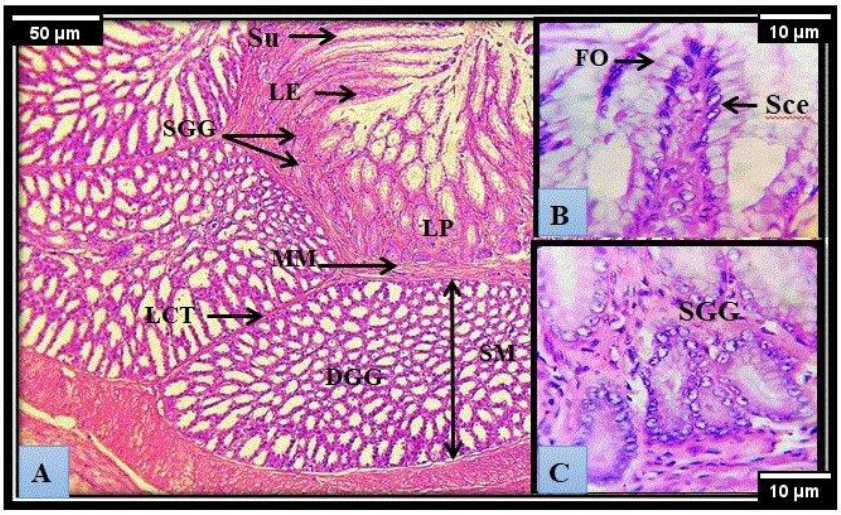

Plate (6) : Transverse section in proventrrculus wall showed in eyes (A, B and C). [Deep gastric gland (DGG), Lining epithelium (LE), Lamina propria (LP), Loose connective tissue (LCT), Muscularis mucosae (MM), Submucosa (SM), Sulcus (Su), Fold (FO), Simple columnar epithelium (Sce), Superficial gastric gland (SGG)], (H & E).

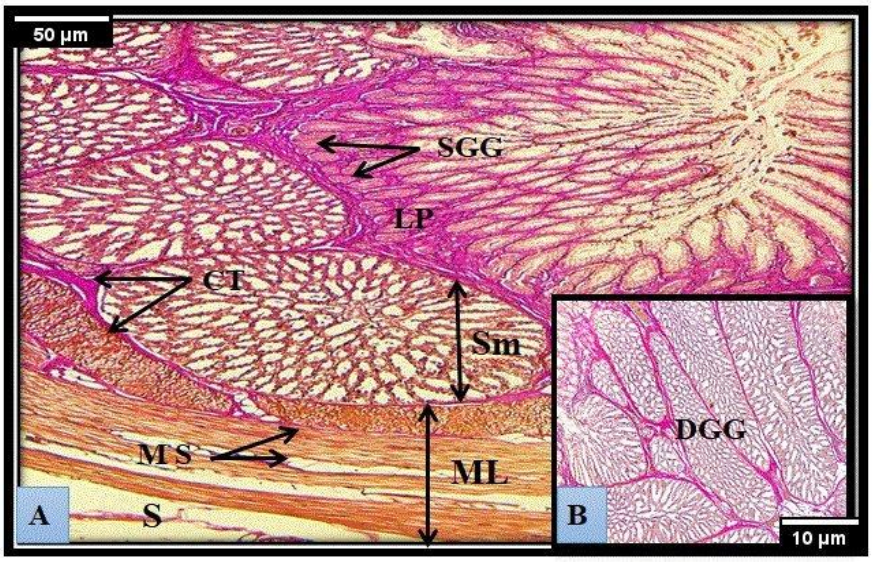

Plate (7): Histological section of the proventriculus wall showing (A, B). [Collagen fibers: Connective tissue septa (CT), Lamina properia (Lp), Submucosa (Sm), Serosa (S), Muscularis (ML), Smooth muscle fibers in muscularis (MS), Superficial gastric gland (SGG). (B) Deep gastric gland (DGG)], (Van Gieson Stain).

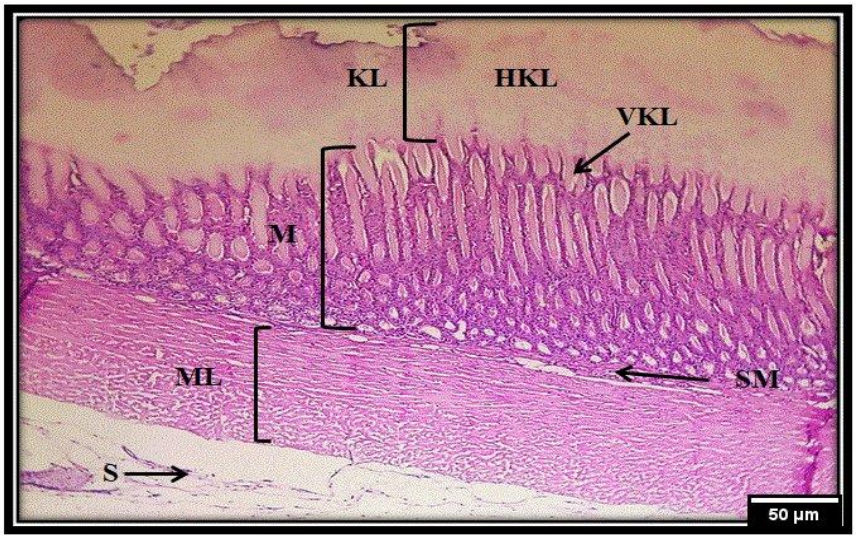

Plate (8): Transverse section in Gizzard wall showing four tunicae. [Horizontal koilin layer (HKL), Mucosa (M), Submucosa (SM), Muscularis (ML), Serosa (S), Vertical koilin layer (VKL)], (H & E).

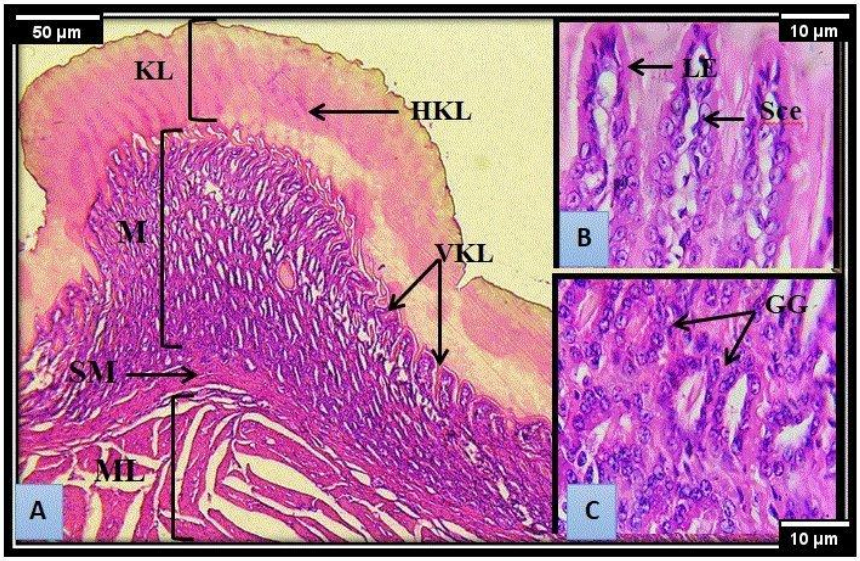

Plate (9): Transverse section in gizzard showing type of koilin (A, B). [Horizontal koilin layer (HKL), Kolin layer (KL), Muscularis (ML), Tunica mucosa (M), Submucosa (SM), Verticale koilin layer (VKL). (B) Lining epithelium (LE), Simple columnar epithelium (Sce), (C) Gastric gland (GG)], (H & E).

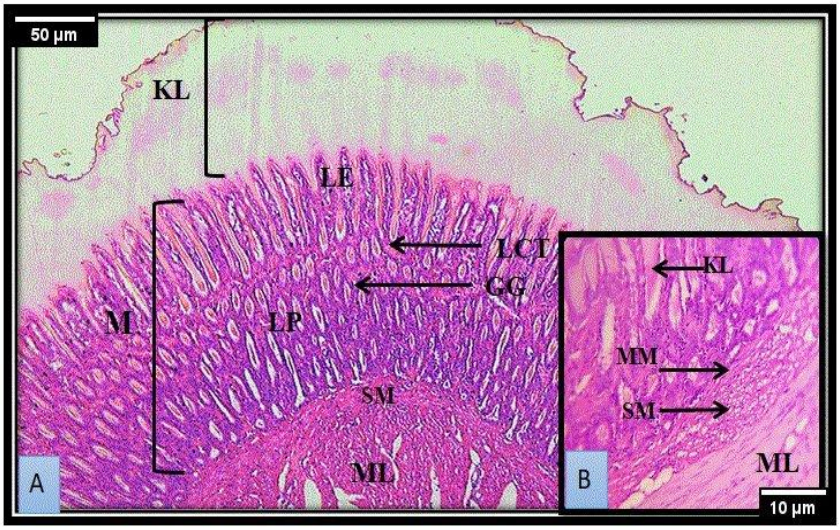

Plate (10): Transverse section in gizzard wall showing secondary layers in tunica mucosa, (A, B). [Gastric gland (GG), Lining epithelium (LE), Lamina properia LP), Loose connective tissue (LCT), Mucosa (M), Kolin layer (KL), Muscularis (ML), Muscularis mucosa (MM), Submucosa (SM)], (H and E).

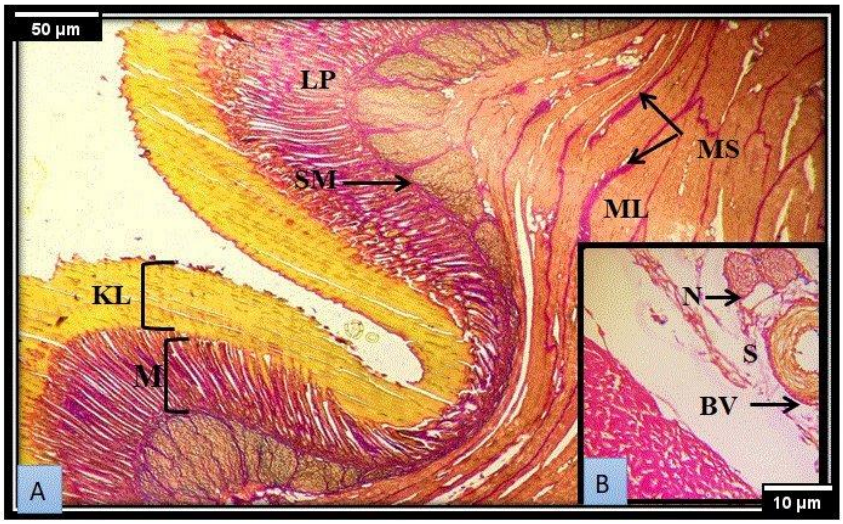

Plate (11): Transverse section in gizzard showing collagen fibers (A, B). [Kolin layer (KL), Lamina properia (LP), Mucosa (M), Muscularis (ML), Smooth muscle fibers in Muscularis (Ms), Submucosa (SM), Blood vessel (BV), Nerve (N), Serosa (S)], (H and E).

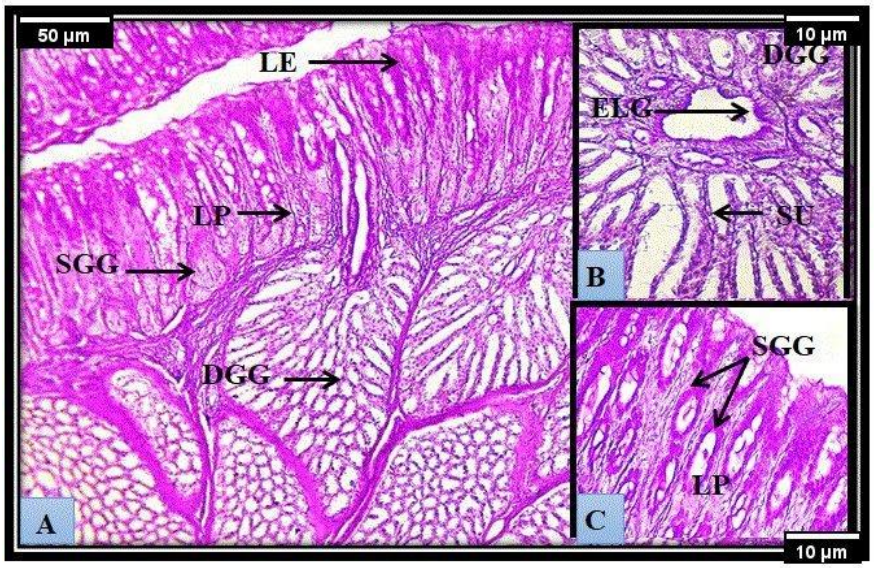

Plate (12): Cross section in the proventriculus of the *Chroicocephalus genei* showed positive reaction for neutral mucins (A, B and C). [Deep gastric gland (DGG), Superficial gastric gland (SGG), Lining Epithelium (LE), Epithelium of mucosal fold (ELG), Secretory units (Su), Lamina properia (Lp)], (PAS stain).

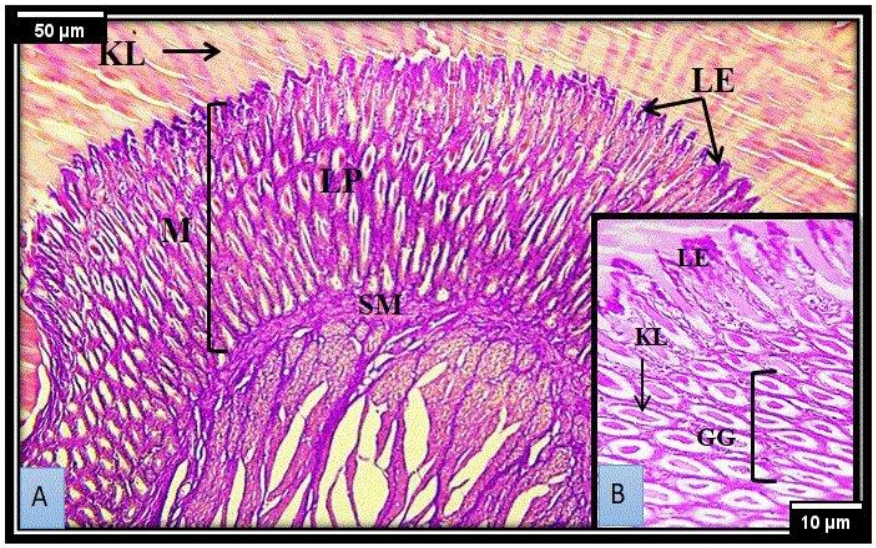

Plate (13): Transverse section in gizzard wall showing positive reaction for neutral mucins (A, B). [Koilin layer (KL), Lamina properia (LP), Submucosa (SM), Tunica mucosa (M). (B) Lining epithelium (LE), Gastric gland (GG)], (PAS stain).

CONCLUSIONS

We can concluded from the current study that the thin-billed gull's proventriculus and gizzard formed the appearance of its stomach. The proventriculus has an extended or pear-shaped form. Stomach located in the centre of the first third of the thoraco-abdominal cavity and extends to the middle of the last third. The gizzard's tunica mucosa is covered in the koilin layer, consists of smooth muscle fibers surrounding the apex of the deep gastric glands. Simple columnar epithelial tissue surrounded the proventriculus, while loose connective tissue with basic tubular glands made up the lamina properia. Deep gastric glands and loose connective tissue make up the proventriculus submucosa, contains collagen fibers and blood arteries. The gizzard's submucosa is bordered by thick connective tissue. The tunica muscularis is composed of the outer circular layer and the inner longitudinal layer of smooth muscle fibers, with collagen-rich connective tissue positioned in between. Mesothelium covered the tunica serosa which consists of loose connective tissue, nerves, adipose cells, and blood vessels. The histochemical methods revealed a favorable response to periodic acid Schiff.

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CONFLICTS OF INTEREST STATEMENT

There isn't any conflict of interest for the researchers.

LITERATURE CITED

Abdellatif, A. M., Farag, A. and Metwally, E. 2022. Anatomical, histochemical, and immunohistochemical observations on the gastrointestinal tract of *Gallinula chloropus* (Aves: Rallidae). *BMC Zoology journal*, 7(1): 61. [CrossRef]

Abumandour, M. M. 2013. Morphological studies of the stomach of falcon. *Scientific Journal of Veterinary Advances*, 2(3): 30-40. [Click here]

Ahmed, A. E. and Kamel, G. A. 2011. Histomorphological studies on the stomach of the Japanese quail. *Asian Journal of Poultry Science*, 5(20): 56-67. [CrossRef]

Aizawa, J., Tivane, C., Rodrigues, M. N., Wagner, P. G., Campos, D. B., Guerra, R. R. and Miglino, M. A. 2013. Gross anatomical features of the gastrointestinal tract (GIT) of blue and yellow macaws (*Ara ararauna*)–oesophagus to cloaca. *Anatomia*, *Histologia*, *Embryologia*, 42(6): 432-437. [CrossRef]

Al-Aaraji, S. A. 2007. A comparative anatomical and histological study of gizzard in three species of birds according to their food type. M. Sc. thesis, College of Veterinary Medicine, University of Baghdad, 215pp.

Al-Aredhi, J. A. M. 2013. Comparative anatomical and histological study of gastrointestinal tract of three wild Iraqi birds black shouldered kite *Elanus caeruleus*, green winged

teal, Anascrecca and the common Quail *Coturnix coturnix* , PhD dissertation in Biology, College of Sciences, University of Kufa, 149pp.

Albideri, A.W., Haba, M. K. and Kadum, M. J. 2011. Histological study of gastrointestinal tract in Squacco heron *Ardeola ralloides* and Rock dove *Columba livia*. Al-Kufa University. *Journal of Biology*, 2(3): 99-108. [Click here]

Al-Hamdany, A. M. T. and Al duleemy, A. S. 2019. Anotomical and Histological Comparative Study of the proventriculus and histochmisitry of mucins in Two Species of Birds Which Differ in Nutrient Nature. *Journal of Education and Science*, 28(2): 150-166. [CrossRef]

Al-Helali, S. H, Al-Sudani, A. A. and Jaber, R. J. 2011. Histological study of stomach in (mallard) *Anas platyrhynchos*. *Ibn AL-Haitham Journal for Pure and Applied Sciences*, 24(1): 15-22. [Click here]

Al-Juboury, R. W. 2016. Comparative anatomical and histological study on the digestive tract in two Iraqi birds, common wood pigeon *Columba palumbus* (L.) and barn owl *Tyto alba* (Scopoil). Ph D thesis. College of Science, Babylon University, 210pp.

Allose, B. 1961. Birds of Iraq. Third edition. Arrabita Press, Baghdad, 279 pp. [In Arabic]

Al-Nakeeb, G. D., Abid, S. A., Fadhil, L. A. and Hussein, R. A. 2019. Comparative histological study of the stomach in two species of Iraqi vertebrates (Magpie *Pica pica* L. and Small Asian Mongoose *Herpestes javanicus* E.). *Baghdad Science Journal*, 16(2): 281-290. [CrossRef]

Al-Saffar, F. J. and Al-Samawy, E. R. 2014. Microscopic study of the proventriculus and Ventriculus of the striated scope owl (*Otus scors brucei*) In Iraq. *Kufa Journal for Veterinary Medical Sciences*, 5(2): 9-23. [CrossRef]

Al-Saffar, F. J. and Al-Samawy, E. R. 2015. Histomorphological and histochemical studies of the stomach of the Mallard (*Anas platyrhynchos*). *Asian Journal of Animal Science*, 9(6): 280-292. [CrossRef]

Al-Saffar, F. J. and Al-Samawy, E. R. 2016. Histomorphological and Histochemical study of stomach of domestic pigeon (*Columba livia domestica*). *The Iraqi Journal of Veterinary Medicine*, 40(1): 89-96. [CrossRef]

Al-Taee, A. A. 2017. Macroscopic and microscopic study of digestive tract of brown falcon berigora in Iraq. *JUBPAS*, 25(3): 915-936.

Morphological, histological, and histochemical studies

Al-Taee, M. Q. A. 2019. Comparative morphohistological study of the stomach in *Francolinus francolinus* and *Ceryle rudis*. M. Sc. thesis in Biology, College of Education for Pure Science (Ibn Al-Haitham), University of Baghdad, 161pp.

Al-Taai, S. A. 2022. Morphological comparison of proventricular and gizzard in starling birds *Sturnus vulgaris* and pigeon *Columba livia*. *International Journal of Veterinary Sciences and Animal Husbandry*, 7(1): 15-18. [CrossRef]

Al-Taai, S. A. H. and Hasan, M. S. 2020. Histomorphological study of proventriculus and gizzard in adult starling birds (*Sturnus vulgaris*). *Plant Archives*, 20(1): 1671-1678. [Click here]

Banasal, S., Bhayani, D. M. and Meel, O. 2023. Histological, micrometrical and histochemical studies on gizzard of pigeon (*Columba livia domestica*). *The Pharma Innovation Journal*, 12(7): 46. [Click here]

Bancroft, J. D. and Stevens, A. 2013. Theory and practice of histological techniques. 17th ed., Churchill Living Stone, Edinburgh, 179pp. [Click here]

Batah, A L., Selman, H. A. and Saddam, M. 2012. Histological study for Stomach (proventriculus and Gizzard) of Coot bird *Fulica atra*. *Diyala Agricultural Science Journal*, 4(1): 9-16. [Click here]

Cooper, R. G. and Mahroze, K. M. 2004. Anatomy and physiology of the gastro-intestinal tract and growth curves of the ostrich. *Animal Science Journal*, 75: 491-498. [CrossRef]

Denbow, D. M. 2000. Gastrointestinal anatomy and physiology. *In*: Strikes, P. D., Avian physiology. 5th ed. San Diego, California, p. 299-325. [Click here]

Dibner, J. J. and Richards, J. D. 2004. The digestive system: challenges and opportunities. *Journal of Applied Poultry Research*, 13(1): 86-93. [CrossRef]

Hassan, S. A. and Moussa, E. A. 2012. Gross and microscopic studies on the stomach of domestic duck (*Anas platyrhynchos*) and domestic pigeon (*Columba livia domestica*). *Journal of Veterinary Anatomy*, 5(2): 105-127. [CrossRef]

Jassem, E. S., Hussein, A. J. and Sawad, A. A. 2016. Anatomical, histological and histochemical study of the proventriculus of common moorhen (*Gallinula chloropus*). *Basrah Journal of Veterinary Research*, 14(4): 73-82. [CrossRef]

Kadhim, K. K., Zuki, A. B. Z., Noordin, M. M. and Babjee, S. M. A. 2011. Histomorphology of the stomach proventriculus and ventriculus of the red jungle fowl. *.Anatomia Histologia Embryologia Journal*, 940: 226-233. [CrossRef]

Karasov, W. H. and Douglas, A. E. 2013. Comparative digestive physiology. *Comprehensive Physiology*, 3(2): 741. [CrossRef]

Kardong, K. V. 2002. Vertebrates comparative anatomy, function, evolution, 4th ed. Mc Grow Hill, New York, 787pp. [Click here]

Kausar, R., Raza, S., Hussain, M. and Bahadur, S. U. K. 2019. Histometerical and morphological studies of digestive tract and associated glands in domestic pigeon (*Columba livia*) with regard to age. *Pakistan Veterinary Journal*, 39(4): 573-577. [Click here]

Khaleel, S. J. 2022. Anatomical, Histological and Histochemical Study of Stomach and Intestine in Adult Peahens *Pavo cristatus*. PhD thesis, College of Veterinary Medicine, University of Baghdad, 160pp.

Nasrin, M., Siddiqi, M. N. H., Masun, M. A. and Wares, M. A. 2012. Gross and histological studies of digestive tract of broilers during postnatal growth and development. *Journal of the Bangladesh Agricultural University*, 10(1): 69-77. [CrossRef]

Rodrigues, M. N., Abreu, J. A. P., Tivane, C., Wagner, P. G., Campos, D. B., Guerra, R. R., Rici, R. E. G. and Miglino, M. A. 2012. Microscopical study of the digestive tract of Blue and Yellow macaws. *Current Microscopy Contributions to Advances in Science and Technology*, 5(2): 414-421. [ResearchGate]

Saleem, G. 2012. Necrotic enteritis, disease induction, predisposing factors and novel biochemical markers in broilers chickens. PhD thesis, Scottish Agriculture Collage, University of Glasgow, 261pp. [Click here]

Selvan, P. S., Ushakumary, S. and Ramesh, G. 2008. Studies on the histochemistry of the proventriculus and gizzard of post-hatch guinea fowl (*Numida meleagris*). *International Journal of Poultry Science*, 7(11): 1112-1116. [Click here]

Sultan, G. H. A, Al-Haaik, A. G. and Hasso, A. A. 2023. Morphometrical and histochemical study of glandular stomach (Proventriculus) in local domestic male ducks (*Anas platyrhchos*). *Iraqi Journal of Veterinary Sciences*, 37(1): 65-71. [Click here]

Taki-El-Deen, F. M. A. 2017. Histological and Histochemical studies on the alimentary canal of sprue winged Lapwing *Vanellus spinosus*. *The Egyptian Journal of Hospital Medicine*, 67(1): 314-321. [CrossRef]

Udoumoh, A. F. and Ikejiobi, J. C. 2017. Morphological features of glands in the gastrointestinal tract of the African pied crow (*Corvus albus*). *Comparative Clinical Pathology*, 26: 585-590. [Click here]

Zaher, M., El-Ghareeb, A. W., Hamdi, H. and Abu Amod, F. 2012. Anatomical, histological and histochemical adaptations of the avian alimentary canal to their food habits *Coturinx coturinx*. *Life Science Journal*, 9(3): 253-275. [ResearchGate]

Zhang, H., Ge. T., Peng, S., Zhong, S. and Zhou, Z. 2014. Microstructure features of proventriculus and ultra structure of the gastric gland cells in Chinese taihe black-bone silky fowl (*Gallus gallus domesticus* Brisson). *Anatomia, Histologia, Embryologia*, 38(5): 1-8. [CrossRef]

Zhu, L. 2015a. Histological and histochemical study on the stomach (proventriculus and gizzard) of black-tailed crake (*Porzana bicolor*). *Pakistan Journal of Zoology*, 47(3): 607-616. [Click here]

Zhu, L. 2015b. Histological study of the oesophagus and stomach in grey backed shrike (*Lanius tephronotus*). *International Journal of Morphology*, 33(2): 459-464. [Click here]

Bull. Iraq nat. Hist. Mus.
(2025) 18 (3): 507- 526.

دراسة مظهرية ونسجية وكيمونسجية للمعدة الامامية والقانصة في النورس مستدق المنقار *Chroicocephalus genei* (Brème, 1839)
(Aves, Charadriiformes, Laridae)

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الخلاصة

هدفت هذه الدراسة إلى التعرف على التركيب المظهري والنسيجي والكيمونسجي للمقدمة البطينية والقوانص في النورس النحيف المنقار *Chroicocephalus genei* (Brème, 1839) باستخدام المجهر الضوئي.

معدة النورس نحيف المنقار تنقسم الى المعدة الامامية والقانصة ، تقع المعدة الامامية على يسار الخط الوسطي للجسم وتغطى كلياً بالفص الايسر للكبد ، وتظهر كمثرية الشكل او بيضوية متطاولة وذات جدران ملساء . تظهر القانصة بشكل عضو عضلي كمثري الشكل وتقع على يسار الخط االوسطي في الربع السفلي من تجويف البطن. اظهرت نتائج الفحص النسيجي ان جدار المعدة الامامية والقانصة تتألف من اربع طبقات رئيسية هي الغلالة المخاطية ،الغلالة تحت المخاطية ، الغلالة العضلية ،الغلالة المصلية ، بالاضافة الى وجود طبقة الكويلين التي تغطي الغلالة المخاطية للقوانص . البطانة الظهارية لجدار المعدة الامامية تغطى بنسيج ظهاري عمودي بسيط ، بينما تحتوي الصفيحة الاصلية على غدد نبيبية بسيطة التي تتكون من نسيج ضام مفكك، وتتكون الغلالة تحت المخاطية من نسيج ضام مفكك وغدد معدية عميقة . تتكون الغلالة العضلية من ثلاث طبقات من الالياف العضلية الملساء، في حين يشكل النسيج الضام المفكك الغلالة المصلية . في القانصة، تبطن البطانة الظهارية بواسطة نسيج ظهاري عمودي بسيط ، وتتألف الصفيحة الاصيلة من غدد نبيبية بسيطة . الغلالة تحت المخاطية للقانصة تتكون من

نسيج ضام كثيف، بينما الغلالة العضلية مؤلفة من الياف عضلية ملساء ، والغلالة المصلية تبطن بواسطة نسيج ضام مفكك ، يظهر الفحص الكيمونسجي وجود كمية كبيرة من السكريات المتعددة المخاطية في المعدة الامامية والقانصة والتي تفاعلت بشكل ايجابي مع صبغة PAS.