HISTOLOGICAL STUDY OF THE STOMACH IN EGYPTIAN MALLARD (ALOPOCHEN AEGYPTIACA)

Zahra’a Daibes¹, Zainab M. Jasim² and Eyhab R. Al-samawy³

³ Collage of Medicine, AL-Muthanna University, Iraq.

Abstract:
This search aim to study the histological structure of Stomach of domestic duck (Mallard). Six healthy birds (males and females) are used and after their slaughter the abdominal region was carefully opened and the stomach separated from it's connection with alimentary canal, cleaned with water and fixed in 10% formalin. The histological study showed that the wall of the glandular and muscular stomach consist of four tunicae:Tunica Mucosa, Tunica Submucosa, Tunica Muscularis and Tunica Serosa. The results suggested that the Muscularis mucosa layer represented the secretary part of glandular stomach, the keratinoid material lining the lumen of gizzard, and the tunica muscularis was the thickest one among four tunicae.

Introduction
Ducks are among the waterfowl found in southern Iraq, that are raised for the purpose production meat and eggs (1, 2).

The Mallard is widely distributed across the Northern Hemisphere, North America from southern and central Alaska to Mexico, the Hawaiian Islands, and across Eurasia, from Iceland and southern Greenland and parts of Morocco (North Africa) in the west, Scandinavia to the north, and to Siberia, Japan, and China in the east (3,4).

The stomach is the effective part of the digestive system of birds and is divided into two parts, one located after the other and separated from each other with a separator. The first part is known as the glandular stomach (Proventriculus) and represents the glandular part of the stomach and it secretes digestive juices that digest food. As for the second part of the stomach that represents the stomach muscle (Ventriculus) or Gizzard, it grinds the food and mixes it with Digestive juices (5,6).

Common name: Mallard Duck

Scientific name: Anas platyrhynchos

Type: Birds
Diet: Omnivore

GROUP NAME: Sord (in flight)

AVERAGE LIFE SPAN IN THE WILD: 5 to 10 years
AVERAGE LIFE SPAN IN CAPTIVITY: Up to 10 years
SIZE: 20 to 26 inches
WEIGHT: 2 to 3 pounds
SIZE RELATIVE TO A 6-FT MAN:

The purpose of this paper was to study the histology of the glandular and the muscular stomach of the mallard.

Materials and Method:
The selected birds were purchased for study from the bird selling markets in Muthanna Governorate, as ten samples were collected from the local ducks. Birds were euthanized prior to their dissection with an intravenous injection of sodium pentobarbitone (80 mg/kg), then after, fixing them on a dissecting board. A mid-line incision was made in the abdominal wall to view the coelomic viscera. The proventriculus and ventriculus (gizzard) were identified and photographed in situ using digital camera (pupil cam., ken-a-vision). Locations and relationships of these organs was well illustrated in figures.

For the histological aspect of the study, the specimens (whole proventriculus, gizzard) from each dissected birds were washed gently by normal saline then immersed in 10% neutral buffered formalin. After well fixation the specimens from the stomach were dehydrated by passing them through a series of ascending ethanol alcohol each for two hours (70%, 80%, 90% and 100%) and then specimens were cleared in xylene for one hour after that embedded in paraffin wax and then the blocks were sectioned at 6µm thickness and stained with either one of the following stains: Mayer’s Hematoxylin and Eosin routine stain for general features identification (7), Masson Trichrome stain for the staining of the collagenous and smooth muscle fibers (8).

Then examined the glass slides with Olympus optical microscope at a different magnification power and photographed the clips using the imaging camera (c35 Olympus).

Results and Discussion
Microscopic examination of the wall of proventriculus revealed the presence of four layers of the typical tubular organ, that were tunica mucosa, submucosa, muscularis and serosa (Fig.). The layers which structured the wall of proventriculus was similarly documented in the proventriculus in many avian species such as ostrich (Struthio camelus) (9)(10), Guinea fowl (Numida meleagris) (11), quail (12), Japanese quail (9) and Coot bird (13). Whereas, in the wall of the proventriculus of Asiatic swiftest (Collocalia spp.), (14) observed only three layers in which only mucosa, muscularis and serosa were detected.
Tunica mucosa showed longitudinal branched folds that were lined by simple columnar epithelium (Fig.). The underlying lamina propria was constructed of loose connective tissue filled with blood vessels and infiltrated lymphocytes (Fig.). The structure of the lamina propria extended inside the folds and possessed simple tubular mucous glands (Fig.). These glands were opened into the lumen of the proventriculus via their ducts. The glands were lined with simple cuboidal epithelium and were dispersed at the apical part of the lamina propria. The propria was separated from the underlying submucosa by fibers of smooth muscle called muscularis mucosa (Fig.). The presence of simple columnar epithelial lining of the mucosa in the studied mallard were similar to mucosal lining of the most avian species (15), guinea fowl (11) and ostrich (16). The mucosal glands which were observed lined with simple cuboidal epithelium in pigeon were in accordance with those observed in the same organ of the Coot bird (Fulica atra) (13) and common quail (Coturnix coturnix) (16). The presence of muscularis mucosa separating markedly the mucosa from the underlying submucosa in the studied mallards was in a good agreement with those observed in the same organ of the red-gartered coot (Fulica armillata) (17) and the red jungle fowl (18). Whereas, (16) found incipient muscularis mucosa in the mucosa of the proventriculus of red-capped cardinal birds and the recent findings of the (8) recorded absence of this layer in the mucosa of falcon’s proventriculus.

Tunica submucosa prominently, this layer found occupying most of the wall thickness of this organ. It was formed of loose connective tissue containing pear-shaped branched tubular proventriculus glands surrounded by a fibrous capsule (Fig.). Such findings were not similar with those of (19) in the burrowing owl (Speotyto cunicularia) whom described these glands as oval and lined by tall columnar epithelium. The glands consists numerous secretory tubules which were lined by cuboidal cells and each tubule continued by one duct opened into the main collecting duct which subsequently opened into luminal surface of the organ. Current findings were similar to those recorded in other birds such as Red-Capped Cardinal (Paroaria gularis gularis) (18) and Coot bird (Fulica atra) (13) but different to those found in the red jungle fowl (18). The current findings concerned presence of proventriculus glands were not parallel with those of (20) and (21) whom referred to the absence of these glands in the submucosa of the proventriculus in chickens.

Tunica muscularis was constructed of two layers, inner thin longitudinal and an outer thick circular layers. Between such layers, fine connective tissue was observed filled with blood vessels (Fig.). Differently to current findings, in parrots (3) observe only one layer of smooth muscle fibers circularly arranged. In other birds found three layers of smooth muscle bundles constituting the muscular layer such as the red-capped cardinal birds (18). The layers were inner longitudinal, intermediate circular and an outer longitudinal in which nerves and ganglion cells were distributed. However, in the falcon proventriculus, (8) found similarly to current studied mallards two layers but the inner longitudinal layer was well developed that constructs most thickness of the wall of this organ in this bird.

Tunica serosa was constructed of loose connective tissue in which nerves, blood vessels, adipose cells were observed and such structures were covered by a layer of mesothelium (Fig.). These findings were similarly observed by (3) in Japanese quail and (13) in Coot bird (Fulica atra).
Similarly to the proventriculus, the microscopic structure of ventriculus also showed the four known tunicae forming its wall (Fig.). Same findings regarding the wall structure were recorded in most avian species such as Red-Capped Cardinal (Paroaria gularis gularis)(18) and in guinea fowl (Numida meleagris) (11).

The color and the presence or absence of the cuticle was previously documented in avian species. The previous data in the literatures indicated a relationship between it and the type of food consumed by the bird. As in the current mallard the presence of cuticle was similar to other avian species that possessed thick cuticle layer with well-developed muscular stomach. In fact many researchers such as (22), (23), (24) and (25), referred to the thickness of the cuticle which is highly correlated with food consumed. They proposed thick cuticle in granivores and a thin in frugivores.

Tunica mucosawas constructed by simple columnar epithelium characterized by basally located oval-shaped nuclei with lightly stained cytoplasm (Fig. ). Similar epithelial covering observed in the ventriculus of the other species such as in owl (21) but differently in that of the Coot bird (Fulica atra) (13) and in mallard in which it was simple cuboidal epithelium (26).

The simple columnar cells covering of the ventriculus was similarly observed in other avian species such as partridge (Rhynchotus rufescens)(12), Red jungle fowl (18) and in the Blue and Yellow macaws (27). The lamina propria showed numerous simple tubular glands lined by simple cuboidal cells. The examination of the ventriculus revealed the presence of eosinophilic secretion going away toward the epithelial surface as a strips forming the cuticle (Fig. ). It spread all over the mucosal surface filling the lumina of the gastric pits as a pinkish thick material. Muscularis mucosa appeared as circularly arranged smooth muscle bundles interrupted by the presence of mucosal glands in the lamina propria. The presence of muscularis mucosa between the mucosa and submucosa in the mallard appeared dissimilar to previous findings in other birds such as codorna nothura (28), red-capped cardinal birds (18), Blue and Yellow macaws (13, 27) and in falcon’s gizzard (15) in which this layer was absent in their mucosal layer.

Tunica submucosawas composed of abundant connective tissue containing blood vessels and nerves (Fig. ). This outcome in a good agreement with those observed in the Red-Capped Cardinal (Paroaria gularis gularis) (29), in most avian species (23) and in Rock dove (Columba livia) (30) that described connective tissue composition in this tunic.

Tunica muscularis appeared as a very thick structure of smooth muscles bundles. In the mallard, three layers of muscles were distinguished that were thin inner, outer longitudinal and very thick intermediate circular layers (Fig.). There were fine collagenous fibers distributed between their bundles. The presence of three layers of muscles fibers was in accordance with the findings of (31) in the Uroloncha domestica, (17) in the Fulica armillata (granivorous species) and (18) in the ventriculus of the red jungle fowl. Conversely, two layers of muscles fibers in the wall of the ventriculus was recorded by (28),(13), (26) and (21) in the same organ of red-capped cardinal, Coot bird (Fulica atra) most avian species and owl, respectively.
Tunica serosa was constructed of loose connective tissue rich in blood and covered by the mesothelium of simple squamous cells. The structure is commonly observed in many avian species such as Ostrich (Struthio camelus) (32), in turkey (33).

**Fig. 1.** Showed the proventriculus wall of mallard showed mucosa (red star), Submucosa (A), Muscularis (B), serosa (C) and proventricular gland (D), (yellow star) showed epithelial cells in mucosa. (a) X100, (b) X400 H & E stain.
Fig. 2. Microphotography of the proventriculus wall of Mallard showed: Connective tissue in mucosa (Green one head arrow), Connective tissue in submucosa (Black one head arrow) and Connective tissue in serosae (Black one head arrow) Masson Trichrome stain 100 X
Fig. 3. Microphotography of the Ventriculus wall of mallard showed: mucosa (A), Submucosa (B), Muscularis (C), serosa (D), mucosal glands (Red star), (Black star), epithelial cells in mucosa

H & E 100 X
References:

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