

Microscopic and morphometric study of the proventriculus and ventriculus of the Striated Scope Owl (*Otus Scors brucei*) in Iraq

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Abstract

The stomach of the Striated Scope Owl (*Otus Scors brucei*) consist of two externally distinguishable chambers: that are the proventriculus (glandular part which secretes the gastric juices) and the gizzard (ventriculus) which has a mechanical function. The proventriculus of longitudinal shape is cranially continuous with the esophagus. The gizzard was rounded shape with a thin wall is extended caudally to the proventriculus. The proventriculus was thick-walled and short (the mean length was 11.4mm , 7.1mm in diameter and 1mm³ in volume). The wall was constructed of the four typical layers of the tubular organ, that are tunica mucosa, submucosa, tunica muscularis and tunica serosa. The average thickness of each tunicawas 3240 µm, 14280 µm, 960 µm and 120 µm, respectively. The Gizzard was rounded sac surrounded by fatty tissue. Noticeably, it lack the smooth muscles fibers which are usually found in the developing gizzard and absence of the keratinoid lining of the mucosal surface. The mean length was 24.34 mm, 12.7 mm in diameter and 3 mm³ in volume. Similarly to the proventriculus, the gizzard's wall was constructed of the same four tunics that are tunica mucosa, submucosa, tunica muscularis and tunica serosa. The average thicknesses of these tunicae are 1560 µm, 1680 µm, 3240 µm and 120 µm, respectively.

دراسة مجهرية وشكلية قياسية للمعدة الغدية و القانصة لطير البوم الخضابي المخطط نوع

في العراق (Otus Scors brucei)

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الخلاصة:

تتكون معدة طير البوم الخضابي المخطط من ردهتين هي المعدة الحقيقية او المعدة الغدية والتي تقوم بأفراز العصارات الهضمية والمعدة العضلية او القانصة والتي تكون وظيفتها ميكانيكية. المعدة الغديه طولية الشكل وتستمر اماميا مع المرئ بينما تقع المعدة العضلية خلفيا للمعدة الغديه وتكون ذات شكل دائري ذي جدار رقيق. تكون المعدة الغدية قصيرة وذات جدار سميك اذ بلغ معدل طولها (11.4) ملم وقطرها (7.1) ملم وحجمها (1) ملم³. يتكون جدار المعدة الغدية من اربعة طبقات نسيجية (المخاطية, تحت المخاطية, العضلية والمصلية) وبلغ معدل سمك كل طبقة بالتتابع 3240, 14280, 960 و 120 ملم مايكروميتر . تظهر المعدة العضلية ككيس دائري رقيق الجدار غير متطور غير مدعوم بطبقة الكراتين ومحاط بطبقة من النسيج الدهني. بلغ معدل الطول (24.34) ملم والقطر (12.7) ملم والحجم (3) ملم³. يتالف جدارها نسيجيا من اربعة طبقات (المخاطية, تحت المخاطية, العضلية والمصلية) وبلغ معدل سمك كل طبقة بالتتابع 1560, 1680, 3240 و 120 ملم مايكروميتر.

Introduction

There are approximately(8600) kinds of birds distributed throughout the world. The largest order of birds is Passeriformes. This order includes nearly 5110 kinds of birds of which the smallest one is the order Struthioniformes (1).

Gut morphology showed considerable variations among different animals depending on phylogenetic, diet quality, the size of the animal and various environmental pressures. In fact, the avian digestive system showed larger number of organs which have greater inter-organ cooperation compare to those in mammals (2). Interestingly, the modifications of the avian digestive tract may resulted as an

adaptation to the nature of their diet (3).

The most active part of the avian digestive system is the stomach which is formed of two distinct parts, that are the glandular portion (proventriculus) and the muscular portion (ventriculus or gizzard) which is located caudal to the proventriculus (4). Histologically the wall of the stomach (proventriculus and ventriculus) is structured from the following layers: tunica mucosa, submucosa, muscularis and tunica serosa (5).

Materials and Methods

Ten birds are used to conduct the current study. The birds bought from the local suppliers from specific markets at Baghdad province. Birds are left 2 weeks for acclimation at animal house of the veterinary faculty/Baghdad university in suitable cages. Weight of birds is calculated before their euthanasia. The birds euthanized prior to its dissection with an intravenous injection of sodium pentobarbitone (80 mg/kg) (6). After that, they are dissected by fixing them on a dissecting board. A mid-line incision is made in the abdominal wall of the bird to view the abdominal

viscera. The proventriculus and ventriculus are washed by normal saline solution to remove blood or any other adhering debris. The contents of the stomach emptied by gentle pressure on each of them, then washed by normal saline again.

Macroscopic linear measurements of these dissected organs is calculated after their extirpation. Measurements such as length, width or diameters of the collected specimens are conducted in millimeters by using the electronic Vernier scale, whereas the weights is measured in grams by using sensitive digital balance. For histological study, half of the specimens (whole proventriculus, gizzard) from each dissected birds is collected and fixed in Bouin's solution and the other half in 10% neutral buffered formalin. After well fixation the specimens is dehydrated by passing them through a series of ascending ethanol each for two hours (70%, 80%, 90% and 100%) and then specimens is cleared in xylene for one hour after that embedded in paraffin wax and then the blocks are sectioned serially at 6 μ m thickness and stained with either one of the following stains(7): Mayer's

Hematoxylin and Eosin as a routine stain to identify the general histological structures, Masson trichrome stain specially for the staining of the collagenous and smooth muscle fibers and PAS for the basement membranes of the epithelial lining of the stomach

Results

The stomach of the Striated Scope Owl (*Otus Scors brucei*) is constructed of two externally distinguishable chambers that are proventriculus or glandular part which secrete the gastric juices and the gizzard or muscular part which has a mechanical function. The proventriculus is cranially continuous with the esophagus and appeared longitudinal in shape. The gizzard or ventriculus extends caudally to the proventriculus and rounded in shaped with a thin wall. The proventriculus appeared as short longitudinal organ characterized with thick-wall. The study revealed that the mean of body weight of this bird was about (290.15 gm), while the mean of organ weight was about (0.81) gm. and the ratio of the organ weight to the body weight was about (0.002%), and the mean of the length, width, diameter and volume

are (12.63, 8.33, 8.95 and 1.16 Mm) thus results in male owl, while the female owl that the mean of body weight of this bird was about (285.09 gm), the mean of organ weight was about (0.75) gm. and the ratio of the organ weight to the body weight was about (0.002%), and the mean of the length, width, diameter and volume are (11.54, 7.4, 6.22 and 1.06 Mm). The wall is clearly thick, whereas the lumen is narrow and contracted. The wall is consisted of the four layers of the typical tubular organ that are tunica mucosa, submucosa, tunica muscularis and tunica serosa (Fig. 1).

Microscopic findings showed that the surface of the *tunica mucosa* of the proventriculus is invaginated at regular intervals forming mucosal folds (Fig. 2). Its mean thickness is (3240) μm . This tunic is composed of three parts, i.e. epithelium, lamina propria and muscularis mucosa. Columnar cells are formed the epithelial lining of the mucosal layer (Fig. 3). The gastric epithelium of the proventriculus is formed of simple columnar and mucus secreting cells. The lamina propria is constructed by connective tissue, blood vessels and lymphatic infiltration. The lamina is extended inside the mucosal folds and contains simple tubular glands which are mucous in their secretion (Fig. 4). These glands are opened into the lumen of the organ. Muscularis mucosa is formed of

smooth muscle fibers which appeared scattered along the lamina propria and surrounds the apical part of the deep

proventricular glands (Fig. 5).

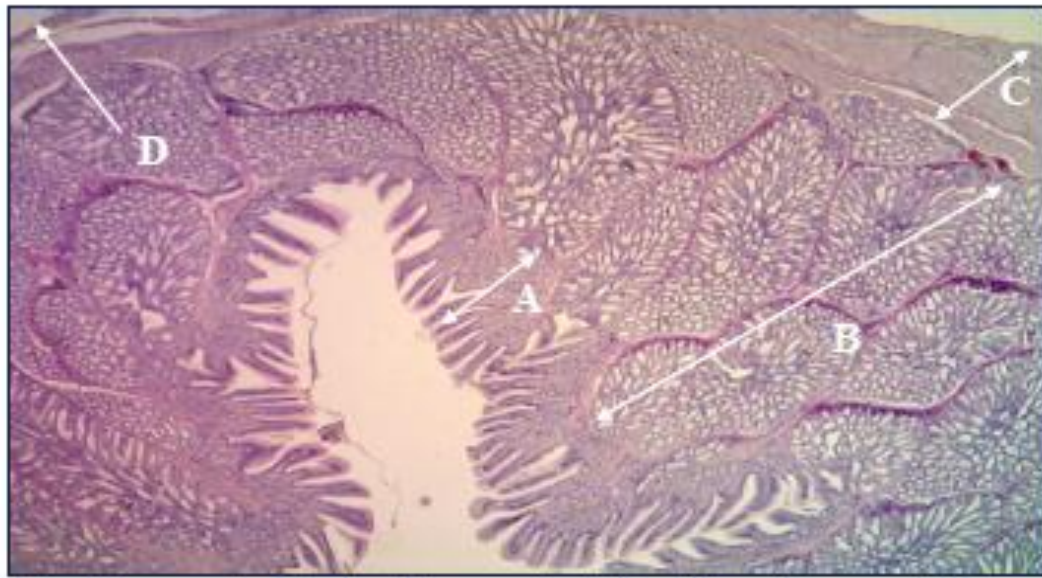


Fig. 1. Cross section of the glandular stomach wall of owl showed T. mucosa (A), T. Submucosa(glandular) (B), T. Muscularis (C), and T. serosa (D), H & E, X40

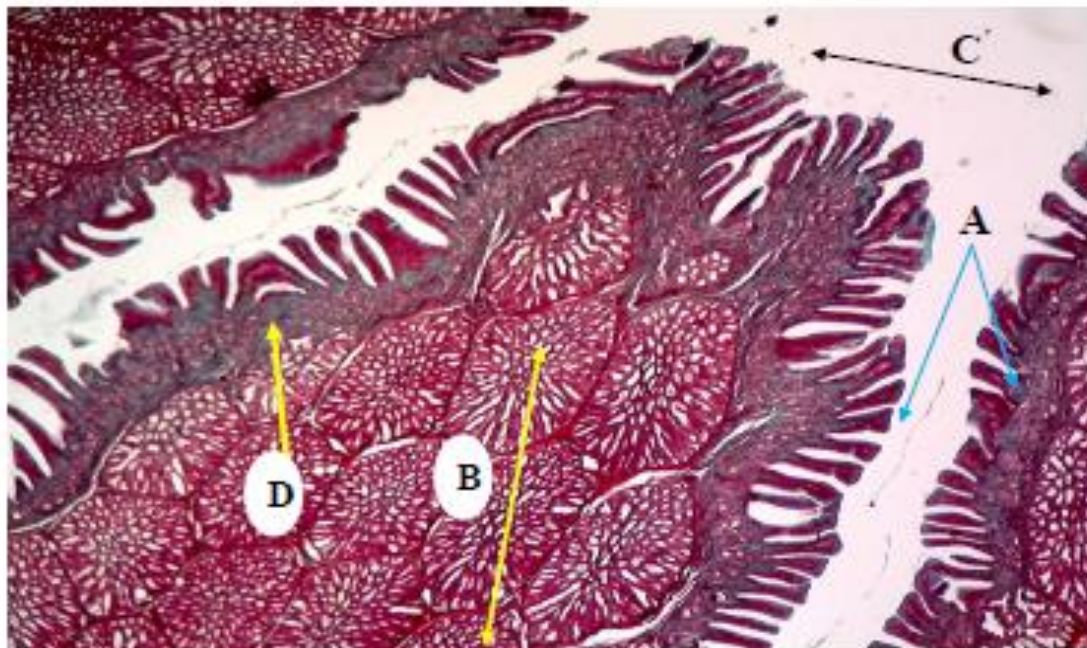


Fig. 2. Cross section of the glandular stomach wall of owl showed folds (A), deep submucosal gland (B), lumen (C), connective tissue of lamina propria (D), Masson's Trichrome, X40

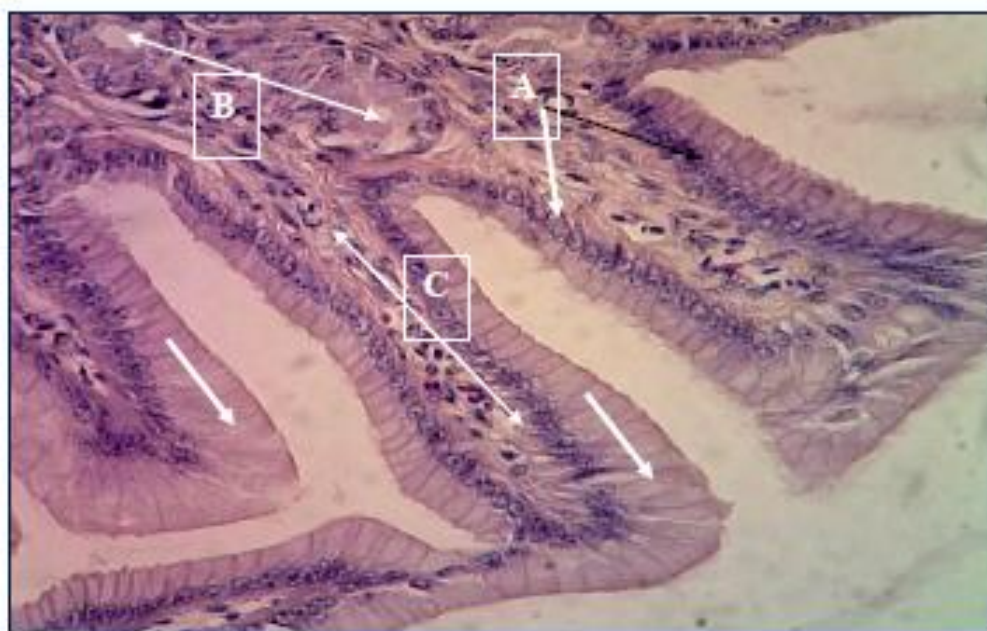


Fig. 3. Cross section of the glandular stomach wall of owl showed epithelial columnar cells (A), simple tubular glands (B), Lamina propria (C) and the surface lining cells (arrows), H & E, X400

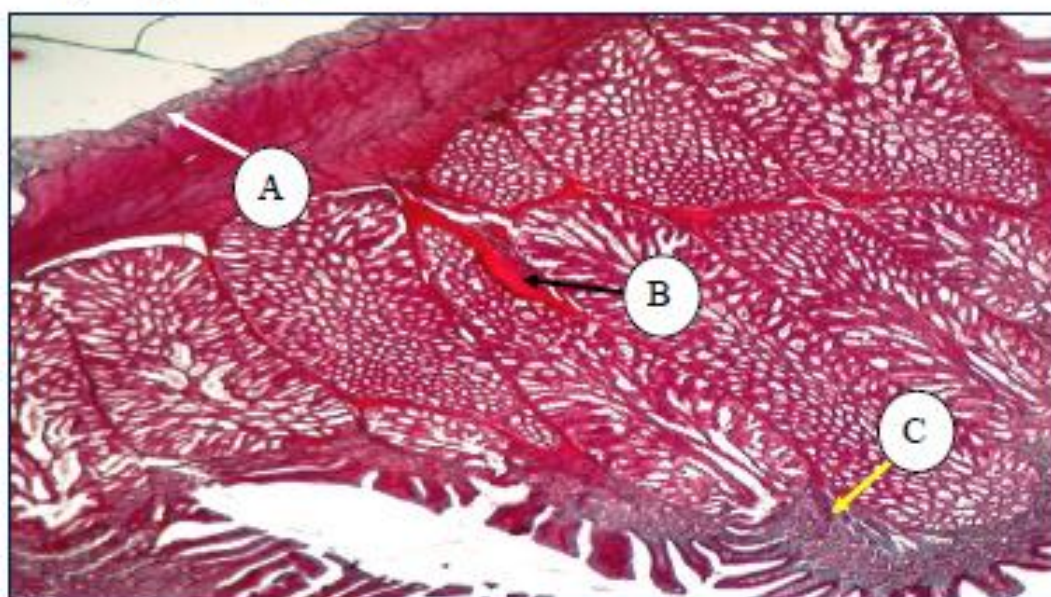


Fig. 4. Cross section of the glandular stomach wall of owl showed serosa (A), septa (B) and lamina propria (C), Masson's Trichrome, X40

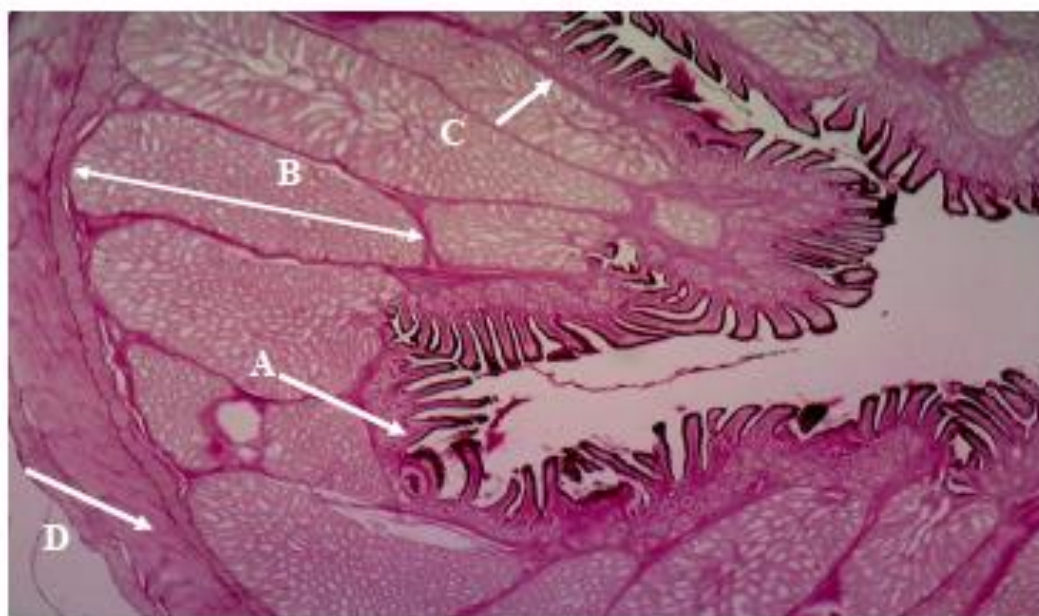


Fig. 5. Cross section of the glandular stomach wall of owl showed basement membrane (A), submucosal gland (B), muscularis mucosa (C), muscularis (D), PAS, X40

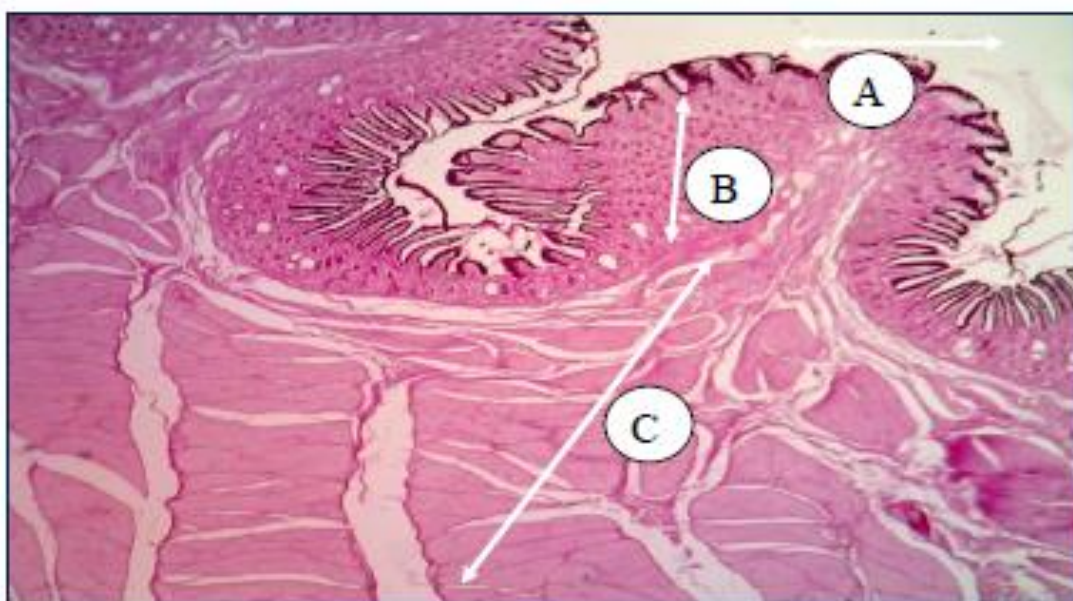


Fig. 6. Gizzard's wall of owl showed lumen (A), mucosa (B) and tunica muscularis (C), PAS, X40

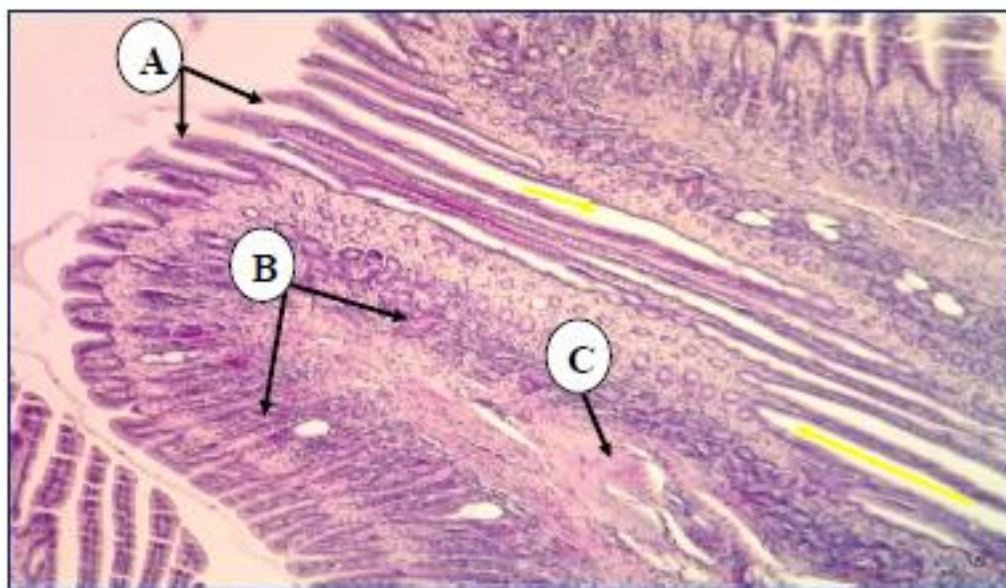


Fig. 7. Gizzard's wall of owl showed mucosal folds (A), gastric glands (B), Submucosa (C) and gastric pits (yellow arrows), H & E, X100

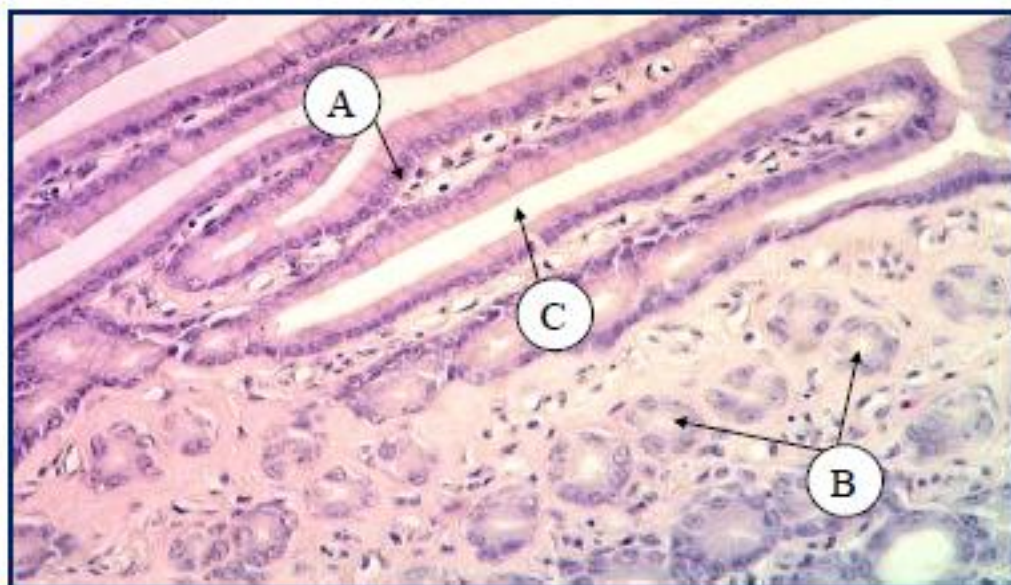


Fig. 8. Gizzard's wall of owl showed epithelial columnar cells (A), simple gastric gland (B) and gastric pit (C), H & E, X400

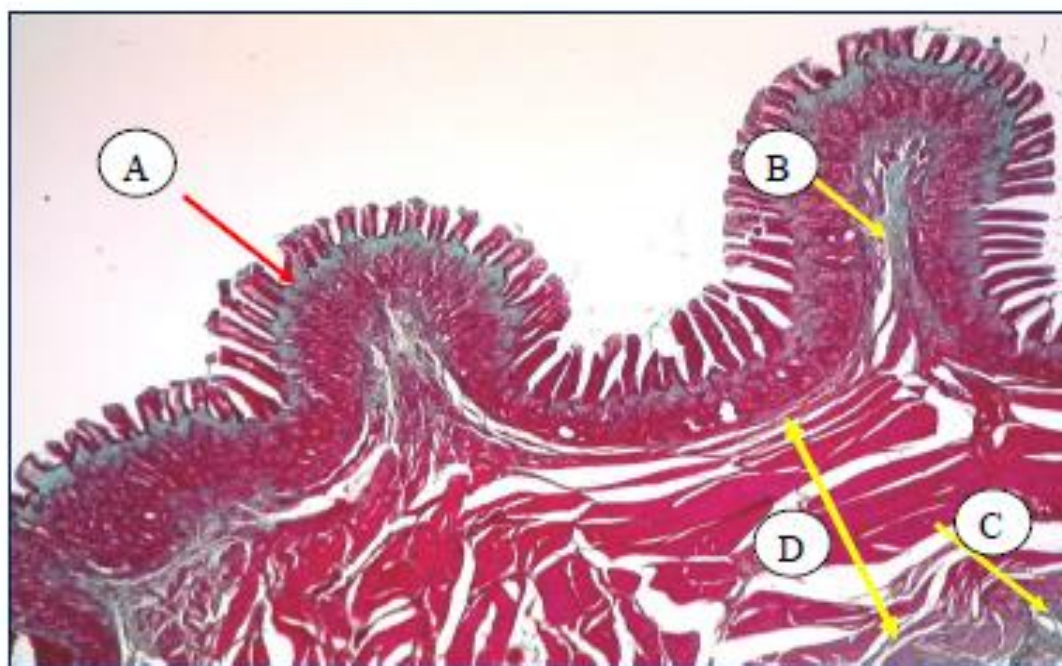


Fig. 9. Gizzard's wall of owl showed lamina propria (A), submucosa (B), serosa (C) and tunica muscularis (D), Masson's Trichrome, X40

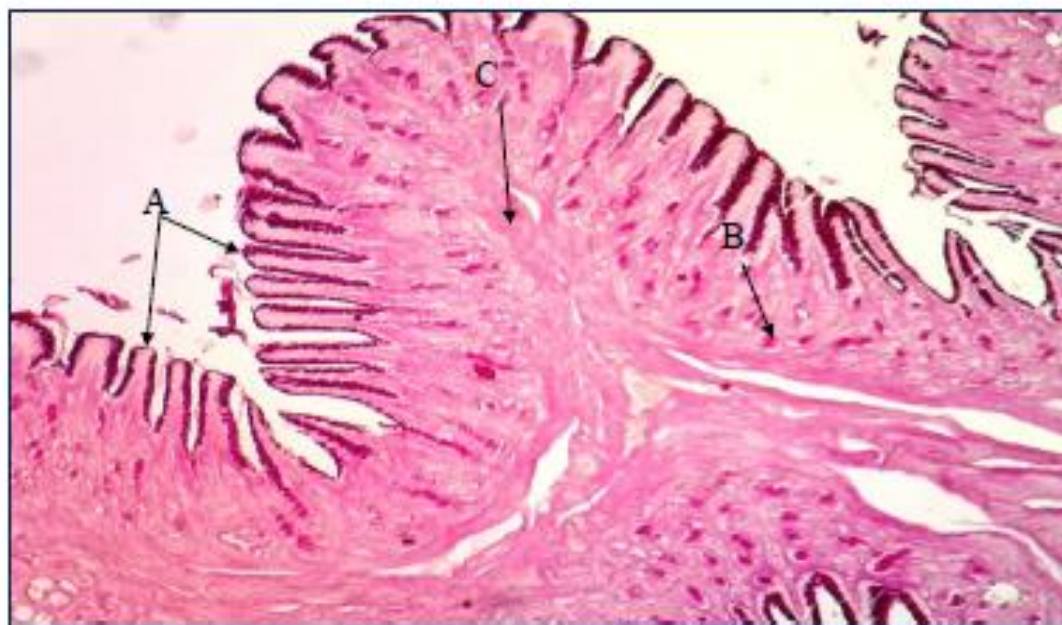


Fig. 10. Gizzard's wall of owl showed mucosal folds (A), simple gastric gland (B) and submucosa (C), PAS, X100

Tunica submucosa is constructed by the connective tissue supplied with well blood vessels. The mean thickness of this layer is (14280) μm . This tunic occupied most of the thickness of the wall of the proventriculus which contains numerous deep proventricular glands. The mass of proventricular glands made up the greatest part of the thickness of the proventricular wall (Fig. 2 & 5). The glands are composed of numerous rounded or polyhedral lobules which are arranged in small groups, each of them draining into the lumen through one of the mucosal papillae. The histological calculation revealed that the submucosal compound glands are about (3120) μm in diameter.

Tunica muscularis is about (960) μm in thickness. The microscopic findings showed that this tunica consist of two layers, inner circular and outer longitudinal of smooth muscles fibers (Fig. 1). Between such muscular layers the rich blood vessels and nervous plexus are found. The thickness of tunica serosa in this bird is about (120) μm . The microscopic results established that the tunica serosa is consisted of connective

tissue in which the nerves and blood vessels are distributed (Fig. 4).

The macroscopic examination showed that the ventriculus or gizzard stomach is rounded sac surrounded by fatty tissue. It is located on the left side of the midline plane next to the proventriculus and covered partially by the left lobe of the liver. It is obviously noted that there is no smooth muscle fibers in the its wall which is found in the developing gizzard and absence of the keratinoid lining of the mucosal surface. The results revealed that the mean of body weight of this bird was about (290.15 gm), while the mean of organ weight was about (3.16) gm. and the ratio of the organ weight to the body weight was about (0.10%), and the mean of the length, width, diameter and volume are (24.63, 12.74, 11.5 and 3.12Mm) thus results in male owl, while the female owl that the mean of body weight of this bird was about (285.09 gm), the mean of organ weight was about (2.87) gm. and the ratio of the organ weight to the body weight was about (0.10%), and the mean of the length, width, diameter and volume are (23.46, 11.56, 10.34 and 3.06 Mm).

Histological structure of the gizzard's wall in this bird is consisted of four layers or tunics similar to what is found in the proventriculus (Fig. 6). *Tunica mucosa* is invaginated into the lamina propria forming different size of gizzard pits (Fig. 7 & 8). The pits are extended into the glandular layer occupying all of the thickness of the mucosa. The height of the mucosa is up to (1560) μm in thickness. This tunic is constructed of three parts, i.e. epithelium, lamina propria and muscularis mucosa. The epithelium is simple columnar cells lining the simple straight tubular mucosal glands (Fig. 8). The mean diameter of the glandular acini is measured about (195) μm which is found in the lamina propria. The propria is structured of loose connective tissue (Fig. 9). The muscularis mucosa resembled a thick band of smooth muscle fibers separating the lamina propria from the underlying tunica submucosa. Tunica submucosa of the gizzard is constructed of abundant connective tissue richly supplied with blood vessels and nerves (Fig. 9 & 10). The mean thickness of this tunica is measured about (1680) μm .

Tunica muscularis is formed of smooth muscle fibers, arranged into two layers, that are outer longitudinal layer and inner circular layer (Fig. 6) and the mean thickness of this layer is about (3240) μm . Finally, tunica serosa is formed of loose connective tissue, containing blood vessels, lymphatic vessels and nerves. This connective tissue is surrounded by simple squamous mesothelium (Fig. 9). The mean thickness of this layer is up to (120) μm .

Discussion

The stomach of the Striated Scope Owl (*Otus Scors brucei*) is constructed of two externally distinguishable chambers that are proventriculus or glandular part which secrete the gastric juices and the gizzard or muscular part which has a mechanical function, such findings is similar with those found in *Rhynchotus rufescens* which is omnivorous bird (8). The proventriculus appeared as short longitudinal organ characterized with thick-walled. The latter character different previously in chicken in which the proventriculus presents elliptical in shape and the organ lying above the liver, between the esophagus and gizzard (3). The wall is consisted

of the four layers of typical tubular organ that are tunica mucosa, submucosa, tunica muscularis and tunica serosa and such findings are coincided with those found in the proventriculus wall of the quail to (9) and (10) in Guinea fowl.

The *tunica mucosa* of the proventriculus is invaginated at regular intervals forming mucosal folds. This tunic is composed of three parts, i.e. epithelium, lamina propria and muscularis mucosa and such finding is in agreement with those observed in jungle fowl (11). Columnar cells are formed the epithelial lining of the mucosal layer. This trait is in a good agreement with those observed by (10) in Guinea fowl, whereas such finding is in disagreement with those of (12). The lamina propria is contained of simple tubular glands, which are opened into the lumen of the organ, a finding similar to those of the fowl (13). *Tunica submucosa* is constructed by the connective tissue and mass of proventricular glands in the proventricular wall and such feature is similar to those found in the proventricular wall of the chicken to (14). The microscopic findings of the tunica muscularis is consists of two

layers of smooth muscles fibers this results similar to those of (15). The tunica serosa consisted of the connective tissue in which the nerves and blood vessels are distributed. These findings are well coincided with those in the proventriculus wall of the burrowing owl (16).

The ventriculus or gizzard stomach appeared as rounded sac surrounded by fatty tissue findings are not in consistence with the previous findings of (13) whom mentioned that the avian gizzard in general is not covered with the fatty tissue. The gizzard revealed no smooth muscle fibers in its wall which is found in the developing gizzard and absence of the keratinoid lining of the mucosal surface and such observations are parallel well to those of (17) whom documented that the koilin layer do not cover the epithelium of gizzard in kestrel and *Accipiter nisus*. Whereas, the observation is not agreed with (18) in their findings in the gizzard of the common quail in which well developed thick and hard cuticle is found.

The gizzard's wall in the current investigated bird is consisted of four layers or tunics similar to the proventriculus, the same findings that

are previously observed by (19). The epithelium of the tunica mucosa is simple columnar cells lining the simple straight tubular mucosal glands. Such finding appeared similar those mentioned by (8), whereas different to those of (15) whom described the lining epithelium of mucosal fold as simple columnar epithelium. The tunica submucosa constructed of abundant connective tissue and blood vessels which was in a good agreement with those observed in the Red-Capped Cardinal (*Paroaria gularis gularis*) by (6). Tunica muscularis is formed of smooth muscle fibers, same as those mentioned by (18, 20). Tunica serosa is formed of loose connective tissue, containing blood vessels, lymphatic vessels and nerves and such results are similar to those found in Red-Capped Cardinal (*Paroaria gularis gularis*) and partridge *Rhynchotus rufescens* (6, 8).

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