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HISTOLOGICAL AND HISTOCHEMICAL STUDIES OF THE STOMACH IN THE IRAQI FALCON (*FALCON BERIGORA*)

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Abstract

The current study was conducted to know the histological and histochemical of stomach walls of Iraqi Falcon *(Falcon berigora*). We studied six healthy birds that obtained from Basra commercial markets. The stomach in the falcons consists of two parts: the proventriculus (pars glandularis) and the gizzard (ventriculus or pars muscularis). Under the light microscopy, the proventricular surface of the gastric epithelium does not contain papila: the present vesicle folds and the mucous tunica of the proventriculus membrane lined with a columnar simple epithelium. The proventriculus tunica mucosa is more folded due to the existence of developed bundles of longitudinal muscle. Absence of the central region between the gizzard and the proventriculus. The ventriculus luminal surface has a cuticle, that is shed small micro area (around the pyloric opening), is sloughed, highly carefully affixed to the gizzard lining surface and fragile membrane. Histochemical study of the proventriculus and ventriculus layers showed positive reaction with PAS, Toldian, and Mallory stain.
***Keywords*:** Falcon, Proventriculus, Ventriculus, Histology.

Introduction

The digestive system comprises of organs attentive with decreased mechanical digestibility of chemical, drink and food absorption (Dyce *et al.*, 2010). Morphology of the birds gastrointestinal tract, the strategy of digestive is closely throughout evolution so that the nutrient content of available foods are matched in their natural habitat (Kadhim *et al.*, 2011). Carvers species have an oesophagal pouch to be an expandable or sizeable crop for food storing so that can be consumed large meals. Generally, carnivores birds have less complicated digestive system than those eating complex carbohydrates rotes (Duke, 1997). However, in birds, the stomach consists of two chambers the proventriculus and gizzard the proventriculus varying in sized regarding large species and distensible in aquatic carnivores while relatively small in carnivores (Hassouna, 2001). Histological the proventriculus wall consists of the large complex tubular gland. The secretory cell product of both pepsinogen and hydrochloric acid contains the function of mammalian head of the parietal cell while ventriculus is a highly muscular grinding organ (Bacha Jr and Bacha, 2012).

The current study aims are to describe the histological architecture of the falcon stomach.

Material and Method

Six healthy adult falcons were used in the present study (as a model for carnivores birds) that bought from Basra commercial markets. The specimens are well anaesthetized by chloroform and then dissected by an incision along with them and exposed the digestive tube. A sample of the dissented stomach, fixed in 1o% formaldehyde then processing for a pre-histology picture (dehydrated and on bedded in paraffin histological section of 5-6mm thick were obtained al stained with routine stain (Eosin and Hematoxylin) for identification of general properties. The following staining using for the show the general carbohydrate were using periodic acid Shiff (PAS) technique to Toldin blue stain were using for muco polysaccharide Mallory stain was used for connective tissue (Bancroft *et al.*, 1982).

Result

The results of the current study revealed that the muscular stomach of the falcon is classified into two varies structures, proventriculus is the first (Ventriculus glandularis, Glandular stomach), and muscular stomach or ventriculus is the second (Ventriculus muscularis, Gizzard). Additionally, the first part is a muscular part and cranial glandular. In contrast, the caudal muscular part is the second that is not separated by an intermediate region or an isthmus from each other.

Histologically: Under light microscopy, the sections of histology indicated that the stomach wall (gizzard and proventriculus) consists of the following layers: tunica mucosa gastris (mucous membrane), tela submucosa gastris (submucosa), tunica muscularis gastris (muscular) and tunica serosa (serosa). Extensively folded of the proventriculus tunica mucosa and separated by grooves due to finding of a well-developed layer of inner longitudinal tunica muscularis, these lined with simple columnar epithelial tissue. The tela submucosa gastris is comprised of dense connective tissue with lobules proventriculus glands these lobules somewhat large and elongated in shape with narrow lumen. The proventriculus gland arranged around central secondary with narrow lumen duct which drains several lobules. The connective tissue in submucosa was intrapted, and there was blood supply of nerve figure 1 (A). Inclined of smooth muscular fibres layer by presents the tunic muscularis in the inner longitudinal and other out of inclined circular fibres. The circular layer is developed less than the longitudinal layer. Take this thick layer of muscular the more significant part of proventriculus wall thick. The proventriculus tunica serosa consists of connective tissue figure 1 (B).

Gizzard: The gizzard covered with low folds of mucous membrane (tunica mucosa), and lined by simple columnar epithelium tissue. The small area of the ventriculus mucous membrane, is located around the pyloric opening area only is lined with secretory mucosal glands product, that hardens to form a weak small cuticle layer on the surface but the luminal surface rest not have those layers; sloughed the cuticle, fragile membrane, shed of the small delicate area and higher strictly adherence to the gizzard lining surface and take yellow or green colour due to bile pigments reflux of small intestine. The surface of tunica mucosa lining with low columnar cells these cells were rounded nucleus at the blue of cells, and under the tunica mucosa, is located the simple tubular gland then lamina mucosa, that compromised by

dense connective tissue. Thin connective tissue was separated the lamina mucosa, neighbouring to lamina mucosae muscularis; tunica muscularis evolved with outer longitudinal layer and thick inner circular layer. A submucosa exists. The tunica serosa is composed of connective tissue, and there were small tubular glands attached to the proventriculus glands, the epithelia of this glands were cuboidal cells with a rounded nucleus in the basal membrane. The lumen of the glands was irregular, dependent on the shape of gland figure 1 (C).

Histochemical Results: Microscopical examination showed the presence of cells in the surface of proventriculus lining the folds of mucosa that PAS-positive strongly as the reaction award increase dark purple colour. The granules reaction was observed in a supranuclear area. The lamina propria connective tissue has expanded amid the mucosa folds that revealed moderate PAS reaction. The glandular stomach contains submucosal glands in which highly stain reacted. The submucosa and the muscularis mucosa blood vessels walls showed a mild to moderate reactions. In the other hand, the mild reaction showed the tunica muscularis but the moderate reaction the collagen fibres disperse, figure 2 (A). Positive reacted of the columnar epithelial cells with Toldin blue stain (acid mucopolysaccharides) in the stomach glandular part. Moreover, the submucosa, the tunica muscularis, and the lamina propria, muscularis mucosa blood vessels walls showed a mild reaction. Positive reacted of the mucosal glands to this combined stain figure 3 (A).

The connective tissue in the submucosa, tunica muscularis, and lamina propria showed Mallory stain positive reaction in proventriculus figure 4 (A).

The delicate cuticle cover in the falcon ventriculus revealed reacted positively to PAS stain to (pink) as it located over lining epithelial and negative reaction with Toldin blue falcon ventriculus. The mucosal folds lined epithelium, in the layer of mucosa and The secretary material within the lumina of the glandular tubules were strong positive reaction with PAS and Toldin stain. The connective tissue in the submucosa, tunica muscularis, and lamina propria revealed positive PAS reaction and negative reaction with Toldin blue in ventriculus; moreover, the fibres of smooth muscles have built reacted PAS weakly of the tunica muscularis and negative with Toldin stain figure 2,3 (B, B). The connective tissue in the submucosa, tunica muscularis, and lamina propria, in ventriculus showed Mallory stain positive reaction Figure 4 (B).

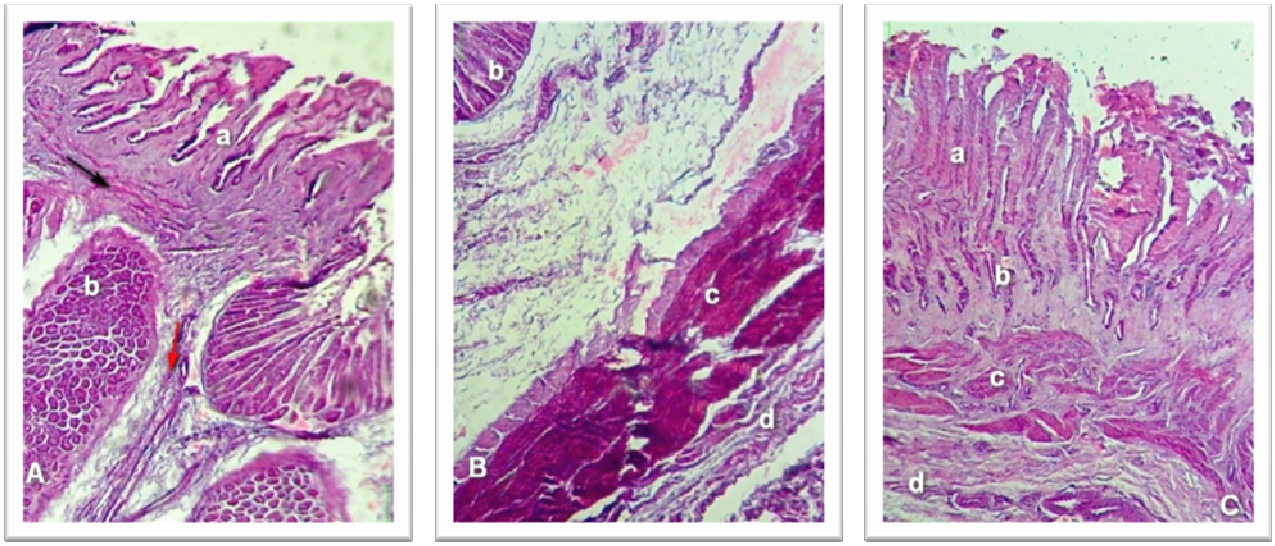

Fig. 1(A): Falcon proventriculus wall showed a. T. mucosa b: T. submucosa. connective tissue in lamina propria (black arrows) and submucosal glands (red arrows), (B): b. T. submucosa c. T. muscularis d. T. serosa , (C):Gizzard of falcon showed a. T.mucosa b. T.submucosa c. T.muscularis d. T.serosa. H&E stain 10X

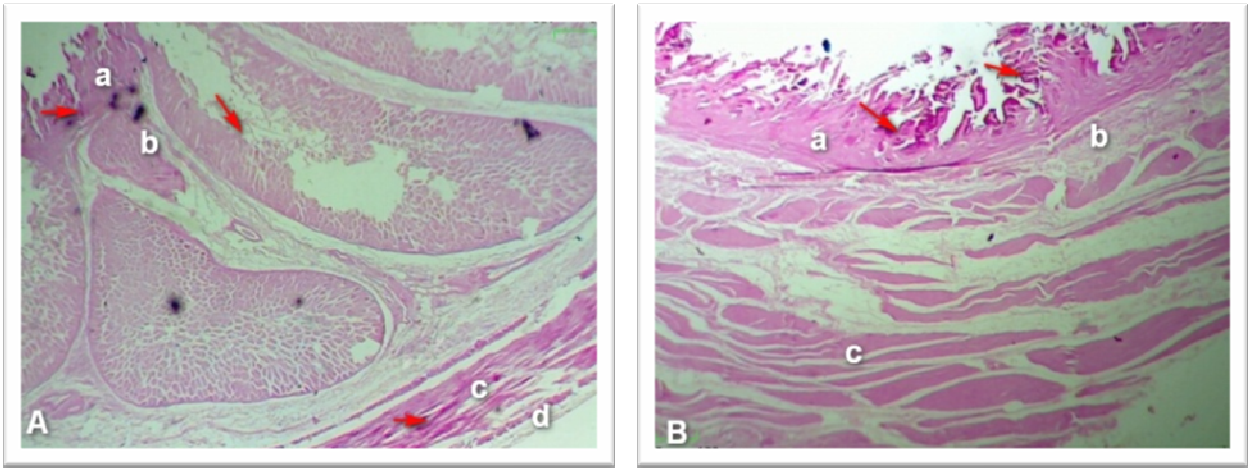

Fig. 2(A): Falcon proventriculus wall showed a. T.mucosa(red arrow) b: T.submucosa(red arrows) and T.muscularis (red arrows), (B): Gizzard of falcon showed a. T.mucosa (red arrows) b. T.submucosa c. T. muscularis. PAS stain 10X.

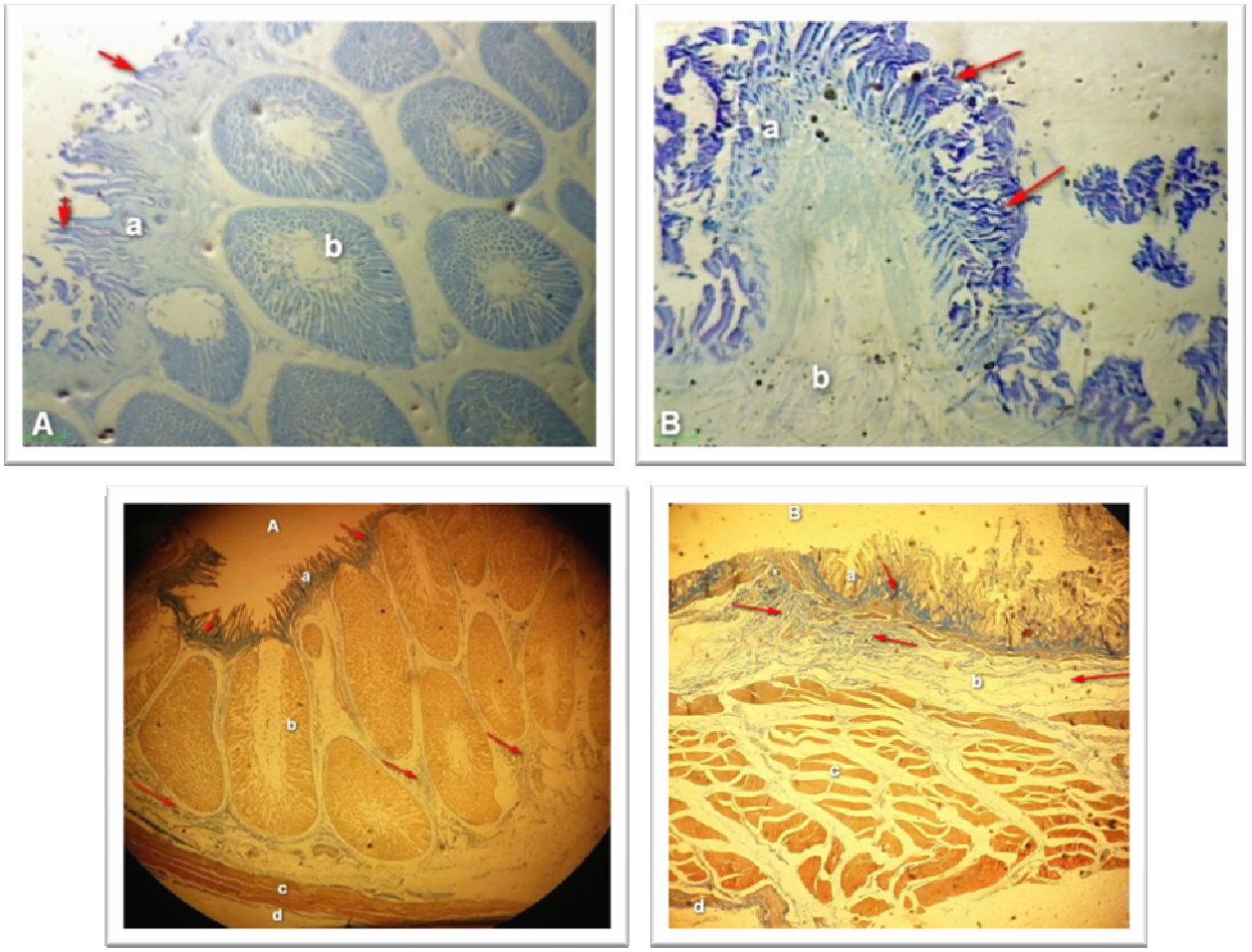

Fig. 3(A): Falcon proventriculus wall showed a. T.mucosa, (red arrow connective tissue) b: T.submucosa(red arrow connective tissue), (B):Gizzard of falcon showed a. T.mucosa (red arrows connective tissue) b. T.submucosa (red arrows connective tissue). Mallory stain 10X.

Discussion

The current histological findings revealed that nearly similar structure of the gizzard and proventricular to other birds, according to results of (Hodges, 1974; Fieri, 1984). These results observe several folds of the M.M of the gizzard and proventriculus, as found in different birds (McLelland, 1979; Fieri, 1984), the gizzard folds are lower.

The gizzard mucosa folds for many types birds, to be longitudinal (Jain, 1976) in P. kramari; (Menin *et al*., 2015) in *Coragyps atratus* foetens), and high (Lima, 1979) in *Columba livia*) while in our results, the proventriculus folds are elongated folds, separated by grooves because exist of thick developed tunica muscularis longitudinal layer. However, the gizzard low folds not accompanied by a distinctive form.

King and McLeland, (1975); Bacha Jr and Bacha, (2012) recorded that the proventriculus mucosa is forced to sulci and folds. The results of Hodges (1974) agreed with the finding of (Banks, 1993) who recorded that extensively folded the proventriculus tunica mucosa into flat hills separated by grooves.

Our results showed the falcon gizzard mucous membrane is developed low folds. In contrast, Vittoria and Richetti (1975) explained that gizzard of garnivores and carnivorous birds, as circular crypts brew that unfolds.

(Akestr, 1986) mentioned that in crypts of Gallus elliptical might attain to the large shape and strict fissures. The proventricular M.M folds are lining simple columnar epithelium, which agreed with the observations of (Calhoun, 1954; Selander, 1963). Epithelium of simple prismatic is lining the gizzard folds. Rossi *et al.* (2005) agreed with our results in partridge, Glerean and Katchburian (1964) showed that the Gallus consists of the high prismatic epithelium. Furthermore, Aughey and Frye (2001) described the proventriculus simple columnar of gastric epithelial. Bacha Jr and Bacha (2012) who agreed with this result exclude sulci base; it was cuboidal. Tadjalli *et al.* (2011) observed to be a simple columnar in ostrich.

De Lima and da Silva Sasso (1985) described cuticle in owl to be a thick cover plate, in which lining the gizzard mucous membrane, in line with Lima (1979) in Cardinal red-capped, (Abumandour, 2013). our results showed a small area of the gizzard mucous membrane, located just surrounding the open of pylori is a small weak layer cuticle. In contrast, the cuticle membrane did not possess by the rest surface of luminal, then sloughed the cuticle, fragile membrane, the small delicate area has shed, often yellow or green colour and higher strictly adherence to the gizzard lining surface.

In our study, the tunica muscularis of proventricular in the falcon found well-developed, found an inner longitudinal muscular fibres layer and outer circular fibres, occupy the

more significant part of the proventricular wall thickness with this thick muscular layer. The birds proventriculus, generally, is noted that the muscle tunic also consists of an inner circular layer and layer of longitudinal external muscle fibres (Calhoun, 1954). Hodges (1974) observed that the external longitudinal layer is thinner than the inner circular. Turk (1982) explained a well-developed tunica muscularis to be set up as inner and outer circular smooth muscle longitudinal layers of the owl. Sturkie (2000) showed that in waterfowl, some passerines and parrots poorly developed the outer longitudinal layer or absent.

The present result, constituted the gizzard muscle tunic by external longitudinal arranged layer and an inner circular layer, and much developed, these findings agreed with Fieri (1984), (granivorous bird and insectivorous); (carnivorous bird) Rocha in Spotyto cunicularia (McLeland, 1979;Turk, 1982). There are 3 layers found within tunic muscle, Espinola and Galliussi (1990) showed the gizzard consist of three layers muscle tunic of Fulica armillata (granivorous bird). Also, in the Uroloncha Domestica gizzard (Imaizumi and Hama, 1969). Proventriculus histochemical results strongly reacted with PAS stain. These results agreed with Hamdi *et al.* (2013), who explained the black-winged kite (Elanus caeruleus) glandular stomach. Additionally, the quail proventriculus, Zaher *et al.* (2012) showed occupying the positive PAS mucin granules all area of supra-nuclear cells in the epithelium lining surface of the folds mucosa. Proventriculus results with Tolidin stain compatible with those results in the ducks (Shyla *et al*., 1992) and domestic fowl (Abumandour, 2014). The results of the ventriculus stricture reacted with PAS stain as the results of Hamdi *et al*. (2013) in the black-winged kite (*Elanus caeruleus*) ventriculus and Guinea. (Selven *et al*., 2008) fowl (*Numida meleagris*). Ventriculus results with Tolidin stain coincided well with Alcian blue stain to be similar findings in another bird-like Guinea fowl (*Numida meleagris*) (Sellvan *et al*., 2008).

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