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Original Research Article

Comparative Morphological and Histochemical Study of Esophagus, in Eurasian Collared Dove (*Streptoplia decaocto*) and Buzzard (*Beuteo beuteo vulpinus*)

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Abstract: The study carried out on 28 esophagus specimens of healthy, 14 Eurasian Collared Dove (***Streptoplia decaocto***) and 14 Buzzard (***Beuteo beuteo vulpinus***). The aimed, to study the esophagus's morphological also histological. The lumen of esophagus in dove appear narrower and shorter in length than Buzzard as well as the crop as well-developed sac , while the crop in buzzard as longitudinal narrow spindle dilation ,and the present research work was done on the histology and histochemistry of the esophagus in dove and buzzard and found that the esophagus was composed of three segment cervical, crop and thoracic ,histologically, the mucosa of cervical, thoracic part was lined by non-keratinized layer of stratified squamous cells. As well as The esophageal glands were absent in cervical part and crop in dove, whereas in the thoracic part these glands were present and their duct open toward the lumen of the esophagus. The mucosal folds well developed in the cervical portion. Histochemically, the epithelium gland of esophagus showed PAS positive reaction that indicated presence of neutral mucopolysaccharides, the esophageal glands showed strong moderate reaction by (PAS)in cervical and thoracic esophagus as well as in thoracic part in dove. Conclusion the results showed that esophagus was significantly different Morphological and histological between two birds.

Keywords: Dove, buzzard, Birds, Esophagus.

INTRODUCTION

The classifications of birds in to granivorous and carnivorous birds, depending on diet consumed (Mohammed *et al.*, 2021). Eurasian Collared Dove *(streptoplia decaocto)* its medium in sized, feed on fruits, vegetables, millet and seeds (Shiels *et al.*, 2019). The Buzzard *(beuteo beuteo vulpinus)* also medium in sized within family Accipitridae, it is a carnivorous bird (Sinclair *et al.*, 1990). According to the differences of feeding there are different characteristics among various species (Zhu L. 2015). The esophagus in birds show long, highly distensible organ (Hasoon and Haba 2015). It located and start dorsally to the trachea then runs to the right side of neck (Zaher *et al.*, 2012), Which connected between pharynx and glandular stomach. (Saran *et al.*, 2018). Its lumen has longitudinal folds so its highly distensible (Hamdi *et al.*, 2013 and Rosekrans *et al.*, 2015). Generally, the anatomical parts of esophagus cervical and thoracic part in dove and buzzard (Reavill D.2011). The shape of crop varies in size according to the type of feeding, species and age (Kieronczyk *etal*,.2016 and Zhu L.2015). histologically the esophagus consist from mucosa, muscularis, adventitia.

The aimed of current to determine effect of food on anatomical and histological characteristics of the esophagus in Eurasian Collared Dove (granivorous bird) and Buzzard (carnivores bird).

MATERIALS AND METHODS

Twenty eight birds are used 14 Eurasian Collared Dove (*Streptoplia decaocto*) and 14 Buzzard (*Beuteo beuteo vulpinus*)**.** The experimental birds are collected from Al-ghazl market (Baghdad) and checked

for their health status. The birds were anesthetized by using xylazine hydrochloride (2%) and ketamine hydrochloride (5%) intra-muscularly. The feathers were removed from the neck and chest, the skin over the neck was dissected carefully and the chest was opened, the anatomical study include location, shape. Bird and esophagus weight and length, and morphology of the lumen esophagus, the organs fixed in 10% formalin solution, the fixed tissues were processed out for routine paraffin blocks making and sectioning techniques. The paraffin sections were cut of 5-6 µm in thickness with the help of microtome machine and stained with following staining techniques:

1. Harris' Haematoxylin and eosin stain for general architecture (Luna, 1968).
2. compensation of periodic acid sheaf and Alcian blue method for acidic and neutral mucosubstances (pH 2.5) (Luna, 1968).
3. Masson's Trichrome Stain (MTS): a specialized stain for staining connective tissue and smooth muscle fibers.

RESULTS AND DISCUSSION

Morphological Study of Esophagus in Dove and Buzzard:

The avian esophagus is long distensible tube extended between oropharynx and proventriculus. It lies dorsally to the trachea on right aspect of neck. Immediately cranial to the thoracic entrance the esophagus of birds returns to the median line and expand ventrally to form the crop. the last part of the esophagus was the thoracic part, this result agreement with (Al Kinany 2017) and (Rajab *et al.*, 2022). The birds weight 22±1.123 and 43±1.98 cm. The esophagus weight in dove and buzzard (1.76 ± 0.092, 3.2± 0.070 grm). The present work revealed that the mean ratio of esophagus length to body length in dove was (49.54%) which is larger and differs significantly at level ($p<0.05$) than that of buzzard (32%) although the mean length of esophagus of dove (10.9±0.40 cm) was lesser than that in buzzard (13.8±0.25 cm) (table 1). The cervical esophagus in dove begins at pharynx end then passes on right side of the neck, (fig. 1) in doves that's lights pink in colures and a flexible shows that's tube in shape with folds and no appearance this result agreement with (El-naseery *et al.*, 2021 and Wei *et al.*, 2022) while the buzzard that's reddish in colours, funnel Shape, wide opening and thick, muscular wall has able to distensible because has long folds which extend within its length to accommodate large amounts of the food this result agreement with (Cavallaro *et al.*, 2019) (Figure 2A,B). **The crop part**, show a sack like structure called the crop it was well developed in doves and used as a storage area the crop is formed by the dilation of the esophagus immediately before it enters the body cavity the crop exhibits longitudinal folds with shallow and wide with ability of extended (Figure 1,2A). This result agreement with (Moţ 2010, Wilkinson *et al.*, 2018 and Rajab *et al.*, 2022) The crop in the buzzard was fusiform shaped and has a poorly developed this adaptation benefits buzzards and other carnivorous birds since they may have to eat oversized prey items and digest them slowly over the day, the internal surface of crop had longitudinal folds (Fig. 1,2B) this result agreement with (Umar *et al.*, 2021) specifically, (Al-Juboory *et al.*, 2015) notes The variances in esophagus and crop due to f difference in its function according to food consumed by the two birds, **The thoracic esophagus**: in dove and buzzard is the last part of esophagus extends to thoracic cavity and connected to proventriculus the first part of stomach that's with longtuidinal folds along this region with different in heights (Figure 2A,B).

Histological Study of Esophagus in Dove and Buzzard:

In dove the cervical Part, mucosa, muscular and adventitia, its histological layers in this part, with the mean thickness (20.40±1.43, 78.51±2.65, 46.32±1.87µm) respectively, (table 2). the luminal surface of the esophagus presented primary folds that high about (178.6±4.176) µm, the free surface of these primary folds presented some small sized secondary folds that high about (126.3±2.915) µm (Table 3) the epithelial mucosa is stratified squamous epithelium its type non- keratinized and lamina propria (Figure 3,12). The current study has showed that tunica submucosa was very delicate or rarely seen. The muscular layer very thick and comprised of longitudinal and circularly, from inner to outer. The tunica adventitia formed from connective tissue and blood vessels. **Crop part** In this study, crop consist of two parts, dorsal part consist of layers (mucosa, muscularis, adventitia) the mean thickness of layers, (10.4±1.14, 10.6±0.89, 15.2±1.30) (table 4) that characterized by absent of folds in mucosal layers because it does not come into contact with the food, While the mucosal folds in ventral crop part consist of layers (mucosa ,muscularis, adventitia) the mean thickness of layers of layers (17±1.58, 38.4±4.66, 23.2±2.16) (table 4) and the lumen are divided into long and short, the mean of high folds is (121.8±2.58 and 66±2.91)µm (Table 5), (figure 4) the epithelial mucosa is stratified squamous non-keratinized ,the lamina propria thin layer of connective tissue . The sub-mucosa layer was very thin, composed of loose connective tissue. The tunica muscularis was comprised of inner longitudinal and outer circularly bundles of smooth muscles fibers. The adventitia is out tunica ,composed of loose connective tissue and blood vessels. Thoracic part, the current study showed that thoracic part of esophagus consisted of tunics; mucosa, muscularis, serosa, (20.56±0.33, 62.61±1.78, 30.56±0.41) (table 6) (figure 5,9,10). The mucosa characterized by present of mucosal folds as in different height as primary and secondary folds its height (83.78±1.78 and 53.56±0.956) µm (Table 3), The epithelial mucosa of mucosal layer lined by stratified squamous cells (non-keratinized) and lamina propria formed from connective tissue, lamina propria was occupied by the mucous type of glands which were varying shapes and size. The tunica sub-mucosa was not clear as it was very thin. The muscular smooth layer was

comprised of longitudinal and circular smooth muscle from inner to outer. The outer most layer tunica serosa was formed by mesothelium cell underlying thin layer connective tissue. In buzzard cervical part, The cervical esophagus consists of following layers, the inner layer mucosa, muscularis and adventitia the outer layer, the mean thickness of layers (44.2±1.62,89±3.80, 96.43±9.51um) (table 2) (figure 5,10). mucosal folds core where the lumen of esophagus in cervical region appear primary and secondary mucosal folds. The mean high of folds is (411±7.483 and 214.60±4.945) µm (Table 3).

The epithelial mucosa of cervical part of buzzard esophagus was stratified squamous epithelial tissue (non-keratinized) with connective tissue (lamina propria). The submucosa layer is poorly in development, there are two layer of smooth muscle, an inner longitudinal an outer circular layer. The outermost layer is known as the adventitia, which is composed of loose connective tissue. **Crop part**, In this result showed crop was consist of tunics from inner to outer: mucosa, muscularis and adventitia and the mean thickness of layers is (49.6±3.64, 73.2±4.32, 83±4.47) (table 4) the mucosal folds short, middle and long folds, the mean of this height folds (212.6±3.57, 149.7±3.31, 113±8.36) µm (table 5) (figure 6). The mucosa of esophageal wall consist of epithelial which lined with non-keratinized stratified squamous epithelial tissue, and lamina propria possessed plenty of compound tubulo alveolar glands extended from the lamina propria. The submucosa, it composed as very thin of dense connective tissue and rarely development. The muscularis external, it was a thick layer consisting of inner longitudinal and outer circular smooth muscle bundles. The outer layer formed from connective tissue and few small sized blood vessels as tunica adventitia. **Thoracic part**, In this current study showed that thoracic part of esophagus consist of tunics inner to outer: mucosa, muscularis external, and serosa (figure 7), and mean thickness of layers (35.2±1.76, 163±3.21, 210.6±3.92um) (table 6) the mucosal fold which appeared as projection from mucosa of esophagus lumen possessed the biggest and the highest number of folds among the mean high can be classified long and short (285±3.67 and 240±2.78) µm (Table 3) is the mucosa of thoracic esophageal wall consist of epithelial which lined by stratified squamous epithelial (non-keratinized), and lamina propria. The tunica sub-mucosa was very thin, there are two layer of tunica muscularis, inner longitudinal and outer circular while; the serosa composed of loose irregular connective tissue, lining by mesothelium cells.

Histochemical results: The esophageal glands showed strong moderate reaction by (PAS) in cervical and thoracic esophagus as well as in thoracic part in dove (Fig 10, 12, 13).

Table 1: Showing percentage of some morphological parameter in dove and buzzard of esophagus of study organs in digestive system

Bird type / Parameter	Dove	ratio%	Buzzards	ratio%
Bird weight (gram)	150 ± 10	-	810 ± 29.83*****	-
Length of bird (cm)	22±1.123	-	43±1.98*****	-
Esophagus Length	10.9±0.40	49.54	13.8±0.25*****	32
Esophagus weight	1.76 ± 0.092	1.17	3.2± 0.070*****	0.39

The numbers represent the mean ± standard error.

Table 2: Showing thickness of mucosa, submucosa, tunica muscularis and tunica adventitia in cervical part of esophagus in dove and buzzard

Bird type / Parameter	Dove	Buzzard
Mucosa (um)	20.40±1.43	44.2±1.62*
Submucosa (um)	-	-
Tunica muscularis(um)	78.51±2.65	89±3.80*
Tunica adventitia(um)	46.32±1.87	96.43±9.51*

Values represent mean ±S.E. Star meaning there was a significant variance between dove and buzzard at (P≤0.05)

Table 3: Showing high of primary and secondary fold in cervical and thoracic part of esophagus in dove and buzzard

Bird type / Parameter	Dove		Buzzard	
	Cervical part	Thoracic part	Cervical part	Thoracic part
High of primary folds (um)	178.6±4.176	83.78±1.78	411±7.483*	285±3.67*
High of secondary folds (um)	126.3±2.915	53.56±0.956	214.60±4.945*	240±2.78*

Table 4: Showing thickness of mucosa, submucosa, tunica muscularis and tunica adventitia in crop part of esophagus in dove and buzzard

Bird type / Parameter	Dove		Buzzard
	Dorsal part	Ventral part	
Mucosa (um)	10.4±1.14	17±1.58	49.6±3.64*
Submucosa (um)	-	-	-
Tunica muscularis (um)	10.6±0.89	38.4±4.66	73.2±4.32*
Tunica adventitia (um)	15.2±1.30	23.2±2.16	83±4.47*

Table 5: Showing high of folds in crop part of esophagus in dove and buzzard

Bird type / Parameter	Dove	Buzzard
Long fold (um)	121.8±2.58	212.6±3.57*
Middle folds (um)	-	149.7±3.31
Short folds (um)	66±2.91	113±8.36*

Table 6: Showing thickness of mucosa, submucosa, tunica muscularis and tunica serosa in thoracic part of esophagus in dove and buzzard

Bird type / Parameter	Dove	Buzzards
Mucosa (um)	20.56±0.33	35.2±1.76*
Submucosa (um)	-	-
Tunica muscularis (um)	62.61±1.78	163±3.21*
Tunica serosa (um)	30.56±0.41	210.6±3.92*

Values represent mean ±S.E.

Star meaning there was a significant variance between dove and buzzard at (P≤0.05)

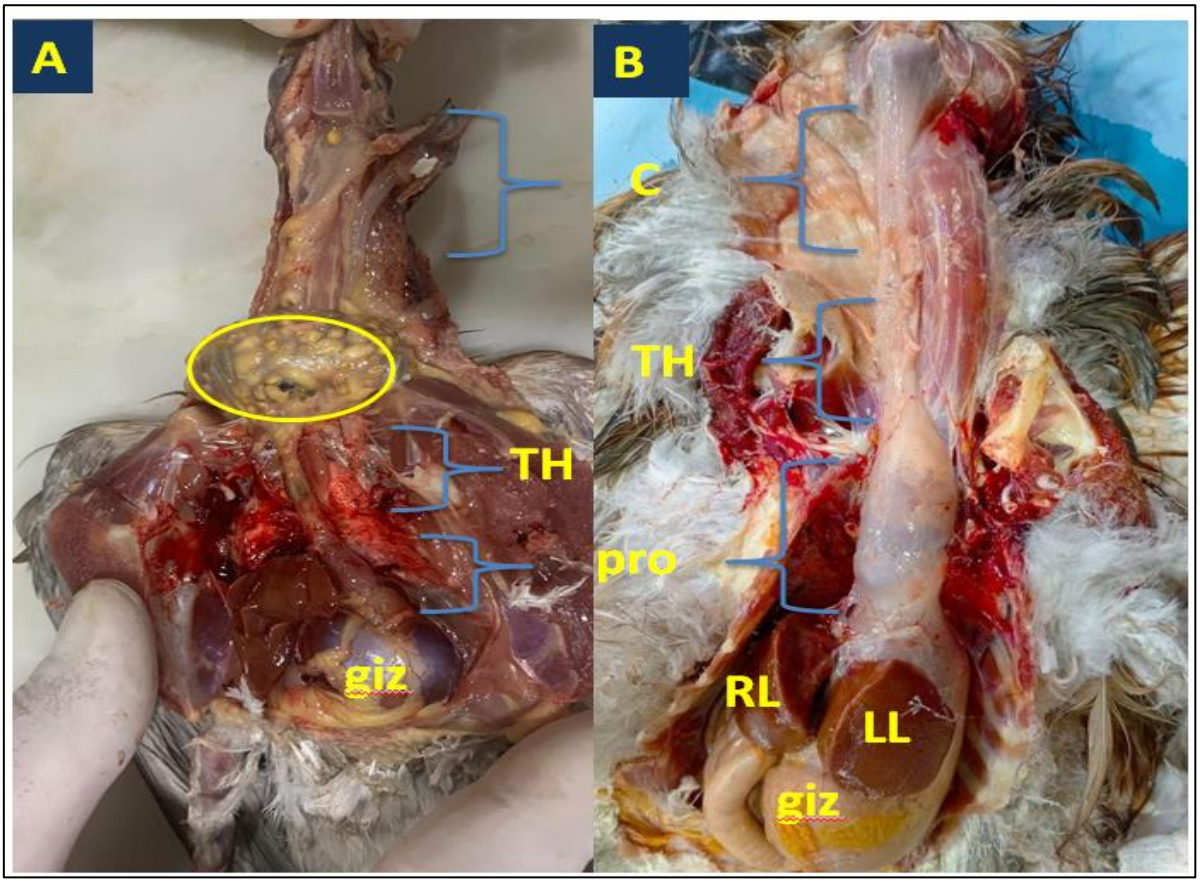

Figure 1: Macro photograph of thoracic and abdominal cavity showing: (A) dove (B) buzzard, cervical part (C), crop part (yellow circle), thoracic part (TH), proventriculus (pro), gizzard (giz), left lobe liver (LL), right lobe liver (RL)

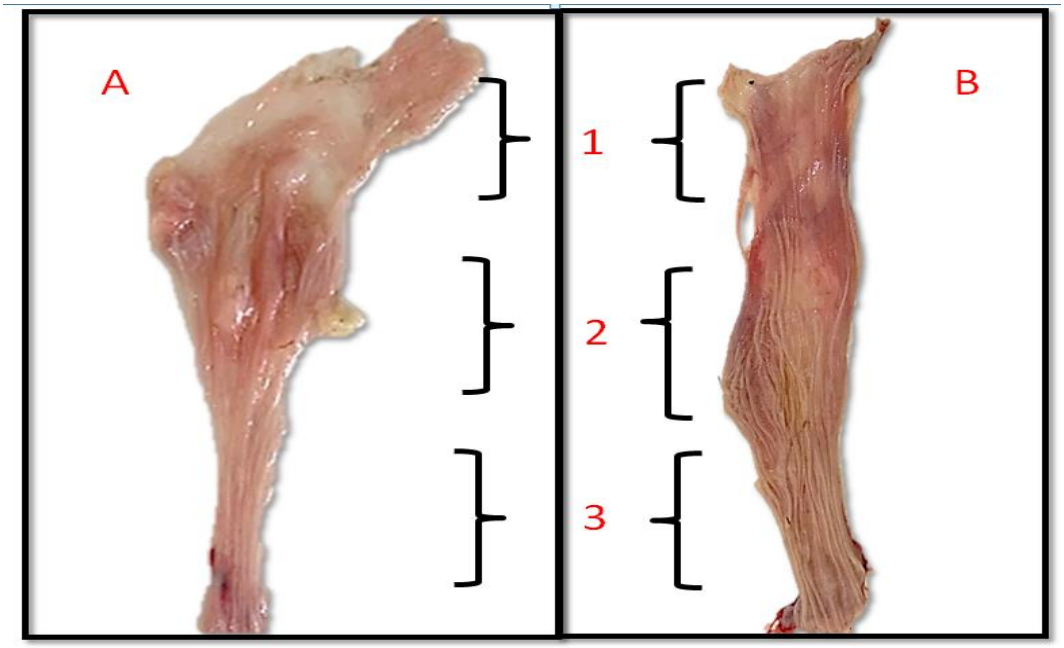

Figure 2: Morphological Photograph of the dissected showing the interior surface of the esophagus of (A) Dove, (B) Buzzard (1) cervical part (2) crop part (3) thoracic part

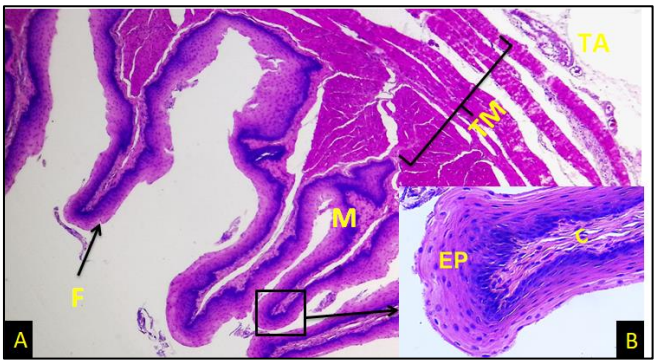

Figure 3: Histological cross-section in cervical region of dove showing: mucosal fold (F) mucosa (M), Tunica muscularis (TM), adventitia (TA), epithelium (EP), core of fold (C), A-(H&E 4X). B- (H&E 40X).

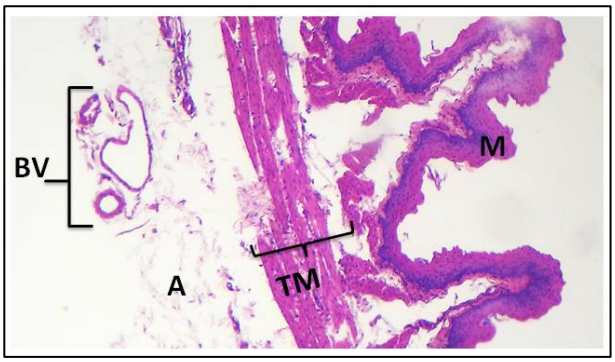

Figure 4: Histological cross-section in crop part of esophagus in dove showing: mucosa (M), tunica muscularis (TM), adventitia (A), blood vessels (BV), (H&E stain .10X).

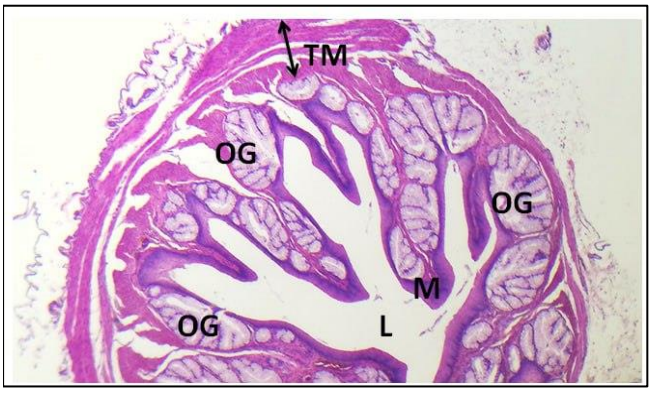

Figure 5: Histological cross-section in thoracic part of esophagus in dove showing: lumen (L), esophageal gland (OG), mucosa (M), tunica muscularis (TM), (H&E.4X).

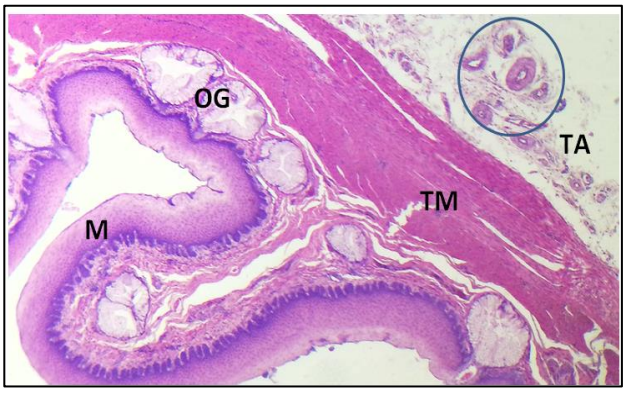

Figure 6: Histological cross-section in cervical part of esophagus in buzzard showing: mucosa (M), esophageal gland (OG), tunica muscularis (TM), tunica adventitia (TA), blood vessel (blue circle) (H&E stain.40X).

Figure 7: Histological cross-section in crop part of esophagus in buzzard showing: mucosa (M), esophageal gland (OG), tunica muscularis (TM), tunica adventitia (TA), blood vessel (BV), (H&E stain.40X).

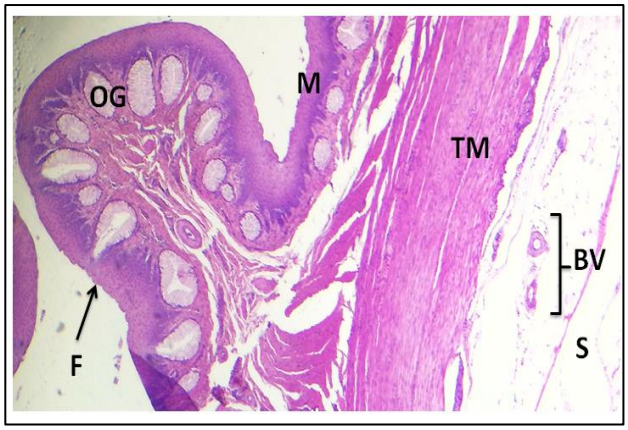

Figure 8: Histological cross-section in thoracic part of esophagus in buzzard showing: mucosal fold (F), esophageal gland (OG), mucosa (M), submucosa (arrow), tunica muscularis (TM), serosa (S), blood vessels (BV), (H&E.40X).

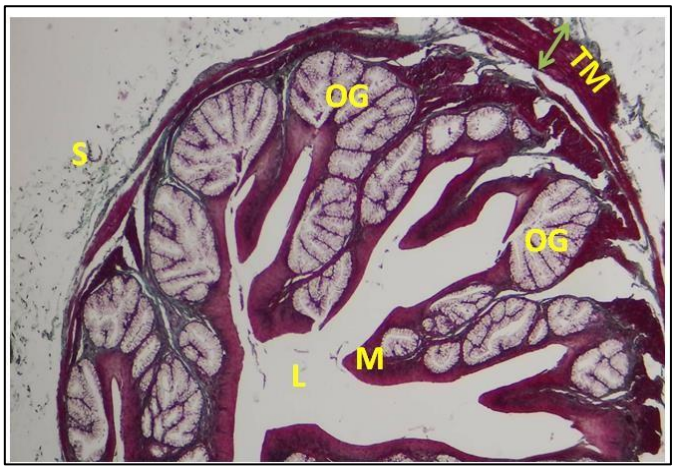

Figure 9: Histological cross-section in thoracic part of esophagus in dove showing: lumen (L), esophageal gland (OG), mucosa (M), tunica muscularis (TM), serosa (S), (Masson's Trichrome stain.4X).

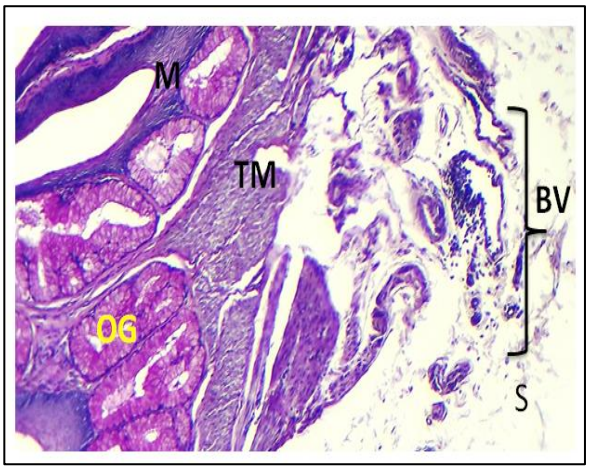

Figure 10: Histological cross-section in thoracic part of esophagus in dove showing: mucosa (M), tunica muscularis (TM), serosa (S), esophageal gland (OG), blood vessels (BV), (PAS stain.40X).

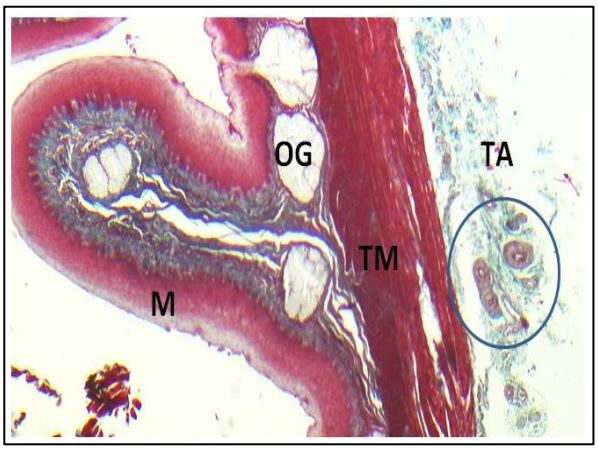

Figure 11: Histological cross-section in cervical part of esophagus in buzzard showing: mucosa(M), esophageal gland (OG), tunica muscularis (TM), tunica adventitia (TA), blood vessel (blue circle), (Masson's Trichrome stain.40X).

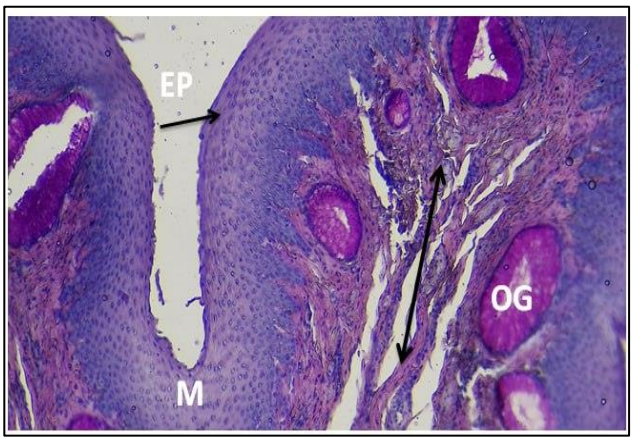

Figure 12: Cross-section in thoracic part of esophagus in buzzard showing: mucosal epithelium (EP), mucosa (M), lamina propria (double head arrow), esophageal gland (OG), (PAS stain.20X)

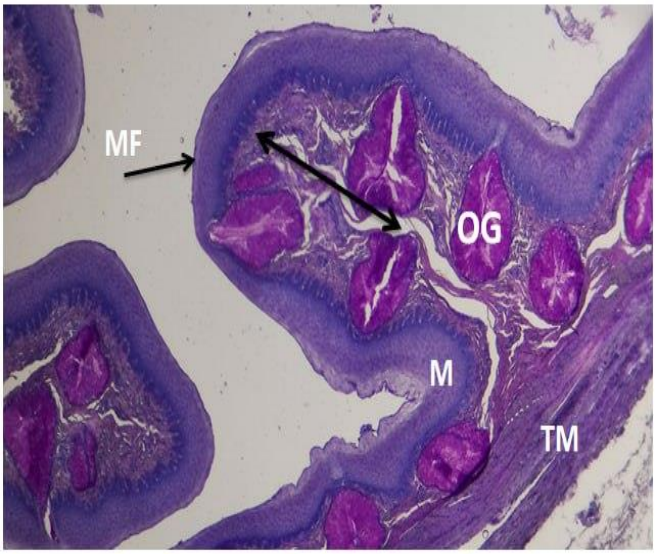

Figure 13: Cross-section in cervical part of esophagus in buzzard showing: mucosal fold (MF), mucosa (M), lamina propria (double head arrow), esophageal gland (OG), tunica muscularis (TM), (PAS stain.20X).

CONCLUSION

1. There are differences in themorphological features (Location, internal surface, color) of esophagus, proventriculus and gizzard in the two orders of birds.
2. The different in shape and length of the internal folds of cervical esophagusbetween dove and buzzard belong tothe different in nature of nutrition's in both birds granivorous and carnivores.
3. The different in the crop part of shape in the dove that sack like for to storageof food and this might change itstexture and color allowing it to accommodate different quantities of food, while in the buzzard the crop part fusiform shaped and has a poorly developed since they may have to eatoversized prey items was storage alongthe esophagus and digest them slowly over the day.

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