

Comparative Microscopic Study on the Tongue, Oesophagus and Stomach of Two Different Birds in Egypt

Fatma M.A. Taki-El-Deen

Department of Biological and Geological Sciences, Faculty of Education
, Ain Shams University – Egypt

ABSTRACT

Aim of the work: The present investigation aims to compare between the tongue, oesophagus and stomach of two birds in Egypt having different food habits.

Materials and methods: The animals under investigation are Whimbrel (*Numenius phaeopus*) and domestic duck (*Anas platyrhynchos*). These birds were caught from Abou-Rawash Constituency and Nile Delta in Egypt. The birds were dissected the tongue, oesophagus and stomach were fixed and stained for the microscopic comparative study.

Results: Histological results of this study found that the tongue of each bird (Whimbrel and domestic duck) is composed of three layers; mucosa, submucosa and muscularis. No lingual papillae are observed. The mucosal layer consists of stratified squamous epithelium. This layer in *Numenius phaeopus* is thicker than in *Anas platyrhynchos*. The submucosa is constructed from connective tissue. The muscularis is represented by bundles of muscle fibers extending in different directions. The lingual glands of *Anas platyrhynchos* are of compound alveolar type and have neutral mucopolysacchride content. The muscularis of the oesophagus consists is consisting of outer circular and inner longitudinal muscle fibers. This layer is thick and well represented in *Anas platyrhynchos* than in *Numenius phaeopus*. The mucosal folds have stratified squamous epithelial cells. Oesophageal tubulo alveolar glands have acid mucopolysacchride content in *Numenius phaeopus* and neutral mucopolysacchride content in *Anas platyrhynchos*. The stomach in each bird (Whimbrel and domestic duck) is differentiated into glandular and muscular portions. The gastric glands of the glandular portion are differentiated into deep and superficial gastric glands. The muscularis of the muscular portion in the investigated birds is composed of circular and longitudinal muscle fibers. This layer in *Anas platyrhynchos* is thicker than in *Numenius phaeopus*. The mucosal layer in *Anas platyrhynchos* has thick tough keratin-like layer (cutica gastrica). The mucosal glands in the investigated birds have acid and neutral mucopolysacchride content. The histological and histochemical results showed differences in the tongue, oesophagus and stomach between the investigated birds.

Keywords: bird, whimbrel, domestic duck, tongue, alimentary canal, histology, histochemistry.

INTRODUCTION

Whimbrel (*Numenius phaeopus*) belongs to order, Charadriiformes, family, Scolopacidae. It feeds on small invertebrates, which are picked from soft mud.

Domestic duck (*Anas platyrhynchos*) belongs to order, Anseriformes, family, Anatidae. It feeds mainly on grains.

Microscopic studies have been achieved to investigate the digestive system of vertebrate animals¹. Also, morphological studies of Birds' tongue such as budgerigar have been reported². The histological studies mentioned that the tongue layers are; mucosa, submucosa and muscularis. The mucosal layer is constructed mainly from several rows of epithelial cell³. Histological studies of gastrointestinal tract were established that the main layers of alimentary canal are; serosa, muscularis, submucosa and mucosa⁴. The serosa represents the outermost layer while the mucosa is the innermost one

which is in contact with the lumen. They noticed that the

microscopic structure may differ according to the nature of food habits of the different birds⁵.

With special reference to tongue, oesophagus and stomach, many studies on birds have been reported⁶. The purpose of this investigation is to study the comparative histological and histochemical structures of the tongue, oesophagus and stomach of two birds with different food habits. These birds are; Whimbrel (*Numenius phaeopus*) and domestic duck (*Anas platyrhynchos*).

MATERIALS AND METHODS

Histological and Histochemical preparations:

The investigated birds were trapped alive, anesthetized and carefully dissected. Tissue samples of the tongue, oesophagus and stomach were obtained, fixed in 10% neutral formalin solution, dehydrated, cleared and embedded in

parablast. Sections of 4-6 μm thick were stained with haematoxylin and eosin⁷ for microscopic examination. Masson's trichrome staining method was used to demonstrate muscles and connective tissue⁸. Alcian PAS staining method was used for demonstration of mucopolysaccharides⁹.

RESULTS

1- The Tongue

Examination of the histological sections obtained from the tongue of *Numenius phaeopus*, showed that it consists of dorsal and ventral surfaces.

The dorsal surface of the tongue is covered by the mucosa which consists of numerous rows of stratified squamous epithelial cells (fig.1). The second layer is submucosa which contains connective tissue and blood vessels (fig.2). The third layer is thick muscularis which is represented by muscle fibers. In addition, it is supported by a hyaline cartilage which is considered as a part of a hyoid apparatus. No lingual papillae are observed in the tongue. No lingual glands are observed (fig.3).

The dorsal surface of the tongue of *Anas platyrhynchos* is characterized by a slight concavity along the mid dorsal line of the tongue. Also, the histological sections revealed that it consists of mucosa, submucosa and muscularis (fig.4). The mucosal layer is constructed from stratified squamous epithelial cells. The submucosa is built up of loose connective tissue which is rich in blood vessels. Lingual glands are well represented in the submucosal layer (fig. 5). The muscularis follows the submucosal layer and consists of bundles of muscle fibres aggregated and extended in various directions. The lingual glands are of compound alveolar type. These glands have neutral mucopolysaccharide content (fig. 6).

2- The Oesophagus

The oesophagus of *Numenius phaeopus* is formed of four distinct layers from outside to the inside; serosa, muscularis, submucosa and mucosa. The serosa is formed of simple squamous epithelium. The muscularis consists of two layers, outer circular muscle fibres and inner longitudinal fibres (fig. 7). The submucosa is formed of connective tissue provided with blood vessels (fig. 8). The mucosa is formed of stratified squamous epithelium. The oesophageal glands are found in the lamina propria and are principally simple alveolar. The content of oesophageal glands is acid mucopolysaccharides (fig.9). The examination of histological section of the oesophagus of *Anas platyrhynchos*

revealed that it is constructed from four layers which are; serosa (in the lower part), muscularis, submucosa and mucosa. The serosa is formed of simple squamous epithelium. The muscular layer is well represented and consists of two layers; outer thick circular and inner longitudinal muscle fibres (fig. 10). The submucosal layer present between the muscularis and mucosal layers. It is rich in connective tissue with blood vessels (fig.10). The mucosal folds are lined by stratified squamous epithelium interrupted by the ducts of submucosal glands. The oesophageal glands are compound alveolar and give red colour with Alcian PAS stain due to the presence of neutral mucopolysaccharides (fig.11).

3- The Stomach

The stomach wall of the *Numenius phaeopus* is composed of the following layers; serosa, muscularis, submucosa and mucosa. The serosa of the stomach is formed of simple squamous epithelium. The muscularis consists of outer longitudinal and inner circular muscle fibres. The submucosa is made up mainly of collagenous fibres and blood vessels. The muscularis of the muscular portion is well represented (fig. 12). The mucosa consists of simple columnar epithelium which contains a large number of gastric glands. In the glandular portion of stomach, the gastric glands are differentiated into deep and superficial glands. The deep gastric glands are compound- branched alveolar and lined with simple cuboidal epithelial cells. These glands give red colour with the Alcian PAS stain due to the presence of neutral mucopolysaccharides. On the other hand, the superficial glands appear in the form of numerous folds of the mucosal epithelium arranged side by side throughout the entire mucous membrane. The wall of these glands is composed of columnar cells and secreting acid mucopolysaccharides since they give blue colour with Alcian stain (fig.13). The mucosal gastric glands have acid and neutral mucopolysaccharide content (fig. 14).

The gastric layers of *Anas platyrhynchos* are the same as that of *Numenius phaeopus*. These layers are; serosa, submucosa, muscularis and mucosa. The serosa is made up of a layer of simple squamous epithelium. The muscularis consists of outer longitudinal and inner circular muscle fibres. The mucosal layer of glandular portion holds two types of gastric glands which are differentiated into deep and superficial gastric glands (fig.15). The gastric glands have acid and neutral mucopolysaccharides (fig.16). The gastric glands of the muscular portion are lined with a

thick tough keratin-like structure known as cutica gastrica (fig. 17).

EXPLANATION OF FIGURES

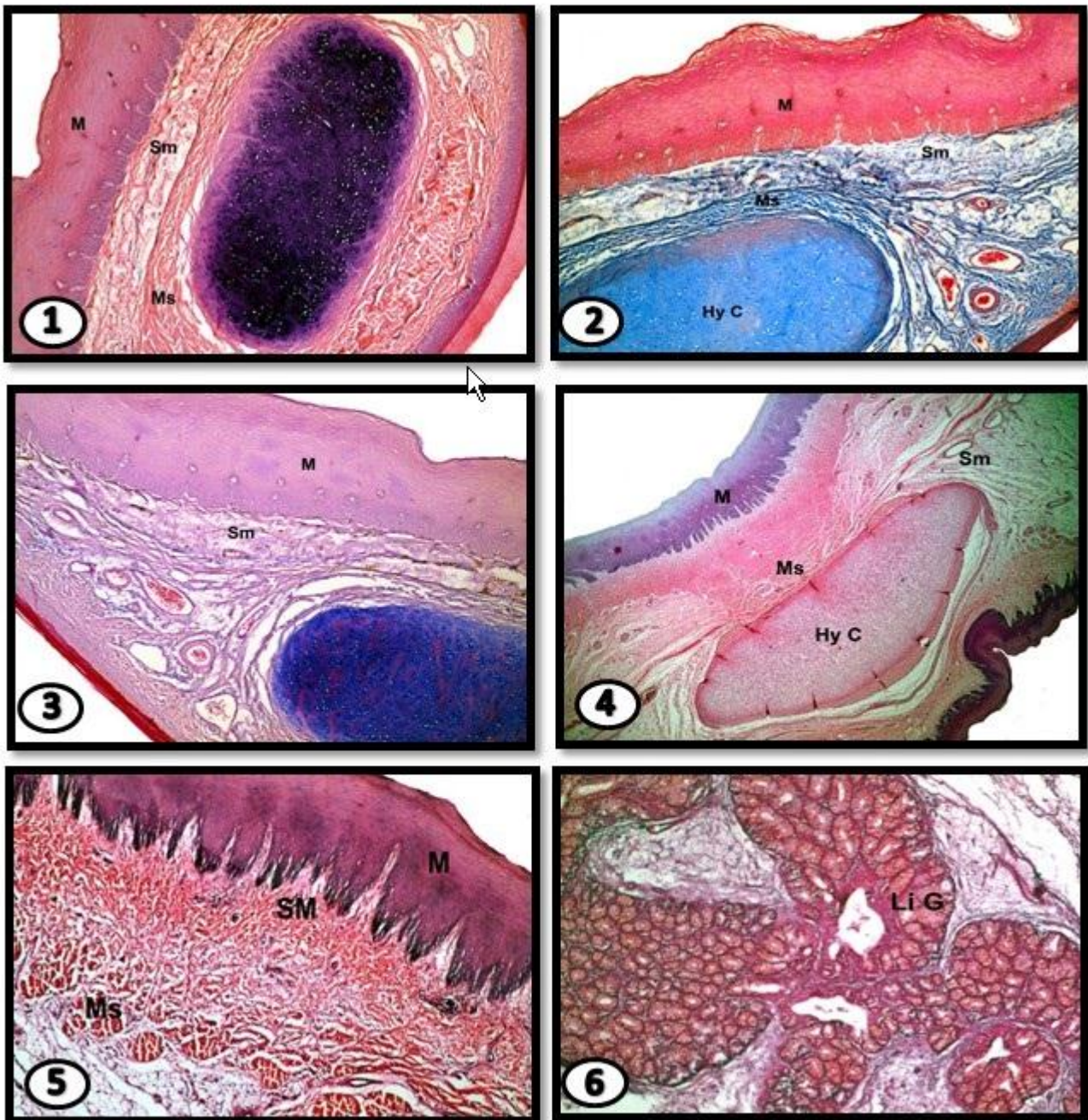


Fig. (1): Photomicrograph of a transverse section of the tongue of *Numenius phaeopus* showing mucosa (M), submucosa (Sm) and Muscularis (MS). (H&E. stain X. 100)

Fig. (2): Photomicrograph of a transverse section of the tongue of *Numenius phaeopus* showing mucosa (M), submucosa (Sm), muscularis (Ms) and hyaline cartilage (Hy C). (Masson's trichrome stain X.100)

Fig. (3):): Photomicrograph of a transverse section of the tongue of *Numenius phaeopus* showing mucosa (M) and submucosa (Sm) and chondroitine sulphate stained hyaline cartilage. (Alcian PAS. stain X. 100)

Fig. (4): Photomicrograph of a transverse section of the tongue of *Anas platyrhynchos* showing mucosa (M), submucosa (Sm), muscularis (Ms) and hyaline cartilage (Hy C). (H&E. stain X. 40)

Fig. (5): Photomicrograph of a transverse section of the tongue of *Anas platyrhynchos* showing mucosa (M), submucosa (Sm) and muscularis (Ms). (H&E. stain X. 100)

Fig. (6): Photomicrograph of a transverse section of the tongue of *Anas platyrhynchos* showing lingual gland (Li G). (Alcian PAS. stain X. 100)

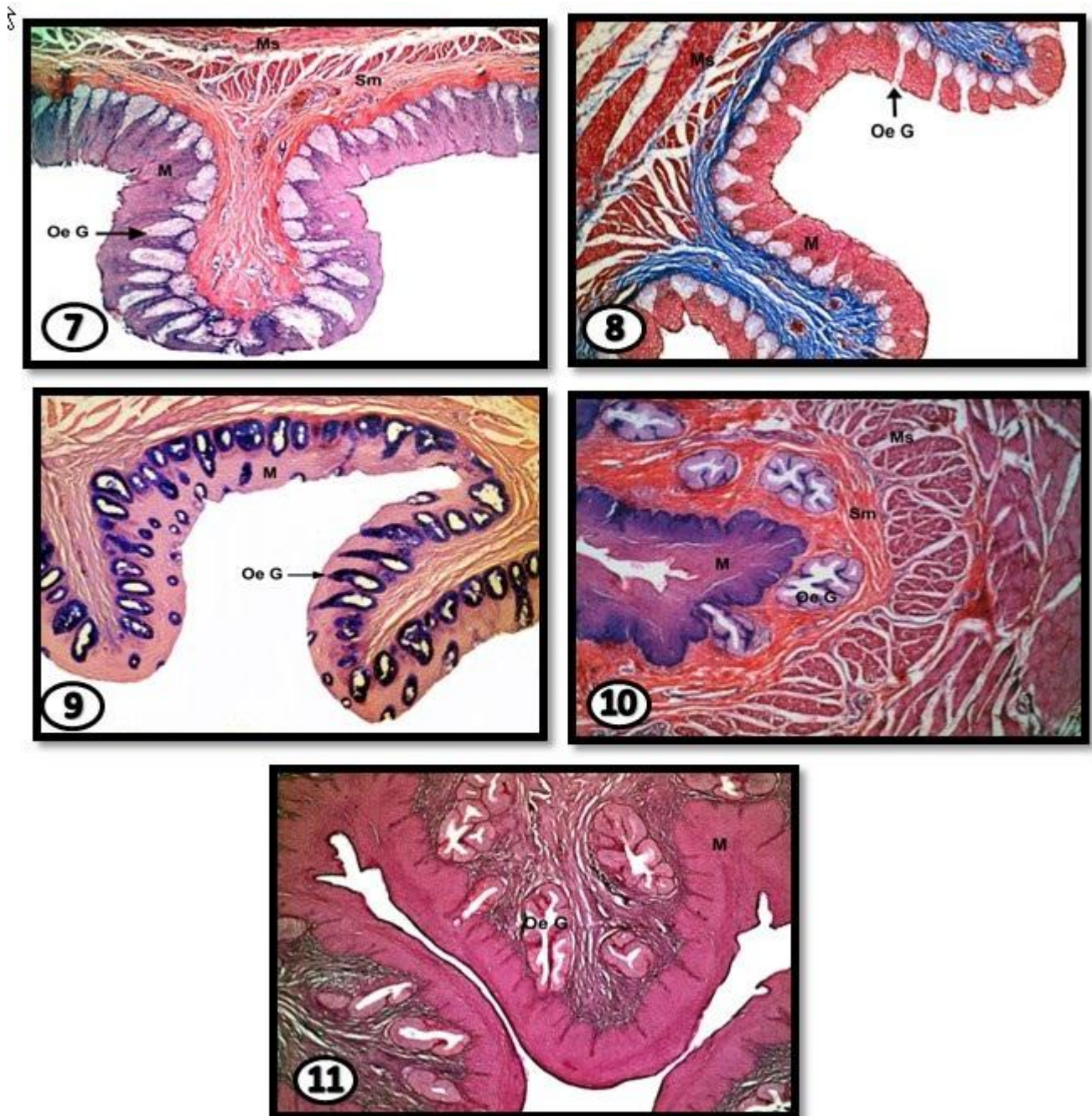


Fig. (7): Photomicrograph of a transverse section of the oesophagus of *Numenius phaeopus* showing the muscularis (Ms), submucosa (Sm), mucosa (M) and oesophageal glands (Oe G). (H&E. stain X. 100)

Fig. (8): Photomicrograph of a transverse section of the oesophagus of *Numenius phaeopus* showing the muscularis (Ms), mucosa (M) and oesophageal gland (Oe G). (Masson's trichrome stain X.100)

Fig. (9): Photomicrograph of a transverse section of the oesophagus of *Numenius phaeopus* showing the oesophageal glands (Oe G). (Alcian PAS. Stain X. 100)

Fig. (10): Photomicrograph of a transverse section of the oesophagus of *Anas platyrhynchos* showing the muscularis (Ms), submucosa (Sm), mucosa (M) and oesophageal glands (Oe G). (H&E. stain X. 100)

Fig. (11): Photomicrograph of a transverse section of the oesophagus of *Anas platyrhynchos* showing the oesophageal glands (Oe G). (Alcian PAS. Stain X. 100)

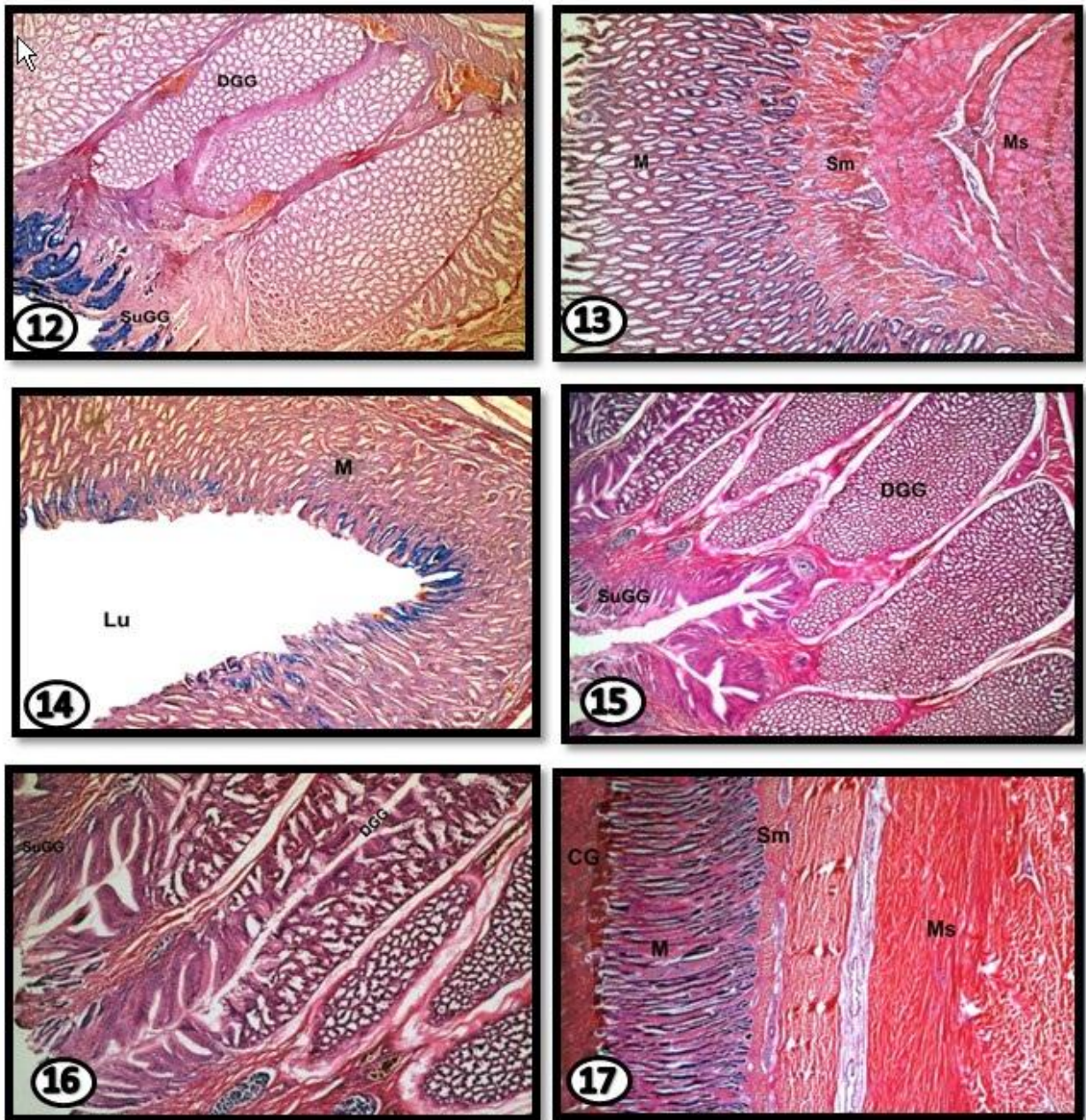


Fig. (12): Photomicrograph of a transverse section of glandular portion of stomach of *Numenius phaeopus* showing the deep gastric gland (DGG) and superficial gastric gland (SuGG).

(H&E. stain X. 100)

Fig. (13): Photomicrograph of a transverse section of muscular portion of stomach of *Numenius phaeopus* showing the muscularis (Ms), submucosa (Sm) and mucosa (M).

(H&E. stain X. 100)

Fig. (14): Photomicrograph of a transverse section of muscular portion of stomach of *Numenius phaeopus* showing the mucosa (M) and lumen (Lu).

(Alcian PAS. Stain X. 100)

Fig. (15): Photomicrograph of a transverse section of glandular portion of stomach of *Anas platyrhynchos* showing the deep gastric gland (DGG) and superficial gastric gland (SuGG).

(H&E. stain X. 40)

Fig. (16): Photomicrograph of a transverse section of glandular portion of stomach of *Anas platyrhynchos* showing the showing the deep gastric gland (DGG) and superficial gastric gland (SuGG).

(Alcian PAS. Stain X. 100)

Fig. (17): Photomicrograph of a transverse section of muscular portion of stomach of *Anas platyrhynchos* showing the muscularis (Ms), submucosa (Sm), mucosa (M) and cutica gastrica (CG).

DISCUSSION

The present work deals with comparative microscopic study to comprise the histological and histochemical structures of the tongue, oesophagus and stomach of two different birds. These birds are; *Numenius phaeopus* and *Anas platyrhynchos*.

The present study found that the tongue layers are; mucosa, submucosa and muscularis. The mucosal layer is consisting of stratified squamous epithelium without any lingual in both birds which is similar to that of emu (*Dromaius novaehollandiae*)¹⁰. However some birds such as Australian lorikeets have lingual papillae¹¹.

The stratified squamous is keratinized in penguin and white-cheeked bulbul¹². The lingual glands of *Anas platyrhynchos* are compound alveolar type and have neutral mucopolysaccharide content.

The lingual glands secretions provide lubrication as well as its protection role against the coarse foods and microorganisms¹³. The muscularis layer doesn't have striated muscle fibers¹⁴. Hyaline cartilage supports the muscularis layer¹⁵.

Histological results obtained from the present investigation revealed that oesophageal layers are; serosa, muscularis, submucosa and mucosa. The oesophageal layers in the Japanese quails are three; serosa, muscularis and mucosa¹⁶. The muscularis of Whimbrel and domestic duck is composed of outer circular and inner longitudinal muscle fibers. The muscularis layer in *Anas platyrhynchos* is thicker than in *Numenius phaeopus*. The muscularis of *Columba palumbus* is composed of inner circular and outer longitudinal muscle fibers¹⁷. Whereas, it is represented in *Lanius tephronotus* by only circular muscle fibers¹⁸. The submucosa is composed of connective tissue containing blood vessels¹⁹. The mucosal membrane is lined with stratified squamous epithelium.

The stomach in of the two birds under investigation is divided into glandular portion and muscular portion²⁰. The gastric wall is consisting of serosa, muscularis, submucosa and mucosa²¹. Serosa is made up of simple squamous epithelium. The muscularis of Whimbrel and domestic duck is composed of outer longitudinal and inner circular muscle fibres, Such as in *Rhynchotus rufescens*²². The muscularis of red-capped cardinal is represented

by three layers which are; external longitudinal, intermediary circular and inner longitudinal²³. The mucosal folds are lined with columnar

epithelium²⁴. In some birds, the mucosal layer of proventriculus is covered with thin layer of cuticle²⁵. Several gastric glands are observed in the mucosal layer²⁶. The gastric glands of glandular portion in the investigated birds are differentiated into deep and superficial. The deep gastric glands are of compound-branched alveolar²⁷. The mucosal glands in *Fulica atra* are of simple tubular glands²⁸. The secretions of the gastric glands in *Numenius phaeopus* and *Anas platyrhynchos* are acid and neutral mucopolysaccharides. In red jungle fowl, the proventricular mucin is only neutral²⁹. The gastric glands secrete its juice during the passage of foods into the muscular portion³⁰. The mucosal lining has a thick cuticle in *Anas platyrhynchos*. Thick cutica gastrica is found in the granivores³¹. The cutica gastrica in the muscular portion of *Anas platyrhynchos* is contact with stones taken with food. It forms an effective surface for hard food and the contractions which occur in muscularis causing trituration of grains³². In addition to that, it is moulted in many species of birds³³.

In conclusion, the present investigation results refer to histological and histochemical variations in the different parts of the two investigated birds. These variations may be due to the differences in the nature of feeding.

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