

RESEARCH NOTE

Histological study on the oesophagus and crop in various species of wild bird

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ABSTRACT

The histology of the oesophagus and crop was studied in six species of birds: Rock Dove, Collared Dove, Rose-ringed Parakeet, Kestrel, House Sparrow and Linnet. In species, the epithelium of oesophagus and crop was a keratinised stratified squamous. The lamina propria was a loose connective tissue containing glands. Glands were either purely mucous or seromucous (mixed). In the rock dove, rose-ringed parakeet and collared dove, there were no glands either in the cervical part of oesophagus or in the crop. There were differences in the histochemistry of glands' secretions. The muscularis mucosa was present as a thick layer of smooth muscle fibres. The tunica submucosa was a loose connective tissue containing vessels and nerves. The tunica muscularis consisted of smooth muscle and was surrounded by the tunica adventitia at the cervical part of the oesophagus and crop, and by the tunica serosa at the thoracic part of the oesophagus.

Keywords: oesophagus, crop, histology

INTRODUCTION

Information on the histology of oesophagus and crop is limited a few species of birds. This study was performed in six wild species of birds to reveal the histological structure of these organs and to identify differences of these structures between avian species.

The histological structure of the oesophagus and crop were examined in three specimens each of the Rock Dove (*Columba livia*), Collared Dove (*Streptopelia decaocta*), Rose-ringed Parakeet (*Psittacula krameri*), Kestrel (*Falco trinnunculus*), House Sparrow (*Passer domesticus*) and Linnet (*Carduelis cannabina*). The birds were purchased from pet stores and checked for their health status before being euthanized. They were euthanized with an overdose of sodium pentobarbitone administrated intraperitoneally. Sodium heparin was added to the barbiturate in equal volumes to reduce blood coagulation. Samples were taken from crop and both cervical and thoracic parts of oesophagus at 1 cm intervals. The thoracic part of the oesophagus was located in the thoracic cavity that is caudal to the crop and cervical part was located mainly on the right side of the neck. The samples were flushed with normal saline and were fixed in 10% buffered formalin for 71 hours. Tissue samples were then dehydrated and cleared by a series of graded alcohols, xylene and

eventually embedded in paraffin. Sections (6 µm) were stained with haematoxylin & Eosin, Masson's trichrome for collagen fibres, Alcian blue-Van Giesson and periodic acid Schiff-Van Giesson for the histochemistry of muco-substances (Luna, 1968). The thickness of the epithelium was measured by micrometry.

The oesophagus and crop of all studied birds were lined by a keratinised stratified squamous epithelium similar to that of domestic fowl (Dellmann and Eurell, 1998). The degree of keratinisation in the Rose-ringed Parakeet and Rock Dove was more than the other birds. The degree of keratinisation of the stratified squamous epithelium in oesophagus varies with the species. The mean dimensions of thickness of the epithelium in different parts of the oesophagus and crop are shown in Table 1.

Table 1 The range of epithelial thickness in oesophagus and crop

Species	Thickness (µm)
Rock dove (<i>Columba livia</i>)	60–100
Collared Dove (<i>Streptopelia decaocta</i>)	70–110
Rose-ringed Parakeet (<i>Psittacula krameri</i>)	90–100
Kestrel (<i>Falco tinnunculus</i>)	80–150
House Sparrow (<i>Passer domesticus</i>)	50–80
Linnet (<i>Carduelis cannabina</i>)	40–50



Figure 1 Histological structure of the thoracic part of the oesophagus of kestrel: EP, epithelium; EG, the oesophageal glands; LP, lamina propria; MM, muscularis mucosa; TM, tunica muscularis; TS, tunica serosa arrow, tunica submucosa; H & E; scale bar, 313 μ m.

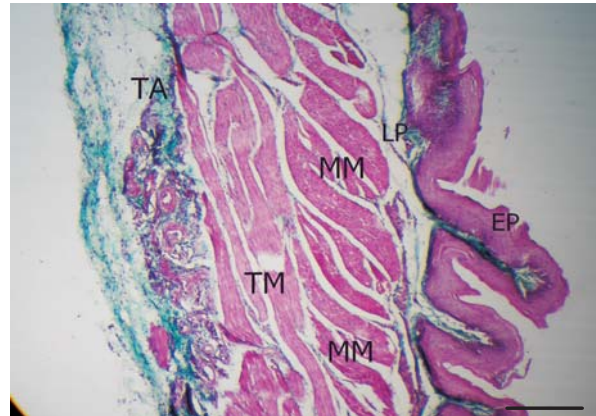


Figure 2 Microphotograph showing the crop of rock dove, note; the crop is without any glands: EP, epithelium; MM, muscularis mucosa; TM, tunica muscularis; TA, tunica adventitia; Green Masson trichrome; scale bar, 125 μ m.

The lamina propria of the oesophagus and crop consisted of a loose connective tissue. This layer contained tubuloalveolar glands in some species although the number, type and location of glands varied. The glands were purely mucous in the House Sparrow, Kestrel and Linnet, and seromucous (mixed) in the Rock Dove, Rose-ringed Parakeet and Collared Dove. In the House Sparrow, the glands were abundant throughout the oesophagus. The crop was not observed in House Sparrow. In the Linnet, both parts of the oesophagus and crop contained a lot of the glands. The amount of the glands in the crop was more than the oesophagus. In the Kestrel, the density of the glands was more at the beginning of both the cervical and thoracic parts of the oesophagus (Figure 1), whereas, there were fewer glands at the caudal part of the cervical part of the oesophagus and crop. In the Rose-ringed Parakeet, there were no glands in the cervical part of the oesophagus, the crop and also at the beginning of the thoracic part of the oesophagus although there were abundant glands in the caudal part of the thoracic part. In the Rock Dove and Collared Dove, there were no glands in both the cervical part of the oesophagus and crop, but the thoracic part of the oesophagus contained the glands (Figure 2).

The lamina propria is a loose connective tissue in the domestic fowl. It contains large mucous glands (Dellmann and Eurell, 1998). The crop is a storage organ where the ingested food is moistened by the mucous secreted by the oesophagus and crop glands. Histological examination of crop tissues of the white leghorn hens revealed development of

lymphoid aggregates in the crop walls following with *Salmonella enteritidis*. This indicates that the crop may serve a role in immune protection in addition to its capacity as a storage organ (Seo *et al.*, 2003). In the fowl, the glands are confined to an area near its junction with the oesophagus (Dellmann, 1993).

In all species studied, when treated with Alcian blue, the secretions of the oesophageal glands showed an intensely positive reaction (Figure 3). In the Rock Dove and House Sparrow, this positive reaction occurred in both Periodic Acid Schiff and Alcian blue stains indicating that the glands produce both acidic and neutral muco-substances. By contrast, in the Kestrel and Rose-ringed Parakeet, the secretions showed a poor positive reaction with Periodic Acid Schiff. It was negative in the Linnet and Collared Dove (Figures 4, 5, 6, 7). So, the muco-substances are mainly acidic in the kestrel and rose-ringed parakeet and entirely acidic in the linnet and collared dove. Sialo- and sulpho-mucins are widely distributed throughout the digestive system of the fowl (Pastor *et al.*, 1988).

The tunica submucosa was a loose connective tissue containing vessels and nerves. It consists of a thin layer of loose connective tissue in the domestic fowl (Dellmann and Eurell, 1998). The tunica muscularis of the oesophagus and crop in all species studied consisted of smooth muscle. Its fibres were arranged mainly in a circular orientation. However, the orientation of fibres in some parts of the tunica muscularis was oblique. The tunica muscularis of the domestic fowl consists two layers; inner circular and outer longitudinal (Dellmann and Eurell, 1998).

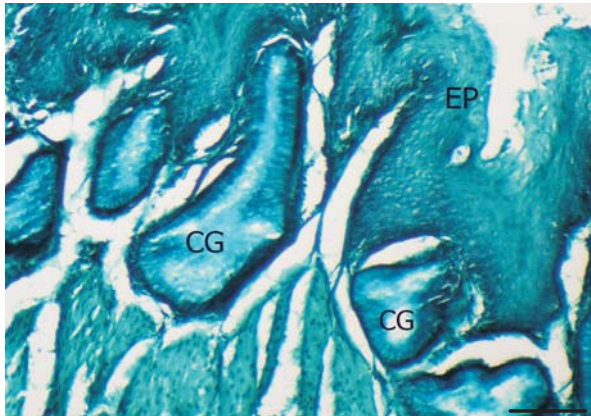


Figure 3 Showing high intensity positive reaction of the glands secretions of the crop in linnet; EP, epithelium; CG, crop glands, Alcian blue-Van Giesson; scale bar, 63 μ m.

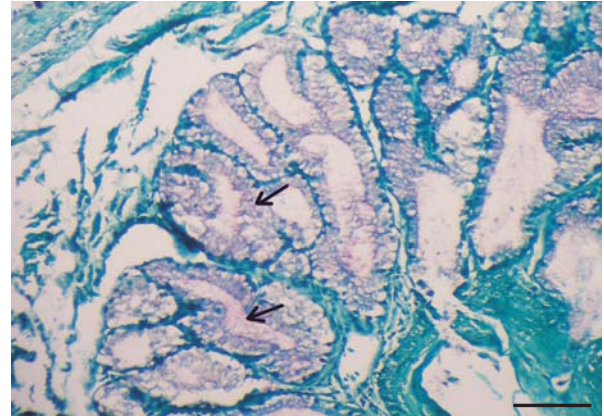


Figure 6 Showing very poor intensity positive reaction of the glands secretions of the oesophagus in rose-ringed parakeet; arrow, secretions of the glands, PAS-VG; scale bar, 32 μ m.

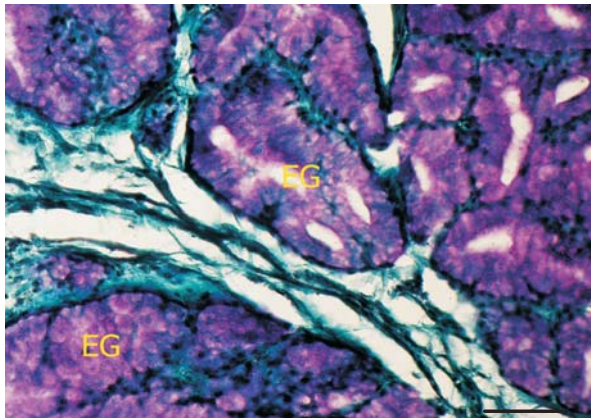


Figure 4 Showing high intensity positive reaction of the glands secretions of the oesophagus in rock dove; Eg, the oesophageal glands, PAS-VG, Periodic Acid Schiff-Van Giesson; scale bar, 32 μ m.

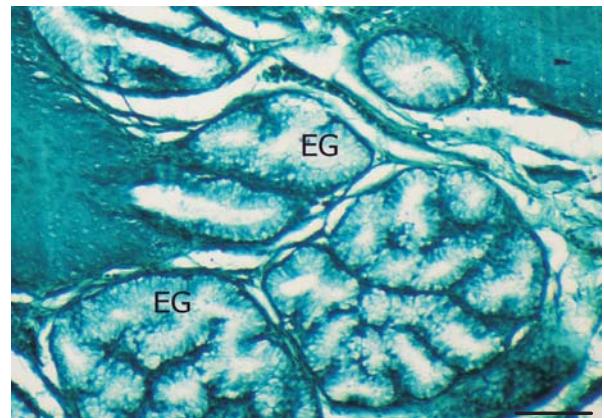


Figure 7 Showing negative reaction of secretions of the oesophageal glands in collared dove; EG, oesophageal glands, PAS-VG; scale bar, 63 μ m.

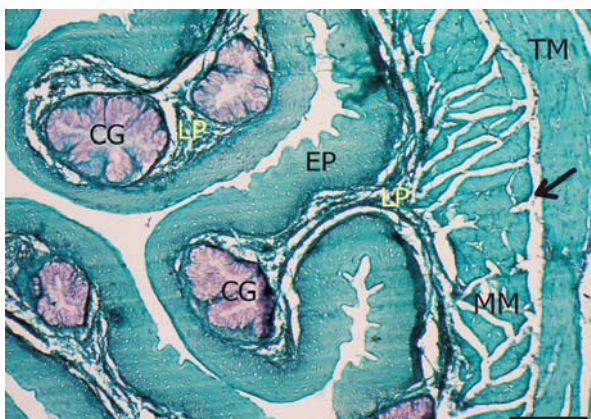


Figure 5 Showing poor intensity positive reaction of the glands secretions of the glands of crop in kestrel; EP, epithelium; CG, crop glands; LP, lamina propria; MM, muscularis mucosa; arrow, tunica submucosa; TM, tunica muscularis; arrow, PAS-VG; scale bar, 125 μ m.

In the cervical part of the oesophagus and crop, the tunica muscularis was surrounded by the tunica adventitia, a loose connective tissue. The thoracic part of the oesophagus was covered by a tunica serosa. There is no difference between the histological structure of the tunica serosa and adventitia of birds.

According to the observations of this study on the amount and type of glandular secretions, we propose that the structure and histochemical study of oesophagus and crop in other species of birds including sea birds would be very informative.

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