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Dharani K

M.V.Sc. Scholar, Department of
Veterinary Anatomy, Madras
Veterinary College, Vepery,
Tamil Nadu Veterinary and
Animal Sciences University,
Tamil Nadu, India

Sathyamoorthy OR

Professor, Department of
Veterinary Anatomy, Madras
Veterinary College, Vepery,
Tamil Nadu Veterinary and
Animal Sciences University,
Tamil Nadu, India

Kannan TA

The Dean, Veterinary College
and Research Institute,
Orathanadu, Tamil Nadu
Veterinary and Animal Sciences
University, Tamil Nadu, India

Nagarajan K

Professor, Department of
Veterinary Pathology, Madras
Veterinary College, Vepery,
Tamil Nadu Veterinary and
Animal Sciences University,
Tamil Nadu, India

Corresponding Author:

Dharani K

M.V.Sc. Scholar, Department of
Veterinary Anatomy, Madras
Veterinary College, Vepery,
Tamil Nadu Veterinary and
Animal Sciences University,
Tamil Nadu, India

Histological characterization of the crop in Siruvidai chicken with emphasis on age related changes

Dharani K, Sathyamoorthy OR, Kannan TA and Nagarajan K

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Abstract

The present study examined the histological organization and age related changes in the crop of Siruvidai chicken across four age groups such as two, six, twelve, and eighteen weeks of age. The crop wall was consistently composed of four tunics—tunica mucosa, tunica submucosa, tunica muscularis, and tunica adventitia. The tunica mucosa was comprising of lamina epithelium, lamina propria, and lamina muscularis, showed progressive thickening with age, accompanied by increased keratinization of the stratified squamous epithelium and mucosal folds deepening. The lamina propria lack mucous glands in all age groups studied. The tunica submucosa appeared as a thin connective tissue layer, gradually thickness increases with age. The tunica muscularis had a thicker inner circular layer and a thinner outer longitudinal layer of smooth muscle fibres, with connective tissue between them containing blood vessels and ganglion cells, indicating enhanced neural regulation. The tunica adventitia consisted of loose connective tissue with blood vessels and nerve bundles. These findings highlight progressive structural changes of the crop wall with age.

Keywords: Crop, Siruvidai chicken, histology, mucous glands and ganglion cells

Introduction

Indigenous chicken contributes to more than 20% of total egg production in India. These birds are also known for their adaptive superiority in terms of their resistance to endemic diseases and other harsh environmental conditions (Nwakpu *et al.*, 1999) ^[13]. Backyard poultry has surged by 45.78 percent, empowering rural households (DAHD, 2025) ^[5].

Siruvidai chicken is an indigenous ecotype reared as backyard poultry in Ariyalur district of Tamil Nadu state of India (Churchil *et al.*, 2023) ^[4]. Akter *et al.* (2018) ^[1] stated that the digestive system of bird has some unique aspects in that they ingest their feed whole, stores it temporarily in the crop and masticate in the gizzard rather than in the mouth.

The crop is a thin-walled, distensible diverticulum of the oesophagus which occurs just before the entrance of the thorax. The function of the crop is to store ingested food (Hodges, 1974) ^[8].

Materials and Methods

Siruvidai chicken of different age groups (irrespective of sex) such as two weeks, six weeks, twelve weeks and eighteen weeks were procured from Poultry Research Station, Madhavaram Milk Colony, Chennai – 51. In each group, six birds will be utilized for the study. Samples of the crop were collected and fixed in 10 per-cent neutral buffer formalin. The fixed tissues were processed and sectioned to 5-6 µm thickness.

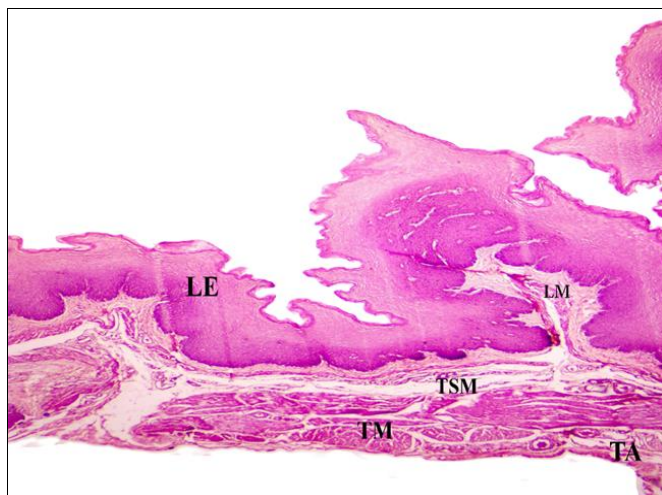
Tissue sections were subjected to various histological and histochemical staining methods such as Haematoxylin & Eosin staining method (Luna, 1968) ^[10], Masson's Trichrome staining method (Luna, 1968) ^[10], Weigert's staining method (Luna, 1968) ^[10], Mercury Bromophenol Blue staining method (Pearse, 1960) ^[14].

Ethical Approval

Reference Number is 21/SA/ IAEC/2024. The research was carried over after the approval from IAEC.

Results and Discussion

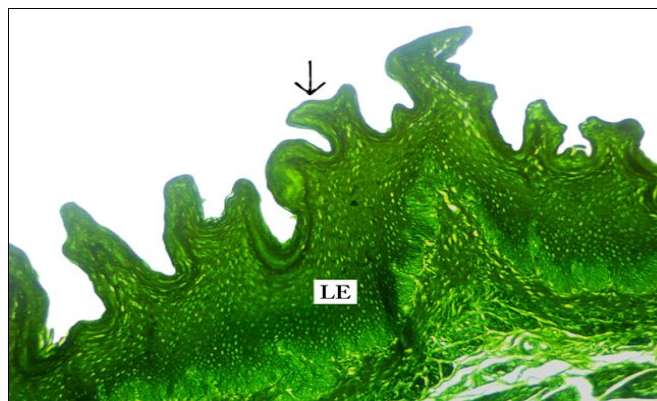
The crop of the Siruvidai chicken was comprised of four tunics, viz., tunica mucosa, tunica submucosa, tunica muscularis and tunica adventitia across the four different age groups studied (Figure 1). It is in agreement with the findings of Mohammed *et al.* (2021) ^[11] in pigeons, cattle egrets, and ducks, and Rahman and Waad (2025) ^[15] in blondinette pigeons. In contrast to the present study, Al-Musawi and Al-Khakani (2024) ^[2] reported that the crop of the buzzard was made up of only three tunics, viz., tunica mucosa, tunica muscularis, and tunica adventitia.



LE-Lamina Epithelium LM-Lamina Muscularis
TSM-Tunica Submucosa TM-Tunica Muscularis
TA-Tunica Adventitia
H&E x 40

Fig 1: Photomicrograph of the crop in six week-old *Siruvidai* chicken showing four tunics.

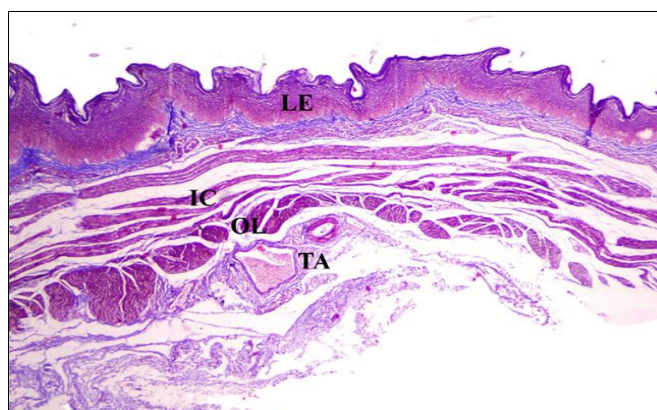
The tunica mucosa was composed of three layers, viz., lamina epithelium, lamina propria and lamina muscularis. The mucosa shown a lot of uneven mucosal folds (Figure 1). The mucosal folds became prominent as age increased from two week-old to eighteen week-old birds. The mucosal folds in the two week-old birds were shallower compared to other ages, which became deeper as the age of the birds were advanced. The lamina epithelium had a lining of keratinized stratified squamous epithelium (Figure 1). It was more keratinized with increasing age in the present study. Banks (1981) ^[3] opined that in anseriform birds, the lamina epithelialis mucosae of the crop was thicker than that of the oesophagus, which was seen in the present study. However, in contrast, Naser *et al.* (2024) ^[12] described that in turkey, the stratified squamous non-keratinized epithelium in was seen. The lining of the basal layer was simple columnar cells with a basally located nucleus. The nucleus was rounded in the four to five layers above the dense basal layer, then became a thin, dark, elongated nucleus and disintegrated on the topmost layer. The cytoplasm was eosinophilic (Figure 1). The epithelium showed positive for proteins in mercury bromophenol blue (Figure 2).



LE-Lamina Epithelium
Mercury Bromophenol Blue x 100

Fig 2: Photomicrograph of the crop in eighteen week - old *Siruvidai* chicken showing the presence of proteins (arrow)

In the present study, the lamina propria was distinct, thin and had loose connective tissue, fibroblast, blood vessels and nerves (Figure 3). It also contained nerve endings, immune cells, and lymphatic tissue. This observation was similar to the findings of Rahman and Waad (2025) ^[15] in blondinette pigeons, but also mentioned that it may contain glands. It was seen as a thick layer within the mucosal folds.

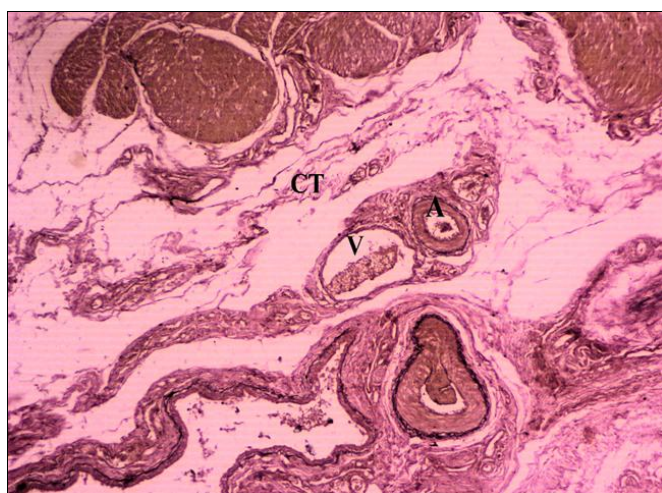


LE-Lamina Epithelium IC-Inner circular
OL-Outer Longitudinal TA-Tunica Adventitia
Masson's Trichrome x 40

Fig 3: Photomicrograph of the crop in eighteen week-old *Siruvidai* chicken showing the presence of collagen fibres.

The lamina propria contained predominantly collagen fibres (Figure 3) along with a few reticular fibres and very less elastic fibres (Figure 4). The mucous glands present in the lamina propria of the oesophagus were absent in the crop of all the age groups studied which was agreeable with Hodges (1974) ^[8] in domestic fowl, Rajabi and Nabipour (2009) ^[16] in Rose-ringed Parakeet, rock dove and collared dove, Kausar *et al.* (2016) ^[9] in Japanese quail and Naser *et al.* (2024) ^[12] in turkey. But in anseriform, the glands were simple, branched, tubuloalveolar mucous glands (Banks, 1981) ^[3]. The lamina muscularis was thin, distinct and oriented as a longitudinal layer of smooth muscle fibres observed in the *Siruvidai*

chicken (Figure 1) which is similar to the observation of Naser *et al.* (2024) ^[12] in turkey. The tunica mucosa layer stained negatively for PAS and Alcian Blue method in the present study.



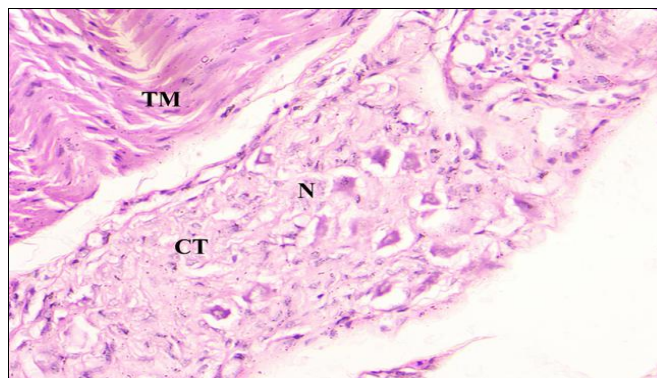
V-Vein A-Artery
CT-Connective Tissue layer
Weigert's method x 100

Fig 4: Photomicrograph of the crop in twelve week - old *Siruvidai* chicken showing elastic fibres in the blood vessels.

The submucosa was a thin layer composed of loose connective tissue, blood vessels and nerves which is concurrent with Al-Musawi and Al-Khakani (2024) ^[2] in the Eurasian collared dove. The submucosa was inappreciable in two week-old birds and it was thin in other age groups (Figure 1). Mohammed *et al.* (2021) ^[11] opined that the propria-submucosa was dense, irregular collagenous connective tissue in the pigeons, cattle egrets and ducks, which is not seen in the present study as propria-submucosa because the lamina muscularis was observed.

The tunica muscularis was arranged as an inner circular layer and an outer longitudinal layer of smooth muscle fibres (Figure 3), which concurs with the description of blondinette pigeons by Rahman and Waad (2025) ^[15]. However, this arrangement differed from the observations of Mohammed *et al.* (2021) ^[11] in pigeons, cattle egrets, and ducks, where the muscularis layer was described as having an inner longitudinal and an outer circular layer. The inner and outer layers were varying in thickness.

Among all the age groups studied, the inner circular layer was thicker than the outer longitudinal layer. Between the two muscular layers, the connective tissue showed blood vessels and an aggregation of ganglion cells were noticed (Figure 5). These ganglion cells were seen greater in number and were noticed in the connective tissue between the muscular layers, particularly near the oesophageal junction, suggesting enhanced neural control in this region. Denbow, 2003 ^[6] stated that the enteric nervous system aids in non-propagating motility, which stimulates the contraction of the crop wall. This layer positively stained for proteins in mercury-bromophenol blue.



N-Nerve cells TM-Tunica Muscularis CT-Connective Tissue
H&E x 400

Fig 5: Photomicrograph of the crop in two week-old *Siruvidai* chicken showing nerve bundles in intermuscular connective tissue layer.

Tunica adventitia had a thin layer of loose connective tissue fibres with varied thickness, containing large blood vessels and nerve bundles (Figure 3). This finding is consistent with the description of Naser *et al.* (2024) ^[12] in turkey. Within this layer, striated muscle fibres originating from the cutaneous muscle or clavicle were also noted, which was in agreement with the observations of Getty (1975) ^[7] in chicken. In contrast, Mohammed *et al.* (2021) ^[11] reported this outer covering as the tunica serosa.

Conclusion

This study gives about the structural organization of the crop. The study also emphasizes the functional significance of the crop as a storage organ in *Siruvidai* chicken. It described age related modifications and its supporting role in digestion and motility.

Conflict of Interest

There is no conflict of interest among the authors.

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