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STUDY ON POSTNATAL GROWTH AND DEVELOPMENT OF CROP AND PROVENTRICULUS OF DIGESTIVE TRACT OF BROILER

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ABSTRACT

The experiment was carried out to investigate postnatal growth and development of crop and proventriculus of digestive tract of broiler. Total 45 ("Cobb-500") chickens of three age groups like day 1(D1), day14 (D14), day 28 (D28) were used each group containing fifteen chickens. All birds were slaughtered after respective days then crop and proventriculus were collected. Total length, diameter and weight were determined by "slide calipers" and electronic balance. Then the samples were processed and stained with H and E stain for histological study. The length (cm), diameter (cm) and weight (gm) of crop and proventriculus were increased gradually with the age where highest at 28 and lowest at day 1. Number of mucosal folds of crop was highest at 1 and lowest at day 28. The keratinized stratified squamous epithelium of crop was thickest at day 28. Submucosa contains thin loose connective tissue. Tunica muscularis contains thick inner circular and thinner outer longitudinal smooth muscle and externally covered by adventitia. The mucosa of the proventriculus has macroscopic papillae with numerous folds and lined by simple columnar epithelium. Submucosal glands are lined by simple cuboidal to low columnar epithelium. Lamina propria contains loose connective tissue and muscularis contains scattered bundles of smooth muscle. Tunica muscularis consists of smooth muscle and externally covered by serosa.

Keywords: morphometry, crop, proventriculus, broilers, age

INTRODUCTION

The digestive system of bird has some unique aspects in that they ingest their feed whole, store it temporarily in the crop and masticate in the gizzard rather than in the mouth. The crop is an expansion of the esophagus, located in the lower neck area, the glandular stomach (proventriculus), the muscular stomach (gizzard) and intestines are the digestive tract of chicken (Nasrin *et al.*, 2012). The digestive tract of chickens conveys and utilizes food to gain nutrients. The esophagus is a tubular organ and is capable of being significantly stretched. It connects the mouth region to the crop in close association with the trachea. The crop provides the capacity to hold food for some time before further digestion commences (Hena *et al*., 2012). This capacity enables the bird to take its food as "meals" at time intervals but permits continuous digestion. Although the mouth excretes the digestive enzyme amylase, very little, if any, digestion takes place in the crop. It is simply a temporary storage pouch. Differential development of the absorptive epithelium may be responsible for changes in absorption capacity of birds (De Verdal *et al*., 2010). An available strain of broilers such as Cobb-500 is the result of genetic modification. They grow fast with better feed conversion ratio (FCR) than any other indigenous variety of chicken. Histology of crop and proventriculus of chickens were described previously but did not provide data about morphology and histology of crop and proventriculus of broilers in details (Hassouna, 2001). However, there was no report in Bangladesh regarding postnatal growth and development of crop and proventriculus of broiler chickens. Therefore, the present study was conducted to describe anatomy (weight, length, size and shape) different segments of digestive tract of broilers of newly hatched and progressively matures broilers in Bangladesh that may be a basis for further study on nutritional modulation in the field of veterinary science.

MATERIALS AND METHODS

The experiment was carried out from December 2013 to January 2014 on postnatal growth and development of crop and proventriculus of digestive tract of broiler was carried out at the department of Anatomy and Histology, Faculty of Veterinary Medicine, Chittagong Veterinary and Animal Sciences University (CVASU), Bangladesh.

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Study population

Forty five (45) day old broiler chickens (Cobb-500) were purchased from Agha poultry farm, Hathazari, Chittagong, Bangladesh. All birds are apparently healthy and without any detectable signs of abnormalities and diseases free. Then the birds were divided into three age groups like D1, D14, D21 each group consists of fifteen (15) broiler chickens. All groups were housed in compartmentalizes rectangular metallic cage wrapped with wire mesh. Optimum temperature, lighting, humidity and ventilation were maintained according to standard. Water and feed were provided *ad libitum*. All procedures were maintained by the Animal Care and Welfare Committee of CVASU.

Sample collection and gross anatomical investigation

The chickens of all groups were slaughtered at day 1, 14, 21 respectively. After complete bleeding the crop and proventriculus were collected. The collected samples were washed properly using normal saline and put to rinse added water properly in laboratory temperature. Total length and diameter were determined by "slide calipers" and weight by sensitive electronic balance (Mettler Toledo B154, ± 0.001g, China).

Histological investigation

After the gross anatomical examination the samples were processed by cutting into a appropriate size and tagged with a piece of paper to identify the sample age, name and number and then fixed by chemical fixation using 10% buffered formalin solution (p^H 7.4) and shaken 24 hours for fixation. After all processing the samples were stained with H and E stain for histological study.

RESULTS AND DISCUSSION

The morphometry of crop

Comparative presentation of the length (cm) and diameter (cm) of broiler crop according to age were shown in Table 1. The table represents that length increased gradually where the highest length is at day 28 and lowest at day 1, similarly the diameter also increased where the highest diameter is at day 28 and lowest at day 1. Unlikely, the number of mucosal fold of crop is decreased where's the high number of mucosal fold at day 1 and low at day 28.

Table 1. The morphometry of crop

Age (days)	Length (cm) ± SD	Diameter (cm) at mid point ± SD	No. of mucosal folds ± SD	Weight (gm) ± SD
1	0.7±0.0316228	0.93±0.1320173	17±0.7559289	0.19±0.0084515
14	1.93±0.1799471	2.9±0.1511858	12±1	2.128667±.0083381
28	2.29333±0.0798809	3.4±0.1309307	8±0.8451543	7.82±0.0774597

The morphometry of proventriculus

Comparative presentation of the length (cm) and diameter (cm) of proventriculus of broiler were given in Table 2. The table shows that the length were increased gradually, where the highest length at day 28 and lowest at day 1 but the diameter was increased very slowly where's the highest diameter at day 28 and lowest at day 1.

Table 2. The morphometry of Proventriculus

Age(days)	Length(cm) ± SD	Diameter(cm)at mid point ± SD	Weight (gm) ± SD
1	1.251333±0.0083381	0.7066667±0.0798809	0.3426667±0.0186956
14	2.810667±0.0070373	1.09±0.0890425	3.266667±0.1046536
28	3.720667±0.0088372	2.186667±0.0833809	6.860667±0.0148645

Histological Structure

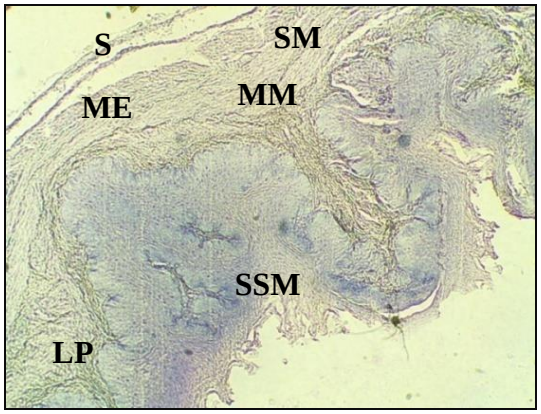
Crop

The histological structures of the crop are similar to the structure of the esophagus. The lining epithelium of the crop was found non-keratinized stratified squamous epithelium which was thicker in the chickens of age group D28 than D14 and D1 age group. The lamina propria contains loose connective tissue and large mucous gland. The lamina muscularis consist of longitudinal arranged smooth muscle fibers where's submucosa consists of a thin layer of loose connective tissue. The tunica muscularis is composed of a thick inner circular layer and a thin outer longitudinal layer of smooth muscle. The crop covered by a typical Adventitia (Randall and Reece, 1996).

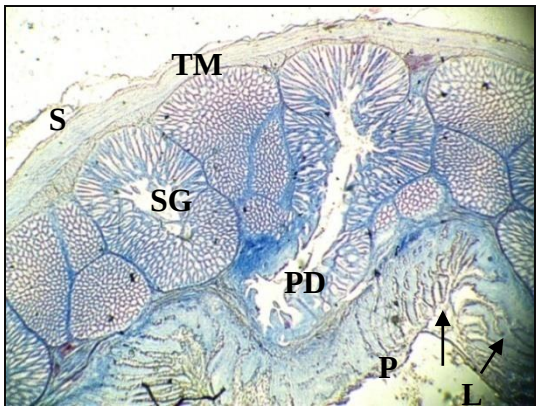
Proventriculus

The mucosa of the proventriculus in the present study was characterized by macroscopic papillae with numerous microscopic folds of varying height that were arranged concentrically around the single duct which is the opening at the apex of each papilla. The mucosal fold into proventriculus called plicae and depression between the folds are called sulci. Simple columnar epithelium lines the lumen and continues into three generations of ducts of the submucosal glands. The glands are lined by a simple cuboidal to low columnar epithelium in which the adjacent cells are in direct contact only on their basal half, thereby giving a serrated appearance to the luminal surface. The proventicular wall is occupied by large compound tubular gland those were multilobular in structures. The lamina propria of the study samples was typical loose connective tissue but lamina muscularis consists of scattered bundles of smooth muscle. The loose connective tissue of the submucosa was followed peripherally by a tunica muscularis which is consisting entirely of smooth muscle. The proventriculus of this study was externally covered by a typical tunica serosa. The proventicular gland were neumeros and the size of the gland were large at D28 then D14 and D1. Previous study from broiler chickns repororted that, the average lengths of proventriculus were 1.23±0.110 cm, 2.83±0.118 cm and 3.70±0.122 cm, at D1, D14 and D28 respectively and the average weights were 0.48±0.042 gm, 2.88±0.268 gm and 6.25±0.028 gm, at D1, D14 and D28 respectively (Nasrin *et al.,* 2012).

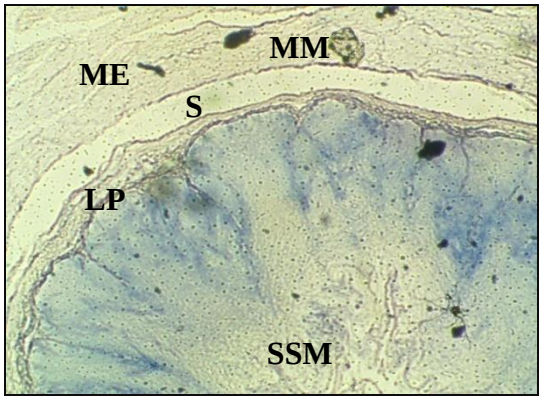
Figure 1. Histological stucture of crop and proventriculus are shown below as D1, D14 and D28.



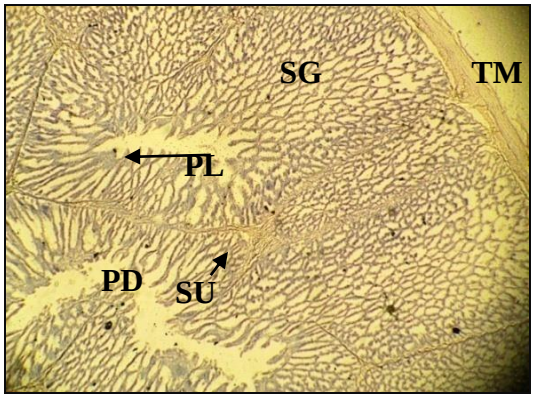
Histology of crop of the chickens at D1. Here, stratified squamous epithelium (SSM), lamina propria (LP), muscularis mucosae (MM), submucosa(SM), muscularis externa (ME) and



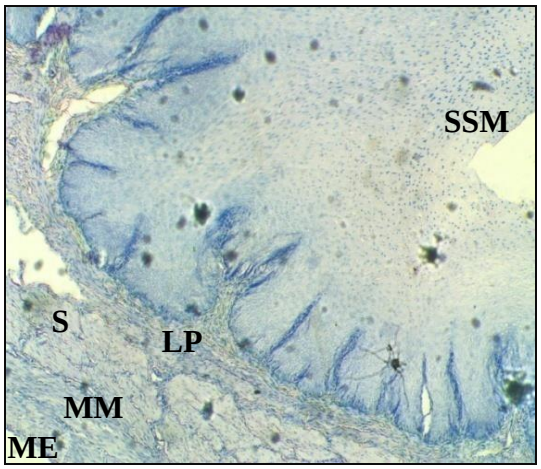
Histology of proventriculus of the chickens at D1. Here, lumen (L), papilla (P) with plicae arrrows, submucosa gland (SG), tunica muscularis (TM), primary duct (PD) and serosa (S) are shown (4x).



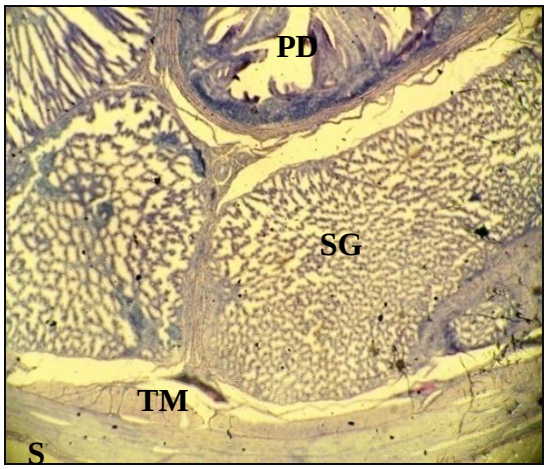
Histology of crop of the chickens at D14. Here, stratified squamous epithelium(SM), lamina propria (LP), muscularis mucosae (MM), submucosa(SM), muscularis externa (ME) and serosa (S) are shown (4x).



Histology of proventriculus of the chickens at D1. Here, papilla (P) with plicae (PL) arrrows, submucosa gland (SG), tunica muscularis (TM), primary duct (PD) and sulcus (SU) are shown (4x).



Histology of crop of the chickens at D28. Here, stratified squamous epithelium(SM), lamina propria (LP), muscularis mucosae (MM), submucosa(SM), muscularis externa (ME) and serosa (S) are shown (4x).



Histology of proventriculus of the chickens at D1. Here, lumen (L), papilla (P) with plicae arrrows, submucosa gland (SG), tunica muscularis (TM), primary duct (PD) and serosa (S) are shown (4x).

CONCLUSION

The average lengths, weights and wide and other histological structures of crop and proventriculus were increased gradually. Based on the above results and discussion that this study portraits a clear picture about the growth rate of Cobb-500 broiler chickens, specially their crop and proventriculus which are also related with the digestion of feed in birds. So that we can come to a certain understanding about the anatomy and histology of these organs as well as a basis for further study on nutritional, anatomical and histological field of Veterinary science.

REFERENCES

1. Animal Care and Welfare Committee, CVASU (2014). Comprises of director external affairs, Dean from Veterinary Medicine and selective departmental heads.
2. Hassouna EMA (2001). Some anatomical and morphometrical studies on the intestinal tract of chicken, duck, goose, turkey, pigeon, dove, quail, sparrow, heron, jackdaw, hoopoe, kestrel and owl. *Assiut Veterinary Medical Journal* 44:47-78.
3. Hena SA, Sonfada ML, Danmaigoro A, Bello A and Umar AA (2012). Some comparative gross and morphometrical studies on the gastrointestinal tract in pigeon (*columbia livia*) and Japanese quail (*coturnix japonica*). *Scientific Journal of Veterinary Advances* 1:57-64.
4. Randall CJ and Reece RL (1996). Color atlas of avian histology. Mosby Wolfe., London.
5. Nasrin M, Siddiqi MNH, Masum MA and Wares MA (2012). Gross and histological studies of digestive tract of broilers during postnatal growth and development. *Journal Bangladesh Agricultural University* 10:69-77
6. Randall CJ and Reece RL (1996). *Color atlas of avian histology*. Mosby-Wolfe., London.
7. Verdal De, Mignon HG, Jeulin S, Bihan DC, Leconte E, Mallet M, Martin S and Narcy CA (2010). Digestive tract measurements and histological adaptation in broiler lines divergently selected for digestive efficiency. *Poultry Science* 89:55- 61.