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Histological Study of Proventriculus of Male Adult Ostrich

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Abstract: The cranial chamber (proventriculus) of the stomach of male adult ostrich (*Struthio camelus*) was examined by means of light microscopy. Five stomaches of adult male ostriches were prepared and studied microscopically. In this research, 6i sections were used for light microscope. The proventriculus has papillary and no papillary regions. Its wall is composed of tunica mucosa, tunica submucosa and tunica serosa. The lamina mucosa is simple columnar epithelium that has simple branched tubular type glands as mucosal glands. The tunica mucosa in papillary region of proventriculus has many folds. The wall non-papillary region of proventriculus showed high longitudinal and semilunar folds respectively. The tunica mucosa, tunica sub mucosa and internal layer of tunica musularis comprised the structure of these folds. The connective tissue of lamina propria-submucosa was dense irregular, but lamina propriety in the areas between the mucosal glands is relatively dense or loose. The tunica submucosa in papillary region of proventriculus is occupied by large submucosal glands that are compound branched tubular type. The delicate smooth muscle fibers were observed in the deep part of lamina propria and between sub mucosal glands in the papillary region of proventrivulus. The connective tissue of lamina propria-submucosa was dense irregular, but lamina propriety in the areas between the mucosal glands is relatively dense or loose. The tunica submucosa in papillary region of proventriculus is occupied by large submucosal glands that are compound branched tubular type. The delicate smooth muscle fibers were observed in the deep part of lamina propria and between sub mucosal glands in the papillary region of proventrivulus. The tunica muscularis is made up of smooth muscle fibers. In the papillary region of proventriculus, they arranged as intervening longitudinal and circular layer, but in the non- papillary region of proventriculus as an inner longitudinal layer, middle circular layer and an outer longitudinal. The tunica serosa is constituted by a dense irregular connective tissues lined by mesothelium.

Key words: Histological Study · Ostrich · Proventriculus

INTRODUCTION

The structure of the stomach in the birds presents variations, which depend on the alimentary habits of the bird [1-3] Proventriculus or glandular stomach secretes the gastric juices and is cranially continuous with the esophagus and presents an elliptical shape [4]. The microstructure of proventriculus in domestic fowl, turkey, gooses and red-capped cardinals were studied [4-6].

With the purpose to correlate the morphology of the stomach and the alimentary habits of birds in general, we carried out a histological study of proventriculus of male adult ostrich.

MATERIALS AND METHODS

Five stomachs of adult male ostrich (1.5-2 years old) obtained from slaughterhouse immediately after slaughter and then fixed in 10%buffer neutral formalin for 72 hours. After macroscopic study, the stomach divided into several segments. Then each segments trimmed and embedded in paraffin. Serial sections at 6-8 μm thickness were cut, mounted and preserved. The sections are stained with Hematoxylin and Eosin and Green Masson's Trichrome stain [7]. Then micrographs were studied.

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RESULTS

Examination revealed that the stomach of adult male ostrich consists of two main parts: proventriculus and gizzard. These two parts connected to each other by a narrow part called strait. However these three parts are remaining of a total tissues structure but each one has its own specific features of texture.

Proventriculus or glandular stomach is a short, thick-walled, spindle-shaped organ lying above the liver and between the esophagus and the gizzard. The lumen is narrow and the thick-spongy walls are composed mainly of tubular glands. In macroscopic view it shows two distinct regions: a vast papillary and non- papillary region

Papillary Region: The wall of this region is consists of tunica mucosa, tunica submucosa, tunica muscularis and tunica serosa. The mucosal lining of the proventricular lumen is thrown into folds of varying height. From the basis of the sulci, short tubular glands extend to the lamina propria. The surface epithelium consists of simple columnar covering and the cells tend to diminish their height towards the base of the sulci and in the glands the epithelium is simple Coboidal. Lamina properia is occupying the center of the mucosal folds. This layer is dense irregular connective tissue with collagen fibers, fibroblasts and lymphoid infiltration. Delicate smooth muscle fibers are scattered in the deepest part of this layer.

Tunica submucosa is filled with proventricular glands. The mass of these glands makes up the greater part of the thickness of the proventricular wall. They are compound branched tubular gland. The glands are composed of numerous rounded or polymorphic lobules which are arranged in small groups. The secretory cells are pyramidal or cubical and they are deeply acidophilic. Surrounding the glands is a connective tissue septum consisting of collagenous and elastic fibers with a few muscle fibers, blood vessels and nerves.

Tunica muscularis consist of inner circular and outer longitudinal muscular layer. Tunica serosa is an irregular connective tissue and the mesothelial layer covers it from the outside (Figs 1, 2, 3, 4, 5).

Non-Papillary Region: This region is consisting of folded and unfolded part. In both parts the muscularis mucosa is absent and the lamina propria and tunica submucosa mixed with each other and collagen fibers and fibroblasts

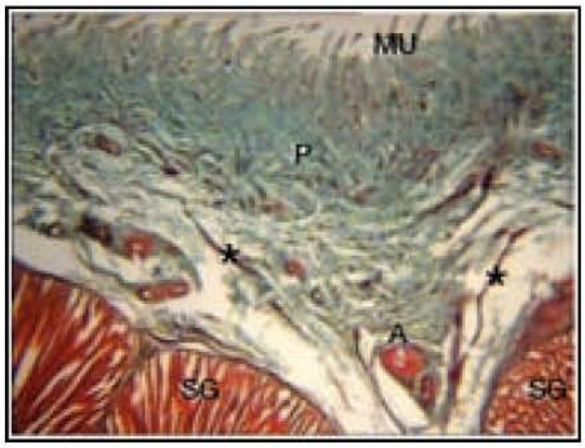

Fig. 1: Photomicrograph of the papillary region of proventriculus inadult male ostrich. mucous layer (MU). Lamina propria (P).smooth muscle fibers (*),arteriol (A). submucousal gland (SG). Green Masson`sTri chrome [´45].

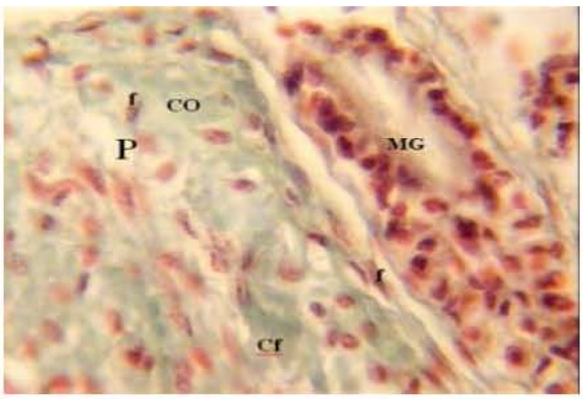

Fig. 2: Photomicrograph of lamina propria (P), between mucosal glands (MG) in papillary region of proventriculus of adult male ostrich. Collagen fibers (CO), Fibroblasts (f). Green Masson's Trichrome (×720).

are made irregular connective tissue accompanied with blood vessels and nerve fibers. And also, there is no submucosal gland here. In the folded part tunica mucosa, tunica submucosa and tunica muscularis make the high folds. The surface epithelium is simple columnar and the mucosal glands are simple branched tubular.

Tunica muscularis in the folded region consist of three layers, inner and outer layer is longitudinal and the middle layer is circular. The inner layer enters the folds and makes a thick layer. However in the unfolded region the inner and outer layer arranged in circular pattern and the middle layer is longitudinal.

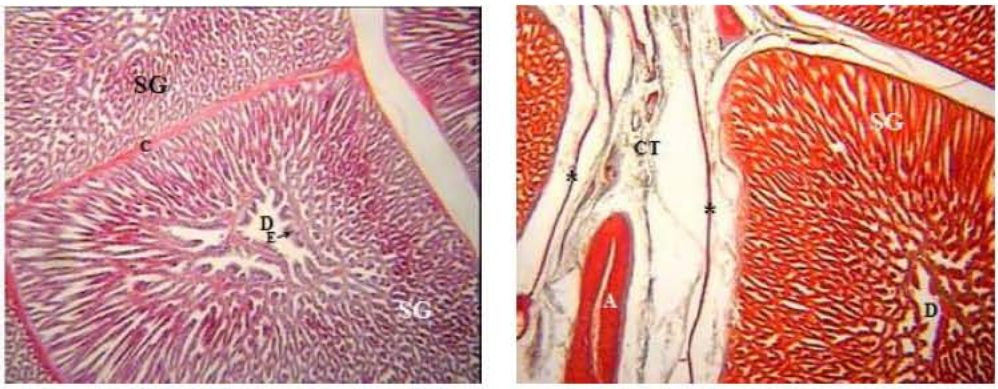

Fig. 3: Photomicrograph of proventriculus in adult male ostrich, Green Masson`sTrichrome [×45].
(D)Central duct of sub-mucousal gland, (E) Duct epithelium, (CT) connective tissue (c) sub- mucosal gland capsule, (A) Small artery, * - muscle fibers, (SG) sub-mucosal gland.

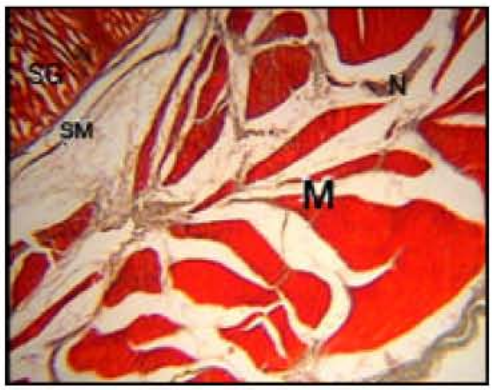

Fig. 4: Photomicrograph of tunica muscularis (M) and a part of sub- mucosalgland (SG) in papillary region of provetriculus in adult male ostrich, Green Masson`sTrichrome [×45].
(SM) smooth muscle fibers, (N) nerve bundle.

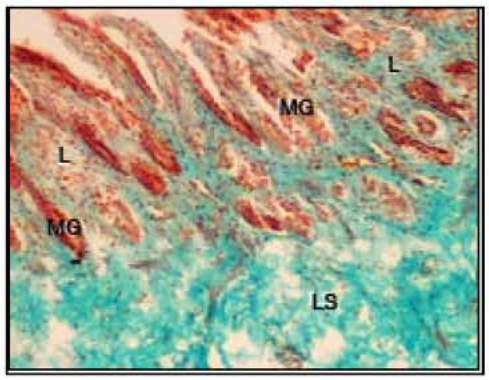

Fig. 6: Photomicrograph of a part of longitudinal fold in folded part of non-papillary region. (MG) Mucosal Glands, (LS) Lamina Propria Sub-mucosa, (L) Lamina propria between glands, Green Masson`sTrichrome [×180].

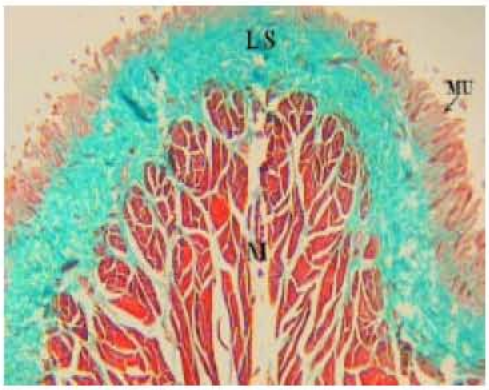

Fig. 5: Photomicrograph of longitudinal fold in folded part of non-papillary region of proventriculuse in adult ostrich,. (MU) mucous layer, (LS) Lamina properia submucosa, (M) internal layer of tunica muscularis. Green Masson`sTrichrome [×45]

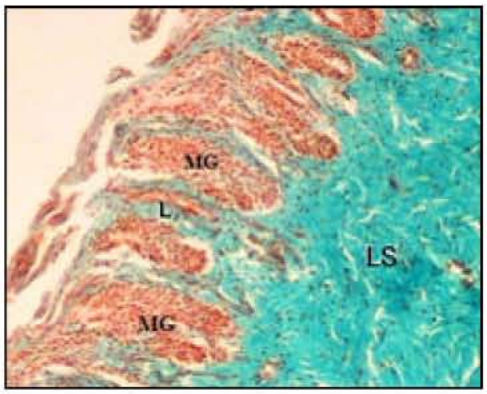

Fig. 7: Photomicrograph of non-folded part in non-papillary region of proventriculus in adult male ostrich. Green Masson`sTrichrome [×180].
(MG) mucousal gland, (L) Lamina propria-sub mucosa, (L) Lamina propria between glands,

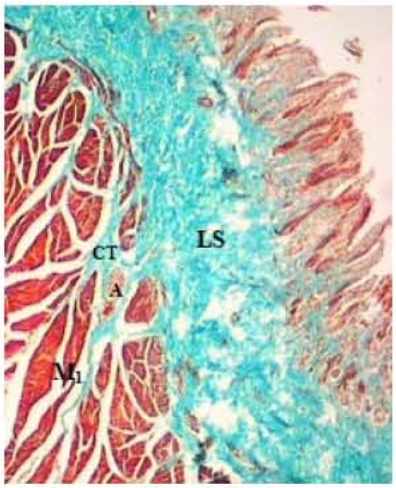

Fig. 8: Photomicrograph of smooth muscle in tunica muscularis in folded part of non-papillary region of proventriculus in adult male ostrich. Green Masson`sTrichrome [×180].
(M1) penetration of muscular layer in folds, (CT) Connective tissue around muscle bundles, (A) Arteriols, (LS) Lamina prpriasubmucosa.

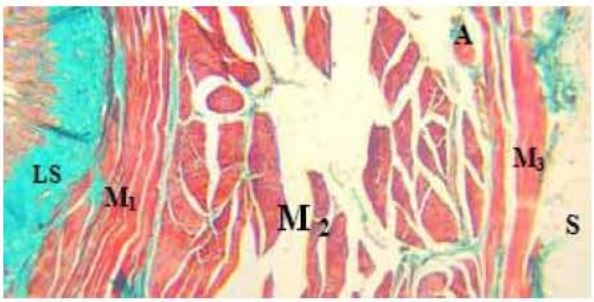

Fig. 9: Photomicrograph of smooth muscle layers in tunica muscularis of non- folded part of non-papillary region of proventriculus in adult male ostrich. Green Masson`sTrichrome [×45].
(LS) Lamina propria-submucosa, (M1) Inner layer of tunica muscularis, (M2) Middle layer of tunica muscularis, (M3) Outer layer of tunica muscularis, (S) Tunica serosa, (A) blood vessels.

Tunica serosa is a thick layer and a row of squamous cells make the mesothelium (Figs 6, 7, 8, 9).

DISCUSSION

The proventriculus is a glandular part of avian digestive system and is highly distensible in some species, which swallow large masses of food. In this part the food may store and/or commence digestion before it progresses to the gizzard. The glandular part of the stomach produces hydrolytic acid and pepsin. However, gastric proteolysis takes place mainly in the muscular part of the stomach. In this part, gut the basic patter of tissue layers is considerably altered by the gross development of the proventricular glands, by the reduction of the submucosa to a very thin layer and by the diffuse spreading of the muscularis mucosa [3, 5].

The mucosa membrane of the proventriculus present several folds birds like fowl, pigeon, turkey, goose and red-capped cardinal [3-6], but in the ostrich the proventriculus shows the papillary and non-papillary region and the non-papillary region folded and unfolded region that are different in histological structure. The shape and arrangement of folds in papillary region and unfolded part of non-papillary region in the ostrich proventriculus are branched and anastigmatic as in other birds [8-11].

In the lamina propria of both parts in the ostrich, there are numerous simple tubular glands, which open in the base of the folds, as in other birds [1, 8]. The localization of these glands in proventriculus varies among the several kinds of the birds. Some investigators believe that these glands located between the ducts of compound glands [12, 13], while the others described them in the base of the vilies [14]. We found these glands lined by simple high cubical epithelium as Farner [1] report. But some authors agree that the epithelium of these glands are simple columnar [11, 15].

In the ostrich few scattered smooth muscle fibers arranged the muscularis mucosa in the deepest layer of lamina propria in papillary region of proventriculus, but there is no muscularis mucosa. In the domestic birds and red-capped cardinal the muscularis mucosa is present as the distinct layer between lamina propria and tunica submucosa [5, 6]. Farner [1] stated that in many types of birds the glands penetrate into the muscularis mucosa during development, separating it into inner and outer layer.

Tunica submucosa of papillary region is filled with proventricular glands. The mass of these glands makes up the greater part of the thickness of the proventricular wall and there is no gland in non-papillary region. There is some doubt as to whether the proventricular glands lie in the lamina propria or within the submucosa [5].

Tunica muscularis in the papillary region of ostrich proventriculus consist of inner circular and outer longitudinal muscular layer. But in the non-papillary

region tunica muscularis in the folded region consist of three layers, inner and outer layer is longitudinal and the middle layer is circular. The inner layer enters the folds and makes a thick layer. However in the unfolded region the inner and outer layer arranged in circular pattern and the middle layer is longitudinal. Bradley and Grahame [16] consider that the tunica muscularis in proventriculus chamber is three layered with brand of longitudinal muscle inside and outside the thick circular band and the small bundles of longitudinal fibers lying internal to the glandular masses make up diffuse muscularis mucosa.

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REFERENCES

1. Farner, D.S., 1960. Digestion and digestive system. In Biology and comparative physiology of Birds. New York: Academic Press. Chapter 11.
2. Sturkie, P.D., 1965. Alimentary canal: anatomy, perhension, deglutition, appetite, passage of ingesta, motility. In Faraner, D.S. Avain Physiology. NewYork, Comstock Publ. Ass. Div. cornell. Univ. Press, 10: 273-311.
3. King and McLelland, 1975. Outline of Avian anatomy. 1st ed., Bailliere and Tindall, London, pp: 37-38.
4. Getty, R., 1975. Sisson and Grossman's. The Anatomay of Domestic Animals. 5th ed., 2, W.B. Saunders Co., Philadelphia, pp: 1968-1981.
5. Hodges, R.D., 1974. The histology of the Fowl. London, Academic Press, pp: 35-88.
6. Catroxo, M.H.B., M.A. Lima and C.E.M.P.D.M. Cappelaro, 1997. Histological aspects of the stomach (proventriculus and Gizzard) of the Red-Capped cardinal (Paroaria gularis gularis). Revista Chilena de Anatomia, 15: 19-27.
7. Luna, L.G., 1968. Manual of histological staining methods of the armed forces institute of pathology, 3rd ed., American Registry of pathology, New York.
8. Lima, M.A.I., 1979. Estudo topoquimico das mucos substancias das estruturas eoiteliais do trato gastrointestinal de Columba livia. Escola Paulista De Medicina, pp: 52.
9. Lima, M.A.I. and W.S. Sasso, 1985. Histochemical detection of glycoproteins in the gastric epithelia of Columba livia. Acta Histochemica., 76: 145-150.
10. Klem, J.R., C.R. Brancato, J.F. Catalano and F.L. Huzmin, 1982. Gross morphology and general histology of the esophagus, ingluvies and proventriculus of the House Sparrow National Academy of Science Proceedings, 56: 141-6.
11. Roch, S.O., 1991. Aspectos morfologicos do tubo digestive da coruja-buraquira Speotyto cunicularia. Escola Paulista De Medicina, pp: 73.
12. Anderw, W., 1959. Textbook of comparative history. Oxford, Univ. Press, pp: 254-263.
13. Vial, J.D., J. Garrido, M. Dabike and G. Koeig, 1977. Muscle proteins and the changes in shape of avian oxynticopeptic cells in relation to secretion. Anatomical Record., 194: 293-310.
14. Fieri, W.J., 1984. Aspectos anatomicos e histologicos do tubo digestive da codorna Nothura maculosa maculosa, pp: 109.
15. Espinola, L.V. and E.A. Galliussi, 1990. Estudioanatomo-histologico deltracto digestive de Fulicaarmillata. Iheringia Seriologica Zoologic., 70: 93-108.
16. Bradley, O.C. and T. Grahame, 1951. The structure of the fowl. 3rd ed. Philadephia, J.B. Lippincot, pp: 29-48.