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Original Research Article

MACRO AND MICROSCOPIC CHARACTERISTICS OF THE GASTROINTESTINAL TRACT OF THE CATTLE EGRET (*BUBULCUS IBIS*)

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ABSTRACT

Introduction: Cattle egret (Bubulcus ibis) is widely spread in Egypt and acts as a reservoir for many diseases. Few study described the anatomical and histological picture of its gastrointestinal tract which plays an important role in its nutrition habits in correlation to transmission of diseases.

Materials and Methods: The present work was carried out on ten cattle egrets of different age and sex. After euthanized; five birds were subjected to normal dissection to study their gross anatomy by injection of 10% formalin. The GIT of the other five birds were sampled and directed to the microscopic anatomy (light, electron microscopy and histochemical study).

Results: The lining epithelium and glands all over the GIT, except the alveolar cells of the proventriculus, were strong alcian blue and Periodic Acid Schiff (PAS) positive. The cone shape proventriculus was covered internally with an eosinophilic mucous layer, the C shape gizzard, and spherical pyloric part of the stomach was covered internally with soft gel likeeosinophilic mucous koilin layer and desquamated cells. The U-shape duodenum and the thicker wall jejunum till the Michel's diverticulum, after this diverticulum ileum starts with straight, short and less numerous intestinal villi. The single left cecum of lymphoid type with nodular lymphoid tissue. Enteroendocrine cells were observed all over the stomach and intestine which demonstrated by Grimelius' silver method. Methyl green pyronin method used demonstrates Nucleic acids (DNA and RNA).

Conclusion: All micro and microscopic features in the study indicate that the cattle egret is carnivores' bird.

KEY WORDS: Cattle egret, GIT, Third stomach, Electron Microscope, Histochemical.

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INTRODUCTION

The Cattle egret (*Bubulcus ibis*) is a cosmopolitan species of heron (*family Ardeidae*) found in the tropics, subtropics and warm temperate zones. It is the only member of the monotypic genus *Bubulcus*. Cattle egret is popular for its role in the bio-control of cattle parasites and land pests; it feeds on a wide range of prey, particularly insects and moths as well as spiders, frogs, earth-worms and fish and is locally distributed in Nile Delta and Valley [1].

The importance of cattle egret to the farmer has initiated an increasing interest to establish more accurate and specific anatomical facts about the gastrointestinal tract of cattle egret [2]. The present study was conducted to investigate in details the macroscopic, histological appearance, histochemical and ultrastructural

characteristic features of the cattle egret (*Bubulcus ibis)*.

MATERIALS AND METHODS

The current study was conducted on ten cattle egrets of different age and sex weighing 0.5-1.5kg, it obtained from the fields around Cairo.

Gross anatomical study: Five birds were injected with 10% formalin [3]. The animals were left in a mixture of 10% formalin, 2% phenol and 1% glycerin for seven days before the routine dissection. The other five birds were manually dissected to report the morphology, weight, length and relations of the different parts of the gastrointestinal tract.

General histological study: Five adult sexually mature apparently healthy male native of the cattle egret (*Bubulcus ibis)* were used in this study. After anesthesia, the birds were slaughtered and the different parts of the GIT were immediately dissected out and sectioned into small pieces. Some of these specimens were fixed in neutral buffered formalin, the others fixed in the Carnoy's fluid. They were processed and embedded in paraplast. Serial and step serial sections of 5-6 µm thick were obtained and stained with Haematoxylin and Eosin (H&E), Masson's trichrome [4].

Histochemical study: The specimens were obtained, fixed and processed as mentioned in general histological study and were stained with Periodic Acid Schiff (PAS), combined Alcian blue (AB) pH 2.5 /Periodic Acid Schiff (PAS) technique for detection of both acidic and neutral mucopolysaccharides [5], Grimelius' silver method to stain endocrine cell granules [6] and methyl green pyronin method for demonstration of Nucleic acids (DNA and RNA) [7].

Transmission electron microscopy: Small tissue blocks from the proventriculus, gizzard, and pyloric part were fixed inparaformaldehyde-gluteraldehyde in phosphate buffer [8]. Specimens were post fixed in 1 % osmium tetraoxide for one hour, washed in 0.1 M phosphate buffer (pH 7.3), then dehydrated in graded ethanol and embedded in open araldite mixture [9]. Semi-thin sections (1µm) were cut, stained with Toluidine blue and examined with light microscope [10]. Ultra-thin sections were cut and stained with uranyl acetate and lead citrate. The sections were examined with a JEOL 1010 transmission electron microscope at Regional Center for the Mycology and Biotechnology (RCMB) Al-AzharUniversity, Cairo, Egypt.

RESULTS AND DISCUSSION

Gaster: The stomach of the cattle egret consists of three parts; the proventriculus (pars glandularis), the ventriculus (pars muscularis) and the pyloric part (pars pylorica gastris). It occupies the ventral part of the body cavity and is suspended by the dorsal mesogastrum. The latter connects the dorsal aspect of the stomach with the loops of jejunum and gall bladder. The ventral surface of the stomach was connected to the ventral abdominal wall by the ventral mesogastrum.

Proventriculus gastris (pars glandularis)

Fig. 1: Left view of the abdomen of the cattle egret.

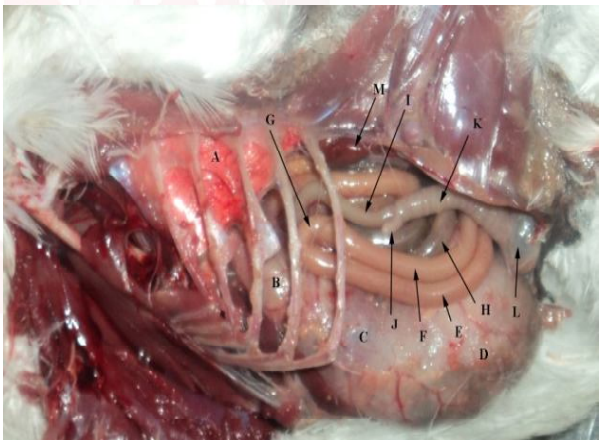


Fig. 2: Right view of the abdomen of the cattle egret.

Gross Anatomy: The proventriculus is short cone shape withcircular cross section(figs. 1, 2, 3 &4/ C). This was in accordance with Bashain owl [11]. HoweverBashain the same bird described its shape as trapezoid [11], Salem *et al.*in the same

bird said that it was lens-shaped [12].Itmeasures about 1.1 – 1.5 cm length.The apex of the cone directed cranially toward the esophagus and its base directed caudally toward its connection with the gizzard. The proventriculus extends from the level of 7th rib to the level of the cranial border of the ileum. It's related dorsally to the loops of the jejunum. It related ventrally to left lobe of the liver where it causing impression on it, and to the gall bladder on the right side. The inner surface of the proventriculus is covered by white mucosa which carries a numerous macroscopic papillae of the proventricular glands. No clear line of demarcation externally between the proventriculus and the gizzard.The proventricular- ventricular isthmus was not present in the cattle egret so that the two organs form one large pear-shaped cavity. This was in accordance with the results of Ford [13] and Hamdiet al.[14]. Hence the ismuthga-striswas also mentioned by El karmotyin duck and geese [15].

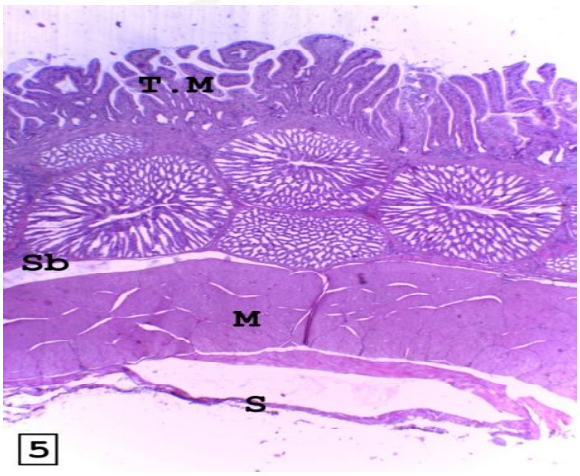
Histological findings: The wall of the proventriculus is constituted by four tunics; mucosa, submucosa, muscularis and serosa (Fig. 5). The four tunics were simulated those observed in red jungle fowl [16] and in cattle egret [17]. But Zhu *et al.*in Yellow-billed Grosbeak didn't identify the existence of submucous layer in proventriculus [18]. Intraepithelial lymphocytes were demonstrated especially in the basal region of the mucosal folds. That may provide the glandular stomach an immunologic defense [19].

Fig. 3: The stomach and part of the small intestine of the cattle egret.

Fig. 4: The stomach of the cattle egret (opened).

A- Lung
B- Esophagus
C- Proventriculus gastris
D- Ventriculus gastris
E- Pars descendens duodeni
F- Pars ascendens duodeni
G- Flexura duodeni
H- Jejunum
I- Ileum
j- Cecum
K- Rectum
L- Cloaca
M- Kidney
N- pars pylorica gastris
O- Liver
P- Cloacal bursa
Q- Pancreas
R- Flexuraduodeno-jejunalis
S- Pancreatic duct
T- Hepato-enteric duct

Fig. 5: Photomicrograph of a transverse section of the proventriculus of the cattle egret, showing four tunics; Tunica mucosa gastris (T.M.), Tela submucosa gastris (Sb), Tunica muscularisgastris (M) and Tunica serosa (S).(H&E X40)



The mucous membrane of the proventriculus possessed several branched Plicaethat projected into the lumen and are separated from each other by Sulciof different depths. The mucosal folds are lined with columnar cells. Ultrastructuraly these cells attached with occludence junction apically and desmosomes laterally. Thesewere true in domestic fowl [20, 21], to seal the adjacent cells and consequently to prevent the proteolytic action of acid on the epithelium [22].

The nuclei are basely euchromatine with peripheral condensation of heterochromatin.The cytoplasm shows free ribosomes, rER, Golgi apparatus, variable number of mitochondria, and apical electron lucent secretory granules.The latter granules fused with each other and with the surface cell membrane to be extruded (Fig. 6).Cells with pyknotic nuclei are observed between surface epithelial cells (Fig. 7).

Fig. 6: Electron micrograph of the proventriculus of the cattle egret, showing surface tall columnar cells with occludence junction apically and desmosomes laterally (arrow), free ribosomes, rER, Golgi apparatus, variable number of mitochondria, and apical electron lucent secretory granules (g). (Uranyl acetate and lead citrateX15000)

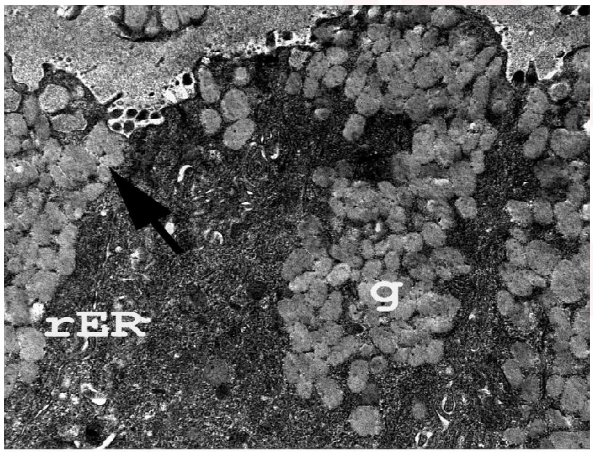
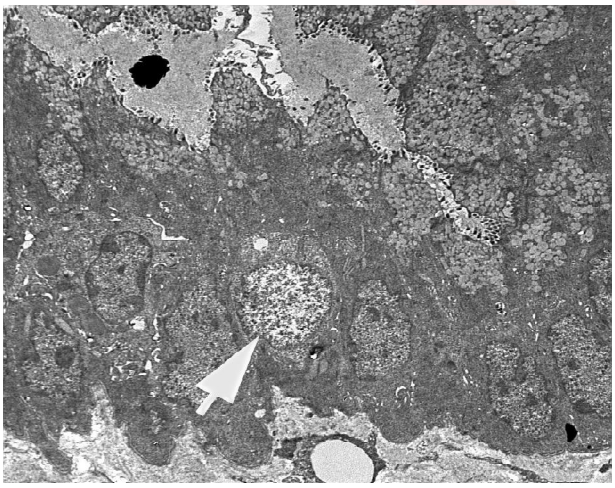


Fig. 7: Electron micrograph of the proventriculus of the cattle egret, showing cells with pyknotic nuclei (arrow) between surface epithelial cells. (Uranyl acetate and lead citrateX5000)



The lamina propriais constituted by irregularly arranged collagen fibers and contains many blood vesselsand numerous simple tubular glands. Intraepithelial lymphocytes were demonstrated especially in the basal region of the mucosal folds. Within the lamina propria, beneath the cells of surface epithelium, granular leukocytic cells containing acidophilic and basophilic granules are observed (Fig. 8).These cells also demonstrated by electron microscopy (Fig. 9).

Fig. 8: Photomicrograph of a transverse section of the proventriculus of the cattle egret, showing the mucosal folds are lined with columnar cells, noticed granular leukocytes (arrow). (H&E X1000)

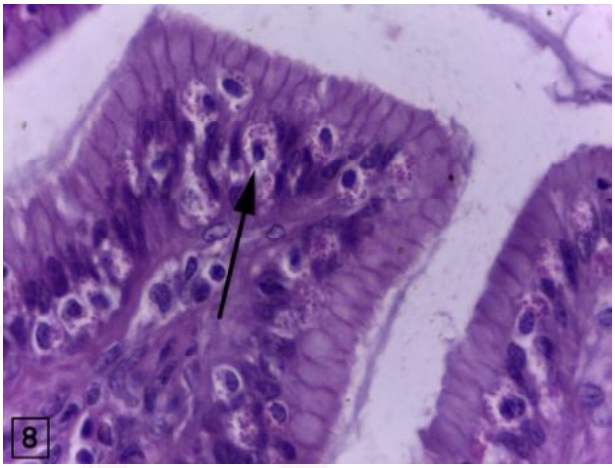
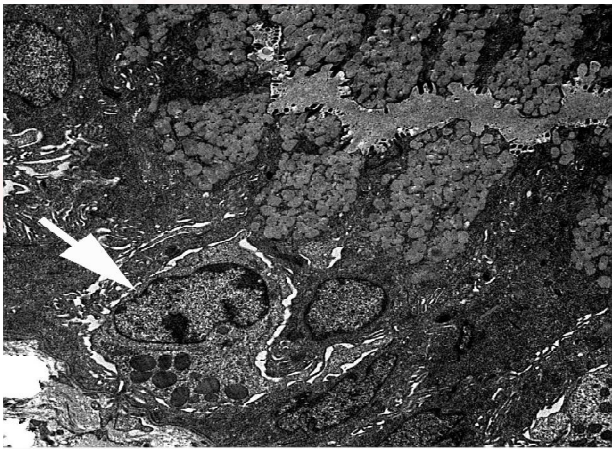


Fig. 9: Electron micrograph of the proventriculus of the cattle egret, showing granular leukocytes (arrow). (Uranyl acetate and lead citrateX5000)



The muscularis mucosa is represented by longitudinal smooth muscle fibers within the lamina propria. The deep proventricular glands are located between the two muscle layers in the submucosa and penetrate the lamina muscularis mucousa to open by papilla in the surface as recordedin burrowing owl [23] and in cattle egret [17]. However, Christpher and Reecerecorded large glands in the lamina propria of proventriculus in domestic fowl [24]. On contrary, these glands found in between two layers of lamina muscularis mucosa [25].

The deep proventricular glands appeared compound tubulo-alveolar units, lined by cuboidal

to low columnar cells with deeply eosinophilic cytoplasm (Fig. 10). Such glands are conical, pyriform or elliptical in shape simulating those noticed by Catroxo*et al.*in red-capped cardinal [26].By electron microscopy the epithelium of deep proventricular glands revealed three types of cells; light, dark cells epithelium and argyrophilic endocrine cells (Fig. 11).

Fig. 10: Photomicrograph of a transverse section of the proventriculus of the cattle egret, showing the compound tubulo-alveolar units are lined by cuboidal to low columnar cells with deeply eosinophilic cytoplasm (arrow). (H&E X1000)

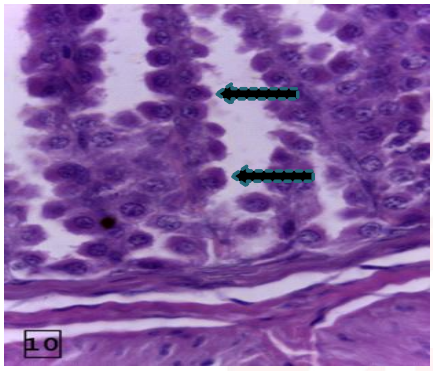
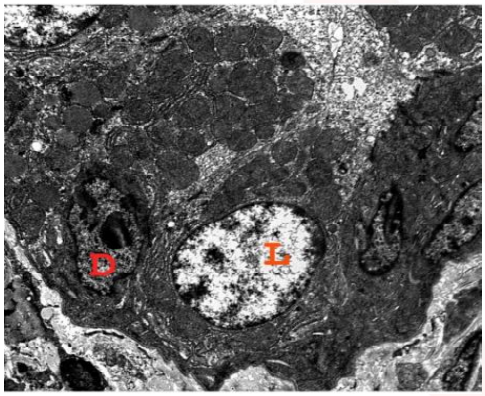
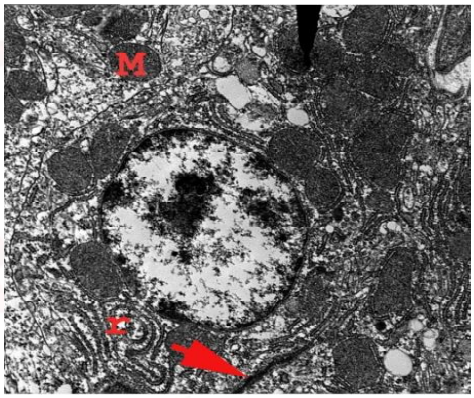


Fig. 11: Electron micrograph of the proventriculus of the cattle egret, showing light (L), dark alveolar cells (D). (Uranyl acetate and lead citrate8000)



The light cell is cuboidal or pyramidal in shape, which corresponded to that mentioned by Kadhim*et al.* in red jungle fowl [16]; in cattle egret [17]. They have prominent spherical central nucleolus with euchromatic peripheral chromatin extend centrally towards it. The cytoplasm had free ribosomes, rER, Golgi apparatus, numerous round mitochondria are occurred mainly in the supranuclear cytoplasm. In between the mitochondria and around it numerous profiles of smooth endoplasmi c reticulum are found. Secretory granules and few vacuoles were also detected. The glands are surrounded by blood capillaries and smooth muscles. Desmosome is demonstrated near the base of the adjacent cells (Fig. 12). The dark alveolar cells havepyknotic nuclei. Their cytoplasm showed the same structure of light alveolar cells but the mitochondria appeared vacuolated.The rER are dilated and large numbers of vacuoles are distributed withinit (Fig. 11).

Fig. 12: Electron micrograph of the proventriculus of the cattle egret, showing light alveolar epithelium with spherical nucleus, euchromatic and peripheral chromatin extend centrally towards the prominent central nucleolus, free ribosomes, rER (r), Golgi apparatus, supranuclear round mitochondria (M), numerous profiles of smooth endoplasmic reticulum, secretory granules and few vacuoles, desmosome (arrow) near the base of the adjacent alveolar cells. (Uranyl acetate and lead citrateX12000)



Two types of argryophil endocrine cells were detected in between the light and dark cells. One iselectron dense and lucent granules (Fig. 13), the othercontains electron dense granules (Fig. 14), bothare closed typecells. While open and closed type were observed in falcon [22]. On the same observation, the open type has not been demonstrated in the proventriculus of chicken. Endocrine cells also observed in between connective tissue [27].

Fig. 13: Electron micrograph of the proventriculus of the cattle egret, showing argryophil endocrine cells (arrow) with electron dense and lucent granules. (Uranyl acetate and lead citrateX12000)

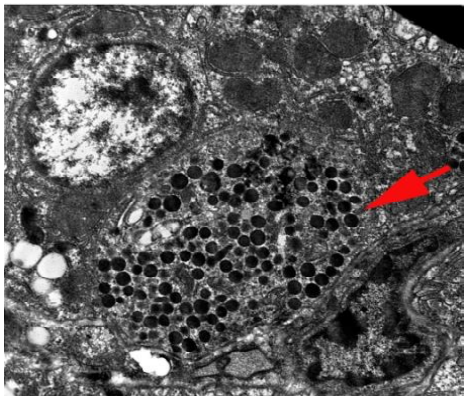
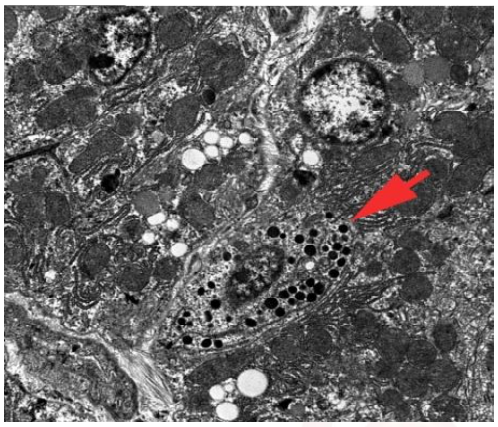


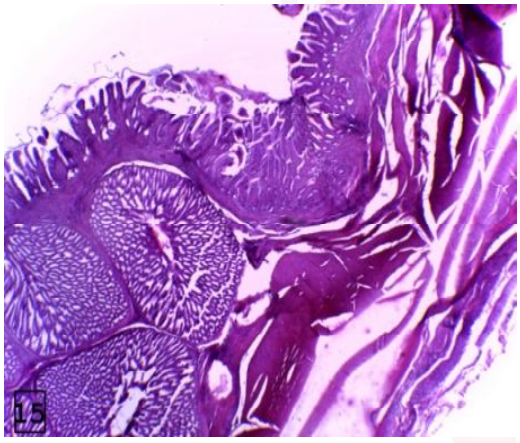
Fig. 14: Electron micrograph of the proventriculus of the cattle egret, showing endocrine cells (arrow) with electron dense granules. (Uranyl acetate and lead citrate8000)



Junction between the proventriculus and the ventriculus:

The mucosa is strongly folded. The lamina propria contained glands resembling those of the ventriculus. Moreover, the muscle tunic of the intermediate zone is gradually increased in thickness towards the ventriculus (Fig. 15).

Fig. 15: Photomicrograph of a transverse section of the Junction between the proventriculus and the ventriculus of the cattle egret. (H&E X40)

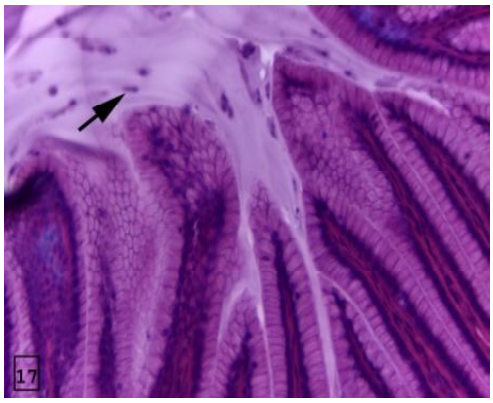


Ventriculus gastris (pars muscularis) Gross Anatomy: The gizzard (figs.1, 2, 3 &4/D) is a large C-shape sac. It has two curvatures and two surfaces.It measures about 2 - 2.5 cmlength, 1 - 1.5 cm thick and 1 – 1.4 cm width. It extends from the cranial border of ilium to the 2nd caudal vertebra. The greater curvature(curvature major) faces sinistroventral and related to the terminal part of the descending duodenum and colorectum.It attached to them by the gastro duodenal ligament. The lesser curvature (curvature minor) faces dextrodorsal andcontinued with the pyloric part of the stomach. It attached to the first part of the descending duodenumby the gastro duodenalligament. Theventral surface connected to the ventral abdominal wall by the ventral mesogastrum. The gizzard is covered internally by the whitish greenish membrane (Cuticulagastris). The latter membrane forms a raised circular fold at the junction of the proventriculus.

Histological findings: The ventricular wall; reveals the presence of four tunics mucosa, submucosa, muscularis and serosa.That was simulatingto red-capped cardinal [26]. However, the ventricular submucosa was not identified due to the absence of the lamina muscularis mucosa in cattle egret [17]. The mucous membrane of the ventriculus shows numerous low branched folds (Plicaeventriculares) compared with those of the proventriculus and separated by wide crypts (Fig. 16). However, these folds were low longitudinal, parallel and interrupted by narrow sulci infan-tailed raven [28].On the other hand, these folds were high in pigeon [29].

Fig. 16: Photomicrograph of a transverse section of the ventriculus of the cattle egret, showing four tunics; mucosa (T.M), submucosa (sb), musculosa (M) and serosa (S). (H&E X40)

Fig. 17: Photomicrograph of a transverse section of the ventriculus of the cattle egret, showing the mucosal folds are lined with low columnar cells and noticed desquamated cells (arrow). (H&E X400)



The mucosal folds were lined with low columnar cells.The mucous membrane was covered by a thin eosinophilic gel like mucous koilin layer and desquamated cells (Fig. 17). With electron microscopy four cell types could be observed in the ventriculus; surface epithelial, chief, intermediate and basal cells according to their location.

Fig. 18: Electron micrograph of the ventriculus of the cattle egret, showing secretory granules (g) in apical zone of the surface epithelial cells and basal nucleus. Noticed gel like mucous koilin (K). (Uranyl acetate and lead citrateX8000)

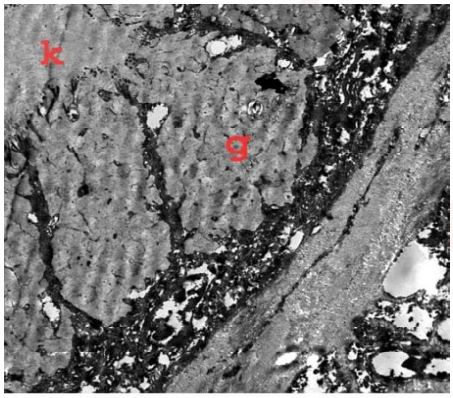
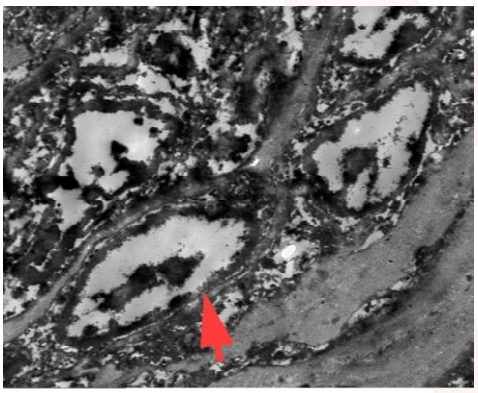


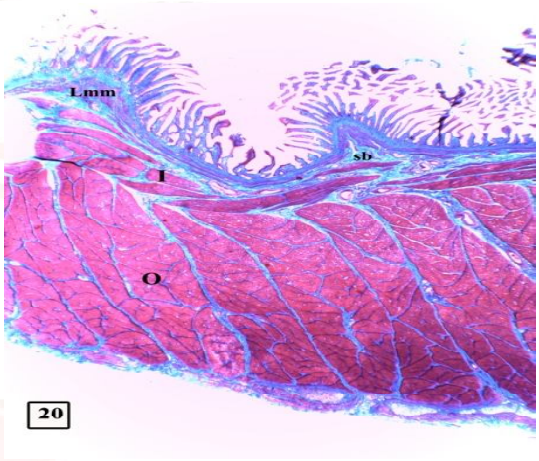
Fig. 19: Electron micrograph of the ventriculus of the cattle egret, showing chief cells (arrow). (Uranyl acetate and lead cirtrateX15000)



The surface epithelial cells bulged into the lumen by microvilli and resting on irregular in contour basement membrane. The apical cytoplasm contains variable number of granules and organelles; free ribosomes, rER, Golgi apparatus and mitochondria. The nucleus is very irregular in outline and locates basely (Fig. 18). Lamina propria is constituted by a thin layer of dense connective tissue that formed mainly of collagen fibers. The lamina propria contains few randomly distributed simple tubular glands containing eosinophilic secretions and is lined by cuboidal epithelium. Ultrastructuraly, these chief cells contain closely packedorganelles. The nucleus is regular and contains prominent nucleoli and heterochromatin in the periphery. The granules discharge at the cell surface and release to the lumen as filamentous layer. Theses filaments become closely packed in the upper parts of the gland, and may form a more or less homogenous mass (Fig. 19). Intermediate cells appeared as chief cells but organelles were less in density.

The muscular tunic of the ventriculus arranged in an inner and outer thicker longitudinal smooth muscle fibers (Fig. 20).

Fig. 20: Photomicrograph of a transverse section of the ventriculus of the cattle egret, showing dense connective tissue that formed mainly of collagen fibers in the lamina propria, lamina muscularis mucosa (Lmm), submucosa (sb) noticed inner circular (I) and outer longitudinal layer (O). (Masson2 s trichrome X40)



Pyloric part (pars pylorica gastris) Gross Anatomy: The pyloric part of the stomach (figs.2, 3 &4/N) is small spherical in shape. It emerges from the cranial part of the lesser curvature of the gizzard by Ostiumventriculo-pyloricum. The latter is presented in the most cranial part of the lesser curvature just under the circular fold. The pyloric part measures about 0.4 - 0.8cm. It opens in the first part of the descending duodenum by Ostiumpylorico-duodenaleand attached to it and to the jejunum by the gastro duodenal ligament. The lining mucosa is a continuation of that of the gizzard.The pyloric part of the stomach was also recorded in grey heron, great bittern, and American darter as a distinct chamber but was very reduced in domestic birds [24, 30]and in cattle egret [17].

Histological findings: The mucous membrane of the pars pylorica presents numerous irregularly arranges folds that are lower and wider than

those of the ventriculus. They separate from each other by wide crypts and are lined by low columnar epithelium (Fig. 21). A faint eosinophilic gel like mucous koilin layer appears covering the lamina epithelialis. The lamina propria of the pars pylorica had the same structure as that of the ventriculus, but somewhat thicker and contained abundant amount of simple tubular glands that are elliptical and flask-shaped and lined by cuboidal epithelium. Ultrastructur-aly, the pyloric region is similar to the gizzard gland (Fig. 22).

Fig. 21: Photomicrograph of a transverse section of the pyloric region of the cattle egret, showing four layers; mucosa (T.M), submucosa (sb), musculosa (M) and serosa (S). (H&E X100)

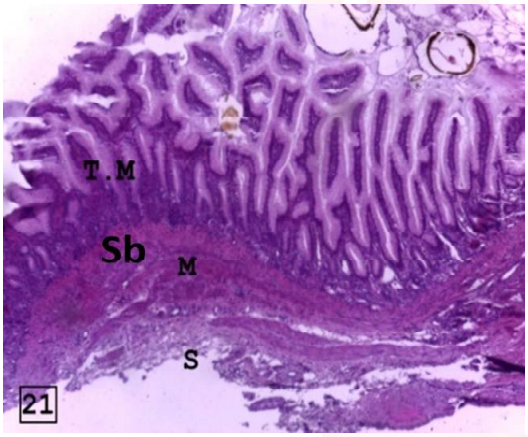
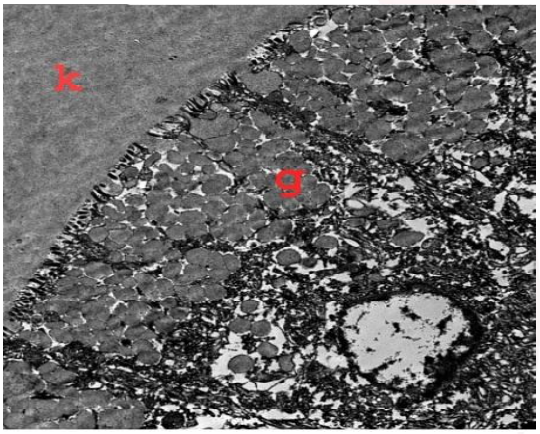


Fig. 22: Electron micrograph of the pyloric gland of the cattle egret, showing surface columnar cells contained apical electron lucent granules (g). Noticed gel like mucous koilin (K). (Uranyl acetate and lead citrateX4000)



Intestinum: The intestinal mass of the cattle egretconsists of two main parts; the small and the large intestines. The small intestine includes; duodenum, jejunum and ileum while the large intestine consists of the left cecum, rectum and cloaca. The average length of the intestinal tract isabout 63.8- 71.6 cm.

Fig. 23: Photomicrograph of a transverse section of the duodenum of the cattle egret, showing deep, narrow and numerous simple longitudinal villi, but more or less finger-like. (Masson2 s trichrome X100)

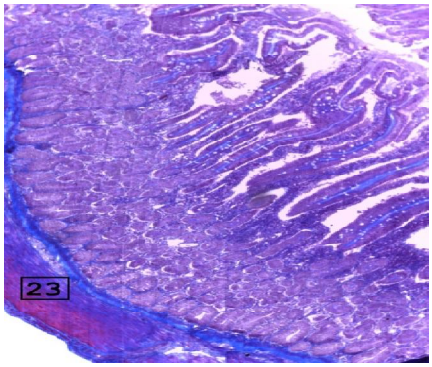


Fig. 24: Photomicrograph of a transverse section of the ileum of the cattle egret, showing short and less numerous simple longitudinal villi. (H&E X40)

Fig. 25: Photomicrograph of a transverse section of the cecum of the cattle egret of the cattle egret, showing the very narrow lumen and lymphoid nodules (arrow). (H& E. X40)

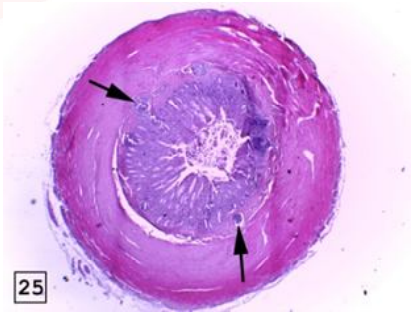


Fig. 26: Photomicrograph of a transverse section of the rectum of the cattle egret, showing high thickness muscular coat of thick inner circular (I) and an outer thin longitudinal (O). (Masson2 s trichrome X40)

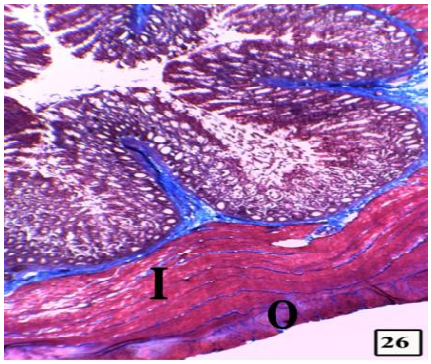


Fig. 27: Photomicrograph of a transverse section of the proventriculus of the cattle egret, showing a weak positive reaction with PAS in mucosal surface (arrow) and secretory ducts. (PAS X100)

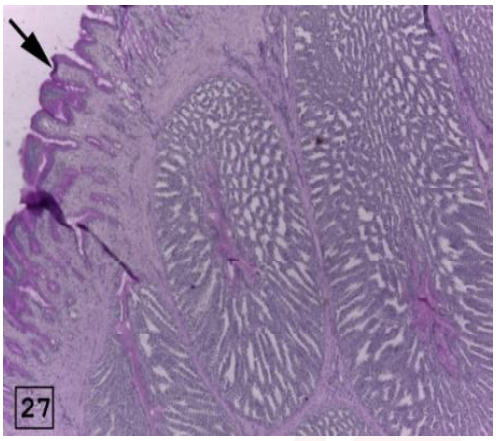
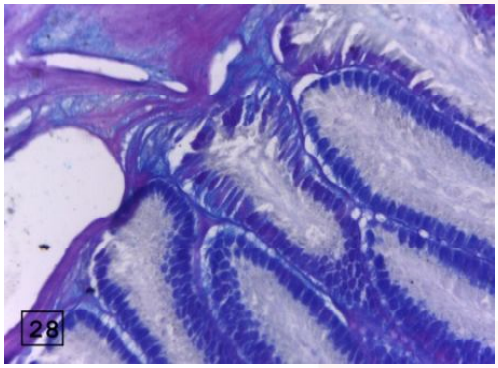


Fig. 28. Photomicrograph of a transverse section of the ventriculus of the cattle egret, showing Alcian blue/PAS positive mucosal folds and thin gel like mucous cuticle (Cuticulagastrica). (Alcian blue/PAS stain X400)



Intestinumtenue (small intestine) Gross Anatomy:

Duodenum The duodenum is U-shape; it follows the greater curvature of the gizzardfrom its dorsal surface.It consists of pars descendens, flexuraduodeni and pars ascendens as well as flexuraduodeno-jejunalis. All parts are attached to the pancreatic lobes by the pancreatico-duodenal ligament.

Pars descendens: The descending part of the duodenum is U shape. It measures about 5.3 - 5.9 cm in length(figs. 1, 2, 3/E). It follows the greater curvature of the gizzard and ends on its left side where it forms the duodenal flexure.

Flexuraduodeni: The duodenal flexure is a U-shaped free part of the duodenum (figs. 3/G). It lies at the level of the 7th rib and measures about 0.5 – 0.7 cm in length. It is related cranially to the caudo-lateral border of the left lobe of the liver.

Pars ascendens: The ascending part of the duodenum is U shape. It is longer than the descending one, where it measures about 6.5 – 7 cm in length (figs. 1, 2, 3/F). This result is similar to that mentionedin duck and geese [15], in goose, hoopoe, kestrel, owl and darter [31]. This result was in contrast to the results of Hassounawho reported that in turkey, the descending duodenum was slightly longer than the ascending one, while in sparrow and heron the two limbs of the duodenum were of the same length [31].

It follows the greater curvature of the gizzard. It is attached to the gall bladder by the hepato-duodenal ligament. This ligament traversesthe pancreatic and hepato-enteric ducts.The two ducts forming short single common duct which opens in the last part of the ascending duodenum. Another larger cystic-enteric duct opens 1-2 mm from the previous duct. The two openings don't form papillae in the lumen of the duodenum.

Flexuraduodeno-jejunalis: The duodeno-jejunalflexure is U shape curved connection between the terminal part of the duodenum and the first part of the jejunum(figs. 3/R). It measures about 1 – 1.5 cm in length. It extends at the 6th ribs from right to the left and related ventrally to the spleen, esophagus and right lobe of the liver and dorsally to the loops of the jejunum. It's connected to the latter by the mesojejunum.

Jejunum: The jejunum is tubular longpart of the small intestine (figs. 3/H).It measures about 15 -16 cm in length. It begins as a continuation of the duodenum after the duodeno-jejunal flexure and endsat theMichel's diverticulum. It occupies the right dorsal part of the body cavity and suspended by the mesojejunum. It consists of two U- shaped parallel intermingled convoluted loops.The two loops are of unequal length, attached with each other by the mesojejunum.The loops are larger in diameter than those of the ileum. The jejunal loops related dorsally to the right kidney andthe ileal loops. Ventrally they are related to the duodenum, proventriculus and gizzard.

Ileum: The ileum is the terminal and the longest segment of the small intestine (figs. 1 & 2/

l). It measures about 22 -23 cm in length. It considered the continuation of the jejunum after the Michel's diverticulum. It consists of two U- shaped parallel intermingled convoluted ilealloops within the jejunal loops, as well as the supra-dudenal and the supra-cecal loops.It proceeds caudally between the left kidney, left cecum and rectum dorsally and the ascending duodenum ventrally. The ileum connected with the left cecum on a level with the cranial end of the pelvic bone by short glistening ileocecal ligament.

Histological findings: Histologically the small intestine is differentiated into two main regions namely, the duodenum till the Michel's diverticulum and the ileum. These results agree with [32,33,14].The small intestine shows the usual tunicae namely; mucosa, submucosa, musculosa and serosa. The mucosa of the intestine is thrown into simple longitudinal villi. These are deep, narrow and numerous in the duodenum but more or less finger-like, while in the ileum, the villi are straight, short and less numerous (Figs. 30, 31). The lining epithelium of these villi is formed mainly of simple columnar cells interspersed with goblet cells; being more numerous in the ileum than in the duodenum. The lamina propria consists of loose connective tissue.The muscularis mucosa is represented by a narrow part of longitudinally arranged smooth muscle fibers towards the side of the submucosa, but on the side of the lamina propria, it is represented by vertically arranged smooth muscle fiber strands. The submucosa is formed of thin loose connective tissue containing a number of blood vessels. The mucosa is invaginated at the bases of the villi into straight tubular glands (crypts of Leiberkühn) which are continuous with the columnar epithelium lining the villi. The lamina propria extends between the crypts of Leiberkühn and forms the underlying layer of the epithelial lining of the villi together with the vertical strands of the muscularis mucosa which extend along the midline of the villi. The crypts of Leiberkühn had been described in other avian species [33-37].

The musculosa consists of two layers of muscle fibers; inner circularand outer longitudinal muscle layers. The musculosa in the duodenum is thinner than that of the ileum.

Fig. 29: Photomicrograph of a transverse section of the ventriculus of the cattle egret, showing Alcian blue positive (arrow head) and PAS positive (arrow) cuboidal epithelium that lined simple tubular glands. (Alcian blue/ PAS X400).

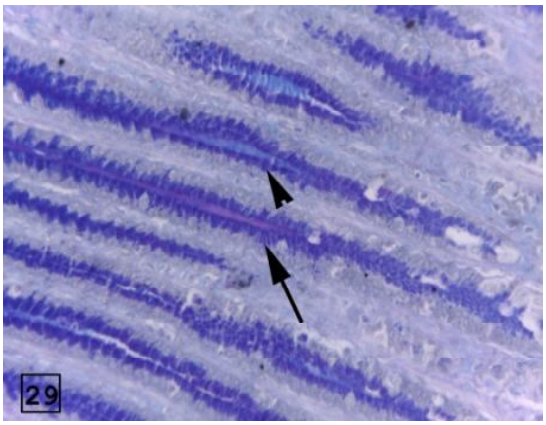


Fig. 30: Photomicrograph of a transverse section of the proventriculus of the cattle egret, showing enteroendocrine cells (arrow) between the secretory alveolar cells of the gland. (Grimelius2 silver method X1000)

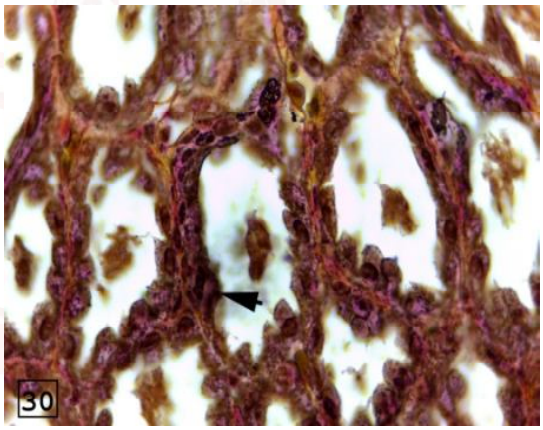
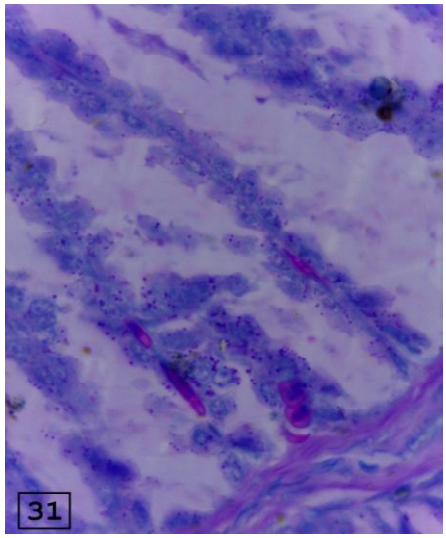


Fig. 31: Photomicrograph of a transverse section of the proventriculus of the cattle egret, showing DNA in the nuclei and the cytoplasm also RNA inside the cytoplasm of the deep proventriculus glands.(Methyl green pyronin methods X1000)



Intestinumcrassum: The large intestine is shorter than the small intestinal tract where it measures about 3.7 – 4.3 cm in length. It forms of left cecum, colorectum (rectum) and cloaca.

Cecum Gross Anatomy: The cattle egret has only one cecum (the left cecum). The right cecum is absent. The left cecum is short(figs. 1/J).It measures about 0.3 – 0.5 cm in length.It is represented bysmall sizefinger like projection on the left side of the terminal part of the ileum. The apex of the cecum is rounded. It is related laterally to the left abdominal air sac, dorsally to the left kidney and medially to the ileum.

Histological findings: The cecum is characterized by the numerous numbers of lymphocytes forming nodules that are located in the mucosa and submucosa. The lumen is very narrow due to the large number of the lymphocytes and the mucosal folds are hardly observed (Figs. 25).The small ceca are important to a bird's immunological system.However, lymphatic ceca had no obvious special structures like the "tonsils" of galliforms [38,39].

Rectum Gross Anatomy: The rectum (colorectum) is a dilated tube (figs. 1/K). It measures about 2.2 - 2.5 cm in length. It is suspended to the synsacrumby the mesorectum. It is related dorsally to the ventral border of the synsacrum and caudal parts of the kidneys, ventrally to the duodenum and loops of the jejunum.

Histological findings: Although the rectum is essentially similar in structure to that of the small intestine and the cecum, the rectal villi were shorter than those of the small intestine.This observation was recorded in Tytoalba [33] and inblack winged kite [14], yet its muscular coat is considerably higher in thickness. The mucosa of the rectum is thrown into long and branched leaf- like villi lined by simple columnar epithelium containing goblet cells. The goblet cells are numerous in number and open into the lumen. At the base of the mucosal folds, rectal glands (simple tubular) are noticed. These glands are lined with simple columnar epithelium and goblet cells. The lamina propria is invaded by small darkly stained lymphocytes.The muscularis mucosa is composed of longitudinal muscle fibers. This layer extends inside the mucosal folds as vertical muscle fiber strands. The musculosa layer is made up of two muscle layers; an inner thick circular and outer thins longitudinal one(Fig. 26).

CloacaGross Anatomy: The cloaca is the terminal ampullated part of the large intestine(fig. 1/L). It measures about 0.8 – 1 cm in length. It extends from the rectum to the vent and divides into three compartments; coprodeum, urodeum and proctodeum respectively. The coprodeum is the widest part; it is separated from the urodeum by thecopro-urodeal fold. The urodeum is the narrowest part of the cloaca where the openings of the two ureters and the other two ductus deferens in male (the two ureters and the left oviduct in female) are present. The proctodeum is the third terminal part of the cloaca and separated from the urodeum by theuro-proctodeal fold.In its dorsal wall opens the cloacal bursa (fig. 1/P),the latter is a white fleshy bud connected to cloaca by the mesorectum. The cloaca is related laterally to the two ureters and the two ductus deferens as well as the left phallic body (in mature male) and the terminal part of the left oviduct (in mature female).

Histochemical findings: Proventriculus: The mucosal surface of the proventriculus gives weak positive reaction with PAS (Fig. 27).The mucosal folds gave strong positive reaction with alcian blue /PASstain. The secretory cells of the glands are negative to alcian blue /PAS.The lining epithelium of the secretory ducts gives a weak positive reaction with PAS (Fig. 27). This finding disagreed in cattle egret [17], who reported that the ducts of the deep proventricular glands a weak or negative reaction with alcian blue/ PAS.

Ventriculus: The mucosal folds give of the ventriculus, (Cuticulagastrica) (Fig. 28) and the cuboidal epithelium that lined simple tubular glands (Fig. 29)exhibited a strong reaction with alcian blue /PASstain. The neutral and acid mucin formed a resistant mucosal barrier to protect the mucosal epithelium fromthe acids and enzymes secreted by the glands in yellow-billed Grosbeak [10].The Koilin layer exhibited a weak reaction with PASand strongwith alcian bluestain;however, in ostrich stated that such layer gave a strong positive reaction with PAS stain [40].

Pyloric region: The mucosal folds give of the pyloric a strong positive reaction to alcian blue /PASstain.

The intestine: The mucosa of the intestine reveals a strong alcian blue and PAS positivereaction in the goblet cells of the villi and the crypts of Leiberkühn as well as the apical plasma membranes of simple columnar epithelial cells.The goblet cells and the crypts of Leiberkühn had acid and neutral mucopolysaccharides; these findings were in agreement with [35, 36, 14].

Enteroendocrine cells are observed in all sites of the stomach and intestine for example within the secretory cells of the deep proventriculus gland (Fig. 30).

Nucleic acids: Histochemical demonstration of DNA reveals appearance of a dense product in the nuclei of the gastric and intestinal mucosal cells. Such a positive staining product is present in the place of the chromatin substances containing DNA. Application of methyl green pyronin methods proved the existence of a considerable amount of RNA and DNA inside the cytoplasm of the columnar epithelial cells in the different gut regions and glands especially in the cells of the deep proventricular glands (Fig. 31).The present work showed a proportional correlation between the RNA content and the proteonic amount of the cytoplasm of the mucosal epithelial cells in the different gut regions [36].

CONCLUSION

The study revealed that macro and micro picture of gastrointestinal tract features indicate that the cattle egret is carnivores' bird.

Conflicts of Interests: None

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