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HISTO-MORPHOMETRIC AND HISTOCHEMICAL COMPARISON OF THE DUODENUM BETWEEN GOAT *(CAPRA HIRCUS)* AND GAZELLE (*GAZELLA SUBGUTTUROSA*)

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Abstract

The ten, clinically healthy dromedary young goat and gazelle of both sexes, aged 2-3 years, the duodenum samples were collection from December 2018 to April 2019, the goat collected at Al-Samawa abattoir and the gazelle were obtained from (AL-Hillia Animal Reservoir) in Babil - Iraq and the study was conducted in department of anatomy, histology in college of veterinary medicine university of Al-Muthanna. The duodenum comprised of descending and ascending limbs forming U-shaped tube called duodenal loop. The pancreas situated between these limbs. The wall of organ consists from the four common known layers of a tube organ: tunica mucosa, tunica submucosa, muscularis Externia and tunica serosa and adventitia. The duodenal mucous membrane in the student animals showed three different parts, that were lining epithelium [simple columnar cells, lamina propria (loose connective tissue with the presence of mucosal glands) with masson trichrome, and muscularis lamina (two thick layers of smooth muscle arranged into inner circular and outer longitudinal bundles). And the *T. submucosa* formed irregular dense connective tissue situated, beneath the muscularis mucosa, and the layer composed of large blood, lymphatic vessels. Underneath submucosa the muscular coat consists of the smooth muscles fibers arranged into two layers. The serosae appeared thin in thickness constructed by loose connective tissue covered by a layer of mesothelial cells. The duodenum was well studied histochemically by applying three stains: PAS, PAS-AB [pH 1] stain. These staining techniques were conducted to view the presence or absence of neutral mucins, acidic mucins respectively.

Key words : Goat, Gazelle, Histology and Histochmistry.

Introduction

Mature goats are herbivorous ruminant animals. Their digestive tracts, which are similar to those of cattle, sheep, deer, elk, bison, and giraffes, consist of the mouth, esophagus, four stomach compartments, small intestine, large intestine and glands (Shapiro, 2001). The duodenum is the initial segment of the small intestine, and in mammalian species, it is grossly characterized by a typical U-shaped morphology with two arms generally designated as descending and ascending loops. The pancreas is normally positioned between the two duodenal loops. Microscopically, the duodenal wall, apart from conforming to the typical four-layered arrangement of its tunics, namely: tunica mucosa, teunica submucosa, tunica muscularis, and tunica serosa, also presents classical features of the small intestine. (Krause, 2000). In the normal duodenum, the intestinal glands, rich in goblet cells, and the submucosal glands termed Brunner's glands have been described as aiding the digestive process by elaborating mucus-rich product which neutralizes the acidic chyme, as well as form slippery visco-elastic gel that protects the mucosal lining (Godwin *et al.,* 2009). The duodenum is responsible for secreting hormones that trigger the pancreatic duct to release pancreatic juice and bile. In addition, the mucus secreted by duodenal submucosal glands helps protecting the duodenum from the acidity, making the duodenum much less sensitive than the rest of the small intestine to the acidic chyme. Therefore, the duodenum protects the rest of the small intestine by neutralizing the chyme to some extent before it passes into the jejunum (Cunningham and Klein, 2007). Although the duodenum is a tiny fraction of the small intestine, it is the site of most of the breakdown of the

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food passing through it. The duodenum is lined with duodenal submucosal glands, which secrete an alkaline mucus that supports the intestinal enzymes and aids in the absorption of nutrients. (Mohammadpour, 2011). The present study was undertaken to study the histomorphometric and histochemistry of duodenum in goats and gazelle.

Materials and Methods

The duodenum samples were collection from December 2018 to April 2019. Specimens of ten, clinically healthy dromedary young goat and gazelle of both sexes, aged 2-3 years (estimated according to the dental equation of the animals), the goat collected at Al-Samawa abattoir and the gazelle were obtained from (AL-Hillia Animal Reservoir) in Babil - Iraq and the study was conducted in department of anatomy, histology in college of veterinary medicine university of Al-Muthanna.

The tissues from abomaso-duodenal junction, cranial, middle and caudal parts of the duodenum were collected and fixed in (10% neutral buffered formalin, Bouin's solution for 48 hours) and processed for light microscopy. The tissue samples were processed through the graded alcohol for dehydration. Cleared in the xylene and embedded in the paraffin of 50° to 60° melting point The paraffin sections of 5-6 µ were cut and stained by routine Harris haematoxylin and Eosin stain (Mukharjee, 1990), Masons Trichrome stain for collagen and muscle fiber and PAS-Alcian blue method pH 0.1 for mucosubstances (Bancroft and Stevens, 2010). Micrometrical observations were recorded on ocular micrometer duly calibrating with stage micrometer. The micrometrical values were subjected to statistical analysis as per the standard procedures of (Panse and Sukhatama, 1967).

Results and Discussion

Morphological aspect

The duodenum comprised of descending and ascending limbs forming U-shaped tube called duodenal loop. The pancreas situated between these limbs. The U-shape of duodenum in the current animals was commonly observed in the other mammalian and these results agree with (Perez, 2014) in peer, (Luay and Siwan, 2017) in Buffaloes and in goat (Bello *et al.,* 2019) they said was formed the first loop of the small intestine, showing incomplete U- shape, pink to slight red in color and the duodenum it bends and runs as the descending, the ascending part the return toward the liver passing to the left of the cranial mesentery to enter the fringe of the mesentery between the descending and ascending loops of the duodenum.

Histological aspects

The organ showed microscopically the four common known layers of a tube organ: tunica mucosa, tunica submucosa, muscularis Externia and tunica serosa and adventitia (Fig. 1, 4). These four layers looked in the duodenum similar findings have been reported in Gaddi goat (Andleeb *et al.,* 2009), buffalo (Hasanzadeh and Monazzah, 2011), sheep (Kumar *et al.,* 2014) and Goat (Kumar *et al.,* 2017) who described the wall of duodenum and jejunum was made up of tunica mucosa, submucosa, muscularis and serosa.

T. Mucosa

The duodenal mucous membrane in the student animals showed three different parts (Fig. 1, 4), that were lining epithelium [simple columnar cells (Fig. 1), lamina propria (loose connective tissue with the presence of mucosal glands) (Fig. 2, 5) with masson trichrome, and

Table 1: The dimensions of duodenum in goat and gazelle (µm) (Mean ± SE).

Duodenum (mm)	Species	Mean
Tunica mucosa	goat	5012.2
	gazelle	4865.3
Tunica submucosa	goat	2373.1
	gazelle	2609.3
Tunica muscularis externia	goat	2099.1
	gazelle	2173.2
Tunica serosa & adventitia	goat	180
	gazelle	200
Duodenal gland(diameter)	goat	2135.6
	gazelle	1698.3
Villi (length)	goat	7430.2
	gazelle	6011.5

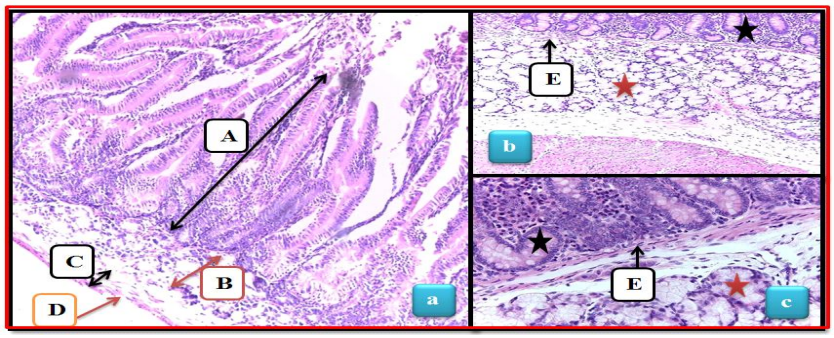

Fig. 1: Photography section of the duodenum wall of goat showed mucosa (A), Submucosa (B), Muscularis (C), and adventitia (D), mascularis mucosa (E), Crypts of Lieberkuhn (Black star) and Brunner's glands (Brown star) (H & E, X40 (a) and 100 (b) and(c) X400).

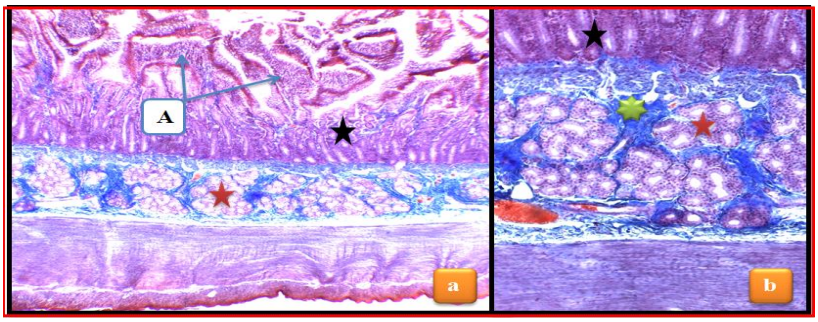

Fig. 2: Photography section of the duodenum wall of goat showed Villi (A), Connective tissue (Green star), Crypts of Lieberkuhn (Black star) and Brunner's glands (Brown star) (Masson Trichrom stain, X40 (a) and 100 (b).

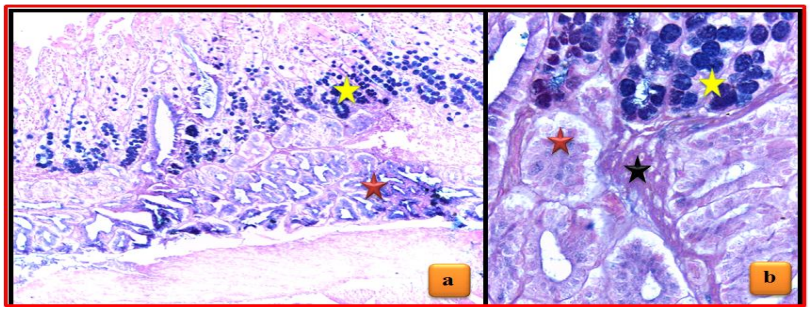

Fig. 3: Cross section of the duodenum wall of goat showed: Connective tissue (Black star) (A), Neutral mucin (Yellow star) (B), Neutral and sulfate mucin (Red star). PAS+AB =pH 0.1 (a) X40 and (b) 100.

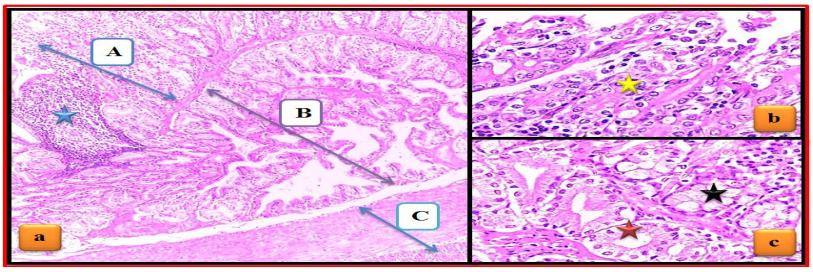

Fig. 4: Cross section of the duodenum wall of gazelle showed mucosa (A), Submucosa (B), Muscularis (C), columnar epithelium (yallow star), Crypts of Lieberkuhn (Black star), Brunner's glands (Brown star) and Lymphatic tissue (Blue star). (H & E, X40 (a) and 100 (b) and (c).

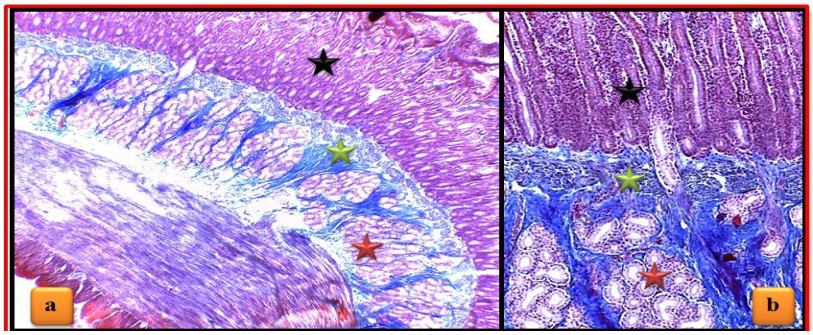

Fig. 5: Photography section of the duodenum wall of gazelle showed : Connective tissue (Green star), Crypts of Lieberkuhn (Black star) and Brunner's glands (Brown star) (Masson Trichrom stain, X40 (a) and 100 (b).

muscularis lamina (two thick layers of smooth muscle arranged into inner circular and outer longitudinal bundles). The presence of two layers of muscularis mucosa in the duodenal mucosae of student animals was similar to the findings observed in the present observation of the tunica mucosa of the tall columnar absorbing cell, villi and goblet cells were in collaboration with the similar observation of (Dellmonn and Brown, 1987) and (Bacha and Bacha, 1990) in ruminants (Thete *et al.,* 2018) in goat and sheep they said the duodenum was lined by a simple type of epithelium comprises numerous goblet cells interspersed among the columnar cells throughout the length of duodenum in cattle sheep and goat. The mean of thickness of this tunica was 5012.2mm in goat, whereas in gazelle was 4865.3 mm.

Duodenal Villi

They were mucosal projections, which constructed from the lamina propria, smooth muscle fibers as well as the lacteal, long leaf-shaped villi that were arranged in a zig-zag pattern in goat. However, in the gazelle, the villi showed blunt apical part and wide basal part. The lining epithelium of these villi was similar to those observed previously in the same organ in goat (*Capra hircus*) by (Hassan and Moussa, 2015) and (Kumar *et al.,* 2014) in sheep. The irregularity that observed in the mucosal surface could be due to the presence of duodenal villi intervening between the bases crypts of Lieberkühn. The means of surface area of the villi were 7430.2 mm^2 and 6011.5 mm^2 in goat and gazelle, respectively.

Duodenal Crypts of Lieberkühn

These were simple tubular glands called intestinal glands that were extended from the muscularis lamina until the bases of the villi. They were lined by a simple columnar epithelium similar to the lining epithelium of the duodenal lumen (Fig. 1, 2, 4, 5). As mentioned by (Dellmonn and Brown, 1987) in ruminants and (Thete *et al.,* 2018) in sheep and goat that describe the crypt covered by columnar epithelium, but disagree with (Yamada, 1970) in mouse, have

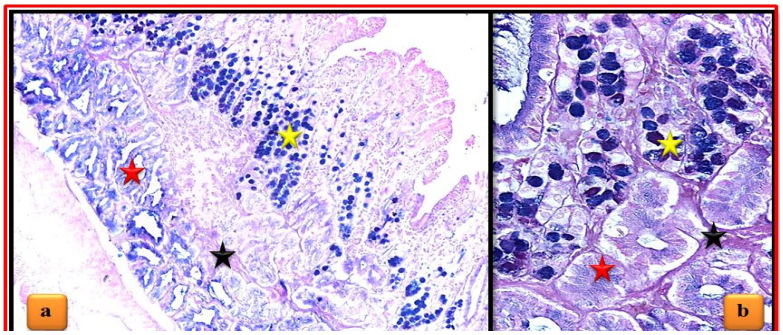

Fig. 6: Cross section of the duodenum wall of gazelle showed : Connective tissue (Black star) (A), Neutral mucin (Yellow star) (B), Neutral and sulfate mucin (Red star). PAS+AB =pH 0.1 (a) X40 and (b) 100

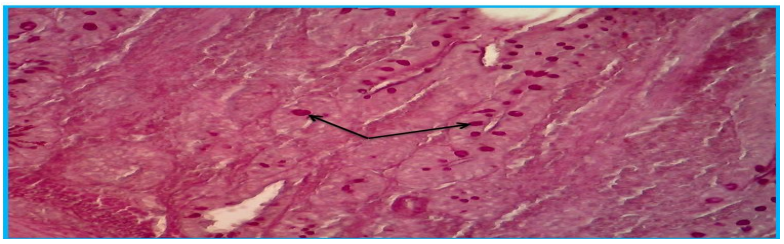

Fig. 7: Cross section of the duodenum wall of goat showed : intestinal glands with neutral mucin (black one head arrow). PAS X 400

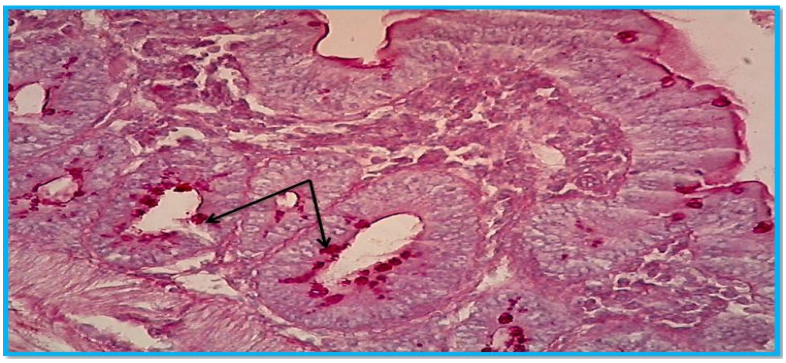

Fig. 8: Cross section of the duodenum wall of gazelle showed : intestinal glands with neutral mucin (black one head arrow). PAS X 400

been revealed that the epithelial lining the duodenal gland were shorter (cuboidal or columnar).

T. Submucosa

It was formed irregular dense connective tissue situated, beneath the muscularis mucosa, and the layer composed of large blood, lymphatic vessels. The mean thickness of this tunica was higher in the goat 2373.1 mm, whereas in gazelle the mean thickness of this tunic was 2609.3 µm. The present study finding revealed that the Brunner's glands was the most characteristic features observed in the duodenum, which show numerous and extending to the plica cirrcularis, these glands were branched tubule-alveolar contained mucus & serous alveoli (Fig. 1, 2, 4, 5). These observations were similar to many previously finding by (Talukdar, 1999) in pig (Kumar *et al.,* 2017) in Goat (Luay and Al-Mansor, 2017) in Gazelle.

Muscularis Externia

Underneath submucosa the muscular coat consists of the smooth muscles fibers arranged into two layers, the inner longitudinal and the outer circular layers in the studied animals (Fig. 1, 4). Evenly the outer layer was thicker than the longitudinal layer over all parts of the duodenum. This finding was agreed with (Ahmed *et al.,* 2009) and (Nzalak, 2010). The mean of thickness of this in goat was thinner (2099.1 mm) compared to that of the gazelle (2173.2mm).

T. Serosa and adventitia

The layer appeared thin in thickness constructed by loose connective tissue covered by a layer of mesothelial cells (Fig. 1, 2, 4, 5) this in some part that attached with peritoneal while the free part of organ covered by loose connective tissue lack of epithelium. The serosa lined externally the muscularis and mean of the thickness of the serosa in were in goat and gazelle 180 mm and 200 mm respectively. These findings were similarly recorded in by (El-Sayed, 2006) and (Alina *et al.,* 2009).

Histochemical aspects

The duodenum was well studied histochemically by applying three stains: PAS, PAS-AB [pH 1] stain. These staining techniques were conducted to view the presence or absence of neutral mucins, acidic mucins respectively. The histochemical examination of the wall of the duodenum showed that the mucosal layer as well as the villi possessed two types of cells that were the columnar cells and goblet cells. The columnar cells gave the negative reaction with the PAS stain in the duodenum of the student animals. Whereas the goblet cells were strongly reacted with this stain in studied animals (Fig. 7,8). Similar observations have been reported in sheep (Kumar *et al.,* 2014) and Gaddi goat (Andleeb *et al.,* 2007). The columnar cells showed poor affinity for PAS but goblet cells showed strong affinity for the presence of glycogen as reported in sheep (Kumar *et al.,* 2014) and Gaddi goat (Andleeb *et al.,* 2007) and goat foetii (Ramakrishna and Tiwari, 1979). The connective tissue in the lamina propria, submucosa and serosa give

mild reaction with PAS in goat, whereas, in gazelle negatively reacted. Additionally, the current findings revealed that the smooth muscle fibers which were constitutes the muscularis mucosa as well as tunica muscularis gave rise fair reaction with PAS in student animals (Fig. 7,8). On applying the combined PAS-AB (pH 1), the goblet cells present in the epithelium showed a strong reaction for acidic mucopolysaccharides but the columnar epithelium showed poor reaction with this stain in student animals (Fig. 3,6). As observed in sheep (Andleeb *et al.,* 2007) and pig (Talukdar, 1999). In addition to that, the connective tissue of the submucosa gave positive reaction for PAS, but negative toward AB part of the stain in case of gazelle, whereas, in goat gave negative reaction for the stain as a whole (Fig. 3,6). The smooth muscle fibers present in the tunica muscularis showed modest reaction with this staining technique in studied animals. As agree with (Andleeb *et al.,* 2007) in sheep (Kumar *et al.,* 2017) in Gazelle (Luay and Al-Mansor, 2017).

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