The Distribution of the Goblet cells, Paneth cells and Brunner's glands in Duodenum of Adult one Humped Camels (*Camelus dromedarius*) *

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Abstract

The purpose of this study was to unveil the light microscopic morphology and distribution of the goblet cells, paneth cells and Brunner's glands in duodenum of the adult one humped camels.The present study was carried out on fifteen duodeni,these have been removed from healthy adult male camels aging (4-5) years, immediately after slaughtering. The specimens were divided into equal five parts, named as following (first ,second,third,fourth and fifth) .Ten specimens ($1cm^3$) was taken from different regions of each part of the duodenum; and fixed into 10% formalin and Bouin's solution approximately 24 hours, then treating by routine histological processing . The sections are stained by H & E, PAS and V.G. stains. Goblet cells, paneth cells and alveoli of the Brunner's glands were counted ,used ten microscopic fields of each part of the duodenum. Mean ± Standard error were calculated.The duodenal wall was composed of four tunicae (mucosa, submucosa,muscularis and serosa or adventitia).Goblet cells,shown as globular shaped cells dispersed among the columnar cells in the epithelium that lined the villi and crypts of Lieberkuhn in the tunica mucosa of the duodenum, and take positive reaction with(PAS) and the Paneth cells, were granular cells in crypts of Lieberkuhn only. The present study revealed the mean number of goblet and paneth cells in crypts of Lieberkuhn were increased in last parts of camel duodenum toward the jejunum. Brunner's glands, appeared as branched tubuloalveolar glands, found in the lamina propria of first, second and third parts and in submucosa of each duodenal part. The mean number of the alveoli of the Brunner's glands in submucosa of the first part were more than that in other parts, and decreased toward last parts, but absent in last sections of fifth part toward the jejunum. Conclusion : The present study revealed reversed relation between number of the goblet and paneth cells with the Brunner's glands in the duodenum toward the jejunum for neutralize of the ingesta and contributing to the immunity of duodenum.

Introduction

Camels are very versatile animals, well adapted to life in the desert because of their unique metabolic pathways which enable the animals to survive without food and water for a few days (1, 2).The intestinal tract of mammals are serves two important functions, facilitates easy absorption of nutritive materials, and act as barrier against microorganisms, toxins and different antigens, this barrier includes ,lymphocytes, plasma cells, macrophage and paneth cells (3,4) .The epithelium of the small intestine of mammals comprises six different cells types ,these are stem cells ,enterocytes cells, goblet cells, Microfold cells(M cells, confined to the dome epithelium overlying Payer's patches), enteroendocrine cells and paneth cells (5).Goblet cells, are unicellular exocrine mucous cells, dispersed among the columnar cells of villi and Lieberkuhn crypts epitheliums, the apical portion of it becomes distended due to mucigen droplets accumulate as large globules, and the nucleus is irregularly oval or triangular in the base part in camel small intestine (*Camelus dromedarius*) (6) .Their density in the caudal part of the ruminant small intestine is two to three times greater than that in the cranial part (5). And their number in duodenum of native goat is higher than that in native sheep (7), also in *Tibetan goat* and *Tibetan sheep* (8).Paneth cells

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(Acidophilic granular cells), are pyramidal shaped cells, in ruminant, horse and man small intestine (4). In camel duodenum (*Camelus dromedarius*), they are tall columnar cells with basally located oval nuclei and apically located small, cytoplasmic granules (9).They are wedge shaped in human small intestine (10) .The distribution of the paneth cells variation among mammals species, the small intestinal epithelium of the ruminants, man and monkeys contains abundant numbers of these cells in the crypts of Lieberkuhn, while the paneth cells are devoid in the dog and pig (5). In goat and sheep small intestine they are more numerous in the base and neck of the crypts than that in the higher parts of the crypts (7, 11).The Brunner's glands are branched tubuloalveolar glands, existed in all mammalian species (4), found in the submucosa of upper part of the camel small intestine (*Camelus bactrianus*) for approximately 2 m caudal from the pylorus and separated into lobules (12). They are lobules in the bovine, Japanese black cattle, Sannen goat and local buffalo, while those of crossbreed sheep didn't lobules (13, 14, 15).

Materials and methods

The present study was carried out on fifteen specimens of duodenum of healthy adult male camels aging (4-5) years collected from AL-Muthana abattoir during February and May 2011 . Each duodenal specimen was divided into equal five parts, named as following (first, second , third, fourth and fifth), the mean length of each part was (44.44 ± 5.402) cm , after removal of duodenum immediately after slaughtering was washed with normal saline solution (0.9%), ten specimens ($1cm^3$) from different regions of each part of the duodenum were taken and fixed by 10% formalin and Bouin's solution approximately 24 hours at room temperature, and then treated by routine histological processing (16),embedding with paraffin wax (58-60 C^0) and sectioning to 5-7µm. The stains were used , Harries Hematoxylin and Eosin (H&E) for demonstrating the general histological components , Periodic Acid Schiff (PAS) for distinguish of carbohydrates and Van Gieson's(V.G) stain for indicate the collagen fibers . The goblet and paneth cells counts in the crypts of Lieberkuhn (only longitudinal sections),and alveoli of the Brunner's glands in tunica submucosa (X 40) in ten sections in each section used ten microscopic fields of each part of the duodenum. The mean ($\bar{X}$) and the standard error (S.E) were calculated for ten slides for each part of the duodenum (17).

Results

The duodenal wall was composed of the four tunicae (mucosa, submucosa, muscularis and serosa or adventitia).Goblet cells, shown as unicellular mucous, globular shaped cells dispersed among the columnar cells, in the epithelium that lined of the villi and crypts of Lieberkuhn in tunica mucosa of the whole duodenum (Fig. 1-7) , the mean number of goblet cells was increase toward the last parts of duodenum ,and was more in fifth part than that in other parts (86 ± 11) , but lesser in first part (45 ± 5) (Table 1) (Fig. 1,8) .The goblet cells were take positive reaction with(PAS) (Fig.3,6,8).Paneth cells, were seen as granular cells found accumulated at the base and entire length of the crypts of Lieberkuhn of the each duodenal parts(Fig.1, 5),, but not found in the villi , showed weak reaction positive with (PAS) .The mean number of paneth cells in fifth part of camel duodenum was more than that in other parts (35 ± 5), but lesser in first part (18 ± 4) (Table 1).Brunner's gland , appeared as branched coiled tubules , lined by mucous cells (Fig.3,6) , and separated into lobules by interlobular connective tissues (Fig.2), their found occasionally in the lamina propria of first ,second and third parts (Fig.1,2,4)and in submucosa of each duodenal parts, the mean

number alveoli of Brunner's glands was massively present and occupied the whole duodenal submucosa of the first part of duodenum and was more than that in other parts (38 ± 7), but lesser in fifth part (9 ± 2) (Table 1) (Fig .1,2,3,6,7),but absent in last sections of fifth part toward the jejunum (Fig.8) ,the glandular cells of these glands were cubical and were weakly positive for PAS (Fig.3,6). The ducts of Brunner's glands penetrate the muscularis mucosa and ascend through the lamina propria, to empty into the base of intestinal glands (Fig. 4).

Table (1): The mean number of goblet cells, paneth cells and alveoli of the Brunner's glands (X40) per microscopic field in all parts of the duodenum (Mean ± S.E)

Measure Part	Goblet cells $\bar{x}$ ± S.E	Paneth cells $\bar{x}$ ± S.E	Alveoli $\bar{x}$ ± S.E
First part	45 ± 5	18 ± 4	38 ± 7
Second part	57 ± 5	22 ± 3	31 ± 5
Third part	63 ± 9	25 ± 5	22 ± 4
Forth part	78 ± 8	30 ± 4	15 ± 4
Fifth part	86 ± 11	35 ± 5	9 ± 2

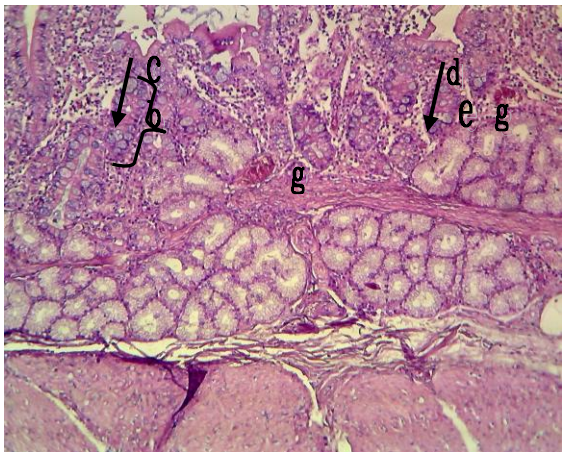


Fig.(1):Longitudinal microscopic section of first duodenal part: crypt (b),goblet cell (c) (arrow), paneth cell (d) (arrow), muscularis mucosa (e),
Brunner's glands (g), H&E X 100

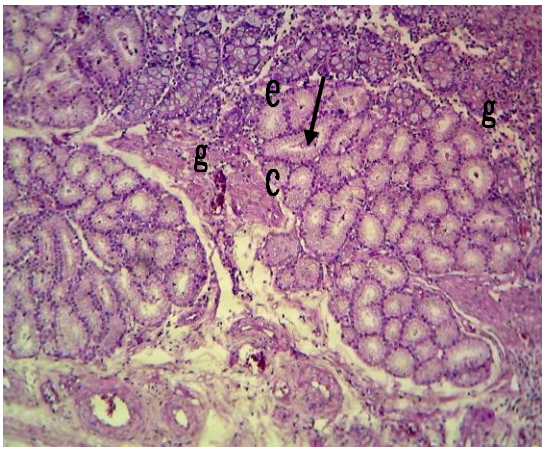


Fig.(2):Cross microscopic section of second duodenal part: goblet cell(c)(arrow),muscularis mucosa (e),Brunner's glands(g) , H&E X 100

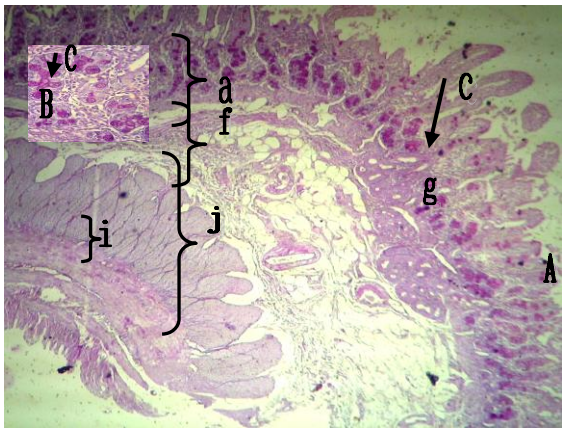


Fig. (3): Longitudinal microscopic section of third duodenal Part(A& B):mucosa(a),goblet cell(c)(arrow), Brunner's glands(g), submucosa(f) , tunica muscular(j),serosa(i), PAS X 40 A,PAS X 400 B

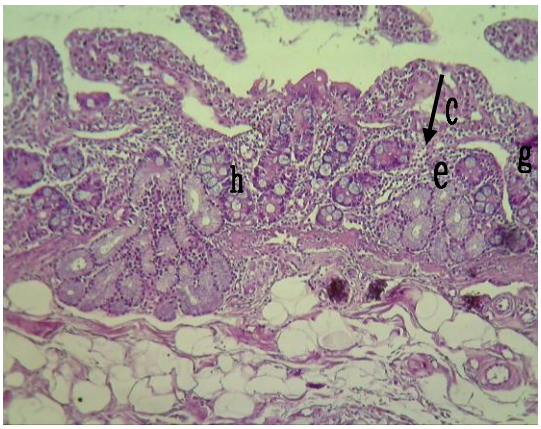
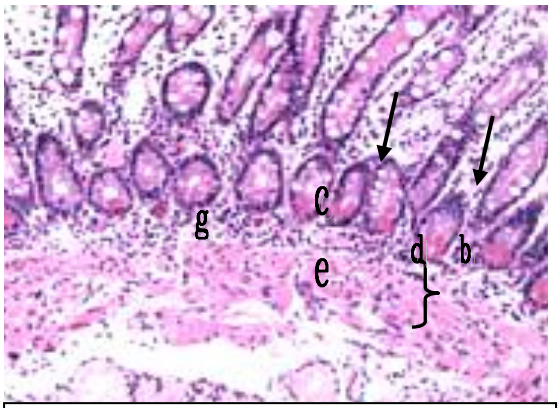


Fig.(4):Cross microscopic section of third duodenal part: goblet cell (c)(arrow), muscularis mucosa(e), Brunner's glands(g),duct of Brunner's glands(h), H&E X 100



Fig(5): Cross microscopic section of third duodenal part, crypt (b) , goblet cell (c) (arrow), paneth cell (d)(arrow), muscularis mucosa (e) , Brunner's glands (g), H&E X 400

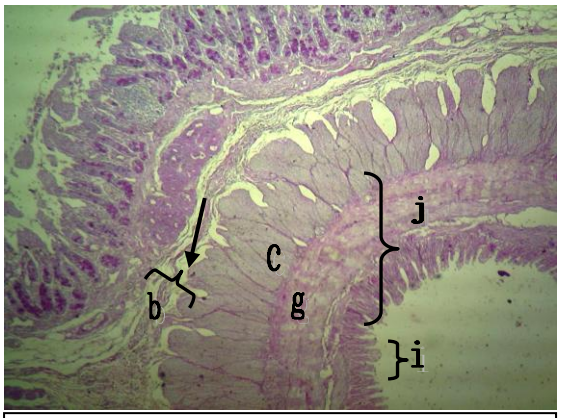


Fig.(6): Longitudinal microscopic section of fourth duodenal Part, crypt (b), goblet cell (c) (arrow), Brunner's glands (g), tunica muscularis (j), serosa(i), PASX40

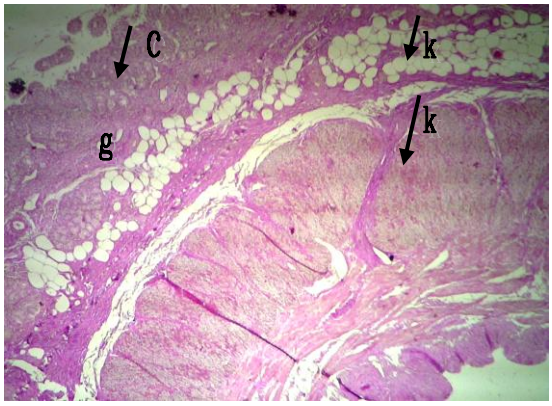


Fig.(7):Longitudinal microscopic section of fifth duodenal part, goblet cell(c)(arrow),Brunner's glands(g), collagen fibers(k) (arrow) ,V.G. S.X 40

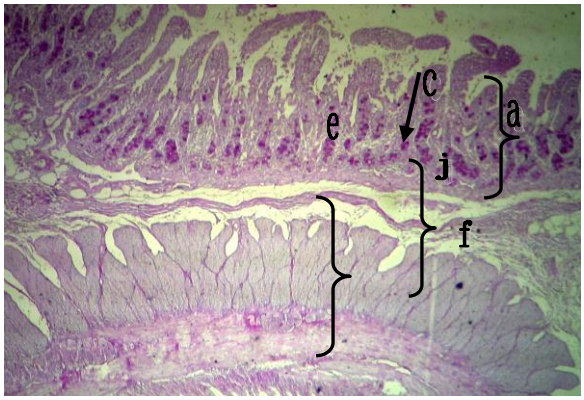


Fig.(8):Longitudinal microscopic section of fifth duodenal part (near jejunum),mucosa (a),goblet cell(c) (arrow), muscularis mucosa(e), submucosa (f), tunica muscularis (j) ,serosa(i) , PAS X40

Discussion

The mean number of the goblet cells was increase toward the last parts, this finding was in accordance with (5) in ruminant and (18) in human. Their function was secretion the alkaline mucus for neutralize of the ingesta in cooperation with Brunner's glands to protect the duodenal lumen as a whole and assist the process of digestion and absorption by maintained an appropriate liquid state of the ingesta (4) in mammals.Paneth cells were granulated epithelial cells .our study revealed the number of the paneth cells increased in last parts toward the jejunum, the number of these cells and their enzymes may be accorded on number and length of the crypts of Lieberkuhn in duodenal parts that considered the ideal microniches for bacterial growth, this finding was agreement with (5) in ruminant. The function of paneth cells are responsible for protecting of the duodenum against bacterial overgrowth (have a crucial role in innate immunity) by phagocytes caused by secretary of lysozyme, immunoglobulin and bacteriolytic enzyme and suggested that they secreted a substance which provided nutrition for crypts cells (10,19) in human and (20) in male rabbit.The Brunner's glands of camel , lie in the lamina propria of first ,second and third parts and in submucosa of all duodenal parts, this finding was agreement with (13) in cow , sheep and goat and (21) in sheep, but disagreement with (12) who mention the duodenal glands of the *Camelus bactrianus* were only distributed in the submucosa . In the first part of the duodenum they are massively present than that in the other parts, and there were decreased in the quantities toward the jejunum, suggest the need for greater amounts of acidic secretion from these glands in first part for aim of neutralize of the alkaline chyme come from the abomasum (22) in camel, this greater buffering capacity against fermentation acids .May be due the camel abomasal was only distally covered with acid-secreting epithelium , secretary sacs of it produced higher bicarbonate secretions that provides for more effective buffering power in the

presence of volatile fatty acid and longed retention time of food lead to decrease the gastrin and histamine that decrease the hydrochloric acid from the parietal cells of the camel stomach (22).The Brunner's glands assist the function of the crypts of Lieberkuhn in transporting immunoglobulin into the duodenal lumen. In addition, the presence of lysozyme in the cells of the secretory units of Brunner's glands continuously secrete bactericidal enzyme in human (23).Conclusion: The present study revealed reversed relation between number of the goblet and paneth cells with the Brunner's glands toward the jejunum for neutralize of the ingesta and available the mucosal immunity to protect of the duodenal lumen .

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توزيع الخلايا الكاسية وخلايا بانث وغدد برونر في عفج الجمال وحيدة السنام البالغة (*Camelus dromedarius*)*

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الخلاصة

تهدف الدراسة الحالية لمعرفة شكل و توزيع الخلايا الكاسية وخلايا بانث وغدد برونر في عفج الجمال وحيدة السنام البالغة ، أجريت الدراسة على خمسة عشر عفج أخذت من ذكور جمال بالغة سليمة عمرها (4–5) سنة بعد الذبح مباشرة . قسمت العينات إلى خمسة أجزاء متساوية (الأول والثاني و الثالث والرابع و الخامس)، تم قطع عشرة عينات من مناطق مختلفة لكل جزء من أجزاء العفج وثبتت بمحلول الفورمالين بتركيز (10%) و محلول بوين لمدة 24 ساعة بعد ذلك مررت العينات بالطرق النسجية الروتينية. لونت الشرائح النسجية بواسطة ملون هارس الهيماتوكسيلين و الايوسين وكاشف شف الدوري (PAS) وملون فان كيزن .تم احتساب عدد الخلايا الكاسية وخلايا بانث (مقاطع طولية) و اسناخ غدد برونر في عشرة مقاطع نسجية في كل مقطع تم اختيار عشرة حقول مجهريه بقوة تكبير (40) لكل جزء من أجزاء العفج. وتم حساب المتوسط الحسابي والخطأ القياسي .جدار العفج يتكون من أربع غلالات (المخاطية وتحت المخاطية والعضلية والمصلية) ظهرت الخلايا الكاسية بشكل كروي منتشرة بين الخلايا العمودية في الغشاء الظهاري المبطن للزغابات وخبايا لايبركن في الغلالة المخاطية لكل أجزاء العفج وأخذت تفاعل موجب بواسطة كاشف(PAS)،خلايا بانث تكون حبيبية توجد في خبايا لايبركن فقط .متوسط عدد الخلايا الكاسية وخلايا بانث أزداد باتجاه الأجزاء الأخيرة. غدد بونر، غدد أنبوبية سنخية متفرعة ،تتوزع في الصفيحة الأصلية للأجزاء الأول والثاني والثالث للعفج وتحت المخاطية لجميع أجزاء العفج ،متوسط عدد اسناخ هذه الغدد في الجزء الأول يكون أكثر من بقية الأجزاء وتقل باتجاه الأجزاء الأخرى ولكن تختفي في المقاطع الأخيرة للجزء الخامس باتجاه الصائم .نستنتج انه توجد علاقة عكسية بين إعداد كل من الخلايا الكاسية وخلايا بانث مع غدد برونر لمعادلة المحتوى وتوفير المناعة اللازمة لحماية العفج .

* بحث مستل من أطروحة ماجستير للباحث الأول