Haryana Vet. (June, 2017) **56 (1)**, 37-40

Research Article

HISTOARCHITECTURE AND HISTOCHEMISTRY OF DUODENUM AND JEJUNUM OF THE GOAT (*CAPRA HIRCUS*)

PARVEEN KUMAR GAHLOT*, PAWAN KUMAR and GURDIAL SINGH
Department of Veterinary Gynaecology and Obstetrics, College of Veterinary Sciences
Lala Lajpat Rai University of Veterinary and Animal Sciences, Hisar-125 004, India

Received: 06.01.2017; Accepted: 26.05.2017

ABSTRACT

The tissues from duodenum and jejunum were collected from six young goats and processed for light microscopy. The villi of the duodenum and jejunum varied in shape and size. These were lined by simple columnar epithelium with few goblet cells. The intestinal glands were simple tubulo-acinar type having simple cuboidal to low columnar epithelium. Lamina muscularis mucosa was uniform in thickness. The submucosa was having loose irregular connective tissue and Brunner's glands in duodenum and Peyer's patches in caudal part of jejunum. Tunica muscularis had inner circular and outer longitudinal layers of smooth muscles. Histochemical studies revealed the presence of glycogen and acidic and neutral mucopolysaccharides in the intestinal glands.

Key words: Duodenum, jejunum, crypts of Lieberkuhn, Brunner's glands, Peyer's patches, histochemistry, goats

The duodenum and jejunum are not only important parts of the gastrointestinal tract, but also work as endocrine portions by secreting some hormones that play role on the regulation of intestine (Oomeri *et al.*, 1980). There is paucity of literature on light microscopic structure of the intestine of small ruminants except some work had been reported in sheep (Kumar *et al.*, 2013, 2014) and goat (Andleeb *et al.*, 2009). The present study was undertaken to study the histomorphology and histochemistry of duodenum and jejunum in goats.

MATERIALS AND METHODS

The small intestine containing duodenum and jejunum was collected from six young goats (8-10 months age) immediately after their sacrifice from local slaughter house. The tissues from abomaso-duodenal junction, cranial, middle and caudal parts of the duodenum and jejunum were collected and fixed in 10% neutral buffered formalin and processed for light microscopy. The paraffin sections of 5-6 µ were cut and stained by routine Harris haematoxylin and eosin stain (Luna, 1968), collagen fibres (Crossman, 1937), Gomori's method for reticular fibres, Weigert's method for elastic fibres, McManus' method for glycogen (PAS), PAS-Alcian blue method for mucosubstances, Alcian blue for mucosubstances (pH 2.5) (Luna, 1968) and Fontana method (Humason, 1972) for enterochromaffin cells.

RESULTS AND DISCUSSION

The wall of duodenum and jejunum was made up of tunica mucosa, submucosa, muscularis and serosa.

*Corresponding author: drparveen@hotmail.com

The tunica mucosa of the both the regions was studded with villi of different shapes and size which were lined by simple columnar epithelium having few goblet cells. The villi of cranial part of duodenum were short, stout with broad base (Fig. 1). There were also flat leaves like villi with pointed to blunt apexes. Gradually these became tall, slender and finger like as progressed towards the jejunum where these attained maximum height (Fig. 2). Similar findings have been reported in sheep (Kumar *et al.,* 2014), Gaddi goat (Andleeb *et al.,* 2009), buffalo (Hasanzadeh and Monazzah, 2011) and pigs (Sloss, 1954; Talukdar, 1999). The villi in both the segments in dog and cat have been reported to be much longer (Titkemeyer and Calhoun, 1955).

The columnar cells of epithelium of duodenum and jejunum had elongated, oval and round basophilic nuclei present towards the base. The cytoplasm was eosinophilic which increased towards the luminal border of the cells. Similar observations have been reported in sheep (Kumar *et al.,* 2013) and Gaddi goat (Andleeb *et al.,* 2009). 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.,* 2013) and Gaddi goat (Andleeb *et al.,* 2009) and goat foetii (Ramakrishna and Tiwari, 1979). In mammals, the striated border of columnar cells was PAS positive in small intestine (Sheahan and Jervis, 1976). The PAS-AB activity was observed in goblet cells of villi epithelium (Fig. 3). The columnar cells showed weak reaction towards the PAS-AB. The villi and the basement membrane of the epithelium showed moderate to weak reaction in the

intestine of Gaddi goatfor PAS-AB (Andleeb *et al*., 2009). The columnar cells showed weak Alcian blue reaction as reported in sheep (Kumar *et al.,* 2013) and Gaddi goat (Andleeb *et al.,* 2009). The Alcianophilic activity was also moderate to strong in the goblet cells of the villi (Fig. 4) in both the segments.

The lamina propria mucosa was dense having reticular, collagen and elastic fibers along with connective tissue cells like fibroblast, lymphocytes and fine blood capillaries. The lymphoid aggregates were observed and these were scattered between the crypts of Lieberkuhn and villi as observed in sheep (Kumar *et al.,* 2014). In contrast, large number of lymphocytes was observed in duodenum and jejunum of buffalo (Barnwal and Yadava, 1975). The intestinal glands were extensive and compactly arranged tubulo-acinar glands which were lined with simple columnar cells, goblet cells, few Paneth cells and enterochromaffin cells (Fig. 1). These were slightly decreased towards the caudal part of duodenum as reported in sheep (Kumar *et al.,* 2013). The nuclei of these glands were round to oval and were present towards the basal portion showing condensation of chromatin material in to smaller basophilic clumps especially towards the nuclear membrane as observed in sheep (Kumar *et al.,* 2013) and pig (Talukadar, 1999). The cytoplasm was finely granular and eosinophilic as revealed in sheep (Kumar *et al.,* 2013) and Gaddi goat (Andleeb *et al.,* 2009). The PAS activity was strong in the crypts especially in the goblet cells showing presence of glycogen in both segments. The glands showed intense activity with PAS-AB indicating the predominance of strong acidic mucosubstances (Fig. 3). The crypts present towards the base or close to lamina muscularis mucosae showed presence of both acidic and neutral mucopolysaccharides with predominance of acidic one, but few intestinal glands also showed predominance of neutral mucosubstances as reported in sheep where mixed concentration of both acidic and neutral mucopolysaccharides were present in both the segments (Kumar *et al.,* 2013, 2014) and Gaddi goat (Andleeb *et al.,* 2009). The Alcianophilic reaction was very strong in crypts especially in goblet cells indicating the presence of weakly acidic sulphated mucosubstances, hyaluronic acid and sialomucins (Fig. 4). The enterochromaffin cells (Fig. 5) were found to be maximum in duodenal region especially in its cranial segment part and these cells decreased towards the jejunum as also reported in buffalo (Barnwal and Yadava, 1975; Lalitha, 1990). Their number was more towards the basal part of the crypts which was in agreement to the earlier findings in sheep (Oomori *et al.,* 1980) and buffalo (Barnwal and Yadava, 1975). The Paneth cells were present towards the base of the crypts and their number was gradually increased towards the jejunum as reported in sheep (Ergun *et al.,* 2003). In contrast, these were not demonstrated in buffalo (Barnwal and Yadava, 1975) whereas in pigs their number increased towards the caudal part of the duodenum (Sloss, 1954). These were moderate in cranial part of the jejunum as reported in pigs (Sloss, 1954) and sheep (Ergun *et al.,* 2003). These were pyramidal in shape and their basophilic nucleus was pushed towards basal portion. Their cytoplasm was intensely eosinophilic towards the supranuclear part of the cytoplasm as also reported in sheep (Ergun *et al.,* 2003).

The lamina muscularis mucosae varied in thickness and at few places it was interrupted due to extension of submucosal glands (Fig. 1) in duodenum and invasion of lymphoid nodules in to the propria towards caudal part of the jejunum (Fig. 2) as observed in sheep (Kumar *et al.,* 2014) and buffalo (Barnwal and Yadava, 1975). It was made up of continuous layer of smooth muscle fibers arranged in two rows in buffaloes (Barnwal and Yadava, 1975), pig (Sloss, 1954; Talukadar, 1999) and other domestic animals (Titkemeyer and Calhoun, 1955).

The submucosa was formed by loose irregular connective tissue and connective tissue cells, fine blood capillaries along with elastic, collagen and reticular fibers. It was mainly occupied by submucosal or Brunner's glands (Fig. 1) which were more in number towards cranial part than caudal part of the duodenum as observed in sheep (Kumar *et al.,* 2013), pig (Sloss, 1954 and Talukdar, 1999). In contrast, these glands were found only in proximal part of duodenum of dogs (Titkemeyer and Calhoun, 1955), ox (Malik and Prakash, 1971) and buffalo (Barnwal and Yadava, 1975). The acini of the glands were of varying shapes and dimensions and these were lined by simple cuboidal to columnar epithelium. The glands showed very weak reaction towards the PAS, whereas acidic mucosubstances were observed towards the luminal surface as demonstrated by PAS-AB. A similar pattern of activity was observed for weakly acidic sulphated mucosubstances by Alcianophilic activity as observed in the Gaddi goat (Andleeb *et al*., 2009), sheep (Kumar *et al.,* 2013). The submucosa increased in size towards the caudal part of the jejunum as it was occupied by lymphoid nodules or jejuna Peyer's patches of various shapes and size as observed in sheep (Kumar *et al.,* 2014) and pigs (Sloss, 1954) and river buffalo (Hasanzadeh and Monazzah, 2011). These varied from pear shape, elliptical, oval, round to rectangular or

hexagonal (Fig. 2). Their size varied from small, medium to large as observed in sheep (Kumar *et al.,* 2014), river buffalo (Hasanzadeh and Monazzah, 2011) and calves (PoPo *et al.,* 2005). Some lymphoid follicles had lightly stained germinal center and darkly stained peripheral zone called corona and follicles were separated by interfollicular regions. The germinal centre contained densely packed lymphocytes, lymphoblasts, plasma cells, and macrophages which were supported by reticular fibres. The densely arranged corona contained deeply stained lymphocytes as observed in goat (Gautam *et al.,* 2013) and buffalo calves (Kapoor and Singh, 2015). The follicle associated epithelium (FAE) was present (Fig. 6) between absorptive epithelial cells and devoid of goblet cells as reported in sheep (Raju *et al.,* 2012), buffalo calves (Kapoor and Singh, 2015), Caspian pony (Asadi *et al.,* 2008), camel (Zidan and Pabst, 2008). The goblet cells were also reported in FAE of equines (Lowden and Heath, 1995). The nodules were encircled by connective tissue capsule having reticular, collagen and elastic fibres as reported in goat (Gautam *et al.,* 2013) and buffalo calves (Kapoor and Singh, 2015).

Tunica muscularis was moderately thick in both the segments. It was consisted of an inner circular and an outer longitudinal layer of smooth muscles fibres. Kumar *et al.* (2014) and Barnwal and Yadava (1975) reported

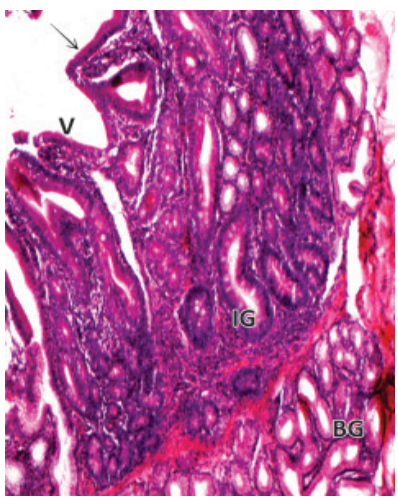

Fig 1. Photomicrograph showing villi (V), epithelium (↑) intestinal glands (IG), Brunner's gland (BG) in duodenum of goat

H&E×100

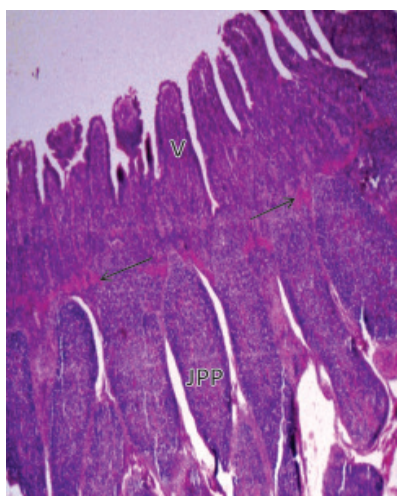

Fig 2. Photomicrograph showing villi (V), LMM (↑), jejunal Peyer's patches (JPP) in jejunum of goat

H&E×100

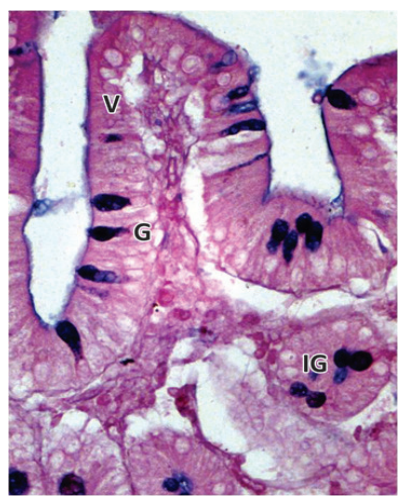

Fig 3. PAS-AB activity in villi (V), goblet cells (G), intestinal glands (IG), in duodenum of goat

PAS-AB×100

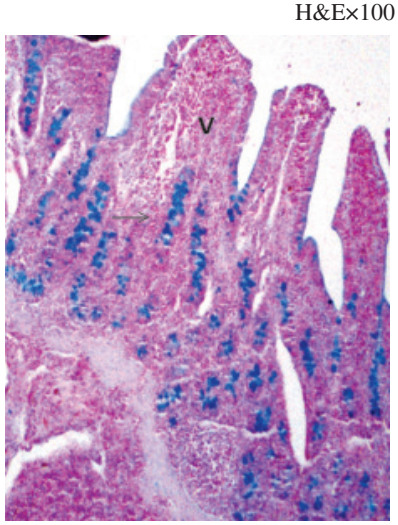

Fig 4. Photomicrograph showing Alcianophilic activity in villi (V) and crypts (↑) of jejunum of goat

Alcian blue×100

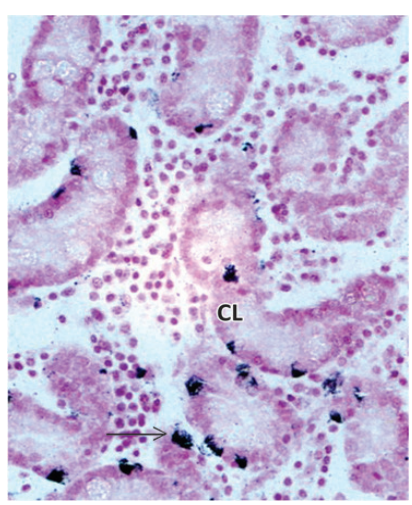

Fig 5. Photomicrograph showing enterochromaffin cells (↑) in crypts (CL) of duodenum of goat

Fontana×400

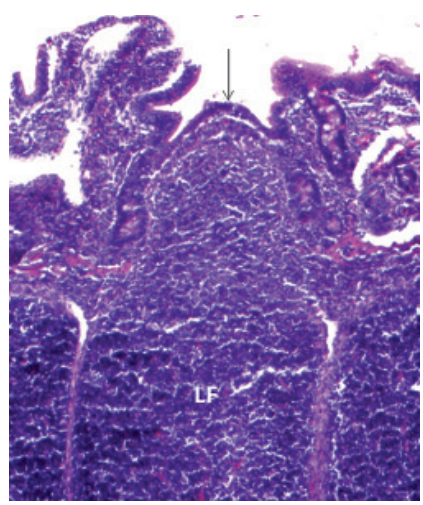

Fig 6. Photomicrograph showing follicular associated epithelium (FAE) (↑), lymphoid follicles (LF) in jejunum of goat

H&E×400

similar findings in sheep and buffalo, repsectively. In carnivores, there was an additional oblique layer of smooth muscles (Titkemeyer and Calhoun, 1955). Tunica serosa formed by loose irregular connective tissue had isolated collagen, elastic and reticular fibers along with varying amount of fatty tissue and few blood capillaries. Flat mesothelial cell layer was present.

REFERENCES

Andleeb, Rajput, R., Bhardwaj, R.L. and Sharma, K.B. (2009). Histochemical studies on the small intestine of Gaddi goat. *Indian J. Anim. Physiol.* **2**: 75-78.

Asadi, M.R., Adibmoradi, M., Ferdowsi, H.R. and Rezakhani, A.H. (2008). Histological study of Peyer's patches of ileum in Caspian pony. Proc.15th Congress of FAVA: 361-362.

Barnwal, A.K. and Yadava, R.C.P. (1975). Studies on the histological structure of small intestine of Indian buffaloes (*Bubalus bubalis*). *Indian J. Anim. Hlth.* **14**: 19-23.

Crossman, G.A. (1937). A modification of Mallory's connective tissue stain with a discussion of principles involved. *Anat. Rec*. **69**: 33-38.

Ergun, E., Ergun, L., Asti, R.N. and Kurum, A. (2003). Light and scanning electron microscopic morphology of Paneth cells in the sheep small intestine. *Revue Med. Vet.* **154**: 351-355.

Gautam, C.K., Talukdar, M., Sarma, K., Sarma, S., Barman, N.N. and Baishya, G. (2013). Distribution pattern and histomorphology of caprine Peyer's patches. *Indian Vet. J.* **90**: 94-95.

Hasanzadeh, S. and Monazzah, S. (2011). Gross morphology, histomorphology and histomorphometry of the jejunum in the adult river buffalo. *Iranian J. Vet. Res.* **12**: 99-106.

Humason, G.L. (1972). Animal Tissue Technique. (3rd edn.), W.B. Freeman and Company, San Francisco, U.S.A.

Kapoor, K. and Singh, O. (2015). Ileal and jejunal Peyer's patches in buffalo calves: Histomorphological comparison. *Vet. World* **8**: 1273-1278.

Kumar, P., Kumar, P., Singh, G. and Poonia, A. (2013). Histological architecture and histochemistry of duodenum of the sheep (*Ovis aries*). *Indian J. Vet. Anat.* **25**: 30-32.

Kumar, P., Kumar, P., Singh, G., Poonia, A. and Prakash, T. (2014). Histological architecture and histochemistry of jejunum of the sheep (*Ovis aries*). *Haryana Vet.* **53**: 55-57.

Lalitha , P. S. (1990). Vacuolated cells in the crypts of Lieberkuhn of intestine of Indian buffalo *(Bubalus bubalis). Indian. J. Vet. Anat.* **2**: 31-32.

Lowden, S. and Heath, T. (1995). Lymphoid tissue of the ileum in young horses: distribution, structure and epithelium. *Anat. Embryol.* **192**: 171-179.

Luna, L.G. (1968). Manual of Histologic Staining Methods of Armed Forces Institute of Pathology. (3rd edn.), McGraw-Hill Book Co., New York.

Malik, M.R. and Prakash, P. (1971). A morphological study of the small intestine of buffalo (*Bubalus bubalis*) and ox (*Bos indicus*). *Ceylon Vet. J.* **19**: 87-91.

Oomeri, Y., Yamashita, T., Yamada, J. and Misu, M. (1980). Light microscopic study on the endocrine cells in the gastrointestinal tract of sheep. *Res. Bull. Obhihiro Univ.* **11**: 541-553.

PoPo, S., Zuki, A.B.Z., Zamri-Saad, M., Rahman-Omar, A., and Effendy, A.W. (2005). Morphological study of jejunal and ileal Peyer's patches of three month old calves. *J. Anim. Vet. Adv.* **4**: 579-589.

Raju, N.K.B., Ramesh, G., Basha, S.H., Ushakumary, S. and Kumar, S.R. (2012). Histochemical studies on the Peyer's patches of sheep (*Ovis aries*). *Global J. Med. Res.* **12**: 11-14.

Ramakrishna, V. and Tiwari, G.P. (1979). Prenatal intestinal histology and histochemistry in the goat. *Acta Anat.* **105**: 151-156.

Sheahan, D.J. and Jervis, H.R. (1976). Comparative histochemistry of gastrointestinal mucosubstances. *Am. J. Anat.* **146**: 103-131.

Sloss, M.W. (1954). The microscopic anatomy of digestive tract of *Sus scrofa domestica*. *Am. J. Vet. Res.* **15**: 578-593.

Talukdar, M. (1999). Gross anatomical, histomorphological and histochemical studies on the stomach and intestine of crossbred adult pig. Ph.D. thesis, Assam Agricultural University, Khanapara, Guwahati, India.

Titkemeyer, C.W. and Calhoun, M.L. (1955). A comparative study of the structure of small intestine of domestic animals. *Am. J. Vet. Res.* **16**: 152-157.

Zidan, M. and Pabst, R. (2008). Unique microanatomy of ileal Peyer's patches of the one humped camel (*Camelus dromedarius*) is not age-dependent. *Anat. Rec.* **291**: 1023-1028.