

## HISTOLOGICAL ARCHITECTURE AND HISTOCHEMISTRY OF JEJUNUM OF SHEEP (*OVIS ARIES*)

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### ABSTRACT

The present study was conducted on jejunum of five adult sheep collected from an abattoir. The tissues were fixed in 10% neutral buffered formalin and processed. Histological studies revealed that the villi varied from elongated pointed to broad base and were lined by simple columnar epithelium with few goblet cells. The intestinal glands were simple branched coiled tubular lined by simple cuboidal to low columnar epithelium. Lamina muscularis mucosae varied in thickness and at few places interrupted by infiltration of lymphoid tissue. The submucosa had lymphoid aggregates similar to that of Peyer's patches in the caudal end of the jejunum. Tunica muscularis had inner circular and outer longitudinal layer of smooth muscles. Histochemical studies revealed that the glands showed a strong AB-PAS reaction.

**Key words:** Jejunum, histology, histochemistry, sheep

The intestine plays an important role in the digestion and absorption of various nutrients. There is paucity of literature on light microscopic structures of the intestine of small ruminants except some work has been carried out in goats (Ramakrishna and Tiwari, 1979) and on duodenum of sheep (Kumar *et al.*, 2013). The present study was undertaken to study the histomorphology and histochemistry of jejunum of sheep.

### MATERIALS AND METHODS

The tissues from duodeno-jejunal junction, cranial, middle and caudal parts and jejunoileal junction were collected from five adult sheep immediately after their sacrifice at a local slaughter house. The tissues were fixed in 10% neutral buffered formalin and processed for light microscopy. The paraffin embedded sections of 5-6  $\mu$  thickness were cut and stained by routine Harris haematoxylin and eosin stain, McManus' method for glycogen (PAS) and Alcian blue for acidic mucopolysaccharides (pH 2.5) to demonstrate different constituents of the tissues (Luna, 1968).

### RESULTS AND DISCUSSION

The wall of the jejunum was comprised of tunica mucosa, tunica submucosa, tunica muscularis and tunica serosa. The tunica mucosa had villi of different shapes and sizes lined by simple columnar epithelium having

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few goblet cells (Figs. 1 and 2). Similar findings have been reported in pig (Sloss, 1954), buffalo (Hasanzadeh and Monazzah, 2011) and other domestic animals (Titkemeyer and Calhoun, 1955). The villi were pointed and elongated in its anterior portion while these were broad and blunt shaped towards the ileum. Barnwal and Yadava (1975) reported leafshaped or tongue shaped villi in buffalo calves and also reported that some villi were pointed at their tip. The villi of dog and cat have been reported to be much longer (Titkemeyer and Calhoun, 1955), however, in pigs these were finger like, long and slender in shape (Sloss, 1954; Talukdar, 1999).

In the cranial part of the jejunum, the villi were elongated with pointed ends but they were elongated with blunt apical ends towards the caudal part of the jejunum. The number of goblet cells varied from few to moderate from cranial to caudal end of the jejunum. The nuclei had 1-2 nucleoli which were centric or eccentric in position. The cytoplasm was slightly eosinophilic and granular. A few lymphocytes were observed between the columnar cells. Barnwal and Yadava (1975) reported oval or round nuclei situated at the base of the cells in buffalo calves. These authors further reported that intracellular lymphocytes were also present at the apical end of the absorbing cells.

The goblet cells of epithelium showed a strong reaction for acid mucopolysaccharides and a moderate

PAS positive reaction for neutral mucopolysaccharides (Figs. 3, 4 and 5). However, Andleeb *et al.* (2009) reported that the luminal border of columnar epithelium of jejunum of Gaddi goat showed decreased to moderate reaction with PAS. Presence of greater concentration of glycogen in epithelium in small intestine of goat foetii has earlier been reported (Ramakrishna and Tiwari, 1979). The villi and the basement membrane of the epithelium showed moderate to weak reaction with Alcian blue stain throughout the intestine in Gaddi goat (Andleeb *et al.*, 2009). In mammals the striated borders of columnar cells were PAS positive in small intestine (Sheahan and Jarvis, 1976) along with positive reaction to Alcian blue. Weak PAS and Alcian blue reactions by the columnar absorptive cells have been reported in goat, sheep and cattle (Ohwada and Suzuki, 1992)

The lamina propria had loose irregular connective tissue along with reticular, collagen and elastic fibers. In addition, there were few lymphoid cells throughout the jejunal length and lymphoid aggregates were also observed

(Fig. 6). In contrast, Barnwal and Yadava (1975) reported large number of lymphocytes in lamina propria in buffalo.

The intestinal glands or crypts of Lieberkuhn were simple, branched, coiled tubular glands lined with simple cuboidal to low columnar epithelium (Fig. 1). Similar findings have been reported in pig (Talukdar, 1999). In buffalo, glands were made up of undifferentiated columnar cells alongwith very few to nil goblet cells (Barnwal and Yadava, 1975). In this study, glands showed PAS positive reaction due to the presence of mixed i.e. acidic as well as neutral polysaccharides whereas strong reaction was observed with Alcian blue (Figs. 4 and 5). In Gaddi goat, the crypts showed moderate reaction in the supranuclear zone of the epithelium with PAS and mild reaction with Alcian blue stain (Andleeb *et al.*, 2009).

The lamina muscularis mucosa varied in thickness and was made up of smooth muscle fibers. At few places it was interrupted due to the presence of large amount of lymphoid tissue and extension of crypts of Lieberkuhn (Fig. 1). In buffalo, it was made up of continuous layer

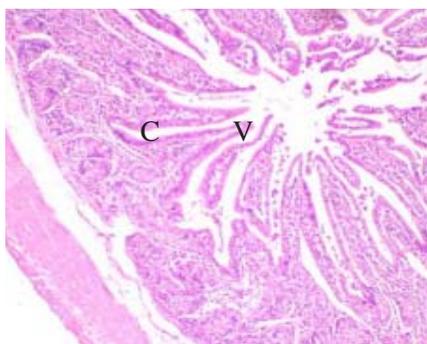


Fig 1. Photograph showing villi (V) and crypts of Lieberkuhn (C)  
H. & E. x 100

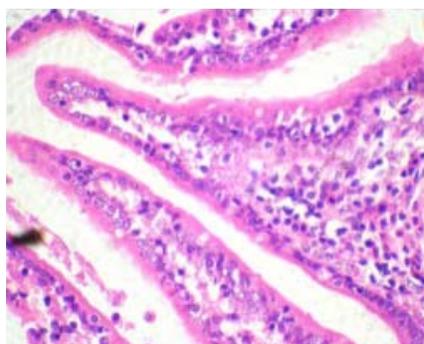


Fig 2. Photograph showing goblet cells in the intestinal villi  
H. & E. x 400

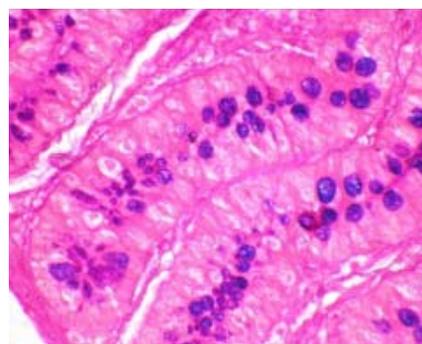


Fig 3. Photograph showing PAS-AB intestinal glands  
PAS-AB x 400

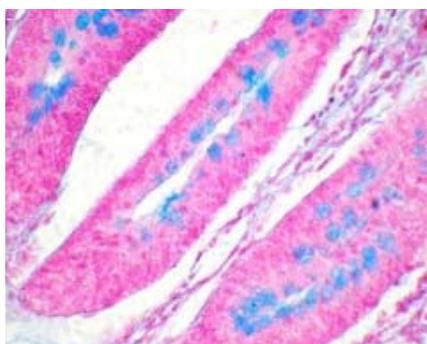


Fig 4. Photograph showing Alcian blue activity in the intestinal glands  
AB x 400

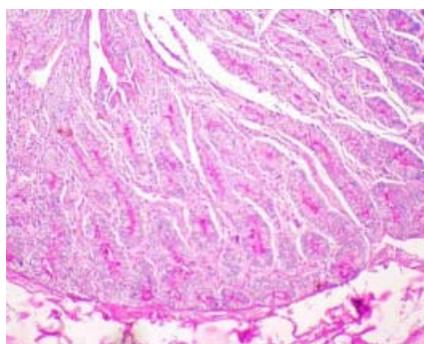


Fig 5. Photograph showing PAS activity in villi and intestinal glands  
PAS x 100

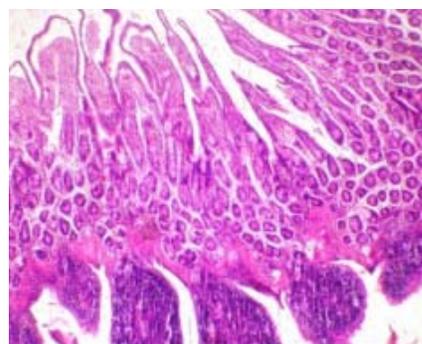


Fig 6. Photograph of jejunum showing lymphoid aggregates  
H. & E. x 100

of smooth muscle fibers arranged in two rows (Barnwal and Yadava, 1975). The lamina muscularis mucosae formed a thin continuous inner circular and outer longitudinal smooth muscle layer in jejunum of pig (Sloss, 1954; Talukdar, 1999) and other domestic animals (Banks, 1986; Stinson and Calhoun, 1993).

The tunica submucosa was formed by loose irregular connective tissue having connective tissue cells, fine blood capillaries along with elastic, collagen and reticular fibers. Payer's patches were present towards the caudal end of the jejunum and at jejuno-ileal junction as reported in buffalo (Hasanzadeh and Monazzah, 2011).

Tunica muscularis was constituted by inner circular and outer longitudinal layers of smooth muscles. In between these layers, there were blood vessels, nerve bundles and at places myenteric plexus was also observed.

Tunica serosa was comprised of loose irregular connective tissue having collagen, elastic and reticular fibers along with varying amount of fatty tissue. Few blood capillaries and flatmesothelial cells were also present. Similar findings have also been reported earlier in domesticated animals (Banks, 1986; Stinson and Calhoun, 1993).

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