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SCANNING ELECTRON MICROSCOPY OF THE MUCOSA OF THE LARGE INTESTINE OF THE CAMEL (*Camelus dromedarius*)

A.M.A. Mohamed[1], A.A.M. Taha[2] and A.M. Ali[2]

[1]Department of Biomedical Science, College of Veterinary Medicine, Sudan University of Science and Technology- Sudan
[2]Department of Anatomy, Faculty of Veterinary Medicine, University of Khartoum, Sudan

ABSTRACT

Scanning electron microscopy of the mucosa of the large intestine of the camel (*Camelus dromedarius*) showed that the caecal mucosa was made of numerous and irregular folds. These mucosal folds appeared in the colon as regular features which had shallow irregular grooves on their surface. But in the rectum, these were irregular in shape. The surfaces of the mucosal folds were covered with a layer of epithelial cells and numerous goblet cells.

Key words: Large intestine, mucosa, one-humped camel, scanning electron microscopy

The functions of the intestines are to facilitate easy absorption of nutritive materials, and to act as a barrier against bacteria, viruses, toxins and different antigens (Pabst, 1987). The scanning electron microscopy has successfully been employed by several workers (Demling *et al*, 1969; Taylor and Anderson, 1972) for the assessment of fine surface features of intestinal mucosa.

Geissinger and Abandowitz (1977) have claimed that the caecum of mice showed short stubby villi by the scanning electron microscope; which is a peculiar feature of the large intestine. Nevertheless, Yu and Chiou (1997) were also convinced that the mucosa of the caecum and colon of the rabbit at various ages showed overlapping folds of villi, with an intact layer of epithelial cells and goblet cells covering the mucosa.

The mucous layer of the colon has several important functions including lubrication of contents of the colon, water proofing of mucosal epithelium and protection of the mucosa against noxious agents (Forstner, 1978). The normal mucous layer of the colon of the rat appeared homogenously dense under the scanning electron microscope and it provided a complete cover for the mucosal epithelium (Traynor *et al*, 1983).

Paulsen *et al* (1994) who examined the surface of the mucosa of the colon of the rat with scanning electron microscope, observed the presence of foci with one to several aberrant crypts. These were seen as structures elevated from the background mucosa. The shape of the luminal openings of the aberrant crypts varied from elongated or tortuous to circular. However, they found no ultrastructural variations between the different foci of the aberrant crypts or between the foci of the aberrant crypts and the background mucosa.

In the large intestine of the horse, the scanning electron microscopy of the right ventral and dorsal colon revealed more prominent openings of crypts than in the caecum. The small colon contained the most prominent openings of crypts with the least variation among horses (Bertone *et al*, 1989).

The objective of this study is to unveil the scanning ultrastructural features of the mucosa of the large intestine of the dromedary.

Materials and Methods

Samples were obtained from healthy adult she-camels (age 5-11 years) from Albogaa slaughterhouse, Omdurman, Sudan. For scanning electron microscopic study, samples about 4cm long from the segments of the different parts of the large intestine were collected immediately after the animals were slaughtered. The samples were longitudinally opened, washed with normal saline. Small specimens were fixed in freshly prepared 2.5% glutaraldehyde in Millonig's phosphate buffer (pH 7.4). Small pieces of tissue of about 1 cm X 1 cm were gradually dehydrated by increasing ethanol alcohol concentrations and by critical point drying with liquid CO_2. Dried tissue specimens were placed on an

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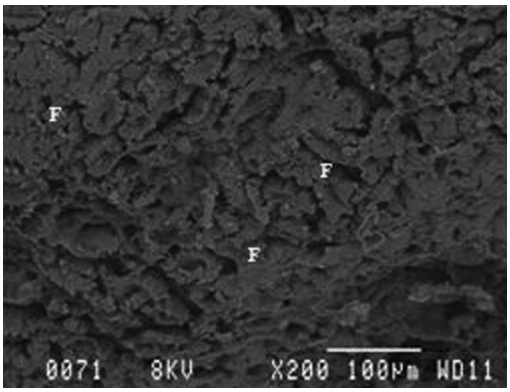

Fig 1. Scanning electron microscopy of the term showing numerous and irregular folds (F) at the luminal surface (X200).

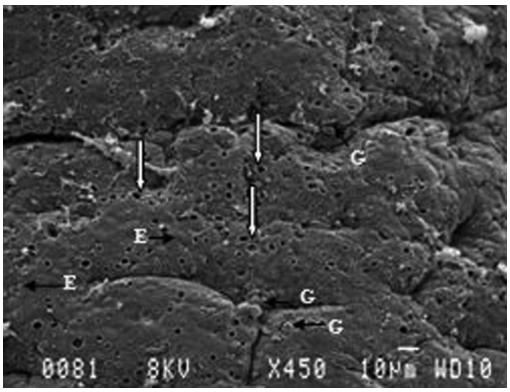

Fig 4. Scanning electron microscopy of the colon. The surface mucosal folds showed epithelial (E) and goblet (G) cells together with the opening (white arrow) of gland of Lieberkühn (X450).

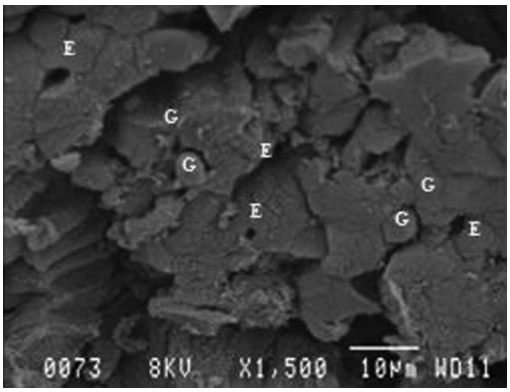

Fig 2. Scanning electron microscopy of the term showing numerous displaying epithelial (E) and goblet cells (G) (X1500).

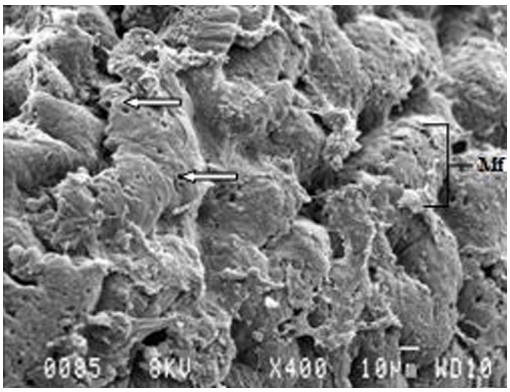

Fig 5. Scanning electron microscopy of the rectum showed irregular mucosal folds (Mf) and the openings (white arrow) of gland of Lieberkühn (X400).

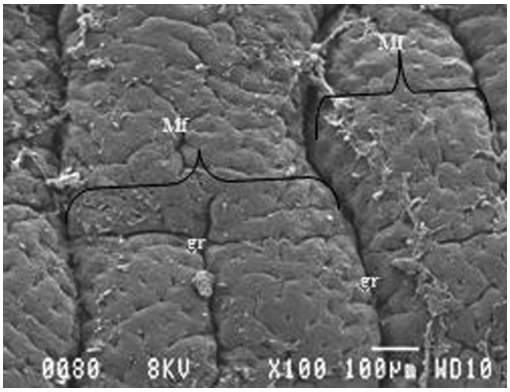

Fig 3. Scanning electron microscopy of the colon showing regular mucosal folds (Mf) separated by deep longitudinal grooves at the luminal surface. These are shallow irregular grooves (Er) on the surface of the field (X100).

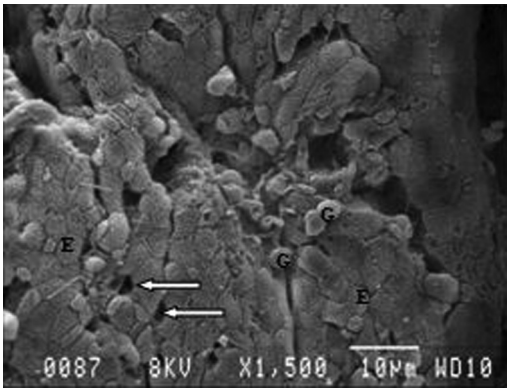

Fig 6. Scanning electron microscopy of the rectum showed the epithelial cells (E) with gobbler cells (G) and the openings (white arrow) of gland of Lieberkühn (X1500).

aluminum stub with silver paint, sputter-coated with gold, viewed and photographed in JEOL 840 scanning electron microscope (Robinson and Gray, 1990).

Results

Scanning electron microscopy showed that the luminal surface of the three segments of the large intestine (caecum, colon and rectum) was thrown into mucosal folds. The mucosa of the caecum was made of numerous and irregular folds (Fig 1). The folds were covered by a layer of epithelial cells and a number of goblet cells (Fig 2).

The folds at the mucosal surface of the three parts of the colon (ascending, spiral, and descending

colon) were present as a constant feature. These folds displayed shallow irregular grooves on their surface (Fig 3). At higher magnifications they showed more prominent crypts openings of the glands of Lieberkühn and also displayed epithelial cells and goblet cells (Fig 4).

The mucosal folds of the rectum were irregular in shape and contained diffuse crypt openings (Fig 5). These folds also showed epithelial cells and great numbers of goblet cells (Fig 6).

Discussion

The present study of the mucosal surface of the large intestine by the scanning electron microscope appeared to be the first one on this species of animal, the one-humped camel. It showed that the caecal mucosa has numerous folds present in the shape of irregular features whereas in the colon, these were present in regular forms displaying shallow irregular grooves on their surfaces. In the rectum, the mucosa has irregular mucosal folds. The surface of the mucosal folds of all parts of the large intestine showed great numbers of epithelial and goblet cells.

The present results of the scanning electron microscope differed from similar studies carried out in experimental animals, mice (Geissinger and Abandowitz, 1977) and rabbit (Yu and Chiou, 1997). In the mice short stubby villi in the mucosa of the caecum were reported whereas overlapping folds of villi, with an intact layer of epithelial cells and goblet cells covering the mucosa were present in the caecum and colon of the rabbit. Contrary to the findings of Yu and Chion (1997), Sabatakou *et al* (1999) have showed that the villi that appeared in the caecum and colon of the rabbit during prenatal life until one day old have actually disappeared afterwards and were replaced by ridges. This appears to be in line with the findings of Ono (1980) who also reported that at birth, numerous villi were present on the caecal mucosa of the rabbit but they become decreased progressively till day 9 then disappeared completely after day 10. However, Ferrer *et al* (1991) and Sabatakou *et al* (2003) stated that the proximal part of the caeca of the chicken showed villi similar to those of the small intestine.

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