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SCANNING ELECTRON MICROSCOPIC STUDY OF MUCUS CELL OPENING IN THE ALIMENTARY CANAL OF *HETEROPNEUSTES FOSSILIS* (BLOCH)

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ABSTRACT
The detail of goblet cells was identified in the mucosal folds with special attention in the different region of the gut epithelium of *Heteropneustes fossilis*.Mucus gland openings were visible in between the elevated wrinkled or microridged individual epithelial cells in the roof of buccopharynx and the anterior portion of the oesophagus. The number of these cells is almost the same as much as epithelial cells in an approximately 1:1 ratio. Heavy mucus secretion is observed in the pyloric region of the stomach. Whereas prominent mucus gland opening were not visible in the cardiac region of the stomach. The mucosal membrane of the intestine is characterised by the zigzag folds, with plenty of mucus secretion. The mucus cells opening of the rectum are numerous making reticular appearances with heavy fold of mucus. The number of mucus cell opening in the gut of *Heteropneustes fossilis* is variable this indicates that the mucus secretion and its function vary in the different region of the alimentary canal. The study gives an idea about the number of mucus cell opening in the different region have their functional importance.

INTRODUCTION

Heteropneustes fossilis is an air breathing fish inhabiting unique ecological niche the wetlands, where oxygen content is low. This fish is an omnivore, its alimentary canal is of moderate size, and the aim of the present study was to investigate the mucosal adaptation of the gut with special reference to the mucus cell opening in the different region of the gut mucosa. In present work the detail ultrastructure of goblet cell were identified in the mucosal folds of the gut epithelium of *Heteropneustes fossilis*.

There is extensive information on gut epithelium of different teleosts using scanning electron microscope and has been well documented in the literature by (Marsh and Swift, 1969, Ezeasor and Stokoe 1980, Sinha 1983, Macdonald 1987, Mandal and Chakrabarty 1996, Suicmezand Ulus, 2005,Namulava *et al.*, 2013). (Yuko Ohkubo *et al.,* 2005) focused on the presence of taste buds in fishes ,(Madhu Yashpal *et al.,* 2006) studied the surface architecture of mouth cavity of *Rita rita*. Limited information is documented about the distribution and morphology of mucus cell in the gut mucosa. The paper deals with surface architecture of the different parts of the gut of *Heteropneustes fossilis* to better understand its role in relation to the food and functioning of the gut.

MATERIALS AND METHODS

The live specimen of *Heteropneustes fossilis* standard length 20-25 cm (N = 10) were collected from the natural habitat (wetlands) of North Bihar in the month of August (2006) and maintained in aquarium at 25 ± 2^{o}C. The fish were anaesthetized in MS222.Various region of the gut were dissected out, the tissue were prepared for scanning electron microscopy following Munshi and Hughes (1986). After washing out thoroughly the food particles with distilled water the tissue were fixed in 6 and 12% chilled glutaraldehyde prepared in 0.2M phosphate (pH 7.4) and dehydrated in different grades of alcohol at 4^{o}C. Thereafter, the material were transferred to a mixture of absolute alcohol and acetone in different concentration and finally preserved in anhydrous acetone at room temperature.

All the tissues were than critically point dried using carbon dioxide under high pressure. The dried materials were than gold coated and were studied under Phillips P SEM 500 Microscope with a resolution power up to 6, 400 at RSIC Bose Institute, Kolkata.

RESULTS AND DISCUSSION

Heteropneustes fossilis (Bloch) is an omnivorous fish. Its alimentary canal shows various degree of differentiation of its internal mucosal lining .In the present study, the details of the mucosal modification,the opening of the mucosal gland in the internal mucosa of the fish have been investigated by using scanning electron microscope.

Buccopharynx

The surface of the buccopharynx is rough at different regions.Mucus gland openings are visible in between each

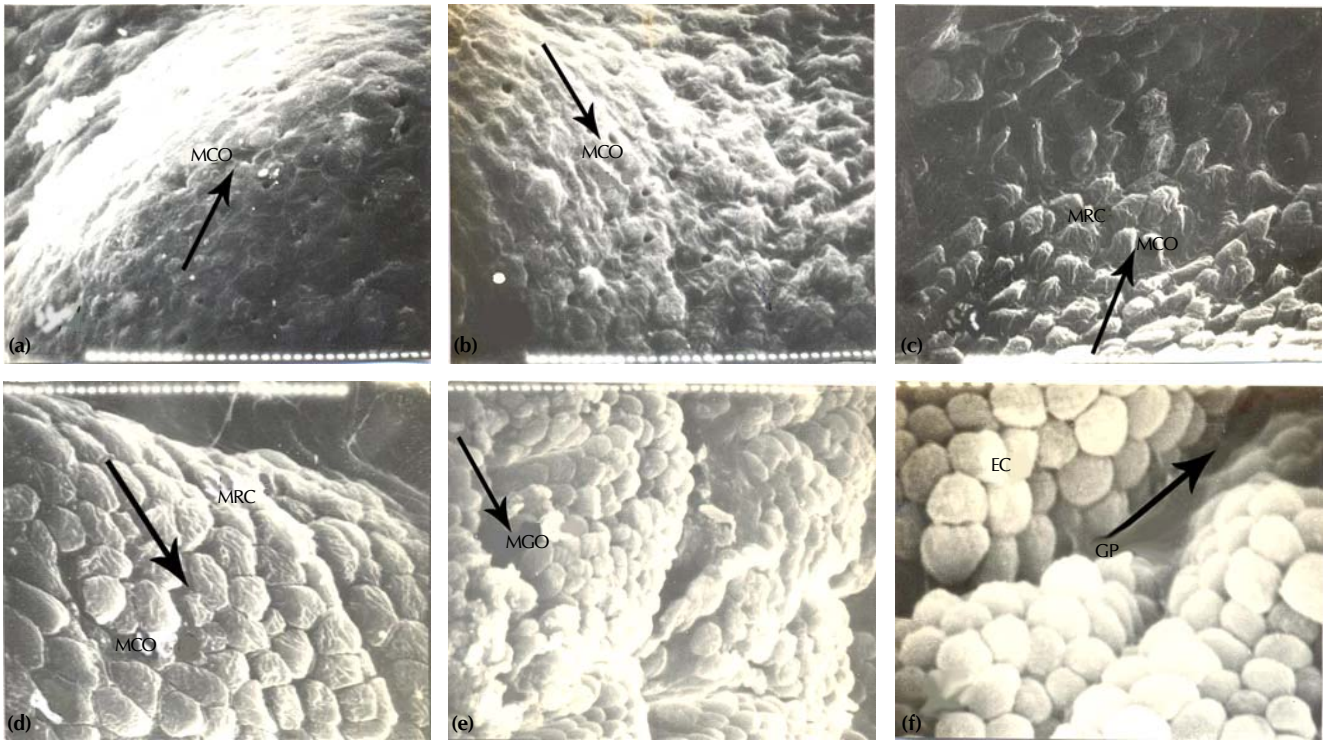

Plate-1: (a) Surface of Palate showing opening of mucus cell.x3200, (b) Surface of Floor with wrinkled cell.x3200, (c) Oesophagus showing MCOin between the epithelial cells.x1600, (d) Oesophagus x3200, (e) Cardiac stomach showing gastric pits no mucus cellx1600 and (f) Cardiac stomach showing Epithelial cellsx6400

microridge sculptured epithelial cells .The number of these cells are almost the same as much as epithelial cells in a ratio of 1:1.The pores of mucus cell are located at the cell junction and encircled by stratified epithelial cells. Mucus is seen precipitated from the surface of the buccopharynx. Plate 1 Fig.1

The floor of the buccopharynx serves as passage of respiratory water current .The mucus covering the surface make it slippery for the passage of food .The microridge surface epithelium of the buccopharynx helps in holding up the mucus.

The palate of the Buccopharynx has many longitudinal folds, it is lined by elevated microridge epithelial cells with prominent chemoreceptor cells. Numerous mucus glands opening are scattered all over the palate region. The mucus cell pores are very distinct and the number is also in similar range with that of floor of the palate. Fig. 2.

The mucus cell opening in the floor and palate are many fold high than the stomach and intestine of the fish. The secretion of mucus cells in the buccal cavity are associated with multiple function, particle entrapment, lubrication of the buccal epithelium and smooth passage of food and to protect from possible abrasion (Bucke, *et al.,* 1971 and Petrinec *et al.,* 2005) also reported similar function of mucin in the pike. (Yashpal *et al.,* 2009, Mandal and Chakrabarti,1996) reported oval depression of mucus cell located on cell junctions and encircled by stratified epithelial cells. Similar prominent opening of mucus gland was observed in between microridge cells of the roof and palate. The number of these cells opening was many fold higher than those of oesophagus. (Suicmez and Ulus, 2005) reported numerous mucus secreting goblet cells in *O.angorae* these finding support the finding of present work.

Oesophagus

The surface of oesophagus is thrown into longitudinal folds. The mucus gland opening are present between the elevated wrinkled or microridged individual epithelial cells. Fig. 3. The mucus gland opening is clearly visible in the anterior portion of the oesophagus. The number of the mucus cells or the opening are somehow lesser in number than the buccopharynx region. Fig. 4

The major feature of the oesophagus is the sculpturing of the luminal plasmalemina of the superficial cells into microridges. Moderate number of mucus gland opening was observed in between these epithelial cells. (Mandal and Chakrabarti ,1996) reported discrete oval or circular opening of mucus cell located in between the stratified epithelial cells. (Suicmez and Ulus 2005) reported numerous mucus secreting goblet cells in *Orthrias angorae*.

Stomach

The gastric folds of cardiac stomach are more prominent than the pyloric folds which are less elevated .Gastric pits are lined with epithelial cells. Prominent mucus gland opening were not visible in the cardiac region of the stomach, the opening of mucus gland opening is not well demarked in this region. Fig. 5. Few mucus cell opening are characterized by the presence of mucus secretion surrounding the opening of the gastric pits. Heavy mucus secretion is observed in the pyloric

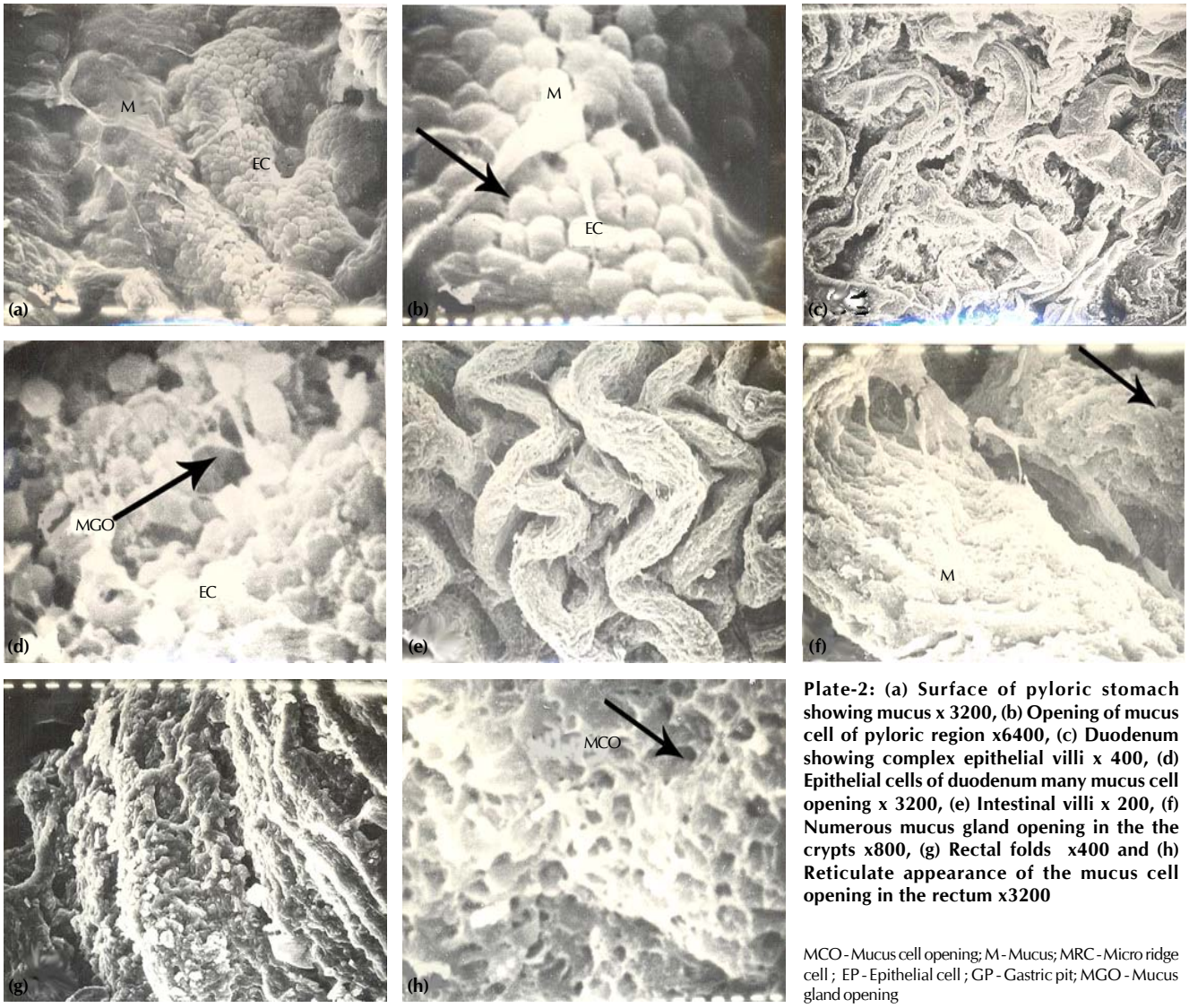

Plate-2: (a) Surface of pyloric stomach showing mucus x 3200, (b) Opening of mucus cell of pyloric region x6400, (c) Duodenum showing complex epithelial villi x 400, (d) Epithelial cells of duodenum many mucus cell opening x 3200, (e) Intestinal villi x 200, (f) Numerous mucus gland opening in the the crypts x800, (g) Rectal folds x400 and (h) Reticulate appearance of the mucus cell opening in the rectum x3200

MCO - Mucus cell opening; M - Mucus; MRC - Micro ridge cell ; EP - Epithelial cell ; GP - Gastric pit; MGO - Mucus gland opening

region of the stomach, as well as the mucus cell pores are present between the margin of the epithelial cells. Fig. 6

The stomach of *Heteropneustes fossilis* is thrown into folds covered with several hundred of columnar epithelial cells encircling the gastric pits. Secretion of mucus and its opening was not evident in the cardiac region. A very contrast feature was observed in the pyloric region of stomach. A large amount of mucus secretion was observed, large mucus gland opening was visible in the pits of gastric folds. According to (Martin and Blaber, 1984), gastric glands were packed beneath the epithelial layer, but the epithelium did not have goblet cells .

The intestine is differentiated clearly into the anterior duodenum and the posterior intestine on the basis of the nature of the mucosal folds and function .

Duodenum

The mucosal folds of the duodenum gives a reticulate appearance, enclosing deep pockets .The septa gives the appearance of zig zag pattern. Epithelial cells are covered with mucus and mucus gland opening are visible in between the mucus secretion. Prominent compound mucus gland opening are visible in between the crypts of epithelial cells lining. Plate 2. Fig. 1&2.

Intestine

The mucosal membrane of the intestine is characterized by the zig-zag folds, with plenty of mucus secretion. Prominent mucus gland opening are visible in the crypts of intestinal folds loaded with heavy mucus secretion. Many mucus glands opening are discernible. The surface is covered over by mucus in such a way that it is difficult to recognize the epithelial cell boundaries. Fig. 3&4

Few mucus cell opening was visible in between the secondary folds of duodenum in *Heteropneustes fossilis*. (Mandal and Chakrabarti, 1996) reported that the packing of the columnar cells is interrupted in certain areas by prominent mucus cells in *Notopterus notopterus* and *Oreochromis mossambicus*. (Petrinec *et al.,* 2005) observed much more mucus cell in cat fish (*Silurus glanis*) than in Pike (*Esox lucius*) (Sis *et al.,* 1979, Clarke and Witcomb1980 and Albrecht *et al.,* 2001) reported

that numerous mucus secreting goblet cell were present among the columnar cells similar finding was observed in the post intestine of *Heteropneustes fossilis*.

Rectum

Along the entire lumen of the rectum, there are numerous annular mucosal folds .The mucus cell opening of the rectum are numerous making reticular appearance with heavy fold of mucus. The pores of mucus cell opening appears like minute pocket in the mucosal lining. Fig. 5&6

The surface epithelium of rectum is devoid of microridge and microvilli, but numerous mucus cells opening were observed. Secretion of the mucus and opening of pocket like mucus opening gives reticular appearance. Similar type of arrangement of mucus folds has also been reported in the rectum of *Mystes aor* (Sinha and Chakrabarti, 1986), *Mystes vittatus*, (Chakrabartil and Sinha, 1987), *Notopterus notopterus* and *Oreochromis mossambicus*,(Mandal and Chakrabarti, 1996). However the excess of mucus will help in the expulsion of faecal matter.

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