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Scanning Electron Microscopic Studies on Small Intestine of the Post-Hatch Uttara fowl

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The structure of the different segments of small intestine was examined using scanning electron microscopy. Scanning electron microscopic study revealed variable shaped villi in each intestinal segment of Uttara fowl. By day 112 of age, the villi were tongue like in the duodenum, leaf like with domed tip in the jejunum and uniform, cylindrical shaped with rounded tip in the ileum. Post-hatch structural alterations like microvilli, secretory pores and different cells were seen in the ultrastructure of the small intestine of Uttara fowl. These structure having major role in digestion and absorptive functions of small intestine.

Key words: Small Intestine, Villi, SEM, Uttara fowl.

The Uttara fowl (hill fowl) is an important indigenous breed of poultry spread over vast area of Uttaranchal in India. Uttara fowl is generally reared under backyard poultry farming system.

The intestinal epithelium of poultry undergoes profound anatomical adaptations around the time of hatch as the embryo switches from in ovo nutrition to an exogenous diet made of complex ingredients. Intestinal villus increases the surface area for absorption of food. Thus more active and more number of villi are responsible for faster growth and more production. In spite of large quantum of literature available on avian species the reports on Scanning electron microscopic features of small intestine in Uttara fowl are meager. Keeping in view the above facts, the present study was conducted to study the ultrastructural details of intestinal villi of Uttara fowl.

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MATERIALS AND METHODS

The study was carried out on the structural organization of the small intestine of the Uttara breed of fowl, a total of 24 birds were procured from Instructional Poultry Farm of G.B.P.U.A&T, Pantnagar. The birds were divided into four age groups viz day old, 7, 28, and 112 days old birds with 6 birds in each group. From these, two birds were used for electron microscopic investigations. The tissue samples from each intestinal segment of Uttara fowl were cut into smaller pieces to be fixed in 2.5% glutaraldehyde for 24 hours at 4ºC. The fixed tissues were subjected to washing with 0.1M phosphate buffer saline (at pH 7.2), three changes of 15 minutes each at 4ºC. The specimens, washed repeatedly in Hanks' balanced salt solution (HBSS) for about 10 minutes. The washed tissues were then allowed to undergo post-fixation with 1% Osmium tetraoxide for 2 hours at 4ºC, dehydrated with graded ethanol (30%, 50%, 70%, 90% and 100%) and dried with liquid CO_2 at the critical point for 60-90 minutes by using EMITECH K850. Specimens were then mounted on aluminium stubs with double-stick tape and coated with gold by using JEOL JFC-1600 auto

fine coater and observed under a JEOL JSM-6610 LV scanning electron microscope.

RESULTS AND DISCUSSION

The mucosa of entire small intestine showed villi of variable shapes and sizes according to age. The epithelium which composed the surface of villi and glands were simple columnar. This observation was similar to the observation of Aitken (1958) and Nasrin et al. (2012) in chicken. Post-hatching developmental alterations in the ultrastructure of the intestinal villi were observed being leaf-shaped in 7 day old birds. Most of the villi showed a rounded tip but few conical-shaped villi were also observed. At day 28 of age, villi of the duodenum had enlarged to develop cylindrical shape with apical surface showing dome shaped tips (Fig. 1). These observations were contrary to the reports of Rao and Williams (1972) they observed that the villi developed to a plate-like pattern in duodenum by day 28 of age in mice. The villi thereafter developed a characteristic tongue-like shape by 112 day of age wherein most of the villi showed conical tips but few had rounded tips (Fig. 2).

In the jejunum of day old chicks, the tongue-like villi having a conical tip surface were more numerous than cylindrical-shaped villi with rounded tip. Epithelial cell protrusions over the whole apical surface were observed in the present study (Fig. 3). Epithelium loss with exposure of the

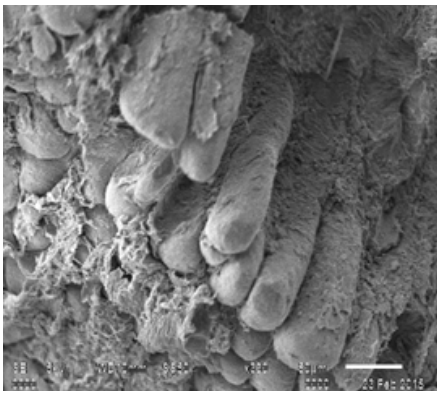

Fig. 1. Scanning electron micrograph of duodenal villi in 28 day old bird showing long, cylindrical villi with a dome tip

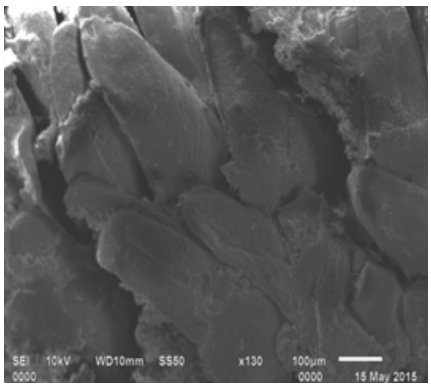

Fig. 2. Scanning electron micrograph showing tongue shaped duodenal villi in 112 day old bird

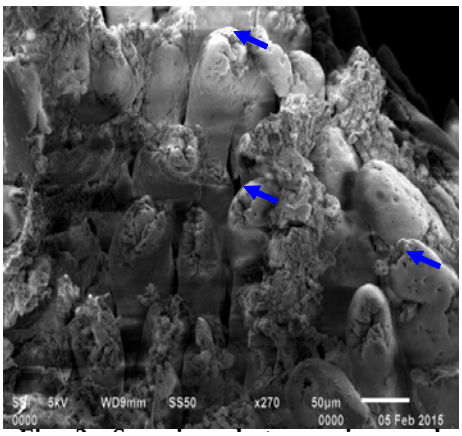

Fig. 3. Scanning electron micrograph showing conical shape jejunal villi with epithelial cell protuberances (arrow) in day old chick. The shape of the villus tip varied from round to conical

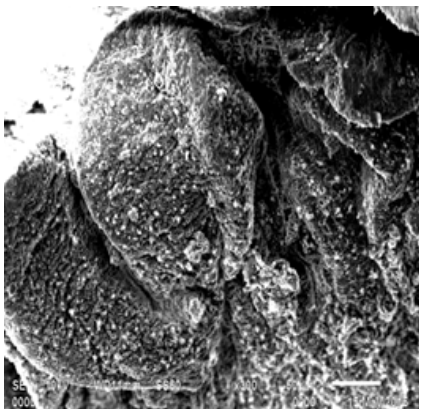

Fig. 4. Scanning electron micrograph of jejunal villi showing leaf-shaped with numerous microvilli in 28 day old bird

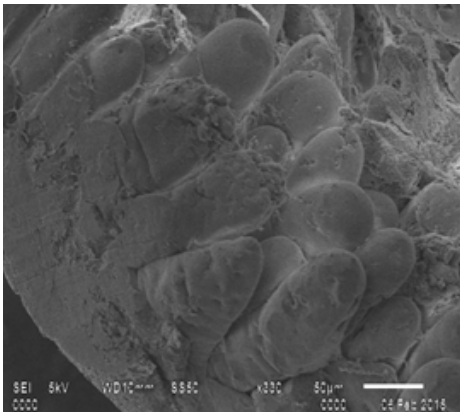

Fig. 5. Scanning electron micrograph of ileum showing uniform finger like villi having dome shape tip in day old bird

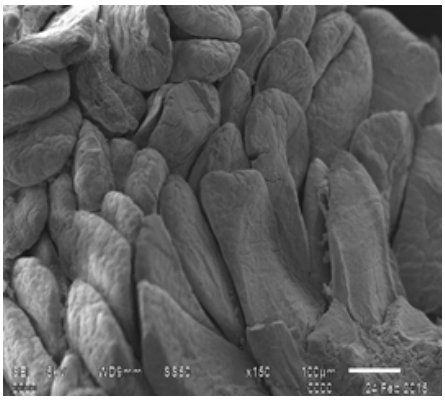

Fig. 6. Scanning electron micrograph showing spatula and conical shape villi in ileum of 28 day old bird

connective tissue have been seen at the apex of the villus. These morphological alterations of villi suggest a more active intestinal function immediately after hatching. According to Bohórquez *et al.* (2011) in turkey poults at hatch regions of active cell turnover or extrusion zones have been seen at the apical end of individual villi in the jejunum. Similar findings were reported by Skrzypek *et al.* (2005) in the jejunal segment of pigs, which supports our findings. At day 7 of age, leaf-like villi mostly having round tips and broad base were observed, few villi were thin and conical shaped in the present findings. At day 28 of age, flat, tongue-like villi were observed. However, few villi having broad leaf-shaped with more number of microvilli and secretory pores (Fig. 4). Contrary to the reports of Rao and Williams (1972) reported that the villi developed to a plate-like pattern in jejunum of mice by day 28 of age. Jejunal villi were flat with mainly having dome to wide rounded tips but few villi had leaf-like shape in 112 day old birds. Leaf-shaped villi have been observed by Musgrave *et al.* (1973) in bovine intestine of 112 days old, which corresponds to shape of jejunal villi in Uttara fowl.

Observation of the ileal villi from day old chicks indicated two morphological types, numerous uniform, broad finger-shaped villi with dome surface tips and few villi were conical shaped (Fig. 5), which is in line with the reports of Kalita *et al.* (2009) in Kadaknath fowl. Yamauchi and Isshiki (1991) observed on the first day after hatching, villi of each intestinal segment show a finger-like shape in both Broiler and White Leghorn breeds. This corresponds to the shape of ileal villi in Uttara fowl in the present study. At 7 day of age villi were thin, finger-like shape with conical tip. Most of the villi in the ileum of 28 day old chicks were long, flat, spatula-shaped with broad surface, whereas few villi showed conical tips (Fig. 6). At day 112 of age, two types of villi were observed which showing uniform finger-like with rounded tip morphology in more number and broad leaf-like surface were observed in some of the villi.

Summary

The shape of the intestinal villi of different segments continually changed in association with the advancing age. The surface of the villi in different segments was not smooth but possessed few epithelial cells and microvilli. These features indicate fast intestinal activity for their digestive and absorptive function at very younger age.

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