Ultrastructural Studies of Mammary Gland in Lactating & Nonlactating Nondescript Goat

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ABSTRACT

The ultrastructural study was conducted on mammary gland of four lactating and four nonlactating goat. The tissue samples were processed for transmission electron microscopic study. Transmission electron microscopic observations revealed the presence of three types of cells in the alveoli of mammary gland in lactating goat. These cells were, glandular epithelial cells, myoepithelial cells and wandering cells. The alveolar epithelial cells were active and polar in nature. The apical membrane of polar epithelial cells showed secretory activity with microvilli. The nuclei showed more euchromatin than heterochromatin. The large round to oval mitochondria with well developed lamellar cristae were observed throughout the cytoplasm in close association with secretory material. The rough endoplasmic reticulum was extensively developed and dilated, consisted of parallel cisternae. Well developed Golgi complex was found in supranuclear region which consisted of parallel, membrane bounded, flattened cisternae. The secretory epithelial cells were firmly joined with one another by junctional complex. The myoepithelial cells were elongated in shape. The wandering cells were pear shaped and their nuclei occupied the major proportion of the cell. In mammary gland of nonlactating goats there was loss of structural integrity, hyalinization, degeneration, sloughing off and death of glandular epithelial cells occurred.

Key words : Goat, Lactating, Mammary gland, Nonlactating, Ultrastructure

Transmission electron microscopy not only plays a major role in the evaluation of alveoli but also helps to understand the ultrastructure of organelles and secretory material. Ultrastructural study would be the useful tool and confirm the normal synthesis and intracellular changes associated with lactation cycle. The present study would be the baseline for further ultrastructural study on clinical and experimental mastitis and other ailments of the mammary gland.

Ultratructural studies were conducted on bovine mammary gland (Sordillo and Nickerson, 1988) and buffalo (Chaurasia, 2010). However, there is paucity of literature on electron microscopic studies of mammary gland in goat during lactating and nonlactating stage. Keeping in view the above facts in mind, the present study has been undertaken.
MATERIALS AND METHODS

For ultrastructural studies, tissue samples of four lactating and four non-lactating mammary glands were collected immediately after slaughter of the animal from small animal abattoir, Jabalpur (M.P.). These samples (1x1mm thick) were primarily fixed in 3% glutaraldehyde in 0.05M phosphate buffer (pH 7.2) in vials for 24 hours at 4°C. Rinsed in the same buffer and were fixed in 1 per cent osmium tetroxide in 0.1M phosphate buffer (pH 7.2-7.4) for 1 hour at 4°C. The tissues were embedded in pure embedding media and allowed for polymerization. With Leica ultracut UCT, ultramicrotome semithin sections of 0.5 μm were cut for selection of area for ultrathin sectioning. The ultrathin sections (60-90 nm) were stained with uranyl acetate followed by lead citrate and examined under TEM (Morgani) and required photographs were taken (Bozzola and Russel,1998).

RESULTS AND DISCUSSION

Lactating stage

Electron microscopic observations of lactating mammary gland revealed that three types of cells present in the alveoli. These were glandular parenchymal secretory epithelial cells, myoepithelial cells and wandering cells (Fig.1.). The present observation is in agreement with the findings of Chaurasia (2010) in buffalo.

Glandular epithelial cells showed strong evidence of immense secretory activity and synthesis of secretory material. These cells were enriched and filled with active well developed Golgi apparatus, rough endoplasmic reticulum (rER), mitochondria, fat globules and protein granules. There were few microvilli on the apical surface. The presence of microvilli could be attributed to increase the surface area of the cells for immense activity and secretion as stated by Linzell and Peaker (1971) in cow.

In lactating phase, the glandular epithelial cells appeared active and polar in nature. The amount of secretory material was profuse in apical region and nucleus pushed towards the basal part of the cell, hence showed distinct polarity of the cell. (Fig.2) as reported by Annen et al. (2007) and Hurley (2009) in cow and Chaurasia (2010) in buffalo. The nuclei of glandular epithelial cells were oval or elongated with indentations. The nuclei had more euchromatin than heterochromatin. The heterochromatin was clumped peripherally and attached with the nuclear envelope. Scanty heterochromatin was associated with nucleoli and some also scattered with the euchromatin.

The mitochondria were seen large, round to oval shape with well developed lamellar cristae (Fig.3.). These were scattered throughout the cytoplasmic in close association with secretory material. Similar findings were recorded by Sordillo and Nickerson (1988), Annen et al. (2007) in cow and Chaurasia (2010) in buffalo mammary gland. However, mitochondria were also found in clumps as reported by Chaurasia (2010) in buffalo which indicated that the glandular epithelial cells were very active and attributed to the continuous need of energy for cell metabolism and milk synthesis.

The rough endoplasmic reticulum (rER) was found throughout the cytoplasm especially in the perinuclear region. The cisternae were well defined, dilated and filled with electron dense protein particles. These cisternae were studded with ribosomes. (Fig.4.). Present finding regarding presence of focal swelling is in agreement with the observations recorded by Reid and Chandler (1973) in lactating Ayrshire cow. The smooth endoplasmic reticulum (sER) was distributed throughout the cytoplasm in the form of small vesicles.

Well developed Golgi complex was found in supranuclear region which consisted of parallel membrane bounded flattened cisternae (stacks) and associated vesicles at lateral surface on either face of stacks (Fig.5). Similar observations regarding Golgi complex in lactating gland were made by Reid and Chandler (1973) in Cowie and Buttle (1980) and Annen et al. (2007) in cow.

The cytoplasm of the alveolar epithelial cells filled with large amount of secretory material predominated the cell organelles. However, in some cells, organelles were more than secretory material. The alveolar epithelial cells contained two distinct types of secretory material that is lipid droplets and protein granules. Fat globules coalesced to form large fat droplets. The present observation is in line with the findings of and Reid and Chandler (1973) in cow. Intermediate electron dense, spherical lipid droplets of varying size were observed throughout the cytoplasm. The apical large lipid droplets were surrounded by thin rim of cytoplasm (Fig.6). In mammary gland active secretory cells with electron dense fine granules within the vesicles of Golgi apparatus were observed. These secretory vesicles moved to the apex of the cell and allowed the granules to escape into the lumen by exocytosis. These granules were noticed towards alveolar lumen and released by exocytosis (Fig.7). This report supports the findings of Copenhaver et al. (1975) in women.

The glandular epithelial cells were firmly joined to one another by junctional complex (Fig.8.). During lactation these tight junction of epithelial cells were impermeable. It is in accordance with the findings of Linzell and Peaker (1971) and Nguyen and Neville (1998). They concluded that junction inhibit direct paracellular exchange of substance between blood and milk compartments during lactation.

Present studies revealed that the myoepithelial cells were present between basement membrane and glandular epithelial cell. These cells were elongated in shape and were rich in mitochondria. The finding of Chaurasia (2010) in buffalo. The nucleus was elongated to fusiform shape (Fig.9). The above finding is in agreement with the finding of Murakami (1978) in rats and Pulley (1973) in cow. Cytoplasm showed few, small mitochondria and myofilaments. Other cytoplasmic organelles were scarce. Secretory granules and droplets were absent. The cytoplasmic processes extended in both directions. The myoepithelial cells were attached with basement.
membrane by hemidesmosomes (Fig.9). The wandering cells were located in the periphery of glandular epithelial cell. They were pear shaped. The oval nucleus of the wandering cell was large and occupied the major proportion of the cytoplasm. (Fig.1).  

**Nonlactating Stage**

The alveolar epithelial cells lining the alveoli were shrunken and regular arrangement was not observed. The cell boundaries between epithelial cells of the alveoli were indistinct and attachment between them were not appreciable. The epithelial cells had lost their polarity. The nuclei were present at variable level either at basal, lateral or apical region of the cell. The nuclei were irregular in shape (Fig.10).

There was marked reduction in cytoplasmic nuclear ratio. The present observation is in agreement with the findings of Sordillo and Nickerson (1988) and Chaurasia (2010) in buffalo. Cytoplasm density was found reduced due to reduction in cytoplasmic organelles and secretory material, which resulted into small alveoli and increased intra-alveolar connective tissue. Cytoplasm showed foamy appearance due to stasis of vesicles. Secretory content were scanty and their distribution did not reveal polarity. Few mitochondria, rER and free ribosomes were observed. The present observations are in agreement with the findings of Holst et al. (1987) and Sordillo and Nickerson (1988). They stated that predominance of fat droplets and stasis vacuoles are indicative of the fact that the cells were not capable of synthesis and secretory activity and were about to degenerate.

There was loss of structural integrity, hyalinization, degeneration, sloughing off and death of epithelial cells, some of the epithelial cells were sloughed off while others were on the process of sloughing (Fig. 11 and 12). In some cells shrinkage of nuclear material into a homogenous and hyperchromic mass indicative of pyknosis of the nuclei. In desquamated cells nuclei were not seen and had homogenous material which indicated that the cells were hyalinized (Fig.12). This is in line with the findings of Chaurasia (2010). The nuclear membrane was irregular in outline and showed folds and indentation. In some cells karyolysis was also seen (Fig. 11). Intercellular junction between glandular epithelial cells of the alveoli were loose and leaky and had a gap between cells in nonlactating stage as also reported by Leitner et al. (2007) in cow.

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### REFERENCES


