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Light and Electron Microscopic Study of Lungs in Bidri Goat and Deccani Sheep

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Abstract

The histological study of lungs in Bidri goat (*Capra hircus*) and Deccani sheep (*Ovis aries*) was carried out to know the structural differences in lungs of these animals. Lungs of both the species had respiratory bronchioles, alveolar duct, alveolar sac and alveoli. Respiratory bronchioles were lined by simple cuboidal epithelium in both the species and more number of respiratory bronchioles was seen in adult Bidri goat than adult Deccani sheep. The alveolar ducts were lined by low cuboidal to simple squamous epithelial cells. Alveoli were spherical structures lined by flat and membranous Type-I pneumocytes and large dome shaped Type-II pneumocytes. In transmission electron microscopy (TEM), more numbers of lamellar bodies were seen in cytoplasm of Type-II pneumocytes of Deccani sheep as compared to Bidri goat. Macrophages and mast cells were noticed in interalveolar septa of both the species. In scanning electron microscopy (SEM), no major structural difference was noticed.

Key words: Alveoli, Sheep, Goat, Pneumocytes, Transmission electron microscopy

Introduction

Goat and sheep are the important segments of animal wealth. The challenging problem in the growth of goat and sheep husbandry is heavy mortality due to respiratory tract diseases and defective development of respiratory alveolar system. In order to gain complete understanding of cause and their possible elimination the knowledge of histomorphology of the lungs mainly respiratory tract is essential. It has been proposed that sheep is a good model for research in asthma, acute bronchial obstruction and human broncho-alveolar carcinomas (Demartini *et al*., 1988) and sheep lung surfactant is now a days used to treat respiratory distress syndrome in infants, hence the present work was undertaken to study the histo-morphology of the lungs in Bidri goat and Deccani sheep.

Materials and Methods

The present study was carried out in the Department of Veterinary Anatomy and Histology, Veterinary College, Bidar, Karnataka. The materials for the study were collected from eight adult Bidri goat and eight adult Deccani sheep immediately after slaughter from local slaughter house. The collected whole lung was washed in normal saline. The samples were taken from medial, central and lateral portion of all six lobes namely, right cranial, right middle, right caudal, right accessory, left cranial

and left caudal and they were fixed in different fixatives like 10% Neutral buffered formalin, Zenker's fluid and Bouin's fluid. The samples were processed in Isopropyl alcohol- Xylene sequence and embedded in paraffin by routine method (Luna, 1968). Sections were cut at 6-8 µm thickness and were utilized for histomorphological studies. The staining techniques carried out to study histomorphological feature of lung were Harries Haematoxylin and Eosin stain (Luna, 1968), Van Geison's stain for collagen fibres (Bancroft *et al.*, 2008), Verhoeff's method for elastic fibres (Singh and Sulochana, 1996), Gomori's method for reticular fibres (Luna, 1968), Azan's Trichrome method for connective and muscle fibres (Singh and Sulochana, 1996) and Unna's method for mast cells (Luna, 1968).

For the electron microscopic study samples from lateral portion of cranial lobe of right lung of adult Deccani sheep and adult Bidri goat were collected and fixed in 2.5% gluteraldehyde in 0.1 M Phosphate buffer (Ph 7.2) for 24 hours at 4ºC and later fixed in 2% aqueous osmium tetroxide for 4 hours and transmission electron microscopy (TEM) and scanning electron microscopy (SEM) was carried out at RUSKA Labs, College of Veterinary Sciences, SVVU, Rajendranagar, Hyderabad, as per standard procedure.

Results and Discussion

Lungs consisting of respiratory bronchioles, alveolar duct, alveolar sac and alveoli observed in both adult goat and sheep in the present study were similar to the earlier reports of Trautmann and Fiebiger (2002) and Dellmann (2006) in other domestic animals. Respiratory bronchioles were observed in both species, but number of respiratory bronchioles was more in adult Bidri goat than Deccani sheep, whereas Banks (1993) reported that respiratory bronchioles were infrequently observed in ruminants and swine, poorly developed in horse and man, while well developed in monkey and carnivores. Iovannitti *et al*. (1985) and Pirie *et al.* (1990) reported absence of distinct true respiratory bronchiole in calf and horse, respectively, and Singh *et al*. (2001) reported absence of true respiratory bronchioles in buffalo. In the present study respiratory bronchioles were distinct with less wide lumen, were lined by simple cuboidal epithelium and very few number of ciliated cuboidal epithelium that too in most proximal region and were interrupted by alveoli that out pocketed from wall and gave 2-4 generation of alveolar duct in both adult Bidri goat and Deccani sheep (Fig. 1). In both species the basal membrane of respiratory bronchiole epithelial mucosa had very small amount of connective tissue and smooth muscle fibres. These findings were similar to earlier reports of Baskerville (1970), who reported non-ciliated flattened epithelial cells in pig respiratory bronchioles, Bouljihad and Leipold (1994) in sheep, Trautmann and Fiebiger (2002) in domestic animals, and Kahwa and Purton (1996) and Suman *et al*. (2005) in goat.

Alveolar duct is tubular structure surrounded by alveoli and followed a long course and gave off several branches. The wall of the alveolar duct had low cuboidal and simple squamous epithelial cells and small quantity collagen, reticular and smooth muscle fibres were distributed in the wall and finally duct terminated in interalveolar septa in both species (Fig. 2). The present findings are similar to the earlier reports of Trautmann and Fiebiger (2002) and Dellamann (2006) in domestic animals, Singh *et al*. (2001) in buffalo, Suman *et al*. (2005) and Baba and Choudhary (2008) in goat. Alveolar sac was completely surrounded by alveoli and small quantity of connective tissue fibres and smooth muscle cells were observed in inter-alveolar septal terminal which projected into sac. These were similar with the earlier reports of Atwal and Philip (1971) in goat.

Alveoli were roughly spherical structure opened into alveolar ducts, alveolar sacs or into respiratory bronchiole. Alveoli were demarcated by septa composed of simple squamous epithelium overlaying a thin interstitium. The epithelium consisted of two morphologically distinct cells, type-I pneumocytes and type-II pneumocytes and little amount of connective tissue fibres. Type-I pneumocytes were numerous and flattened squamous epithelial cells in both species. Type-II pneumocytes were few in number; they were dome shaped, cuboidal in shape and protruded into the lumen of alveoli with the cytoplasm in both adult Bidri goat and Deccani sheep (Fig. 3). These findings are same as the

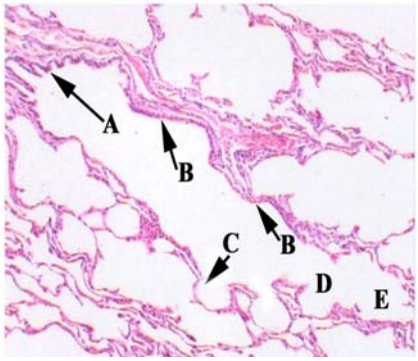

Fig.1: Photomicrograph showing terminal bronchiole (A), respiratory bronchiole (B), alveolar out-pouching (C), alveolar duct (D) and alveolar sac (E) in adult Bidri goat (H&E, X 10)

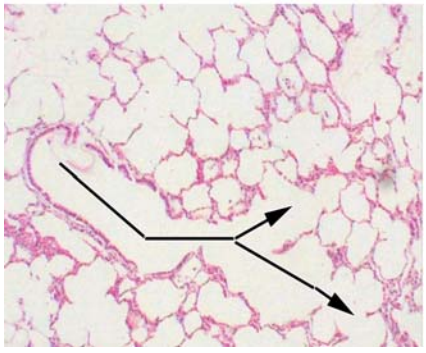

Fig.2: Photomicrograph showing terminal bronchiole, respiratory bronchiole, alveolar duct and alveolar sac in adult Deccani sheep (arrow) (H&E, X 10)

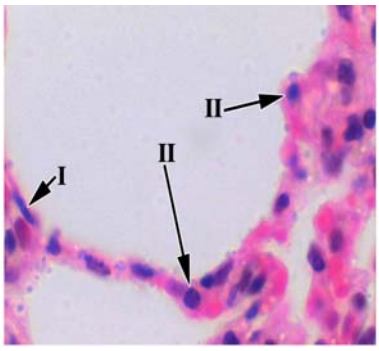

Fig.3: Photomicrograph showing flattened type-I pneumocyte (I) and type-II pneumocyte (II) which had round nucleus and projected in to lumen of alveoli in interalveolar septa of adult Bidri goat (H&E, X 100)

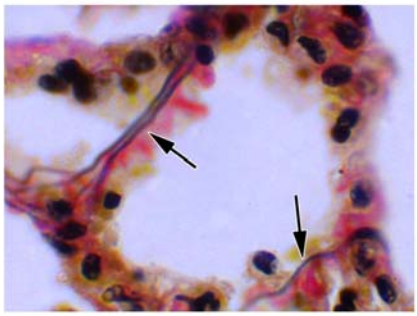

Fig.4: Photomicrograph of showing elastic fibres in interalveolar septa (arrow) of adult Deccani sheep (Verhoeff's stain, X 100)

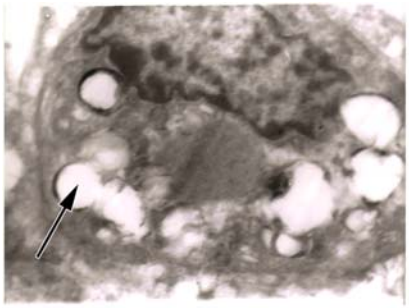

Fig.5: Transmission electron photomicrograph of type-II pneumocyte showing lamellar bodies (arrow) in adult Bidri goat (X 1158)

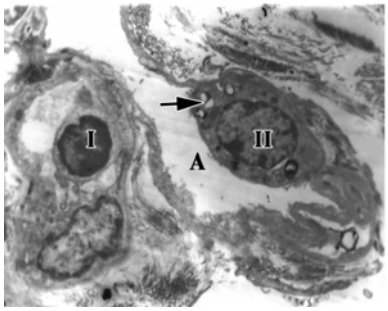

Fig.6: Transmission electron photomicrograph showing lumen of alveoli (A), type-pneumocyte (I) type-II pneumocyte (II) and lamellar bodies in type-II pneumocyte (arrow) in adult Deccani sheep (X 4825)

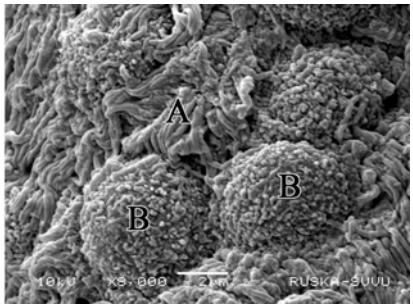

Fig.7: Scanning electron photomicrograph of terminal bronchiole showing ciliated cuboidal epithelial cell (A) and non-ciliated clara cell (B) in mucosal epithelial lining of adult Bidri goat (X 8000)

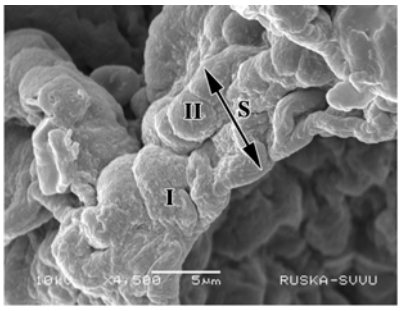

Fig.8: Scanning electron photomicrograph showing interalveolar septa (S), type-I pneumocyte (I) and type-II pneumocyte (II) in adult Deccani sheep (X 4500)

reports of Singh *et al*. (2001) in buffalo, and Suman *et al*. (2005) and Baba and Choudhary (2008) in goat. The presence of type-I and type-II pneumocytes of alveoli were reported in goat (Kahwa *et al.,* 1997) and in yak and mithun (Kalita *et al*., 2003). However, it differed with the findings of Kahwa and Purton (1996), who described only type-I pneumocytes in alveolar wall of goat. Interalveolar septa were composed of a very thin layer of connective mainly of fine elastic, reticular, collagen and smooth muscle fibres and well organised capillary network in both species (Fig. 4). The present findings are similar to earlier reports of Bouljihad and Leipold (1994) in sheep, and Atwal and Philip (1971), Kahwa and Purton (1997) and Baba and Choudhary (2008) in goat. Macrophages, mast cells and plasma cells were observed in the interalveolar septa of both adult goat and sheep. These findings are similar to earlier observations of Baba and Choudhary (2008) in goat.

Alveolar diameter was 40.86±1.06 µm in adult Bidri goat, whereas, it was 41.08±0.77 µm in adult Deccani sheep. These findings corroborated with the earlier report of Baba and Choudhary (2008) in goat (45±0.87 µm) without significant difference in the alveolar diameter of right and left lung.

In TEM study, the type–I pneumocytes had large nucleus and there cytoplasm extended the alveolar surface as irregular processes which overlapped with another type-I pneumocyte or type-II pneumocyte and these pneumocytes were flat and covered the major portion of alveoli. The basement membrane of type-I pneumocytes and capillary endothelium appeared fused in both species. Type-II pneumocytes were cuboidal in shape with round nucleus found at the junction of alveolar wall and the cytoplasm contained characteristic lamellar bodies in both adult Bidri goat and Deccani sheep (Fig. 5 and 6). It was also observed that lamellar bodies were more in type-II pneumocytes of Deccani sheep as compared to that of Bidri goat. These findings are in agreement with the reports of Baskerville (1970) in pig, Bouljihad and Leipold (1994) in sheep and Kahwa *et al*. (1997) in goat. Yutaka *et al.* (1965) reported phospholipids lamellar bodies in type-II pneumocytes of sheep and they were source of pulmonary surfactant. More of lamellar bodies observed in cytoplasm of type-II pneumocytes of Deccani sheep than that of Bidri goat may be due to breed and species variations. Therefore, Deccani sheep can able to withstand more respiratory distress than the Bidri goat. Yuh Fakuda *et al.* (1983) reported that type –I pneumocytes were numerous than type-II cells and they occupy 97% of the alveolar septa in the lung of adult sheep. In the present finding also more number of type-I pneumocytes were noticed than type-II pneumocytes in both goat and sheep.

SEM observations revealed that the mucus membrane of terminal bronchioles was folded and was lined by few ciliated epithelial cells and large number of non-ciliated epithelial cells known as clara cells. The clara cells had small microvillous projection on their surface. Alveoli were roughly spherical in shape and were separated by adjacent alveoli by interalveolar septa which consisted of connective tissue. The alveolar wall was lined with two types of cells, i.e. large number of type-I pneumocytes which were flat and covered major portion of alveoli and the type-II pneumocytes which were few in number, dome shaped and projected in the lumen of alveoli (Fig. 7 and 8). These findings were similar to reports of Singh *et al*. (2002) in buffalo, Iovannitt *et al.* (1985) and Mariassy *et al.* (1975) in cattle and Rybicka *et al.* (1974) in calf. Kahwa and Purton (1997) reported that the alveoli of goat were lined by alveolar type-I pneumocytes characterised by extensive thin cytoplasmic sheet spreading over the alveolar surface, whereas alveolar type –II pneumocytes were round or oval in outline and slightly raised from the surface.

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Conflict of Interest: All authors express no conflict of interest.

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