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Histochemical studies on the trachea of Pashmina, Bakerwali and non-descript goats of U.Ts. of Ladakh and Jammu & Kashmir: A comparative study

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Abstract

A comparative study was carried out on the histochemical features of the trachea of adult Pashmina, Bakerwali and non-descript goats (ten each). It was observed that the tracheal epithelial cells of all the breeds of goat showed moderate to weak reactions to glycogen indicating the presence of little or moderate amount of glycogen in various cell types of the tracheal epithelium in the goats under study. It was also found that the ciliated columnar epithelial cells of the tracheal epithelium in all the breeds of goat showed moderate to strong reactions to acidic sulfated mucosubstances. The cilia showed an intense reaction. However, the goblet cells exhibited moderate reactions to neutral mucosubstances. Also, the tall columnar ciliated epithelial cells of the tracheal epithelium of all the breeds of goat showed moderate to strong reactions for basic proteins. Different cell types of the tracheal epithelium of all the breeds showed negative reactions for fats with Sudan Black B stain.

Keywords: Trachea, histochemistry, pashmina, bakerwali, non-descript goat

Introduction

The respiratory system generally consists of organs that allow for a union between air and blood such that exchange of gases (mainly CO₂ and O₂) is made possible. In addition, the respiratory system plays a vital role in thermo-regulation. The sense of smell and voice are associated with it [1]. Respiratory system plays an important role in the vital functions of conduction and exchange of oxygen, olfaction, phonation and thermoregulation of the body. A major function of conducting portion is to condition the air before it enters the lungs. Inspired air is cleansed, moistened and warmed by conducting portion of respiratory system [2]. The trachea forms the part of the conducting system which transports air from the external environment to the lungs. Additionally, the respiratory system has extensive structural and functional correlation with the cardiovascular system. In spite of using improved managerial practices even on organized farm sectors, heavy mortality is still reported due to respiratory tract diseases like *Caprine pleuropneumonia* and other viral infections [3]. The overall fitness of domestic animals to their environmental circumstances is conditioned by their morphological, physiological, behavioral and reproductive adaptation [4]. Histochemistry is the science that pursues the detection of specific molecular components of the tissue or of substances administered to trace cellular migration and metabolism while maintaining or paying special attention to topographical relationships [5]. Francois Vincent Raspail, a French Botanist, the founder of histochemistry, said "*Histochemistry will unmask all causes of diseases and replace traditional jargon with the positive language of scientific observations*" [6]. Histochemical study on the respiratory system has been conducted in domestic mammals by various workers. Suman *et al.* [7] in goat and Baba *et al.* [8] in Black Bengal goat. Goat shows distinctive organization of respiratory organs as compared to large ruminants [9]. However, review of literature reveals that the studies on the histochemical aspects of respiratory organs of goat are very scant as compared to those of other domestic animals.

Materials and Methods

The work was done in the Division of Veterinary Anatomy, F.V.Sc. & A.H., R.S. Pura Jammu. The samples of trachea from adult Pashmina goats were collected from slaughter houses of U.T. of Ladakh.

Similar organs of Bakerwali goats and non-descript goats were collected from slaughter houses in and around Jammu city. Minimum 10 samples from each goat breed were collected. The representative tissue samples from trachea of all the goats were preserved in 10% Neutral Buffered Formalin (NBF) solution ^[10] and these tissues were processed for paraffin block preparation by alcohol-benzene schedule ^[10]. Tissue sections of 5 µm thickness were obtained from these blocks on clean glass slides with the help of rotary microtome. The sections were then subjected to various histochemical methods as detailed hereunder.

Table 1: Different histochemical stains used in the study

Purpose	Stain	Source
Histochemical stains		
1. Glycogen	Best Carmine Method	[10]
2. Proteins	Bromophenol Blue	[11]
3. Neutral and acidic mucopolysaccharides	PAS-Alcian Blue method (pH 2.5)	[10]
4. Fat	Sudan Black B method	[10]

Results and Discussion

The functional role of the various mucopolysaccharides in connective tissues is still largely presumptive. They occur in different proportions in different tissues, and the pattern of distribution in the same tissue changes with maturation, aging and environmental factors.

1. Glycogen

The tracheal epithelial cells of all the breeds of goat showed moderate to weak reactions to glycogen indicating the presence of little or moderate amount of glycogen in various cell types of the tracheal epithelium in the goats under study (Fig. 1). Presence of few glycogen granules in the tracheal epithelium was also reported in yaks, which is a high altitude living animal ^[12]. The connective tissue fibres and different cells of the lamina propria layer also showed weak reactions as these contained little or traces of glycogen (Fig. 1). But, the smooth muscle bundles of the lamina muscularis mucosae layer showed moderate reaction to glycogen as these muscles were responsible for movement of the tracheal epithelium during the respiratory processes (Fig. 2). Similar findings were also reported in one humped camel of south Iraq ^[13]. The endothelial cells of the blood vessels, the columnar cells of the tracheal glands also exhibited weak reactions to glycogen in all the goat breeds. But, the loose connective tissue of the tunica submucosal layer of the trachea showed negative reactions to glycogen. However, the perichondrium of the tracheal hyaline cartilage showed moderate reactions to glycogen, but the chondrocytes showed almost negative reactions. The moderate reactions as seen in the perichondrium of the tracheal hyaline cartilages might be due to the fact that the inner aspect of the perichondrium acts as a precursor for generation of new chondrocytes into the cartilage.

2. Neutral and acidic mucopolysaccharides

In the present study, the ciliated columnar epithelial cells of the tracheal epithelium in all the breeds of goat showed moderate to strong reactions to acidic sulfated mucosubstances. The cilia showed an intense reaction (Fig. 3). However, the goblet cells exhibited moderate reactions to neutral mucosubstances (Fig. 3). This showed contrast content of mucosubstances- the ciliated columnar cells possessed the acidic mucosubstances, whereas the goblet cells secreted

mainly the neutral mucosubstances in the goats under study. The lining epithelium of the opening ducts of the tracheal glands showed weak to moderate reactions to acidic sulfated mucosubstances which indicated that the lining high cuboidal to columnar cells of these ducts too have secretory functions and they do secrete acidic mucosubstances and contribute to the mucous lining on the tracheal surface epithelium (Fig. 4). Similar observations on the PAS activity had been reported in Yak ^[12] and one humped camel ^[13]. In this study, a mixed type of reactions to neutral and acidic sulfated mucosubstances was observed among the tracheal glands in Pashmina goats. The glandular epithelium of the tracheal glands which were located superficially near the tracheal epithelium, showed moderate to strong reactions to neutral mucosubstances, while those situated deeply exhibited a strong to intense reactions to acidic sulfated mucosubstances. But, in case of both Bakerwali and non-descript goats, the tracheal glands showed strong to intense reactions to acidic sulfated mucosubstances only (Fig. 5). Such diverse reactions to histochemical entities of the tracheal glands in Pashmina goat might be its typical breed characteristic feature and this might play a role in the process of its adaptation to hypoxic conditions in its high altitude habitats. The loose connective tissue of the tunica submucosal layer of the trachea showed weak to moderate reactions to acidic sulfated mucosubstances. The ground substance of the tracheal hyaline cartilage showed moderate reactions to neutral mucosubstances, while the chondrocytes showed moderate reactions to acidic sulfated mucosubstances. This showed that the content of hyaluronic, chondroitin sulfate, dermatin sulfate, heparin sulfate, heparin and keratin sulfate content of the amorphous ground substance of the tracheal hyaline cartilage in the form acidic sulphated mucosubstances was moderate in all the goats under study (Fig. 6).

3. Basic Proteins

The tall columnar ciliated epithelial cells of the tracheal epithelium of all the breeds of goat showed moderate to strong reactions for basic proteins (Fig. 7). However, the basement membrane of the tracheal epithelium exhibited a strong reaction to basic proteins (Fig. 7). The goblet cells showed weak reactions as this cell were full of mucous only (Fig. 8). Hussein and Ibrahim ^[13] also found similar results in one humped camel. However, the smooth muscle bundles of the lamina muscularis mucosae layer showed moderate reaction to basic proteins. The endothelial cells of the blood vessels and the columnar cells of the tracheal glands exhibited strong reactions to basic proteins in all the goat breeds. The perichondrium of the tracheal hyaline cartilage showed strong reactions to basic proteins, but the chondrocytes showed almost negative reactions. On the other hand, the matrix of the tracheal hyaline cartilage exhibited moderate to strong reactions to basic proteins (Fig. 9). Similar histochemical architecture of the trachea had been reported in other animals and camel ^[13] and in yaks ^[13].

4. Fat

In the present study, different cell types of the tracheal epithelium of all the breeds of goat showed negative reactions for fats (Fig. 10). Similarly, the basement membrane of the tracheal epithelium, connective tissue fibres and different cells of the lamina propria layer were non-reactive to Sudan black B stain (Fig. 10). Again, the tracheal glandular epithelium did not reveal any lipid inclusions in their

cytoplasm (Fig. 11). The perichondrium of the tracheal hyaline cartilage and the chondrocytes too showed negative reactions to fat. But, literature was not available to compare with the present findings.

Photomicrographs with Legends

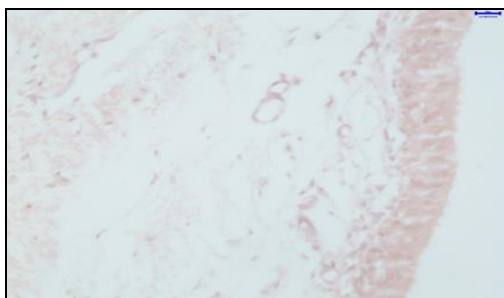


Fig 1: Photomicrograph of tracheal epithelium of an adult Pashmina goat showing weak reactions to glycogen. Best Carmine Method, 100X.



Fig 2: Photomicrograph of smooth muscle bundle of tracheal epithelium of an adult non-descript goat showing moderate reactions to glycogen. Best Carmine Method, 100X.

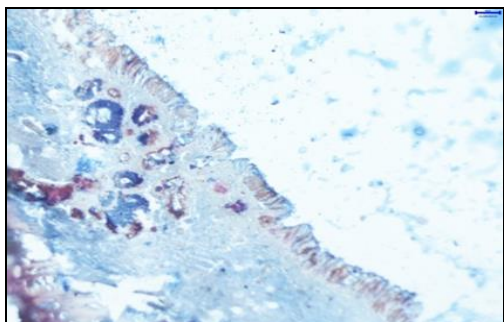


Fig 3: Photomicrograph of tracheal epithelium of an adult Bakerwali goat showing moderate to strong reactions to acidic sulfated mucosubstances. PAS-Alcian Blue method, 100X.

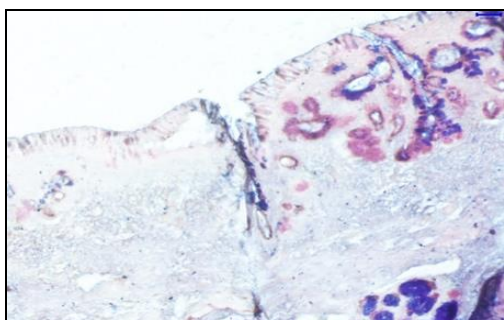


Fig 4: Photomicrograph of opening ducts (arrows) of the tracheal glands of an adult Pashmina goat showing weak to moderate reactions to acidic sulfated mucosubstances. PAS-Alcian Blue method, 100X.

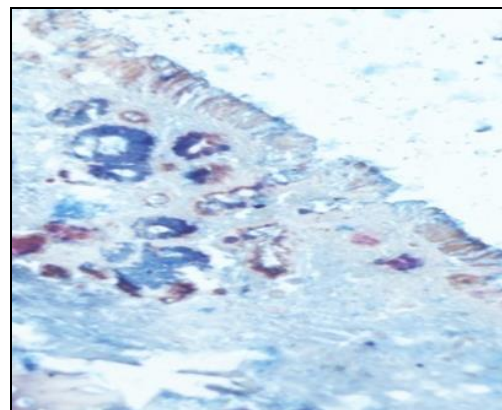


Fig 5: Photomicrograph of the tracheal glands (arrows) of an adult Bakerwali goat showing strong to intense reactions to acidic sulfated mucosubstances. PAS-Alcian Blue method, 100X.

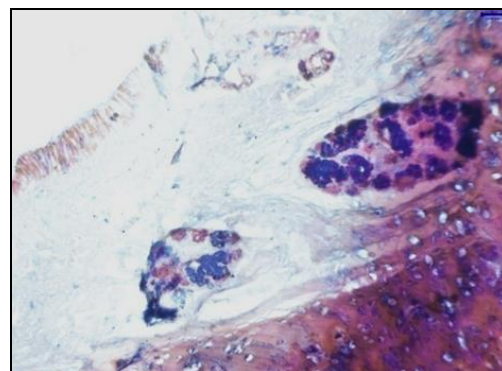


Fig 6: Photomicrograph of the chondrocytes of the trachea of an adult non-descript goat showing moderate reactions to acidic sulfated mucosubstances. PAS-Alcian Blue method, 100X.

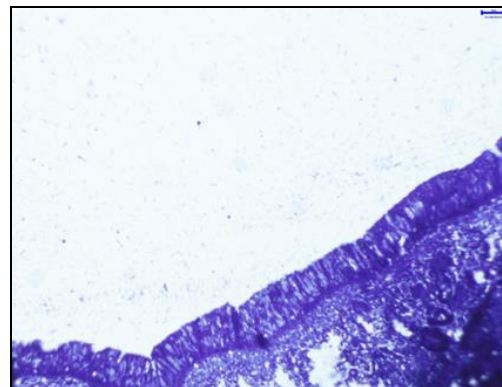


Fig 7: Photomicrograph of the tracheal mucosa of an adult Bakerwali goat showing moderate to strong reactions for basic proteins. Bromophenol Blue method, 100X.

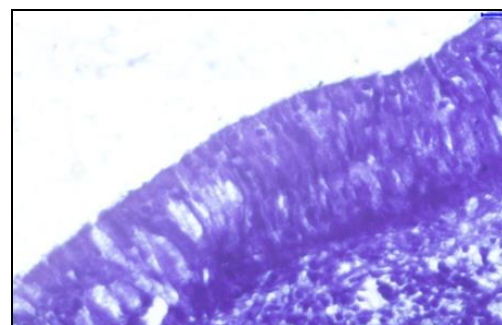


Fig 8: Photomicrograph of the tracheal mucosa of an adult Bakerwali goat showing weak reactions for basic proteins in goblet cells. Bromophenol Blue method, 400X.

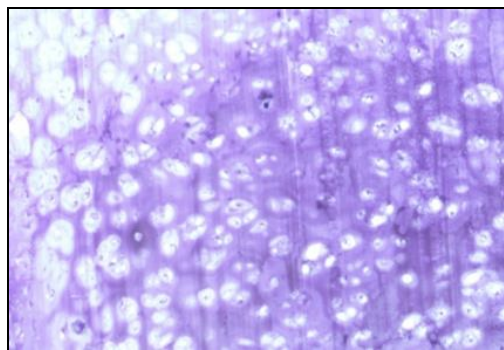


Fig 9: Photomicrograph of the tracheal hyaline cartilage of an adult Pashmina goat showing moderate to strong reactions to basic proteins. Bromophenol Blue method, 400X.

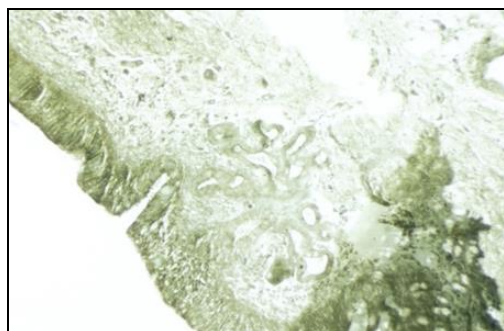


Fig 10: Photomicrograph of the tracheal mucosa of an adult Pashmina goat showing negative reactions for fat. Sudan Black B method, 100X.

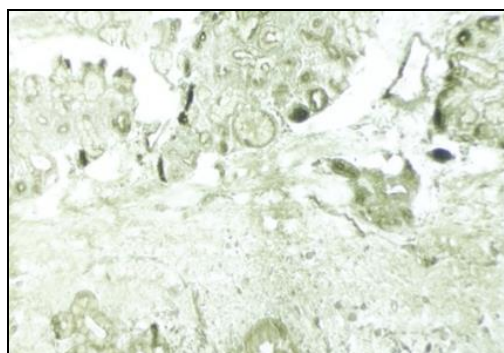


Fig 11: Photomicrograph of the tracheal glands (arrows) of an adult Bakerwali goat showing negative reactions for fat. Sudan Black B method, 400X.

Conclusion

All the cell types of the tracheal epithelium in all the breeds under study contained little or moderate amount of glycogen, however, the ciliated columnar epithelial cells of the tracheal epithelium in all the breeds of goat showed moderate to strong reactions to acidic sulfated mucosubstances. Different cell types of the tracheal epithelium of all the breeds showed negative reactions for fats with Sudan Black B stain.

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