



## Histological Studies on Teat of Barbari Goat in Eastern Plain Zone of Uttar Pradesh

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Received: 14 Aug., 2022

Revised: 22 Sept., 2022

Accepted: 26 Sept., 2022

### ABSTRACT

Present study was done to explore the histology of teat in 24 Barbari goats collected from slaughter house Fair Export Pvt. Ltd. situated at Barabanki, Uttar Pradesh which comes under Eastern Plain zone. The teats of Barbari goats were symmetrical in size and conical in shape and comprised of teat canal, Furstenberg rosette and streak canal. Only one sinus, one teat canal and one teat orifice were reported in teat of barbari goat. The streak canal was noticed at the distal section of duct system and it was lined by the epithelium extending from the teat epidermis. In lactating animals, stratified columnar epithelium bordered the teat canal. Close to the tip of teat, cornified layer of squamous epithelium were seen. On the Furstenberg's rosette, the epithelium lining the streak canal transformed from stratified squamous keratinized to two-cell layered cuboidal epithelium. In lactating teats, the accessory lactiferous glands were fully developed.

### HIGHLIGHTS

- One sinus, one teat canal and one teat orifice were reported in teat of barbari goat.
- Epithelium of streak canal transformed from stratified squamous keratinized transformed into two-cell layered cuboidal epithelium.
- Development of the accessory lactiferous glands in lactating teats.

**Keywords:** Barbari goat, teat, epithelium, Furstenberg's rosette, myoepithelial cells

Goat has been described as "Poor Man's Cow" because of its immense contribution in ensuring food and nutritional security to the rural people economy. Barbari is one of the most prolific, dual purpose goats found in Etawah, Aligarh, Agra, Hathras, Mathura and Firozabad districts of Uttar Pradesh (Singh *et al.*, 2008). Barbari goat have two teats which are symmetrical in size and shape. In the prepubescent stage, goat have conical shape teat with the tip pointing downward but during lactation, they are directed laterally. Teat cistern, Furstenberg rosette and teat canal is commonly present in almost all animals including ruminants (Dyce *et al.*, 2002; Senthilkumar *et al.*, 2020). The cavity that lies immediately adjacent to the teat canal

is called as teat cistern which is bigger and extended in goats. The streak canal is lined by the epithelium extending from the teat epidermis and constitute the distal section of duct system (Mahdi, 2009). On the Furstenberg's rosette, the epithelium lining of the streak canal changed from stratified squamous keratinized to two cell layered cuboidal epithelium (Paramasivan, 2013; Senthilkumar *et al.*, 2020).

**How to cite this article:** Singh, N., Kumar, M., Singh, K.N., Gupta, R.K., Tripathi, K. and Choudhary, P.K. (2022). Histological Studies on Teat of Barbari Goat in Eastern Plain Zone of Uttar Pradesh. *J. Anim. Res.*, 12(05): 789-793.

**Source of Support:** None; **Conflict of Interest:** None



## MATERIALS AND METHODS

The samples were collected immediately after the slaughter at Fair Export Pvt. Ltd, Barabanki, which comes under Eastern plain zone of Uttar Pradesh and histological study was conducted in the Department of Veterinary Anatomy & Histology and Department of Veterinary Pathology, College of Veterinary Science and Animal Husbandry, Acharya Narendra Deva University of Agriculture and Technology, Kumarganj, Ayodhya-224229 (U.P.). For the histological examination, 24 udders were taken from she goat of 2-4 years. Tissue pieces from Base, Middle and Apex of the teat were collected and fixed in 10% neutral buffered formalin. These tissue pieces were then treated with routine histological technique (dehydration in ascending grades of alcohol (ethanol), cleared in xylene and embedding in paraffin wax). The paraffin blocks were sectioned in 5-7  $\mu\text{m}$  thickness. The prepared slides were stained with the Ehrlich's Haematoxylin and Eosin stain to make the histological observations (Bancroft and Gamble, 2003).

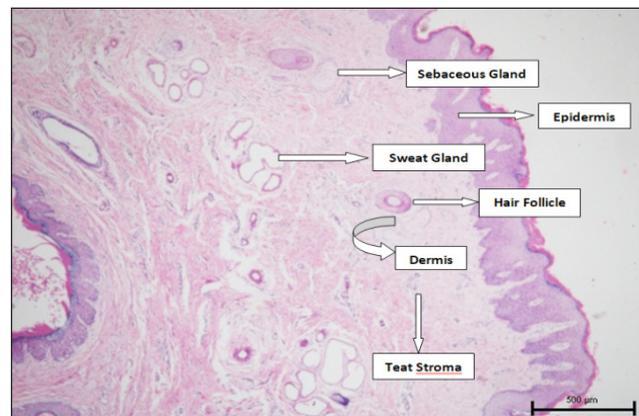
## RESULTS AND DISCUSSION

### Skin of teat

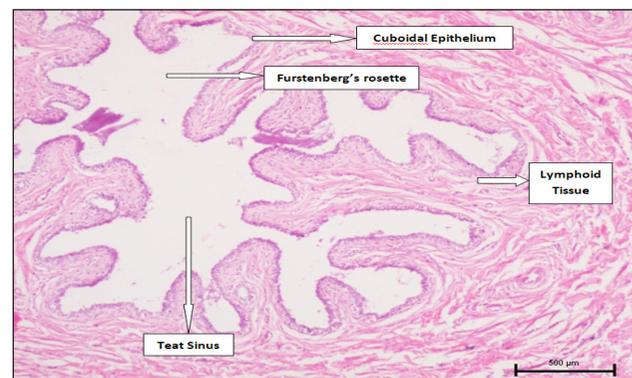
The wall of the teat was composed of three layers, the outer layer being normal skin made up of epidermis and dermis (Fig. 1) with a less number of fine hairs usually associated with clump of sebaceous glands surrounding the hair follicle and the middle and tip of teat being completely hairless. The second layer was the fibro muscular layer which was the thickest and it provide most of the thickness to the teat wall (Fig. 1). It was mostly made up of dense connective tissue which was made of bundle of collagen fibers, fibroblast and elastic fibers, blood vessels and numerous of small clusters of accessory glands in a circular manner at the base of teat (Fig. 2). The epithelial lining of the teat opening was the third most inner layer. Two layer of cuboidal cell lined the sinus, which changed into stratified squamous keratinized of the teat orifice (Fig. 2). Erection of the teat may be caused by the presence of large luminal arteries and veins in the fiber-musculo-vascular layer of the teat. May (1970) came to the same conclusion that the epithelial lining of the teat canal and teat orifice was made up of keratinized stratified squamous epithelium, which may provide resistance

against infections. The current observations are consistent with the finding made by Treece *et al.* (1966).

The outermost layer of epidermis is made up of stratified squamous epithelium, which is made up of dead cells and keratin, and may be responsible for suppressing bacterial growth. Paramasivan *et al.* (2013) observations contradicts that the gland of non-lactating sheep and goat were mostly made up of interstitial tissue, collagen fibers bundles, elastic fibers and a large quantity of fatty tissue. The glandular tissue elements appeared as small isolated lobules formed primarily from intra-lobular ducts and few small round alveoli which were lined by simple cuboidal cells with small nuclei and myoepithelial cells were present between the epithelium of ducts or alveoli and their basement membrane.



**Fig. 1:** Microphotograph of mammary gland showing sebaceous gland, sweat gland, epidermis, dermis, hair follicles (H & E 100 X)



**Fig. 2:** Microphotograph of mammary gland showing Furstenberg's rosette, cuboidal epithelium and teat Sinus (H & E 100 X)

### Teat cistern

In the present study, only one sinus, one teat canal and one teat orifice in the goat were noticed. However, there were 2 to 3 teat cisterns in mare and sow, 8 to 12 in cat and bitch, and a similar number of teat canals and orifices were reported in above animals by Nickel *et al.* (1981), Trautmann and Fiebiger (2002) and Avdic *et al.* (2015). In one humped camel, two teat cisterns in a single teat were reported by Kausar *et al.* (2001) and in rodents and primates, ten to twenty canals were reported by Reece (2005). In the current study, the cavity that lies immediately adjacent to the teat canal is called as teat cistern which was bigger and extended in goats. It stores the milk which drains from the gland. It continued into the glandular parenchyma of the udder as the gland cistern. These were extremely little sinuses that received milk from afferent milk ducts. These cavities were not connected to any other cavity system in the mammary complex. Teat sinus has stratified squamous keratinized epithelium lining the outside wall (Fig. 2). According to Avdic *et al.* (2015), the teat sinus is continuous dorsally in doe with an irregular hollow in the lower part of the gland. The teat sinus (Fig. 2) was large and the teat canal was less than 1 cm. According to Frandson *et al.* (2009) and Avdic *et al.* (2015) teat cistern is connected to the exterior of the teat by a small opening at the end of the teat. According to Paramasivan *et al.* (2013) the streak canal lumen was generally closed by epithelial folds that pressed inward from the streak canal wall, leaving only a star-shaped potential opening. However, Paul *et al.* (2013) found that teat cistern of desi and crossbred cows was lined by stratified squamous keratinizing epithelium. Roy (1979) and Avdic *et al.* (2015) found comparable results in goat. In this investigation, the sub-epithelial stroma consisted of blood vessels with loose connective tissue including cells and simple coiled tubular glands. Trautmann and Fiebiger (2002) found similar results in mare, cat and bitch. These observations are in consistent with findings of Paramasivan *et al.* (2013) who reported that lining cells of accessory lactiferous glands secrete lipids along with keratin play a significant role in keratin plug development between milking and during dry periods. This keratin plug acts as a barrier against bacterial invasion.

The teat cistern of non-lactating goats was lined by columnar epithelium which abruptly changed into stratified squamous epithelium of the streak canal. A

large network of elastic fibres ran through the lamina propria. Similar observations were made by Trautmann and Fiebiger (1957) in ruminants, two to three layers of cuboidal cells were noticed in goat. This observation was supported by Bhatia and Shankar (1981) who discovered supplementary glands in the tunica propria of the streak canal and the teat cistern. In this study, two layers of columnar epithelium were reported in the teat cistern of goat. This is in accordance with Sulochana (1981) in goat and Banks (1981) in cow.

### Teat canal

During different stage of lactation, the gland sinus emerged as branching ducts lined by a double layer of cuboidal epithelium to stratified cuboidal epithelium (Fig. 2). In pubertal animal, it continued downhill as a teat canal, which later converted into stratified columnar epithelium during the lactation stage (Fig. 3.)



**Fig. 3:** Microphotograph of mammary gland showing teat canal and teat sphincter (H & E 100 X)

The sub-epithelium stroma contained connective tissue cells, and the elastic fibres grew significantly coarse in lactating goat. This is consistent with findings of Bhatia and Shankar (1981) and Avdic *et al.* (2015) in goats. The teat canal in ewes is lined by layered cornified squamous epithelium adjoining by a vascular zone in the lamina propria (Fig. 3). In the present study, the accessory lactiferous glands and ducts were also seen in the stromal tissue of goat in lactating stage and they extended downhill to the streak canal. Only lactating teats had well developed accessory compound tubulo-alveolar glands were found in tunica propria, primarily in the wall of the teat canal

and teat cistern. These observations corroborate with the findings of Brooker (1984), Bhatia and Shankar (1981) and Avdic *et al.* (2015). It continued downwards as teat canal, which in pubertal animals was fully developed and lined by stratified columnar epithelium which later converted into stratified columnar epithelium during pregnant and lactation which is similar to findings of Bhatia and Shankar (1981) and Avdic *et al.* (2015 in goats).

### Streak canal

In the present study, the streak canal constituted the distal section of duct system and it was lined by the epithelium extending from the teat epidermis (Fig. 3). Stratified squamous keratinized epithelium bordered the streak canal (Fig. 3). On the Furstenberg's rosette, the epithelium lining of the streak canal changed from stratified squamous keratinized to two cell layered cuboidal epithelium (Fig. 2). The sub-epithelium of Furstenberg's rosette was folded into primary and secondary folds that protruded into the lumen. Similar findings were reported by Senthilkumar *et al.* 2020 in sheep and goats, Nigam and Tyagi (1970) in buffalo, Kausar *et al.* (2001) in camel.

In the Furstenberg's region of the goat teat, there were 6 to 10 connective tissue folds. In bovine teat, Nickerson and Pankey (1983) found six to ten connective tissue folds in the Furstenberg's region. Plasma cells were shown to be the most numerous cell type in the sub epithelium stroma at the squamo-columnar junction where they moved into the epithelial lining (Fig. 2). Mast cells and polymorph nuclear leukocytes were also observed. The rosette region could serve a key role in protecting mammary tissue from infection. These findings corroborated with the findings of Nickerson and Pankey (1983) and Senthilkumar *et al.* (2020) whereas Celik and Asti (1992) found an increase in plasma cell concentration in the sub-epithelial connective tissue of Furstenberg's rosette. The rosette area might play a key role in protecting mammary tissue from infection.

### CONCLUSION

It may be concluded that teat of barbari goat consist of teat canal, streak canal and Furstenberg rosette. Hair follicles, sebaceous glands and sweat glands are fundamental characteristic of teat of barbari goats. The epithelium of streak canal transformed from stratified squamous

keratinized transformed into two-cell layered cuboidal epithelium. Development of the accessory lactiferous glands take place in lactating teats.

### ACKNOWLEDGEMENTS

The authors are thankful to Dean, College of Veterinary Science and Animal Husbandry, ANDUAT, Kumarganj, Ayodhya for the facilities and cooperation provided.

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