Original Research

Gross and Histological Studies of Lacrimal Gland in Goats (*Capra hircus*)

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Abstract

The aim of this study was to describe the gross morphology, morphometry, histology and histochemistry of the lacrimal gland. A total of six goat heads with an average age range from (7-9) months were collected from the corporation slaughter house, Chennai. It was a holocrine compound tubuloalveolar gland. Thin connective tissue capsule surrounded the gland and septa divided the gland to lobes and lobules. The acini were lined with a single layer of columnar cells with small intracytoplasmic eosinophilic vacuoles apically and spherical nucleus with prominent nucleolus basally which were frequently binucleated. Long fusiform myoepithelial cells with elongated nucleus were found between the basal surface of the epithelial cells and the basement membrane. The duct system started with intralobular which continued into interlobular duct and was drained with main excretory duct which opened as lacrimal ducts. The intralobular duct was lined with columnar epithelium. They converged into interlobular duct to join the main collecting duct.

Key words: Goat, Histology, Lacrimal Gland, Morphology

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Introduction

Lacrimal gland is part of the lacrimal apparatus and is responsible for the production of the aqueous layer of the tear film. The aqueous layer is responsible for moisturizing and nurturing the cornea. The antibacterial factors in the secretion of lacrimal gland, includes immunoglobulins and soluble mucins which help to maintain corneal health (Iwata, 1973). The lacrimal apparatus in most species consists of dorsal and ventral lacrimal puncta, paired canaliculi, lacrimal sac and the nasolacrimal duct (Prince *et al.*, 1960). The reports on the lacrimal apparatus system in the goats are scanty. In the present work, gross, histological and histochemical observations were performed on the lacrimal glands in adult goats.

Materials and Methods

A total of six adult goat heads with an average age range from (7-9) months were collected from the corporation slaughter house, Perambur, Chennai. The lacrimal glands were dissected out and gross observations were noted. Morphometrical parameters like length, width and thickness of the gland were measured using measuring scale and thread. Then the gland was fixed immediately in 10% neutral buffered formalin solution, Bouin's solution and Zenker's fixatives. The specimens were processed and embedded in paraffin wax. Sections of (5-6µ) thick were obtained and stained with Haematoxylin and Eosin (H&E) for routine histo-architecture, Masson's trichrome stain for demonstration of collagenous fibers and smooth muscle, Gomori's method for Reticulum for demonstration of reticular fibers, Weigerts stain for demonstration of elastic fibers, Alcian blue pH 2.5 for demonstration of acidic mucosubstances, Unna's method for demonstration of mast cells and Van Geison's method for demonstration of collagen fibres (Bancroft and Stevens, 1996). Morphometric data were analysed statistically and presented as Mean ± Standard deviation.

Results and Discussion

The gross observations of the lacrimal gland in goats revealed that they were the prominent and biggest orbital glands located in the dorsolateral quadrant of the eye ball. Lacrimal glands were flattened, oval in shape and light brown in colour. Lacrimal gland had two parts *viz.*, body and appendages like part (Fig. 1). Similar findings were observed in Bison (Pinard *et al.*, 2003) in cattle (Aslan *et al.*, 2005) and in goat (Mohammadpour (2008). In contrast to this, Pinard *et al.* (2003) observed that in cattle, appendage like part was absent. Getty (1975) observed ovoid gland in donkey, triangular in pig and bipartite in ox. Alsafy (2010) observed three lobes in the lacrimal gland of camel. It was surrounded by the periorbital tissue and periosteum on the inner surface of the supraorbital process of the frontal bone. Lacrimal gland was overlapped by the rectus dorsalis muscle.

The mean size of the gland in the present study was recorded as; length 39.1 ± 0.31 mm, width 13.6 ±0.18 mm and thickness 5.0 ± 0.08 mm on the right side and length 40.0 ± 0.16 mm, width 14.3 ± 0.18 mm and thickness 5.0 ± 0.08 mm on the left side. This was in contrast to the findings of Nawrot *et al*. (2015) in European bison in which the measurements were larger when compared to the goat. These may be due to the species difference and size of the head.,Histologically, a thin irregular connective tissue capsule surrounded the gland and septa from the capsule divided the lacrimal gland into lobes and lobules (Fig. 2). These findings were in accordance with the results of Pinard *et al.* (2013) in bison and cattle, Nawrot *et al.* (2015) in European bison, Nawrot *et* al. (2016) in Red Kangaroo and Shaker and Walaa (2016) in dog.

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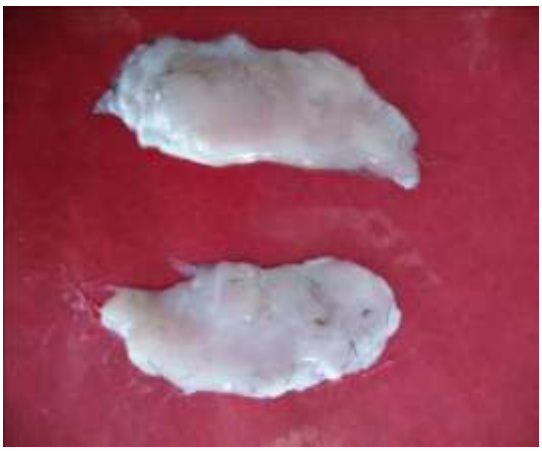

Fig. 1: Photograph showing the right (R) and left (L) Lacrimal gland (H) of adult goat

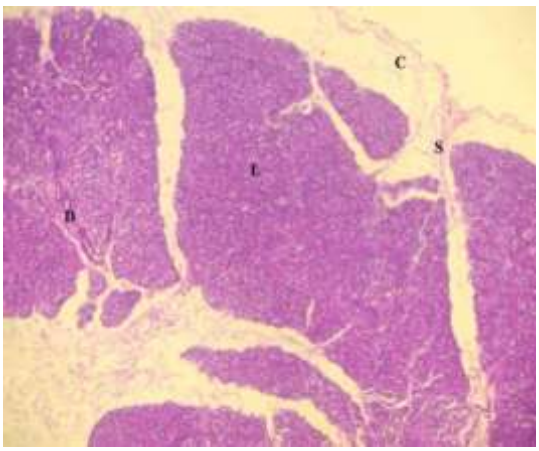

Fig. 2: Photomicrograph showing the collagen fibres in the capsule (C) and Septa (S) dividing the parenchyma into lobes (L) and lobules D – duct. H & E x 100

The capsule was composed of collagen (Fig. 3), elastic and reticular fibres with fibroblasts, melanocytes, adipose tissue (Fig. 4), nerve bundles, lymph nodes and mast cells. This was in agreement with Nawrot *et al.* (2015) in European bison, Abbasi *et al.* (2014) in Lori Sheep and Nawrot *et* al. (2016) in Red Kangaroo.

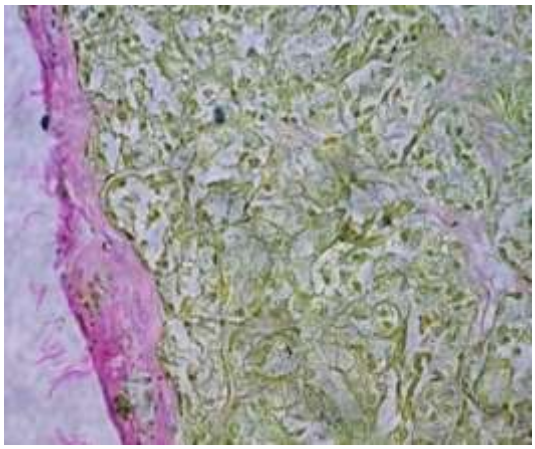

Fig. 3: Photomicrograph showing collagen fibres in the septa (S) and capsule (C). Van Gieson x 100.

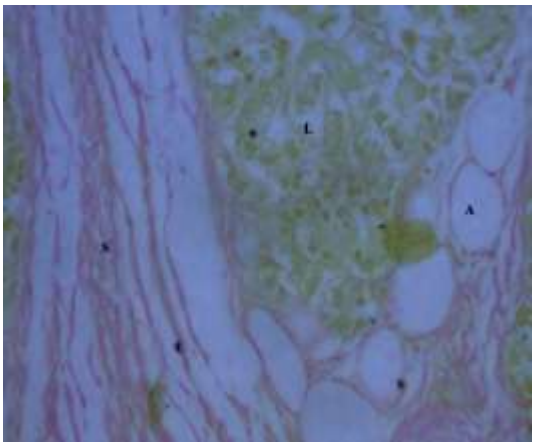

Fig. 4: Photomicrograph showing Septa (S) with collagen fibres and adipose tissue (A) Van Gieson x 400

In the present study, the reticular fibers were thick in the capsule and septae and formed a thin network between and around the acini (Figs.5 & 6). The interstitial tissue was sparse and had fibroblasts, collagen fibres, blood vessels, lymphocytes and nerves fibres. Numerous adipocytes penetrated into the glandular tissue together with the connective tissue and surrounded the lobules. Similar reports were observed by (Abbasi *et al*., 2014) and (Nowrat *et al.*, 2015).

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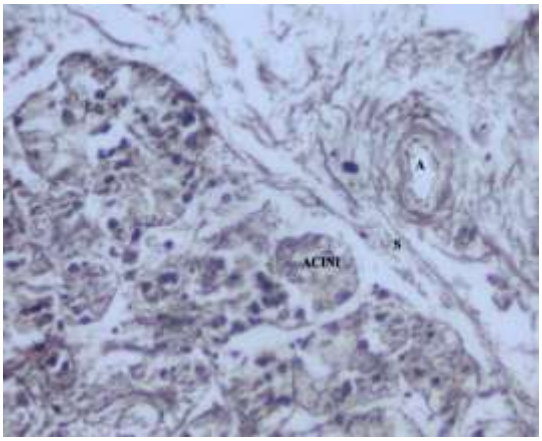

Fig. 5: Photomicrograph showing reticular fibres in the capsule and artery (A) and surrounding the acini (ACINI). Gomori's reticulin method x 100

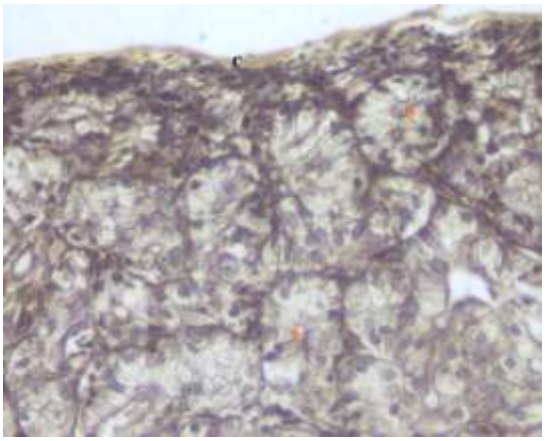

Fig. 6: Photomicrograph showing the presence of thin reticular fibres surrounding the acini (A) C– Capsule. Gomori's reticulin method x 400

Lacrimal gland of the goat was a holocrine, seromucoid compound tubuloalveolar gland. This observation was in agreement with the results of Pinard *et al.* (2003) in bison and cattle. In contrast to this, Shaker and Walaa (2016) observed the lacrimal gland had separate serous and mucous units in dog. Gargiulo *et al.* (1999) mentioned that the mixed seromucous glands were reported in pig, horse, goat, and hamster, while in the rat, it was a serous gland and in sheep, majority of acini contained mixed serous, seromucous and mucous cells. Sexual dimorphism was not observed in the lacrimal gland of goat morphologically and histologically. This finding was in agreement with Nawrot *et al.* (2015).

The acini of the lacrimal gland of goat were variable in shape and size but some appeared large with relatively wide lumen. The acini were lined with a simple columnar epithelium as per Pinard *et al.* (2003) in bison and cattle, Abbasi *et al.* (2014) in Lori sheep and Nawrot *et al*. (2016) in red kangaroo. The acini were lined with a single layer of columnar cells with acidophilic cytoplasm at the apical part and small to medium sized intracytoplasmic lipid vacuoles with round nucleus with prominent nucleolus at the basal part (Fig. 7). Some columnar cells were often binucleated. These results were in line with the findings of Pinard *et al.* (2003) in cattle and Abbasi *et al.* (2014) in Lori Sheep while in bison, the columnar cells lining the acini contained basophilic granular cytoplasm. Basophilic cytoplasm was also observed in Red kangaroo (Nawrot *et al*., 2016). Some small intracytoplasmic lipid vacuoles were also observed at the apical part of the cell (Fig. 8). Goblet cells were not seen in the acinar cells. Gesase and Satoh (2003) mentioned that when the secretory process was accompanied by the loss of the cytoplasamic fragments into the lumen it was considered as an apocrine secretion. Our results showed that there were numerous cytoplasmic bleb-like protrusions at the luminal surface of the epithelial cells. Some of these cytoplasmic blebs along with the nucleus were separated into the lumen of the secretory acini and hence was considered as a holocrine secretion. This observation was in agreement with reports of Nowrat *et al.* (2015) and Abbasi *et al.* (2014).

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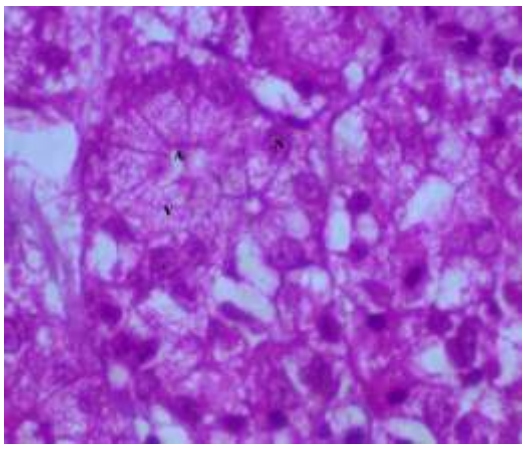

Fig. 7: Photomicrograph of the Acini showing spherical nucleus (N) with apical eosiniophilic granular cytoplasm with vacuoles (V). H X E x 1000

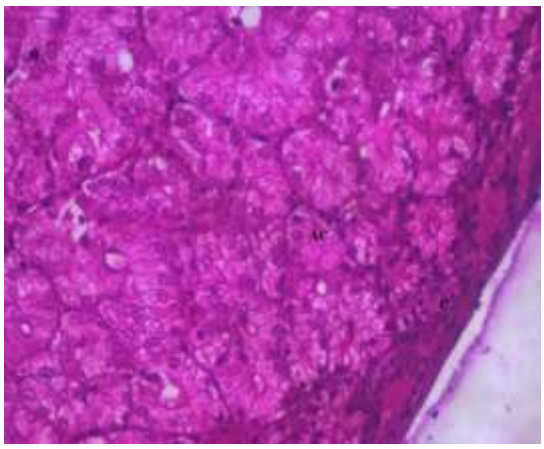

Fig. 8: Photomicrograph showing acini of various size and shape with intracytoplasmic budding (c) and spherical nucleus (N) with apical eosiniophilic granular cytoplasm with vacuoles (E). H X E x 1000

Histochemical studies with PAS stain revealed weak reaction in the capsule, septa and in the cytoplasm of the acinar cells. The reaction was confined to the apical part, basement membrane and the luminal secretory materials (Fig. 9) and the cytoplasmic bleb-like protrusion proved the presence of neutral or weakly acidic glycoproteins (Fig. 10). Whereas a strong reaction was found in cattle and bison (Pinard *et al.*, 2003), in Lori sheep (Abbasi *et al.*, 2014) and in dog (Shakar and Walaa, 2016). Alcian blue staining gave a strong reaction in the apical part of the acini at pH 2.5 in cattle and bison (Pinard *et al.*, 2003) and in dog (Shakar and Walaa, 2016) whereas, in the present study a negative reaction was observed.

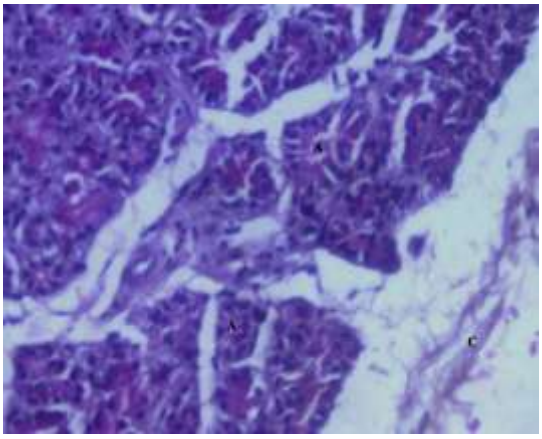

Fig. 9: Photomicrograph showing weak PAS positive reaction in the capsule and septa and moderate in acini. PAS x 400

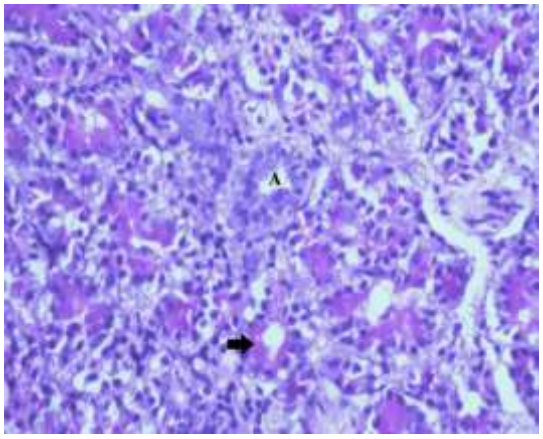

Fig. 10: Photomicrograph showing moderate PAS positive reaction in the apical (E) part of the acini (A) (Arrow). PAS x 1000

In the present study, myoepithelial cells were found surrounding the acini as reported by Nawrot *et al.* (2015) in European bison, Shakar and Walaa, (2016) in dog, Nawrot *et al*. (2016) in Red Kangaroo and

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Abbasi *et al.* (2014) in Lori sheep. The nucleus of myoepithelial cell was elongated oval and interposed between the basal surface and the basement membrane (Fig. 11). The main function of myoepithelial cells in any exocrine gland was to expel their secretory products into the lumen of the acini by their contraction (Yamazaki *et al.,* 1981). In the present investigation, bundles of myelinated nerve fibers were detected above the capsule. Plasma cells were detected beneath the capsule, in the interlobular septa and in the interstitial tissue. This findings is in agreement with the report of Nawrot *et al*. (2016) in Red kangaroo. Scott *et al.* (1993) explained that the plasma cells secreted different classes of immunoglobulins. The secretory immunoglobulins afforded the upper respiratory tract with protective antibodies through the tears. In goat, the lacrimal gland possessed a distinct duct system. It started with intralobular and then interlobular duct and was drained into the main excretory duct which opened at the inner surface of the nictitating membrane. Similar findings were observed by Abbasi *et al.* (2014), Al- Murshidi (2015), Nawrot *et al*. (2016) and Shaker and Walaa (2016). The intralobular duct was lined with simple cuboidal epithelium (Fig.12) which was similar to that found in one humped camel (Fahmy *et al.*, 1979), in dogs (Shakar and Walaa, 2016). The epithelial cells became stratified columnar at the distal part of the duct as per Shakar and Walaa (2016) in dogs. Similar findings were observed in present work.

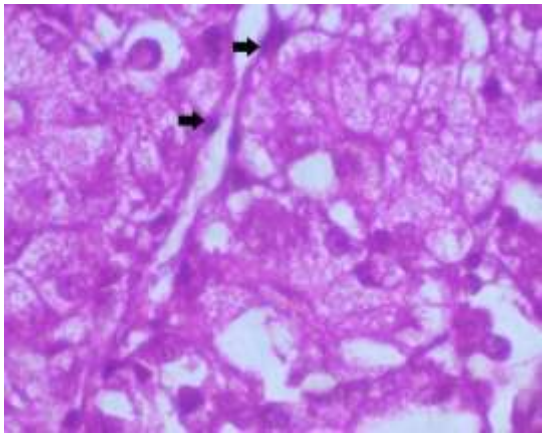

Fig. 11: Photomicrograph showing myoepithelial cells (Arrow) between basal part of acinar epithelial cells and basement membrane. H x E x 1000

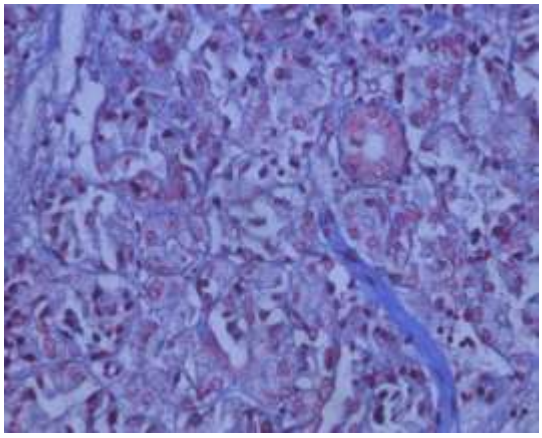

Fig. 12: Photomicrograph showing Intralobular duct (arrow) lined by simple cuboidal epithelium and acini. Masson's Trichrome x 400.

However, in rabbits the intralobar ducts were lined by pseudostratified columnar epithelieum (Al Mursidi, 2015). In the present study, the epithelial lining of the duct system showed PAS positive granules and the excretory duct showed goblet cells in between with strong PAS reaction (Fig. 13). Similar results were observed by Abbasi *et al.* (2014) in Lori Sheep and Shakar and Walaa (2016) in dogs.

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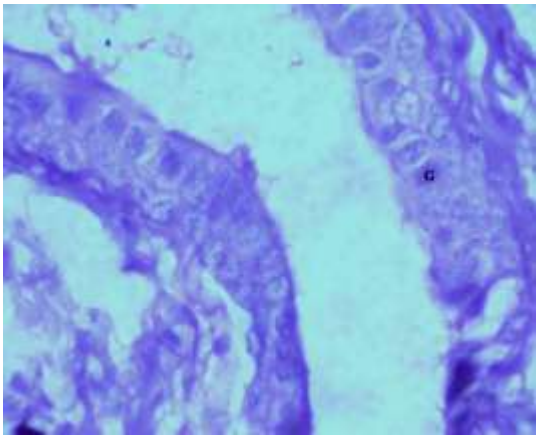

Fig. 13: Photomicrograph showing intralobar duct lined by stratified cuboidal epithelium with goblet cells (G). PAS x 1000

Conclusion

In conclusion, the lacrimal glands were holocrine, seromucoid compound tubuloalveolar glands that were composed of lobes and lobules with acini of various sizes and shapes. Each acinus was lined with a layer of columnar cells and a layer of flat basal cells resting on a basement membrane. The duct systems were initially intralobular, and then became interlobular, and finally emptied into intralobar ducts. Histochemical studies with PAS stain revealed weak reaction in the capsule, septa and in the cytoplasm of the acinar cells. The reaction was confined to the apical part, basement membrane and the luminal secretory materials and the cytoplasmic bleb-like protrusion proved the presence of neutral or weakly acidic glycoproteins.

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