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## Histological Study of Lacrimal Glands in Rabbits (*Oryctolagus cuniculus*).

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### ABSTARCT

Lacrimal glands (LGs) are an important part of the lacrimal apparatus that plays an essential role in eye health; they are composed of several large lobes that are divided into smaller lobules of numerous secretory units, the acini. The duct system is highly branched, and is responsible for transporting lacrimal fluids to the ocular surface. Ten adult female healthy rabbits weighting 2.3-3.5 kg were used in this research. The animals were anaesthetized and then sacrificed. Lacrimal glands were obtained, fixed and processed for histological sectioning and then sections stained with H&E. Results revealed that lacrimal gland is surrounded with a connective tissue containing adipose tissue. The gland shows an irregular-rounded to oval shape and white to pale brown in color. Histological examinations revealed that the lacrimal gland is lobulated and cells of parenchyma are mixed including serous and mucous cells. Intralobular, interlobular and excretion ducts of the gland are lined with cuboidal, stratified cuboidal and pseudostratified columnar epithelium, correspondingly. and a sex related differences in the size of the lacrimal acini.

**Keywords:** Lacrimal gland, anatomy, histology, rabbits

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## INTRODUCTION

Lacrimal glands are trust for the production of a fluid that helps maintain corneal health, this fluid is the tears (Mohammadpour, 2008). The activity of the lacrimal secretory system can be grossly divided into the production of basal secretions and reflex secretions. It is difficult to evaluate the relative contributions of the main and accessory lacrimal glands to the basal and reflex tears. It has been believed that the accessory lacrimal glands are the source of basal tears, while reflex secretion is the result of the main and accessory lacrimal glands collectively; but this idea has been challenged. But, more recently, it has been suggested that all aqueous tear secretion is the result of stimulation (Maitchouk, 2000).

In mammals lacrimal glands are located in the glandular lacrimal fossa under the zygomatic process of the frontal bone dorsolaterally to the eye ball surface (Dursum, 2000; Aslan *et al.*, 2005). The major part of the gland was covered by the supraorbital and frontal processes dorsally, and the small caudal part of it (about 1cm wide) was covered only by adipose connective tissue, fascia and skin.

Between domestic mammals these glands have shape differences, as it is triangular in pig (Nawrot and Dziegiel, 2008) and bipartite in sheep (Abbasi, *et al.*, 2014) and it is oval in goat and ovoid in donkey (Alsafty, 2010).

The lacrimal apparatus is a system that provide a passage for the drainage from the eye to the nasal cavity ;it consisted of a simple lacrimal sac ,paired canaliculi with the ventral and dorsal puncta (Bigam and Shadhast, 2009) .

Lacrimal glands are composed of several large lobes that are divided into smaller lobules of cellular secretory units, the acini. The duct system is highly branched and is responsible for transporting the lacrimal fluids to the ocular surface.

## MATERIALS AND METHODS

Ten adult healthy rabbits weighting 2.3-3.5 kg were used in this research. The animals were anaesthetized with diethylether, The entire eye complexes were removed. Eyeballs were removed from orbits cutting off the skin and surrounding tissues. Extensive care was employed to avoid any damage to lacrimal glands .Glands were fixed in formaline 10% for 24-36 hours and dehydrated in the usual manner for wax embedding. Serial sections, 5  $\mu$ m in thickness, were taken through each gland and stained with haematoxylin and eosin.

## RESULTS AND DISCUSSIONS

In most tetrapod vertebrates the orbital and nasal regions are connected by the nasolacrimal duct .The fluids that are produced by the orbital glands typically passes across the cornea and conjunctiva and then they are drained through this duct into the nasal cavity. Though most mammals appear to have at least one large orbital gland, the adult rabbit possesses either four or five distinct glandular masses. The secretion from these orbital glands forms the lacrimal fluid that drains into the nasolacrimal duct (Janssens *et al.*, 1999; Schlegel *et al.*, 2001).

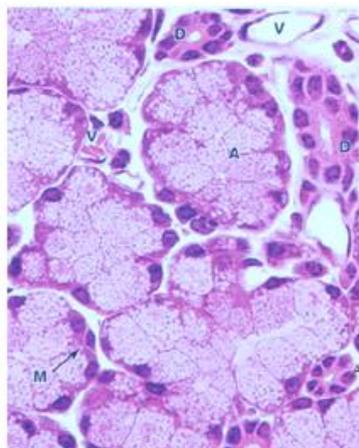
The lacrimal gland is surrounded by a connective tissue containing collagen fibers that divides the parenchyma of the gland into lobes and lobules (Nawrot and Dziegiel, 2008)

Histological examinations of the secretory units of the lacrimal gland explained that it is a mixed gland consisting of a tubulo-acinar units. The secretory acini are of two types ;serous and mucous . The surrounding connective tissue penetrates the gland and divides it into several lobules . This connective tissue septum is rich in blood vessels and possesses excretory ducts. The sizes of lobules varies between each lacrimal gland and there is not a distinctive pattern is present among them. The cells in serous acini are cuboidal to low columnar whose spherical nuclei are located near the cell's basal region. The cytoplasm of these cells displays an basophilic reaction. The mucous cells have a vacuolar cytoplasm and their flattened elongated nuclei are situated in the basal surface of the cell. The serous and mucous parts are mixed together but in some regions the serous acini are dominant while in other regions the mucous ones are abundant.

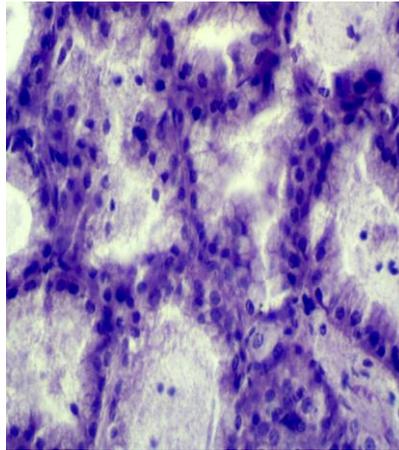
These types of mixed seromucous glands have also been found in many mammals including the pig, horse, goat, hamster. Lacrimal gland of the canine is a mucous gland while in the rat, it is a serous gland. But in the sheep they are mixed serous, seromucous and mucous cells (Gargiulo et.al.,1999;Abbasi et.al.,2014)

Intercalated ducts represents the smallest branches of the lacrimal duct system to which the secretory end pieces are attached and emerge from the acini as a distinctive group of cells. These ducts are lined with a single layer of cuboidal epithelial cells that stain red (eosinophilic), in contrast to the pyramid-shaped acinar cells that typically show a foamy and pale appearance because of the numerous glycoprotein-rich secretory granules in its cytoplasm . Many intercalated ducts combine together to form a larger intralobular ducts. The epithelial cells in the intralobular ducts are simple cuboidal and are stained slightly deeper than intercalated epithelium. Both intercalated and intralobular ducts are closely attached with the acini and are surrounded by some loose connective tissue. Intralobular ducts are fused together to form interlobular ducts, which drain several lobules of the gland. Interlobular duct epithelial cells are simple cuboidal to low columnar. They stain deeply with eosin without distinctive intercellular plasma membranes between them, in contrast with acinar cells. Nuclei in these ducts are spherical and are located close to the basal membrane. Interlobular ducts are fused together to form intralobar ducts, which drain every individual lobe. Epithelial cells that lines the intralobar ducts are simple to pseudostratified columnar . They have a basal spherical nuclei. They are surrounded by increasingly more connective tissue and, are accompanied by neurovascular bundles. Interlobar ducts are of variable dimensions due to compression by the surrounding tissues . Their epithelial lining range from simple to pseudostratified to stratified columnar, as they approach the main excretory duct. . Like other exocrine secretions, it is believed that lacrimal fluid is produced in two stages: formation of a primary fluid in the acini, and modification into the final fluid during transit through the duct system. These two stages were confirmed some time ago by micropuncture analyses of lacrimal fluids from rat and rabbit.this interpretation explains the highly branched lacrimal duct system,and it is agreed with the study of ( Rismondo *et.al.*,1989)and(*Ding et.al.*,2010).Results revealed also some morphological differences between sexes ;the secretory acini of males was significantly larger than that of females, our findings suggest that sexual dimorphism of the lacrimal gland may be a general phenomenon betweenrabbits and this finding was supported by the study of( Cornell-Del *et.al.*,1985) .this difference may be due to the influence of androgens. as, testosterone is known to enhance an enlarged and hyperactive lacrimal gland in the rabbit(Sullivan and Allansmith,1985) .

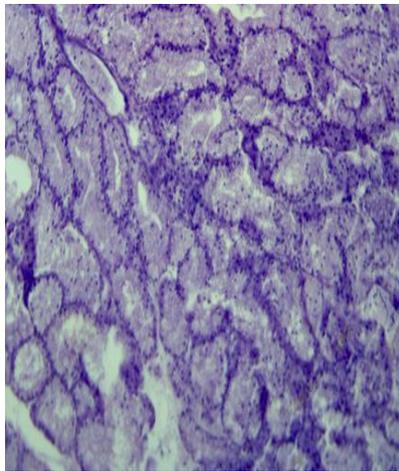
In conclusion; lacrimal glands are an ideal tubuloalveolar exocrine glands that are composed of lobes and lobules with many fine tubules. Each tubule is lined with a layer of cylindrical cells and a layer of flat basal cells resting on a basement membrane. The basal cells are myoepithelial . The collecting tubules are initially intralobular, and then become extralobular, and finally empty into fine ducts. These ducts are lined with a layers of epithelial cells.



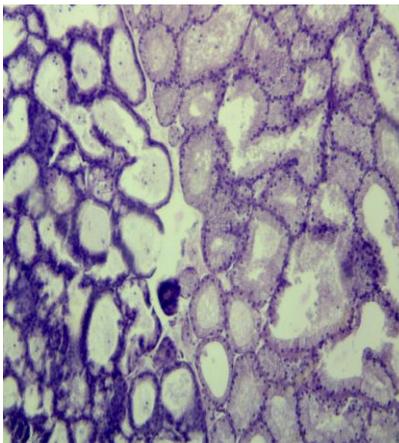
**Figure (1):** An acini; The mucous secretory cells of the gland, has a flattened nucleus at the base of the cell and an empty vacuolated appearance of the apical cytoplasm. These pyramidal cells are arranged in tubules and produce gellike mucin (glycoprotein and water mixture) secretions that usually protect or lubricate epithelial cell surfaces .  
**M,myoepithelial cells,V.blood vessel,D.inter&intralobular ducts (40x) H&E.**



**Figure (2):** Lacrimal gland, serous secretory cells has a spherical nucleus, and the secretory vesicles (granules) are located in the apical part of the cytoplasm. These serous cells are organized in acini and produce a watery proteinaceous secretion (40x).



**Figure (3):** An intercalated duct of lacrimal gland (10x)



**Figure (4):** Lacrimal gland secretory acini, it is a mixed gland containing both mucous secretory portions (M) and serous secretory portions (S). The serous cells forming a moon-shaped cap on top of the mucus are called a serous demilune (10x).

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