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Histological and histochemical study of the lacrimal gland in adult local breed cattle *(Bos Taurus)*.

A Graduation Project Submitted to the Department Council of the Internal and Preventive Medicine-College of Veterinary Medicine/ University of Al-Qadisiyah in a partial fulfillment of the requirements for the Degree of Bachelor of Science in Veterinary Medicine and Surgery.

By

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بِسْمِ ٱللَّهِ ٱلرَّحْمَٰنِ ٱلرَّحِيمِ

فَتَعَالَى ٱللَّهُ ٱلْمَلِكُ ٱلْحَقُّ ۗ وَلَا تَعْجَلْ بِالْقُرْآنِ مِنْ قَبْلِ أَنْ يُقْضَىٰ إِلَيْكَ وَحْيُهُ ۖ وَقُلْ رَبِّ زِدْنِي عِلْمًا

صدق الله العلي العظيم

طه 114

Certificate of Supervisor

I certify that the project entitled (**Histological and histochemical study of the lacrimal gland in adult local breed cattle (*Bos Taurus*))** was prepared by (**Haneen Abd Al_ameer Abbas)** under my supervision at the College of Veterinary Medicine / University of Al-Qadisiyah.

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-- / -- / 2021

Certificate of Department

We certify that **Haneen Abd Al_ameer Abbas** has finished his/her Graduation Project entitled (**Histological and histochemical study of the lacrimal gland in adult local breed cattle (*Bos Taurus*)**) and candidate it for debating.

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-- / -- / 2020

الاهـــــــداء

الى مَالكِ كَينُونَتي و وُجُودِي، المُعينُ لي في مَسيرتي الطَّويلة ، مَن يأخُذ بِيدي بالرُغمِ مِن ضَعفِي و قِلَّةَ حِيلتي " ربي العظيم . "

إلى تِلكَ اليدينْ التيّ زرعتْ فيَّ حُب التقدُمِ و المسيرِ ، الشيبةُ التي رسمتْ ببياضِ عُمرها حياتيْ كُنتم خير عونٍ يُرشدني دوماً إلى الصواب " والديَّ العزيزينْ.. "

إلىَ مَن ساندني في تَقدُّمي و قدَّم لي الوقت و الجهد ساعياً في نجاحي" الدكتور نبيل عبد مراد المعموري "

و أنتهي بتقديمِ مسيرةِ كُلّ تلكَ الأعوام

لكُلِ أُمٍ لم تُزهر وجنتيها بنجاحِ ولدها و سبقها التُراب في احتضانه ، عسى أن يكفي شُكري و يجد لهُ مكاناً صغيراً في قلبكِ..

Haneen Abd Al_ameer Abbas

Abstract

The present study designed to provide information for histological structures & histochemical component of the lacrimal gland in adult local breed cattle *(Bos taurus)*.

Histological study

For histological study eight fresh specimens of glandular part of the cattle. The lacrimal gland in cattle covered by a capsule which sends many connective tissue septa to penetrate the parenchyma of the gland and divided it into many lobes and lobules in various size and shape. The lacrimal gland was a compound mixed acinar gland consist of serious and mucous acini.

The serous acini rose shaped, lined by pyramidal cells with basally located rounded nuclei; mucous acini were lined with a columnar cell had ovoid to flattened nucleus basally located, while the mixed acini made by mucous pyramidal cell surrounded by serous cell or vasa versa take crescents shape(demilune). It had an ovoid nucleus located at a basal part of a cell.

Extra glandular ducts lined with stratified cuboidal epithelium with goblet cells, while in goat lined by stratified high cuboidal to columnar epithelium with numerous goblet cells.

Histochemical study

The serous acini of the lacrimal gland in cattle showed –ve reaction for PAS, AB and PAS-AB. The mucous acini in cattle gave a +ve reaction for PAS and less number of mucous acini show +ve reaction AB. Few to a moderate number of acini show positive reaction for PAS- AB. The goblet cells which found in the epithelium

lining the duct system take +ve reaction for PAS, AB and PAS-AB stains with variation in degree of reaction.

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1. Introduction

Cattle is the most important species of ruminants, which provide meat, milk and leather. They are spread in different countries (AL-Sadi, 1980). The eyes were the sensory organ responsible for eyesight. It is well protected from injuries by the bone which formed the orbit. It has accessory structures important in the process of maintaining eye, including the lacrimal gland, third eyelid gland (Akers and Denbow, 2013).

In bovine, caprine, ovine, camel and equine except canine, swine, feline the lacrimal gland was situated within the orbital between the dorsolateral part of the eyeball and the supraorbital process of the frontal bone and the frontal process of the zygomatic bone. The major part of the gland was covered by the frontal processes dorsally, whereas a small caudal part (about 1cm wide) was covered only by adipose tissue (Periorbital fat), fascia and skin in canine and feline the orbital cavity shallow due to the absence of frontal and zygomatic process (Bacha and Bacha, 2000 and Alsafy, 2010).

The lacrimal gland covered by capsule send connective tissue septa divided it into many lobules. The septa contain blood vessels, nerves, ducts and some adipose tissue. The mucous acini of the gland are located at the periphery of the lobule of the gland (Getty, 1975) in domestic animal and (AL-Obeady, 2016) in dog and sheep. Its produced the major part of the aqueous fluid while the lipid produced by the miebomian gland (tarsal gland) and mucin, which is produced by conjunctival goblet cells (Martin, et al., 1988; Gargiulo, et al., 2000 and Pinard, et al., 2003). There is very little research about the histological and histochemical of the lacrimal gland in local breed cattle so the aim of our study designing to providing a new histological and histochemical information about lacrimal apparatus to be in correlation with other science such as medicine, surgery and physiology department.

2. Literature Review

2.1. Histological study.

2. 1. 1. Lacrimal gland.

The lacrimal glands in bison and cattle were of tubuloacinar units separated by dense connective tissue into many lobules. The connective tissue septa separated each lobule into acinar and tubular units. The acini were composed of columnar cells or tall pyramidal. It had a small lumen. The tubule was surrounded by low columnar cells with large lumens. The bison acinar cells had basophilic, vacuolated and granular cytoplasm. While, in cattle, the acinar cells were an eosinophilic, uniform and granular cytoplasm. In both cattle and bison, the nuclei of the acinar cells were round to oval in shape in the basal part of it. Inter-lobular ducts lined by pseudostratified columnar epithelium (Pinard, et al., 2003).

Kleckowska-Nawrot, et al., (2015) described the lacrimal gland in European bison was a multilobar tubulo-acinar gland. It was cover by a thick connective tissue capsule, consist of collagen and elastic. The mean thickness of the capsule was 395.5μm in females and 316.91μm in males. The capsule sends septa that penetrated the parenchyma of the gland to divide the gland into many lobes in different size and shape. It could seem sparse adipocytes and blood vessels in the septa. The mean thickness of the interlobar septa was 138.82μm in males and 169.22μm in females. The acini had irregular lumen was composed of tall conical cells enclosed by basal basket cell (myoepithelial cells). The mean outer diameter of the glandular acini was 27.98 μm in male and 34.36μm in the female. The secretory cell had large and round nuclei basally located. The tubules had large lumen was consist of one layer of cuboidal cells with round nuclei situated in the basal part of the cells. The average outer diameter of tubules was 42.89μm in male and 46.72μm in the female.

The lacrimal gland in Philippine water buffalo was surrounded by a capsule which consists mainly of collagen fibers, send connective tissue septa that divided the gland into many lobules to take various sizes. Each lobule was consisted of several rounds to oval-shaped secretory acini. It was a mixed gland but mainly mucous compound tubulo-acinar gland. The interlobar ducts located in the interlobar connective tissue septum. It was lined with tall simple or stratified columnar epithelium. Each acinus consisted of many secretory columnar cells arranged radially around a small lumen. The excretory duct system was intercalated and intralobular ducts dispersed among the secretory acini (Maala, et al., 2007 Girgiri and Kumar, 2018).

The lacrimal glands of the Iranian river buffalo consisted of tubuloacinar units the gland divided by dense of connective tissue septa which rich with blood vessels into many lobules by septa. The septa separated the acinar and tubular units from each other. The acini consisted of tall columnar cells or pyramidal had small lumens. The tubules were lined by short columnar cells with large lumens. The tubules were seen combined between the acini. The acinar cells characterized by basophilic, granular and vacuolated cytoplasm. Inter-lobular ducts lined by pseudostratified columnar epithelium (Shadkhast and Bigham, 2010).

In Awasi sheep and native black goat, the lacrimal glands were surrounded by a thick capsule composed of mainly collagenous fibers, elastic fibers, smooth muscle fibers, adipose tissue, blood vessels and nerve fibers. The capsule sends a sheet of connective tissue septa which divided the parenchyma of glands into many lobules containing the blood vessels and interlobular ducts. The secretory units were mixed surrounded by basket cells. The intercalated ducts were lined by low cuboidal epithelium, but gradually increased in height to convert stratified cuboidal to

stratified columnar epithelium with goblet cells in the interlobular ducts (Daryuos and Ahmed, 2012b)

Also, Daryuos and Ahmed, (2012b) in goat and sheep recorded the mean of total diameter, lumen diameter and height of serous acini 34.08±0.59 µm, 6.16±0.36 µm, 13.97±0.33 µm, 34.74±0.66 µm, 6.2±0.41 µm and 14.31±0.39 µm respectively. While the mean of total diameter, lumen diameter and height of mucous acini in goat and sheep 36.6±0.48µm, 7.4±036µm, 14.65±0.36µm, 37.49±0.35µm, 7.2±046µm, 15±0.45µm respectively. Whilst the mean of total diameter, lumen diameter and height of mixed acini in goat and sheep 35.5±0.85µm, 6.6±0.75µm, 14.5±0.65µm, 36.78±0.75µm, 7.5±0.45µm and 14.6±0.54µm respectively.

Gargiulo, et al., (1999) described the lacrimal gland in sheep was a compound tubulo-acinar gland. It was lobulated and highly vascularized. The secretory units acini lined by pyramidal or columnar cells filled with variably stained granules.

In sheep, the lacrimal gland was compound tubuloacinar gland. The secretory units were lined with cells filled by heterogeneous granules (Gargiulo, et al.,2000).

The lacrimal gland in Lori sheep was mixed consisting of tubulo-acinar units serous and mucous acini. The connective tissue capsule penetrates the parenchyma of the gland to form connective tissue septa divided the gland into several lobules in varies size and shape. The connective tissue septa were rich in blood vessels and possess excretory ducts. The cells in serous acini were cuboid to low columnar with rounded nuclei located near the basal part of the cell. The cytoplasm had an eosinophilic reaction. The cells of mucous acini had elongated nuclei located in the cell base of it and a vacuolar cytoplasm. The mucous and serous parts were mixed together, while in some regions of gland the serous acini were dominant but, in

another region, the mucous acini were more abundant. The intralobular ducts lined by simple cuboid epithelium, while the interlobular and excretory ducts lined with stratified cuboidal. In some cases, it could be seen the goblet cells in between epithelia The epithelial lined the excretory ducts was pseudostratified columnar with goblet cells (Abbasi, et al., 2014).

The lacrimal gland in different animal species composed of serous acini which lined with cuboidal cells. The lobules surrounded by loose connective tissue (Menaka and Puri, 2015 and Yao and Zhang, 2017).

In small ruminants (goat and sheep) the interlobular ducts were lined by stratified cuboidal epithelium with goblet cell (Sinha and Calhoun, 1966).

In the Bactrian Camels, the lacrimal gland was tubuloacinar and the acini had large lumen lined by cuboidal cells (Chengjuan, et al, 2008); while Awkati and Al-Bagdadi, (1971) in dromedary camel show the lacrimal gland was compound alveolar and secretory units were lined by pyramidal cells.

The lacrimal gland in camel was enclosed with a thick connective tissue capsule consisted mostly of collagenous fibers with elastic fibers and some reticular. The capsule sends thin connective tissue septa that penetrated the glandular parenchyma to divide the gland into many lobes and lobules into different shapes and sizes. In the septa could be observed interlobular ducts. The lacrimal gland consisted of serous secretary units (alveoli and tubules) which were lined with simple cuboidal cells arranged in one layer around a narrow lumen. The secretory units and intralobular ducts were enclosed by a thin layer of reticular fibers. All duct beginning small and then increased in size and reach to excretory ducts. The interlobular duct

was lined with stratified columnar epithelium with numerous large goblet cells and surrounded by loose connective tissue (Elmahadi, 2017).

Mohammadpour, (2011) reported the lacrimal gland in camel was compound tubuloalveolar with serous type. The gland was composed of many lobules vary size which separated by connective tissue. There are three types of the acinus, secretary units, tubule and alveoli that separated from each other within a lobule. The most secretory units consist of alveolar and tubular units. Young and Van Lennep, (1978) reported that the secretory endpiece consists of one (homocrine) or more (heterocrine) cells types serous, mucous, seromucous, serous demilunes and mucous demilunes.

The lacrimal gland in camel was lobulated and covered by a dense connective tissue capsule that rests on a smooth muscle layer. The capsule sends connective tissue septa to penetrate the parenchyma of the gland and divided it into many lobes and lobules into different sizes and shapes. The capsules and septa connective tissues were consisted of collagen fibers and they were rich with adipose tissue. The elastic and reticular fibers were also detected together with some smooth muscle fibers. Each lobule consisted of clusters of serous acinar unite. Each acinus had a small lumen, while the tubules had a wider lumen. The acini and tubules were lined with tall simple cuboidal cells and round to oval centrally nuclei. The basket of cell elongated shape dark and oval nuclei present around the excretory unite. The acini and tubules which empty secretion into the intralobular ducts. The intralobular ducts empty into the interlobular ducts. The small interlobular duct was lined with simple cuboidal or simple columnar epithelium, but the large ones were lined with pseudo-stratified columnar epithelium with goblet cells. The interlobular ducts were

surrounded by loose connective tissue in which there were blood vessels, elastic and reticular fibers (Ibrahim and Abdalla, 2015).

Ibrahim, (2015) described the lacrimal gland in camel was covered by a connective tissue capsule that sent septa, which divided the parenchyma of the lacrimal gland into many lobes and lobules in different sizes and shapes. Each lobule consists of an aggregation of secretory units that were compound tubulo-alveolar and they were surrounded by interstitial connective tissue. The secretory unit was lined by a layer of pyramidal cells (tall cuboidal) with oval nuclei. The cells rested on a basement membrane were surrounded by basket cell (Myoepithelial cell).

The intraglandular ducts system of the lacrimal gland in camel were intra-lobular, inter-lobular and excretory ducts. The intra-lobular ducts lined by low simple cuboidal epithelium tissue. The intra-lobular ducts run to inter-lobular ducts which opened into the excretory ducts and finally opened into the dorsal conjunctiva. The inter-lobular and excretory ducts were lined by pseudostratified columnar epithelium tissue, that was rich in goblet cells and surrounded by a loose connective tissue. The mean height of epithelia of the secretory units was 13.51μm in winter and 17.878μm in summer. The Lumen diameter 7.85μm in summer and 8.65μm in winter. The mean thickness of interstitial connective tissue was 5.13μm in summer and 5.49μm in winter (Ibrahim, 2015).

The lacrimal gland in alpaca was covered by a thin connective tissue capsule and seem the adipose tissue beneath the connective tissue capsule. Many fat cells speared into the glandular tissue together with the septa (interlobular connective tissue) that divided the parenchyma of the gland into lobes. The capsule and septa were contained numerous of blood vessels, lymphocytes, fibrocytes and plasma cells.

The gland was tubule acini, the serous acini cell was a tall conical cell with the irregular lumen and surrounded by myoepithelial cells. The nuclei of secretory cells were giant, oval in shape and concentrated in base of the cell. These cells had vacuolated and basophilic granular cytoplasm. The tubule consisted of the simple cuboidal layer with the large lumen and eosinophilic cytoplasm. It had oval nuclei located in the basal part of the cells (Klećkowska-Nawrot, et al.,2015).

The lacrimal gland in Roe deer was a tubuloacinar gland surrounded by relatively poor connective tissue capsule that sends septa to divide the gland in too many lobules. The acini were composed of two types of cells. Tall conical cells (serous cells) had a small lumen surrounded by myoepithelial cells and sporadic conical cells (mucous cells) with a large and irregular lumen. The secretory cell nuclei were oval to round and were situated in basal areas and central parts of both cells. These cells had vacuolated cytoplasm and basophilic granular. The glandular secretion was aggregated in the apical parts of the cells. The nuclei of the mucus-producing cells were oval and they concentrate near the basal area of the cell. The excretory ducts were lined with a basal layer of cuboidal cells with nuclei situated in the central position of the cell (Kleckowska-Nawrot, et al., 2013).

Sugiura, et al., (2010) and Mirhish and AL-Obeady, (2016) described the lacrimal gland in the dog was compound tubulo-alveolar or acinar gland. It was consisted of many lobules that separated by inter lobular loose connective tissue septa. Mirhish and AL-Obeady, (2016) recorded the glandular lobules was measured 1245.63μm. It consists of serous and mucous secretory units and the diameter were 46.4μm and 33.5μm, respectively. The mucous alveolar cells were tall columnar cells. It had darkly stained round nuclei in the basal part of the cell, whereas the serous acini cells were low cuboidal cells. It had centrally positioned nuclei. The

myoepithelial cells (basket cell) were situated between the glandular epithelium and the basement membrane. The connective tissue was thick and resting between the secretory units. It was composed of only collagen bundles and no smooth muscles fibers. The duct system of glandular tissue beginning with intralobular duct, that lead to interlobular duct in connective tissue septa. Both ducts were lined by low cuboidal cells. The average diameter of the right and left intralobular duct were 19.83µm and 20.5µm respectively. The interlobular duct leads to main excretory duct the convey secretion to the posterior surface of lids that lined with stratified cuboidal epithelium cells. The mean diameter of the right and left interlobular duct were 39.65µm and 40.97µm respectively.

El-naseery, et al., (2016) described the lacrimal gland in dog composed of stroma and parenchyma. The stroma consisted of a dense connective tissue capsule that was covering bundles of smooth muscle fibers. The capsule sent septa to divide the glandular parenchyma into many lobes and lobules differ in size and shape. The adipose cells were detected in the capsule and inside the glandular lobule. The stromal connective tissue of the capsule and septa consisted chiefly of collagen fibers and few elastic fibers. The glandular parenchyma was consisted of the secretory unites and the duct system. The secretory units consisted of serous and mucous type, but the mucous secretory acini were predominant were tubular in shape with a wide lumen. It lined with tall columnar cells, of basal oval nuclei and pale acidophilic vacuolized cytoplasm. The serous secretory units were mainly acinar in shape with a narrow lumen lined with pyramidal cells of nearly central rounded nuclei and homogenous acidophilic cytoplasm. The secretory unit (acini) open directly into intercalated ducts. The intercalated ducts were lined by two types of epithelium simple squamous epithelium and simple cuboidal epithelium. The intralobular ducts

were lined by simple cuboidal epithelium and surrounded by a thin layer of connective tissue. The interlobar ducts were lined by simple columnar epithelium and surrounded by a thick layer of connective tissue.

Kleckowska-Nawrot1 and Dziegiel, (2008) described the lacrimal gland in big was compound tubulo-alveolar gland. Each lobe consists of many lobules that contain excretory unite. The basket cells were found between the basement membrane and base of excretory unite. The excretory ducts were lined by simple cuboid epithelium with a round nucleus.

2.2.2. The excretory ducts

Sinha and Calhoun, (1966) and Kuehnel and Scheele, (1979) found in sheep, goat and pig the excretory ducts were lined by pseudostratified columnar epithelium with goblet cells and the lamina propria consist of dense collagenous fibers. While Daryuos and Ahmed, (2012b) described the excretory ducts in Awasi sheep and black goat were lined by stratified columnar epithelium with goblet cells.

Abbasi, et al., (2014) described the excretory ducts in Lori sheep were lined by stratified cuboidal to pseudostratified columnar epithelium with goblet cells.

Ibrahim and Abdalla, (2015) described excretory ducts in the camel were lined with pseudostratified or stratified columnar epithelium rich with goblet cells, lymphocytes. The lamina propria was made of dense irregular connective tissue comprising mainly collagenous fibers, some smooth muscle fibers, adipose tissue and blood vessels. Also (Awkati and Al-Bagdadi, 1971) in camel described the excretory ducts were also lined with stratified columnar epithelium, the subepithelial layer was vascular and infiltrated with lymphocytes.

In Camel, the excretory ducts were lined with stratified columnar epithelium with numerous large goblet cells. In the subepithelial layer contain groups of mucous glands and lymphocytes were observed. The surrounding connective tissue contained blood vessels, nerve fibers and adipose tissue (Elmahadi, 2017).

In Roe Deer, the excretory ducts were lined by simple cuboidal cells (Kleckowska-Nawrot, et al., 2013).

2.3. Histochemical study

Triveni, et al., (2018) recorded in cattle, goat and sheep the secretory units of lacrimal gland have a strong PAS +ve reaction, while few secretory units take strong PAS +ve reaction and few secretory units showed weak PAS +ve reaction in buffalo. Also few secretory units and secretory cells in some secretory units showed +ve reaction for Alcian blue at pH 2.5 in cattle, goat, buffalo and sheep

In sheep, the acinar cells of lacrimal gland gave positive reaction about 40% with PAS stain but in different degrees from moderate to strong PAS-positive cells were always situated in the periphery of the glandular lobules. The goblet cells take a strong reaction with PAS and Alcian blue pH 2.5. It was scattered among the epithelial lining cells in the interlobular ducts which gave strong +ve for PAS (Gargiulo, et al.,2000).

In Lori sheep, the mucous cell of lacrimal gland gave a high affinity to Alcian blue and PAS staining (Abbasi, et al.,2014).

Pinard, et al., (2003) described the histochemical reaction of the lacrimal gland in bison and cattle were PAS staining appears the presence of positive granules in all

acini of these glands in both species. Some acini had more heavily stained than others in both species. Alcian blue stain with pH 2.5 revealed similar staining in both species and seen positive granules in the acini. In some specimens seen the granule in the apical portion of the acinar cells; the other acinar cells were completely stained with positive granules.

Elmahadi, (2017) described the Alcian blue-pH2.5 reaction with acinar cells of the lacrimal gland in camel show negative or weak reaction and positive reaction in numerous tubules, intralobular and interlobular ducts. The excretory ducts seemed with a strongly positive reaction goblet cells and mucous glands. While PAS stain was a strongly positive reaction with granules in the acini, tubules, intralobular ducts and connective tissue septa. The interlobular and excretory ducts had a very strong positive reaction in their goblet cells and a few cells were Alcian blue and PAS positive.

The lacrimal gland in alpaca when used PAS staining to detect the presence of neutral and acid glycoproteins seem numerous of secretory acini gave strong positive reaction containing PAS-positive granules, and some of the acini gave an average positive reaction, while some of the cells –ve reaction. Alcian blue pH 2.5 staining has detected the presence of acid sulfated mucins and sialomucins mucous cells gave (++) in the acini and tubules (Klećkowska-Nawrot, et al., 2015).

In Roe deer, the PAS staining of the lacrimal gland appeared the presence of limited secretory cells containing slightly PAS-positive granules (+) (2-3 mucous cells), whereas the remaining ones were serous PAS negative. Apical portions of the cell of the excretory ducts also appeared a little positive PAS reaction. Alcian blue pH 2.5 staining appeared the presence of moderately positive granules in the apical

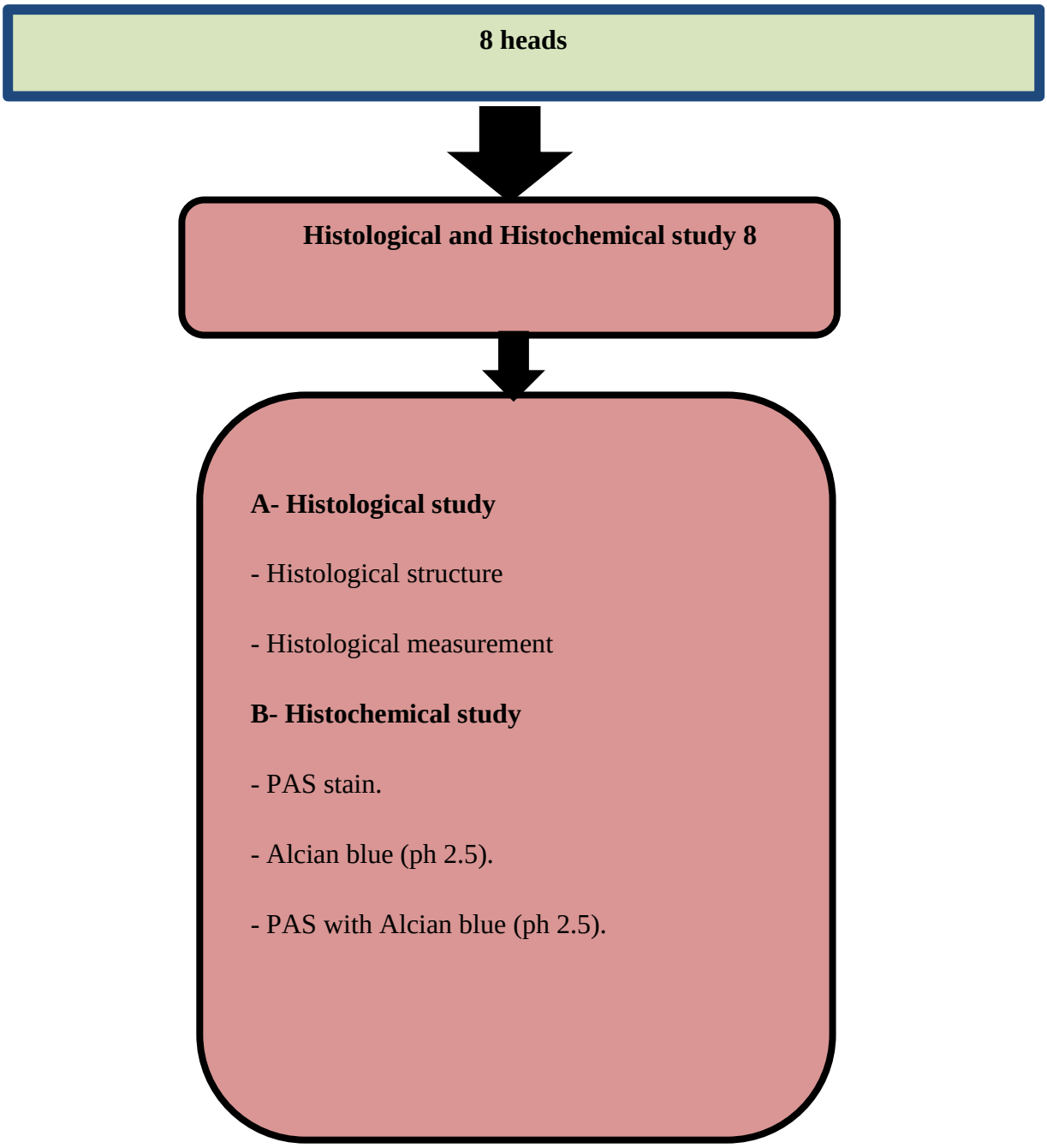
portion of the secretory cells and the epithelial cells in the interlobular ducts. also could be observed the presence of solitary cells fully filled by Alcian blue pH 2.5 positive granules (+) (Kleckowska-Nawrot, et al., 2013).

El-naseery, et al., (2016) and Mirhish and AL-Obeady, (2016) described the staining reaction the connective tissue of capsule of the lacrimal gland in the dog was stained positively by Alcian blue, whereas smooth muscle fibers were stained positively by Periodic Acid-Schiff. The lining cells in some secretory unites were positively stained with Periodic Acid Schiff and Alcian blue.

The secretory acini of the lacrimal gland in Philippine water buffalo were strong reaction to the PAS and Alcian blue pH 2.5 stains. The ducts reacted negatively to Alcian blue stains (Maala, et al., 2007).

3. Materials and methods

3.1 Study design:



3.2. Collection of Specimens:

The present study design to the distinctive histological and histochemical structures of the lacrimal gland in adult local breed cattle *(Bos taurus)*.

Eight head of healthy heads of cattle and goat, aging (1.5-2) year collected from slaughterhouses after examination and ensure that eyes and nasal cavity were free from any pathological lesions.

3.4. Histological study

For histological study eight fresh specimens of lacrimal glands and the nasolacrimal duct of the cattle healthy appearance. The histological specimens were dissected immediately and freshly. It washed with normal saline. There were a histological sample of different sites of the lacrimal glands (body and appendage eight sites).

The histological sample fixative in 10% neutral buffered formalin (N.B.F) for 48 hours at room temperature, then washed with tap water for two hours, after that the sample was processed by routine histological processing methods including:

1) Dehydration. **2)** Clearing. **3)** Infiltration. **4)** Embedding. **5)** Sectioning.

6) Mounting. **7)** Staining by HandE and Masson's trichrome. **8)** Cover slipper and labeling (Suvarna, et al., 2013).

Dehydration by using series spiraling of alcohol beginning with 50%, 60%,70%, 80%, 90% and 100% for 2 hours for each concentration.

Clearing by using Xylen twice 10-50 minutes for each solution. Infiltration by putting the tissue specimens in paraffin wax on (56.5-58°C) for overnight.

Embedding the specimens within paraffin wax for to made blocks. Sectioning the specimens to 5-7µm by using rotary microtome.

Rehydration by alcohol abdicable series beginning by 100%, 90%, 80%, 70%, 60% and 50%.

Finally staining the specimens by Mayer's hematoxylin and eosin and Massons Trichrome stains. Mounting was the process of adding the amount of DPX and then putting the cover slide on the sections strip on glass slides to cover it (Luna, 1968). Finally, examine the histological slides under X4, X10, X20 and X40 of the light microscope.

The histometric measurements of glandular epithelium thickness of capsule, septa, and diameter of acini, intra glandular ducts, excretory, punctum, canaliculi, sac and nasolacrimal duct and high of acinar and duct cells. Done by a light microscope, ocular micrometer and stage micrometer (Galigher and Kozloff, 1964)

3.5. Histochemical Study

Several slides of lacrimal glands and duct system of the cattle and goat. It was stain by special histochemical stain including: -

1) Periodic Acid Schiff (PAS): For detection of mucin, muco-protein, glycoprotein, mucopoly saccharides and basement membrane.

2) Alcian Blue stain (pH 2.5): For detection of acidic mucopolysaccharides.

3) Combined Alcian Blue (pH 2.5) + PAS stains: To determine the acidic mucin and neutral mucin in the acini of the gland (Suvarna, et al., 2013).

4. Results:

4.1. Histological results

4.1.1. Glandular part

4.1.1.1. Lacrimal gland in cattle

The lacrimal glands was elongated, irregular outline, flattened and clear lobulated. The gland was light brown in color, usually surrounded by periorbital fat. Each gland was consist of two parts main part (body) and appendage part (Fig.1, 2, 3 and 4).

The histological structure of lacrimal gland in local breed cattle *(Bos taurus)* similar in the two parts of gland body and appendage. The gland covered by dense irregular connective tissue. The connective tissue capsule sends many connective tissue septa (trabeculae) which penetrate the parenchyma of the gland divided it into many lobes and lobules in various size and shape (Fig. 5 and 6).

The capsule and septa consist mainly of collagen fibers. In both capsule and septa could be seen adipose cells and blood vessels (Fig.5 and 6). The mean thickness capsule and septa were 640±72.57µm and 132±28.85µm respectively

The lacrimal gland was a compound mixed acinar gland consist of serous and mainly mucous acini surrounded by myoepithelial cells (Basket cell). Each lobule of gland made up mixed acinar secretary units of various size. The serous acini rose shaped. It was lined by pyramidal cells with rounded nuclei in a basally located and the cytoplasm had homogenous acidophilic (Fig.7 and 8). The mean height of the cell, outer diameter, the lumen diameter of acini were13.5±0.66µm, 33±1.1µm and 5.2±0.16µm respectively.

The mucous acini were lined with a columnar cell had ovoid to flattened nucleus basally located. The cytoplasm was pale vacuolated and granular cytoplasm (Fig.8 and 9). The mean height of the cell, outer diameter and lumen diameter of acini were 13.5±0.84µm, 34±2.01µm and 5.75±0.33µm respectively. The mixed acini usually mucous with serous cells. It had an ovoid nucleus located at a basal surface of a cell (Fig. 7). The mean height of the cell, outer diameter and lumen diameter of acini were 13±0.33µm, 30±0.52µm and 4.75±0.4µm respectively.

4.3.1.2. Intraglandular duct system of the lacrimal gland in cattle

There were many types of ducts that convey the secretion of the lacrimal glands started with the smallest duct the intercalated duct and ended by the largest duct excretory duct (Fig. 5 and 6).

A. Intercalated ducts

These were the smallest ducts in the lacrimal glands had small lumen lined by low cuboidal epithelium with a large round to ovoid dark nuclei basally located. The myoepithelial cell was seen surround the intercalated ducts. The duct located among the acini's in lobule (Fig.5). The mean height of epithelium, outer diameter and lumen diameter were 9.5±0.62µm, 26.5±1.54µm and 7.5±0.91µm respectively.

B. Intralobular duct

Larger than intercalated duct present with the lobules surrounded with connective tissue. It was lined with a simple cuboidal epithelial with ovoid to round nuclei basally located (Fig. 5, 6, 7 and 8). The mean height of epithelium were outer diameter and lumen diameter of 12.5±0.91µm, 45±2.98µm and 19.5±2.26µm respectively.

C. Interlobar excretory duct

These ducts located among the lobules of the gland in the connective tissue septa. It was lined with simple columnar epithelium with rounded to oval nuclei located near the base of the cells the epithelium convert to stratified cuboidal or columnar (Fig.5, 6 and 7). The mean height of epithelium, outer diameter and lumen diameter were 19.5±1.33µm, 118.5±14µm and 85.5±8.93µm respectively.

D. Excretory duct

The excretory duct was made up with the joined of the interlobar ducts and the last one trans the secretion into the extraglandular ducts in the conjunctiva of the upper eyelid. The duct has a large lumen located in the capsule. The duct was lined by simple columnar epithelial cells converted lastly into stratified columnar epithelium that formed by 2-3 layers of cells with ovoid to round nuclei found near the base of the cells (Fig.5, 6, 9 and 10). The mean height of epithelium, outer diameter and lumen diameter was 23±1.31µm, 274±31.8µm and 222.5±31.01µm respectively.

4.3.1.5. Main excretory duct in cattle

The main excretory duct were 6-7 ducts opening in the mucosa of the conjunctiva in the upper eyelid (fornix). It was received the secretion from the intraglandular excretory duct. The duct lined with stratified cuboidal epithelium with goblet cells. It has ovoid to round nuclei. The duct was surrounded by dense irregular connective tissue containing mainly collagen fibers, smooth muscle fibers and lymphocyte (Fig. 11 and 12). The mean height of epithelium, outer and lumen diameter of were 36±1.35µm, 218±14.03µm and 134.5±5.01µm respectively .

4.4. Histochemical results

The positive result for Periodic acid Schiff stain (PAS) indicated present neutral mucopolysaccharide, positive result for Alacian blue indicated present acidic mucopolysaccharide, the positive result to AB – PAS stain indicated present acidic (AB+), neutral (PAS+) and mixed mucopolysaccharide.

4.4.1. Glandular part

4.4.1.1 Lacrimal glands in cattle

The lacrimal gland in cattle was mixed gland composed of mucous, serous and mixed acini (Fig.13). Thus, the mucous acini show positive reaction (+ve) for PAS in two degrees strong and weak positive while the serous acini showed negative reaction (-ve) for PAS. The mixed acini (demilune) show a +ve reaction to PAS whilst the acini gated –ve reaction (Fig.14 and 15). The intraglandular duct system which includes intercalated duct, intra and inter lober duct and excretory duct showed –ve reaction (Fig.14 and 15). The acini of the lacrimal gland in cattle show a different reaction to AB stain. Some mucous acini showed strong +ve reaction for AB other mucous acini showed –ve read for AB. All the serous acini have –ve reaction for AB. The mucous acini in the mixed acini gave +ve reaction to AB. The intraglandular duct system showed –ve reaction (Fig.16 and 17). The reaction of acini of lacrimal gland of cattle for AB-PAS appears some acini were positive for PAS and others showed positive reaction for both AB-PAS. The intraglandular duct system showed –ve for both stain (Fig.18 and 19).

4.4.1.3. Main excretory duct in cattle

The epithelium which lining the main excretory duct had goblet cells showed strong +ve reaction for PAS (Fig.20). Also showed a positive reaction for AB Fig. (Fig.21). The goblet cells gave a +ve reaction with AB-PAS stain (Fig.22).

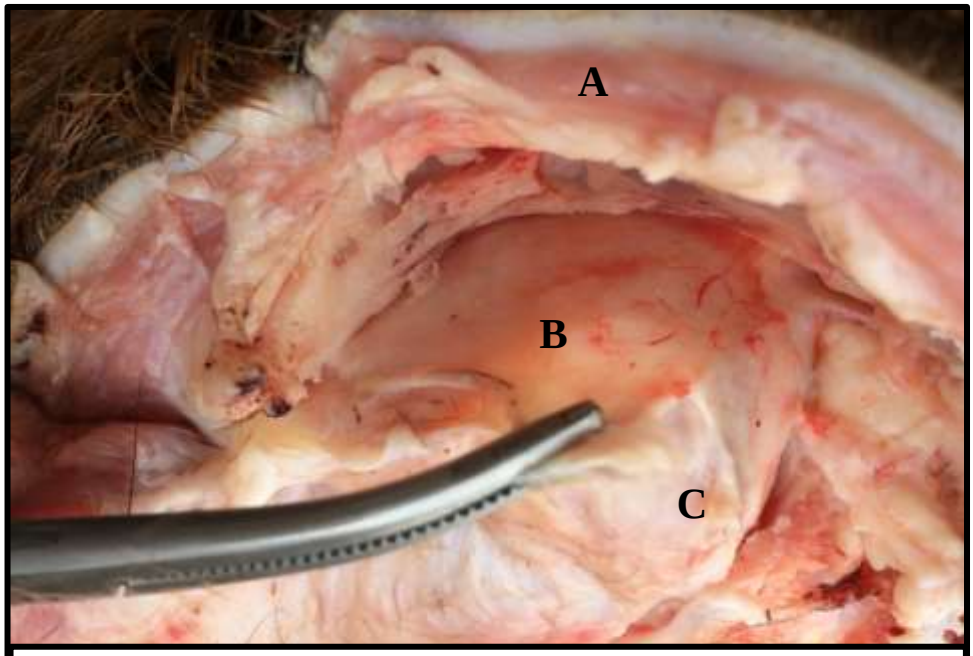


Fig.(1). Lacrimal gland inside the orbital cavity of cattle show:
A-Zygomatic process of frontal bone. **B**- Periorbital connective tissue. **C**-Ventral border of lacrimal gland.

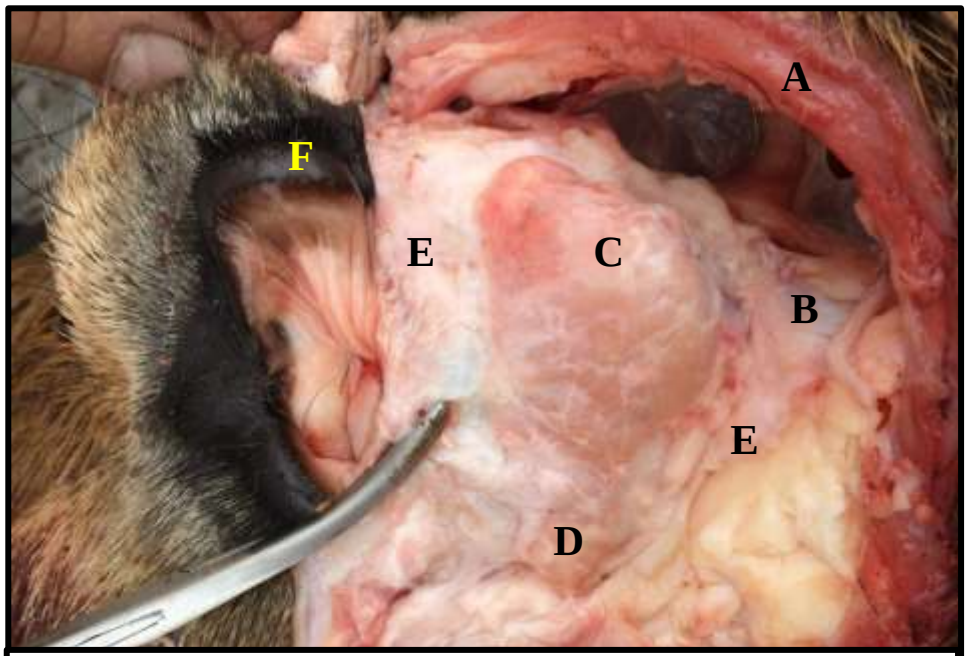


Fig.(2). Lacrimal gland in cattle Show: **A**-Zygomatic process of frontal bone. **B**- Periorbital connective tissue. **C** -Body of lacrimal gland. **D**-Appendage of lacrimal gland. **E**-Periorbital ocular fat. **F**- Upper eyelid**.**

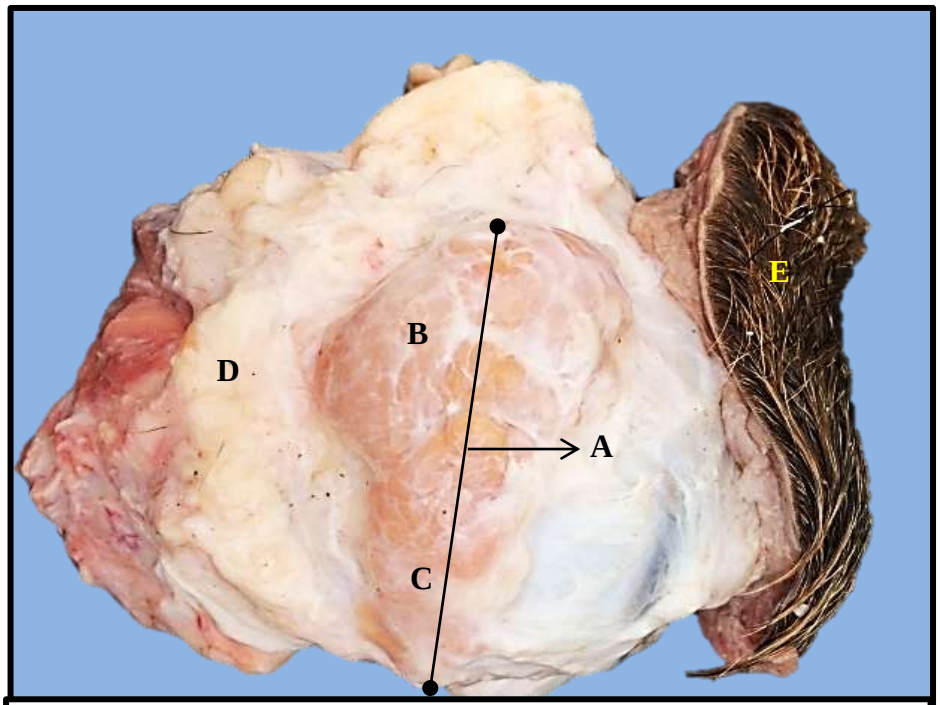


Fig.(3). Caudodorsal view of lacrimal gland in cattle show: A- Lacrimal gland. **B**- Body of lacrimal gland. **C**- Appendage of lacrimal gland. **D**-Periorbital ocular fat. **E**-Upper eyelid**. F**-Medial end. **G**- lateral end

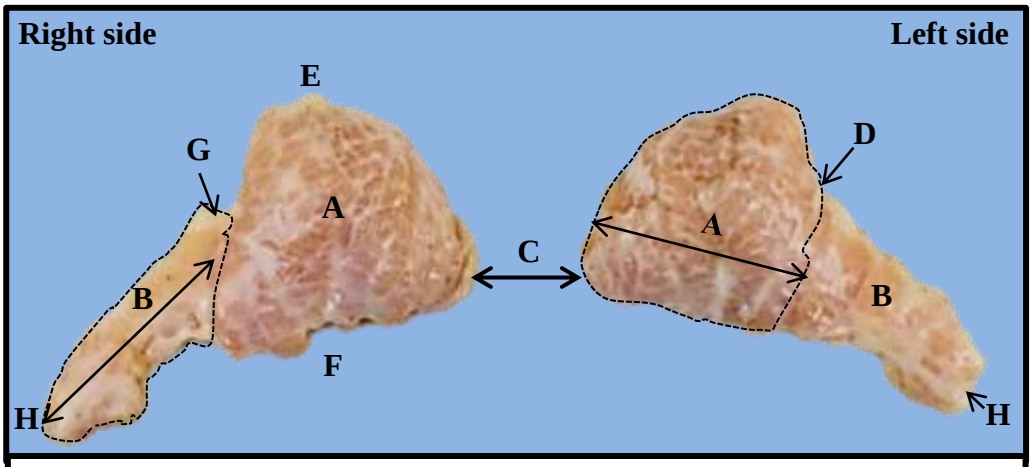


Fig.(4). Dorsal view of lacrimal gland in cattle show: A- Body of lacrimal gland. **B**- Appendage of lacrimal gland. **C**- Medial end. **D**-Lateral end. **E**- Caudal border. **F**-Cranial border. **G**- Attached border. **H**- Free border.

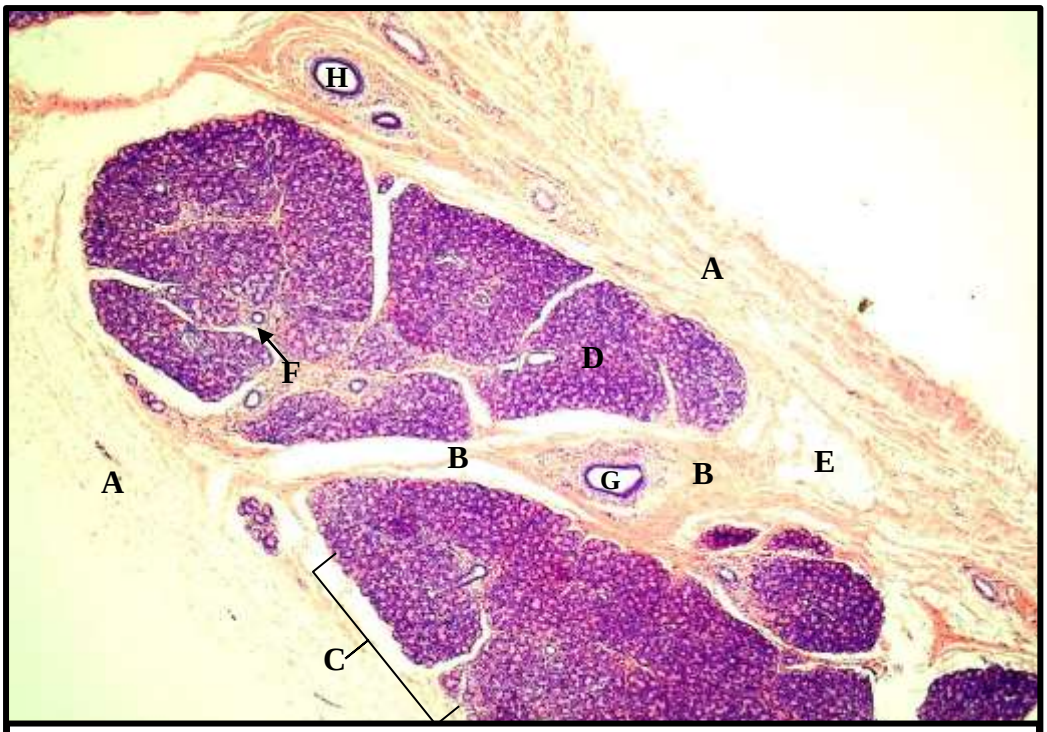


Fig.(5) Cross section of lacrimal gland in cattle shows: A. Capsule B. Trabcule. C. Lobe. D. Lobule. E. Adipose tissue. F. Intarlobar duct. G. Interlobular duct. H. Excretory duct. H&E, X10

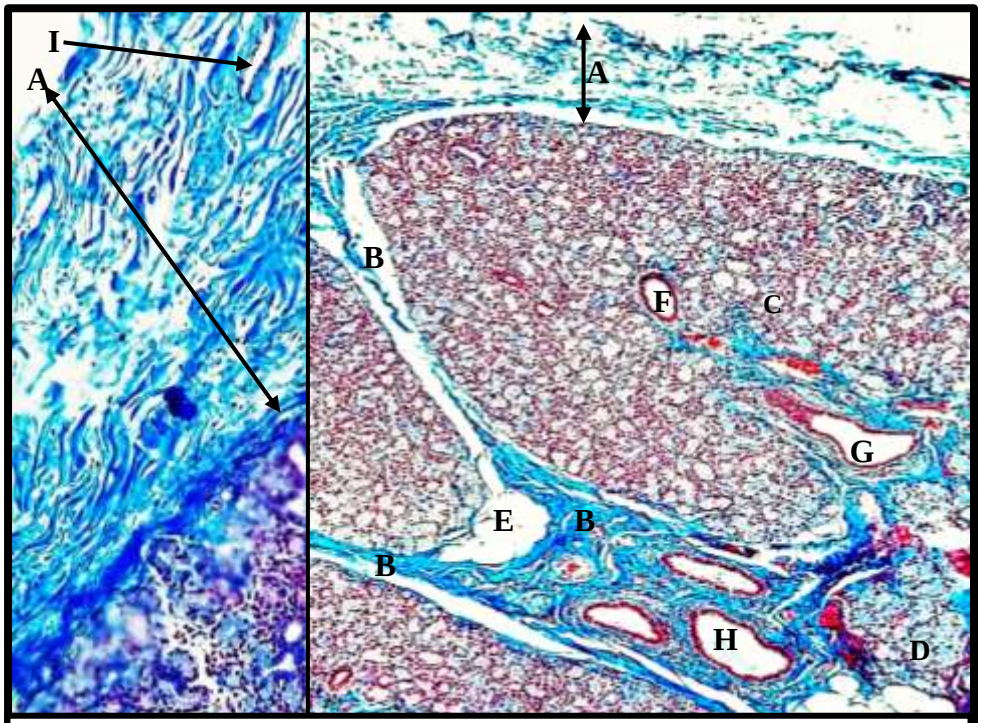


Fig.(6) Cross section of lacrimal gland in cattle shows: A. Capsule B. Connective tissue septa. C. Lobe. D. Lobule. E. Adipose tissue. F. Intralobular duct. G. Interlobular duct. H. Excretory duct. I. Blood vessels. Masson's Trichrome.X10 and X 20.

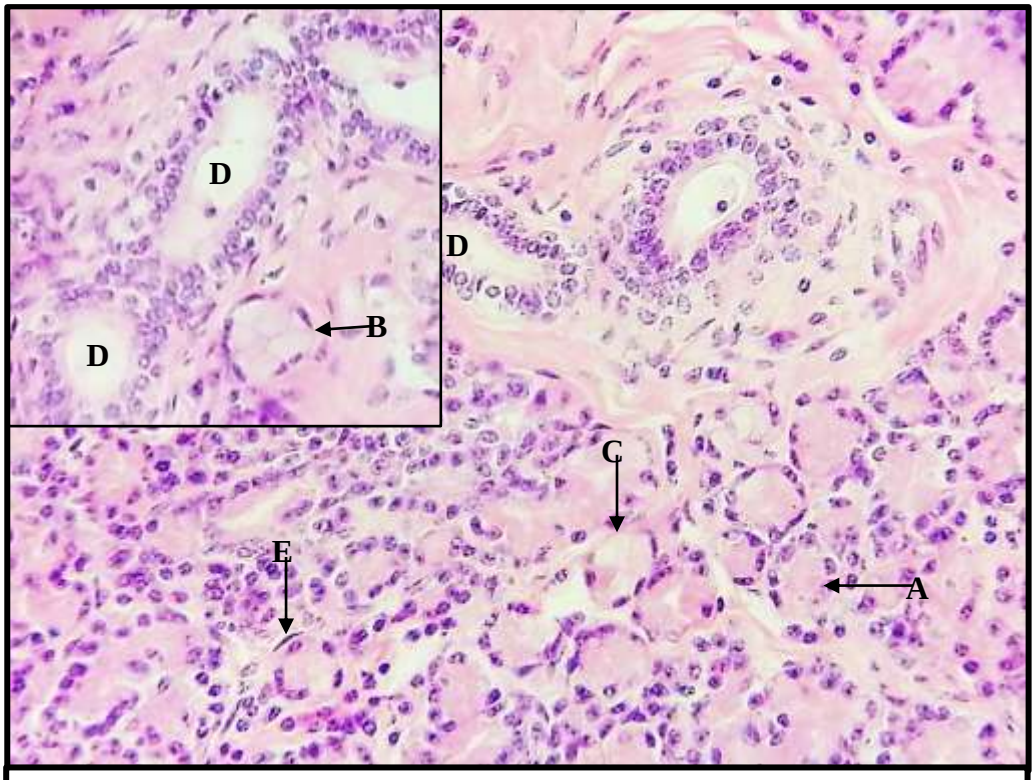


Fig.(7) Cross section of lacrimal gland in cattle shows: A. Serous acini. B. Mucous acini. C. Mixed acini. D. Intralobular duct. E. Myoepithelial cell. H&E X40.

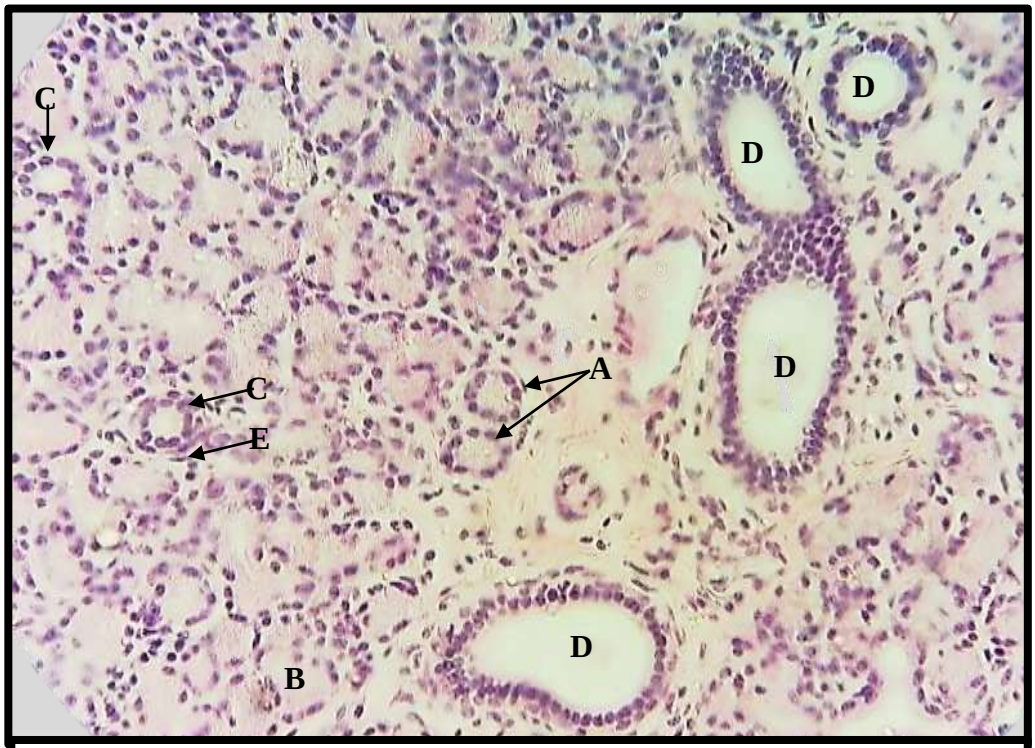


Fig.(8) Cross section of lacrimal gland in cattle shows: A. Serous acini. B. Mucous acini. C. Intercalated duct. D. Intralobular duct. E. Myoepithelial cell. H&E X20.

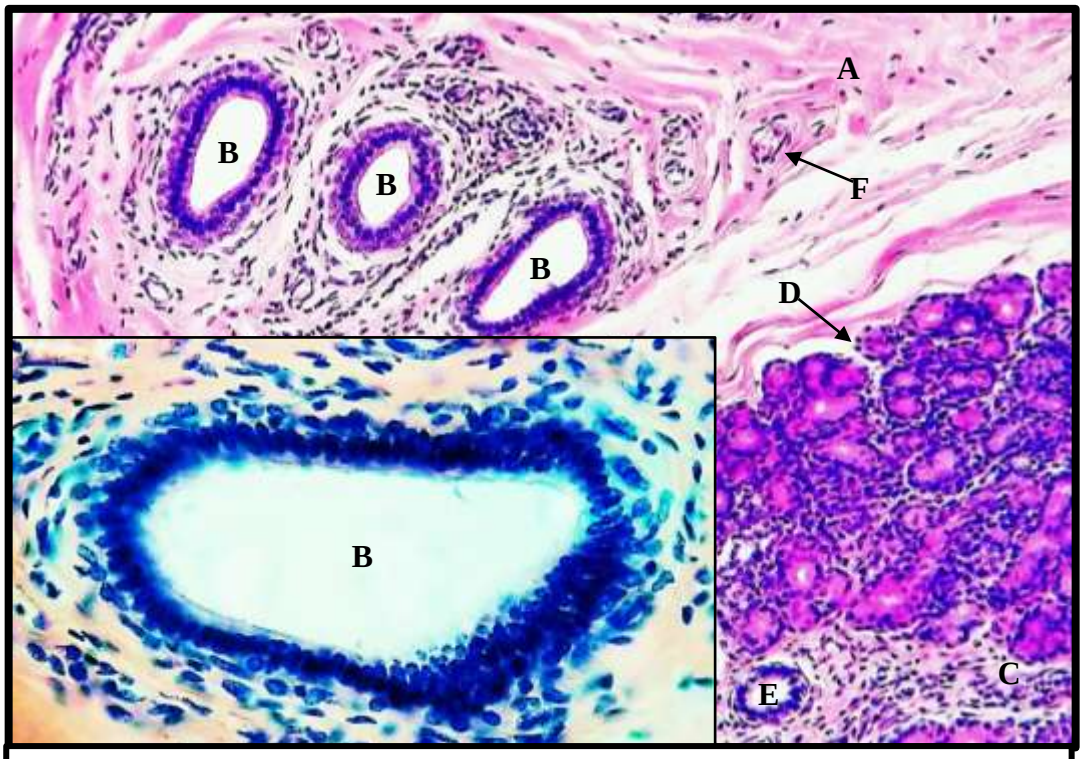


Fig.(9) Cross section of lacrimal gland in cattle shows: A. Connective tissue capsule. B. Excretory duct within the connective tissue. C. Interlobular C. T. septa. D. Lobule. E. Interlobular duct. F. Blood vessels within C. T. H&E X40 and X20.

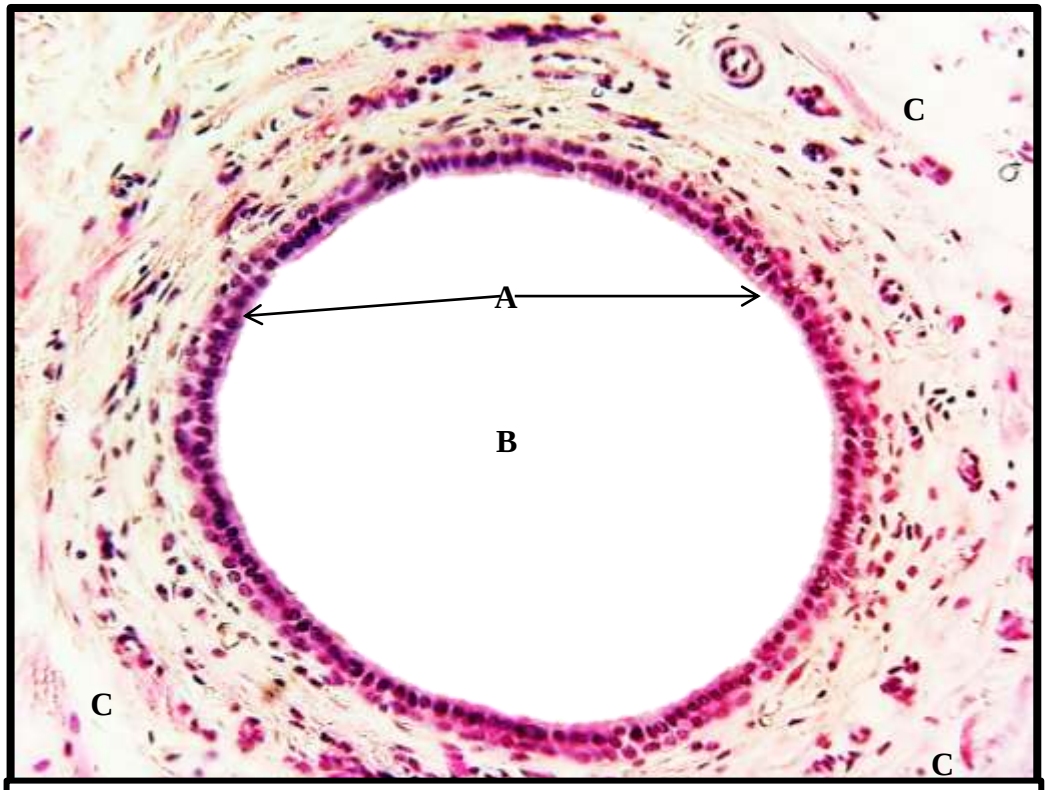


Fig.(10) Cross section of excretory duct of lacrimal gland in cattle shows: A. Stratified columnar epithelium. B. Lumen of excretory duct. C. Connective tissue surrounding the excretory duct. H&E X40

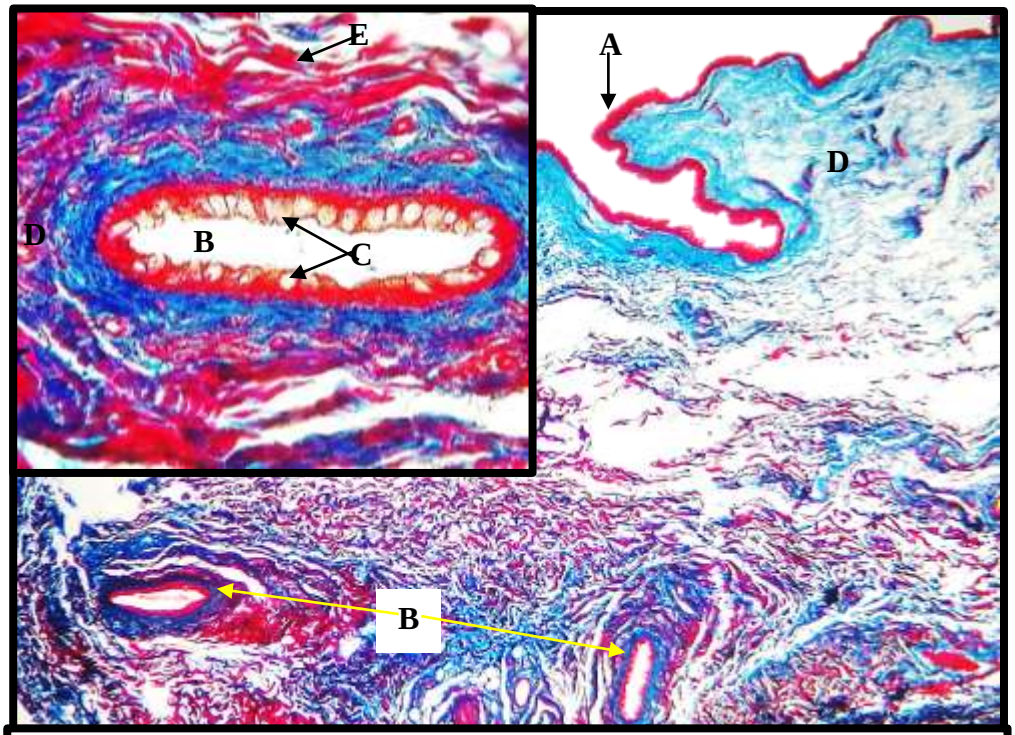


Fig.(11) Cross section of main excretory duct in cattle shows: A. Conjectival surface. B. Excretory duct. C. Goblet cells D. Connective tissue. E. Smooth muscle fibers. Masson's Trichrome. X4 and X20.

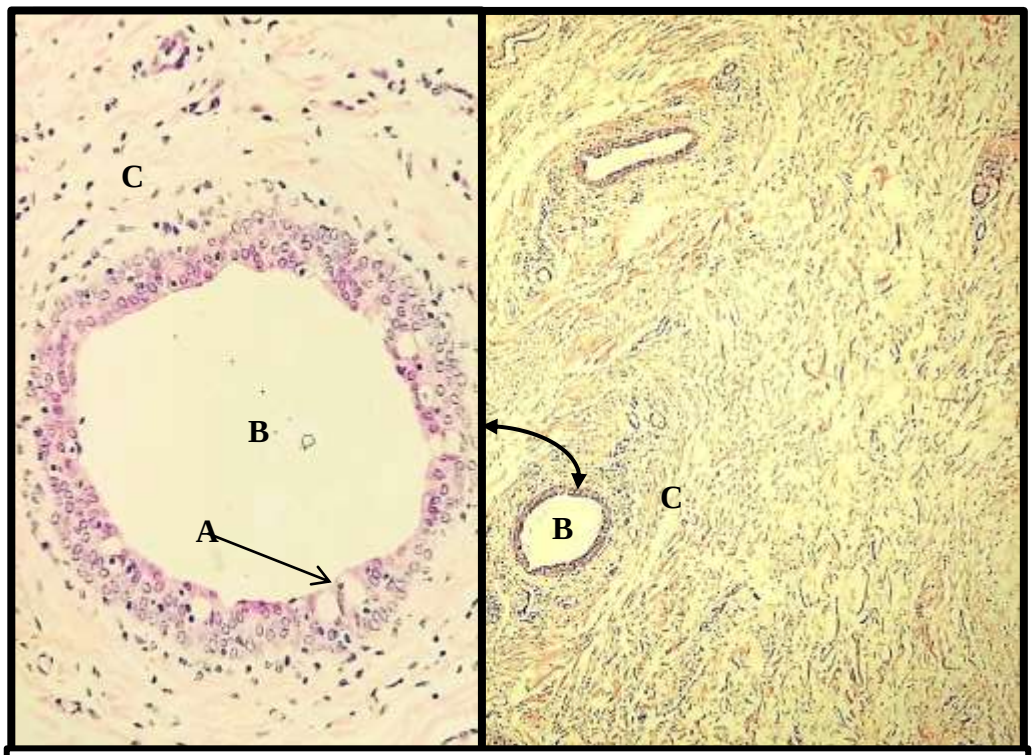


Fig.(12) Cross section of main excretory duct in cattle shows:
A. Stratified cuboidal epithelium with goblet cells. B. Lumen of duct. C. Connective tissue. H&E X4 and X20.

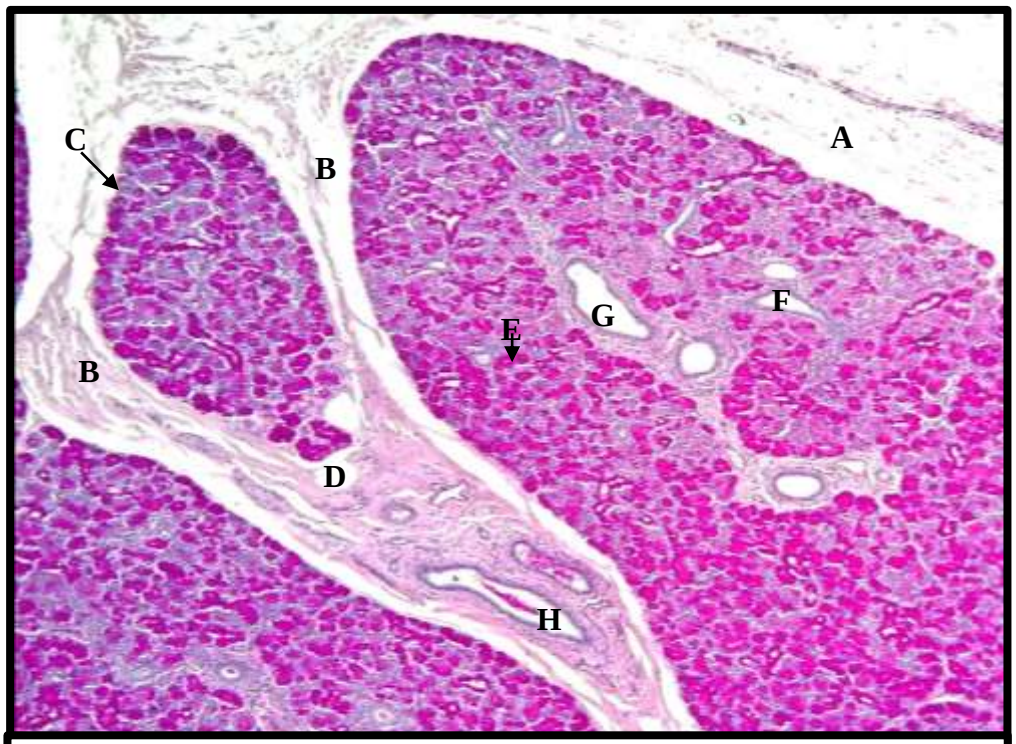


Fig.(13) Cross section of lacrimal gland in cattle shows: A. Capsule B. Connective tissue septa. C. Lobe. D. Adipose tissue. E. Mucous acini. F. Intralobular duct. G. Interlobar duct. H. Excretory duct. PAS, X10

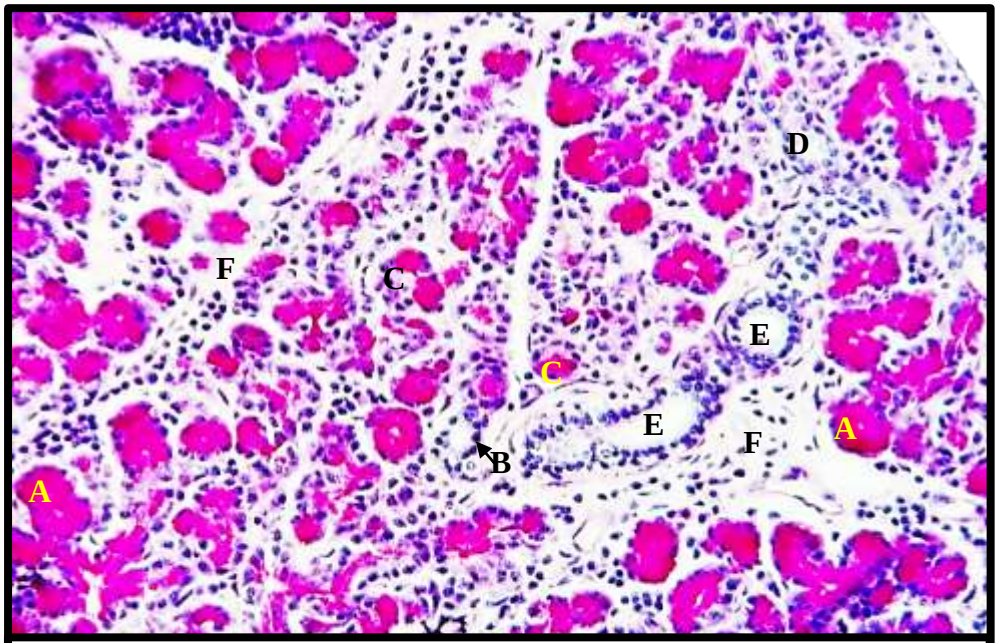


Fig.(14) Cross section of lacrimal gland in cattle shows: A. Mucous acini. B. Serous acini. C. Mixed acini D. Intercalated duct. E. Intralobular duct. F. Connective tissue septa. PAS, X20

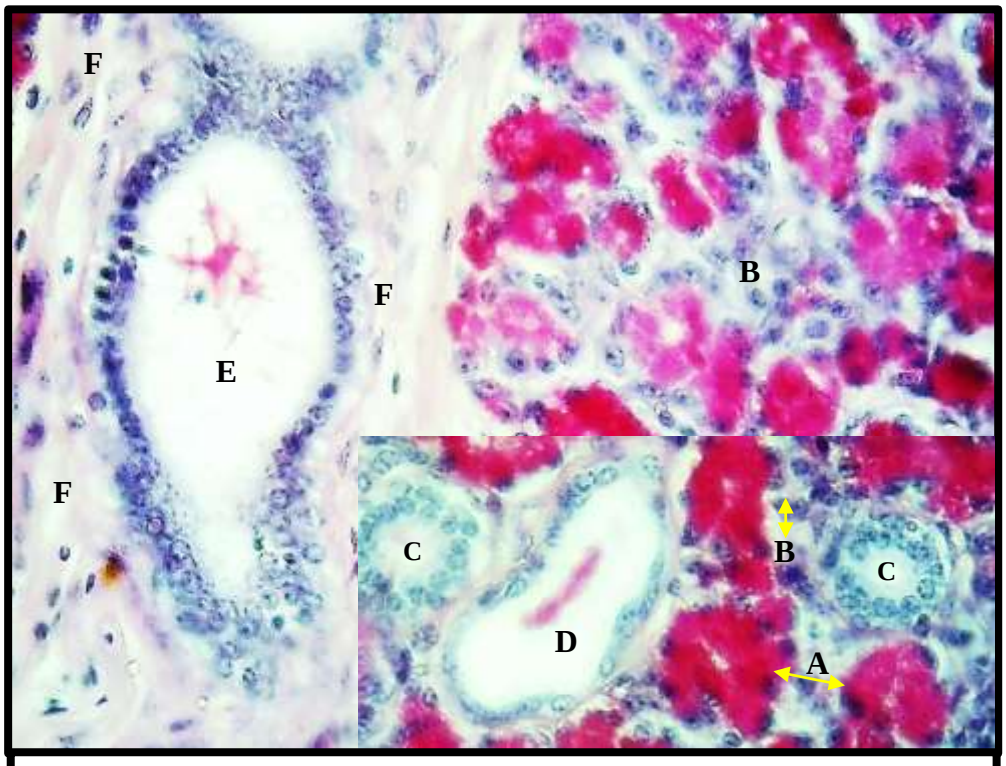


Fig.(15) Cross section of lacrimal gland in cattle shows: A. Mucous acini. B. Serous acini. C. Intercalated duct. D. Intralobular duct. E. Interlobar duct. F. Connective tissue septa. PAS, X40

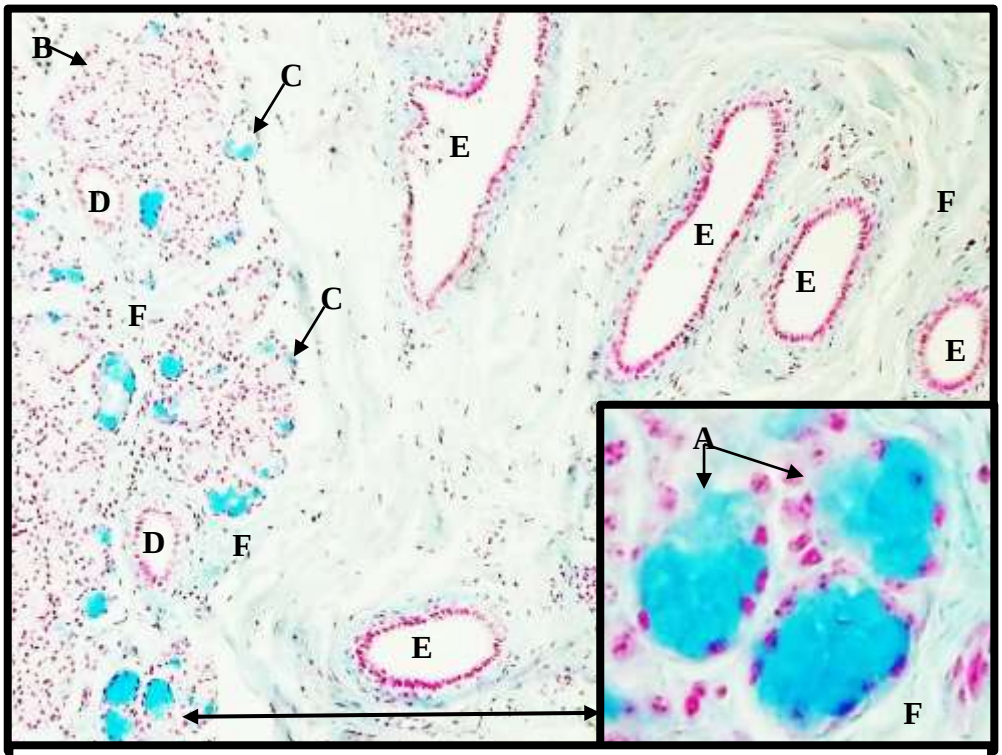


Fig.(16) Cross section of lacrimal gland in cattle shows: A. Mucous acini. B. Serous acini. C. Mixed acini D. Intralobular duct. E. Excretory duct. F. Connective tissue septa. Alacian blue, X10 and X40

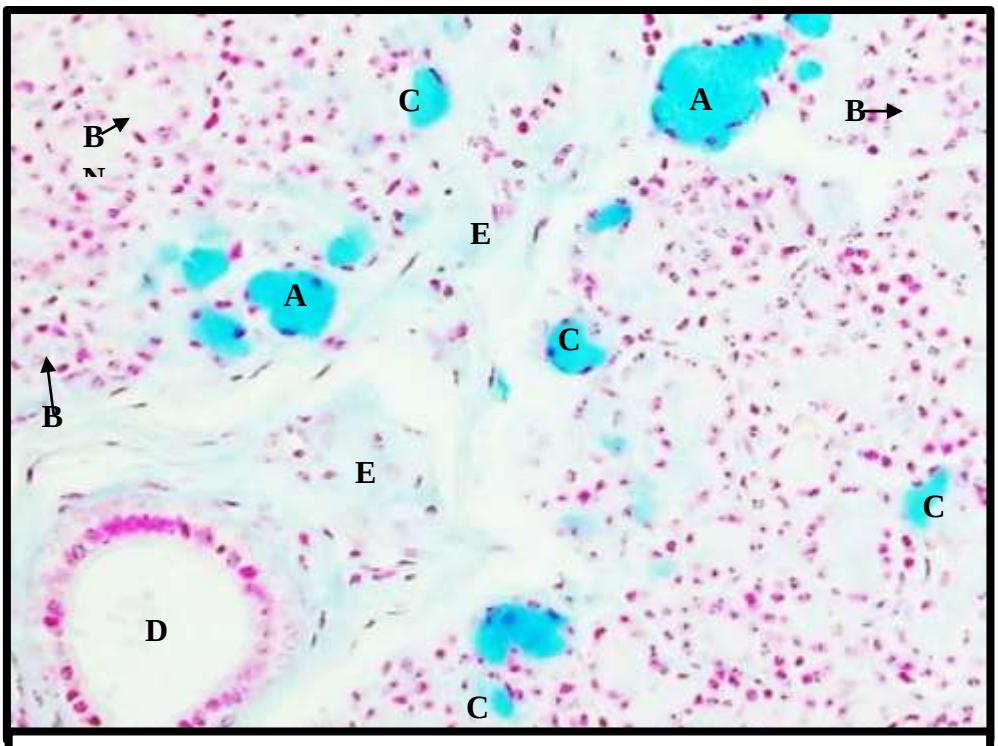


Fig.(17) Cross section of lacrimal gland in cattle shows: A. Mucous acini. B. Serous acini. C. Mixed acini D. Interlobar duct. E. Connective tissue septa. Alacian blue, X20

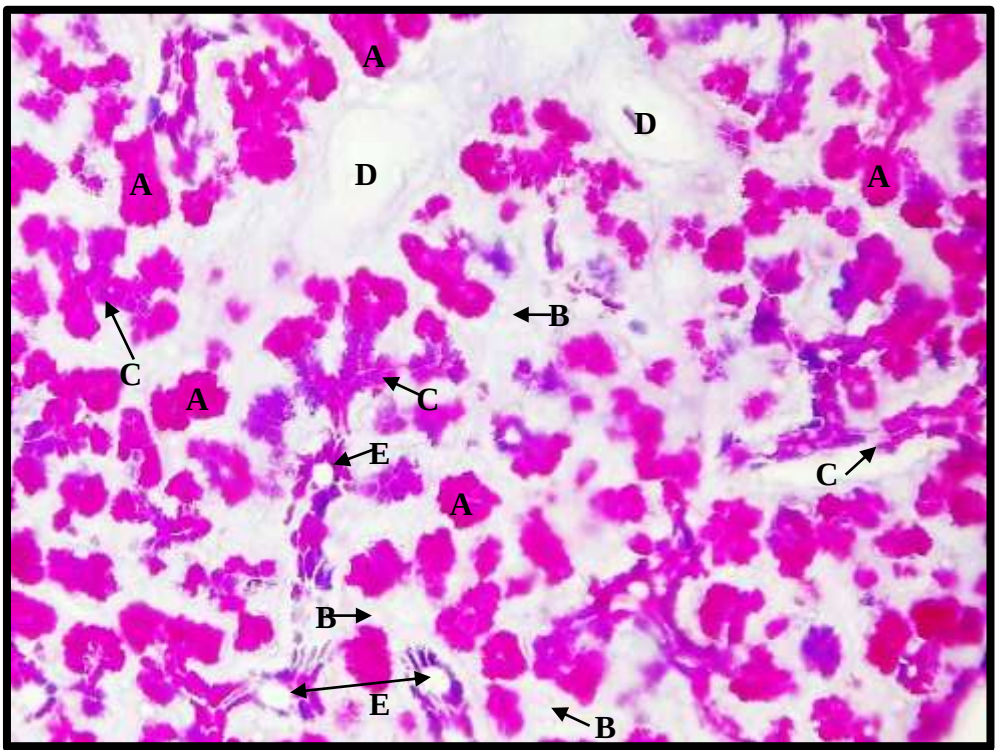


Fig.(18) Longitudinal section of lacrimal gland in cattle shows: A. Mucous acini. B. Serous acini. C. Intercalated duct. D. Interlobular duct. E. Intralobular duct. PAS-Alacian, X10

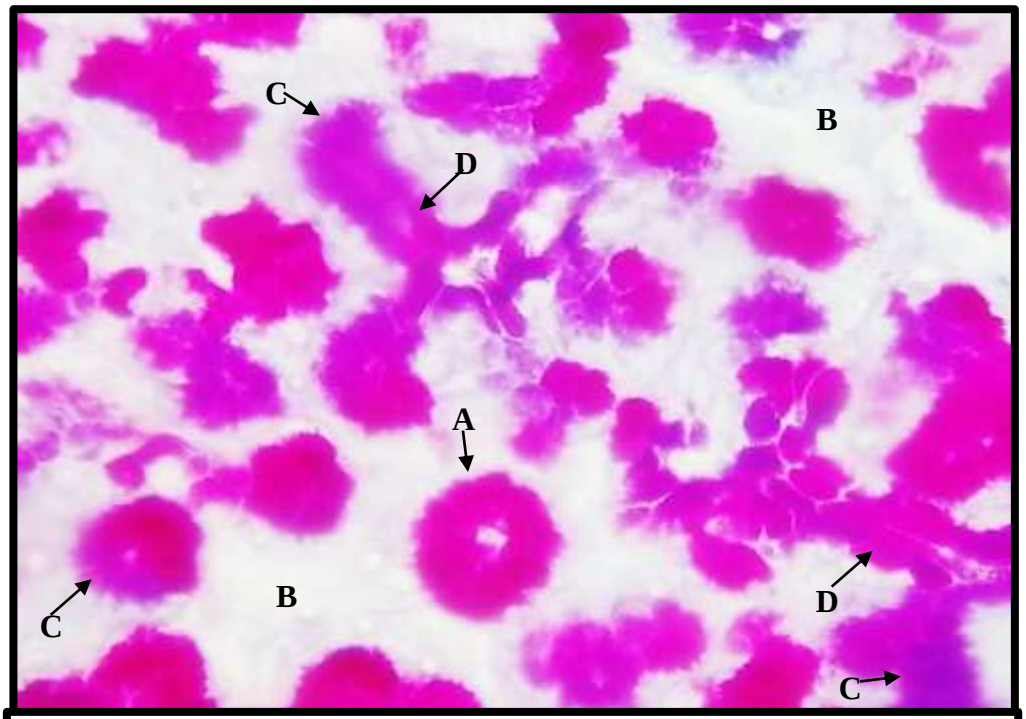


Fig.(19) Longitudinal section of lacrimal gland in cattle shows: A. Mucous acini. B. Serous acini. C. Mucous acini. D. Intercalated duct. PAS-AB , X40

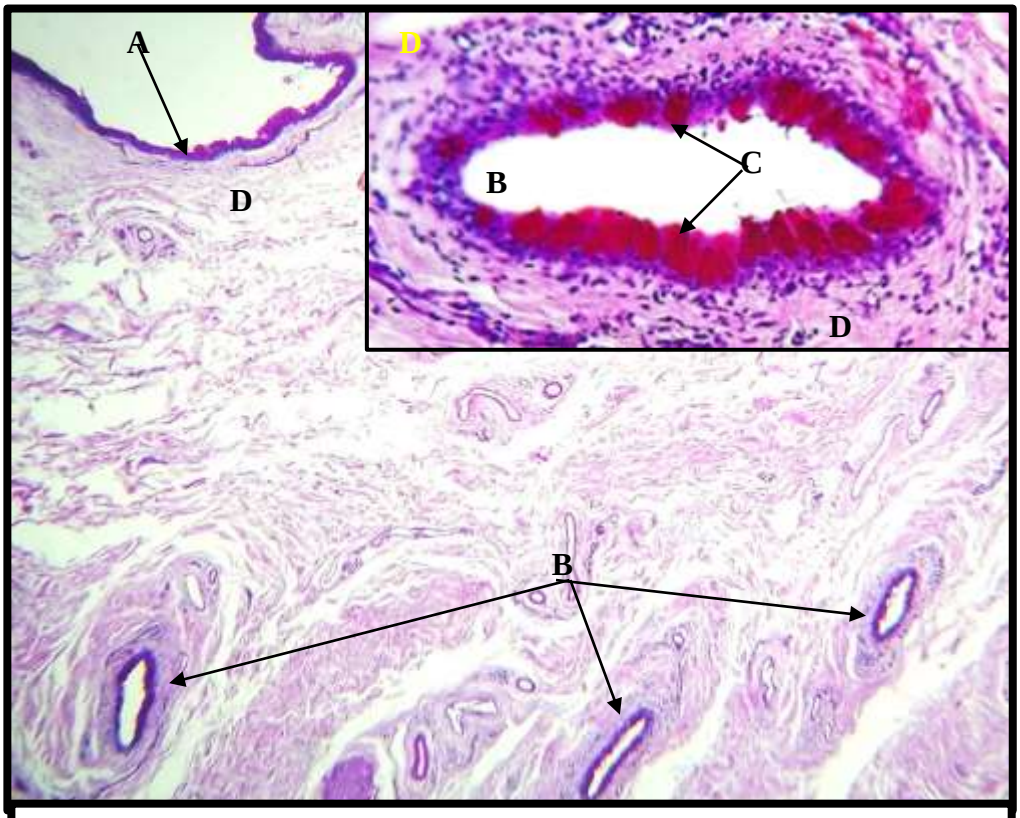


Fig.(20) Cross section of main excretory duct in cattle shows: A. Conjectival surface. B. Main excretory duct. C. Goblet cells D. Connective tissue. PAS, X4 and X20.

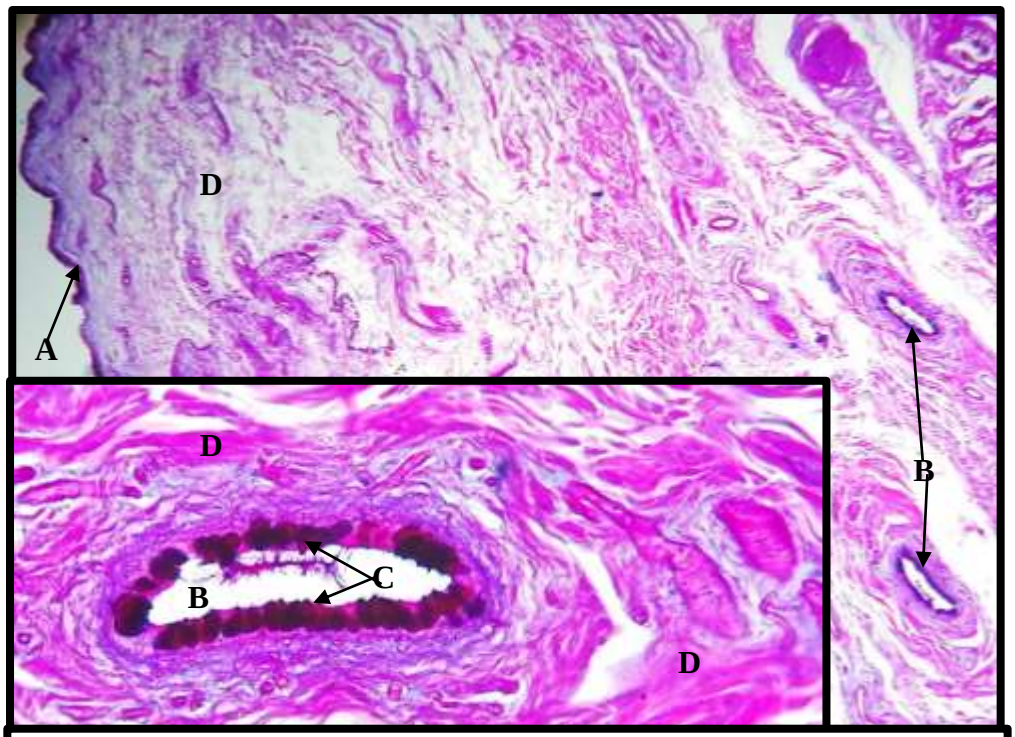


Fig.(21) Cross section of main excretory duct in cattle shows: A. Conjectival surface. B. Main excretory duct. C. Goblet cells. D. Connective tissue. combined PAS-Alacian blue, X4 and X20.

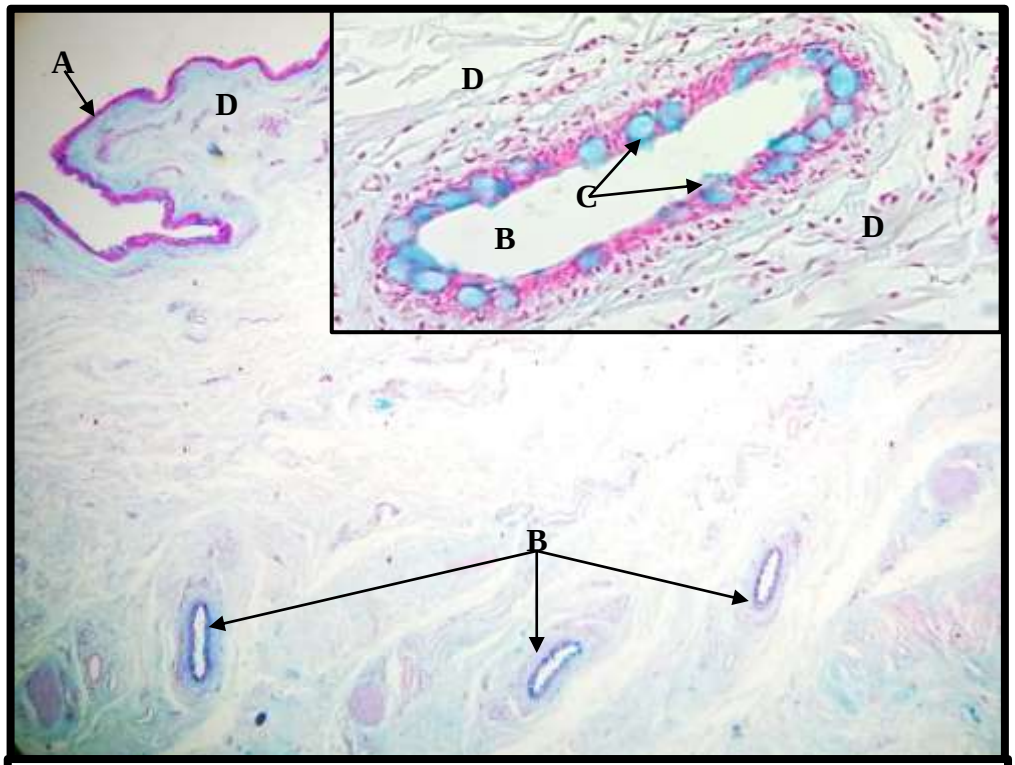


Fig.(22) Cross section of main excretory duct in cattle shows: A. Conjectival surface. B. Main excretory duct. C. Goblet cells. D. Connective tissue. Alacian blue, X4 and X20.

Discussion:

5.1. Histological study

5.2.1. Lacrimal glands in cattle

The lacrimal glands in cattle were surrounded by dense connective tissue. The connective tissue capsule sends many extensions of connective tissue septa which penetrate the parenchyma of the gland and divide the gland into many lobes and lobules in various size and shape. The capsule and septa consist mainly from collagen.

This finding agreed with Pinard, et al., (2003) in bison, Maala, et al., (2007) in buffalo, Shadkhast and Bigham, (2010) in buffalo, Daryuos and Ahmed, (2012b) in goat and sheep, Abbasi, et al., (2014) in sheep, Ibrahim and Abdalla, (2015) in camel, Ibrahim, (2015) in camel, Kleckowska-Nawrot, et al., (2015) in cattle**,** El-naseery, et al., (2016) in dog**,** Elmahadi, (2017) in camel and Girgiri and Kumar, (2018) in buffalo described the lacrimal gland was cover by a thick connective tissue capsule, consist of collagen and elastic. The capsule sends septa that penetrated the parenchyma of gland to divided the gland into many lobes in different size and shape. Usually there was similarity in structure of the framework of all glands, and disagreed with Klećkowska-Nawrot, et al., (2013) in Roe deer, Klećkowska-Nawrot, et al., (2015) in alpaca and Mirhish and AL-Obeady, (2016) in dog show the lacrimal gland covered by a thin or poor connective tissue capsule and seen the adipose tissue beneath the connective tissue capsule and the capsule send septa. The septa (interlobular connective tissue) that divided the parenchyma of the gland into lobes.

The results explained the mean of thickness capsule and septa in cattle was 640±72.57µm; 132±28.85µm; 570±79.65µm and 147.5±13.27µm respectively, there

were non-significant differences. This results in disagreement with Kleckowska-Nawrot, et al., (2015) that described in European bison the mean thickness of the capsule was 395.5µm in females and 316.91µm in males. Also, Daryuos and Ahmed, (2012b) showed the mean thickness of capsule in sheep and goat were 151.13±9.96µm and 153.06±4.67µm respectively. The differences in the measurement were due to the different species, age and genus.

The lacrimal glands in cattle was a compound mixed acinar glands consist of serous and mucous acini. Each lobule of lacrimal gland made up mixed acinar secretary units consist from acini in various size. Acini separated by thin connective tissue septa called intralobular connective tissue. The serous lined by pyramidal cells in cattle and cuboidal with rounded nuclei in a basally located and the cytoplasm had homogenous acidophilic, while the mucous acini were lined with a columnar cell in cattle had ovoid to flattened nucleus basally located. The cytoplasm was pale vacuolated and granular cytoplasm.

This finding agreement with Pinard, et al., (2003) reported the lacrimal glands in bison and cattle were of acinar units. The acini were composed of columnar cells or tall pyramidal with a small lumen. The bison acinar cells had basophilic, vacuolated and granular cytoplasm. While in cattle the acinar cells were an eosinophilic, uniform and granular cytoplasm. In cattle and bison, the nuclei of the acinar cells were round to oval in shape in the basal part of it. Abbasi, et al., (2014) explained that the lacrimal gland in Lori sheep was mixed consisting of tubulo-acinar units serous and mucous acini. The cell in serous acini was cuboid to low columnar with rounded nuclei located near the basal part of the cell. The cytoplasm had an eosinophilic reaction.

This result nearly accordance with Gargiulo, et al., (1999), Gargiulo, et al., (2000), Sugiura, et al., (2010), Shadkhast and Bigham, (2010) and Ibrahim, (2015) reported the lacrimal glands in sheep bison, cattle, dog, buffalo and camel were compound tubuloacinar units separated by connective tissue into many lobules, each lobule contain acinar and tubular units. The acini were composed of columnar cells or pyramidal. The acinar cells characterized by basophilic, granular and vacuolated cytoplasm. Awkati and Al-Bagdadi, (1971) show the lacrimal gland in dromedary camel was compound alveolar and secretory unites were lined by pyramidal cells.

The present study confirmed the agreement with Kleckowska-Nawrot, et al., (2013) in Roe deer and Mirhish and AL-Obeady, (2016) in a dog which showed the lacrimal gland was mixed gland.

This result nearly accordance with Maala, et al., (2007) in buffalo and El-naseery, et al., (2016) in dog described the lacrimal gland composed of mixed compound tubuloacinar and predominant mucous type. The mucous acini lined with tall columnar cells and oval nuclei with pale acidophilic vacuolized cytoplasm. The serous acinar was lined with pyramidal cells with central rounded nuclei and homogenous acidophilic cytoplasm.

These results were in disagreement with Mohammadpour, (2011) in camel, Menakab and Puri, (2015) and Klećkowska-Nawrot, et al., (2015) in alpaca which reported that the lacrimal gland in their animals was purely serous. The serous acini lined by tall conical cells with an oval nucleus and surrounded by the myoepithelial cell.

The current study appeared the mean outer diameter, lumen diameter and height of cell lining of the serous acini in cattle were 33±0.66µm, 5.2±0.10µm and

13.5±0.40µm respectively. But the mucous acini in cattle have to mean outer diameter, lumen diameter and height were 34±1.20µm, 5.75±0.2µm and 13.5±0.5µm respectively. There was no significant value between the measurement of serous and mucous acini only in the lumen diameter.

The present study the lacrimal gland in cattle has mixed acini made by mucous pyramidal cell surrounded by serous cell take crescents shape. The mean height of cell lining acini in cattle 13±0.33µm; and the mean outer diameter and lumen diameter of acini in cattle was 30±0.52µm and 4.75±0.4µm respectively

The measurement of this study was in the different type of acini that were differences from the measurement in the other animals Daryuos and Ahmed, (2012b) in goat and sheep, and Kleckowska-Nawrot, et al., (2015) in European bison usually the difference related to the different species, age and genus of animal.

The duct system in the lacrimal glands of cattle in our study consist from the intercalated duct, intralobular duct, interlober duct, excretory duct and main excretory ducts that convey the secretion of the lacrimal glands into conjunctival mucosa of the upper eyelids.

These results appeared that the intercalated duct in cattle was smallest ducts in the lacrimal glands had small lumen lined by low cuboidal epithelium with a large round to ovoid dark nuclei rested near the basement membrane. The mean height of epithelium, outer diameter and lumen diameter in cattle were 9.5±0.62µm, 26.5±1.54µm and 7.5±0.91µm respectively.

The intralobular duct in cattle lined with a simple cuboidal epithelial. The mean height of epithelium, outer diameter and lumen diameter in cattle was 12.5±0.91µm, 45±2.98µm and 19.5±2.26µm respectively.

While the interlobular duct in cattle lined with simple columnar epithelium which changed into stratified cuboidal to stratified columnar when extending toward the main duct. In cattle, the mean height of epithelium, outer diameter and lumen diameter was 19.5±1.33µm, 118.5±14µm and 85.5±8.93µm respectively.

The excretory duct in cattle lined with stratified cuboidal to the stratified columnar epithelium that formed by 2-3 layers of cells. In cattle, the mean height of epithelium, outer diameter and lumen diameter was 23±1.31µm, 274±31.8µm and 222.5±31.01µm respectively.

These results were in accordance with Daryuos and Ahmed, (2012b) in Awasi sheep and native black goat the intercalated ducts were lined by low cuboidal epithelium tissue, but gradually increased in height to convert stratified cuboidal to stratified columnar epithelium tissue with goblet cells in the interlobular and main excretory ducts were lined by two layers of cuboidal or columnar epithelium; while Abbasi, et al., (2014) in Lori sheep the intralobular ducts lined by simple cuboid epithelium, while the interlobular and excretory ducts lined with stratified cuboidal.

This result nearly in accordance with Elmahadi, (2017) in camel explain all duct of the lacrimal gland was beginning small and then increased in size and reach to excretory ducts. The interlobular duct was lined with stratified columnar epithelium with numerous large goblet cells and surrounded by loose connective tissue.

The present study confirms that the agreement with Maala, et al., (2007) Philippine water buffalo reported that the excretion system of the lacrimal gland was intercalated and intralobular ducts dispersed among the secretory acini, whilst

interlobular ducts located in the interlobular connective tissue septum. It was lined with tall simple or stratified columnar epithelium.

Disagreement with Ibrahim and Abdalla, (2015) who reported that in camel the acini and tubules empty secretion into the intralobular ducts. The intralobular ducts empty into the interlobular ducts. The small interlobular duct was lined with stratified columnar or stratified cuboidal epithelium, but the large ones were lined with pseudo-stratified columnar epithelium with goblet cells. Also, Ibrahim, (2015) in camel reported the intra-lobular ducts lined by low simple cuboidal epithelium tissue. The inter-lobular and excretory ducts were lined by pseudostratified columnar epithelium with rich goblet cells.

From the result authors most animals had the same pattern of intraglandular duct system(intercalated duct, intralobular, intralobar and excretory duct except in some animals had no intercalated duct Ibrahim and Abdalla, (2015) in camel and in dog by Sugiura, et al., (2010)found only intercalated and excretory duct present. Also, there was some difference in the type of lining epithelial in the duct system. There was a difference due to variance in the species of animal.

5.2.2. Main excretory ducts in cattle

The recent results revealed that extraglandular ducts in cattle lined with stratified cuboidal epithelium with goblet cells with ovoid to round nuclei. In cattle, the ducts surrounded by dense irregular connective tissue containing mainly collagen fibers, smooth muscle fibers and lymphocyte. The mean height of epithelium, outer and lumen diameter of ducts were 36±1.35µm, 218±14.03µm and 134.5±5.01µm respectively.

These results disagreed with Sinha and Calhoun, (1966) in sheep and goat and Kuehnel and Scheele, (1979) in pig the excretory ducts were lined by

pseudostratified columnar epithelium with goblet cells. Also, these findings were in accordance with Abbasi, et al., (2014) who described the excretory ducts in Lori sheep which were lined by stratified cuboidal or pseudostratified columnar epithelium with goblet cells.

The current result agreed with Awkati and Al-Bagdadi, (1971) in camel, Daryuos and Ahmed, (2012b) in Awasi sheep and black goat and Elmahadi, (2017) in camel the main excretory ducts lined with stratified columnar epithelium with goblet cells. Whilst Ibrahim and Abdalla, (2015) described excretory ducts in the camel were lined with pseudostratified or stratified columnar epithelium rich with goblet cells. There was a little difference in the epithelial lining in the duct system in different animals usually this is due to the level of secretion of fluid or due to the degree of the functional stage.

5.3. Histochemical study

5.3.1. Glandular part

5.3.1.1. Lacrimal glands in cattle

The lacrimal gland in cattle was composed of serous, mucous and serous mucous acini of this study. The serous acini of the gland take –ve reaction with PAS, AB and PAS-AB stains. In PAS stain mucous acini in both take +ve reaction in different degree between strong to weak and the mucous cells in the mixed acini take +ve reaction with PAS. The intraglandular ducts take –ve reaction. In AB stain, the mucous acini of the gland gave different reaction; some mucous acini showed a strong +ve reaction and other –ve read. Some mucous cells in the mixed acini gave a +ve reaction and other –ve reaction for AB. The companions AB-PAS stain of some mucous acini showed strong +ve for PAS stain other were positive for both AB-PAS.

From these results which compared between the secretory acini (mucous, serous and mixed) in the cattle when compared with results of the authors who found similarity in general reaction Gargiulo, et al., (2000) in sheep, Pinard, et al., (2003) in bison and cattle, Maala, et al., (2007) Philippine water buffalo, Abbasi, et al., (2014) in sheep, Kleckowska-Nawrot, et al., (2013) in Roe deer, Klećkowska-Nawrot, et al., (2015) in alpaca, El-naseery, et al., (2016) in dog, Mirhish and AL-Obeady, (2016) in dog, Girgiri and Kumar (2018) in buffalo and Triveni, et al., (2018) in cattle, sheep and goat. While Elmahadi, (2017) in camel and Triveni, et al., (2018) in buffalo showed the acinar cells gave a negative or weak reaction for PAS stain; also +ve reaction for goblet cells in the lining of intralobular, interlobular and excretory ducts for PAS stain.

5.3.1.2. Main excretory duct in cattle

The epithelium which lining the main excretory duct in cattle had goblet cells take +ve reaction for PAS, AB and AB-PAS stains.

Conclusions

1- The current histological study appeared non-significant differences between the main part (body) of gland and appendage part of the lacrimal gland in the cattle.

2- The goblet cells were absent in all parts of the intraglandular duct system of cattle.

3- The histochemical study appeared the mucous acini of the lacrimal gland in cattle consist of mainly of natural mucins which gave a +ve reaction for PAS and –ve reaction for Alacian blue (AB), whereas the little amount of carboxylated and sulphated mucosubstances that gave +ve reaction AB and –ve reaction for PAS. Also, carboxylated Sialomucins and sialomucins sulphated gave +ve reaction AB and occasionally –ve reaction for PAS. Also, the mucosubstances and polysaccharides that contain glycol group stain with PAS-AB combination.

Recommendations

1-Study the effect of the season on the morphometric and histochemical structure of the lacrimal apparatus in local breeds cattle.

2- Ultrastructure of the cellular components of the lacrimal gland in local breeds cattle.

3- Study the immunohistochemical of the lacrimal gland in local breeds cattle.

4- Compare the morphometric and histochemical study between the local breeds cattle (male and female).

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