

ANATOMICAL AND HISTOLOGICAL STUDY IN THE UDDER OF LOCAL IRAQI CATTLE (*Bovidae caprinae*)

S. E. ALsadi , TH, Fadeal

Department of Anatomy and Histology College of Veterinary Medicine

University of Mosul. Mosul. Iraq

Key words : Anatomy , Udder , Cow

Corresponding Author; somaiassi@yahoo.com

ABSTRACT

The appearance of the udder varies greatly depending on maturity and function status as well as on individual and breed characteristic sometimes weighing as much as 60 Kg in many dairy cows it is extremely large in particular the size, shape and position of the teats do have a practical importance in determining the suitability of the udder to hand or machine milking , five udder of cattle were taken , aged between (2-5) years from a local slaughterhouse , the skin was removed , we examined and described the outer anatomy ,these sample were fixed in 10% formalin solution , and processed by the routine histological technique then studies under light microscope .

The udder consists of four separated glands suspended of medial and lateral collagens lamina, the medial lamina is more elastic than lateral lamina, the medial lamina are more collagenous and originate from the sub pelvic tendon. The lateral lamina is multiple, the teat is long and cylindrical in shape and the wall is thick.

The anatomical study showed that the udder was divided into four identical quarters with the four main nipples and the additional nipples sometimes associated with the glandular tissue, the glandular tissue covered by connective tissue that extends inside and covers the whole gland and is described as the hanging system. It consists from the medial and the lateral ligaments, The aim of histological study of the udder in cattle to understand the comparative nomenclature and to know the surgical anatomy of the bovine teat , the layers of the wall ,the vascular patron , the distribution of smooth

muscles, the annular fold, the vascular pattern and the venous circle surrounding the base of the teat to appreciate the protective function of the teat canal as well as the pattern of intra udder duct system were studied to obtain more details information about the udder value in production of milk and healthy udder are essential to the secretion of milk that wholesome to drink and sufficient in quantity to be profitable to dairymen, The substance of the udder consist of gland parenchyma and connective tissue intermingled in proportion that can sometimes be estimated by palpation through the skin, annular fold a constriction between glandular and teat parts of the milk sinus, it consist of muscular fibers, connective tissue and circular venous channels (Furstenberg's rosette) fold of teat canal mucosa that extends into the teat sinus.

INTRODUCTION

The udder of the cow takes on added significance due to the importance of milk as a human food source, the four parts of the bovine udder, each associated with one teat, all four quarters are completely separated from each other so an infection can be in only one quarter (1, 2,3) Acquired teat cistern obstructs fistulas, blind quarters and membranes obstruction, skin lesion and mastitis. Mastitis is of a great economic importance of farm animals (4), also mastitis is one of the most significant health problems of dairy herds, together with lameness and fertility problems (5). The teat canal act as a path of entry of microorganisms to the udder tissue and the one factor common to nearly all occurrences of mastitis is simultaneous incidence with mastitis (6).

Udder changes during pregnancy are best observed in primigravida, the teat of pregnancy heifer begin to enlarge about the fourth month, and with a little experience it is an easy matter to distinguish them from those of the non pregnant or early pregnant animal. From the six month the udder become more firm to the touch and their enlargement can be seen, hypertrophy is progressive and particularly marked during the terminal month. As parturition approaches, the glands become grossly enlarged and oedematous and the teats take on a waxy (7,8). The papillary duct (teat canal) or streak canal is the exit for milk from the teat sinus or cistern and it is surrounded by the teat sphincter muscle. The papillary duct and sphincter muscle represent a significant

component of the defense mechanism against mastitis, and they are the most frequently injured portion of the teat (9). The venous drainage travels with the arterial supply since udder tumor may metastasize to the draining lymph node, removal of these is routinely performed, when udder tumors are surgically removed and the milk vein can be used for intravenous injection or blood sampling (2).

MATERIALS AND METHODS

A total of five udders were collected from healthy local cows of (2-5) years old from local slaughterhouse of Mosul province, entire udder was immediately removed after slaughtering animal, care was taken to avoid damage of the udder tissue. The gross anatomical study includes investigation of external features of udder and teat and related ligaments as well as the length, width and depth of teat. Length of teat was measured from the base of teat to the apex, diameter of teat was done at the mid-point of its length, all the measurements done by using vernier Calipers and measurement tape.

For histological study, tissue sample from different parts of gland and teat were taken, all specimens were fixed in (10%) neutral buffered formalin then routine histological technique was made, dehydration, clearing, embedding in paraffin then section by using rotary microtome to get (5-7) μ m thickness sections, the sections were stained with Hematoxyline and Eosine (10), the nomenclature used was adopted by Nomina Anatomica Veterinaria (2005). Microphotographs were captured using the color USB 2.0 digital image camera (Scope Image 9.0- China) which was provided with image processing software.

RESULTS

Anatomical study:

The udder of the cow are consolidated in a single mass fig. 1 the udder (upper) divided into quarters that correspond to the four glands, each bears one of the principal teats. The body of the gland ellipsoidal in form but flattened transversely, the base of each gland is slightly concave and slopes obliquely, the intermammary groove is the external indication of the separation of the two halves of the udder, a prominent median

intermammary groove generally marks the division of the udder into right and left halves, the dorsal surface of the most of udder is shape to fit against the belly wall but the part below the pelvic is less regular and narrower since laterally compressed between the thigh.

The skin covering the udder is thin supply and freely movable over the underlying fascia except of the teats where it is found to the deeper layers of the wall, it tend to fall into fold over the caudal part of the udder that ascends toward the perineum. Which it is attached by means of a well developed suspensory apparatus consist of essentially of primary lamina, histological results four sheets of connective tissue applied to the lateral and medial side of each half of udder and meeting at the teats to form the capsule of the udder, secondary lamina seven to ten sheets arising from the primary lamina to enter the udder divided into lobes, medial lamina two elastic sheets from the ventral abdominal wall near the linea alba and extended ventrally between the two halves of the udder fig 2 The lateral lamina, two collagenous sheet arising from the pelvic symphysis, both medial and lateral lamina are thick dorsally and become progressively thinner when traced ventrally between the two halves of the udder.

The accessory teat or supernumerary teats (polythelia) extra teats that may or may not be connected to primary udder tissue, they are often found caudal to other four lobes fig 1. The internal compartments of the udder separated by adipose tissue, the lobes are divided into lobules consist of, milk (lactiferous) duct the large ducts converging milk from the alveoli to the milk sinus, milk (lactiferous) sinus the large strong cavity within the teat and the glandular body fig. 3, teat papilla projecting part of the udder fig 4, each teat has single lactiferous duct which widens dorsally into a roomy lactiferous since, the teat is long and cylindrical in shape four well developed teat. Length of teat(6 -7)cm & the diameters of teat (3-4.5) cm., the teat canal or duct leading from milk sinus to the teat opening. The main blood supply, from the external pudendal arteries are the branch into cranial and caudal mammary branches which anastomosis to form a ring around the base of the udder fig 5, the internal pudendel enters the caudal parts of the ring, the cranial mammary artery travels cranially on the ventral abdominal wall to anastomosis with caudal mammary artery.

Nerve supply, from the iliohypogastric and ilioinguinal nerves to the skin of the cranial udder and by the geniofemoral nerve to the skin of the caudal udder.

Drainage of the udder is effected by the external pudendel vein, and superficial cranial and caudal epigastric vein, which pursue flexuous subcutaneous course over the ventral abdominal wall, called milk vein which has a strikingly tortuous course, and there are two superficial inguinal lymph node or mammary lymph node, is located at the base of gland is usually palpable under the skin.

Histological study:

The gland is composed of many histological lobes which are separated from each other by interlobular connective tissue, lobes are subdivided into many lobules by intralobular connective tissue, the lobes and lobules are increasing in the size and the parenchyma of mammary gland consist of connective tissue containing alveoli, the grips like clusters of milk-secreting cell of mammary gland fig 6, alveolus and network of the duct and bundle of connective tissue, the alveolus also surrounding by fibers connective tissue and two layers of cuboidal cell, the intralobular duct drain by the interlobular duct which, empty in large ducts that are lactiferous duct fig 7, the grips like clusters of milk-secreting cell of mammary gland fig 8, it opens into lactiferous sinus, these duct line by two layers of cuboidal cells). Annular fold a constriction between glandular and teat parts of the milk sinus, it consist of muscular fibers, connective tissue and circular venous channels (Furstenberg's venous ring) venous circle surrounding the base of the teat, this is variable in size and many occlude the connection between the two sinuses (high spider) some times it has to be cut to allow milk into the teat sinus. The structures of the gland alveolus and network of the duct and bundle of connective tissue fig. 9.

The alveolus also surrounding by fibers connective tissue and two layers of cuboidal cell, the substance of the udder parenchyma and connective tissue inter mingled in proportions that can some times be estimated by palpation through the skin. It is in relation caudally to the large mammary lymph node and quantity of fat.

The tissue layers in the teat of cow include skin, inner fibers (stroma) and mucosa, stroma is vascular and muscular layer containing vein and drain to the large subcutaneous venous plexus at the junction of the teat and udder, the inner fibers layer is a thin membrane that is interposed between the mucosa and the stroma.

The teat canal is lined with keratin as a result of a specialized stratified squamous epithelium arranged longitudinally fig.10. Several lactiferous ducts empty into a lactiferous sinus at the base of the teat, this sinus is continuous with a teat sinus that open to the outside by way of the simple teat canal fig 11. The gland sinuses and the teat sinus the lactiferous sinus has a capacity of several hundred milliliters.

The wall of teat consist of three layers , the outer layer is the skin formed from only an epidermis and dermis fig 10 without any sebaceous glands ,hair follicle or sweat gland , middle layer is the fibro muscular vascular layer which is the thick layer ,it is composed of dense connective tissue mead of collagen ,elastic fibers and blood vessels fig . 11 ,smooth fibers arranged in circular manner at the base of teat , inner layer mucosa is the epithelium lining of the teat sinus and teat orifice , the teat sinus is lined by simple cuboidal cells , myoepithelial cells are present between the duct and basement membrane fig 12 ,teat opening lend with stratified squamous epithelium thrown into longitudinal folds and the sphincter muscles fibers around the teat opening.

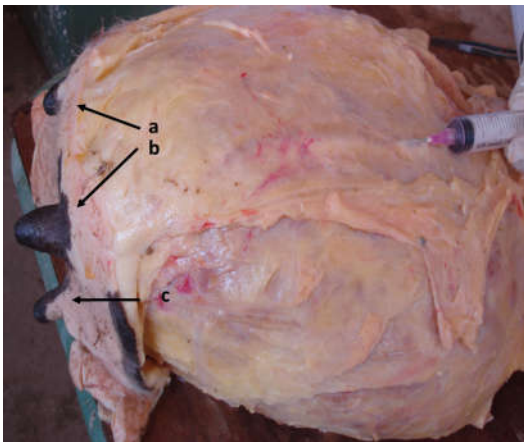


Fig .(1) show the^(a) cranial ^(b)caudal quarters of the cow udder and^(c) accessory teat

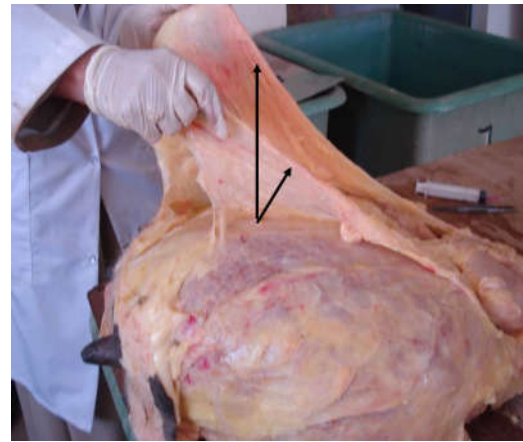


Fig. (2) show the medial lamina of the suspensory ligament(apparatus) from quarters of the cow udder

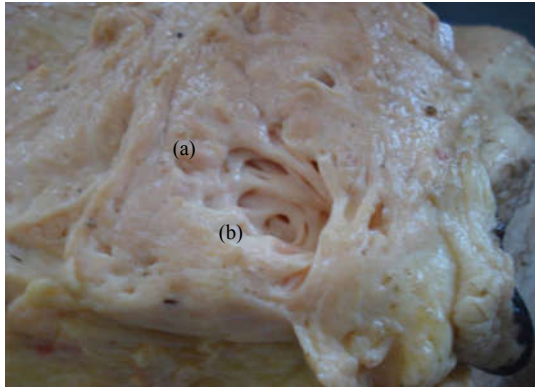


Fig. (3) Sagittal section of glandular tissue of the quarter show (a) lactiferous sinuses (gland sinuses) and (b) teat canal

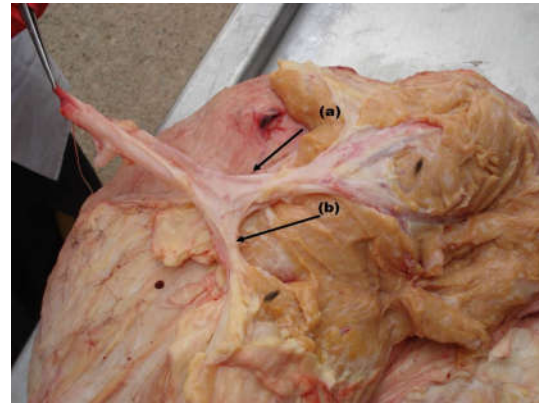


fig. (4). Show the (a) cranial and (b) caudal artery of the mammary gland

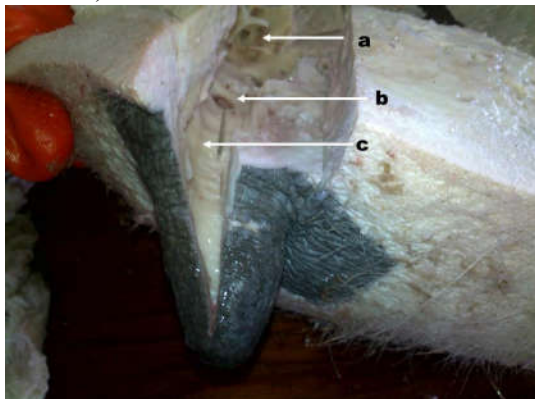


Fig (5) Sagittal section of glandular tissue of the quarter show (a) lactiferous sinuses (gland sinuses) , (b) teat canal and (c) papillary duct

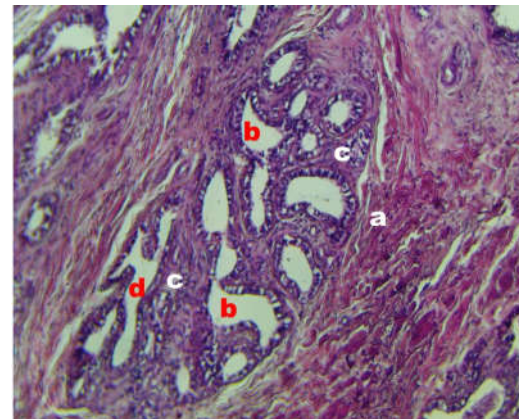


Fig (6) histological section of the glandular tissue of cow udder with (a) lobules , (b) interlobular , (c) intralobular connective tissue and (d) cluster of the duct surrounded by the interstitial connective tissue H&E magnification 120X

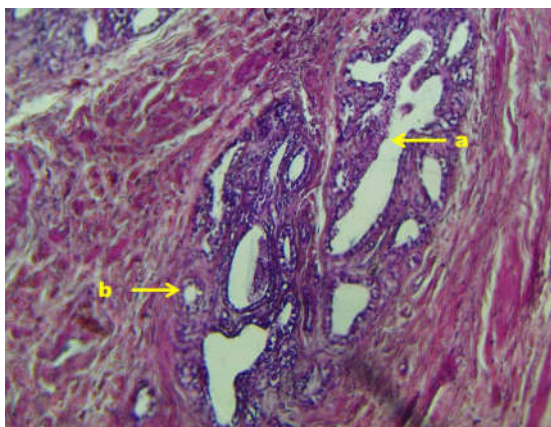


Fig (7) histological section of the lobes of cow udder show developing duct system and interstitial connective tissue, (a) lactiferous duct and (b) alveoli ,, H&E stain magnification 120 X

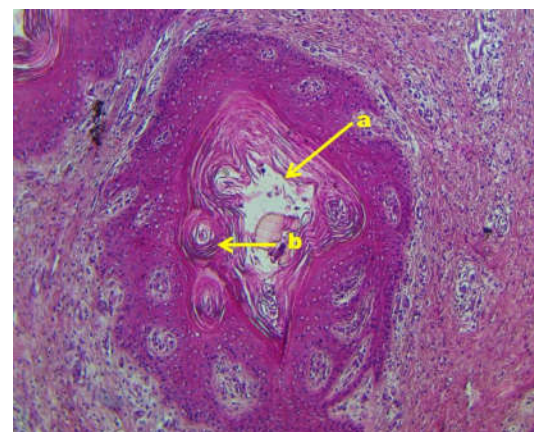


Fig . (8) histological section of the glandular tissue of cow udder with (a) milk concretion and (b) blood vessels in the base of teat H&E stain magnification 120 X



Fig. (9) histological section of the udder in cow show (a) lactiferous duct , (b) small lactiferous duct , (c) interlobular ducts and (d) alveolus , H&E stain magnification 120 X

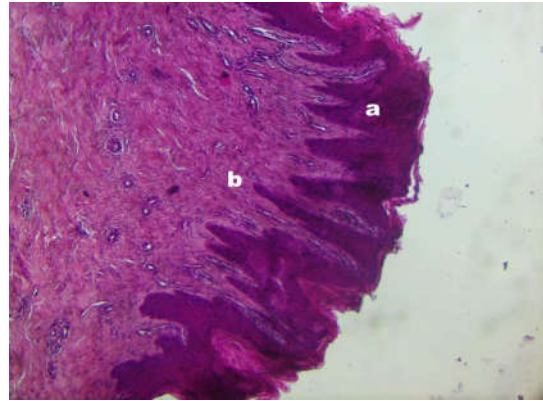


Fig. (10) histological section of the teat in cow show wall layers of the teat, (a) first layer epidermal of skin (b) dermal of skin , H&E stain magnification 120 X

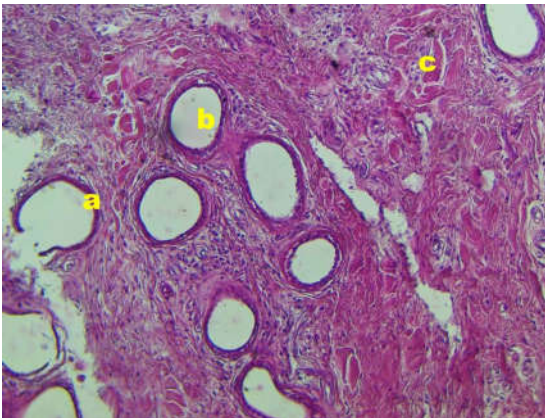


Fig. (11) lactating mammary gland of the cow udder show (a) the epithelium lining of teat since , (b) active alveolus and (c) interlobular septum H&E stain magnification 120 X

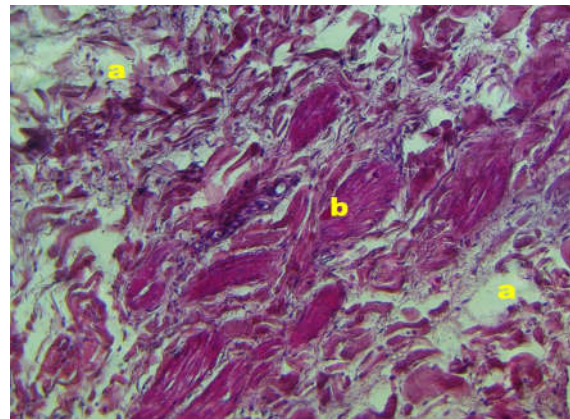


Fig. (12) histological section of the teat udder cow show (a) alveoli and (b) second layers fibrous mucosa, H&E stain magnification 120 X.

DISCUSSION

Anatomical Study:

In the present study the suspensory apparatus ,it is best developed in the cow , both medial and lateral lamina are thick dorsally and become progressively thinner when traced ventrally between the two halves of the udder due to elastic fibers , as the udder fills is stretches more than the lateral lamina and the teat angle laterally helps prevent them from dragging on the ground the heavily laden udder ,and effect that is made more obvious by the teats diverging to the sides . A minor contribution to the support is made by a few ribbons of elastic tissue that arise from tunica flava and dive into the adjacent part of the udder base (12) .

Also (13) in cow man shined about the udder in which the parenchyma predominates has a soft consistency when empty , amore turgid feel when distended with milk , the attenuation is explained by the detachment of numerous lamellae that penetrate obliquely into the quarters to interleave with roughly horizontal layers of gland tissue, the medial and lateral lamina also merge over the cranial and caudal borders of the udder halves.

This study it has been demonstrated that the blood supply they branch into cranial and caudal mammary branches which anastomosis to form a ring around the base of the udder , because since it is estimated that some 500liters of blood must flow through udder for every liter of milk secreted , it is clear that the vascular arrangements must be generously conceived (3) .

The results showed that The accessory teat or supernumerary teats that may or may not be connected to primary mammary gland tissue, they are often found caudal to other four , similarly was also noted by (9) in dairy cow that the supra mammary teats are the most common congenital anomalies ,which is likely heritable.

Histological study:

This work it has been demonstrated that the alveolar ducts are drained by lactiferous ducts to the lactiferous sinus ,the number of the duct system in one mammary gland varies with the species of domestic animals from (1-14) depending of the number of primary epithelium sprouts that grow from the mammary bud into the mesenchyme ,(15,16 ,17) in cow and buffalo the duct system per gland is the secondary unit is the alveolus , the alveolar ducts are drained by lactiferous ducts to the lactiferous sinus , this has two parts in the cow and buffalo. The alveolus also surrounding by fibers connective tissue and two layers of cuboidal cell, the substance of the udder parenchyma and connective tissue inter mingled in proportions that can some times be estimated by palpation through the skin. It is in relation caudally to the large mammary lymph node and quantity of fat . The tissue layers in the teat of cattle include skin , inner fibers (stroma) and mucosa, stroma is vascular and muscular layer containing vein and drain to the large subcutaneous venous plexus at the junction of the teat and udder, the inner fibers layer is a thin membrane that is interposed between the mucosa and the stroma.

The increasing in the size of lobes and lobules in lactating gland due to rapid growth of glandular tissue as a results of hormonal effects (16,17,18) The non-lactating mammary gland consist mainly from interstitial connective tissue of collagen bundle and abundant of elastic fibers and adipose tissue more than glandular tissue , our results agreement with (19)

In our results the tissue layers in the teat of cattle include skin , muscular fibers (stroma) and mucosa, stroma is vascular and muscular layer containing vein and drain to the large subcutaneous venous plexus at the junction of the teat and udder, the inner fibers layer is a thin membrane that is interposed between the mucosa and the stroma .

According to the wall of teat consist of three layers , the outer layer is the skin formed from only an epidermis and dermis without any sebaceous glands ,hair follicle or sweat gland. That teat opining lend with stratified squamous epithelium thrown into longitudinal folds

.in addition ,the teat canal is lined with keratin as a result of a specialized stratified squamous epithelium arranged longitudinally , results of these study agreement

with (15) the canal is lined with keratin as a result of a specialized stratified squamous epithelium arranged longitudinally. Keratin in the papillary duct binds bacteria and then desquamates to form a plug with anti-microbial activities that may deter bacterial entrance (9). The teat or streak canal of the healthy state acts both as a vascular obstruction to milk flow and as a unique deterrent to ascending infection of the canal.

The outer layer is the skin formed from only an epidermis and dermis without any sebaceous glands, hair follicle or sweat gland. These results were in agreement with (16) who mentioned that in cow and sow or it may contain fine hairs and well-developed sweat and sebaceous glands, such as in other domestic animals.

REFERENCES

- 1- Mishra PK, Mishra M and Naga JB. (1978). Relation of mammary measurement with milk yield in dairy cow. *Indian J Anim. Sci.*; 26 (1); p p: 630-650.
- 2- Pasquini CH, Spurgeon T and Pasquini. (1999). *Anatomy of domestic animals. Systematic and regional approach. 7th. Ed. United states of America*, p p: 533- 334.
- 3- Dyce KM, Sack WO and Wensing CJG. (2010). *Text book of veterinary anatomy. published in China library of Congress cataloging in. WB Saunders comp*, PP : 688-691.
- 4- Seham MA and Nafdy A. (1995) Some studies on the most important pathological affection of the mammary gland in Assiut Government. *Assiut Vet Med J*; 32(64), pp: 124 -131.
- 5- Sayed AS. (2003). Studies on some biochemical and hematological changes in cattle mastitis. *Assiut Vet Med J.*; 49 (98), pp : 144- 153.
- 6- Morcos MB, ELyas AH, Safwat EE and Amer AA. (1987). Bovine mastitis concomitant with post partum metritis. *Assiut. Vet Med J.* 19 (38), p p: 47- 54.
- 7- Rabi FO, AL- Samarrae NS and AL-Saffer FJ. (1995). General features of the udder and the histological structure of restarted and involutes mammary gland in one humped camel. *-Iraqi J Vet Sic*; 8 (2), p p:233
- 8- Das kl, SughCS and Sharma HR. (1982). Note on udder and teat biometry in goats. *Indian J Anim. Sci.* 52 (8), p p: 717-719.

9 -Divers J TH and Peek SF.(2008) . Rebhuns diseases of dairy cattle . 2ed. New York .Print in China . SAUNERS . Elsevier ; p p:327.

10- Koning HE and Liebich HG. (2007). Veterinary anatomy of the domestic mammals , Text book and color atlas . 3 ed. Ed. The Royal veterinary college. London England ; pp :595-601.

11- Nomina Anatomica Veterinarian Submitted by the International Committee on Veterinary Nomenclature(.2005) .Vienna; PP:134

12 -Hurley WL.(2005) . Anatomy of the mammary gland in cattle . cited by AL-Hakeem YA. Anatomical and radiological study of the lactating and non lactating mammary gland of the camel M s c Thesis Baghdad Uni. College of Vet Med. Pp:56

13- El-sheikh AS and Sultan ZA .(1987) . Development change in the udder section tissue of the Egyptian buffalo . Indian . J. Anim. Sci. 47 .10 ,p p:60

14 - Roy MK, Gangul A and Sing LP.(1997) . Histological of the teat non – lactating and lactating common Indian she goat . Indian J. Anim. Sin. ; 49 (9).p p:725 – 729 .

15- Atyia MA .(2009). Anatomical histological and radiological study of the mammary gland in the small ruminant . Bas J Vet Res , 8 (2)p p: 10-20 .

16- Dellmann HD and Brown SM. (1981). Textbook of veterinary histology. 3rd ed. Philadelphia: LEA and Fibiger, p p: 405-408.

17- Kernan JA .(2000). Histological and histochemical methods ,theory and practical of udder . Printed and bound in Great Britain by the Bath press , British library London cataloguing; p p: 107.

18- Steven AJ. (1998) .Wheatears functional histology. 3rd ed. Philadelphia, London,pp:102-103.

19 - Bloom WF. (1993). Text book of histology. 12th ed. Philadelphia: Chapman &Hall,pp:287-288.c