

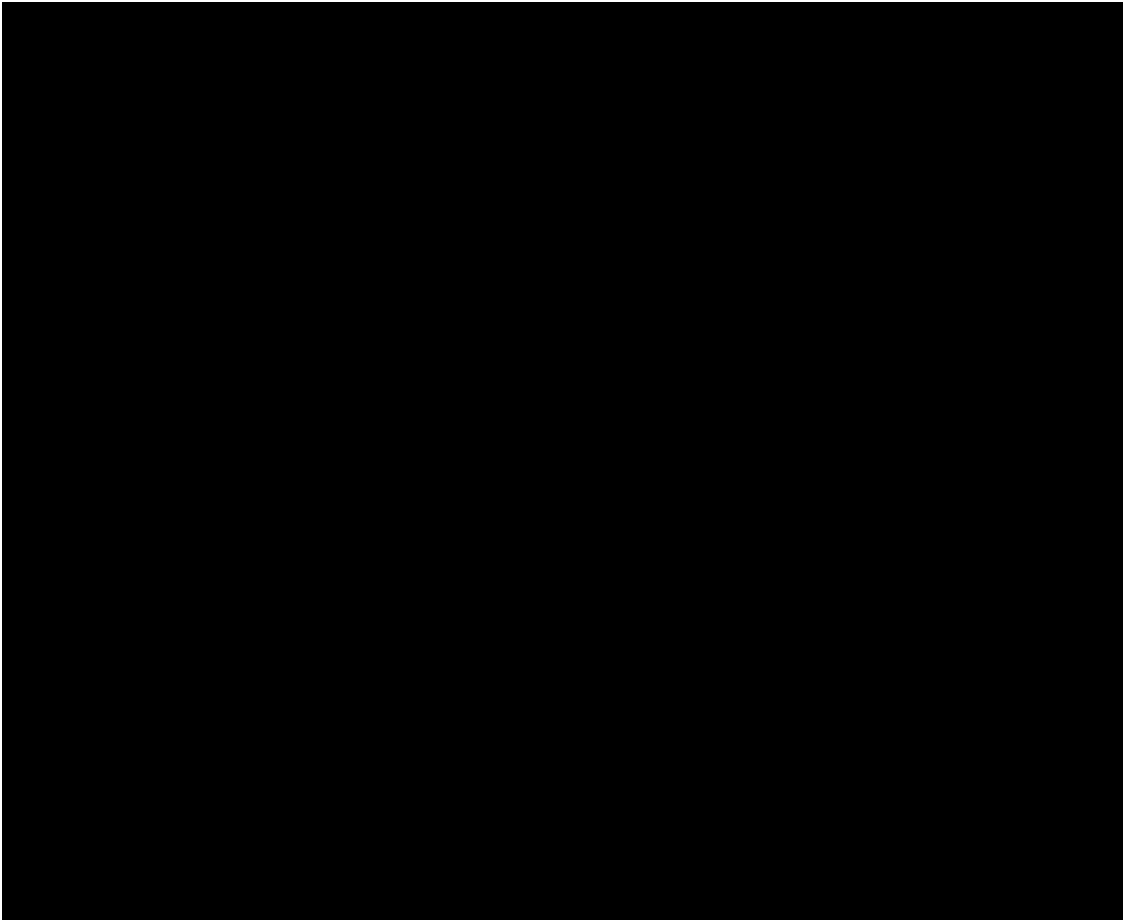
Lactation
ANS 215
Physiology and Anatomy of
Domesticated Animals

I. Introduction

- A. Lactation is the last stage of reproduction
- B. Key characteristic of class Mammalia

II. Anatomy

- A. Dairy cow has inguinal mammary glands (4) called an udder
 - i. Split into right and left halves with front and rear glands on each half.
 - ii. Each half has independent vascular and nerve supply, lymphatic drainage and suspensory apparatus



- iii. All the milk from one teat is produced by the glandular apparatus of that quarter.
- iv. The parenchyma of the mammary gland refers to the epithelial or glandular tissues as opposed to the stroma or connective tissue support.
- v. The milk secreting unit of the mammary gland is the alveolus



vi. Alveoli empty their contents into ducts which lead to a gland Cistern or storage area at the base of the gland. Each alveolus is a component of a lobule. Several lobules form a lobe.

vii. Expulsion of milk occurs through the teat canal which is kept tightly closed by a muscle sphincter.

B. Duct System

i. The various ducts converge to form larger ducts that empty into the lactiferous sinus which is composed of the gland cistern (within the gland) and teat cistern (within the teat)..

ii. Ducts are referred to as lobular or lobar depending on whether they serve lobules or lobes.

iii. Intralobular and interlobular refer to ducts within and between lobules.

iv. Ducts are composed of a double layer of cells while the alveolus is composed of a single layer of cells.

v. The gland cistern drains into the teat cistern which drains via the streak canal to the exterior of the gland

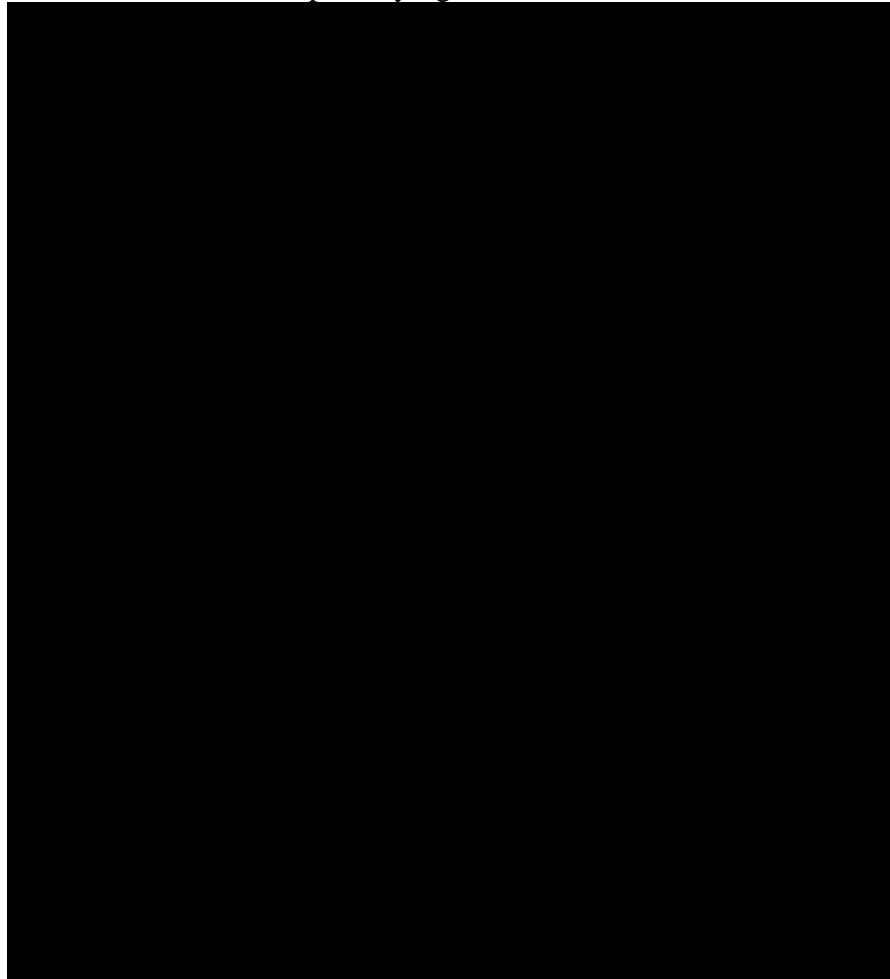


C. Teat

- i. Part of the mammary gland from which milk is extracted and suckled by the young is called the teat.
- ii. One teat for each gland
- iii. The teat or streak canal is normally closed by a smooth muscle sphincter that encircles the canal.
- iv. Tightness of the sphincter affects milking rate and mastitis resistance

D. Suspensory Apparatus

- i. Support from the longitudinal axis of the body for the udder is provided by the suspensory apparatus which is composed of medial and lateral suspensory ligaments

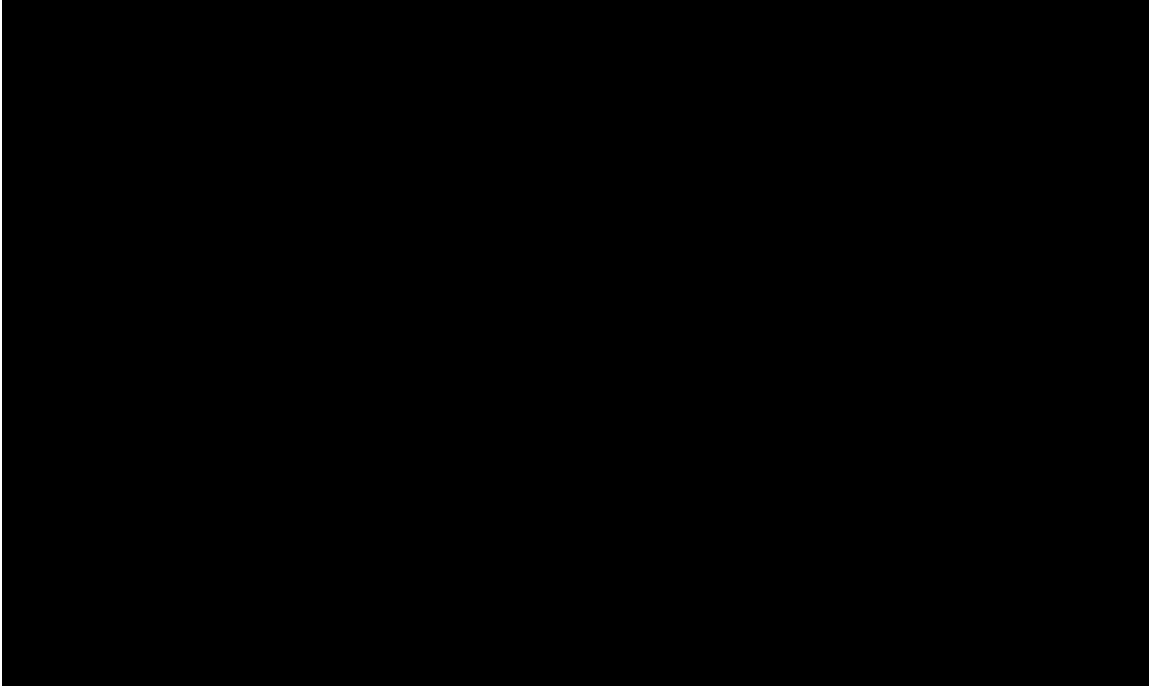


- ii. The medial suspensory ligament is derived from the elastic Fibers (connective tissue) that cover the abdominal wall. It passes down between the two halves and covers the medial side of each half, passes around to the front to about the middle of the cranial quarters, and around the back to the middle of the caudal quarters.

- iii. The lateral suspensory ligaments are composed of white, fibrous connective tissue derived from the subpelvic tendon.
 - 1. The lateral ligaments cover the lateral side of each half and meet the medial suspensory ligament at the front and back of each half.
 - 2. A number of connective tissue extensions come off the lateral suspensory ligament to divide each gland into lobes and lobules.

E. Blood Supply and Venous Drainage

- i. The principal blood supply to each half of the udder is the external pudendal artery (called the mammary artery in cattle)
 - 1. Arises from the abdominal aorta
 - 2. Passes through the inguinal canal and divides to supply the front and hind quarters.



- ii. Blood returns to the vena cava by the external and internal Pudendal vein and the subcutaneous abdominal (milk) vein

- iii. Lymphatic drainage follows the venous drainage. The Primary lymph node in the udder is the supramammary lymph node

F. Myoepithelial Cells

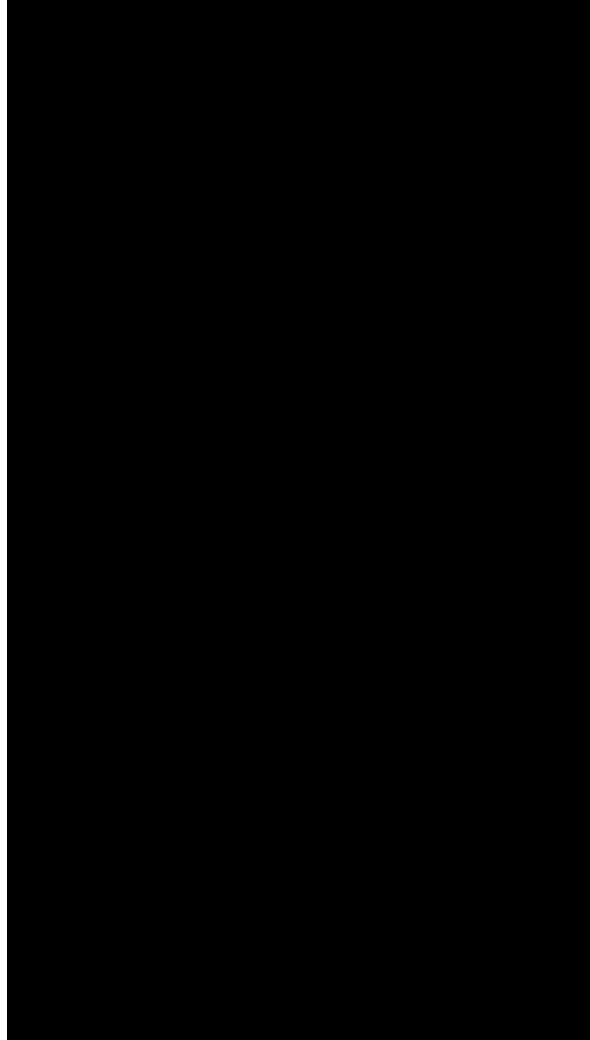
- i. Contractile cells that cover the alveolar units and ducts.
- ii. Contract under the influence of oxytocin and force milk out of duct system into gland and teat cisterns and eventually out of the udder.

III. Mammary Gland in Other Animals

- A. Mammary glands can be inguinal, thoracic or abdominal.
- B. Goat, Cow, Sheep and Horse have inguinal glands
- C. Pigs, Dogs and Cats have multiple glands from the thoracic to the inguinal region and are all litter bearing.

IV. Mammogenesis

- A. Mammogenesis refers to the growth and development of the mammary gland.



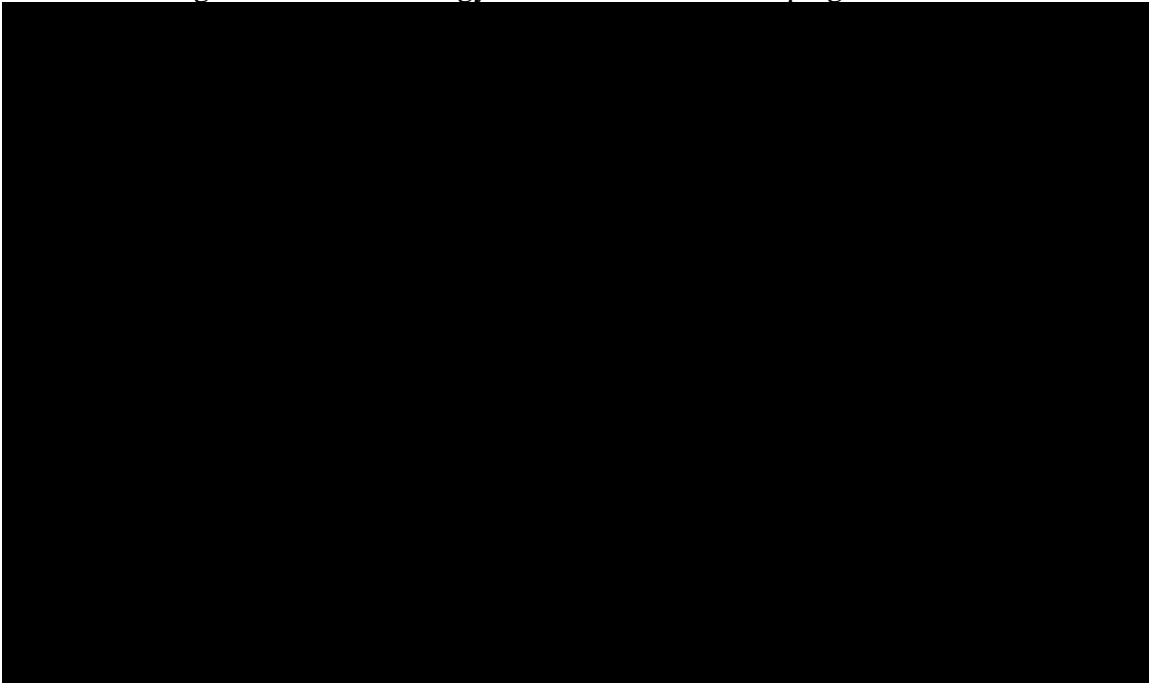
- B. During embryologic development, a milk or mammary band appears on each side of the abdominal wall. Mammary glands develop along this band according to the species. Most domestic animals have glands only in the inguinal region.

C. Development in Cattle

- i. At birth, the female calf has a teat and gland cisterns that are formed.
- ii. Mammary ducts are confined at this stage to the region of the gland cistern.
- iii. The growth of the mammary gland is similar to the rest of the body growth until puberty. At this point the growth of the glandular tissue exceeds the general rate of body growth.
- iv. Onset of pregnancy initiates a dramatic increase in mammary development culminating with lactogenesis (onset of milk secretion) at parturition.
- v. Hormones involved in mammary development are estrogen and progesterone at puberty and placental lactogen during pregnancy in combination with estradiol and progesterone.
- vi. Hormones involved in onset of milk secretion are prolactin, cortisol and somatomedins.
- vii. Maintenance of lactation requires prolactin, growth hormone, thyroid hormones, and glucocorticoids.

V. Milk Composition

- A. Gross composition of milk refers to the amount of fat, protein, carbohydrate and water and minerals are present in milk.
- B. Milk composition varies by species and is determined to some extent by growth rate and energy demands of the developing neonate.



C. Protein

- i. Principal proteins are caseins

- ii. Other proteins include alpha-lactalbumin, beta-lactoglobulin and blood serum albumins
- D. Carbohydrates
 - i. Primary carbohydrate is lactose
 - ii. Lactose is osmotic determinant of milk
 - iii. Principal precursors of lactose are glucose and galactose
- E. Lipids
 - i. Milk lipids are primarily triglycerides
 - ii. About 40% are formed de novo in the mammary gland
 - iii. About 60% are pre-formed from dietary or body fat sources
 - iv. In ruminants, milk fat is formed from the volatile fatty acids (acetate, butyrate and propionate)
- F. Minerals
 - i. Primary minerals are calcium, phosphorus, sodium, potassium and chlorine
 - ii. Milk is important source of dietary calcium and phosphorus
- G. Vitamins
 - i. Milk is important source of B vitamins and vitamin K

VI. Colostrum

- A. First milk produced after parturition
- B. Contains high concentration of immunoglobulins of blood origin
- C. Provide immune protection to the newborn mammal
- D. More important in domestic animals than in man because there is no transfer of immune globulins across the placenta in domestic animals while there is in humans.
- E. Colostrum must be consumed by the newborn domestic animal within a few minutes following birth to permit uptake of immunoglobulins across the gut wall before digestion begins.
- F. Initiation of digestion and cessation of immune globulin transport across the gut wall is termed “gut closure”.
- G. Survival of newborn domestic animals not given colostrum is low due to disease during the first 30 days of life.

VII. Milk Removal

- A. At nursing, the stimulation of the teat ends induces release of oxytocin from the posterior hypothalamus
- B. Oxytocin is delivered to the mammary gland by the blood stream and causes milk ejection or “milk letdown”.
- C. Noradrenaline interferes with this process.

