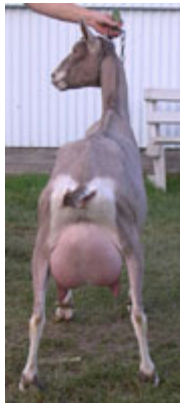
# The Goat Mammary System

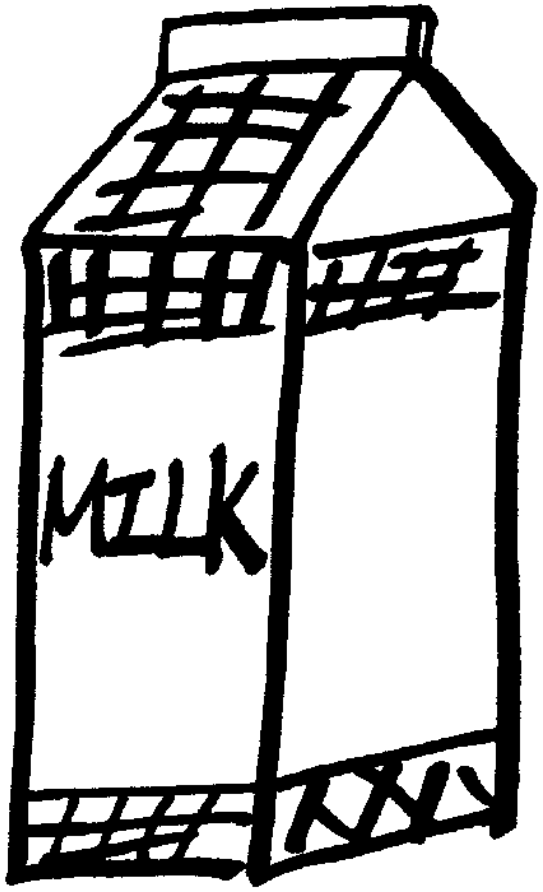
Roy Beckford

Lee County Extension

UF/IFAS

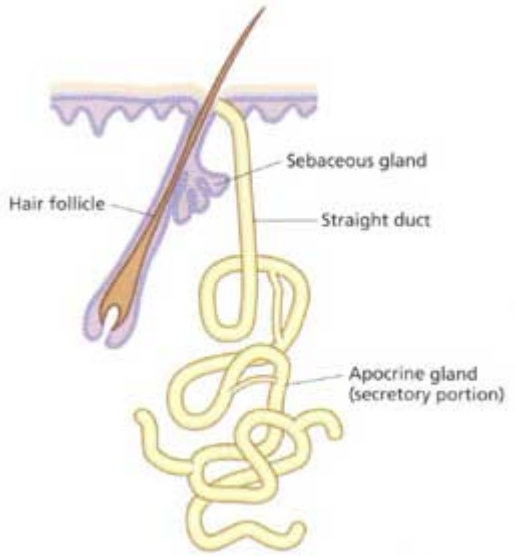
# Mammals and Mammaries

- A major characteristic of mammalian species is that they employ lactation as a critical part of their reproductive strategy
- Lactation produces milk from the mammary **gland**



# Mammals and Mammaries

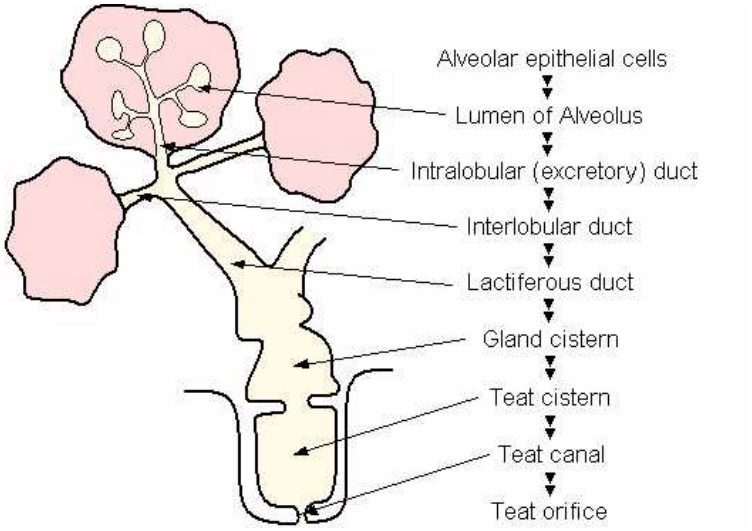
- A **gland** is a secreting organ.
- The secretion may be poured out (secreted) onto the surface of the animal, poured into a cavity, or taken into the blood without appearing externally.




Sweat Gland

# Mammals and Mammaries

- Glands can be of simple structure such as **coiled tubular** or **branched alveolar**, or of compound structure such as **branched tubulo-alveolar**.
- The mammary gland has a compound, branched tubulo-alveolar structure



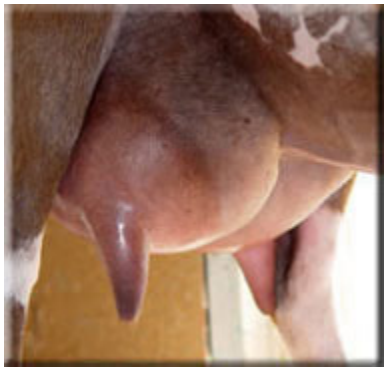

Mammary Gland

# Mammary Glands

- Mammary glands are present in both sexes.
- Functional activity in the male is rare, although milk have been developed in both virgin does and bucks by repeated gentle massage of the mammary area.
- Differentiation in growth of mammary glands between the sexes is usually not obvious until puberty.
- At that time, glandular enlargement occurs in the female.
- Most of it is in increased amount of connective tissue and fat deposition, but not increased formation of secretory tissue.

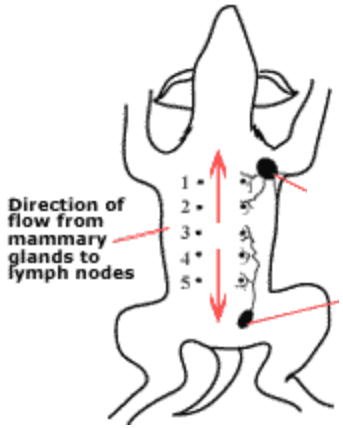
# Mammary Glands

- The mammary glands of goats are specialized cutaneous glands related to the sebaceous (oil producing glands of skin and hair) and sweat glands.
- From a physiological viewpoint, they might be viewed as accessory reproductive organs, as they are intrinsic to the reproductive function.



# Mammary Glands

- In all mammalian species, the mammary glands form on the ventral or underside of the animal.
- The number of glands that an animal has is determined at a very early stage of mammary development when the animal is a developing embryo




# Location of mammary glands

| Species | Thoracic Region | Abdominal Region | Inguinal Region |
|---|---|---|---|
| Cattle | - | - | 4 |
| Goat, Sheep | - | - | 2 |
| Horse | - | - | 2 |
| Pig | 6 | 6 | 4 |
| Cat | 4 | 2 | 2 |
| Dog | 4 | 4 | 2 |
| Rat | 6 | 2 | 4 |
| Mouse | 6 | - | 4 |
| Guinea pig | - | - | 2 |
| Human | 2 | - | - |

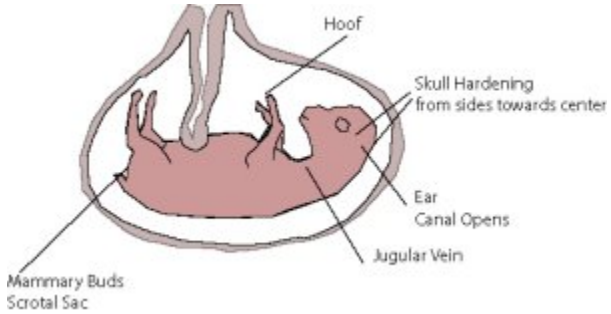
# Development Periods

Development of the mammary gland is generally broken into five phases. These are development during :

1. **Fetal Period**
2. **Prepubertal Period**
3. **Postpubertal Period**
4. **Pregnancy, and**
5. **Lactation.**

# Fetal Period

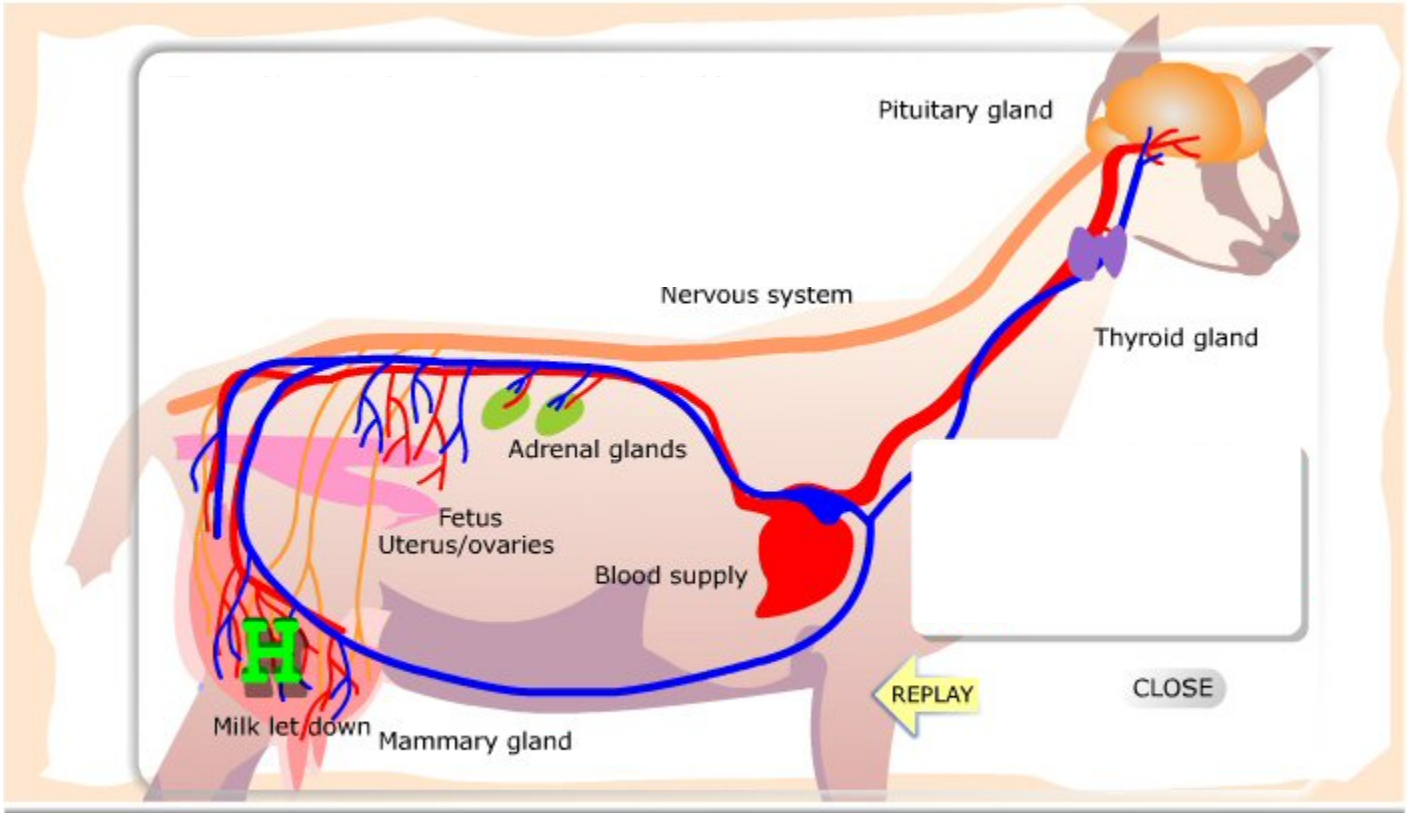
- Mammary development begins when the animal is an early fetus and proceeds beyond initiation of lactation.



# Pre-Pubertal Period

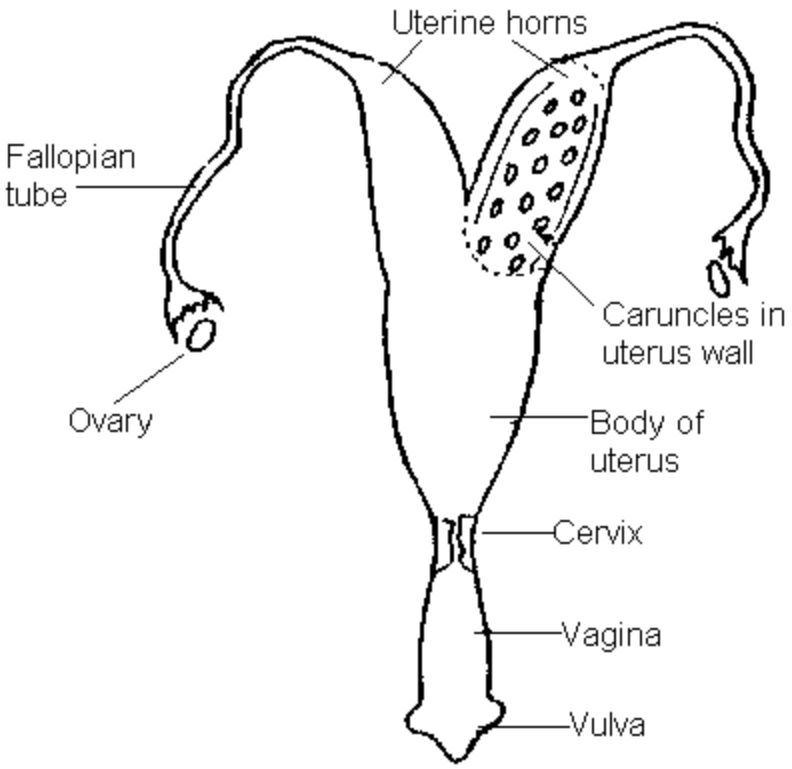
- Sexual development in the goat is a process of maturing, and the interaction between the hypothalamus, pituitary and gonads, which started during embryonic development.
- Puberty is generally defined as the point of sexual development at which the animal becomes capable of reproduction (First ovulation in the female)

# It starts in the brain



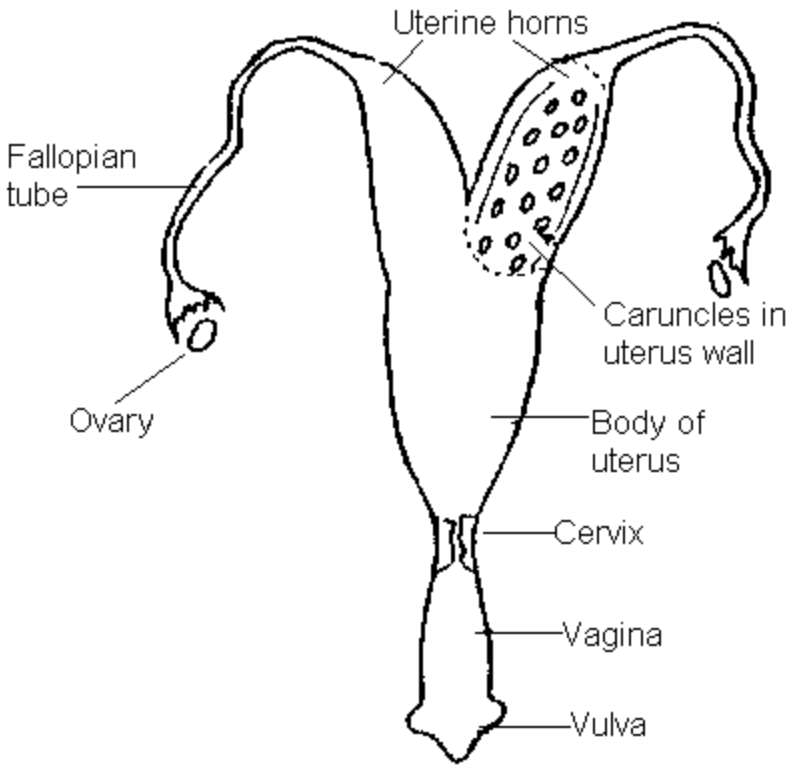
# Post-Pubertal Period

- The estrous cycle is controlled by the hormonal interactions of the ovaries with the pituitary glands located at the base of the brain.
- Diets and feed intake account for the physiological stage of production of the goat, particularly in the female (lactation, gestation).



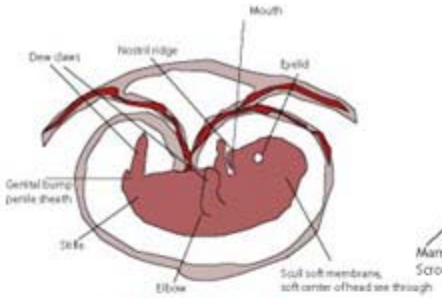
# Post-Pubertal Period

- Estrus (or heat) periods bring on increased formation of secretory tissue.
- Estrus also causes duct recession during the anestrus period.
- The process of mammary gland enlargement is minimal however, and the glands will not approach a functional state until the animal becomes pregnant.

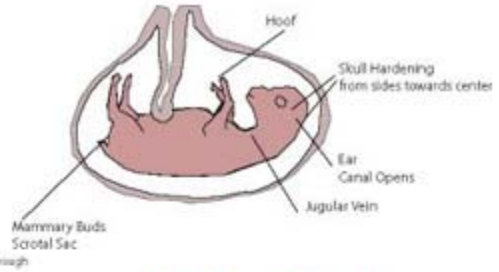


# Pregnancy Period

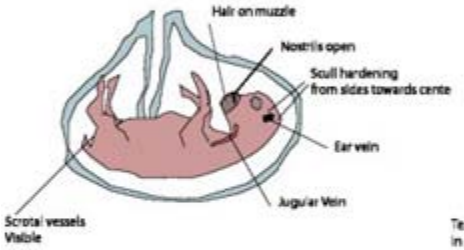
- Mammary growth (of the mother) accelerates throughout pregnancy.
- Fastest during the later stages of pregnancy, which coincides with the most rapid period of fetal growth.
- Pregnancy is often considered to be the period of most extensive mammary growth.



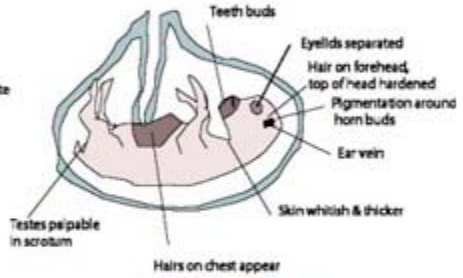

By the 20th day



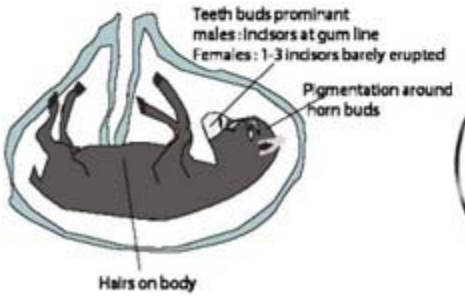

41st thru 49th days




At 60 days




By the 90th day

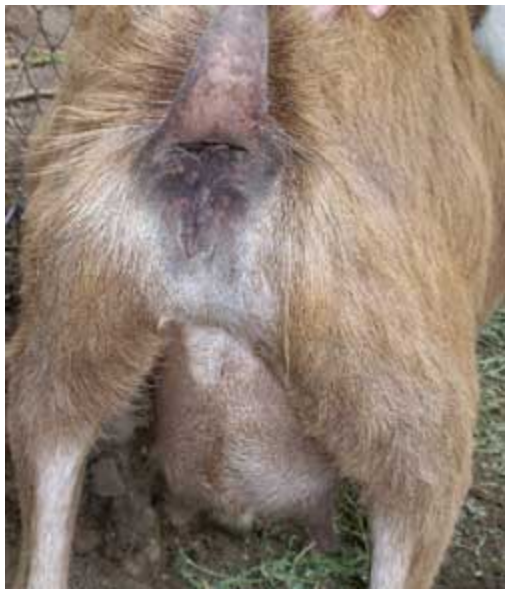



112th to 126th days


Birth at 145 to 155 days

# Pregnancy Period

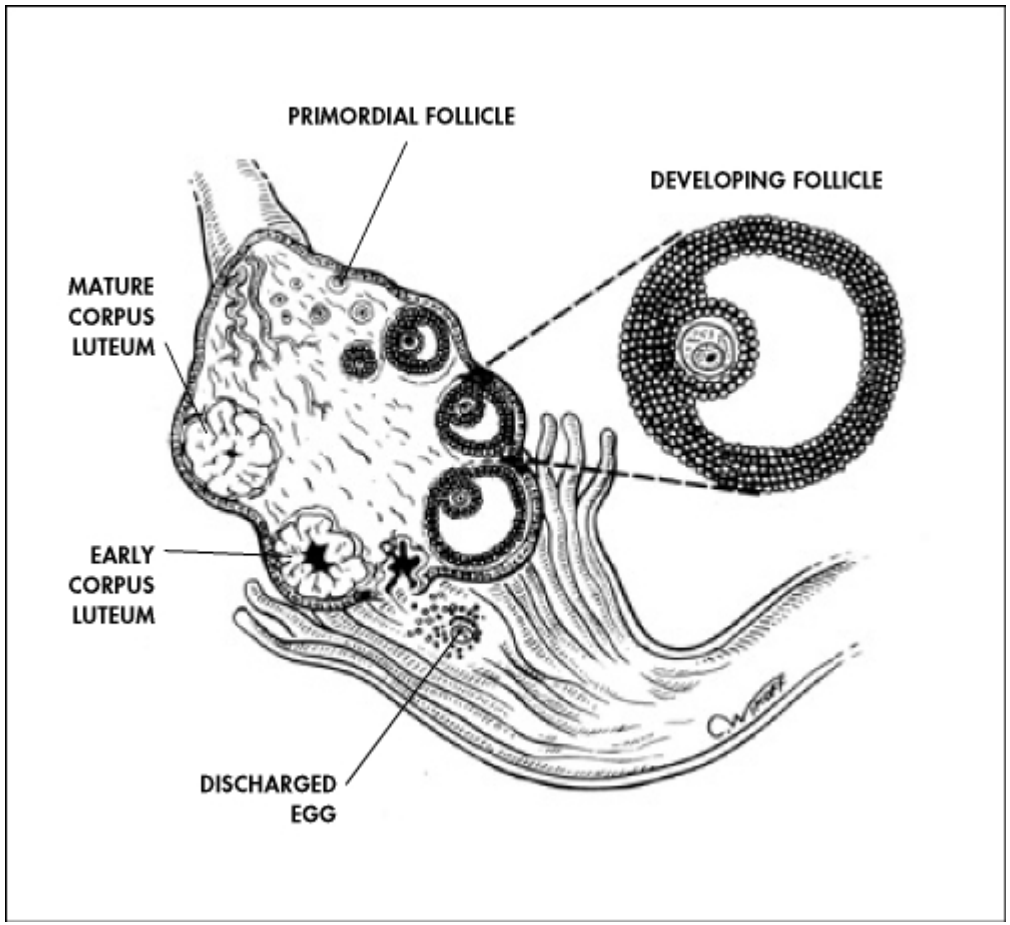
- The milk secretory cells develop only during pregnancy.
- The Pregnancy period is extremely important in determining the number of secretory cells in the lactating gland and the subsequent production of milk.
- Estrogen and progesterone are required both for the complete development of the mammary system, along with the other pituitary hormones.



# The Pregnancy Period

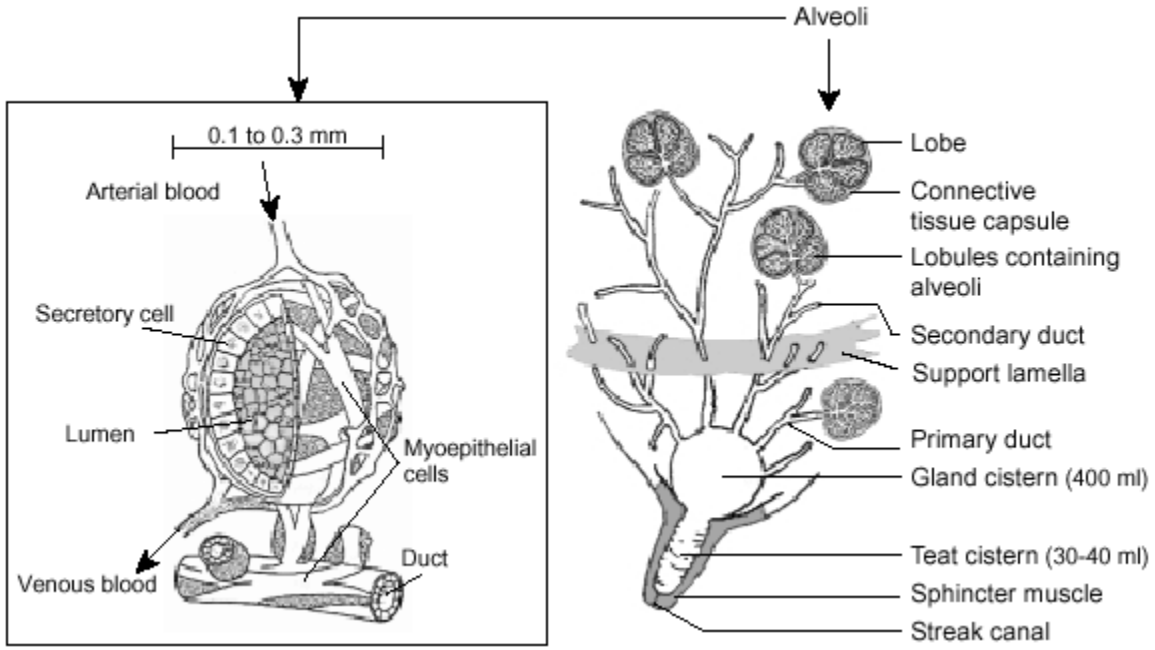
- Growth of lactating tissue is dependent mainly upon two hormones, **Estrogen** and **Progesterone**.
- Estrogen from the developing Corpus luteum.
- The corpus luteum is the naturally regressed stage of the follicle after it has ovulated, releasing ova into the oviduct.
- Estrogen, which is cyclic, stimulates the duct development of the mammary gland.
- Progesterone is almost continuously secreted during pregnancy, causing secretory tissue development.
- As the gestation period nears its end, the mammary glands become capable of producing milk.

# Corpus luteum



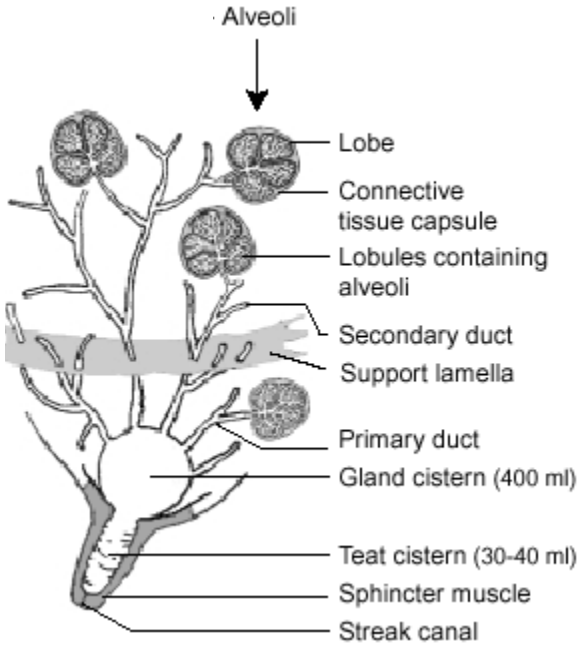
# Lactation Period

- The hormone of most interest in this period is oxytocin.
- It is responsible for milk let-down, causing the myoepithelial cells that surround the alveoli to contract, forcing the milk out into the ducts



# Lactation Period

- Oxytocin release is initiated in several ways, the most natural being nursing.
- It will directly stimulate the nerve fibers of the teat, causing the release of the hormone and transportation via the bloodstream to the mammary glands, with subsequent contraction of the myoepithelial cells.
- Milk let-down reflex can be produced by other repetitive occurrences.

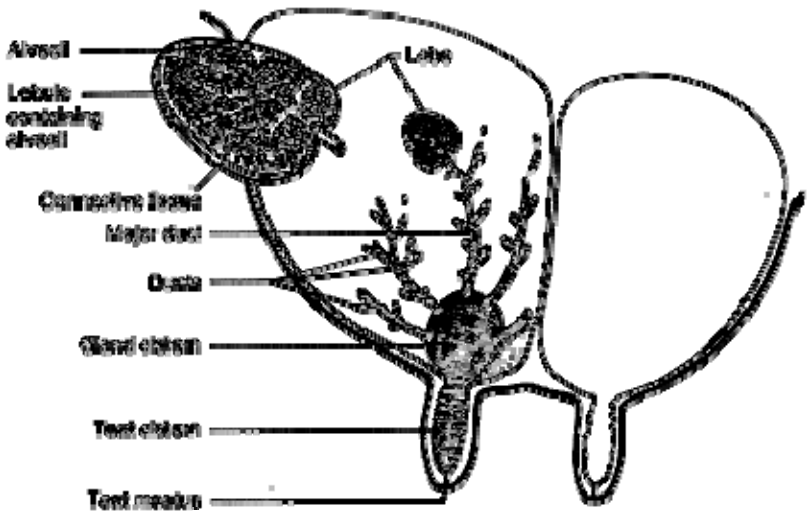


# Late Lactation Period

- After parturition, the rate of milk secretion increases for some time, reaches a peak, and then gradually declines.
- A loss of secretory epithelial cells occurs during involution, although some new cells are being formed.
- The general activity level of the individual cells declines also.

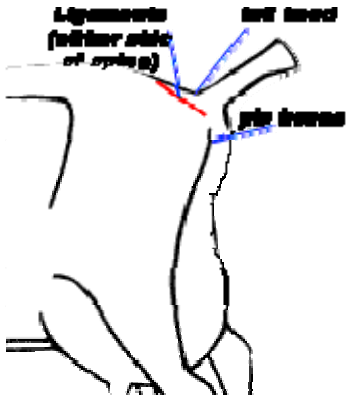
# MAMMARY GLAND STRUCTURE

- The udder of a goat is made up of two mammary glands or “halves."
- Each half is a functioning entity of its own which operates independently and delivers the milk through its own teat.



# Support system.

- A set of ligaments and connective tissue maintain the udder close to the body wall.
- Strong ligaments are desirable because they help to prevent the occurrence of pendulous udder, minimize the risk of injuries, and avoid difficulties when using milking equipment.



# Support System

- The median suspensory ligament is an elastic tissue that attaches the udder to the abdominal wall. Viewed from behind, the inter-mammary groove marks the position of the median suspensory ligament.
- Being elastic, it acts as a shock absorber and accommodates changes in the size and weight of the udder
- Damage or weakness of the this ligament cause the udder to stretch downward, making it more difficult to milk and increasing the likelihood of injuries, especially to the teats.

# Blood supply and capillary structures

- Milk production demands a lot of nutrients that are brought to the udder by the blood. To produce 1 kg of milk, 400 to 500 kg of blood must pass through the udder.
- In addition, the blood carries hormones that control udder development, milk synthesis, and the regeneration of the secretory cells between lactations (during the dry period).

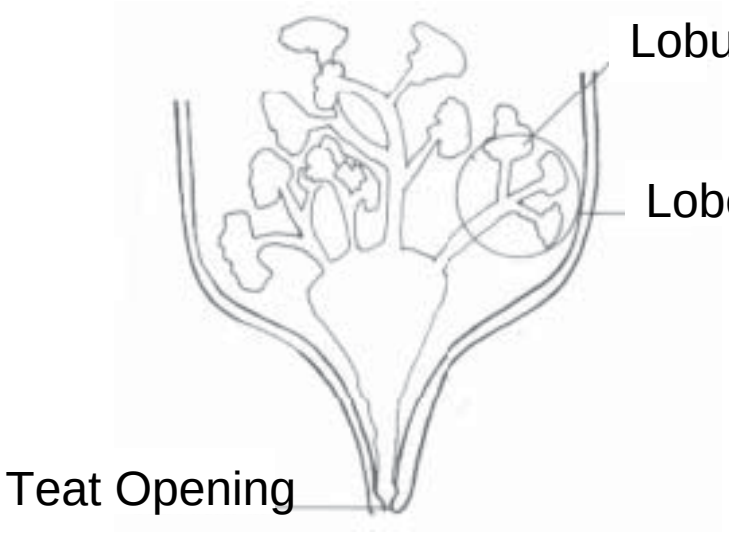
# Lymph system

- Lymph is a clear fluid that comes from tissues highly irrigated by blood.
- The lymph helps to balance the fluid flowing in and out of the udder and helps to combat infections.
- Sometimes the increased blood flow at the onset of lactation leads to an accumulation of fluid in the udder until the lymph system is able to remove the extra fluid.
- This condition, referred to as udder edema, is more prevalent in first-kid does heifers and older goats with pendulous udders.

# Innervation of the udder

- Nerve receptors on the surface of the udder are sensitive to touch and temperature.
- During the preparation of the udder for milking, these nerves are triggered and initiate the "milk let down" reflex that allows the release of milk.
- Hormones and the nervous system are also involved in the regulation of blood flow to the udder.
- For example, when a goat is startled or feels physical pain, the concerted action of adrenaline and the nervous system decreases blood flow to the udder, inhibits the "milk let down" reflex and lowers milk production.

# Internal Structure



# Duct and milk secretory systems

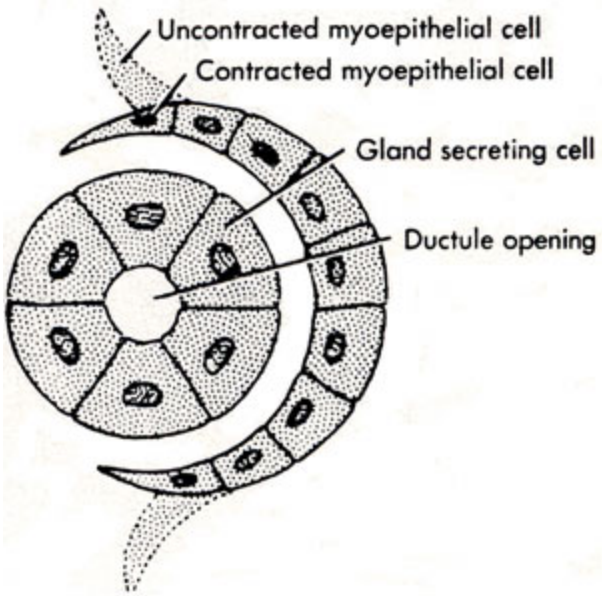
- The alveoli are connected to a duct system through which the secretion flows to the exterior of the animal.
- It also means that there is considerable external innervation of the skin covering the gland, but not much internal innervation other than the nerves controlling the blood vessels.
- The alveolus is a functional unit of production in which a single layer of milk secretory cells are grouped in a sphere with a hollow center

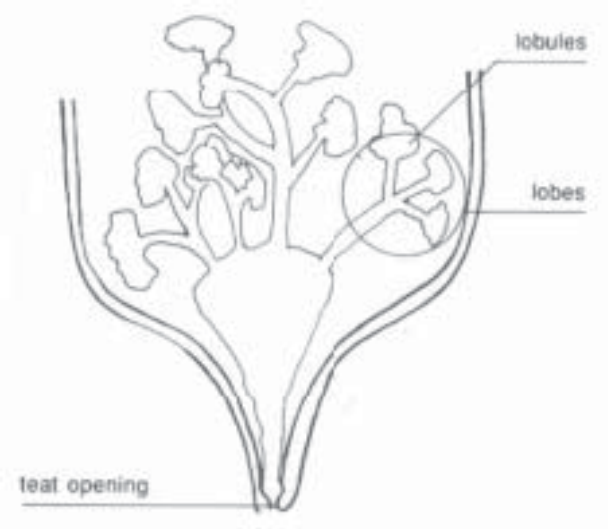
# Duct and Milk Secretory Systems

- Capillary blood vessels and myoepithelial cells (muscle-like cells) surround the alveolus, and the secreted milk is found in the internal cavity (lumen).

The functions of the alveolus are:

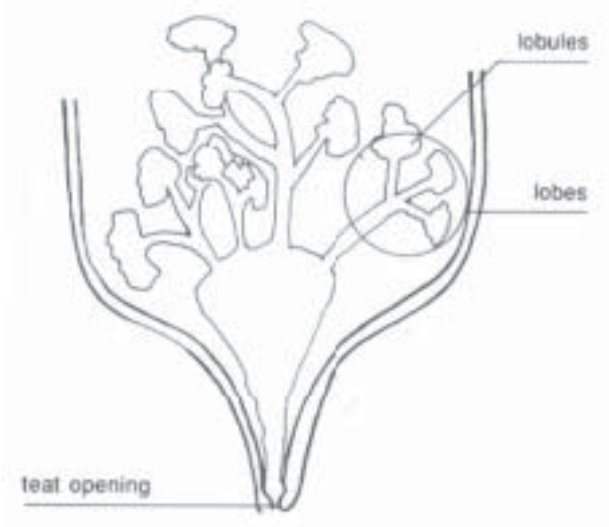
- To remove nutrients from the blood
- To transform these nutrients into milk
- To discharge the milk into the lumen



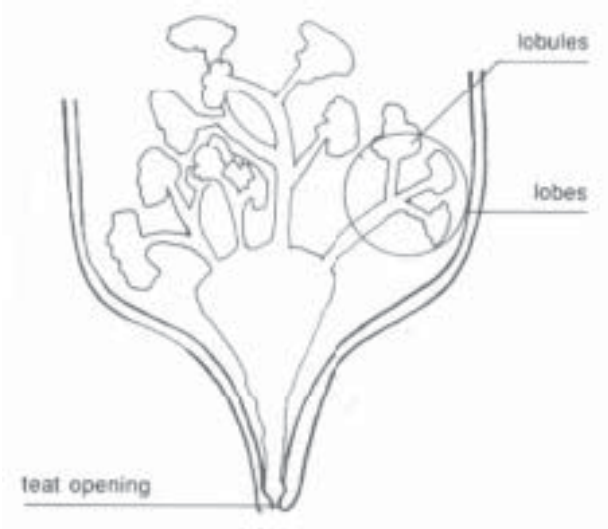
# Milk Expression

- The milk leaves the lumen through a collecting duct. A lobule is a group of 10 to 100 alveoli drained by a common duct.
- Lobules are themselves organized into a larger units called lobes. The lobes discharge the milk into larger collection ducts that lead to the gland cistern, which lies directly above the teat of the gland



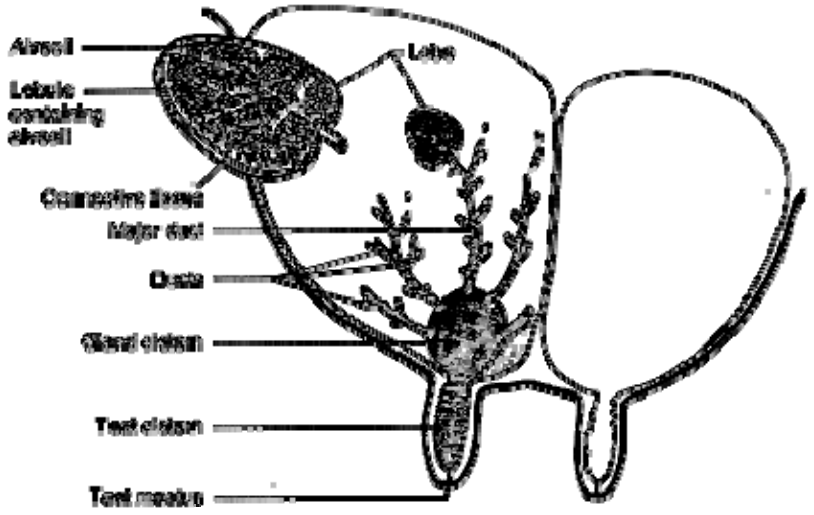
# Milk Expression

- The udder is thus composed of billions of alveoli where milk is secreted.
- The ducts form channels of drainage in which milk accumulates between milking.
- However, it is only when the myoepithelial cells that line the alveoli and the smaller ducts contract in response to the hormone oxytocin (milk let-down reflex) that milk flows into the gland cistern.



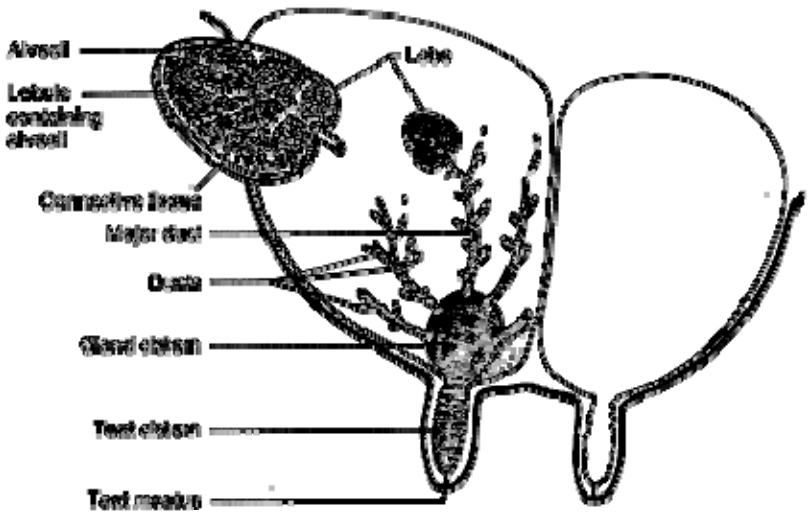
# Milk Production

- The teat forms a passageway through which the milk can be withdraw from the gland.
- The teat tip closes with a smooth muscle ring or sphincter called the "streak canal."
- At its upper end, the teat is separated from the gland cistern by only a series of delicate folds of sensitive cells particularly vulnerable to damage.

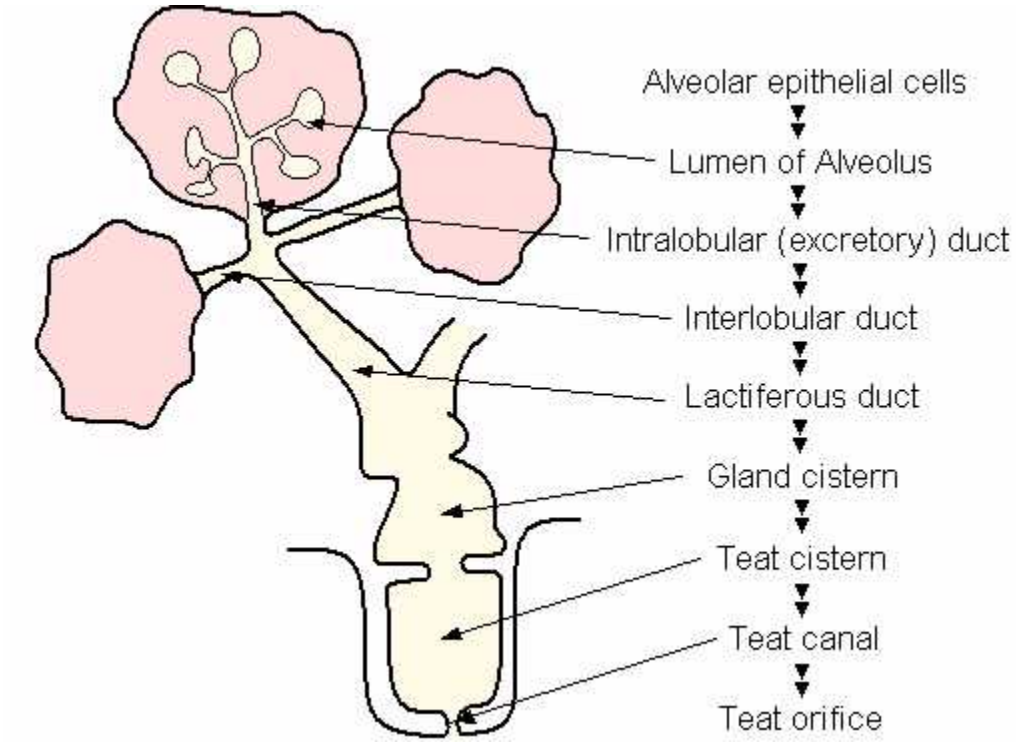


# Physical Barriers

- These folds of tissue are also found at the other extremity of the teat directly above the streak canal (rosette of Furstenburg).
- The teat is thus designed as a effective barrier to invading bacteria.
- Preservation of the normal teat structure is essential to the maintenance of the natural defense mechanism against mastitis-causing bacteria.

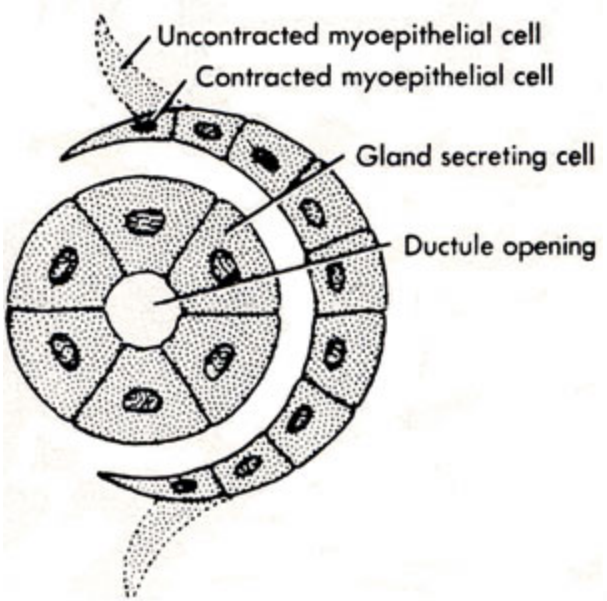


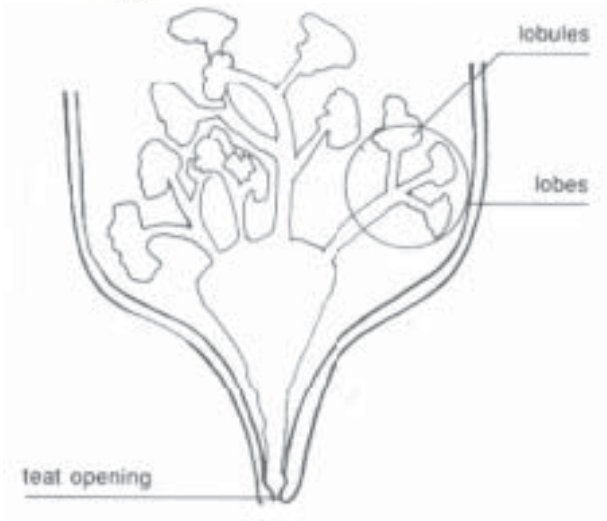
# Summary


Alveolar epithelial cells
Lumen of Alveolus
Intralobular (excretory) duct
Interlobular duct
Lactiferous duct
Gland cistern
Teat cistern
Teat canal
Teat orifice

# Summary

- The milk-producing cells are grouped into lobes, and within these are lobules.
- These are further divided into alveoli, which are tiny sac-like structures.
- They have an internal cavity called a lumen, and are lined by milk-secreting epithelial cells.
- Each alveolus is surrounded by muscle cells which contract during ‘milk letdown’.



# Summary

- Milk flows by suction through the canals and cisterns to the kid or milker.

And that’s how the system works!!!!!!!!!