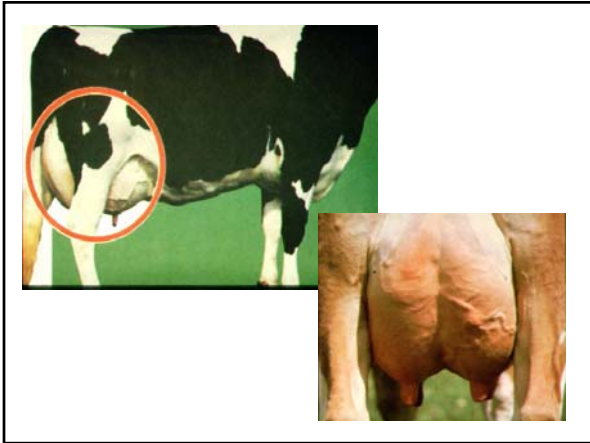


Lactation Physiology

Mammary Gland

Slides courtesy of Dr. H.D. Tyler, Iowa State University

References: Dr. M. A. Barnes, Virginia Tech and Dairy Cattle Science, 4th Ed. 2005.



The mammary gland nourishes the neonate

- Exocrine gland; common to all mammals
- Function: nourish the neonate
 - **Food source:** fat, protein, sugar (CHO), vitamins, minerals, water
 - **Protection:** _____ (first Ab protection; absorbed via intestinal tract)



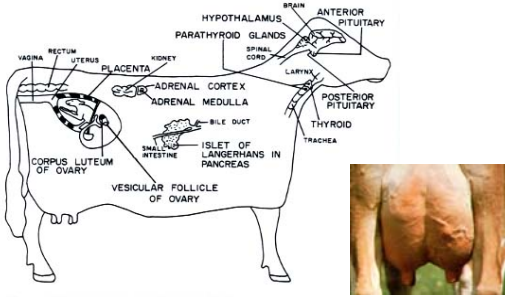
The mammary gland is part the reproductive system

- The mammary gland is loosely considered part of the reproductive system:
 - Serves a “reproductive function”; nourishment of the neonate = survival of species.
 - Relies on same endocrine (hormonal) support for development and function.



Example: gonadal steroids, prolactin, etc.

Endocrine Glands Affect Mammary Function



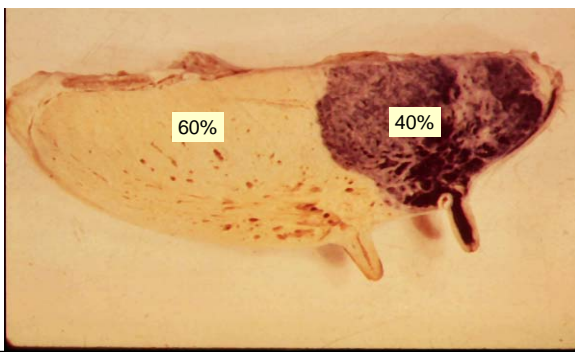
Mammary Gland Structure

- Udder consists of four separate glands
 - A teat hangs from each quarter
 - Bottom of teat closed by sphincter muscle known as _____
 - Can have extra nonfunctional teats
 - Called _____
 - Removed when calf is young
- Conformation of teats
 - Each teat has one streak canal
 - Sphincter in each teat should be tight enough to prevent leakage

Mammary Gland Structure

- Support system = **Stroma** (*connective tissue*)
- Glandular; secreting tissue =
 - **Alveoli-**
 - **Duct system-** lined by epithelial cells
 - **Lobules & lobes-** clusters of alveolar tissue supported by connective tissue

Separate Mammary Glands-Quarters

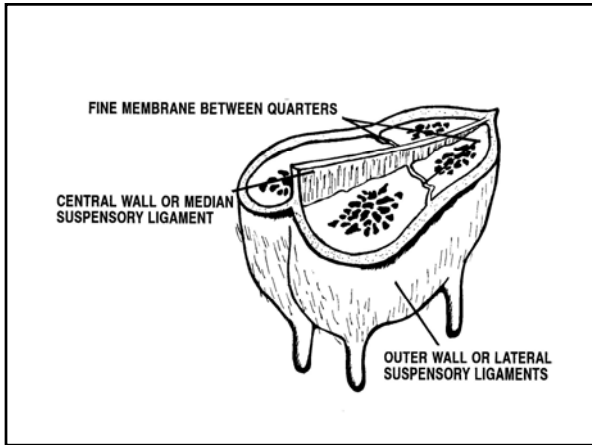


Mammary Gland Structure/Suspension

- Intermammary groove separates left and right halves of the udder
- Udder can weigh anywhere from 7 to 165 pounds
 - May support up to 80 pounds of milk
 - Rear quarters secrete 60% of the milk
 - Udder continues to grow in size until cow is 6 years of age
- 3 major supporting structures
 - Skin
 - _____ ligament
 - _____ ligament

Mammary Gland Suspension

- Skin
 - Minor role in support
- Median suspensory ligament
 - _____
 - Connects udder to abdominal wall
 - Elastic tissue which responds to weight of milk in udder
- Lateral suspensory ligament
 - Inflexible
 - Surround the outer wall of udder
 - Attached to prepubic and subpubic tendons



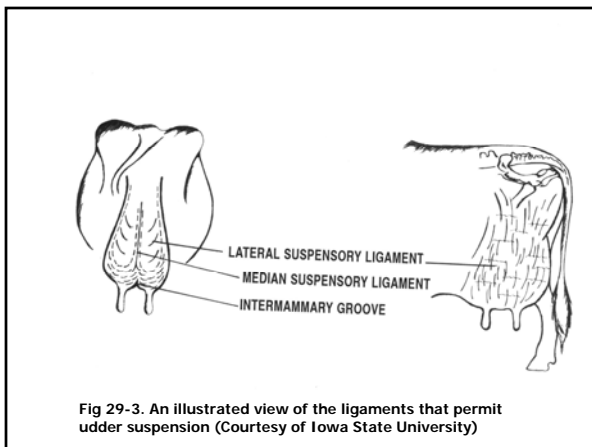


Fig 29-3. An illustrated view of the ligaments that permit udder suspension (Courtesy of Iowa State University)

Internal Anatomy

- Streak canal
 - Functions to keep milk in udder and bacteria out of udder
- Teat cistern
 - Duct in teat with capacity of 30-45 milliliters
 - Separated from streak canal by folds of tissue called _____
- Gland cistern
 - Separated from teat cistern by the cricoid fold
 - Holds up to 400 milliliters of milk
 - Collecting area for the mammary ducts
 - From this branches the mammary ducts

Mammary Gland Support

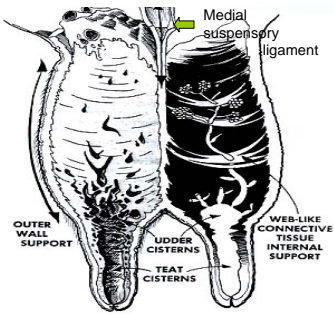


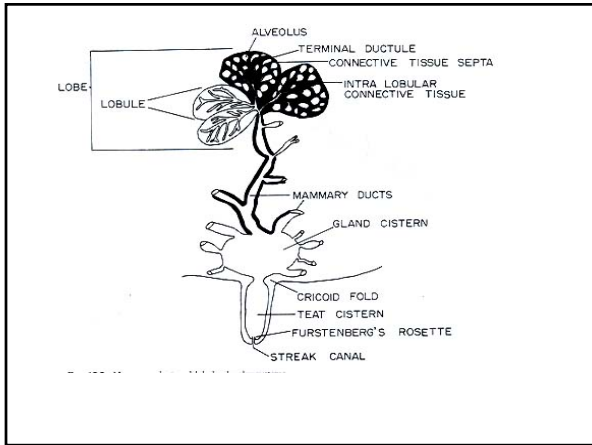


Fig 29-4. A dissected mammary gland showing the gland cistern, teat cistern and streak canal (Courtesy of Mark Kirkpatrick)

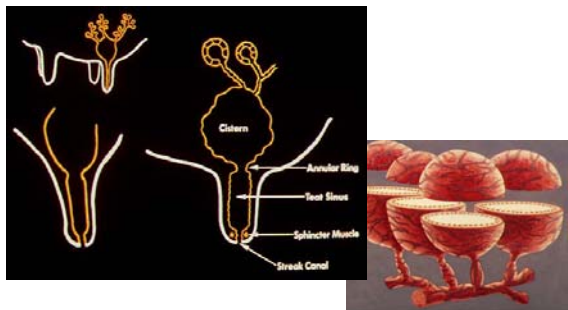
Alveoli and Duct System

- ❑ Alveoli is the basic milk producing unit
- ❑ Each cubic inch of udder tissue contains 1 million alveoli
- ❑ Each alveoli surrounded by network of capillaries and ---

- Contraction of myoepithelial cell stimulates **milk ejection**
- ❑ Groups of alveoli empty into a duct forming a unit called a lobule
 - Several lobules create a lobe
 - ❑ Ducts of lobe empty into a galatophore, which empties into the gland cistern



Alveoli and Duct System



Alveolar Products



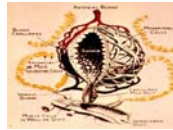
Alveolus:

- basic secretory unit; lined by **epithelial** cells which synthesize and/or secrete:
 - **lipid** - _____(FFA)
 - **protein** - _____
 - **lactose** - disaccharide; major CHO; osmoreactive molecule (draws water)
 - **minerals & vitamins** - Ca, P, K; Vits. A, B, C, D
 - **water**

Alveolar Structure

Alveolar components & function:

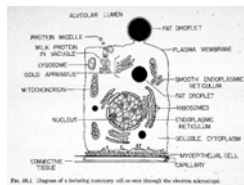
- **epithelial cells** - milk synthesis & secretion
- **lumen** - collect milk components & water
- **myoepithelial cells** - _____
- **basement membrane** - selective transfer
- **terminal duct** - milk transport out of alveoli
- **capillary system** - supply milk precursors and deliver hormones

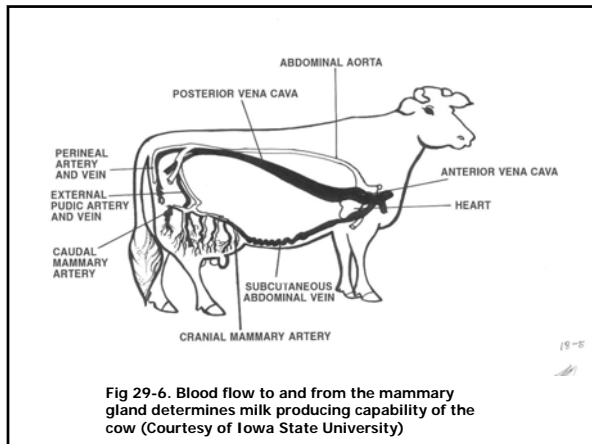


Mammary Cell Function

Alveolar milk component synthesis:

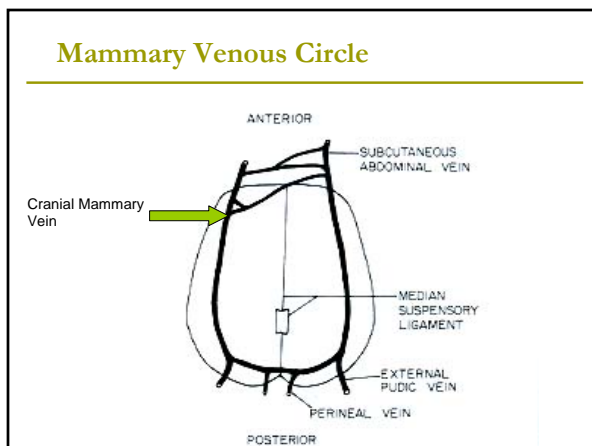
- **RER** > lipid, caseins
- **Golgi apparatus** > lactose (also packages lactose, caseins, minerals, water)



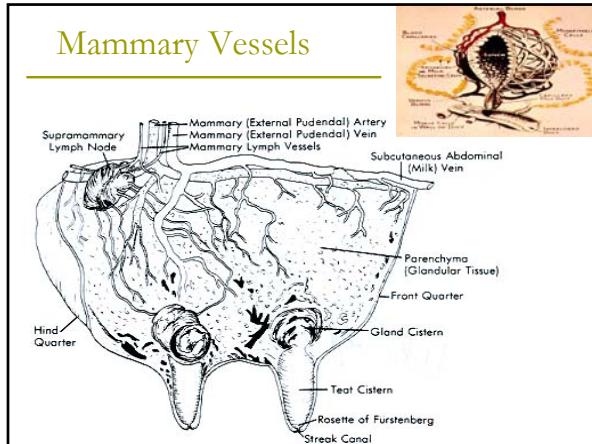


Circulation

- ❑ One gallon of milk requires _____ gallons of blood being passed through udder
- ❑ Blood enters the udder through external _____
- ❑ Blood exiting udder from veins at the base of udder blood can travel through two routes
 - Via external pudic veins
 - Via _____ veins

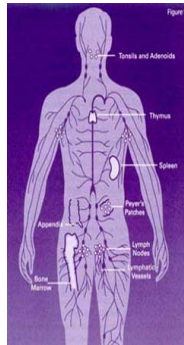


Mammary Vessels



Lymphatic System

- **Lymph is clear, colorless**
 - contains less protein than blood plasma
 - contains high [] of _____
- contains few RBC's
- carries glucose, salts, fat (chylomicra from intestine)
- _____
- carrier of fibrinogen (clotting protein)

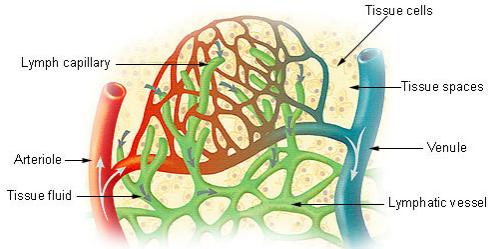


Lymphatic System

- Helps regulate proper fluid balance within udder and combat infection
- Fluid drained from tissue only travels away from udder
- Lymph travels from udder to the thoracic duct and empties into blood system
- Flow rates of lymph depend on physiological status of the cow

Function of the Lymphatic System

Lymph Capillaries in the Tissue Spaces



Lymphatic System- Edema

Edema:

- low pressure, passive system fed by a high pressure vascular system!
- this situation results in pooling of interstitial fluid if evacuation of lymph is impaired



Example: tissue trauma; increased mammary blood flow at parturition

Alleviating Mammary Edema

- Preparturient milking may be helpful
 - store colostrum from healthy cows to feed calves
- _____ to reduce mammary pressure
- Diuretics, corticoids to reduce swelling
- Mammary massage, icing
 - work fluid towards supramammary lymph nodes
- _____
- Don't feed too much, too early before calving
