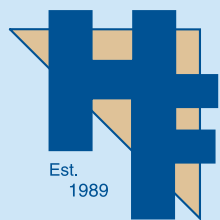


Milking and Lactation



**HOLSTEIN
FOUNDATION**

*"Developing Future Leaders
for a Vibrant Dairy Community"*

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Understanding Lactation

Lactation is the period of time that a mother secretes milk from her mammary glands. The lactation cycle is the period between one calving and the next. The cycle is split into phases; the early, mid lactation, late lactation and the dry period. In an ideal world, cows calve every twelve months, as they must calve in order to be able to produce milk.

A dairy cow is a **mammal**. Mammals are animals that have hair, are warm-blooded and nourish their young with milk. The mammary gland of a cow is a fascinating structure. Mammary glands develop prior to birth and further develop and grow when the cow is pregnant. We commonly refer to the mammary glands of a cow as the **udder**. These skin glands are located on the underside of the cow, between the rear legs. The four glands are referred to as quarters.

Several factors play a role in determining how much milk a cow will give such as age, breed, genetics and the environment. The average Holstein cow produces 9 gallons or 75 pounds of milk per day. However, the range can vary from 4 to 11 gallons a day. On average cows produce 90 glasses of milk per day. A cow should spend 10 to 14 hours a day lying in the stall resting and making milk. Moderate exercise is important to maintain high milk production. Mature cows produce about 25% more milk than two-year-olds. Milk production increases until about eight years of age. Holsteins are the most prominent breed of dairy cattle producing around 23,000 pounds of milk a year.

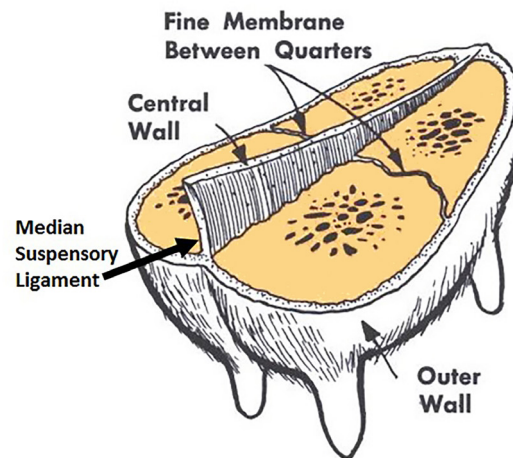
Approximately 400 to 500 gallons of blood pass through the udder for each gallon of milk produced. One of the roles of the mammary gland is to take nutrients from the cow's blood and synthesize them into milk that is then secreted into the mammary gland. At the end of pregnancy these glands undergo a process that initiates milk secretion.

The production of milk requires that a cow be in lactation, which is the result of giving birth. Gestation is around 279 days, when the majority of mammary development occurs. The actual lactation begins at calving. It doesn't only involve the production of milk, but also the development and function of the mammary gland, the metabolic and reproductive status of the cow and the development of the calf.

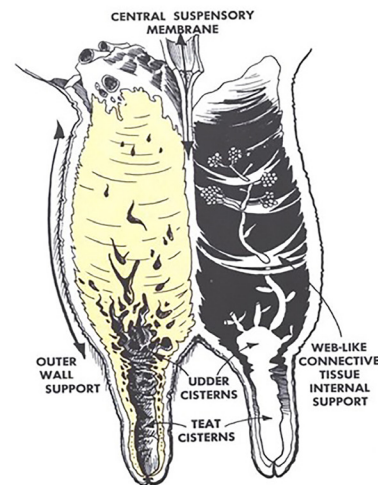
Hormones and the removal of milk from the udder are the two key components that contribute to the maintenance of lactation. In order for lactation to begin again the cow must be bred to produce calves each year. Therefore, lactation is the result of having a successful reproductive program.

Colostrum is the first milk produced by the cow after calving. The composition of colostrum is different from that of normal milk as it contains higher concentrations of antibodies.

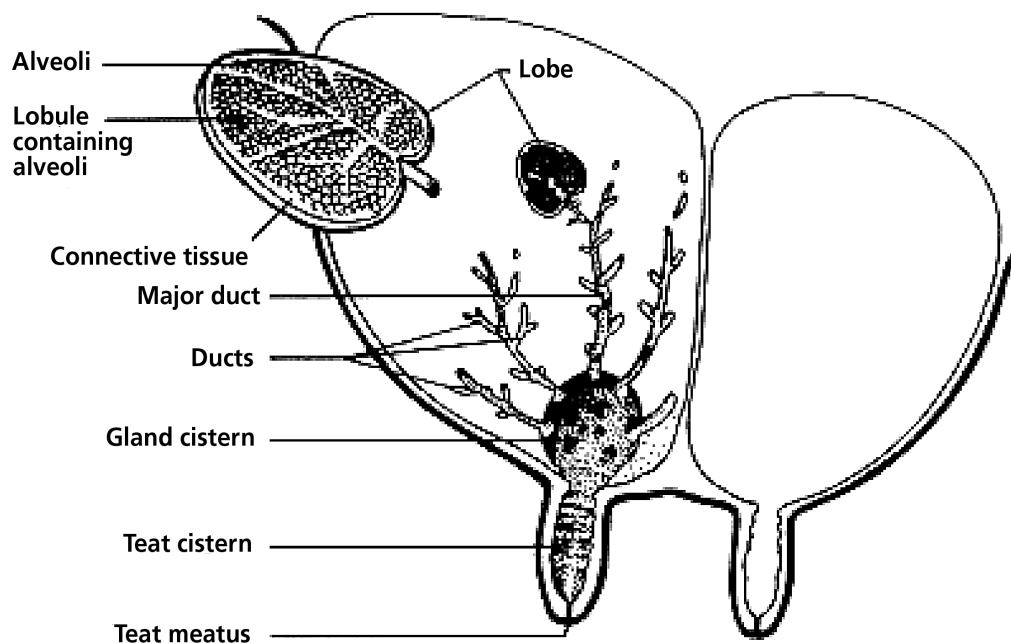
UDDER SUSPENSION & DIVISIONS



UDDER ANATOMY — SUPPORTIVE TISSUE



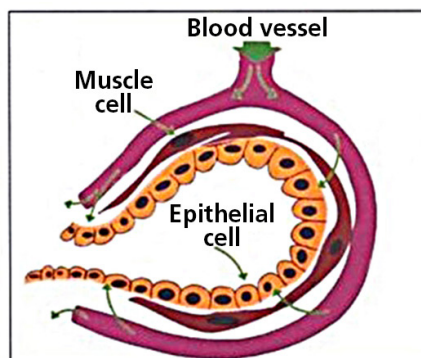
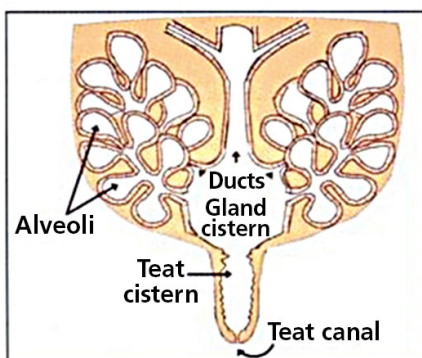
Functions of the Udder



Milk is a major source of nutrition and is composed of water, lactose, fat, proteins, minerals and vitamins. Milk is produced by cells grouped as hollow spheres and tiny storage units called alveoli (singular: alveolus). They appear as sac-like structures and are lined with epithelial cells. Epithelial cells are secretory cells that produce milk during lactation. Within each mammary gland are millions of alveoli. Since there are many alveoli, all the milk that has been secreted from the cells into the alveoli empty into ducts and subsequent larger ducts which further lead to the gland cistern.

The **orifice**, **streak canal** and **cistern** are all parts of a cow's teat. The orifice is the opening to the papillary duct; normally held closed by the sphincter muscle in the wall of the teat and elastic tissue around the orifice. Invasion through the orifice is the primary route in most cases of mastitis. The streak canal is located at the end of each teat. The canal is $\frac{1}{4}$ to $\frac{1}{2}$ inch in length and is made up of extensions of the skin that lie close together. The streak canal is held closed by sphincter muscles. The streak canal prevents the escape of milk between milkings and acts as a barrier to the entry of bacteria. The teat cistern is the final storage area of milk before the cow is milked. The gland cistern joins to the teat cistern at the base of the udder. It is located just above the teat cistern and acts as a milk

reservoir. The gland cistern is the largest storage area for milk as it collects milk from the major milk ducts that flow into it and fills rapidly during milk letdown. The teat cistern is the cavity inside the teat that holds $\frac{1}{2}$ to $1\frac{1}{2}$ ounces of milk. The teat cistern is where milk accumulates before it is removed through the teat end during milking. It refills continuously during milking.

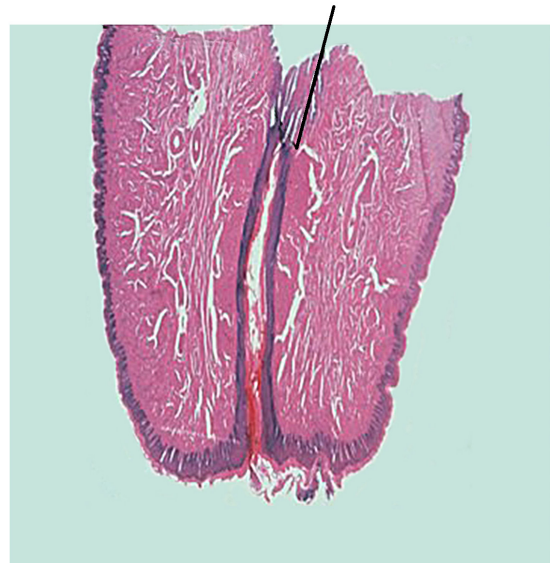




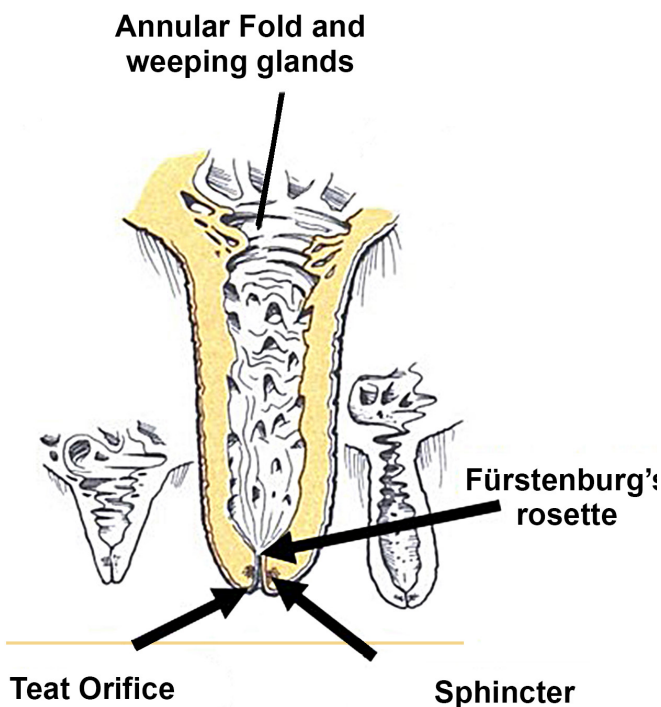
In the internal milk production process, epithelial cells start to replenish the milk supply immediately at the end of milking. The reduced udder pressure increases the blood flow allowing for the high rate of production. The hormone prolactin is present to stimulate the epithelial cells.

The **supramammary lymph glands** or nodes act as filters that destroy and remove bacteria from the udder. The streak canal is the main barrier against intramammary infection. It is kept closed by a ring shaped muscle at the lower end of a cow's teat called the **sphincter**. When a cow is milked this causes the sphincter muscles to relax, opening the orifice. The streak canal actually remains open an hour after milking, so it is important to help prevent bacteria from teat end contamination. The cells that line the streak canal contain **keratin**. Keratin is a waxy substance similar to ear wax. This substance helps to seal the teat end between milkings and inhibits the growth of bacteria.

STREAK CANAL AND LINING OF KERATIN



UDDER ANATOMY — INDIVIDUAL TEAT

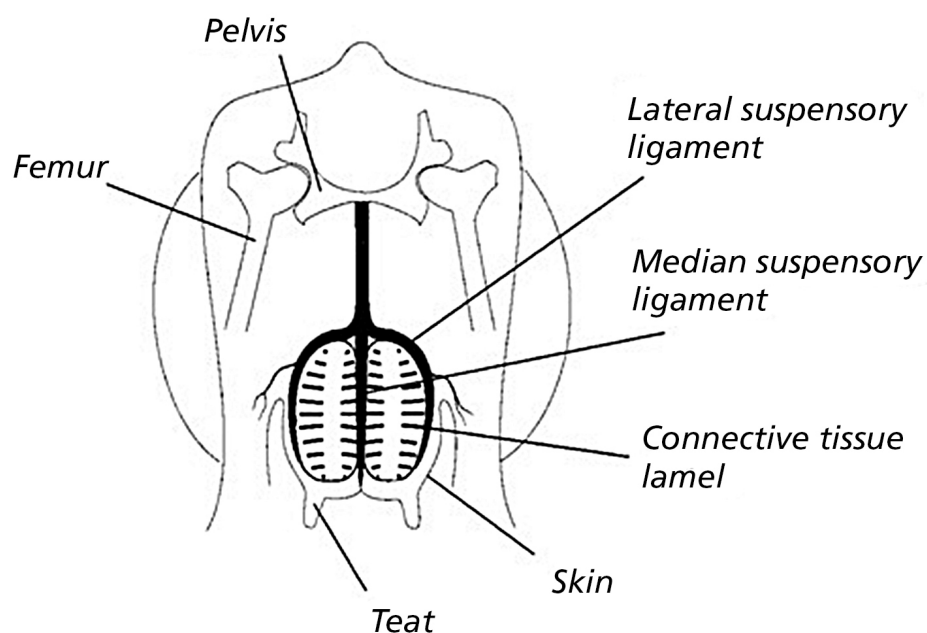


The **Fürstenburg's rosette** is located directly above the streak canal. It is made up of loose folds of membranes that smooth out as milk accumulates in the udder. This aids in blocking the escape of milk between milkings.

The most important support for the udder is the **median suspensory ligament**. The median suspensory ligament is located at the center of the udder providing a balanced suspension. It divides the udder into left and right halves. This major ligament has the ability to stretch as the gland fills with milk. **Subcutaneous mammary veins** also known as milk veins emerge at the front of the udder and run along the abdominal cavity and re-enter the body at the milk wells. Swelling of the udder is known as edema and is common at calving because a cow's udder has poor blood circulation.

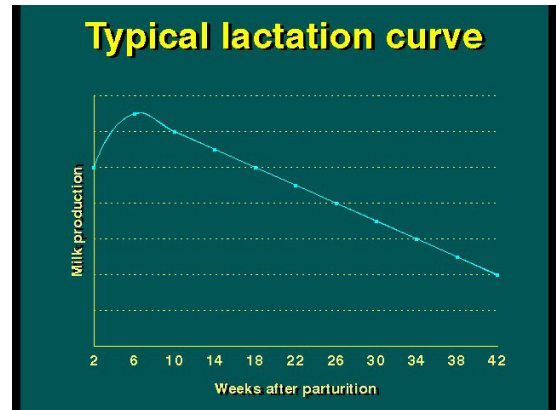
Only one teat drains one gland of the dairy cow. Almost 50% of calves are born with extra teats, often called supernumerary teats. Extra teats need to be removed before an animal reaches one year old. Many recommend removing extra teats as early as two weeks old. Sometimes cows will have a blind quarter. This is when one of the quarters does not secrete milk.

UDDER SUSPENSION



Lactation Curve

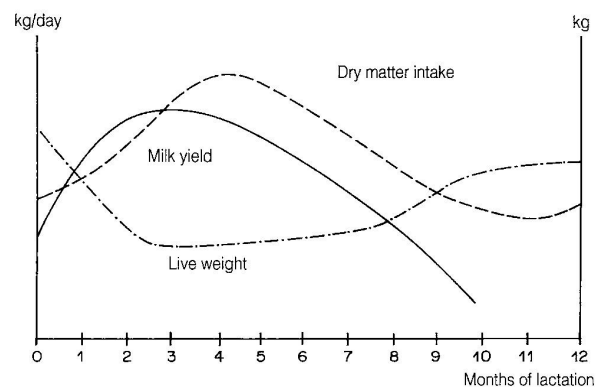
Often a cow's lactation cycle is referred to in stages: early lactation, mid lactation, late lactation and the dry period. Nutrient requirements will vary with the stage of lactation and gestation. Your nutrition program can play a critical role in milk production and reproductive performance. Milk production will start suddenly and increase daily in early lactation. As this happens greater amounts of nutrients are needed. Mammary tissue function declines after peak lactation mainly due to the decrease in mammary cell quantity. It is common to group cows according to their stage of lactation in group housing facilities.



STAGE 1 – EARLY LACTATION – 14 TO 100 DAYS

In early lactation, milk production begins at a high rate which continues to increase for three to six weeks after calving. This is known as peak milk production. In the first 100 days a cow's feed intake starts to lag and cows may begin to lose weight because of their rapid milk yield compared to their dry matter intake. This is called a **negative energy balance**. Once peak dry matter intake is achieved the cow will stop losing weight.

Feed intake can be influenced by several factors such as consistency, quality and quantity of feed and digestibility. Fresh feed should always be available after milking to encourage consumption. Protein is a critical nutrient during this stage. During this phase the cow should be bred, typically between 60 to 70 days in milk.



STAGE 2 – MID-LACTATION – 100 TO 200 DAYS

In mid-lactation the object is to maintain peak production for as long as possible and maximize dry matter intake. Cows should be eating 4% of their body weight. Feeding high quality forage is important in mid-lactation. Protein requirements are reduced during mid-lactation.

STAGE 3 – LATE LACTATION – 200 TO 305 DAYS

During late lactation, milk production will continue to decline along with feed intake. Cows will gain weight to support the growing fetus and replenish tissues lost from early lactation.

DRY PERIOD

The mammary gland of a cow requires a dry period. The **dry period** includes the time between no longer milking the cow and calving. The recommended dry period is 45 to 60 days. If the dry period is less than 40 days milk yield will be reduced. The same goes for dry periods over 70 days. A separate feeding program for dry cows is a must.

At 45 to 50 days before calving you should stop milking the cow. A lot of producers infuse the udder with antibiotics to prevent infections. Once milking is ceased and the cow is dried-off, **involution** of the mammary gland takes place. Involution is the process of the return of the uterus to normal function after calving, transforming from a pregnant to a non-pregnant state. This process is primarily due to the hormone oxytocin. **Lactoferrin** is a major protein found in mammary secretions during involution and helps with disease resistance. If bred on time, a year after the birth of her first calf a cow will calve again.

Metabolic Diseases

When a cow is lactating, her health is carefully and constantly monitored. Discussing management of your herd, especially early lactation cows, with your vet will help to identify areas where you may be able to improve. The following is a list of common metabolic diseases seen in dairy cattle. Consulting with a nutritionist is also important to help prevent metabolic diseases.

DISPLACED ABOMASUM

- commonly referred to as twisted stomach where the abomasum moves to an abnormal position in the body cavity
- usually occurs during first month of lactation
- causes discomfort and pain
- reduces feed intake and milk yield
- treated by walking, rolling or surgery

FATTY LIVER

- caused by an accumulation of fat within the cow's liver
- result of the cow breaking down too much fat for the liver to process properly
- lower milk yields, depressed appetite, incidences of milk fever, ketosis, mastitis, retained placenta and reduced fertility
- treated long term with IV infusions of glucagon

KETOSIS

- happens when fatty acids are transported to the liver in greater quantities than can be metabolized, creating a negative energy balance
- occurs 10 days to 6 weeks after calving
- depressed appetite, decreased milk production, weight loss, listless behavior, acetone breath, constipation, and increased milk fat percent
- treated by propylene glycol drenches or glucose injections into the vein

MILK FEVER (HYPOCALCAEMIA)

- caused by low calcium levels near calving
- exhibits signs of agitation and tremors in muscles of the head and limbs
- staggers and has trouble standing
- staring eyes, cold legs and ears, dry muzzle, constipation and drowsiness
- treated by injecting calcium subcutaneously and/or intravenously

RETAINED PLACENTA (FETAL MEMBRANES)

- failure to expel fetal membranes within 24 hours after parturition (normally expulsion occurs within 3–8 hours after calving)
- foul-smelling discharge
- cows expel the membranes 2–11 days after calving
- observe the cow closely for signs of illness and treat any symptoms that occur

Functions of Hormones in Milk Production

The control of lactation is regulated by **galactopoeitic** hormones. Galactopoesis is defined as the maintenance of lactation. Many of the hormones involved in mammary growth are also responsible for fetal development. These hormones include: prolactin, growth hormones, thyroid hormones and steroid hormones.

PROLACTIN

Every time milk is removed from the cow the hormone prolactin is released which causes stimulation. Prolactin remains a key factor in milk secretion during lactation. Also, extended light periods increase concentrations of prolactin associated with milk production.

GROWTH HORMONES

Growth hormones help coordinate changes in physiological processes and in body tissues. Growth hormone is essential for maintaining lactation as it supports increase in synthesis of lactose, protein and fat in the mammary gland.

OVARIAN HORMONES

Ovarian steroids such as estrogen and progesterone are not necessary for maintenance of lactation. Progesterone alone has no effect because there are no progesterone receptors in the mammary gland during lactation. Increased blood concentrations of estrogen may affect milk production.

OXYTOCIN

Stimulation of the mammary gland, particularly the teats, results in the secretion of the hormone oxytocin. Oxytocin travels via the blood to the mammary gland and ultimately results in the physical removal of milk from the alveoli. Oxytocin is essential for milk removal.

THYROID HORMONES

Thyroids hormones are essential for maximum secretion of milk as they stimulate oxygen consumption, protein synthesis and milk yield. In addition, there is an inverse relationship between a cow's milk yield and blood levels of thyroid hormones in early lactation.

Milking Procedures

MILKING

Most farms milk two or three times a day. More frequent removal of milk can increase milk yield. Always make a cow's milking experience a positive one as this will minimize stress and maximize yield at each milking. Cows should always be treated gently and follow a consistent milking routine. Milkers should make sure they disinfect themselves before milking by thoroughly washing their hands with soap and water. This will minimize the spread of pathogens.

UDDER STIMULATION

Udder care and hygiene in cows is important in milking, aiding uninterrupted milking and preventing mastitis. Before a milking machine is attached to the udder, teats should be cleaned, well stimulated and dry.

The streak canal has to be open in order to remove milk. This can be achieved through stimulation by a milking machine, hand milking or suckling. Stimulation of the teats activates pressure sensitive receptors which are transferred into nerve impulses that travel to the brain. The stimulation of a cow's teats results in the release of **oxytocin** and causes milk let-down. Proper stimulation is the key to optimal milking performance and is most effective by stimulating the teat through stripping the fore milk and cleaning teats properly.

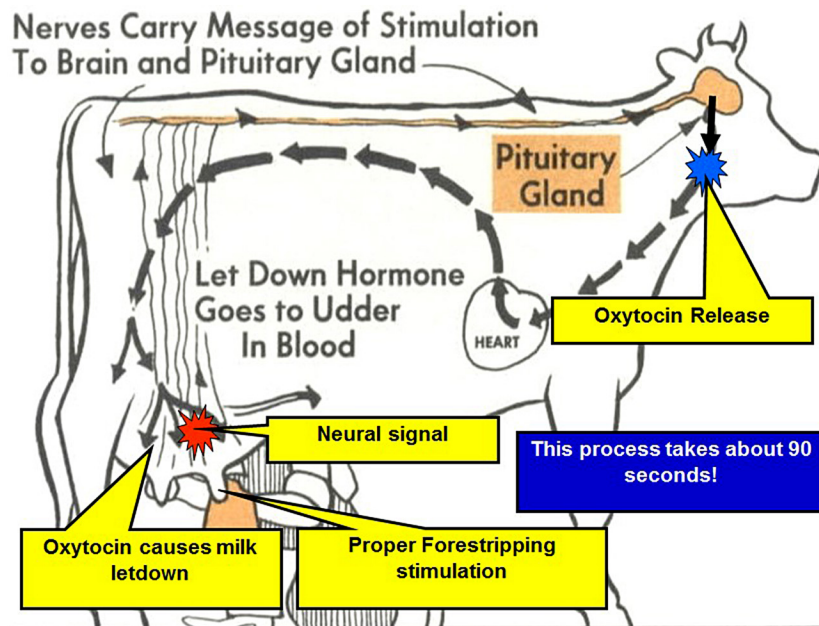
Oxytocin can also be released by visual or auditory cues such as the sight and sounds of the milking parlor. Oxytocin travels through the blood to the mammary gland and causes the **myoepithelial cells** to contract. The myoepithelial cells are arranged in a star shape which allows the muscle cells to cover a large area providing maximum contraction potential. This results in the squeezing of milk into lower udder ducts where a milking machine can remove it. It takes about one minute for a cow to let-down her milk after

PROPER MILKING PROCEDURES:

- Provide consistent routine
- Wear gloves – keep clean
- Pre-dip – get a minimum of 30 seconds contact time, dip teats completely
- Forestrip – check for mastitis and stimulate
- Clean teats – wipe in a downward twisting motion and make second pass cleaning teat ends
- Attach and align milking unit after proper stimulation (*90 seconds after start of stimulation is optimal*)
- Remove milking unit - make sure to properly shut-off vacuum and to remove promptly to prevent over milking
- Post-dip teats – completely covering teats

MILK LET DOWN

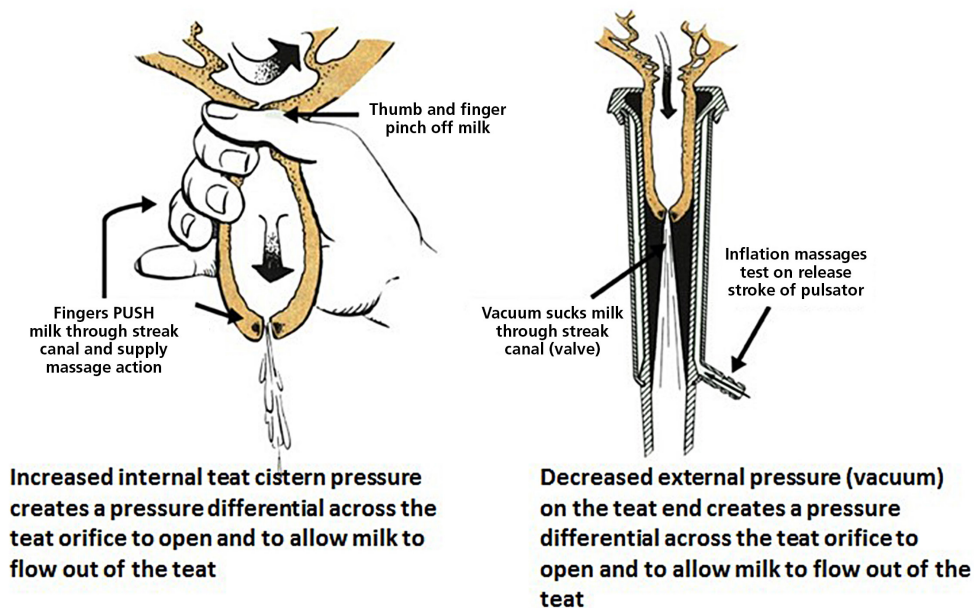
Oxytocin ↓	Stimulation	2 seconds	
	Release oxytocin	12 - 22 seconds	
	Vena cava		
	Lungs		
	Heart		
	Arteries		
	Tissues		
	Mammary gland		
	Cells contract	6 seconds	
	Cistern fills up	20-30 seconds	
	TOTAL	60 seconds (90 second - full release)	Attach Unit



udder stimulation. A second hormone called **adrenaline** can also enter the bloodstream from the result of fear or pain. This will slow milking as it reduces production for 20 to 30 minutes. Never forestrip milk directly on your hands or the floor as this can spread mastitis to other cows.

A pre-dip solution should stay on the udder for 30 seconds to assure bacterial kill. When using a teat dip it is important to cover the entire teat.

THE MILK HARVEST PROCESS



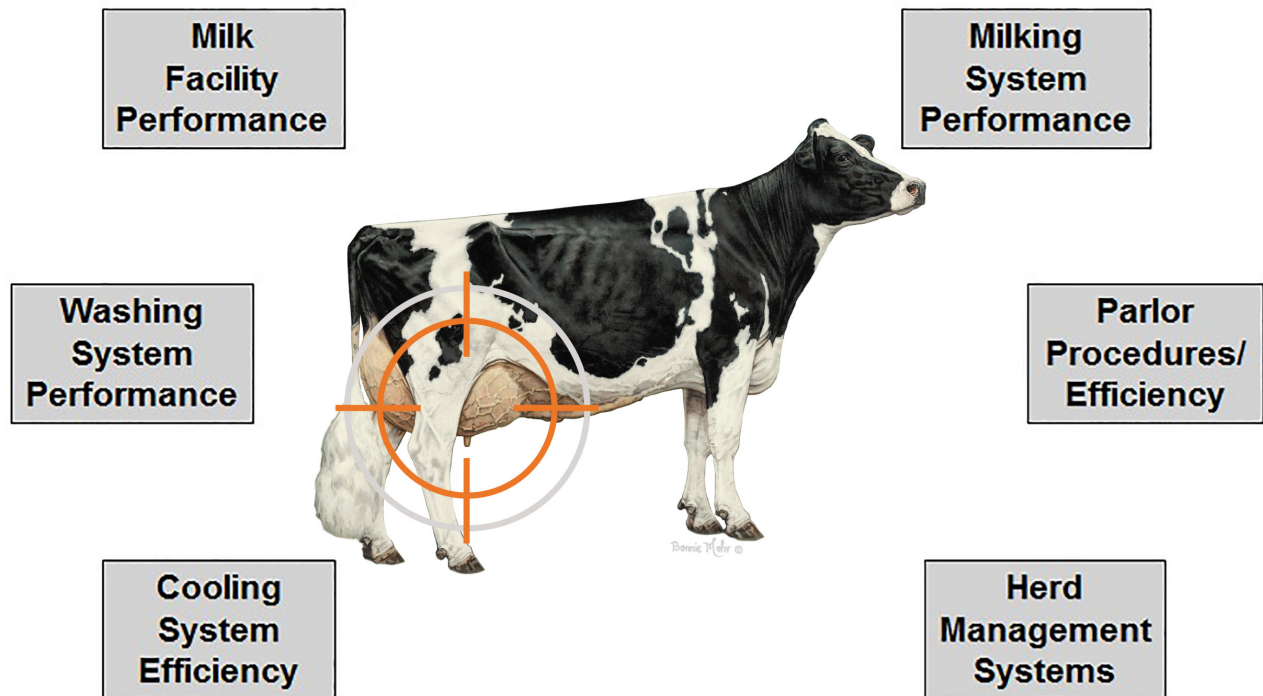


MILKING UNIT

The milking unit should be applied 90 seconds after stimulation. Teat swelling is a good sign this has been achieved. The actual let-down of milk occurs about 60 seconds after the udder has been stimulated. Milking machines remove milk from cows by creating a vacuum at the teat ends that overcomes teat end muscles and sucks out the milk. The inflation into which the teat is inserted is under continuous vacuum that opens the streak canal and allows milk to flow. It is important not to overmilk or undermilk a cow. Automatic take-offs provide a consistent milk out. Overriding automatic take-offs should be used sparingly. For most cows, the automatic take-offs should come off when milk flow drops below 1.5 to 2.2 pounds.

Before applying the milk unit, turn the valve on the milk hose to prevent air from entering the inflations. When ready, open the valve and bend the inflation down to stop air then attach straight up onto the teat. Repeat until all four inflations have been attached. For the best alignment and to prevent slippage adjust the hose and claw. If done properly you will immediately see a heavy milk flow. Insufficient prep will cause a lack of milk flow resulting in high vacuum levels at the teat end and possible damage. The biggest problem during milking machine attachment is letting in too much air. Always keep a watchful eye when milking. Look for abnormal milk, swelling or hardening of the udder to ensure the success of a healthy lactation.

Maintaining Milk Quality



Milk Quality

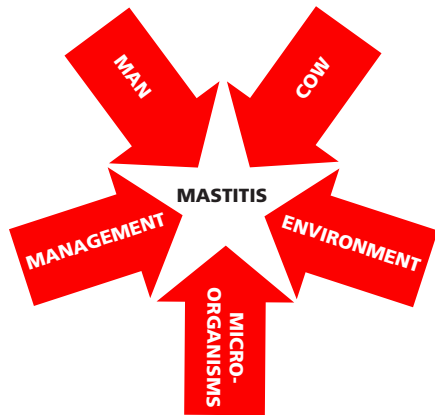
In order to produce large volumes of quality milk, clean, dry, comfortable housing is needed as well as good milking hygiene and properly functioning milking equipment.

Typically, milk that comes from a healthy, infection-free udder will contain less than 1,000 colony-forming units per milliliter. The National Mastitis Council defines the somatic cell count for a normal, healthy mammary gland as 150,000 to 200,000 per milliliter. Producing quality milk is a continual process every day.

Many early lactation infections begin during the three weeks before and after calving. The best indicator of milk quality can be found in the bulk tank. You should culture the bulk tank once a month. The **Standard Plate Count (SPC)** test is used to measure the number of mesophilic organisms in milk, and whether or not state regulatory standards are met. **Preliminary incubation (PI)** count is a measure of milk quality that is usually related to the hygiene of milkers and cleanliness of equipment. Milk-mineral deposits on milk handling equipment are known as **milk stones**.

Keeping records on all treatments is important. The most common reason milk from dairy farms is contaminated with antibiotic residues is because of accidental human error. Milk contamination on the farm can come from a variety of sources. Flies, dirt on an animal's hair coat, and dust can all cause milk contamination. Rest assured, milk with antibiotics in it never reaches the grocery store shelf. Each tanker load of milk must be tested for and free of antibiotic residues before it is permitted to be unloaded at the processing plant.

Mastitis



Mastitis is often the end result of the interaction of several factors.

Mastitis occurs when microorganisms enter a cow's udder through the teat canal. It is an inflammation of the udder and one of the most costly diseases in dairy cattle. The organisms multiply and cause damage to the extremely delicate milk-producing tissues. Mastitis organisms are divided into two categories: contagious and environmental. Contagious organisms can be passed from cow to cow on a milker's hands, equipment, udder towels and wash water. Environmental organisms enter the teat canal and are found in a cow's surroundings such as bedding, manure and soil.

Three forms of mastitis are commonly recognized: **acute, clinical and subclinical**. Both acute and clinical are the type of mastitis you can actually see. Acute mastitis is easy to recognize, but can be life-threatening. Visible signs include: a hard, hot and tender quarter. Visible signs of clinical mastitis

include: clots, flakes and watery milk. Subclinical mastitis is the most common. A milk quality test will be needed to determine this type of mastitis as all visible signs are hidden.

Monitoring your bulk tank milk will help in the prevention of mastitis which can be done by collecting routine samples for a culture test. Somatic cell records from your monthly milk test will be able to help you narrow down problem cows and identify which organisms are present in your herd. Somatic cells are mostly white blood cells that fight infection.

The **California Mastitis Test (CMT)** is one of the most popular methods of helping identify infected quarters by indicating somatic cell count (SCC) levels. This cowside test uses a four-compartment paddle and a blue substance to test a sample of milk from each quarter. It can help identify cows that probably have mastitis and provide an estimate of its severity.

If you use antibiotics make sure you follow the **withdrawal times** and observe the milk discard times. Withdrawal time is the number of hours or days which milk must be withheld or discarded following treatment with a drug or a cow must be kept prior to culling.

Proper sanitation is important during lactation. Mastitis can be caused by using wet sawdust as bedding. Many producers routinely clip the udders of their milking cows. Keeping udder hair short can lead to reduced exposure to bacteria, improved milk somatic cell counts, a decrease in udder preparation time, an increase in milking speed, a decrease in bacterial counts of milk, improved teat disinfection function, improved cleanliness of milker's hands and milking units, improved milk sediment scores and a reduction in the number of towels needed to wash and dry udders.

A MASTITIS CONTROL PROGRAM SHOULD INCLUDE:

- Monitoring milk quality
- Maintaining comfortable environment
- Maintaining milking equipment
- Maintaining proper milking procedures such as teat dipping
- Working with vet to treat mastitis
- Using dry cow treatment in all four quarters
- Vaccinating
- Separating and culling treated or infected cows

FOR PROPER USE OF CMT



- 1) Squirt 2 cc or 1/2 teaspoon of milk from each quarter into each paddle well.
- 2) Tip the paddle to an almost vertical position to get equal amounts of milk into each well.



- 3) Add an equal amount of CMT reagent to each well for a 50-50 mixture (easiest if reagent is in a squeeze bottle).
- 4) Swirl the paddle and tip it to see the bottom. Read the reaction within 10-15 seconds for the most accurate results.
- 5) Wash the paddle clean with water in between test.

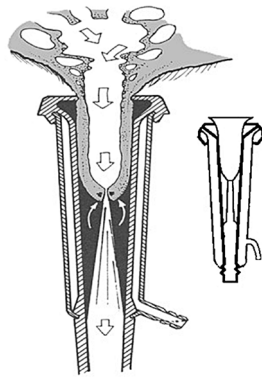
*See package instructions for complete usage details.

Photos from CMT Factsheet, prepared by R. Mellenberger, Dept. of Animal Science, Michigan State University and C. Roth, Dept. of Dairy Science, University of Wisconsin-Madison

Milking Equipment

PULSATION SYSTEM

- The ultimate function of the milking system is to apply vacuum to the teat end, providing the removal of milk from the teat end.
- This vacuum creates a pressure differential between the inside and outside of the teat which opens the streak canal and allows milk to flow.



The milking machine creates a controlled vacuum at the end of the teat which allows milk to flow. This process massages the teat which provides stimulation and minimizes blood and lymph congestion in the teat end. The importance of properly functioning milking equipment cannot be overstated. It is important to routinely maintain and evaluate the claw vacuum, vacuum stability and pulsator rate and ratio. Average claw vacuum levels ranging from 10.5Hg to 12.5Hg are considered good.

BASIC PULSATION

Variables

- The opening and closing of the liner and the duration of time is controlled by the pulsation system's rate and ratio in combination with vacuum levels and liner design.

Equipment must be cleaned between milkings to remove mineral deposits, milk fat and protein. Hot water with disinfectant will be very effective in maintaining a top-notch milking facility. A pre-rinse solution of heated water at 110 degrees Fahrenheit will effectively remove the bulk of milk residues from milk contact surfaces. When washing milking equipment, most cleaning chemicals exert the most power around 160 degrees F.

The **pulsator** is the part of the milking system that is an automatic valve that allows air to enter or exit the shell alternately. It is referred to as the heartbeat of the milking system. The time the inflation is expanded compared to the time it is collapsed is called the **pulsation ratio**. The **agitator** is the mechanical device used in the milk tank for stirring the milk to facilitate cooling and provide a uniform mixture for sampling.

The utility room houses the **vacuum pump** which is the heart of the milking system. The vacuum pump removes air from a partially closed system and therefore creates a partial vacuum. This should be serviced annually. The vacuum regulator regulates the level of vacuum in the system and should be checked weekly for cleanliness.

The milking machine liners, short air tubes, pulsation hoses and milk hoses need to be replaced regularly. Milking machine synthetic liners should be replaced according to manufacturer recommendations, usually every 1,000 to 1,500 milkings. Milking hoses should be changed at least every 6 months. You should inspect all inflations and short air tubes weekly for holes, tears and cracks.



Milking Systems

The type of milking facility can vary greatly on farms. Both tie-stalls and parlors with good lighting, traction and hygiene offer great milking facilities. Your system should be geared toward your herd size and the amount of labor you have. The most important thing to keep in mind is to strive for a consistent and clean milking routine.

Properly designed facilities will help with overall efficiency of daily tasks and herd health. Cow comfort is extremely important in maintaining lactation. The main types of milking parlors used today are: Side Opening (Tandem), Herringbone (Fishbone), Parallel (Side by Side), Swing (Swing-over) and Rotary (Carousel, Turnstile).



Tie-stall barns were once the main type of dairy cattle housing in the United States. Stalls are large enough to accommodate one animal. Milking can be very labor intensive as tie-stall facilities require milkers to do a lot of walking, bending and kneeling to complete the milking process.



The **side opening parlor** milks each cow one at a time. This type of parlor is well suited for producers who like to observe cows individually.



Herringbone parlors are very common in the U.S. Cows stand at an elevated platform that is angled away from the operator in this parlor type.



Parallel parlors feature an elevated platform as well, but are angled at 90-degrees facing away from the operator. Milkers access the udder from the rear legs which can make sanitation and unit attachment difficult.



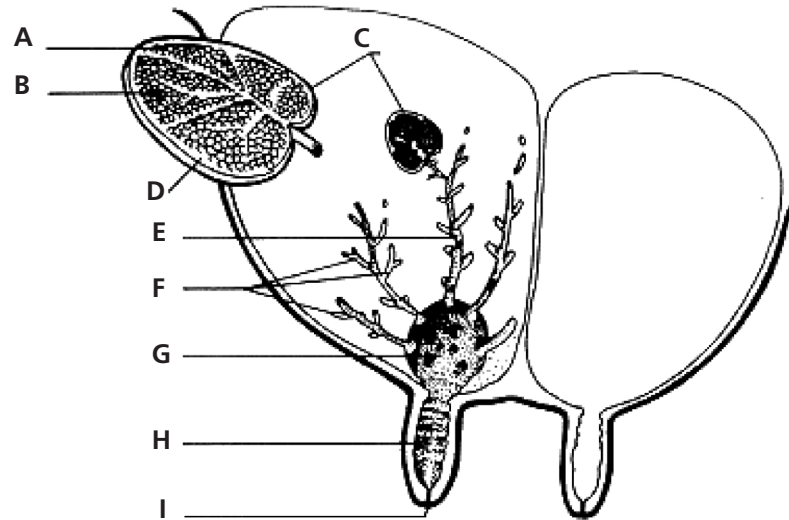
Swing parlors are similar to herringbone parlors, however cows are angled at about 70 degrees and the unit is attached through the hind legs. The primary advantage is that fewer milking units are needed as one set of units milks both sides. When the cow is done milking the unit swings to the other side.



Rotary parlors are best suited for large herds. Most rotary parlors require three operators for machine attachment, machine detachment and problems that may occur.

Exercises

1. Identify the parts



- | | | |
|----------|----------|----------|
| a. _____ | d. _____ | g. _____ |
| b. _____ | e. _____ | h. _____ |
| c. _____ | f. _____ | i. _____ |

2. List three signs or symptoms that a cow has mastitis.

- | |
|----------|
| a. _____ |
| b. _____ |
| c. _____ |

3. Draw a typical lactation curve.

Explain why a cow's milk production changes over the course of her lactation.

(make outline of chart with pounds of milk on left and days in milk at bottom)



3. (continued)

4. List three things a dairy producer can do to ensure a high standard of milk quality.

- a. _____
- b. _____
- c. _____

5. Match the numbers with the correct practice.

10.5 – 12.5 Hg	Amount of time pre-dip should stay on
30 seconds	Blood that passes through udder for each gallon of milk produced
400 – 500 gallons	Good claw vacuum level
2 – 3 times	Time that adrenaline blocks blood flow and reduces milk production
20 – 30 minutes	Number of times cows are milked a day
1.5 to 2.2 pounds	Amount of milk left in udder when automatic take-offs come off during milking
110 degrees F	Temperature when cleaning chemicals exert the most power
160 degrees F	Heated water temperature that removes the bulk of milk residues from surfaces

Answer Key

1.
 - a. Alveoli
 - b. Lobule containing alveoli
 - c. Connective tissue
 - d. Lobe
 - e. Major duct
 - f. Ducts
 - g. Gland cistern
 - h. Teat cistern
 - i. Teat meatus
2. Signs of mastitis include: clots, flakes, watery milk, udder swelling or hardening, redness, tender, heat, pain, fever and shock. Other answers are acceptable.
3. Page 8 features an example of a lactation curve. During the early stage of lactation milk production increases until 6 weeks after calving. This is when peak milk production takes place up to 100 days. A cow's feed intake will lag as she begins to lose weight because of rapid milk yield compared to her dry matter intake. During mid lactation the focus is to maintain peak lactation for as long as possible up to 200 days. During late lactation milk production will continue to decline along with feed intake. Cows will start to gain weight to support the calf they are carrying.
4. Some of the things you can do to maintain a high standard of milk quality include: good milking hygiene (wash hands with soap and water before milking and/or use gloves), provide a consist routine that includes pre-dip, forestrip, cleaning teats and post-dip, use properly functioning milking equipment (routinely evaluate claw vacuum, vacuum stability, and pulsator rate - don't overmilk or undermilk), parlor efficiency, cooling system efficiency and washing system performance (clean equipment between milking). Other answers are acceptable.
5. Match the numbers with the correct practice
 - 10.5 – 12.5 Hg - Good claw vacuum level
 - 30 seconds – Amount of time pre-dip should stay on
 - 400 – 500 gallons - Blood that passes through udder for each gallon of milk produced
 - 2 – 3 times - Number of times cows are milked a day
 - 20 – 30 minutes – Time that adrenaline blocks blood flow and reduces milk production
 - 1.5 to 2.2 pounds – Amount of milk left in udder when automatic take-offs come off during milking
 - 110 degrees F - Heated water temperature that removes the bulk of milk residues from surfaces
 - 160 degrees F – Temperature when cleaning chemicals exert the most power



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Sources

<http://classes.ansci.illinois.edu/ansc438/Lactation.html>

<http://classes.ansci.illinois.edu/ansc438/Beginning/beginning.html>

<http://classes.ansci.illinois.edu/ansc438/mamstructure/anatomy.html>

<http://classes.ansci.illinois.edu/ansc438/Mamdevelop/involution.html>

http://www.epa.gov/agriculture/ag_101/dairyphases.html

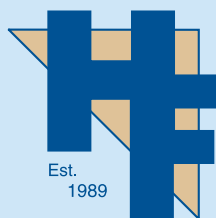
ABS Global, Inc., A.I. Management Manual, Fifth Edition 2002

Caring for Dairy Animals Reference Guide, Dairy Quality Assurance Center, Nancy Bushwick Malloy

Feeding the Dairy Cow During Lactation, Macdonald Campus of McGill University, Department of Animal Science, Dairy Cattle Production 342-450A

GEA Farm Technologies, Inc., Keith Engel, Dairy Farm Hygiene and Supplies Specialist

Milking Parlor Types, Douglas J. Reinemann, Ph.D., UW-Madison Milking Research and Instruction Lab., 2003



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