Good Milking Practices
Michigan State University Extension Service
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Revised January 1953
20 pages

EXTENSION BULLETIN 293

GOOD MILKING PRACTICES

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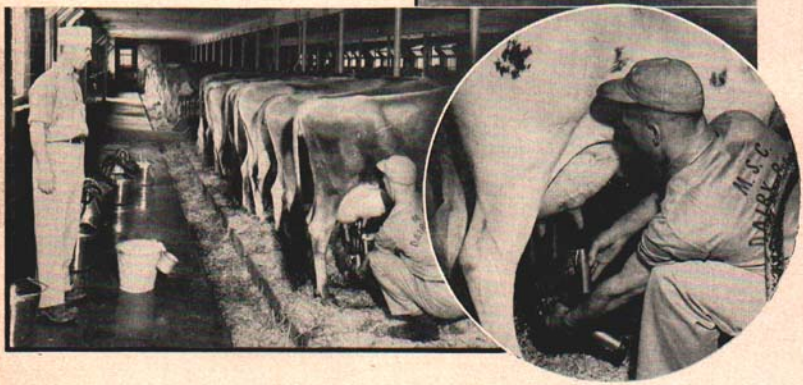

MICHIGAN STATE COLLEGE
COOPERATIVE EXTENSION SERVICE
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SUMMARY

1. A knowledge of good milking procedure and milk secretion is important in securing high levels of milk production and maintaining healthy udders.
2. The "let down" of milk in the cow must be secured for good milking. To secure this "let down" before milking, follow the routine procedure of washing and massaging the udder 45 seconds to one minute with chlorine solution (100 parts per million), and using a strip cup.
3. The number of milker units should vary with the number and activity of the persons doing the milking, so that each cow may be milked in 3 to 5 minutes.
4. Cows should be trained to milk out completely by machine. Do not let the teat cups "crawl" on the udder. This may result in internal injury that can lead to mastitis.
5. Hormones developed in the ovaries and pituitary aid in the development of the udder, and in the "let down" of milk.
6. Milk is secreted in the udder, from food nutrients carried there by the blood. Thus a large circulatory system to the udder is essential for large production.
7. To allow for a rest period, a cow should be dried off by stopping milking 6 weeks to 2 months before freshening.

Issued October 1948
First Revision, January 1953

Good Milking Practices

By W. W. SNYDER[1], D. L. MURRAY[2], and EARL WEAVER[3]

The dairy enterprise on the farm is conducted to make money, and the chief source of income is from the sale of dairy products. Milk and milk products have a nutritive value which has made this food one of the most important agricultural products in the diet. Dairy products make up over one-third of Michigan's agricultural income.

To make money the dairyman must produce a clean, wholesome product and must produce it in large quantities per animal. Dairy Herd Improvement Association records, and farm management studies conducted by the Agricultural Economics Department of Michigan State College show that returns over feed cost increase rapidly with increased production per cow. An important factor in the high level of milk production is a thorough knowledge of good milking practices and of milk secretion.

It is the purpose of this publication to present information on good milking practices and the relationships of the "letting down" of milk, the growth, development, structure and circulation of the udder with milk secretion—all of which may be utilized in securing the maximum returns from the herd.

MILKING

Secretion of large amounts of milk in the udder creates a tension. Milking relieves this tension. Thus proper milking is a pleasant sensation to the cow.

"LETTING DOWN" OF MILK

The "letting down" of milk is a conditioned or learned reflex. It cannot be controlled by the cow. After secretion, milk is stored in such minute droplets within the many fine ducts of the udder that it will not flow out by gravity at milking time. Cows with weak sphincter muscles at the teat canal may leak some of the milk stored in the teat-and-gland cistern. Only the milk stored in the cisterns of the teat and the gland can be removed by the milker without aid from some other source. The central nervous system may respond to one of several

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practices to bring about this assistance. Practices such as feeding just before milking, the rattle of milking equipment, turning on a radio, or washing the udder—when followed in a routine manner before each milking—may bring about this response.

VALUE OF WASHING AND MASSAGING THE UDDER[4]

The washing and massaging of the udder in a chlorine solution (100 parts per million), one minute before milking, is the recommended procedure. This accomplishes three purposes: it destroys bacteria on the cow's udder, and on the hands of the milker; cleans the udder of dirt; and gives the best responses in "let down" of milk (Fig. 1). Originally it was believed that water at 125°F. gave best results. More recently it has been found that colder water is acceptable, if used regularly.

The washing and massaging of the udder in warm water sets up nerve impulses that travel to the brain. The brain passes these on to the pituitary gland, and stimulates it to secrete a hormone called "oxytocin". This hormone is carried by the blood to the udder, where it causes contraction of the smooth muscles about the "alveoli" and ducts. That contraction forces the milk into the teat-and-gland cisterns, where it can be removed by the machine or hand milker.

Approximately a minute is required to secure the "let down" after washing the udder. The effect of the oxytocin lasts from 7 to 9 minutes. The maximum effect occurs with the first 2 to 3 minutes. Thus the milking should be completed as quickly as possible. Any distraction or change from the accustomed procedure—such as rough treatment, visitors in the barn, irregularity of feeding routine or change of milker—may upset this reaction and milk will not be "let down" completely.

A MILKING PROCEDURE

It may be desirable to arrange the cows in order of ease of "let down" for milking. This may be impossible, however, for it is also desirable to place cows with any udder disturbance at the end of the line to be milked last. It may be difficult, too, because stalls are frequently constructed of different length for animals of different sizes.

[4]For clean milk production, see Michigan State College Extension Bulletin E-245, "Producing Quality Milk."

Fig. 1. Wash and massage the udder thoroughly with chlorine water (100 parts per million) before milking. This will set up the desired stimulus which will release a hormone in the blood stream. The hormone upon reaching the udder will cause the muscles to contract and force the milk into the cisterns of the teat and gland where it can be removed. Washing the udder will also aid in clean milk production and the prevention of spread of disease.

MILKING BY MACHINE

The clean, sterile milking machine should be fully assembled and brought into the barn at milking time. In addition, an extra machine milker pail, a pail of chlorine water (100 parts per million), a cloth or suitable paper towel for washing udders, strip cup, and two small-topped milk pails will be needed. If two men are to carry on the

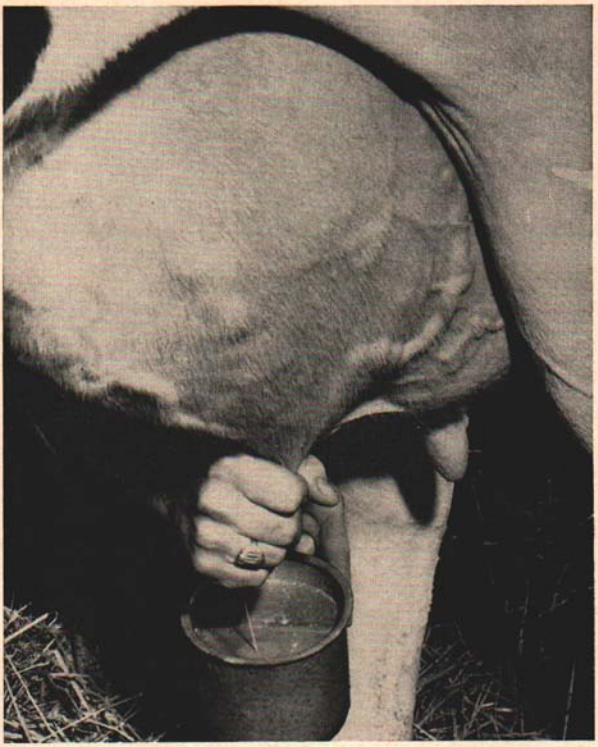


Fig. 2. The strip cup should be used following the washing of the udder to determine if the milk is normal, and to keep high-bacteria-count milk from the main supply. This practice regularly followed also acts as a stimulus for the "let down" of milk.

milking, two milker units and an additional small-top pail will be desirable. When one man is doing the milking, one unit may be advisable. An additional unit may be used in either case, if the milking on each cow can be completed in 3 to 5 minutes.

Preparing the Cow

The udder of the first cow in the line should be thoroughly washed to remove dirt, destroy bacteria, and bring about the "let down" of milk. Two streams of milk from each teat should be observed in a

strip cup, immediately following the washing of the udder, to discover abnormal milk—and to remove milk high in bacteria (Fig. 2). Apply the milking unit to the cow 45 seconds to one minute, following the washing of the udder (Fig. 3). Develop a technique when applying the teat cups to avoid sucking any bedding or dirt into them, which could add dirt to the milk and possibly carry infection into the udder. If a second or third unit is to be used, the cows may be prepared in the same manner and the machine applied.

Fig. 3. About one minute is required for the "let down" of milk after applying the stimulus. Thus the milking machine should be applied at that time. Most cows may be trained to milk out in three to five minutes.

Strip by Machine

About 2½ minutes after the machine is applied (this will vary with different cows), and the udder is nearly milked out, massage the udder and apply rhythmic downward pressure on the claw of the machine. In this manner the cow may be stripped by machine. Most animals can be trained to strip out completely, so that no hand stripping is

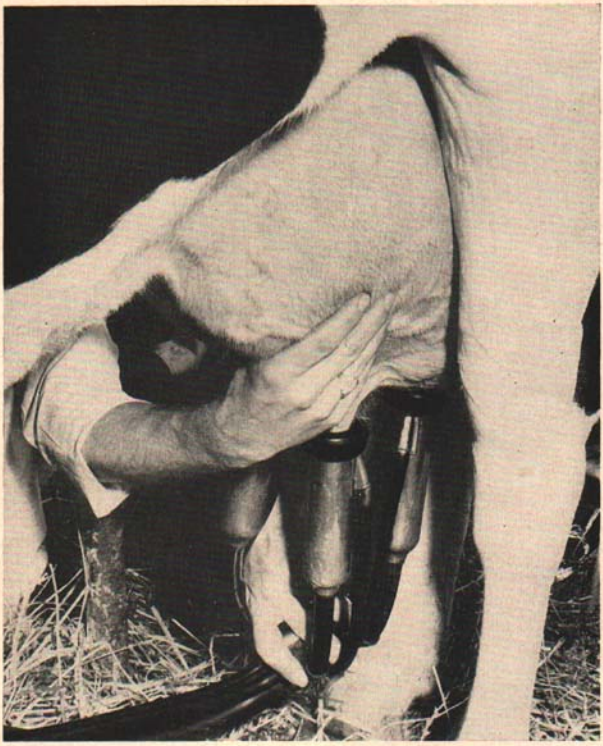


Fig. 4. Machine stripping should be started when the udder is nearly empty and before the teat cups crawl. With one hand apply rhythmic downward pressure on the claw of the machine, pulling the teat cups part way down on the teats. The other hand may be used to massage the udder, and to determine when the milking is complete. Release the vacuum and remove the machine as soon as milk stops flowing.

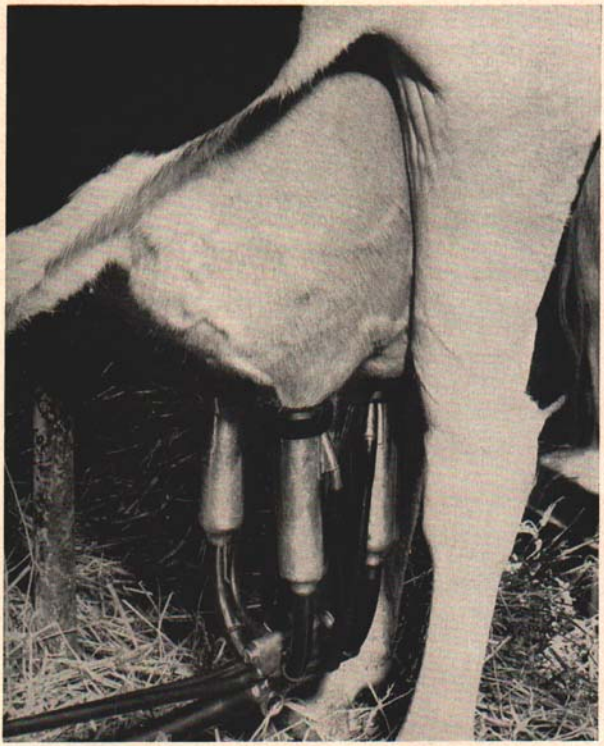


Fig. 5. This picture shows an undesirable practice of allowing the teat cups to crawl up on the udder as the cow milks out. When this condition occurs, the opening from the udder into the teat is closed. This allows the machine to irritate the internal lining of the teats—and may cause injury that will lead to infection. When milk is not flowing through the teat, the pull of the vacuum on the lining of the teat may also cause injury.

necessary (Fig. 4). There will be problem individuals, thus they should always be checked. Care should be taken not to develop the hand-stripping habit.

The vacuum should be released and the machine removed as soon as the gland is empty. The teat cup should not be allowed to "crawl up" to the base of the teat (Fig 5); this will aid in preventing internal

teat injury. When second man is used, he may examine the udders, strip where necessary, carry the milk, weigh, record, strain and cool it —following the milking of each one or two cows.

With some machines it may be desirable to have an extra milker pail and change the top. In others it will be more desirable to pour the milk into small-top milk pails, and use them to strip into. It may be desirable, in order to prevent and control mastitis, to rinse the teat cups in two pails—one of clear water and the other of chlorine solution —following the milking of each cow. A cart to carry the washing pails and water for washing the udder may be advantageous in shortening the time required—thus making it possible to move the milkers within the time limit and the response of each cow.

Problem Cows

A limited number of "problem" cows do not respond well to machine milking. If response is not secured after a thorough trial, they should be milked by hand or sold into a herd where hand milking is used.

Some individual cows do not respond well to the "let down" of milk. This is found more frequently in older cows that have been changed to this system of milking, than in cows that were trained to this plan when young. Cows that do not respond are usually more nervous. Some slightly abnormal situation, such as a visitor in the barns, irregular milking or a change in method interferes with the desired nervous response. Extreme care in handling such animals to avoid excitement—such as regularly following the same procedure, attention to the uniform temperature of the wash water, and extra massaging—will aid in securing the "let down" in such animals. Every effort should be made to overcome such a situation quickly. If it is allowed to continue, milk will be left in the udder and milk production will be reduced.

HAND MILKING

Prepare the cow the same as for machine milking, and proceed to milk. The full hand should be used. The squeeze should start at the top of the teat first. Avoid squeezing the thumb into the teat. Care should also be taken to have the nails short. Any injury may set up a nervous reaction that will interfere with the "let down," or even open the way for infection. The two front quarters and the two rear quarters should be milked together, since they give approximately

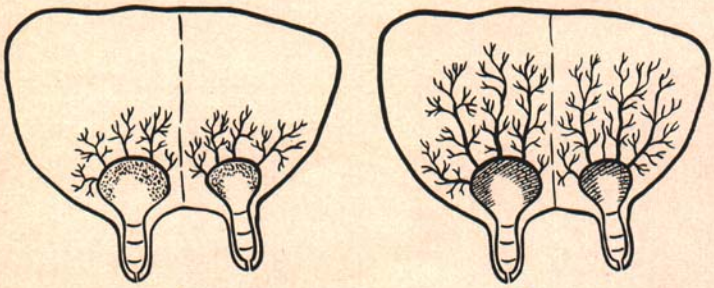
the same amounts of milk. Clean, dry hands should be used to avoid washing dirt into the pail.

Milk rapidly so that the maximum effect of the "let down" may be secured. Stripping should be avoided, because it prolongs the milking and may cause internal injury to the teat. Prolonged stripping may also influence the cow to desire this type of milking. Proceed from cow to cow as rapidly as possible. Weights of milk which vary widely indicate an abnormal condition of the cow, or improper milking.

GROWTH AND DEVELOPMENT OF THE UDDER

The udder of the heifer calf at birth is practically the same as the male. It is made up of skin, fat, and four small teats. Extra rudimentary teats should be removed at an early age, preferably by the time the calf is 6 months old. The regular teats have a cistern, and there is also a miniature gland cistern above each teat. A few ducts may lead from the gland to the cistern. The size and shape of the udders of calves and yearlings may be greatly influenced by the fat they contain. Thus the external appearance, especially in the younger heifers, may be of little value in selecting animals for future production or type.

On the other hand, W. W. Swett of the U. S. Department of Agriculture, Bureau of Dairy Industry, has determined that the glandular formation within the udder starts developing soon after birth and goes



A. B.

Fig. 6. (A.) This illustrates the udder of a calf at birth. It is made up of skin, fat, four small teats, a small teat-and-gland cistern, and a number of small ducts. (B.) This illustrates the udder of a heifer after sexual maturity (following several estrus or heat periods). The hormone estrogen, secreted by the ovaries following sexual maturity, stimulates the development of the ducts within the udder.

through definite stages. This formation has little relation to external appearance. He has information which indicates that the size of the glandular formation within the udder at 4 months of age may be used to determine high, medium, or low future production of the animal. At 3 months of age all the rudiments of the udder except the secretory cells have been developed. The development of the udder as a whole is limited until the animal reaches sexual maturity (the start of the heat periods). (Fig. 6.)

HORMONES

Hormones are secreted by ductless glands. They are carried by the blood to other parts of the body where they affect growth development and function. The hormones affecting the mammary growth, development and function are secreted largely by the ovaries and pituitary.

The hormone "estrogen" is secreted by the ovaries following sexual maturity. This hormone stimulates the development of ducts within the udder. A second hormone known as "progesterone," secreted by the corpus luteum (or yellow body) of the ovary, stimulates the development of the grapelike structures called "alveoli" which contain the secreting cells of the udder. Some evidence indicates that the

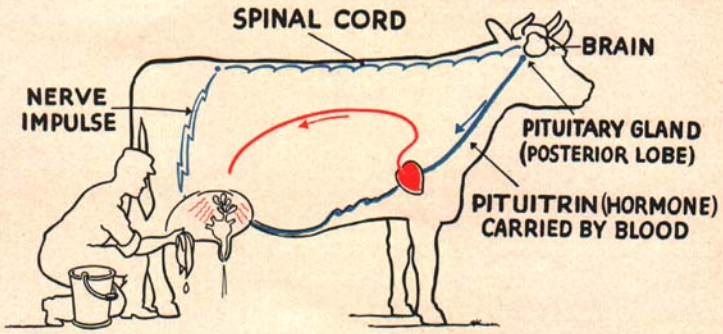


Fig. 7. The washing of the udder provides the stimulus for the involuntary or conditioned reflex for the "let down" of milk. Nerve impulses are carried to the brain. A second series of impulses pass from the brain to the pituitary gland at the base of the brain. The pituitary is stimulated to secrete the hormone oxytocin ("pituitrin"), which is carried by the blood to the udder; there it causes the muscles to contract, forcing the milk into the cistern of the gland.

effect of estrogen and progesterone may be indirect through the pituitary gland. Oxytocin aids in the "let down" of milk. (See page 3, and Figs. 1 and 7.)

STRUCTURE OF THE UDDER

The udder consists of four distinctly separate glands. The longitudinal division of the udder—which divides it into halves—is much more distinct, both externally and internally, than the horizontal divisions that separate the halves into quarters. Studies in the Michigan State College dairy herd show that, on an average, 42 percent of the milk is produced in the front quarter; 58 percent in the rear quarters. The front quarters of the udder are wider than the rear. On the other hand, the rear quarters are much deeper. This is evident when an udder is removed from the cow, and viewed from the top and side. The udder of a mature cow is illustrated in Fig. 8.

The exterior of the teat is made of heavy muscular tissue. The internal lining is much more delicate and more easily injured. The streak canal is a passageway into the teat cistern. The opening of this canal is controlled by a sphincter muscle. The milking is done against this muscle. Thus it controls the ease of milking. It is questionable even in hard milkers if this muscle should be interfered with. Such action frequently leads to infection and mastitis. The streak canal in heifers is sealed until freshening. Precautions should be taken from calfhood to freshening to prevent the seal from being broken, allowing infectious bacteria to enter.

Above the teat is the cistern of the gland. From 20 to 60 ducts lead to this cistern from the innermost part of the udder. The ducts branch many times. At the extremities of the ducts are many grape-like structures, the alveoli. These are lined with a single layer of epithelial cells—through which the nutrients pass from the blood, and in which the milk is secreted (Fig. 8).

THE UDDER ATTACHMENTS

The close attachment of the udder to the body of the cow is important in maintaining a long life of usefulness. Weakly attached udders became pendulous, and are more readily injured. Injuries open the way for mastitis.

The udder is attached to the body by the "medial suspensory ligament," the "lateral ligament," and "the skin".

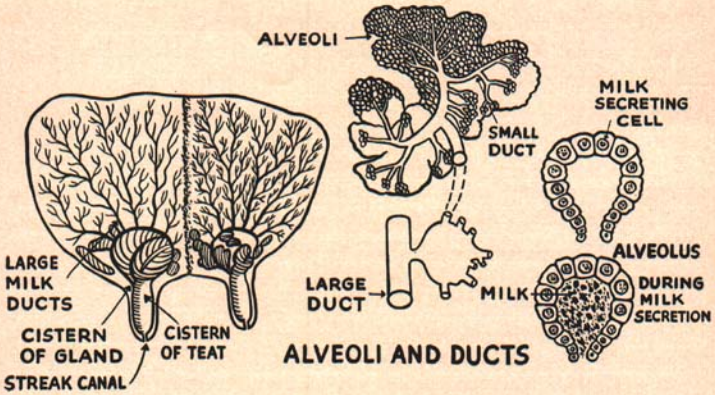


Fig. 8. This illustration shows the mature cow's udder. The corpus luteum or yellow body of the ovary secretes the hormone "progesterone" which, along with "estrogen," stimulates the development of alveoli (grape-like structures) at the end of the ducts. The alveoli are lined with epithelial cells (through which nutrients from the blood pass, and in which milk is secreted). Between milkings, the milk is stored in millions of alveoli and the many branching ducts. Internal udder pressure is brought about with proper milking procedure to force the milk into the cisterns of the teat and gland. A sphincter muscle controls the opening of the streak canal.

The medial suspensory ligament is the major support of the udder. It is approximately 4 inches long and is located at the top of the udder where the four quarters join. Evidence of a weakness of this ligament may be seen in those cows in which the center of the floor of the udder falls and the teats strut to the side. Udders that are seriously pendulous are due largely to a weakness of this ligament.

The lateral ligament is sheet-like in form, covering the top and sides of the udder. It aids especially in holding the fore and rear udder closely attached to the body. The skin also aids in attaching the exterior of the udder to the body.

THE CIRCULATORY SYSTEM

Large quantities of blood are required for milk secretion. Four hundred pounds of blood must be circulated through the udder to supply the nutrients for each pound of milk produced. Thus a cow producing 50 pounds of milk daily must pump 10 tons of blood through the udder. (The work required by the heart to pump this amount of blood is equal to raising a 10-ton weight 36 inches.)

ARTERIAL BLOOD

The arterial blood carries to the udder the food nutrients from which milk is secreted. It reaches the udder largely through the external "pudic artery". This is a well-protected artery that enters the udder at the top. The blood is pumped by the heart through this artery to the udder, and returns to the heart through the veins. The pudic artery divides to carry the blood to the four quarters of the udder. The arteries, after entering the quarters, subdivide many times until they become minute arteries (capillaries) which carry the nutrients to the secreting cells of the alveoli. (Fig. 9.)

VENOUS BLOOD

The venous blood has three outlets from the udder. The external "pudic vein" parallels the pudic artery that carries the blood to the udder. The "perineal vein" carries the blood upward from the rear of the udder through the pelvic arch. The third outlet of venous blood is through the subcutaneous adbominal "milk veins", leading forward from each fore quarter along the underline until they enter the abdomen through the milk wells. The milk veins may be tied off and milk secretion will not be interfered with. This indicates that the other two outlets have the power of expansion to allow all the blood to return to the heart. This may be necessary, for no doubt frequently when the cow lies down these veins are closed. Thus large, long and crooked milk veins are not necessary for high milk production. Seldom if ever does one see a cow with such milk veins, however, that is not a good producer.

THE LYMPHATIC SYSTEM

The lymphatic system of the udder is a second circulatory system. It starts about the cells bathed by the lymph. The function of the lymphatic system is to remove foreign substances or bodies as "lymphocytes," and tissue waste from the udder, and to aid in the defense against infection. These substances are carried by the lymph through ducts which lead to "lymph nodes" located in the upper rear part of the udder. The lymphatic system also aids in destroying bacteria. The flow of lymph, as with venous blood, is accelerated during milking. This, no doubt, aids in expelling the milk more quickly and completely.

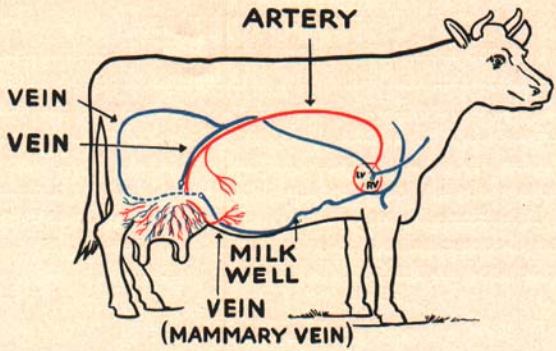


Fig. 9. This figure illustrates the circulatory system of the dairy cow. The arterial blood (designated in red), containing the materials from which milk is secreted, is pumped to the udder by the heart—largely through one artery. The three veins that return the venous blood from the udder to the heart are indicated in blue.

The lymph nodes and ducts are considered important in controlling inflammation in the udder at calving time. The practice of applying hot applications to a congested udder, or massaging it, aids the circulatory systems in removing the cause of the congestion. It will be helpful when massaging to apply the pressure in an upward direction, to force the lymph into the larger ducts and toward the lymph nodes. The ducts frequently seen on the exterior of an udder are partly lymph ducts, and partly veins. They may be distinguished by their color: the veins will be bluish; the lymph ducts are white. Large numbers of veins and ducts are usually associated with a good-quality udder and high milk production. (See Fig. 10.)

MILKING BEFORE FRESHENING

Milking before freshening has proven advantageous in preventing the breakdown of udders, especially in heifers. Many herdsmen favor this practice because it prevents the strain that otherwise develops, owing to the congestion in the udder at freshening. The practice of milking before freshening does cover up weaknesses, thus making it impossible to overcome them by breeding and selection. If this

practice is followed, arrangements should be made to preserve the colostrum milk for the calf—or to have another cow that will freshen normally at about the same time to provide the colostrum.

MILK SECRETION

Milk secretion is a continuous process. The arterial blood is carrying nutrients to the secreting cells continuously. The blood sugar is the chief source of lactose or milk sugar, and is converted into this form by the alveoli. The fatty acids in the blood are changed into milk fat. Likewise, the albumin of milk is made from the amino acids of the blood. Globulin appears to be the main constituent from which casein is derived. Globulin is the only milk protein identical with blood protein. It comprises only 0.05 percent of milk protein.

The constituents in milk, with minor exceptions, differ in form from that in which they exist in the blood. Thus milk is secreted by the cells of the alveoli. Fats, sugars, and proteins of the type found in milk do not exist elsewhere. The water, minerals and vitamins pass into the milk from the blood stream.

The pressure within the udder is at a minimum following milking. As milk is secreted in the udder, pressure is built up, making it more

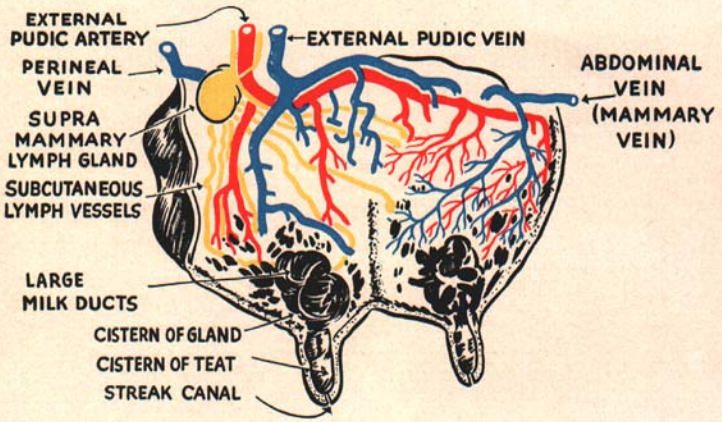


Fig. 10. This figure illustrates the blood circulation within the udder. The red ducts carry the arterial blood; the blue ducts, the venous blood. The lymph glands or nodes, and the ducts carrying the lymph, are shown in yellow.

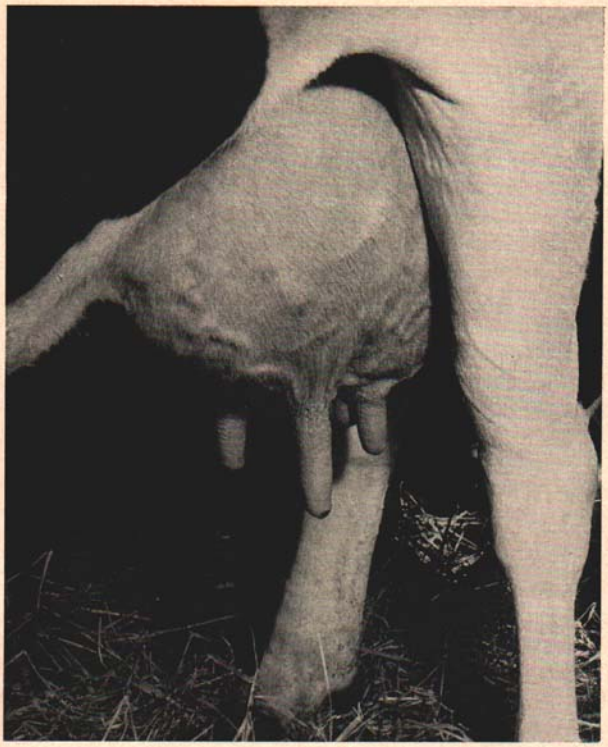


Fig. 11. Note the shrunken condition of this udder which has been milked out. The pressure has been eliminated by removing 26 pounds of milk. Compare with the same udder in Figs. 1, 2 and 3 before milking.

and more difficult for the nutrients to pass from the blood through the secreting cells. Thus the more frequently a cow is milked, the more milk will be secreted. Experimental results indicate that cows milked three times daily will produce 15 to 20 percent more milk than when milked twice a day. Cows milked four times daily will produce 5 percent more than when milked three times. The amount of increase will depend on the level of production, stage of lactation, and the individual animal. Additional feed will be required to supply the nutrients for this additional quantity of milk (Fig. 11).

DRYING OFF

To give cows a rest period before freshening, they may be dried off at the proper time by stopping milking. Milk will build up in the udder, creating a pressure until it reaches one-fourth the pressure within the blood stream. Secretion at that point stops. In a short time the milk in the udder is absorbed into the circulatory system, and the cells of the alveoli discontinue functioning. Cows have been dried off in this manner during the first month of lactation without detrimental effect to the udder.

ACKNOWLEDGMENT

The authors wish to thank Dr. C. W. Turner, Dairy Husbandry Department, University of Missouri, Columbia, for the privilege of adapting Figs. 6, 8, 9, and 10 from the text, *The Comparative Anatomy of the Mammary Glands*, and thank the *Surge News*, Chicago, for the privilege of adapting Fig. 7 for use in this publication.

Cooperative extension work in agriculture and home economics. Michigan State College and U. S. Department of Agriculture cooperating. D. B. Varner, Director, Cooperative Extension Service, Michigan State College, East Lansing. Printed and distributed under acts of Congress, May 8 and June 30, 1914.

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