



MILKING MANAGEMENT AND MASTITIS CONTROL

IN DAIRY GOATS

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The objective of milking management is to efficiently and effectively milk animals so that maximal yield of high quality milk is produced, while maintaining normal composition, avoiding new udder infections, and minimizing milking time. A large part of this is the prevention and control of mastitis.

Mastitis is defined as an inflammation of the mammary gland. It usually is caused by bacterial invasion of the udder. In goats, the main bacteria include: Staphylococcus aureus, environmental staphylococci, and environmental streptococci (Strep species or Strep non-agalactiae). These bacteria penetrate through the teat canal and invade the udder. They may invade deep into mammary gland tissue. They then release toxins which cause the animal's defense mechanisms to produce polymorphonuclear neutrophilic (PMN) leukocytes, a type of white blood cell. The leukocytes are attracted to the affected area and attempt to engulf and destroy the invading bacteria. The concentration of leukocytes increases as the number of bacteria multiply. As the leukocytes pass from the blood stream and between the mammary cells within the alveoli, the milk producing cells are destroyed and replaced with connective or scar tissue. The presence of leukocytes is determined by somatic cell counts (SCC) which include PMN leukocytes and dead epithelial cells. In animals with high SCC, over 50-60 percent of the cells are PMN leukocytes.

Subclinical mastitis is the most prevalent type of mastitis in goats. Its presence is not apparent. There is no observable abnormality of the milk. However, microbial culturing of aseptic milk samples could reveal the presence of microorganisms. Inflammatory changes in milk can be detected by SCC. Subclinical mastitis can reduce milk yields, adversely affect milk quality, and lead to clinical mastitis.

Clinical mastitis results in milk with visible abnormalities, including flakes, clots, or watery appearance. With acute mastitis, clinical symptoms are accompanied by swelling, heat, hardness, and sensitivity of the affected half.

SCC in goat milk should be determined by procedures specific for DNA, so that PMN leukocytes could be distinguished from cell-like or cytoplasmic particles (Dulin et al., 1982). The Fossomatic appears to provide more accurate SCC than either the Coulter Counter or the direct microscopic SCC. Dairy Herd Improvement (DHI) programs usually count SCC with Fossomatic.

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Poutrel and Lerondelle (1983) sampled 163 does in three French herds. The average SCC for non-infected animals was 614,000 (Table 1). The major infection was caused by environmental or coagulase-negative staphylococci, with an average SCC of 1,293,000. However, the prevalence of infections caused by major pathogens was 15.1 percent, with an average SCC of 4,804,000. Over 62 percent of the major infections were caused by Staphylococcus aureus and 36 percent were environmental streptococci. Over 85 percent of those udder halves infected with major pathogens had SCC above 1,000,000 or CMT scores of 1 or higher. Pettersen (1981) sampled a 60 doe herd weekly for one lactation. Clinical mastitis occurred in eight goats with five cases caused by Staph aureus. Another four goats were found to shed Staph aureus intermittently. Sometimes milk samples from Staph aureus infected animals will produce negative culture results.

Table 1. Level of mastitis infection and somatic cell counts in French goat herds (Poutrel and Lerondelle, 1983).

Infection status	% of animals	Somatic cell counts
Uninfected	67.4	614,000
Envir. staphylococci	17.5	1,293,000
Major pathogens	15.1	4,804,000
<u>Staphylococcus aureus</u>	9.4	
Envir. streptococci	5.4	

SCC of 600,000 in non-infected halves appears to be higher than expected. Mellenberger (1979) examined 412 halves in seven Michigan herds and found an average SCC of 282,000 in non-infected animals, using the Wisconsin Mastitis Test. The primary cause of infection was environmental staphylococci. Dulin et al. (1983) collected aseptic milk samples from 35 lactating does in three herds. Foremilk samples were collected beginning at two weeks after kidding and continuing every two weeks until two months in lactation and then monthly. Table 2 shows that SCC in non-infected goats (both halves) were usually below 300,000, rising slightly as lactation progressed. SCC in infected halves increased from 400,000 to over 2,000,000 with advancing lactation. Their work also showed that SCC in the non-infected half was elevated by an infection in the other half, with SCC exceeding 400,000 at 60 days after infection and 700,000 after 120 days.

A mastitis infection causes a marked decrease in milk yield regardless of lactation number (Table 3). These data also show that SCC do not increase with lactation number. Increased SCC are caused by infection of the mammary gland. Major and minor pathogens cause subclinical mastitis in goats, which is accompanied by elevated SCC and reduced milk yields.

The somatic cell count in milk from non-infected goats should be less than 300,000. Goats with higher SCC probably have mastitis infections.

Table 2. Somatic cell counts in mastitis infected and non-infected goats at different stages of lactation (Dulin et al., 1983).

Postkidding	Infected	Non-infected (both halves)
2-4 wk	385,000	56,000
6-8 wk	456	57
10-12 wk	664	101
14-16 wk	865	267
5 mo	682	209
6 mo	740	323
7 mo	1,183	162
8 mo	2,104	267
≥9 mo	2,667	414

Table 3. The relationship between mastitis infection, somatic cell counts and milk yields in goats of different lactations (Dulin et al., 1983).

Lact. no.	<u>Infected animals</u>		<u>Non-infected animals</u>	
	SCC	Milk/day	SCC	Milk/day
1	568,000	4.8	150,000	5.9
2	1,140	6.4	116	7.3
≥3	804	6.6	229	9.5

Mastitis Control

A mastitis control program must reduce the number of bacteria exposed to the teat, minimize conditions which allow these organisms to be transferred from doe to doe, prevent damage to the keratin layer inside the teat canal that usually provides protection against invasion, and decrease situations which assist bacterial penetration of the teat canal. The last two conditions usually accompany machine milking and, probably, are not important factors in hand milking. An effective mastitis prevention and control program should emphasize the following:

1. Cleanliness and sanitation.
2. Proper milking procedures and routine.
3. Teat dipping.
4. Intramammary antibiotic therapy at drying off.
5. Environment and udder contamination between milkings.
6. Milking system design and maintenance.
7. Proper nutrition.

Milking Procedures

1. Wash hands immediately before milking. Consider the use of rubber gloves if milker has cuts, cracks, or sores on hands or if there is a severe mastitis problem in the herd.

2. Examine 2-3 streams of foremilk from each udder half. This helps stimulate milk let-down and flushes bacteria out of the teat canal and teat cistern. It is important in the detection of clinical or acute mastitis.
3. Teats and teat ends must be clean before milking. Wash teats with sanitizing solution (25 ppm iodine or 100 ppm chlorine). Wash with single-service paper towels. Do not use any towel on more than one animal. Do not use cloths, rags, or sponges as they transfer infection from doe to doe, even when soaked in sanitizer.
4. Consider pre-dipping with teat dip in lieu of washing. It is necessary to wash only when teats are dirty. Allow 30 seconds of contact time before drying off.
5. Dry teats off with a second paper towel. Teats must be thoroughly dry before milking. Washing teats with a common cloth and then not drying is not recommended for the control of mastitis.
6. If using a milking machine, attach milking unit within 60 seconds of initiating preparation. Position milker to avoid liner slippage or squawking teat cups.
7. Remove teat cups by shutting off vacuum at the claw. Don't remove teat cups by inserting thumb or finger into mouthpiece and admitting vacuum.
8. Dip teats in an effective teat dip as soon as doe is milked out. Cover at least the bottom 50 percent of teat. Use a teat dip rather than multi-purpose sanitizer. At the end of milking, do not pour left-over teat dip back into the bottle. Use a cup rather than a spray.

Nine goat herds, ranging from four to 26 does, responded to a survey regarding milking procedures. Only one herd did not wash udders before milking, but three herds used a common cloth. Iodine, chlorine, and chlorhexidine were used as sanitizer. Only four of the nine herds dried udders with paper towels; three herds did not dry teats. Although six herds checked foremilk for abnormalities, only two herds used a strip cup. Only two herds pre-dipped udders with teat dip before milking and both used chlorhexidine. All nine herds used teat dip after milking but six herds used a spray rather than a cup and only teat ends were dipped by four herds. Many herds used an iodine teat dip.

Drying-Off

At drying-off, each goat should be treated with a commercially prepared intramammary infusion product. Dry treatment is effective in reducing subclinical infections and provides protection against development of new infections, especially during the first two weeks after drying-off. Dry animals are prone to new infections during the first two weeks of the dry period and also for the week preceding parturition.

Teat dip and then dry with a paper towel. Cleanse the teat end with an alcohol pad. Do not contaminate the cleaned teat end or infusion cannula. Insert the cannula only 1/8th inch into the teat canal. Teat dip immediately. Check animals a week later. Treat a second time if there is hardness or swelling. Clean teats before re-treating.

Remove grain from does at drying-off. Do not allow access to lots or pastures which have ponds, standing or stagnant water, or swampy areas.

Six of the nine herds in the survey treated all does with an antibiotic at drying-off. Cephapirin and cloxacillin were used by most. Two herds dry-treated only problem does. Several herds treated animals more than once. Only one treatment is recommended.

Milking Machines

The purpose of milking equipment is to make it easier and faster to milk greater numbers of animals. The milking machine must allow rapid and thorough milk-out, while preventing damage or irritation to the mammary gland, development of new mastitis infections and changes in milk composition or quality. The milking machine can contribute to mastitis infections through transfer of infectious organisms on teat cup liners, trauma to the teat and udder, and assisting the penetration of bacteria through the teat sphincter via milk droplet impacts (Jones, 1984).

Milking machines remove milk from the animal by applying a partial vacuum at the teat. The recommended vacuum level is 10 to 14 inches (Spencer, 1983). The teat cup includes a shell and liner (or inflation). A constant vacuum is supplied to the teat end (inside the liner). Each milking unit has a pulsator which causes the vacuum between the shell and liner to switch from milking to rest phase or to alternate from vacuum to air source. During the milking phase, there should be equal vacuum on the inside and outside of the liner. The liner is open and milk flows. In the rest phase, air is admitted between the shell and liner and the vacuum inside the liner causes it to collapse around the teat and massage the teat. This massage prevents congestion of blood and body fluids inside teat tissue and minimizes damage to the teat sphincter and keratin inside the teat canal. Pulsation ratios probably should be 50:50 to 60:40.

The vacuum pump is the heart of the milking system. It supplies the vacuum. Vacuum pumps must be of adequate size to maintain a stable vacuum level at the teat end, while compensating for losses caused by operation of the pulsators, leaks in the system, and air losses that occur with unit attachment, liner slips, or fall-offs. A vacuum pump supplying 20 cubic ft of air ASME/min should be adequate for most goat operations. An effective, well-maintained (clean) vacuum regulator or controller is important. Regulators admit air into the system to hold vacuum at the desired level. Also, they must be sensitive to vacuum drops and respond immediately. The regulator should be installed near or attached to the vacuum reserve tank and should be located in an area free of dust and dirt but also where it is accessible for monthly cleaning.

The vacuum supply is connected to the milking units by vacuum supply lines and milk lines. Restricted vacuum or milk lines may cause machine malfunction and may lead to teat and udder damage. The pulsator vacuum line carries air from the pulsator to the pump. Air is admitted during the rest phase and must be evacuated to open the liner. With bucket milkers, this vacuum line also supplies the vacuum to the teat end. In pipeline milkers, the milk line supplies teat end vacuum and assists in the transfer of milk to the receiver jar. The milk line is connected to the vacuum reserve tank through a vacuum supply line to a sanitary or moisture trap and the receiver jar.

Pulsator vacuum lines should be looped to the vacuum reserve tank or to a header line. A 1-1/2 inch i.d. plastic (pvc) line should be more than adequate for either pipeline or bucket systems.

Milk lines can be stainless steel or glass. There must be a continuous slope of 1 inch per 10 feet to the receiver jar. There must be no low spots. It is

preferred that milk lines be installed below the animal to avoid lifting of milk. If this is not possible, the maximum height of the milk line above the animal platform should be 5 feet. Milk should not flow over a riser to the receiver jar. Milk lines should be looped to the receiver. The 3-A Standards for dairy cattle recommend no more than four milking units per slope for a 1-1/2-inch line and eight units for a 2-inch line. Considering differences in milk yields between does and cows, a 1-1/2 inch looped milk line should be adequate for most dairy goat milking systems.

Cleaning and Sanitizing Milking Equipment

All milking equipment and utensil surfaces that come into contact with milk must be thoroughly cleaned and sanitized before the next milking. Cleaning removes milk soils or organic and mineral solids after milk is removed. Sanitizing kills residual microorganisms present on surfaces immediately prior to milking.

Equipment should be rinsed with lukewarm (110 - 115°F) water immediately after milking to prevent drying of milk solids on surfaces. Then equipment should be washed with alkaline cleaner. For hand washing, soak all parts at 120-135°F for at least five minutes and then brush all parts thoroughly. For pipelines and bulk tanks, start with 160-165°F water and circulate cleaning solution for seven to eight minutes. Solution temperature should be at least 115°F at the end of the cycle. Brush all other parts. Rinse the detergent solution with tap water before rinsing pipeline and bulk tank with acid rinse. Circulate for two to three minutes but do not recirculate.

Immediately before every milking, circulate sanitizer solution for 2-3 minutes. Sanitize hand-washed parts.

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