

Producing Milk With a Low Bacteria Count

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This NebGuide provides cleaning, sanitizing, mechanical, environmental and other procedures to follow to assure a low bacterial count in milk.

Bacteria are tiny, rapidly reproducing microorganisms that are too small to be seen without a high power microscope. Their minute size makes it very difficult to eliminate them from dairy equipment.

Because bacterial growth in milk may cause spoilage, and possibly human illnesses, a low bacterial count is one of the best indicators of top quality milk. Milk will almost always be top quality if it is properly harvested from healthy, clean cows using clean equipment, cooled quickly and kept cold.

Ways to Reduce the Bacterial Contamination of Milk

Milk with clean equipment in a clean environment.

Cleanliness of the milking area and the milk house is very important in maintaining a low bacterial count. Of particular importance is the cleanliness of milking equipment surfaces. Routine attention to the following points will help assure a low bacterial count:

Clean and sanitize frequently. To assure low bacteria counts in milk, wash equipment immediately after use and sanitize it just before every milking as required by regulations. Less frequent cleaning and sanitation can result in higher bacterial counts.

Use cleaners and sanitizers properly. To avoid bacterial contamination from surfaces that contact milk, routine use of a four-step cleaning and sanitizing process is recommended:

1. Rinse with 100 to 115°F water *immediately* after completing milking.
2. Wash as soon after using as possible (regulations specifically require this). Wash clean-in-place (CIP) equipment with a 140° to 165°F (non-foaming) chlorinated alkaline cleaning solution. Other types of commercial products may be satisfactory. For hand washing, use brushes and a solution temperature of at least 120°F.

3. If you have hard water, rinse with an acid solution at 100° to 110°F and allow to drain and air dry. Otherwise, you need only rinse with clear water. Visually inspect equipment after rinsing for proper cleaning.

4. Apply an EPA-approved and registered sanitizer of proper strength just before every milking (required by regulations). Do not rinse equipment after applying the sanitizer. Allow the system to drain before milking begins to prevent sanitizer residues in the milk.

The *initial rinse* flushes residual milk from the equipment surfaces. Rinse water should be at least 100°F but no greater than 115°F. *Use a thermometer regularly* to check the water temperature. Water that is too hot will set or “cook” the milk onto surfaces; water that is too cold will not remove the fat. Flush the entire system and all milk contact surfaces.

For pipeline milking systems, do not circulate a pre-rinse but discharge to a drain. Continue flushing until the water is clear at the outlet. The amount of water needed varies from 20 to 50 or more gallons, depending on the system’s size.

Once rinsed, the equipment must be washed. Alkaline cleaners are used to remove residual milk and to help prevent milkstone build-up. Use the proper concentration of the chlorinated alkaline cleaner for *washing*—too weak a solution will not clean properly and may leave a film of fat on the equipment surface. Water will “bead” on such a surface. Too strong a solution corrodes surfaces, increases deterioration of rubber hoses, inflations and gaskets, and wastes money. Be sure to *read the product label for the manufacturer’s directions*. The correct water level should be marked on buckets and tanks used for washing milking equipment to facilitate mixing the proper concentration every time. *Note:* Store chlorinated cleaners in tightly closed containers to help keep the chlorine from escaping.

Most cleaners are compatible with water that contains up to 10 grains per gallon of calcium and magnesium hardness. Specially formulated cleaners containing water conditioning chemicals are necessary for water with 10 to 30 grains of hardness. Water softening treatment is invariably needed when a water supply contains 30 or more grains of total hardness. Obviously, checking water quality on a dairy farm is essential to producing high quality milk.

The temperature of the cleaning solution is very important to ensure proper cleaning. Cleaning solutions should be 165°F to start for CIP equipment, and not less than 120°F at the end of the cleaning cycle. Water at 170°F and over may cause clear milk tubing to turn brown.

To assure enough hot water is available, be sure the water heater is of adequate size and set at the right temperature. For some dairy farms, equipment suppliers recommend installing two hot water heaters—one for washing the cows and one for washing the equipment. If enough hot water is not available, check with a chemical supplier for assistance. Tepid water cleaners or cleaners that function at low temperatures (about 120°F) may be recommended if a soft water supply is available.

A booster heater can be installed in the wash sink to maintain a high water temperature. Another alternative is to insulate the stainless steel or glass lines. The insulation must be a closed cell foam to prevent water absorption, and the outside surface must be smooth. Attach foam pieces to within an inch of all fittings and valves. Use plastic or metal clips to hold the insulation around the line. Insulating lines may raise the temperature at the end of a CIP wash cycle by 20°F. Insulated and covered wash vats may also be used. A heat recovery system is another alternative. In most systems, milk warms the compressor refrigerant fluid, which in turn heats the water and increases the supply of hot water at milking time.

Keep CIP wash cycle times to a minimum, usually 8 to 10 minutes—the longer the circulation time, the greater the temperature drop. Manual timers can be put on CIP systems that don't have automatic timers to control circulation time. *Note:* Never use detergents that foam in CIP systems as they can cause pumps to burn out.

For equipment that needs to be hand washed, prepare a solution with 120° to 160°F water. Use a cleaner that is compatible with the water supply and follow the manufacturer's directions. Disassemble and soak all small parts for a few minutes. Then scrub all parts with good quality brushes specifically designed for the individual pieces. For bulk tanks that must be manually cleaned, thoroughly wash problem areas such as the bridge, covers, agitator, calibration stick and valve after each pick up. Weigh jar connections are an area of particular concern and should receive special cleaning.

The third step is the *final rinse*, which removes residual cleaning compounds. On farms with hard water, adding acid to the rinse may be necessary to prevent milkstone build-up.

The fourth step is *applying a sanitizer*. Sanitize equipment just before it is to be used rather than immediately after it has been washed. This assures a low number of bacteria on the equipment and prevents corrosion of the stainless steel, which can occur if certain sanitizers are in contact with the metal for a long period of time. The most common active ingredients in chemical sanitizers include chlorine, iodine and acid anionic compounds. Except for very specific conditions, quaternary ammonium compounds do not have regulatory approval for use as dairy farm equipment sanitizers. Surfaces must be completely clean because a sanitizer's effectiveness is retarded by the presence of organic matter, such as milk, dirt and manure.

As with cleaners, proper concentration, time of exposure (at least 2 minutes), and water temperatures (75 to 90°F is optimum for chlorine sanitizers) are important when using a sanitizer. A chlorine solution exposed to air dissipates rapidly, especially at warm solution temperatures. Don't attempt to save sanitizer from one milking to the next. The sanitizer should not be rinsed off before milking. To prevent residue in the milk, it's important that: 1) the sanitizer be drained off; and 2) the sanitizer's concentration not exceed the manufacturer's recommendations.

Regulations require the use of approved sanitizers. Do not use household sanitizers such as chlorine bleach as they are not labeled for this use.

Replace hard and cracked rubber parts. As inflations age, they become hard and cracked, and difficult to clean. Because bacteria are small, they can live and multiply in these cracks. To assure low bacteria counts, replace inflations on a routine basis, typically after 1,200 milkings or as recommended by the manufacturer. Other rubber parts, including air lines, milk lines and water hoses, also become cracked and should be replaced on an as-needed basis.

Be sure equipment drains dry between milking. The moist, warm environment provided by a poorly drained pipeline or claw assembly is ideal for microbial growth; thus, adequate equipment drainage or dryness is important. All lines, hoses, claws and related equipment must be installed to assure complete drainage at the end of the final rinse cycle. Proper ventilation of the milking parlor and the milk house helps assure that equipment dries between milkings.

Clean vacuum system. Vacuum systems are often overlooked as a source of bacterial contamination. Because milk can get into vacuum systems through cracked inflations, it is important that they be kept clean. This helps assure low counts by preventing bacterial growth in the vacuum system and subsequent movement into the milk line during either milking or cleanup. It also helps assure a good vacuum by preventing the clogging of lines.

Clean air and vacuum hoses regularly. Pulsators are another part of the vacuum system to clean on occasion. Check the manufacturer's recommendations for cleaning.

To clean the vacuum lines, mix 6 ounces of a liquid chlorinated alkaline detergent per gallon of hot water. The system's trap or pump tank's capacity determines the volume of solution needed. Do not draw more solution into the system than the trap or tank will hold.

Draw the cleaning solution through a stanchion hose into the vacuum line at each stall cock. Drain the dirty solution from the trap. Rinse the line and trap with the same amount of clean, hot water and drain again.

Next, prepare an acid rinse solution using 3 ounces of a liquid acid rinse per gallon of water. Draw this solution into the vacuum line at each stall cock, starting at the one farthest from the pump. Drain from the tap.

Rinse again with the same amount of clean, hot water, starting at the stall cock farthest from the pump. Drain from the trap. Open all of the stall cocks and run the pump to dry the lines.

Maintain adequate volume and turbulence of cleaning solutions. This is of particular concern in large diameter (2- or 3-inch) pipelines. Without adequate volume and turbulence (velocity), the top of the line will not clean because the wash solution does not come into contact with it. Proper turbulence (velocity) is maintained by air injection or by pumping in flooded systems. Larger vacuum pumps may be needed in some systems to assure proper velocity. Milk lines of varying dimensions (i.e., 3-inch line connected to a 1 1/2-inch line) generally should not be installed. They are especially difficult to clean due to inadequate cleaning solution turbulence.

“Dead ends” in the milk line are impossible to adequately clean in a CIP system because cleaning solutions cannot make effective contact with them. Consequently, milk solids build up in dead ends and bacteria grow there, causing count problems in the milk. This is why regulations do not allow dead ends in milk pipelines.

Clean gaskets routinely. To prevent a bacterial build-up in pipeline couplings, gaskets must be cleaned regularly. Replacement may be necessary if gaskets are worn or extend into the milk line due to improper installation.

Cool Milk Rapidly

Proper refrigeration of bulk milk is needed to ensure a quality product. Refrigeration stops or substantially reduces the multiplication of most bacteria.

Storage at temperatures below 40°F prevents the growth of most bacteria that cause disease. Some spoilage bacteria grow at temperatures below 40°F, but their growth rate is slow.

By regulation, bulk tanks on Grade A farms must be able to cool milk in the tank to 45°F within two hours after the first milking. On farms producing manufacturing grade milk, the milk must be cooled to 40°F within two hours. On both Grade A and manufacturing grade farms the blend temperature must not rise above 50°F.

It's also important to prevent freezing milk in the bulk tank. If milk freezes, the tank's cooling efficiency is reduced, the milk may develop an off-flavor, and the milk's freezing point may rise, giving a false indication of water adulteration. Regular service and maintenance of the bulk tank helps to assure proper milk cooling. Checking to see if the compressor is the right size and periodic cleaning of the condensing unit are very important. Having a standby generator can be most helpful if the electricity goes off for any reason.

Agitating the milk in the bulk tank at milking time helps assure rapid cooling. Installing a recording thermometer is an excellent way to monitor a bulk tank's cooling adequacy.

Use Proper Udder Preparation And Milking Techniques

Clip udders as needed to reduce the soil and hair that can get into milk from the udder. Generally, hair long enough to be sucked into the inflation is *too long*.

Forestripping is an important aspect of udder preparation and needs to be done for three reasons: a) to check for mastitis; b) to eliminate the high numbers of bacteria normally found in foremilk; and c) to stimulate milk let-down. Forestripping should be done *before* washing the udder, providing the teats are fairly clean. This way mastitis-causing bacteria transmitted by forestripping can be eliminated by premilking sanitation. Forestrip the udders after washing if the teats are not clean when the cows come into the barn.

Premilking sanitation (udder washing) is a critical point for controlling the bacteria count in milk. Although a large percentage of bacteria are removed from teats by the physical washing process, using a sanitizer helps to further reduce their numbers. The water used for premilking sanitation (washing) of the teats must contain a sanitizer of proper strength (required by regulation). In all cases, follow the recommendations of the sanitizer manufacturer regarding concentration of product and wash temperature. The proper concentration for chlorine sanitizers is 50 to 200 ppm; for iodine, 12.5 to 25 ppm (do not use quaternary ammonium compounds as a premilking sanitizer). *Note:* Avoid using premilking sanitizers in concentrations greater than those recommended by the manufacturer as this may cause udder damage.

Sprayers are more convenient and generally more sanitary for washing udders than are buckets of water. Low pressure sprayers that deliver a low volume of water are better than high pressure sprayers that provide a high volume. Bacterial build-up can occur in a bucket of wash water, particularly when sponges and washcloths are used. However, if single-service paper towels are used, the chance for bacterial build-up and cross contamination from a bucket of wash water is reduced.

When washing the cow's udder, particularly with a sprayer, it is important to wet only a minimum of it. If the entire udder is wetted, dirty water drains down its sides and into the teat cups, thereby increasing the milk's bacteria count. After washing, use a single-service paper towel to dry the udder. Never use a towel on more than one cow.

Fresh and antibiotic-treated cows present special sanitation concerns. Milk these animals last to prevent contamination of the good milk, or use separate milking equipment and trap. Wash this equipment after each milking to assure that contaminated milk in the trap does not overflow into the milk line.

Provide A Clean, Dry And Properly Ventilated Environment For Cows

A properly designed and maintained environment helps assure the cows' cleanliness and health. This in turn leads to the production of milk with a low bacteria count. Muddy lots have made bacteria counts a real problem for some dairies. Concrete used around feeders, waterers and barn entrances will minimize muddy conditions.

It is important to keep cows out of swampy areas where stagnant water may get on teats and udders. And, it is critical that cow stalls be kept bedded and as clean and dry as possible.

Wash Hands Before Milking And During Milking As Necessary And Wear Clean Clothes

Having clean hands is particularly important when putting filters into place or replacing them. Clean hands also help prevent the spread of mastitis.

Prevent Mastitis

Reducing the incidence of mastitis indirectly helps reduce the bacterial count. The best means of preventing mastitis is through: a) teat dipping; b) dry cow antibiotic treatment; c) correct use and maintenance of milking machines; d) routine veterinary service—treat clinical cases promptly; and e) culling chronically infected cows.

Milk Foaming

Milk's aeration or foaming may affect its bacterial count. Generally, the more air that is incorporated into milk, the faster the bacteria grow. Equipment designed and maintained to prevent foaming will help keep bacteria counts down. Air leaks in the milking system are one of the more frequent causes of foaming. Therefore, repair all leaks and avoid enlarging claw air vents. Never use air vents in both the claw and inflation systems. Other causes of foaming include the improper entrance of milk into the bulk tank and improper positioning of milk hose nipples into milk lines.

Replace Leaking Bulk Tank Outlet Valves

A leaking bulk tank outlet valve can also contribute to a high bacteria count in milk. Milk passing through this outlet is warmer than that in the bulk tank. The resulting bacteria

build-up contaminates the milk conveyed through it to the bulk truck. Replace leaking valves. Be sure to disassemble and clean the valve each time the bulk tank is emptied.

Using the bulk tank milk outlet valve to obtain milk for on-farm use may also contribute to a bacteria build-up if it is not washed and sanitized after the milk is withdrawn. Under no circumstances should jugs or dippers be used to obtain milk from bulk tanks for on-farm use because this may introduce large numbers of bacteria or other contaminants into the milk.

Have Milk Picked Up Frequently

Milk picked up on a daily basis generally has lower bacterial counts than milk picked up every other day. On-farm pick-ups less frequent than every two days should be discouraged.

Additional dairy information can be found at www.nebraskadairy.unl.edu.

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