Milk Quality On the Dairy – Who Is Responsible?

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Consumers, processors and regulatory agencies are increasingly interested in the safety and wholesomeness of milk resulting in increased emphasis on the farm management to insure the production of milk quality. Despite technical advances in milk processing, the quality of milk is still determined at the dairy farm.

The employees who milk the cows, "milkers," have the important yet routine job of harvesting the milk from the udder of the cows in a manner that maintains milk quality and protects the udder from infections. In addition, the milkers have the responsibility of washing and sanitizing the milk handling, cooling and storage system on the dairy. They handle a complex set of equipment and chemicals that affect milk quality. During milking they detect cows with clinical mastitis. Other non-milking employees also influence milk quality. Some employees manage the bedding and housing areas where the cows live. Other employees provide antibiotic treatments for cows that are infected with mastitis and manage the cows while they are in the hospital pen. Given that these employees have a considerable influence on milk quality, the question of how to direct and motivate them to maintain high standards of performance is a challenge to the dairy management. Management has great influence on milk quality by the priority they place on the production of high quality milk and the infra-structure support they provide.

Milk Quality Measures

Standard Plate Count. The SPC is the total quantity of viable bacteria in a millimeter (ml) of raw milk expressed as CFU/ml. The bacteria are counted but not specifically identified. The SPC is performed on milk samples collected from the bulk tank milk. This is usually done at least monthly by the milk processing plant. The SPC is primarily an indicator of the sanitation used by milkers as they milk the cows, the capacity of the equipment to rapidly cool the milk to less than 40 F within 2 hours after milking, and the cleaning and sanitizing of the milking equipment.

The SPC will be elevated when cows are milked with wet or soiled udders and teats, with unclean or inadequately sanitized milking equipment, or the system fails to rapidly cool the milk to less than 40 F. The SPC may also be elevated when cows with mastitis due to *Streptococcus agalactiae* or environmental *Streptococcus* species are milked into the bulk tank. Damaged or over-used inflations or liners may also influence the SPC.

Milking employee influence on SPC: Employees are responsible for attaching the milking units only to cows with clean and dry udders and teats. Employees are responsible for reporting problems with wash and dry pen equipment or lack of towels to clean and dry the udders and teat to the dairy management. Employees are responsible for following instructions for properly cleaning and sanitizing the milk system. Lack of supplies or faulty equipment should be reported to the management. Milkers should detect cows with mastitis at each milking. They should follow dairy protocols for handling and treatment of cows with mastitis. The milk from cows with mastitis or those that have been treated with antibiotics should not be sent to the bulk tank.

Influence by other employees on SPC: Workers responsible for properly bedding the free stalls and corrals should provide adequate bedding to keep the cows clean and dry. Failure to provide a clean, dry, comfortable place for the cows to rest may result in overly dirty cows arriving at the milk parlor and may make it more difficult for the milkers to properly prepare the cows prior to milking.

Management influence on SPC: The management is responsible for maintenance and function of the wash and dry pen equipment, provision of adequate supplies of towels in the milking parlor, provision of cleaning and sanitizing chemicals, function of the water heaters or adequate amounts of hot water for the cleaning equipment, maintenance of the milking equipment function and the function of the milk cooling equipment. Management is also responsible for providing clean, dry housing areas for the cows. Management is responsible to train the milkers in the proper milking techniques.

SPC guidelines: SPC counts of <5000 CFU/ml are achievable and indicate high quality milk. Realistically, SPC of <10,000 CFU/ml. can be consistently achieved on most dairies and are acceptable. SPC counts >10,000 CFU/ml. indicate a need for improvement.

Laboratory Pasteurized Count: The LPC is the measure of bacteria that survive after pasteurization in the finished milk products. These bacteria come from the environment of the cow (*Streptococcus* sp. and the coliforms) and incubate on the milking equipment. These surviving bacteria produce off flavors and reduce the shelf-life of dairy products. The LPC is performed on bulk tank milk samples at least once per month by most milk processors. The LPC generally reflects the sanitation level during milking and the adequacy of the milking system cleanup between milking periods. Worn rubber liners or gaskets may harbor bacteria and contribute to the LPC count. The LPC and the coliforms counts may be elevated with wash-up problems.

The LPC will be elevated when the milking system is not adequately washed and sanitized allowing the contaminating bacteria to grow. Elevated LPC counts occur when the wash water is under 120 F, there is insufficient agitation of the wash water during washing, with faulty air injectors, by lack of enough or low quality soaps and chemicals, and incorrect use of soaps and chemicals. The sources of these bacteria are wet, dirty udders and teats and failure to properly prepare the cows before milking.

Milking employee influence on LPC: Milkers are responsible for milking cows with clean, dry udders and teats. They should also alert the management when worn rubber liners or gaskets are noticed. The milkers are responsible for following the wash and sanitization protocols to insure an adequately cleaned and sanitized milking system.

Influence by other employees on LPC: Workers responsible for properly bedding the free stalls and corrals should provide adequate bedding to keep the cows clean and dry. Failure to provide a clean, dry, comfortable place for the cows to rest may result in overly dirty cows arriving at the milk parlor and may make it more difficult for the milkers to properly prepare the cows prior to milking.

Management influence on LPC: The management is responsible for maintenance and provision of cleaning and sanitizing chemicals, function of the water heaters or adequate amounts of hot water for the cleaning equipment, maintenance of the milking equipment function and the function of the milk cooling equipment. Management is responsible for training employees to properly clean and sanitize the milking system.

LPC guidelines: LPC counts <50 CFU/ml are attainable. LPC counts should be <200 CFU/ml. Counts >200 CFU/ml are considered high and should be investigated.

Coliform Count: The coliform count reflects the extent of fecal bacteria in the milk. The coliform count is performed on raw milk samples from the bulk tank. Coliform counts are usually performed at least monthly by the milk processor. The coliform count may reflect milking cows with wet, manure soiled udders and teats or growth of coliforms within the milking system. Cows with coliform mastitis rarely influence the coliform count.

The coliform counts may be elevated when milkers fail to properly clean and dry the udder and teats prior to milking. Counts may be elevated when dirty milking equipment is used to milk the cows or when the water source is contaminated.

Milking employee influence on the coliform count: Milkers are responsible for milking cows with clean, dry udders and teats. The milkers are responsible for following the wash and sanitization protocols to insure an adequately cleaned and sanitized milking system.

Influence by other employees on the coliform: Workers responsible for properly bedding the free stalls and corrals should provide adequate bedding to keep the cows clean and dry. Failure to provide a clean, dry, comfortable place for the cows to rest may result in overly dirty cows arriving at the milk parlor and may make it more difficult for the milkers to properly prepare the cows prior to milking.

Management influence on the coliform count: The management is responsible for maintenance and provision of cleaning and sanitizing chemicals, function of the water heaters or adequate amounts of hot water for the cleaning equipment, maintenance of the milking equipment function and the function of the milk cooling equipment. Management is responsible for training employees to properly clean and sanitize the milking system.

Coliform count guidelines: Coliform counts are attainable at <50 CFU/ml. Counts of 10 CFU/ml are associated with high quality raw milk. Coliform counts > 100 CFU/ml suggest a need to investigate the source of the counts.

Preliminary incubation count: The PIC count is a measure of bacteria that will grow at refrigerator temperatures. The PIC gives an indication of the on-farm sanitation and holding temperatures of the milk in the bulk tank. The PIC is similar to the SPC in that it is performed on raw milk from the bulk tank; however, in the PI testing the milk is held at 55 F for 18 hours before culturing in the same method as the SPC.

The PIC may be elevated when the milking handling and cooling system is not properly cleaned and sanitized or when cows are milked with poor udder preparation. Failure to rapidly cool the milk (<40 F within 2 hours), marginal cooling or prolonged storage times may result in high PI counts. Expanding the milking cow numbers and extending the milking times without increasing the cooling capacity may result in elevated PIC.

Milking employee influence on PIC: Employees are responsible for attaching the milking units only to cows with clean and dry udders and teats. Employees are responsible for reporting problems with wash and dry pen equipment or lack of towels to clean and dry the udders and teat to the dairy management. Employees are responsible for following instructions for properly cleaning and sanitizing the milk system. Lack of supplies or faulty equipment should be reported to the management. Employees should report problems with cooling the milk to the management.

Influence by other employees on the PIC: Workers responsible for properly bedding the free stalls and corrals should provide adequate bedding to keep the cows clean and dry. Failure to provide a clean, dry, comfortable place for the cows to rest may result in overly dirty cows arriving at the milk parlor and may make it more difficult for the milkers to properly prepare the cows prior to milking.

Management influence on PIC: The management is responsible for provision of adequate supplies of towels in the milking parlor, provision of cleaning and sanitizing chemicals, function of the water heaters or adequate amounts of hot water for the cleaning equipment, as well as the maintenance and function of the milk cooling equipment. Management is also responsible for providing clean, dry housing areas for the cows. Management is responsible to train the milkers in the proper milking techniques and operation of the cleaning and sanitization of the milking equipment.

PIC guidelines: The PIC values are generally higher than the SPC. A PIC 3 to 4 times the SPC suggests a potential problem with cleaning and sanitization of the milking system or poor udder preparation prior to milking. High quality milk will have a PIC of <10,000 CFU/ml. Counts of <50,000 CFU/ml are acceptable. PIC >50,000 CFU/ml or >4 times the SPC should be cause for concern.

Sediment: Sediment is a measure of the cleanliness of the cows being milked. Sediment is the fine debris that is capable of moving through the milk filter into the bulk tank milk. High sediments may also be associated with high bacteria counts.

Sediment may enter the milk when extremely fine sand is used in the bedding materials of the cow housing. It may also enter the milk when the milkers are not using water to clean the udders and teats prior to milking.

Employee influence on sediment: Sediment may enter the milk when the milkers are told not the wash the udders and teats prior to milking the cows. Sediment may also be found when milkers are not properly preparing the udders and teats during wet weather.

Management influence on sediment: Sediment may increase in the milk when the management instructs the milkers not to wash the udders and teats prior to milking. Sediment may also occur when management decides to use fine sand in the bedding areas for the cows.

Sediment guidelines: Sediment should not be detected in the milk.

Added water: The milk is tested by the milk processor for added water using a freezing point test. When water is added to the milk, the freezing point will be altered. Added water is commonly found when water is accidentally left in the milking system between milkings.

Employee influence on added water: Added water may be found when the milkers fail to properly drain the milking system between milkings.

Management influence on added water: The management should instruct the milkers to insure that the milking system is completely emptied of wash or rinse water prior to every milking period.

Added water guidelines: No added water should be detected.

Antibiotic drug residues: Antibiotics are commonly used to treat mastitis or other conditions in dairy cows. Each antibiotic has label instructions that indicate the approved reasons for using the antibiotic, the dose or amount of the antibiotic, how often the antibiotic dose should be repeated, the route of administration, and the type of cow permitted to be treated with the antibiotic. Each antibiotic preparation also has a specific withdrawal time for both milk and meat. The withdrawal time is the time from the last treatment with the antibiotic until the milk is permitted to be put in the bulk tank for shipment to the processor.

Antibiotic residues occur when employees fail to follow the specific label instructions when treating cows. They may also occur when treated cows are accidentally milked into the bulk tank before the withdrawal period is completed. Residue may also occur when employees fail to clearly identify treated cows with chalk marks, leg bands or neck

chains. They may also occur when written records of treatments are not kept or are not checked prior to returning the treated cow to the milking herd. Treated cows should be housed and milked separately from main milking herd.

Milking employee influence on antibiotic residues: Residue may occur when employees milk treated cows that have been identified as treated.

Other employee influence on antibiotic residues: Non-milking employees may be charged with properly treating, identifying and separating milking cows from the main milking herd. Employees may inadvertently cause an antibiotic residue by using an antibiotic in a manner other than indicated on the drug label. Residue may also occur when employees treat cows and fail to properly identify the cows and separated from the milking herd. Employees may cause residue by removing treatment identification and returning the treated cows to the milking herd before the milk withdrawal time has been completed.

Management influence on antibiotic residues: Management is ultimately responsible to train all employees in proper antibiotic use and drug residue prevention. Management along with the dairy veterinarian should develop written protocols for use of antibiotics and records systems to properly document antibiotic use as a mean to prevent residues.

Antibiotic residue guidelines: Antibiotic residue in milk should not be permitted.

Somatic cell counts: Low levels of somatic cells are normally found in milk (<100,000 cells/ml). The somatic cell count can be measured on bulk tank milk or milk from individual cows. When mastitis occurs in a cow, the somatic cell count (SCC) in the milk for that cow will increase in approximate proportion to the severity of the infection within the udder. Milk production is inversely related to SCC. An elevated SCC in a particular cow will also influence the somatic cell count of the bulk tank milk (BTSCC). Elevated BTSCC will reduce the quality of the milk from the herd resulting in lowered herd milk production, loss of quality milk premiums, reduced cheese yields and decreased shelf-life of the finished products.

The individual cow SCC increases when there is an infection within the udder. These infections are caused primarily by bacteria and mycoplasma. The source of these pathogens may be infected cows or the environment. Infected cows transfer infections during the milking process on the milking machine and hands of the milkers. Environmental infections enter the udder through the teats from sources in the cow housing areas in between milking periods. Both clinical and non-clinical cases of mastitis contribute to the BTSCC. The BTSCC is reflective on a qualitative basis to the extent of individual cow SCC or mastitis infections.

Milking employee influence on SCC: The milkers play an important role in the control of mastitis particular contagious mastitis that spreads from cow to cow during milking. Milkers should only put milking units on cows with clean, dry udders and teats. Milking units should be promptly removed from the cows when milk ceases. Every cow should be treated with a post-milking teat dip that covers at least 90% of the teat. Milkers should

pre-strip all cows in order to detect clinical mastitis at the earliest time after the onset of mastitis. Milkers should follow the dairy protocol for informing the dairy management when cows with clinical mastitis are detected.

Non-milker employee influence on SCC: Bedding in the housing areas should be kept clean and dry to prevent excessive growth of bacteria that may cause mastitis from environmental sources. Employees that treat cows with mastitis should use appropriate intramammary infusion methods to prevent the introduction of pathogens into the mammary gland and the spread of pathogens to other cows. Employees that treat cows with mastitis should not return the treated cows to the milking herd until they have clinically normal appearing milk. Employees that milk the cows in the hospital pen should be very careful not to spread mastitis from one cow to another via the milking units or their hands.

Management influence on SCC: Management should insure that milkers are properly trained in the application of mastitis prevention and control measures during the milking process. There should be a written protocol provided to the milkers stating the procedure for handling cows detected with clinical mastitis. Workers who treat cows with mastitis should be trained in proper intramammary infusion techniques. Management should provide adequate bedding materials and a schedule for bedding management that provides for a clean, dry place for all cows to rest. Management should use a program of total dry-cow antibiotic treatment for all cows at the end of their lactation. Management should review information on the prevalence of mastitis within the herd on a regular basis and send chronically infected cows to market.

Guidelines for SCC: On an individual cows basis, cows with SCC <250,000 cells/ml have a low risk of being infected with mastitis at any stage of lactation. Cows with SCC >250,000 cells/ml have an increased risk of being infected. Almost all cows with a SCC >500,000 cells/ml will be culture-positive for a mastitis pathogen. Repeated SCC > 250,000 cells/ml on a consecutive or intermittent basis 2 or 3 of 4 test periods) indicates a chronic infection. BTSCC <200,000 cells/ml indicate high quality milk. BTSCC >300,000 cells/ml suggest a need to review the dairy mastitis prevention and control program. In some milk cooperatives, BTSCC >400,000 cells/ml will result in a lower price for the milk. For sale off the dairy in California, the BTSCC must be <600,000 cells/ml.

Clinical mastitis: Clinical mastitis is the form of mastitis that is visibly apparent to the milkers. Clinical mastitis will result in abnormal milk (flakes, clots, watery) and possibly signs of sickness in the cow as well. Milk from cows with clinical mastitis should not be milked into the bulk tank milk for sale. Milk from cows with clinical mastitis will also have elevated SCC and be of poor quality. Cows detected with clinical mastitis should be segregated from the milking herd and handled according to the herd protocol. Early detection and treatment of clinical mastitis can be expected to reduce the incidence of chronic, non-responding cases of mastitis.

Most all forms of mastitis pathogens are capable of causing clinical mastitis. The Staphylococcal sp., Streptococcal sp. and mycoplasma generally cause mild clinical mastitis that may become chronic while the coliform bacteria often cause severe, life-threatening mastitis.

Milking employee influence on clinical mastitis: Milkers should pre-strip all cows prior to milking in order to detect clinical mastitis at the earliest time after the onset of mastitis. Milkers should follow the dairy protocol for informing the dairy management when cows with clinical mastitis are detected. The milkers play an important role in the control of mastitis particular contagious mastitis that spreads from cow to cow during milking. Milkers should only put milking units on cows with clean, dry udders and teats. Milking units should be promptly removed from the cows when milk ceases. Every cow should be treated with a post-milking teat dip that covers at least 90% of the teat.

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Management influence on mastitis: Management should insure that milkers are properly trained in the application of mastitis prevention and control measures during the milking process. There should be a written protocol provided to the milkers stating the procedure for handling cows detected with clinical mastitis. Workers who treat cows with mastitis should be trained in proper intramammary infusion techniques. Management should provide adequate bedding materials and a schedule for bedding management that provides for a clean, dry place for all cows to rest. Management should review information on the prevalence of mastitis within the herd on a regular basis and send chronically infected cows to market.

Guidelines for clinical mastitis: A reasonable goal is to limit clinical cases of mastitis to 2 cases or less per 100 cows per month. This goal for clinical mastitis might be expressed as <24% of the cows affected per year.

Concluding Considerations

It is clear that milkers, non-milkers and management have a role in the complex task of producing high quality milk. Management and employee must become very knowledgeable about the milk quality factor and the tasks that impact each factor. Each group will need to complete their tasks with a high degree of proficiency in order for the milk to be of high quality. They can obtain positive results by focusing on one milk quality parameter at a time and by maintaining crystal clear communications about who

is responsible for each milk quality parameter. Consumers, processors and regulators are expecting high quality milk and the dairies can produce it.