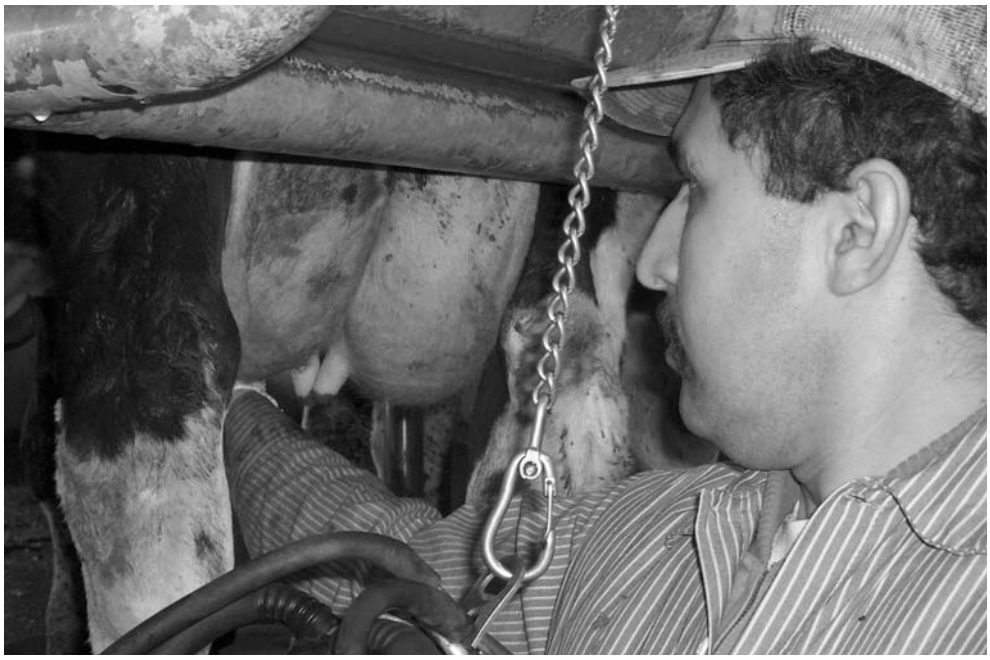
5

Milk Quality Incentives[1]



Vinton E. Smith

John H. Kirk, DVM, MPVM

Extension Veterinarian
University of California, Davis
School of Veterinary Medicine, Tulare

(559) 688-1731 Ext 224
jkirk@vmtrc.ucdavis.edu

Consumers, processors and regulatory agencies are increasingly interested in the safety and wholesomeness of milk, which in turn has resulted in a greater emphasis on management practices that insure the production of high quality milk. Despite technical advances in milk processing, the quality of milk is still determined at the dairy farm.

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, there are important questions as to how to motivate them to maintain high standards of performance. The use of incentives to motivate dairy employees is often cited as the means to improve performance. The effectiveness of incentives depends on the program design and should be a part of a larger program of employee supervision and training.

MILK QUALITY MEASURES

Milk from the dairy is frequently analyzed for several milk quality parameters. Such data is generated both on the dairy and by the milk processor. There are actually so many parameters that are analyzed that employees can easily be overwhelmed by the information. It is the job of the dairy managers to select and underscore the data that is most appropriate to the specific goals sought after. The dairy manager must transform the data into information that the employees can relate to their daily job performance. Here, we will consider some of the most critical milk quality measures.

When milkers properly clean and dry the teats before attaching the milking machine, they will harvest high quality milk.

Vinton E. Smith

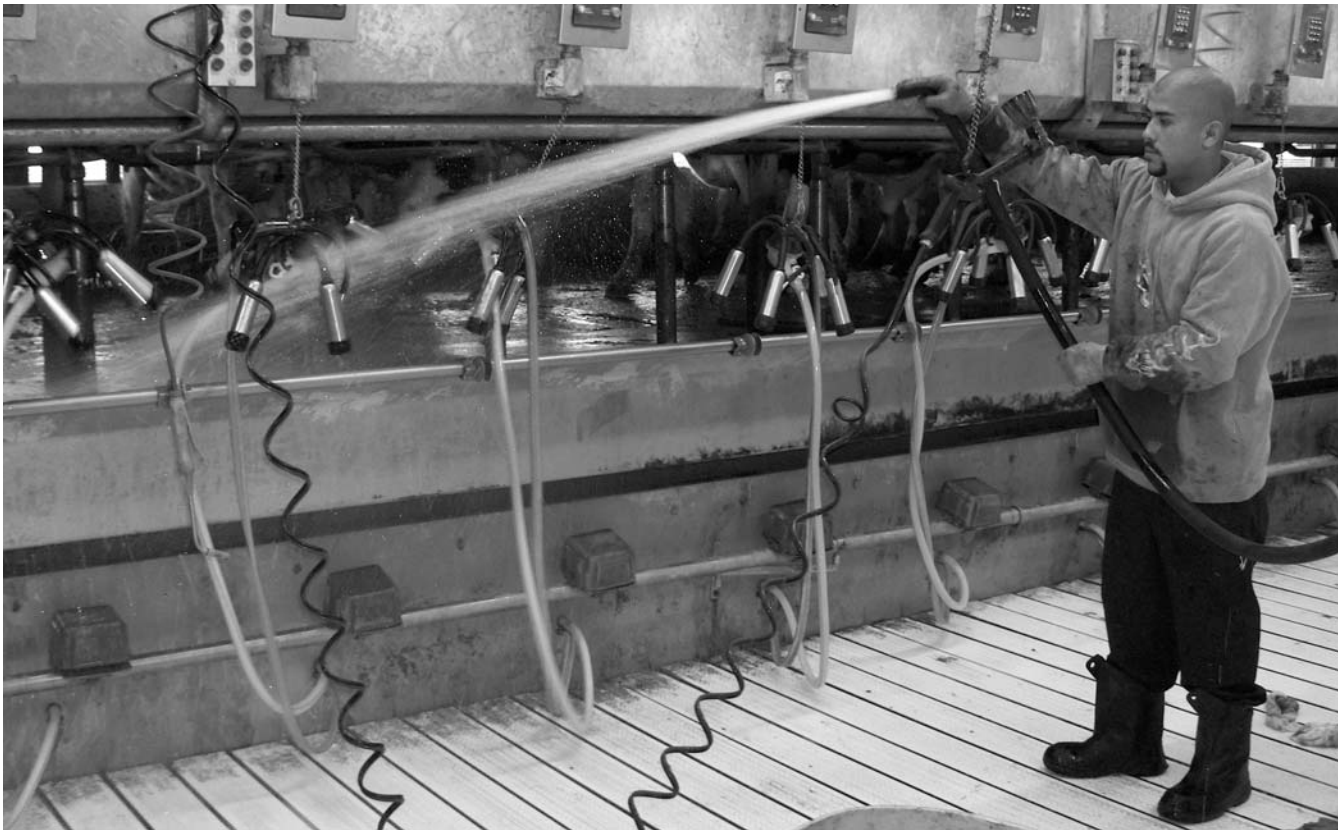
Standard Plate Count (SPC)

The SPC is the total quantity of viable bacteria in a millimeter (ml) of raw milk expressed as CFU/ml (colony forming units per ml). The bacteria are counted but not specifically identified. The SPC is performed on milk samples collected from the bulk tank. 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.

Thus, 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 (1) attaching the milking units only to cows with clean and dry udders and teats; (2) reporting problems with wash and dry pen equipment, or lack of towels or supplies to clean and dry the udders and teats to management; (3) following instructions for properly cleaning and sanitizing the milk system; (4) detecting cows with mastitis at each milking; and (5) ensuring that protocols for handling and treatment of cows with mastitis are followed (milk from cows with mastitis or those 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


Vinton E. Smith

Milkers should insure that the milking equipment is properly cleaned and sanitized between milking periods and should maintain the cleanliness of the equipment during milking to insure high quality milk.

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 (LPC)

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,

Vinton E. Smith

While the milkers are responsible for using the milking equipment properly to collect milk of high quality, the managers of the dairy are responsible for overall maintenance of the milking equipment and training employees.

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 sanitation protocols to insure an adequately cleaned and sanitized milking system.

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 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 sanitation protocols to insure an adequately cleaned and sanitized milking system.

Influence by other employees on the coliform count: 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 (PIC)

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. It 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 sanitation 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 sanitation 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 (SCC)

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

Fore-stripping of each quarter prior to attaching the milking units allows for early detection and treatment of mastitis resulting in lower somatic cell counts.

Vinton E. Smith

Vinton E. Smith

All teats should be completely covered with teat dip after the milking machines are removed at the end of milking to control contagious mastitis and produce high quality milk.

the control of mastitis: particularly 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 or pictorial 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.

Non-milker employee influence on clinical mastitis: 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 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.

It should be clear at this point, that the production of high quality milk is a complex task with inputs from the milkers, other dairy workers and the dairy management. Each group will need to complete their tasks with a high degree of proficiency in order for the milk to be of high quality.

On dairies where milkers meet their milk quality goals, the dairy management can reward them for their efforts by using a well designed incentive program.

MILK QUALITY INCENTIVE DESIGN

Chapter one deals with the design of an incentive pay program at the dairy. Specific issues that need further underscoring for milk quality incentives are included here. Feedback should be offered soon after the task is completed to reinforce the desired performance behavior. If weekly or monthly performance data are available--for example, bacteria counts in milk--it is desirable to issue incentives on that basis as well. When rewards come only once a year for benchmarks achieved in the distant past, the employees may fail to associate the reward with the quality of the performance. Furthermore, a quarterly or annual reward may be too distant to positively motivate today's performance.

Many of the milk quality criteria are complex, and involve conditions that cannot be perceived by the human senses. Hence, management must be able to educate and train the employee so that they can clearly see how their performance affects the desired outcomes. Similarly, the employees must perceive that the goal is within reach, and within reasonable employee performance expectations. A farm that

Brian Manning

attempts to move from poor milk quality to superior milk quality in a very short time by placing responsibility solely on the employees is sure to fail. The employees will perceive the goal as unattainable, no matter how attractive the incentives.

It is imperative that management select the appropriate performance criteria to be monitored and linked to employee incentives. Incorrect monitors will quickly reveal themselves, as employees become frustrated by efforts that do not achieve the desired results. For example, most farm managers monitor total milk shipped on a daily basis. On occasion, daily milk production is monitored as a means of assessing the extent of mastitis in a dairy herd. The linkage between udder health and milk yield has been scientifically proven. It is incorrect, however, to extend that association and assume that all milk yield variation is due to mastitis. Clearly, management factors like nutrition and feeding have a far greater influence on milk production.

The largest pitfall of most milk quality incentive programs is the lack of checks and balances. A dairy producer had a significant problem with severe acute clinical Coliform mastitis. Management believed that if these cases could be caught early enough, treatment would be more effective and less harm would come to the cow. The manager also believed that the milkers did not like to identify sick cows, as it required special handling of the cow that only slowed them down and prolonged the work day. In an attempt to deal with the problem, the manager instituted a financial incentive of five dollars for each case of clinical mastitis that was detected early. As a result, the detection rate nearly tripled and most of the cases were incorrectly diagnosed. The opposite is also true--if you pay for decreased cases of clinical mastitis you may initially find a decrease in the number of cases reported by employees, only to find elevated SCC's and more severe cases of clinical mastitis later.

SPECIAL CONSIDERATIONS

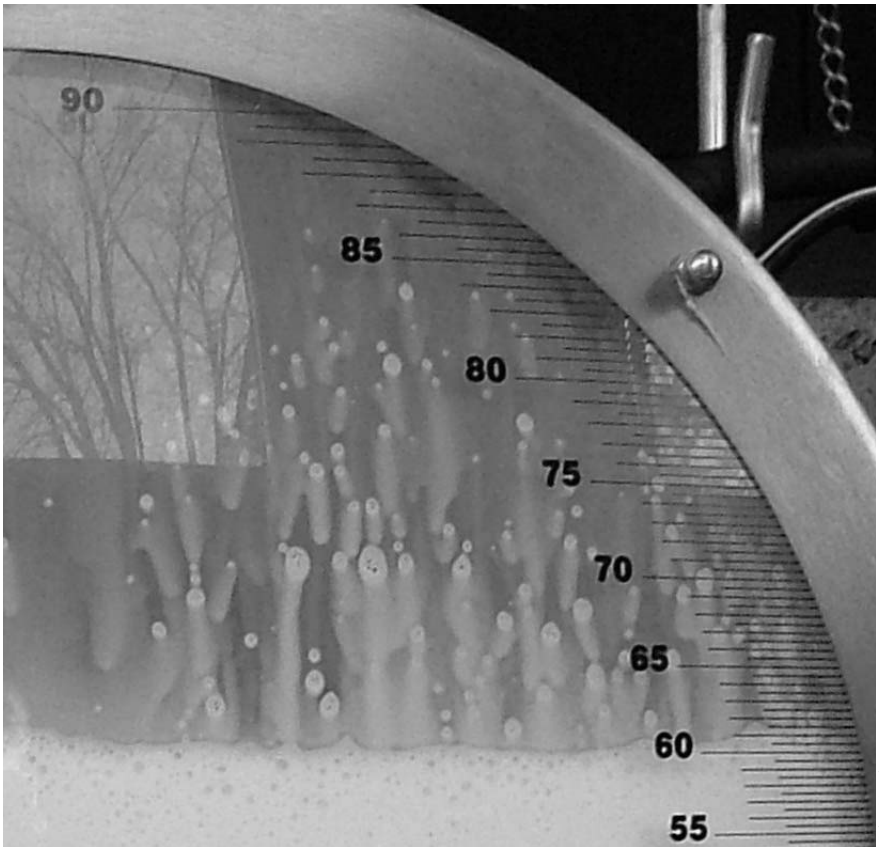
A review of the major milk quality criteria indicates that employees do not have complete control over the quality of milk produced, nor the rate of new mastitis infections. Since it is not possible to establish a perfect correlation between milker's performance, milk quality, and mastitis control, dairy management must be able and willing to adjust the criteria when the situation warrants. For example, some dairy cows are kept in the herd, even though they are subject to recurrent episodes of mastitis. Data from this type of cow is not used in the determination of the incentive award.

Milk quality data can behave in ways that are somewhat unusual; i.e., subject to extreme variations resulting from specific farm conditions and practices. Techniques such as averaging, high and low throw out, seasonal averages, trend analysis, and zero tolerance are useful tools and will assist in the equitable measurement of performance.

1. *Averaging*. For data that does not differ by orders of magnitude; i.e., 10.s, 100.s, 1000.s, etc., simple averaging is appropriate. The bulk tank somatic cell count, for example, could be averaged over many weeks and the incentive goal determined by the monthly average value. In this manner one or two higher or lower counts in a short time period would not influence attainment of the goal.

2. *High and low throw out*. Milk quality data is subject to erratic and great variations. Throwing out the highest and lowest value for the month or quarter may be appropriate when a few erratic values are evident. All of the bacteria count data, SPC, LPC, CC, and the PI can behave this way. In contrast, prolonged elevation in the bacteria counts is a very clear evidence of a problem.

3. *Seasonal Averages*. In some locations, weather and management factors may change conditions which employees cannot mitigate. In such a case, the average seasonal performance



Brian Manning

Employee incentives can be powerful tools if used correctly and fairly by management to motivate employees to increase production of high quality milk on dairies.

can be calculated to establish the norm or goal from which incentives are determined. Employee performance expectations are adjusted for seasonal weather or management practices.

4. *Trend analysis*. Trend analysis, a sophisticated analytical tool, is useful for determining if any one or set of data points is within the normal and expected variation. Using trend analysis to set a course for improvement in performance is similar to the step-wise goal process, but instead of a series of steps, the goal is to follow a declining or inclining ramp. In step-wise analysis it is easy to tell when performance is on step. If we have a straight line goal for bulk tank SCC, for example, how can we tell if any given SCC is on the proper trend? For those that use computers and spread sheets the answer is easy. The trend is selected from the management goal; i.e., in the next 48 months, bulk tank SCC should drop from 700,000 to 150,000 cells per ml. of milk. A few months of data will determine and help predict the normal variation. The computer can then indicate which SCC values are better or worse than those expected along the trend to lower somatic cell counts and incentives awarded accordingly.

5. *Zero Tolerance*. Some milk quality parameters may be too important to consider trend movement or step-wise movement. Zero tolerance is another form of fixed goal, except that the goal is no occurrences. Examples of the use of zero tolerance might include antimicrobial residues and added water. Both problems can subject the producer to economic losses and fines. The legal standard is zero occurrences. Effective antimicrobial residue avoidance requires that the employee have the knowledge, tools, and authority to act to keep the milk residue free. This requires knowledge of what drugs are used and which specific farm tests are needed.

CONCLUDING CONSIDERATIONS

Employee incentives are powerful tools if used correctly and fairly to improve milk quality. Management and employee must become very knowledgeable about the milk quality factor they choose to improve. They can obtain positive results by focusing on one problem at a time and by maintaining crystal clear communications.

CHAPTER 5 REFERENCES AND RECOMMENDED READING

1. This chapter is an update of Milk Quality Incentives (Dairy Incentive Pay 3rd Edition) by Richard H. Bennett. Substantial portions of that chapter where preserved here.

Peters, Tom & Waterman, R. H. *In Search of Excellence*, Harper & Row, 1991.

Guidelines for Effective Installation, Cleaning, and Sanitation of Milking Systems (NDPC2), September 1993, *Northeast Dairy Practices Council*, (315) 449-7547.