The Society for engineering in agricultural, food, and biological systems

Paper Number: 033016
An ASAE Meeting Presentation

Survey of Milk Quality on United States Dairy Farms Utilizing Automatic Milking Systems

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Written for presentation at the
2003 ASAE Annual International Meeting
Sponsored by ASAE
Riviera Hotel and Convention Center
Las Vegas, Nevada, USA
27- 30 July 2003

Abstract. *Milk quality parameters were recorded for United States dairy farms utilizing automatic milking (AM) from August 2000 to June 2003. Additional farms were admitted to the study as they began operation so that the full data set includes 12 AM farms. Somatic cell count (SCC) and total bacterial count (TBC) data was analyzed and compared to corresponding data from conventional farms in Wisconsin as well as data from European AM installations. The geometric mean SCC was 267,670 cells/ml and geometric mean TBC was 13,283 cfu/ml for all U.S. AM farm data collected. The study featured two primary objectives. The first was to assess seasonal variations in milk quality on AM and conventional farms. The second was to assess changes in the quality of milk from AM installations as the amount of time the system had been in operation increased. A clear and significant seasonal effect was evident for the SCC data, with higher values observed during the summer months (July, August, and September). There was no significant difference in SCC between AM farms and conventional farms. There was slight evidence of a seasonal effect on TBC. TBC of milk from AM farms was found to be lower than that from conventional farms. There is some evidence that both SCC and TBC decrease as the amount of time a farm utilizing AM increases.*

Keywords. automatic, milking robots, milking machines, milk production, somatic cell count, total bacterial count

Introduction and Literature Review

The introduction of automatic milking systems is arguably the most significant technological change in the dairy industry since machine milking in the late 19th century. Much like milking machines did for previous generations of farmers, automatic milking systems have the potential to enhance quality of life for the dairyman and his cows, as well as increase milk production and quality.

The number of automatic milking (AM) systems installed throughout the world has increased dramatically in the last five years. In late 1997 just over 100 AM systems were in operation; by early 2003 over 1700 farms were utilizing automatic milking. As these systems proliferate, a key concern is the quality of milk produced and how it compares to that produced with conventional systems. The primary difference between conventional and AM systems is that with AM the dairyman is not likely to be present as each cow is milked. The human eye and judgment can no longer be depended upon to assess the health of the cow and quality of her milk. Instead, the AM system and its array of sensors must be relied on to make these judgments. Additionally, the design of an AM system is so sufficiently different from its conventional counterparts that other aspects of how the system is managed, especially with respect to cleaning, must be rethought.

Because the effects of these differences have not been fully characterized, AM systems do not currently enjoy the same legal status as their conventional counterparts. The United States Food and Drug Administration (FDA) issues the Pasteurized Milk Ordinance (PMO), which establishes rules for the production of milk shipped across state lines in the U.S. Changes to the PMO are proposed, debated, and voted on at the National Conference of Interstate Milk Shippers (NCIMS) (Reinemann et al., 2002). At the 2001 NCIMS, a proposal was submitted to study the impact of AM systems on the quality and safety of the U.S. raw milk supply (28th National Conference, 2001). At the time of that meeting, the PMO had no provisions for AM installations, and U.S. systems were considered "experimental". At the 2003 NCIMS, two years of data from U.S. AM installations had been collected and at that time, changes to the PMO were proposed that would accommodate AM systems (29th National Conference, 2003). Refer to the Appendix for a copy of this proposal. The state delegates voted to endorse those revisions. The FDA is now reviewing the revisions endorsed at the conference and will issue a ruling soon (all revisions are subject to FDA veto).

Recent studies have compared the quality of milk harvested with AM systems to conventional systems. In one such study the somatic cell count (SCC) of cows milked with the AM system was found to be significantly higher than cows milked conventionally, although still in good standing. (Davis and Reinemann, 2002) Two other studies found no significant effect of milking method on SCC (Svennersten-Sjaunja et al., 2000 and Shoshani and Chaffer, 2002).

Objectives

The objective of this study was to assess milk quality on U.S. AM farms. Two specific questions were of interest. The first attempted to assess whether milk quality of AM farms varied with time of year (seasonal variation), and how that data compared to that from conventional farms. The second assessed whether milk quality changed with the amount of time an AM farm had been in operation. Studies presenting data in a format similar to that for the second assessment have been performed in Europe. Europe has larger installation base and longer history with regard to AM.

Materials and Methods

Data Collection

The data set for this study was acquired according to recommendations made at the 28th meeting of the NCIMS. Those recommendations stipulated that standard plate count (SPC) and somatic cell count (SCC) are to be tested for every tank of milk produced on an AM farm. However, in order to maximize the number of farms in the study, some farms were admitted that sampled at less than the recommended frequency, or reported plate loop count (PLC) instead of SPC. In this paper results from either test are referred to as total bacterial count (TBC). The full data set from all AM farms spanned August 2000 to June 2003, although data for that entire period is available for only one farm. Data from other farms was added as they began operation; in total data from twelve farms was collected.

In order to answer the first question a comparison between milk harvested with AM and by conventional means was necessary. SCC and SPC data from all licensed Wisconsin dairy farms producing Grade A milk and not using AM was obtained from the Wisconsin Department of Trade, Agriculture, and Consumer Protection (DATCP). Duplicate SCC or TBC tests on a given day were averaged to yield a single value, and any farms with missing data points were omitted. Although not all of the robotic milking installations included in the study were located in Wisconsin, it was felt that the Wisconsin data would provide for an adequate comparison.

Statistical Methods

Mixed models were used in SAS (SAS Institute, 2001) in an attempt to answer both of the previously defined questions. In all analyses, repeated measures of the milk quality parameter, such as SCC or TBC, were made on the experimental unit of farms. Akaike's Information Criterion (AIC) was considered when choosing a covariance structure; a first order autoregressive correlation was found to be most appropriate for all models. Backwards elimination was used to determine the final statistical models. A logarithmic transformation was used on both SCC and TBC to normalize the distribution of these data.

The first question asked whether time of year or milking method has an effect on milk quality. While only one data point was available per conventional farm per month, multiple data points in a month were often recorded on AM farms. In this case one data point per AM farm, per month, was randomly selected. The data set was reduced to include only a 15 month time window, encompassing January 2002 to March 2003. This allowed the maximum number of farms to be included in the model, while minimizing missing data points due to farms beginning operation during the analysis window. A categorical variable, MC (month count), was defined as the number of months since January 2002. The full model tested was:

$$\textbf{Response} = \mu + \textbf{milking method} + \textbf{MC} + (\textbf{milking method*MC}) + \varepsilon$$

Response = log(SCC) or log(TBC)

μ = population mean of response

milking method = robot or conventional

MC (month count) = 1 to 15

ε = error

The second question asked whether milk quality on AM farms followed a trend as the time a farm has been in operation increases. To answer this question two models were considered. In the first, a categorical variable, DOP (day of operation), was defined as the number of days a farm had been in operation when a data point was recorded. To capture seasonal effects, the month of the year (MOY) was also included in the model. The full model tested was:

$$\textbf{Response} = \mu + \textbf{DOP} + \textbf{MOY} + (\textbf{DOP*MOY}) + \varepsilon$$

Response = log(SCC) or log(TBC)

μ = population mean of response

DOP (day of operation) = days farm has been in operation, 1 to 365

MOY (month of year) = month of the year data was recorded, 1 to 12

ε = error

The second model described the amount of time a farm had been in operation in months by defining another categorical variable, MOP (months of operation). All data points in a given month for each farm were averaged to yield a single measurement for that month. In this way, the effect of extreme response values, as well as model complexity, was reduced. The full model tested in this case was:

$$\textbf{Response} = \mu + \textbf{MOP} + \textbf{MOY} + (\textbf{MOP*MOY}) + \varepsilon$$

Response = log(SCC) or log(TBC)

μ = population mean of response

MOP (month of operation) = months farm has been in operation, 1 to 12

MOY (month of year) = month of the year data was recorded, 1 to 12

ε = error

The data set for the last two models includes only the first 12 months of operation for each farm. There are two reasons for this. First, many of the farms in the study have only been in operation a little more than a year, and for some not even a full year of data is available. The number of AM farms in operation more than 12 months in the U.S. is very small. At the time of this writing, only seven farms had been operating a year or more. Beyond 12 months very little data is available. Second, the goal of this part of the study was to assess initial changes in milk quality; one year was considered sufficient to capture these changes.

Results and Discussion

Descriptive Statistics

A total of 2035 SCC samples and 1658 TBC samples from AM farms were available at the time of this writing. The geometric mean was 267,670 cells/ml and 13,283 cfu/ml for SCC and TBC, respectively.

After preprocessing (averaging multiple daily tests, omitting farms with missing data, including only data from the aforementioned 15 month window) the conventional farm data set included 166,020 samples for both SCC and TBC. The geometric mean SCC was 288,005 cells/ml and geometric mean TBC was 14,767 cfu/ml. For comparison, if only AM data from the 15 month window is included in the calculation the number of SCC samples falls to 1391, with a geometric mean of 254,214 cells/ml. The number of TBC samples is 1148, with geometric mean 12,598 cfu/ml.

Monthly Variation in Milk Quality

For this analysis, conventional farm data was compared to robotic farm data. In order to reduce the number of conventional farms in the study and therefore, model fitting time, a random sample of 200 conventional farms was taken. Additionally, a random monthly response value for the robot farms was chosen, as described earlier. The randomly selected data was then combined and analyzed with the model in SAS. Because a random sample was taken, each run of the model produced slightly different results. It was found that selecting a new random sample of conventional farms caused little variation in model results. Additionally, each random sample of AM farm SCC data produced similar results. However, this was not the case with results from the TBC analysis. The consequences of and possible reasons for these variations are discussed later in the paper.

The month count variable used in this part of the study allows variation in milk quality throughout the year to be examined. Additionally, by including more than one year of data, any evidence of a year-to-year pattern will be revealed. For instance, a previous study found greater incidence of high SCC during the summer months (June to August) (Ruegg and Tabone, 2000). Similar results would be expected for this data, with low SCC in the colder months, such as January (month count = 1 and 13) and higher SCC in the hotter months, such as July (month count = 7).

Somatic Cell Count

The time of year a sample is taken, described in the model by month count, was found to be significant at the $\alpha = 0.05$ level ($p < 0.0001$). Additionally, whether the milk was produced conventionally or with AM did not have a significant effect, nor was there a significant interaction effect. As stated previously, the random sampling in the analysis causes slightly different results each time the model is run. In this case the p-value remained unchanged between runs, although the least squares means are slightly different. LS means for five runs of the model are shown in figure 1. An increase in SCC during July, August, and September (the hotter summer months) is obvious, with lower values observed during other months of the year.

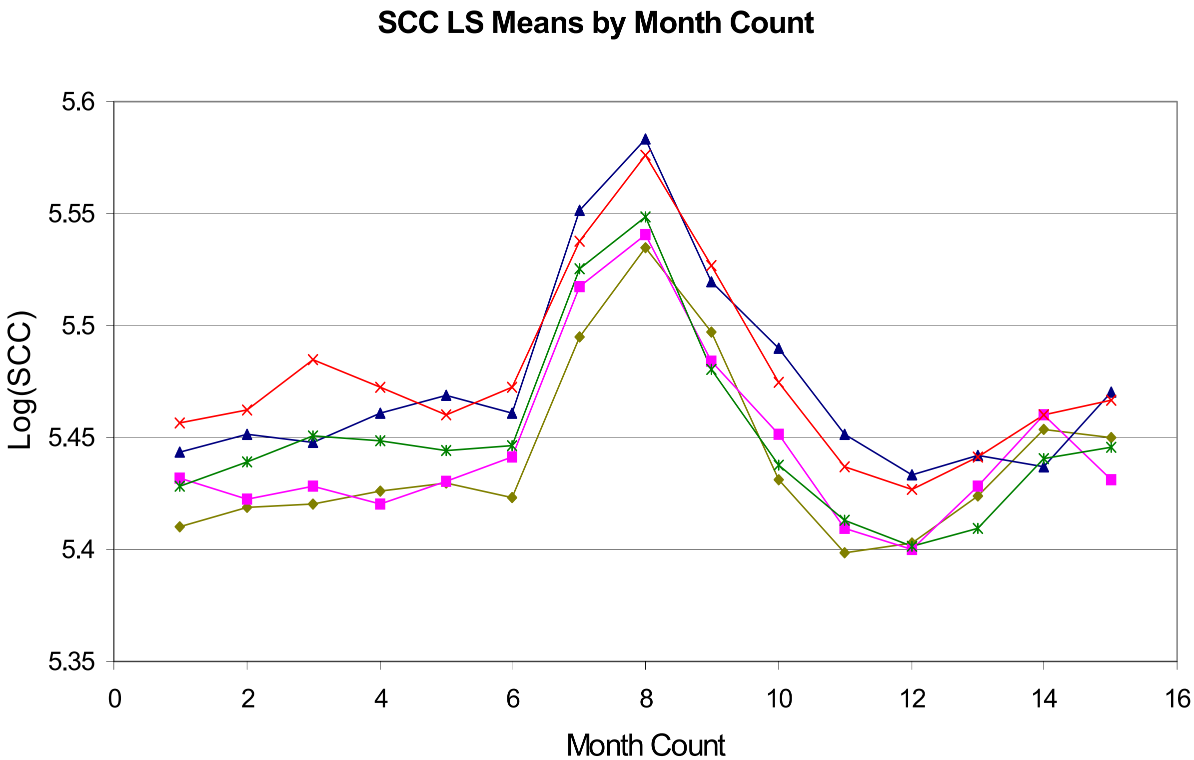

Figure 1. Graph of Log(SCC) versus months of the year, with month count 1 = January 2002, month count 2 = February 2002, … , month count 13 = January 2003, etc. Five runs of the model are shown, with slightly different results (although exhibiting a similar trend) for each run.

Total Bacteria Count

As mentioned previously, analyzing the TBC data for seasonal variation yielded somewhat different results each time the model was run. In four of ten runs, the interaction between month count and milking method was significant. With the interaction term removed from the model, in four of five runs, month count was found to be significant, with milking method being found significant in all five runs. In each run, the LS mean TBC for AM farms (average between runs 3.9 (8200 CFU/ml)) was slightly lower than that for conventional farms (average between runs 4.2 (15,000 CFU/ml)). TBC LS means plotted versus month count for the five runs are shown in figure 2.

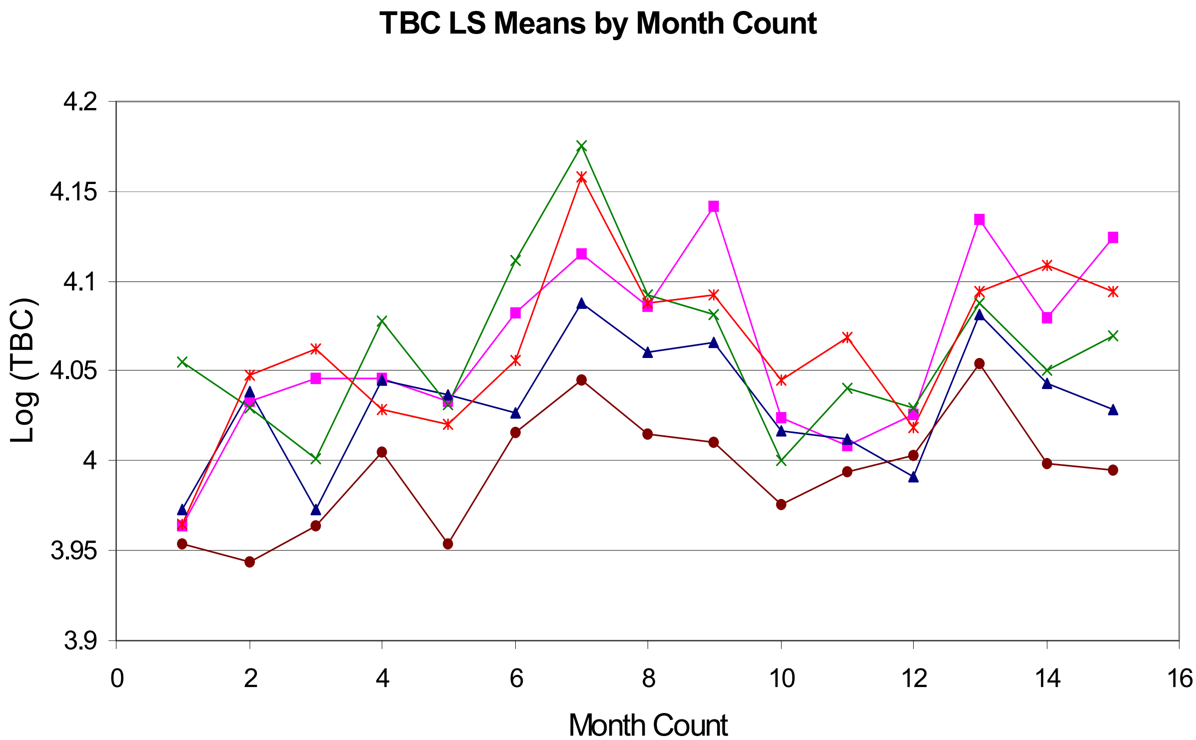

Figure 2. Plot of Log(TBC) versus month count.

Although month count was significant in four of the five runs, there is no obvious trend in the LS means values. There is a slight increase in log(TBC) during the summer months; however, the trend is not nearly as clear as that for the SCC data. The variation between model runs is partially explained by previous studies, which have shown TBC data to be characterized by sudden elevations known as “spikes” (Hayes, et al., 2001). Each run of the model includes a different random sample of the TBC data; if a random sample included a spike in a particular month, the least squares mean for that month may be quite different than in a run of the model which did not capture the spike. Due to the variation between runs, it is difficult to draw any definitive conclusions about the interaction term in the model. However, it appears that there is some evidence of seasonal variation in TBC. It is also reasonable to conclude that AM farms are capable of producing milk with equal or lower TBC than conventional farms.

Milk Quality Variation with Duration of AM Farm Operation

For this analysis the data is reported according to how long a farm has been in operation. For example, the first month on the following graphs represents data from the first month of operation for all farms regardless of calendar month. The goal of this analysis was to determine if milk quality changed with operating duration on an AM farm. One hypothesis was that milk quality would improve with time as the dairyman refined his management practices for the automatic milking system.

Somatic Cell Count

The second and third statistical models presented are intended to seek out "trends of improvement" in the AM farm data. In the first of those two models, DOP was found to be significant ($p = 0.0001$). MOY is not significant at the $\alpha = 0.05$ level ($p = 0.0512$). Substituting MOP for DOP as the operating duration variable results in a model with no significant terms. However, it is worth noting that if farms in operation for eight or less months are excluded from the analysis, MOY is found to be a significant term in both models. This is not a surprising result, as the first model presented in this paper revealed seasonal variation as having a significant effect on SCC.

With reference to the model with a significant DOP effect, LS means values for log(SCC) can be plotted to examine any trends present in the data. Refer to figure 3 for this plot. Also shown on the graph is Monthly Mean, which represents a geometric average of all tanks from all farms for each month of operation. The errors bars show deviations of ± 2 standard deviations from the mean. The raw log(SCC) data points and the US legal limit for SCC (750,000 cells/ml = 5.9 after log transformation) are shown as well (Grade "A" Pasteurized Milk Ordinance, 2001). Examining the LS mean values reveals a slight downward trend in the data; however, the significance of DOP in the model is likely due to the relatively great day to day variation or differences due to extreme LS mean values. Therefore, although there is some evidence of a "trend of improvement" in the SCC data, the change is minimal and occurs over a relatively long period of time.

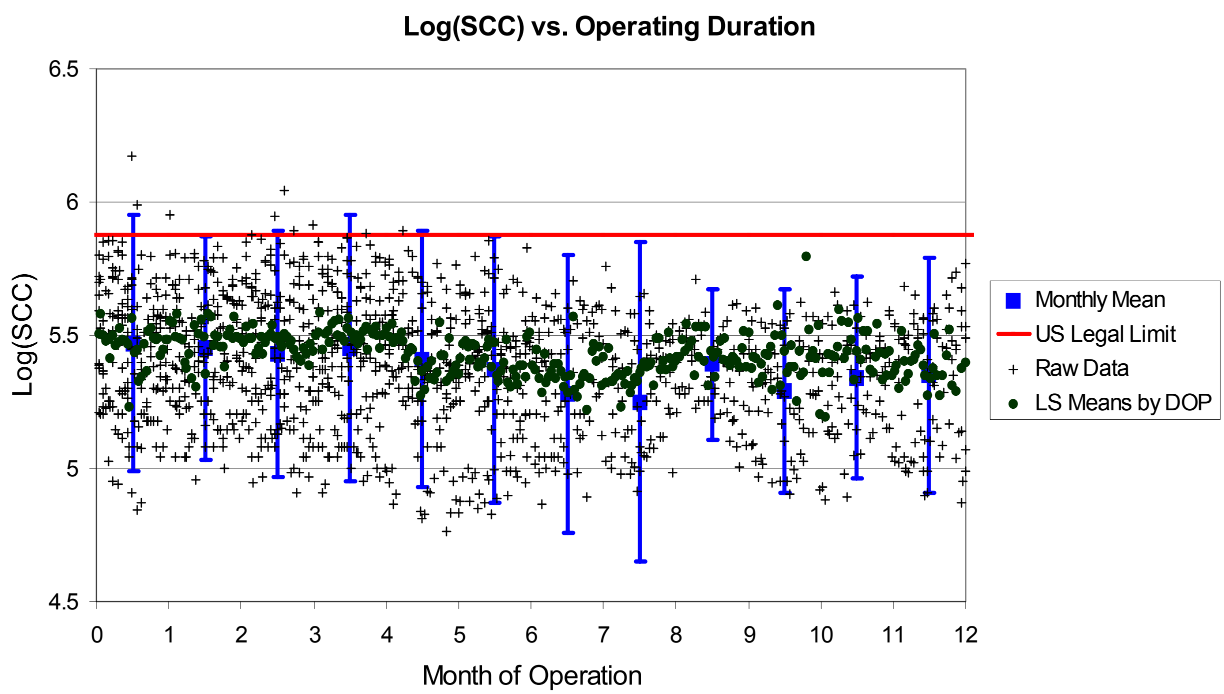

Figure 3. Log(SCC) plotted versus the length of time the farm has been in operation.

Calculating the percentages of milk tanks that test over certain thresholds is another useful way to examine the data. For SCC, two thresholds were established: 750,000 cells/ml and 400,000 cells/ml, the U.S. and European legal limits, respectively. Table 1 presents the number of tanks sampled and the percent of those tanks exceeding each threshold.

Table 1. Percentages of tanks over thresholds for SCC.

Month of operation	1	2	3	4	5	6	7	8	9	10	11	12
Total tanks sampled	131	160	164	169	152	143	110	86	64	78	80	73
% > 400,000 cells/ml	29	24	29	30	20	17	13	6	5	5	1	10
% > 750,000 cells/ml	2	1	1	1	1	0	0	0	0	0	0	0

The number of tanks sampled decreases with time because some farms included in the study have been in operation for less than a year. It is first notable that a very small percentage of farms with AM systems produce milk that exceeds the U.S. legal limit for SCC. Additionally, this percentage shrinks to zero as the length of time the farm has been in operation increases. As expected, a greater number of U.S. farms exceed the lower European threshold. For instance, during the first four months of operation nearly 30% of all tanks sampled had somatic cell counts greater than 400,000 cells/ml. However, over time these percentages are observed to decrease to approximately 5% during the last four of the twelve months considered.

These observations are consistent with European findings. A study was conducted of milk quality data spanning February 2001 to October 2001 from AM systems in Denmark, Germany, and The Netherlands. The European data shows a similar milk decrease in SCC as the duration of operation for the AM farms increases. Also, although month-to-month data is not available for the European farms, percentages of tank samples with SCC greater than 400,000 cells/ml in Denmark, Germany, and The Netherlands were 11.1%, 9.3%, and 5.5%, respectively (van der Vorst, et al. 2002).

A comparison can also be made to Wisconsin conventional farms. In that data set, 30.1% and 3.3% of all samples tested for SCC exceeded the 400,000 cells/ml and 750,000 cells/ml thresholds, respectively. With regard to somatic cell count, U.S. AM farms are producing, or have the potential to produce, milk of similar quality to that produced conventionally in the US and with AM in Europe.

Total Bacteria Count

TBC data was analyzed in a manner identical to that of the SCC data. The data was modeled with DOP and MOY as well as MOP and MOY. The models were run with data from all farms as well as a data set that excluded farms with eight or less months of operation. In only one of those four cases was a model found with a significant term. Using a data set that excluded the aforementioned farms, MOP was found to be significant ($p = 0.0318$). However, as with the SCC data, when the LS mean values are plotted no clear "trend of improvement" is evident.

LS mean values by MOP are shown in figure 4. As with the SCC data, the Monthly Mean values and legal limit for TBC (100,000 cfu/ml = 5.0 after log transformation) is shown (Grade "A" Pasteurized Milk Ordinance, 2001). Once again, a very slight downward trend may be present in the data set.

It is notable that the maximum raw value for each month is attributed to a variety of farms; there is not a single "problem farm." Also, the reason for an extremely high bacteria count is often a cleaning system failure, such as a hose that became detached or pinched.

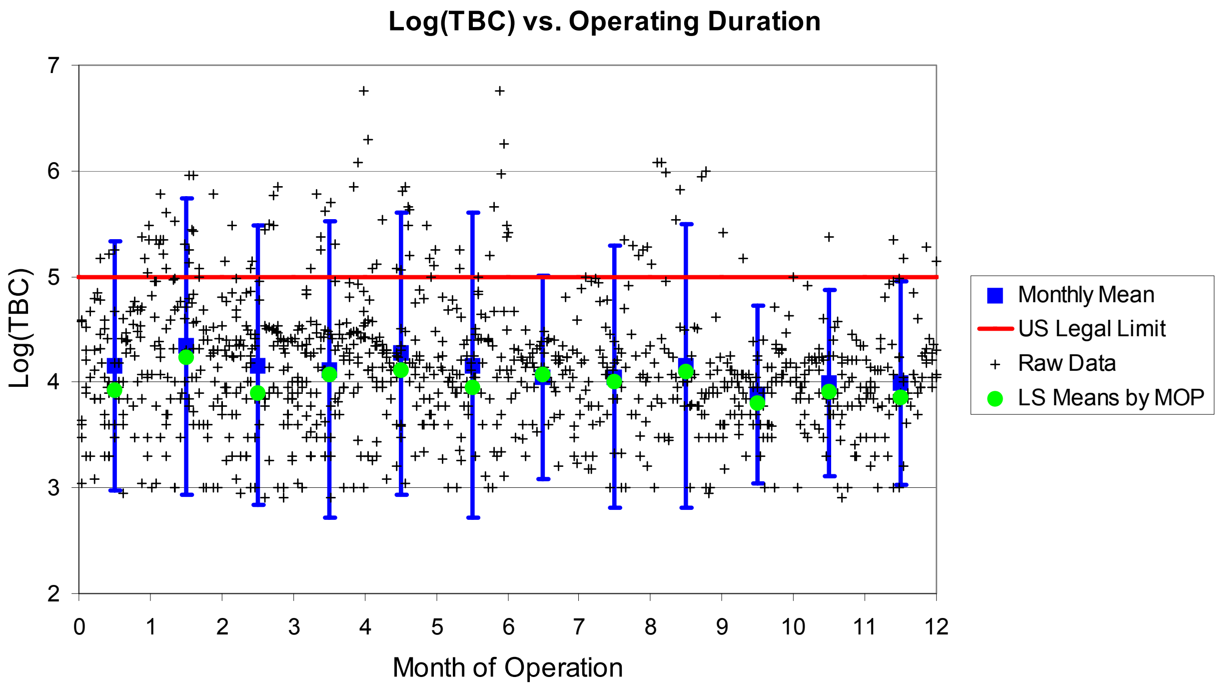

Figure 4. Log(TBC) plotted versus the length of time the farm has been in operation.

Similar to SCC, the percentages of tanks testing greater than certain thresholds for TBC were calculated, with results shown in table 2. Two thresholds were again used: 30,000 cfu/ml and 100,000 cfu/ml, the latter being the legal limit for TBC in both the United States and Europe. Once again, the incidence of tanks exceeding both thresholds decreases with the amount of time the AM system has been in operation.

Table 2. Percentages of tanks over thresholds for TBC.

Month of operation	1	2	3	4	5	6	7	8	9	10	11	12
Total tanks sampled	76	102	115	125	112	94	80	74	64	79	79	68
% > 30,000 cfu/ml	34	38	27	22	26	27	11	22	20	3	8	12
% > 100,000 cfu/ml	8	18	9	10	14	10	4	7	9	3	3	3

Comparisons can again be made with the European study. In that study, a gradual decline in mean TBC is observed, with an average value of about 4.2 (15,000 cfu/ml) one year after introduction of the system. Also, in Denmark, Germany, and The Netherlands 2.5%, 7.7%, and 2.8% of tanks sampled during the study exceeded the 100,000 cfu/ml threshold (van der Vorst, et al. 2002). In the Wisconsin data set, 10.5% of samples taken exceeded the lower TBC threshold, while 1.9% exceeded the higher threshold. Again, values for US AM and conventional farms, as well as European AM farms, are comparable.

Conclusion

The results of this study provide insight into the quality of milk produced with automatic milking systems. Two milk quality parameters were investigated: somatic cell count (SCC) and total bacterial count (TBC). The study found strong evidence of a seasonal variation in SCC, with higher SCC associated with the summer months. The data revealed some evidence of a decrease in SCC as the operating duration of an AM farm increased. There was no significant difference in SCC between AM farms and conventional farms. With respect to TBC, there was some evidence of a significant seasonal effect as well as a decrease in TBC as operation duration increased. TBC of milk from AM farms was found to be significantly lower than that from conventional farms.

Acknowledgements

This research was funded by a USDA Hatch grant.

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Appendix

29th NATIONAL CONFERENCE ON INTERSTATE MILK SHIPMENTS

Proposal #:	103
Committee:	

	No Action	Passed as Submitted	Passed as Amended
COUNCIL ACTION			
FINAL ACTION			

A. Proposal

To revise the PMO by adding Definitions, text and an appendix to address the technology of automatic milking of lactating animals.

B. Reason for the Submission

Through passage of proposal 146 at the 2001 NCIMS, a steering committee was established to monitor milk quality of farms using automatic milking installations. After studying these systems the committee has compiled the changes needed in the PMO.

C. Public Health Significance and Rationale Supporting the Submission

This proposal would give automatic milking installations the same requirements already in the PMO for conventional milking systems. There is no public health significance to the approval of this proposal.

D. Proposed Solution

Changes to be made on page(s):		1, 17-21, 23, 33, 99	of the (X - one of the following):		
X	2001 PMO,		1995 EML,		2001 MMSR,
	1995 DMO,		2001 Procedures,		2400 Forms,
	2001 Constitution and Bylaws				

Proposed additions in **boldface**

REVISIONS

SECTION 1. DEFINITIONS

Terms used in this document, not specifically defined herein, are those within Title 21, *Code of Federal Regulations* (CFR) and/or the *Federal Food, Drug, and Cosmetic Act* (FFD&CA) as amended.

The following additional definitions shall apply in the interpretation and the enforcement of this *Ordinance*:

Abnormalities of Milk:

- **Abnormal milk: Milk that is visibly changed in color, odor and/or texture.**

- **Undesirable milk: Milk which, prior to the milking of the animal, is known to be unsuitable for sale, such as colostrum.**

- **Contaminated milk: Milk, that is unsaleable or unfit for human consumption following treatment of the animal with veterinary products, e.g. antibiotics which have withhold requirements, or treatment with medicines or insecticides not approved for use on dairy animals by the U.S. Food and Drug Administration (FDA) or the Environmental Protection Agency (EPA).**

Automatic Milking Installation (AMI): The term automatic milking installation covers the entire installation of one or more automatic milking units including the hardware and software utilized in the operation of individual automatic milking units, the animal selection system, the automatic milking machine, the milk cooling system, the system for cleaning and sanitizing the automatic milking unit, the teat cleaning system, and the alarm systems associated with the process of milking, cooling, cleaning and sanitation.

Clean: Direct product contact surfaces that have had the effective and thorough removal of product and/or contaminants.

SECTION 6. THE EXAMINATION OF MILK AND MILK PRODUCTS

ADMINISTRATIVE PROCEDURES

LABORATORY TECHNIQUES:

5. Screening and Confirmatory Methods for the Detection of ~~**Abnormal**~~ **Undesirable** Milk: The results of the screening test or confirmatory test shall be recorded on the official records of the dairy farm and a copy of the results sent to the milk producer.

STANDARDS FOR GRADE “A” RAW MILK FOR PASTEURIZATION, ULTRA-PASTEURIZATION OR ASEPTIC PROCESSING

ITEM 1r. ABNORMAL MILK

Lactating animals which show evidence of the secretion of ~~**abnormal**~~ milk **with abnormalities** in one (1) or more quarters, based upon bacteriological, chemical or physical examination, shall be milked last or with separate equipment and the milk shall be discarded. Lactating animals **producing contaminated milk, that is,** lactating animals which **have been** treated with, or ~~**lactating animals which**~~ have consumed chemical, medicinal or radioactive agents, which are capable of being secreted in the milk and which, in the judgment of the Regulatory Agency, may be deleterious to human health, shall be milked last or with separate equipment and the milk disposed of as the Regulatory Agency may direct. **(For applicability to automatic milking installations see Appendix R).**

PUBLIC HEALTH REASON

The health of lactating animals is a very important consideration because a number of diseases of lactating animals, including salmonellosis, staphylococcal infection and streptococcal infection, may be transmitted to man through the medium of milk. The organisms of most of these diseases may get into the milk either directly from the udder or indirectly through infected body discharges which may drop, splash or be blown into the milk.

Bovine mastitis is an inflammatory and, generally, highly communicable disease of the bovine udder. Usually, the inciting organism is a streptococcus of bovine origin (type B), but a staphylococcus or other infectious agent often causes the disease. Occasionally lactating animal's udders become infected with hemolytic streptococci of human origin, which may result in milkborne epidemics of scarlet fever or septic sore throat. The toxins of staphylococci and possibly other organisms in milk may cause severe gastroenteritis. Some of these toxins are not destroyed by pasteurization.

ADMINISTRATIVE PROCEDURES

This Item is deemed to be satisfied when:

1. Milk from lactating animals being treated with medicinal agents, which are capable of being secreted in the milk, is not offered for sale for such a period as is recommended by the attending veterinarian or as indicated on the package label of the medicinal agent.

2. Milk from lactating animals treated with or exposed to insecticides, not approved for use on dairy animals by the U.S. Environmental Protection Agency, (EPA) is not offered for sale.

3. The Regulatory Agency requires such additional tests for the detection of ~~**abnormal**~~ **milk with abnormalities**, as they deem necessary.

4. Bloody, stringy, off-colored milk, or milk that is abnormal to sight or odor, is so handled and disposed of as to preclude the infection of other lactating animals and the contamination of milk utensils.

5. Lactating animals secreting ~~**abnormal**~~ milk **with abnormalities** are milked last or in separate equipment, which effectively prevents the contamination of the wholesome supply. ~~**Abnormal m**~~ **M**ilking equipment **used on animals with abnormalities in their milk** is maintained clean to reduce the possibility of re-infecting or cross infection of the dairy animals.

6. Equipment, utensils and containers used for the handling of ~~**abnormal**~~ **milk with abnormalities** are not used for the handling of milk to be offered for sale, unless they are first cleaned and effectively sanitized.

7. Processed animal waste derivatives, used as a feed ingredient for any portion of the total ration of the lactating dairy animal, have been:

    a. Properly processed in accordance with at least those requirements contained in the Model Regulations for Processed Animal Wastes developed by the Association of American Feed Control Officials; and

    b. Do not contain levels of deleterious substances, harmful pathogenic organisms or other toxic substances, which are secreted in the milk at any level, which may be deleterious to human health.

8. Unprocessed poultry litter and unprocessed recycled animal body discharges are not fed to lactating dairy animals.

ITEM 2r. MILKING BARN, STABLE OR PARLOR - CONSTRUCTION

A milking barn, stable or parlor shall be provided on all dairy farms in which the milking herd shall be housed during milking time operations. **(For applicability to automatic milking installations see Appendix R).** The areas used for milking purposes shall:

ITEM 3r. MILKING BARN, STABLE OR PARLOR - CLEANLINESS

The interior shall be kept clean. Floors, walls, ceilings, windows, pipelines and equipment shall be free of filth and/or litter and shall be clean. Swine and fowl shall be kept out of the milking area. Feed shall be stored in a manner that will not increase the dust content of the air or interfere with the cleaning of the floor. Surcingles, or belly straps, milk stools and antikickers shall be kept clean and stored above the floor. **(For applicability to automatic milking installations see Appendix R).**

ITEM 9r. UTENSILS AND EQUIPMENT - CONSTRUCTION

ADMINISTRATIVE PROCEDURES

This Item is deemed to be satisfied when:

13. Automatic milking installations shall comply with all applicable PMO requirements and/or 3A standards.

APPENDIX A. ANIMAL DISEASE CONTROL

Sanitarians may find the screening test a useful device for detecting ~~**abnormal**~~ **undesirable** milk. Sample screening methods, as well as somatic cell diagnosis and reduction programs are discussed in the references above as well as the Dairy Practices Council, 51 East Front Street, Suite 2, Keyport NJ 07735 publication: *The Field Person's Guide to Troubleshooting High Somatic Cell Counts*.

Regulatory action should not be based on the use of mastitis screening tests alone. Screening tests should be used as an adjunct to a complete program of mastitis control and milking-time inspections.

Appendix R. Operation of Automatic Milking Installations for the Production of Grade A Raw Milk for Pasteurization

This Appendix is intended to clarify how automatic milking installations are to perform to be considered in compliance with the PMO. It is formatted to follow the Items as outlined in "STANDARDS FOR GRADE "A" RAW MILK FOR PASTEURIZATION, ULTRA-PASTEURIZATION OR ASEPTIC PROCESSING. Both requirements and recommendations are discussed.

Item 1r, Abnormal Milk:

Automatic milking installations shall have the capability to identify and discard milk from animals that are producing milk with abnormalities. Odor is currently evaluated on a bulk tank basis and should be no different for a herd using automatic milking installation technology.

Animals producing milk with abnormalities shall be diverted to a holding pen to be milked immediately prior to the system being cleaned. An alternative would be to have the system clean the parts of the milking system that came into contact with the milk with abnormalities after any animal producing milk with any abnormality used the system.

Item 2r: MILKING BARN, STABLE OR PARLOR - CONSTRUCTION

The automatic milking installation milker box shall be treated the same as any other parlor. The goal is a clean environment in which to milk animals. All ventilation air must come from outside the cattle housing area.

ITEM 3r. MILKING BARN, STABLE OR PARLOR – CLEANLINESS

The milker box shall be kept as clean as any milking and equipment cleaning area. It is recommended that the milking platform be regularly flushed with water to remove any manure that may have accumulated.

ITEM 9r. UTENSILS AND EQUIPMENT - CONSTRUCTION

Automatic milking installations are the same as any other milking system from a sanitary construction standpoint and shall meet the same standards as a conventional milking system in respect to fit and finish of the milk contact surfaces.

ITEM 10r. UTENSILS AND EQUIPMENT – CLEANING

Automatic milking installations are a continuous milking system and shall be shut down to clean at an interval sufficient to prevent the milking system from building up with soils. It is recommended that this interval not to exceed 8 hours.

ITEM 11r. UTENSILS AND EQUIPMENT – SANITIZATION

Automatic milking installations shall be sanitized after each cleaning and before each use, as is the case with any other milking system.

ITEM 12r. UTENSILS AND EQUIPMENT – STORAGE

Automatic milking installations shall have positive air ventilation systems in operation whenever the system is cleaning. The air for this system must come from outside the cattle housing area and should be as clean and dry as practical. This positive air system may also need to run during milking if needed to minimize odor, moisture and/or for pest control.

ITEM 13r. MILKING - FLANKS, UDDERS AND TEATS

Automatic milking installation manufacturers shall submit data to FDA to show that the teat prepping system employed in their system is equivalent to "Teats shall be treated with a sanitizing solution just prior to the time of milking and shall be dry before milking." This provision is under 13r Administrative Procedures, Item 4. Each installer shall provide the producer and the regulatory agency with a copy of this approval including a detailed description of the approved procedure. Each producer shall keep a copy on file at the farm.

ITEM 14r. PROTECTION FROM CONTAMINATION

The teat cups of the milking cluster need to be adequately shielded during the udder prepping process to assure that contaminants may not enter through the teat cup and get into the milk.

Automatic milking installations are designed to automatically shift from milk to wash, therefore adequate separation of milk and CIP solution shall be provided to minimize the risk of cross contamination of milk with cleaning and sanitizing solutions. A failsafe valve system equivalent to an inter-wired block-and-bleed (as referenced in STANDARDS FOR GRADE "A" PASTEURIZED, ULTRA-PASTEURIZED AND ASEPTICALLY PROCESSED MILK AND MILK PRODUCTS" item15p) shall be located as needed to prevent cross contamination. Separation shall be provided between, milk with abnormalities and milk intended for sale, and between cleaning/sanitizing solutions and milk intended for sale.

Automatic milking installations, which have a pipe into the wash vat that is continuously connected to the system, shall have a valving system that provides for an air break equal to the diameter of the wash line.

ITEM 18r. RAW MILK COOLING

For automatic milking installations the raw milk for pasteurization shall be cooled to 10ºC (50ºF) within 4 hours or less after starting the milking operation and the milk shall be cooled within two more hours to 7ºC (45ºF). The bulk milk storage tank temperature should not exceed 7ºC (45ºF) after that point. Bulk milk tank recording thermometers are recommended.

E. Rationale of Proposed Solution

These revisions are necessary to the continuous adaptation of technology for the dairy industry.

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