UDDER HEALTH AND MILK QUALITY ON ONTARIO DAIRY FARMS UTILIZING VOLUNTARY MILKING SYSTEMS

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Introduction

Voluntary (robotic) milking systems (VMS) have been used on commercial dairy farms in Europe since 1992. Recently, these systems have been introduced in Canada. There may be as many as a thirty farms across Canada utilising VMS by the end of 2001. While there are many documented advantages of VMS, especially for the family operated 100-150 cow dairy farm, there are also some potential concerns. Chief among the concerns are issues related to milk quality and udder health. Reports from the Netherlands and Denmark have suggested that bulk milk somatic cell counts have increased after introduction of VMS (2,4,6). Further, given the random milking order and variable application of post-milking teat disinfectants, there is a potential for cow-to-cow spread of contagious pathogens such as *Staph. aureus*, an infection which is present in low numbers on most dairy farms(1,3,5). The goals of this project are to assess the milk quality and udder health on farms using VMS, and to compare the milk quality and mastitis indicators to a control group of similar farms, not using VMS. This report includes the initial descriptive detail and statistical analysis of the milk quality data collected in Ontario since July 1999.

Materials and Methods

Fifteen Ontario farms using VMS were identified and, based on their milk production and herd size, were each matched to 2 control herds. Since most of the robotic milking systems have been installed in free-stall facilities, the sampling frame from which to select control farms was restricted to the approximately 1,000 known free-stall farms in the province. Milk quality data, including bulk tank somatic cell count (BTSCC), bacteria count (in Bactoscan units) and freezing point, were collected for the 23-month period from July 1999 (the month in which the first VMS system was installed in Ontario) to May 2001. While a bulk tank milk sample is collected from each of Ontario's approximately 6,300 dairy farms at each pick-up (every other day), not all samples are tested for regulatory purposes. Somatic cell and freezing point (for added water) determinations are made weekly, so that weekly data were available for analysis. Bacteria counts are performed only once a month, using the Foss Bactoscan bacteria counting system, so the analysis was based on monthly observations.

The data were analysed using repeated measures models with an auto-regressive error structure over time for each herd. All models included a random herd effect and a time component (either week or month). Bactoscan and SCC outcome variables were log transformed to satisfy the assumption of normality.

Results and Discussion

Initial statistical analysis of the SCC data suggested that there was considerable variability in the cell counts in the VMS herds during the first 33 weeks following introduction of the VMS to the herd. Since all of the control herds were established herds, and it was hypothesized that at least some of the initial variation might be due to short term problems encountered during "start-up" of the new facilities, data from the first 33 weeks of milking in VMS herds were excluded from the analysis.

In table 1, monthly SCC, Bactoscan and freezing point results for robotic milking herds are compared to results of the 30 control herds. Data prior to April 2000 are based on less than 5 robotic herds and are not included in the table. The data presented in table 1 exclude all SCC determinations from the first 33 weeks of robotic milking.

Table 1. Monthly Milk Quality of Ontario VMS herds compared to 30 control dairy herds.

Month	Number of Herds		Average SCC (x1'000 cells/ml)		Average Bactoscan		Average Freeezing Point	
	VMS	Control	VMS	Control	VMS	Control	VMS	Control
04-'00	7	30	*	208	34	18	-0.537	-0.543
05-'00	7	30	*	209	93	21	-0.538	-0.543
06-'00	7	30	*	244	42	118	-0.542	-0.538
07-'00	10	30	*	257	119	24	-0.543	-0.538
08-'00	10	30	*	261	359	22	-0.544	-0.539
09-'00	12	30	289	253	111	85	-0.545	-0.538
10-'00	13	30	240	220	53	46	-0.545	-0.538
11-'00	13	30	219	221	87	37	-0.544	-0.539
12-'00	13	30	264	196	36	20	-0.545	-0.539
01-'01	14	30	298	189	89	33	-0.544	-0.536
02-'01	14	30	285	183	27	72	-0.543	-0.534
03-'01	14	30	267	198	54	31	-0.543	-0.533
04-'01	14	30	253	189	32	32	-0.543	-0.535
05-'01	14	30	266	204	193	70	-0.544	-0.536

* Fewer than 4 VMS herds had exceeded the initial 33-week period after installation.

Even after allowing a 33-week adjustment period, Ontario robotic milking herds have significantly higher SCC's than do the control herds (Table 2 and Figure 1). Given that SCC test results above 500,000 cells/ml of milk are considered to be in the penalty range, approximately 7% of the weekly tests for VMS herds exceeded the penalty level (17 of 252), while only 1% of the weekly tests for the control herds exceeded this level (13 of 1075). It is interesting to note that while the VMS herds had higher SCC's than the control herds, their mean SCC was similar to the overall mean for all herds in the province during the same time period. This may suggest that while larger free-stall herds (the group to which the VMS herds belong and from which the control herds were selected) tend to have lower SCC's than other dairy herds in the province, the VMS herds are not able to achieve the same consistently low SCC levels. The reason for the slight elevation in SCC in VMS herds is not clear. Cow data pertaining to udder health (individual cow SCC's, clinical case records and milk bacteriological culture results) were not available to determine the infection status of cows in these herds. In terms of recommended milking management practices and equipment design, robotic systems appear to do some things better, and others not as well as conventional milking parlors. Robotic systems rinse inflations between cows and several types do not use a milk claw. This reduces the risk of cross contamination between quarters. Detaching milk cups from quarters individually when milk flow stops may improve teat condition and reduce the risk of new infections. Diversion of abnormal milk from clinically infected quarters is only possible if the affected quarter is identified and the diversion is programmed into the system software. Application of post-milking teat disinfectant by an automatic teat spray appears to be less thorough than manual dipping. In robotic systems it is not possible to milk infected cows last.

Analysis of the bacteria content of bulk milk indicates that VMS herds have bacteria counts significantly higher than the control herds (Table 2). For VMS herds, 13% of the official monthly bacteria tests (21 of 164) were in the penalty range (exceeding 109 Bactoscan units). This is higher than the 3% (13 of 420) high counts experienced by the control herds. No comparison has been made to other types of new milking equipment installations. It is conceivable that more frequent penalty level results may be characteristic of the break-in period for all new equipment. Based on producer interviews, specific causes for some of the high bacteria counts experienced by the VMS herds included: compressor problems in the buffer tank, poor automatic washing of the main bulk tank, failure to clean milk lines to an unused milking stall, mechanical failure of a soap dispensing mechanism, mechanical failure of an internal water heater, poor alignment of cups during the wash cycle, and the use of non-potable water. Not all high counts could be attributed to a single cause. General observations pertaining to the cleanliness of stalls and manure contamination of udders, suggests that clean barns and clean cows are important on all farms, but especially so with robotic milking.

Analysis of the freezing point data suggests that VMS herds have a higher average freezing point than the control herds (Table 2 and Figure 2). On a individual test basis, 4% of VMS herd samples tested (25 of 662) exceeded the penalty level of –0.525, while only 1 of 1,674 control herd samples exceeded this limit. The elevation in freezing point is probably the result of minute amounts of water remaining in the system following the frequent rinsing of the claw and milking equipment. The elevations in freezing point were not great enough to suggest that major issues, such as failure of automatic valves and cleaning systems, were the cause.

Table 2. Least squares means for milk quality parameters as generated by repeated measures analysis comparing VMS herds to control herds.

Milk Quality Characteristic	Least Squares Mean for VMS Herds	Least Squares Mean for Control Herds	P-value
SCC (x 1,000 cells/ml)	255	194	0.049
Freezing Point	-0.535	-0.543	0.0001
Bacteria (Bactoscan units)	41	19	0.0003

Figure 1. Weekly average SCC for VMS herds (following an initial 33-week start-up period) compared to 30 control herds from July 1999 to May 2001.

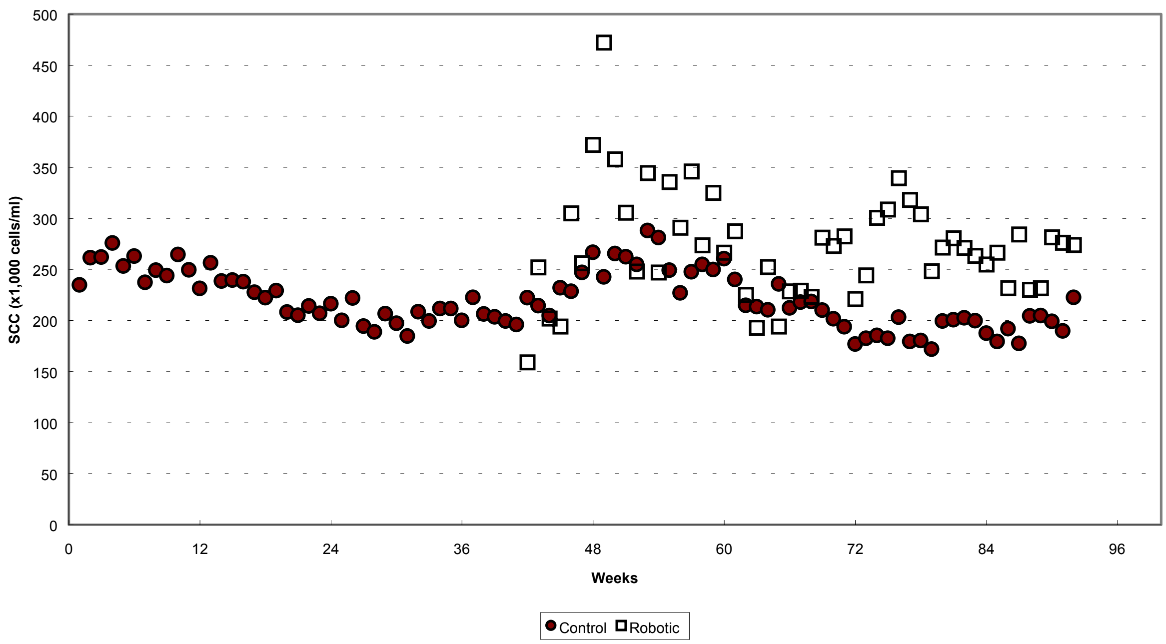
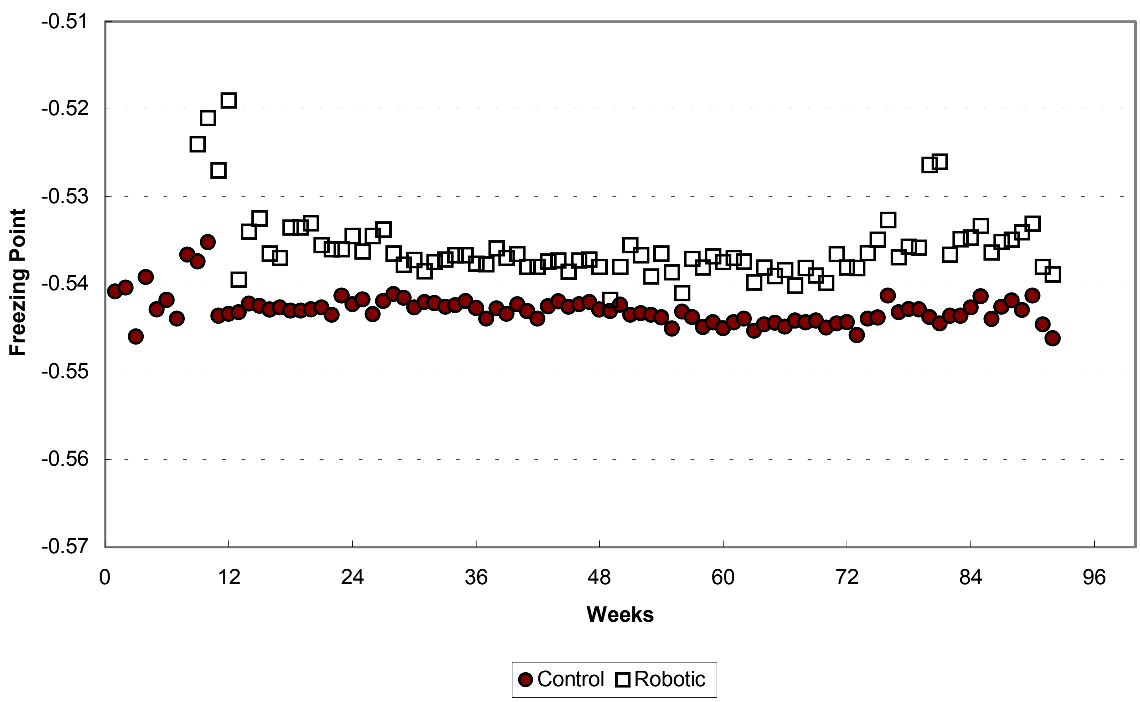


Figure 2. Weekly average freezing point for VMS herds compared to 30 control herds from July 1999 to May 2001.



Milk quality remains a concern among the manufacturers, users and regulators of robotic milking systems. In Ontario, the Dairy Farmers of Ontario (DFO), the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and the companies marketing and planning to market robotic milking systems have worked together to develop installation and operating guidelines for robotic milking systems. These guidelines address many of the milk quality concerns which arise from this new approach to milking cows. The guidelines, now in their final draft, are being followed by all suppliers and herd owners on a voluntary basis. After the industry gains more experience with these systems they will be incorporated into provincial milk quality regulations. Many of these guidelines are equally appropriate for other milking systems and are under discussion as possible new standards for all farms.

Summary

Based on the analysis of the data presented here, there is evidence that milk from herds using VMS has higher somatic cell counts, has higher bacteria counts and contains more water than milk from comparably sized free-stall herds using conventional milking parlors. These observations are based on a relatively small number of farms, yet they are consistent with published reports from several European countries. Ongoing investigations will endeavor to identify and resolve the causes of these problems.

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