A Research Note

Effect of Low-Temperature Cleaning of Milking Equipment on the Microbiological Quality of Raw Milk

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ABSTRACT

Effect on the microbiological quality of milk of using a special cleaning detergent (Diversey-Wyandotte, Inc.) for low-temperature (initial 43.8°C, end of wash 35.4°C) washing in a milking parlor pipeline system was compared to regular high-temperature (initial 73°C, end of wash 43.8°C) wash of the system. Microbiological quality of the milk was determined by standard plate count (SPC) and psychrotrophic bacterial count (PBC). Cleanliness of equipment was evaluated by measurement of calcium deposits and visual inspection. Statistical analysis of data over time (June 5 to September 16, 1980) indicated no difference in SPC and PBC of milk between low- and high-temperature washing and, although there was a significant negative slope of PBC with time, this was due to factors other than treatment. Calcium soil deposition and visible evaluation of the equipment were not different for the wash temperatures.

A significant cost factor in maintaining clean milking equipment is the energy required to heat water for cleaning solutions. One recently devised means for conserving electrical energy is the use of heat reclaimers which recover waste heat from milk tank refrigeration units for heating water. Another approach to reducing energy requirements is the formulation of cleaning compounds that will do an efficient job of cleaning equipment at low temperatures. Palmer and O'Shea (8) reported satisfactory cold-circulation cleaning of pipeline milking systems using a caustic-based detergent solution containing sequestrant and wetting agent. Bigalke (3) made field studies of chlorinated alkaline cleaners that were readily available and successfully used at 60°C. Bradley (4) conducted on-farm studies of a chlorinated alkaline cleaner that was readily available and used at 40.6°C. Bradley (4) conducted on-farm studies of a chlorinated alkaline cleaner that was readily available and used at 40.6°C. Bradley (4) conducted on-farm studies of a chlorinated alkaline cleaner that was readily available and used at 40.6°C. Bradley (4) conducted on-farm studies of a chlorinated alkaline cleaner that was readily available and used at 40.6°C. Bradley (4) conducted on-farm studies of a chlorinated alkaline cleaner that was readily available and used at 40.6°C. Bradley (4) conducted on-farm studies of a chlorinated alkaline cleaner that was readily available and used at 40.6°C.

The purpose of this investigation was to compare the efficacy of a liquid chlorinated alkaline detergent (CD-006-4) formulated by Diversey-Wyandotte, Inc. for low-temperature circulation cleaning with that of the present high-temperature cleaning routine used at the University of Guelph Dairy Cattle Research Centre at Elora, Ontario.

MATERIALS AND METHODS

The milking systems at Elora consists of a double-8 herringbone milking parlor with 16 milker units (one per stall), each with an automatic detacher and a volumetric weigh jar emptying into a 3.7-cm o.d. stainless steel milkline leading to a receiver jar connected to a centrifugal milk pump. Approx. 150 Holstein cows were milked twice daily throughout the experimental period (June to September, 1980). The system was washed by automatic in-place cleaning with sequential cycling as follows: (a) a 6 min pre-rinse with water; (b) a 12 min recirculation of detergent solution at the desired temperature; (c) a post-rinse with water, replaced by an acidified rinse every other wash; and (d) a 6 min circulation of sanitizer at 200 mg/L available chlorine before the next milking.

Water used for cleaning solutions was very hard. Water hardness was tested by EDTA titration (5) to the Eriochrome Black T endpoint, seven times (approx. 2-wk intervals) during the course of the experiments and averaged 254 mg/L (SD = 3) expressed as CaCO3. Hardness varied very little with time as shown by the low standard deviation.

High-temperature cleaning routine regularly used at the research center served as the control during which time Diversey-Wyandotte's liquid chlorinated alkaline cleaner 'Whirl' was used. For the experimental low-temperature cleaning periods, a specially formulated chlorinated alkaline cleaning detergent (CD-006-4) was used. Concentrations of both Whirl and the experimental cleaner were the same and as directed on the label instructions for Whirl. The pH of the wash solutions was measured weekly. During the high-temperature wash period with Whirl, the mean pH was 12.42 (range 12.28 to 12.66) and during the cold-wash period using the experimental cleaner, the pH of the wash solution was 12.47 (range 12.30 to 12.65). After every other wash, the system was given an acidified rinse using 'Dicoloid' as the acid (mean pH = 2.52; range = 2.20 to 3.15). A chlorine sanitizer (Divex) was used just before each milking at approx. 200 mg/L available chlorine.

Water temperature was controlled by an adjustable mixing valve in the line. Water temperature was measured by a thermocouple in the wash sink connected to a continuous chart recorder. During the high-temperature wash period, the mean initial temperature was 73.0°C, SD 1.56, and the mean temperature at end of wash cycle was 43.8°C, SD 1.70. With the low-temperature wash, the mean initial temperature was 43.8°C, SD 3.15.

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of the milk during low-temperature cleaning vs. regular high-temperature cleaning with the cleaning products used in this study. This lack of effect of treatment on bacterial counts was shown further by the small $r^2$ (coefficient of determination) values of 1 and 11 for the regression analyses for the SPC and PBC, respectively.

Factors other than cleaning method (e.g., intramammary infections, ambient temperature, cleanliness of cows and inherent errors in the plate count) could influence microbial counts. The effect of such variables, however, would be largely overcome by the fact that there were three experimental periods done alternately for each wash treatment over a period of 3.5 months.

The use of an acidified rinse on an every-other-wash basis kept calcium deposits on the equipment at extremely low levels. Throughout the experiment the calcium values in the acid swab solutions were less than 5 mg/L for both the control and experimental periods. Residual calcium has been considered an effective means of determining cleanliness of milk contact surfaces (1,2,6,9) and by this criterion the low-temperature compared favorably with the control.

Visual inspection of the milking equipment and pipeline indicated that there were no obvious differences in cleanliness of the equipment washed by either method.

Thus, it has been shown that a specially formulated compound designed for low-temperature cleaning (mean start and end-of-wash temperatures of 43.8°C and 35.4°C, respectively) produced milk of comparable microbiological quality to that produced under regular high-temperature cleaning (mean start and end-of-wash temperatures of 73°C and 43.8°C, respectively). With the cleaning chemicals used by Bigalke (3), soiled equipment was noted when temperature is 5°C higher than the mean end-of-wash temperature of 35.4°C used in this study in which no evidence of unsanitary conditions was observed. Bradley (4) used a new formulation of a chlorinated alkaline cleaner in on-farm experiments and obtained results as good with a wash temperature of 29.4°C as with previously used formulations at 60°C.

It has been found (3) that significant savings in energy costs can be realized by low-temperature cleaning. By selection of specially formulated cleaning chemicals and proper procedures, raw milk of satisfactory microbiological quality can be achieved.

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**REFERENCES**
