A Study of Milking Machine Cleaning Methods*

I. THE SCRUB METHOD COMPARED TO THE FLUSH METHOD

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Introduction

An important problem for the dairy farmer is the cleaning of milking equipment. Improperly cleaned milking machines and accessories constitute a contributing factor to the production of milk with high bacterial count. Often the farmer has a problem of hard water which makes proper cleaning difficult. The time involved in clean-up operation at milking periods must always be considered. The proper use of a detergent like tri-sodium phosphate has given satisfactory results but there are some features in its use that are far from ideal.

A series of studies was made to evaluate methods of cleaning milking machines. A scrub cleaning method using tri-sodium phosphate was evaluated against a flush cleaning method using an alkyl sulfate type of detergent (Dreft (3)). The study reported here consists of a series of tests extending over a period of seven and one-half weeks.

Comparative observations on the effectiveness of the two cleaning methods were based on the following factors:

a) bacterial counts of the wash waters
b) bacterial counts of the milk
c) appearance of the milking machines
d) speed and ease of cleaning
e) the effect of hard water.

Materials and Methods

Animals—Two groups of six cows each were selected for the study. These animals remained in their usual stall positions in the University dairy herd. Milking of the test animals was done by one man who milked no other than test animals at the regular milking periods. Each cow was carefully checked for mastitis by a veterinarian for a period before the studies began and also during the course of the tests. All the cows were found to be normal, healthy animals with no clinical udder abnormalities.

In each test the results obtained from one group of six cows was compared with the results obtained from another group of six. One herd was arbitrarily designated as A, the other herd as B. At the half-way point of each test period the cleaning methods for the groups were interchanged and the test completed. No other changes were made. This procedure made allowance for the normal difference in bacterial counts that was present in the two groups.

Milking Machines—Two new complete milking machines were used exclusively on the test cows during the test period. One machine with its inflations was cleaned only by the flush method; the other machine was cleaned only by the scrub method.

Water Hardness—To observe the effects of hardened water on the cleaning methods the equipment was washed in certain designated tests with water hardened with a mixture of magnesium and calcium salts. The ratio of calcium to magnesium was 2.9 to 1. Whereas the normal water supply in the barn

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tested about 5 grains/gallon, the hardened water gave hardness readings in the vicinity of 21 grains/gallon.

Cleaning Agents—The scrub method of cleaning the milking machine was done with 0.2 percent tri-sodium phosphate solution. This was the type of agent regularly used in the barn. For the flush method 0.2 percent, and later 0.1 percent, Dreft solution was used.

Scrub Method—

1. After each milking, one pail of fresh cool water was flushed through the milker, raising and lowering the teat cups in the pail of water.
2. The unit was taken apart and the milker head, teat cups, inflations, and other rubber parts were scrubbed thoroughly inside and out using a stiff bristled brush with a solution of 0.2 percent tri-sodium phosphate. A special scraper with a long wire handle was used to clean the inside of the rubber tubing.
3. The unit was reassembled and flushed out with a pail of water at 160° F.
4. The milk pail and pail head were hung on a rack to dry.
5. The teat cup assembly was filled with a 0.5 percent lye solution and allowed to stand between milkings.
6. Just before the next milking, the lye solution was drained from the teat cup assembly and the milker unit was flushed out with clear, warm (120° F.) water.

Flush Method—

1. The milking unit was flushed out after milking with one pail of a Dreft solution at 130° F.
2. After all of the Dreft solution had been drawn into the milk pail, the rubber seal was removed from the pail head and both were brushed in the detergent. The outside of the unit was also brushed with the solution. After sloshing the solution around in the pail it was emptied.
3. The unit was reassembled and flush-rinsed with 160° F. water.
4. The pail, pail head, and teat cup assembly were hung up to dry.
5. Just before the next milking, the machine was flushed out with clear, warm water at 120° F.

Sampling—At each milking period samples of the wash waters and of the milk of each group were taken aseptically. The samples were drawn with sterile pipettes which were calibrated to deliver 20–21 ml. and were long enough to be used as stirring rods with little danger of contamination. The necks of the pipettes were constricted and were plugged with cotton to prevent contamination from the milker's moist hands.

As each cow was milked 20–21 ml. of milk was placed into the chilled sterile sample bottle for that group. This procedure gave a pooled group sample (six cows) of approximately 125 ml. All samples were kept in the cold until bacteriological sampling was completed.

The wash water samples were taken with similar equipment. Samples of the flush-water rinse of each unit before milking and the flush-water rinse of each unit after cleaning the machines were taken.

Bacteriological Testing—Each morning duplicate plate counts were run on each milk and water sample of the milkings of that morning and the previous evening. The samples in each case had been kept cold in a portable ice chest with two ice compartments. The plate counts were run in compliance with the recommendations of the eighth edition of *Standard Methods for the Examination of Dairy Products* of the A.P.H.A. and the A.O.A.C. No skimmed milk was added to the tryptone glucose agar because of the low dilution required for the milk samples in this series of tests.

RESULTS AND OBSERVATIONS

Bacterial Counts of Milk Samples—The average counts of the milk samples for each test period are presented in Table 1. These counts are broken

TABLE 1

BACTERIAL COUNTS* OF MILK SAMPLES

				Scrub Method				Flush Method			
				A.M.	P.M.			A.M.	P.M.		
				Bacteria/ml.				Bacteria/ml.			
Test period	*Approx. water hardness gms./gal.*	*% Product*	*Group*	*Ave. (min.–max.)*	*Ave. (min.–max.)*	*% Product*	*Group*	*Ave. (min.–max.)*	*Ave. (min.–max.)*
1/29–2/6	5	0.2 TSP**	A	862 (595–1570)	611 (265–965)	0.2 Dreft	B	2273 (1180–4100)	1618 (1205–2690)
Groups reversed									
2/6–2/17	5	0.2 TSP	B	3769 (2020–10500)	4659 (1040–15100)	0.2 Dreft	A	1190 (485–1995)	884 (505–1545)
2/17–2/24	21	0.2 TSP	B	2286 (1880–2820)	3404 (920–14900)	0.2 Dreft	A	1667 (760–4500)	847 (270–1230)
Groups reversed									
2/24–3/3	21	0.2 TSP	A	1114 (830–1390)	792 (495–1140)	0.2 Dreft	B	3179 (2345–6050)	2132 (1563–3850)
3/3–3/10	5	0.2 TSP	A	1772 (1135–3950)	1078 (780–1470)	0.1 Dreft	B	3024 (1380–5650)	3357 (1290–12300)
3/10–3/17	21	0.2 TSP	A	1749 (1065–3950)	1039 (695–1245)	0.1 Dreft	B	2164 (1070–4950)	1803 (1080–4950)
Groups reversed									
3/17–3/24	21	0.2 TSP	B	2065 (1300–2690)	1506 (1150–2035)	0.1 Dreft	A	1431 (1035–1915)	1032 (560–1685)
			Average	1945	1870			2133	1668
			Overall Average	1908				1900	

* These counts represent the average bacterial count in each test period. The figures in parentheses are the minimum and maximum counts for the period.

** TSP = Tri-sodium phosphate 0.12 H_2O.

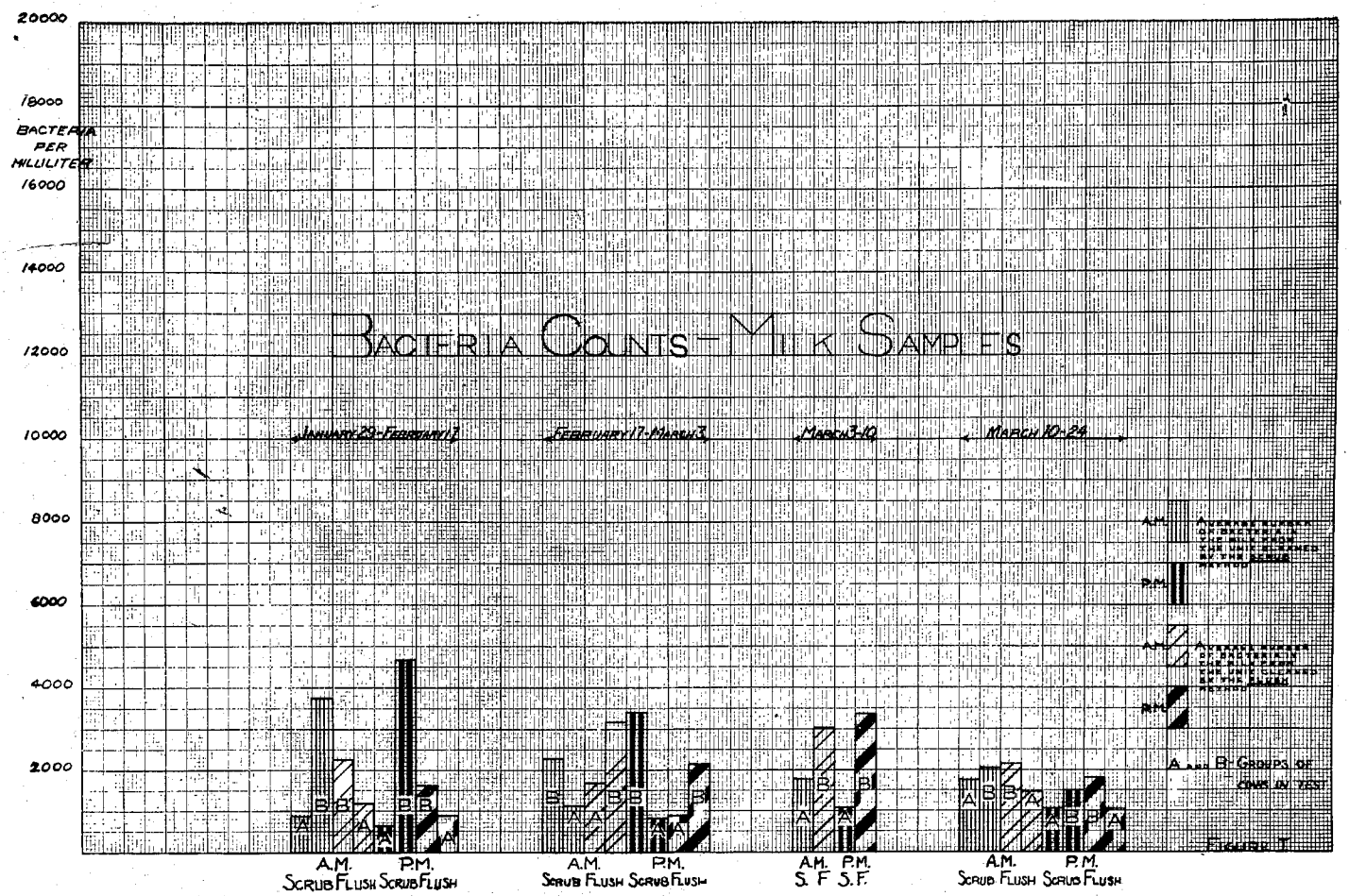

FIGURE 1. Graphic arrangement of average bacteria counts.

down into the A.M. and P.M. milk samples. With each average count the maximum and minimum bacterial counts for the test period are presented in parentheses. The group (A or B) involved in each test is indicated by an A or B beside the name of the cleaning agent used in each test. The average counts are presented in graphic form in Figure 1. The bacterial counts in every case were quite low, well within the requirements for highest quality milk.

It can be seen in the results that the plate counts for the A group are consistently lower than for the B herd in each test. No explanation for this other than normal group difference can be given. This factor must be considered in setting up comparative studies.

Analysis of the results shows little comparative difference in the plate counts for the milk samples between experiments in which relatively soft and moderately hard water were used. Neither tri-sodium phosphate nor Dreft were hindered as cleaning agents by hardened water, as judged by the bacterial counts of the milk samples.

When the amount of Dreft used in the tests was reduced from 0.2 percent to 0.1 percent, little change in bacterial counts was noted.

Although there were daily, test, herd, and milking period variations in plate counts between the flush and scrub method of cleaning milking equipment, the overall picture shows little difference in counts. An average of all the counts for the scrub and flush methods presented in Table 1 shows a difference of only 8 bacteria per ml. (flush = 1900 bacteria/ml. and scrub = 1908 bacteria/ml.). Although this comparison may not be as reliable as the agreement between these overall average figures would suggest, due to varying factors in the tests, there is no indication of a definite dissimilarity in efficiencies between the two methods.

The plate counts for morning samples were mostly higher than for the evening samples. To check our sample storage and delivery system the time of bacteriological testing was changed to the evening in later tests. In experiments not here reported the morning samples were still usually higher.

Bacterial Counts of Wash Water Samples—In only one test (3/17–3/24) did the wash water samples contain enough bacteria per ml., as determined by standard plate counts, to be considered significant (over 30 bacteria/ml.). In all the other tests the post-flush rinse and the pre-flush rinse samples for the scrub and the flush methods showed less than 30 bacteria/ml. In the 3/17–3/24 test, the A.M. pre-flush rinse samples for both the scrub and flush methods showed bacterial counts of approximately 60 bacteria/ml.

Relative Speed, Ease, and Efficiency of the Two Cleaning Methods—The average time for washing the milking machine by the flush method was five minutes; with the scrub method procedure nine minutes were required. This comparison shows that a saving of about 40 percent over the time consumed by the scrubbing process can be realized.

The effectiveness of the flush method of cleaning milking machines with Dreft was readily apparent from the appearance of the milking equipment after the washing operation. Whereas the tri-sodium phosphate left the metal somewhat dull, especially in hardened water, the Dreft-washed metal was bright and shiny. The addition of calcium and magnesium salts to the water to increase the hardness had no noticeable effect on the ability of Dreft to keep the metal bright.

SUMMARY AND CONCLUSIONS

To study the relative merits of cleaning milking machines by the conventional scrub method with 0.2 percent tri-sodium phosphate and the newer

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cedures to appear in the Ninth Edition. Difficulties may be encountered at first where supplies are near the upper limit of the grade by current procedures, particularly if reduction methods are used for grading the raw milk to be pasteurized.

The importance of adherence to the requirements of Standard Methods is stressed. Certainly progressive sanitary milk control should be based on improved laboratory methods such as those to appear in the Ninth Edition of Standard Methods. These methods are designed to yield the most nearly correct information on a milk supply, as only then can we expect reasonably good correlation between farm and plant conditions, care and handling, cooling, age, and bacterial content of the milk.

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flush method with an alkyl sulfate type detergent, a series of tests was run over a two month period. The alkyl sulfate type of detergent used was Dreft, 0.2 and 0.1 percent. Two herds of six cows each were used in the study. The flush method required no scrubbing, but only thorough flushing in a 130° F. solution of detergent followed by a 160° F. clear water rinse.

Standard plate counts of milk samples drawn at each milking showed daily, herd, test and milking period differences but the average bacterial counts for the tests showed no significant difference between the flush and scrub methods. The bacterial counts of the wash water samples were mostly below 30/ml. so were not considered significant.

The cleaning of a milking machine by the flush method took five minutes as compared to nine minutes required for the scrub method. The flush method with Dreft left a brighter appearing milking machine than did tri-sodium phosphate in the scrub method.

An increase in the hardness of the wash water from 5 gr./gallon to 21 gr./gallon had no significant effect upon the bacterial counts of the milk in either washing method, and had no effect upon the appearance of the equipment in the flush method.

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3. Dreft is the Procter & Gamble trademark for a household synthetic detergent.