EVALUATION OF A DETERGENT-SANITIZER FOR USE ON PRODUCER MILKING UTENSILS

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In a field study involving 26 Grade A milk producers a detergent-sanitizer was compared with the customary method of cleaning and sanitizing milking equipment. The producers were divided into two comparable groups and placed on a double-reversal trial with three 5-week periods. Milking utensils appeared cleaner and milk-stone deposits were reduced when the detergent-sanitizer was used in place of the regular procedure. The difference between the two methods of cleaning and sanitizing utensils was not statistically signifcant as measured by thermoduric and total bacterial counts. The relation between the effectiveness of the detergent-sanitizer and the hardness of water was not statistically significant. There was no appreciable amount of quaternary ammonium compound in any of the milk samples as determined by direct measurement and by the activity of a buttermilk culture.

The introduction of detergent-sanitizers to the dairy field has been an attempt to accomplish the cleaning and sanitization of milk-handling equipment in essentially one operation. Products compounded for this purpose contain certain detergents that are compatible with the quaternary ammonium compound used for the disinfectant. After rinsing milk from utensils they are scrubbed in the detergent-sanitizer solution and then allowed to drain until used. During the storage period the quaternary acts as a germicide, as long as moisture is present, to destroy bacteria remaining on the utensils or those deposited from outside sources. Immediately before use the utensils are rinsed with water to free them from the remaining detergent-sanitizer ingredients.

The present study was undertaken to evaluate the effectiveness of a detergent-sanitizer as used by producers having records of varying magnitudes of bacterial counts and having farm water supplies of different degrees of hardness.

Experimental

Selection of producers and experimental plan

A representative group of Grade A milk producers was selected on the basis of their records of sanitation practices, level of raw milk bacterial count, and their distance from the processing plant. These producers were then visited and their participation in the proposed study was solicited. Of the group 26 agreed to participate. During the next 19 days, 5 weigh-vat samples were collected for each producer. On the basis of the raw and laboratory-pasteurized bacterial counts of these samples, the distances of the producers from the processing plant and the times of the arrival of the milk at the plant, the producers were divided into 2 comparable groups.

The experimental plan adopted was of the switchback or double-reversal type. After the grouping of the producers at the end of the initial nineteen-day period, those in Group I were placed on a cleaning program using the detergent-sanitizer[2], and instruction was given on its proper use. Group II was permitted to continue with its conventional cleaning methods (alkaline and acid detergents, chlorination). After 5 weeks, Group I reverted to its usual cleaning procedures and Group II was placed on the detergent-sanitizer cleaning method. After 5 weeks, the groups again reversed cleaning procedures for a final period of 5 weeks. The experimental plan is given in Table 1. This plan was selected because it is particularly effective in removing between-farm differences from experimental error.

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Instructions and observations made on the farm

At the beginning of each detergent-sanitizer period, detailed instructions were given on the method of cleaning with the detergent-sanitizer. The instructions were to rinse the equipment with cool water immediately after use, to brush wash in a warm (about 110° F.) solution containing the proper concentration of detergent-sanitizer, and then to use dry storage of the equipment until the next milking, at which time the utensils were to be rinsed with hot water (which actually was 110 - 120° F.).

Each of the cooperating dairy farms was visited at the beginning of each of the test periods, and again at the termination of the trial. These visits were to observe

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[2]This product under the label of D-S was obtained from the Rigo Manufacturing Co., Inc., Nashville, Tenn.; active ingredients listed were sodium carbonate 35%; methyl dodecyl benzyl trimethyl ammonium chloride (Hyamine 2389) 5%; inert ingredients 60%, composed of non-ionic detergent, sequestering and chelating compounds. The manufacturer's instructions specify that this product be used in a concentration of 1¼ oz. to 10 qt. water.

the condition of the equipment and utensils and to give instructions on the use of the detergent-sanitizer. Also noted on these visits were the types of detergent, sanitizer, and milk stone remover normally used by the producer, and the method usually employed in cleaning and in storing the teat-cup liners. Observations were made on the sanitary condition of the milking machines and all their parts as well as milk cans, coolers, and the general cleanliness of the milk house. Milk-stone deposits in the teat-cup liners, pails, and parts of the machines were noted as well as the age and condition of all the rubber parts.

Milk sampling

Samples of raw milk were collected at the weigh-vat with a stainless steel dipper (about 50 ml. capacity). The dipper was rinsed in water after use and placed in a 200 p.p.m. hypochlorite solution before taking the succeeding sample. The samples were placed in rubber-gasket, screw-cap vials, and the vials kept in a mixture of ice and water from the time of sampling until aliquots were taken for bacterial counts (about 6 hours).

Samples were collected approximately at weekly intervals and on a different day of the week when possible. Generally, 5 samples were collected from each producer during each cleaning period.

Bacterial counts

On each raw sample the standard plate count was made in accordance with *Standard Methods for the Examination of Dairy Products* (9th ed.), using 35° C. for incubation of plates.

Six ml. of each raw sample were placed in a sterile screw-cap vial, pasteurized at 143° F. for 30 min., cooled, and a standard plate count made. These pasteurized samples provided the thermoduric counts.

Activity of buttermilk culture in milk samples

The 4.9 - 5.0 ml. of pasteurized sample remaining after plating was inoculated with 1 per cent of a buttermilk culture. In order to measure the inoculum accurately, 0.5 ml. of a 1:10 dilution (in sterile skim milk) of a buttermilk culture was used to obtain the 1 per cent inoculum. The vials were incubated at 70° F. The purpose of these tests was to determine if any inhibitory activity was present that could be attributed to residual sanitizing agent.

Residual quaternary in milk samples

Each sample of raw milk produced where the detergent-sanitizer was being used, was tested by the Furlong and Elliker (3) method for measuring quaternary ammonium compounds in milk. This method was found to be quite sensitive to the active quaternary in the detergent-sanitizer. The standard titration curve of the number of milliliters of anionic solution plotted against p.p.m. of the quaternary was very similar to that of Furlong and Elliker.

Hardness of water measurements

At the time of the farm visits samples of the water supply were collected. The hardness of the water was determined by the Versenate procedure (1).

TABLE 1. CLEANING SCHEDULE OF THE PRODUCER GROUPS

	Preliminary period	Period I	Period II	Period III
	Farms visited 7/30/53 Sampling started 8/3/53	Farms visited 8/17/53 Sampling started 8/24/53	Farms visited 9/21/53 Sampling started 9/28/53	Farms visited 10/25/53 Sampling started 11/2/53
Group I	Regular[a]	D – S[b]	Regular	D – S
Group II	Regular	Regular	D – S	Regular

[a]Alkaline detergent and hypochlorite; intermittent use of acid detergent; lye soak for teat cups.

[b]Detergent-sanitizer

RESULTS

Appearance of equipment

In normal procedure all producers were using non-soap-type detergents and chlorine-type disinfectants recommended for dairy equipment. Acid cleaners (milk-stone removers) were used periodically. Most producers soaked teat cups in lye solution although a few used a chlorine solution. The age of the teat cup liners varied widely. Prior to the use of detergent-sanitizer about one-third of the liners were either new or in a clean, milk-stone-free condition; the remainder were either old and cracked or very rough and pitted on the inside, and frequently coated with milk-stone. Some of the liners showed indications of having been boiled in lye which kept them in fair condition, but others showed evidence of neglect. At the start of the experiment most of the milk cans observed had rust spots and the tin was dull. Considerable milk-stone was present in cans and pails.

The teat cup liners showed considerable improvement after the periods of detergent-sanitizer use. The new liners were in excellent condition while those showing evidence of milk-stone build-up prior to use of detergent-sanitizer were soft, pliable, and relatively free from milk-stone. The old cracked liners had a gummy layer on the outside which was probably due to the loosening and sloughing off of the dead rubber. After the use of detergent-sanitizer for the 5-week periods, the milk cans and pails took on a luster that was very noticeable. Although the rust spots were still present in the cans, the tinned areas were bright and shiny. The milk-stone was removed in most cases, but some remained, particularly in areas where brushing was difficult.

The general opinion of the producers was favorable to the detergent-sanitizer; in fact after the termination of the experiment a number of the producers expressed a desire to use the detergent-sanitizer procedure routinely. This

TABLE 2A—MEANS OF THE LOGARITHMS OF PASTEURIZED MILK COUNTS FOR THE PRODUCERS IN THE DIFFERENT PERIODS

Farm No.	Water hardness ppm	Mean logarithms of standard plate counts: Preliminary period	Period I	Period II	Period III	Difference[a] (I−(2II)+III)
			Group I			
		(Regular)	(D - S)	(Regular)	(D - S)	
121	118	3.963	3.696	4.447	4.319	−0.879
203	100	3.438	2.913	2.546	2.184	+0.005
208	196	3.082	2.701	2.734	2.382	−0.385
213	225	4.939	3.148	2.770	2.480	+0.088
49	149	2.842	2.668	2.801	2.762	−0.172
28	50	3.088	3.242	2.466	2.602	+0.912
32	66	3.208	2.854	2.924	2.687	−0.307
43	477	2.580	2.576	2.785	2.566	−0.428
152	25	.....	2.679	2.606	2.582	+0.049
160	78	2.264	2.522	2.126	2.030	+0.300
207	64	2.469	2.579	2.381	2.290	+0.107
89	53	2.696	2.908	2.850	2.651	−0.141
CD	70	.....	2.481	2.240	1.969	−0.030
Mean		.....	2.843	2.744	2.577	−0.068
Mean omitting nos. 121 and 208			2.779	2.590	2.436	+0.035
			Group II			
		(Regular)	(Regular)	(D - S)	(Regular)	
99	484	2.652	2.876	2.624	2.469	+0.097
130	48	4.124	2.956	2.309	2.239	+0.577
135	62	3.510	3.891	2.952	2.531	+0.518
220	166	3.785	3.349	3.273	3.231	+0.034
40	702	3.422	3.752	2.736	2.640	+0.920
93	89	2.712	2.711	2.772	2.461	−0.372
150	98	3.222	3.215	2.585	2.481	+0.526
6	288	2.651	2.763	2.428	2.706	+0.613
47	84	2.828	2.954	3.252	2.690	−0.860
122	105	2.414	2.399	1.797	2.005	+0.810
131	140	2.525	2.791	2.790	2.434	−0.355
134	105	2.802	3.140	2.438	2.427	+0.691
BS	140	.....	2.996	2.247	2.228	+0.730
Mean		.....	3.061	2.631	2.503	+0.302

[a]A *negative* difference is an advantage for detergent-sanitizer in Group I
A *positive* difference is an advantage for detergent-sanitizer in Group II

preference was based on the improvement in the condition of the equipment and the simplicity of the detergent-sanitizer method for cleaning and sanitizing.

Effect of cleaning procedures on bacterial counts of milk

Results were computed using all 5 weekly samples of each experimental period, and also using only the last 4 weeks of each period. This was done because of the possibility that the detergent-sanitizer in loosening milk-stone, etc. when first used, might cause some temporary fluctuations in bacterial counts. Statistical analyses showed that the 5-week and 4-week results were essentially the same. A direct test of the change in bacteria count in the first week following the change from regular practice to detergent-sanitizer, showed the possible temporary effects not to be significant. Because the transitory effects were negligible, results are presented only on the 5-week basis.

The mean logarithms of the counts for each producer in each period are shown in tables 2a and 2b. The summarized comparisons of the bacterial counts obtained with detergent-sanitizer and with regular practice are shown in Table 3 for both the pasteurized and the raw samples. Results in Table 3 are given on the basis of the means of the logarithms of the observed counts, and also as the geometric means of counts.

Results were computed using all 26 farms and also deleting 2 farms in Group I. These 2 farms developed a temporary sanitation problem

TABLE 2B—MEANS OF THE LOGARITHMS OF RAW MILK COUNTS FOR THE PRODUCERS IN THE DIFFERENT PERIODS

Farm No.	Water hardness ppm	Mean logarithms of standard plate counts: Preliminary Period	Period I	Period II	Period III	Difference[a] I − 2(II) + III
			Group I			
		(Regular)	(D - S)	(Regular)	(D - S)	
121	118	5.136	5.195	5.651	5.236	−0.871
203	100	5.308	4.859	4.086	4.303	+0.990
208	196	5.400	5.471	5.046	4.466	−0.155
213	225	5.536	5.283	3.928	3.452	+0.879
49	149	4.618	4.675	4.192	5.344	+1.635
28	50	4.818	5.890	4.152	3.883	+1.469
32	66	3.964	4.034	4.672	4.089	−1.221
43	477	4.171	4.350	4.072	3.342	−0.452
152	25	.....	4.912	4.111	4.266	+0.956
160	78	4.039	3.865	4.148	2.773	−1.658
207	64	4.051	5.343	3.925	3.978	+1.471
89	53	4.693	5.591	4.110	4.471	+1.842
CD	70	.....	4.238	4.015	3.871	+0.079
Mean		.....	4.901	4.316	4.113	+0.382
Mean omitting nos. 121 and 208			4.822	4.128	3.979	+0.545
			Group II			
		(Regular)	(Regular)	(D - S)	(Regular)	
99	484	5.772	4.843	5.632	4.851	−1.570
130	48	5.046	4.216	4.812	3.606	−1.802
135	62	5.362	5.497	4.256	4.213	+1.198
220	166	5.272	4.884	5.236	4.672	−0.916
40	702	4.793	4.894	5.685	4.336	−2.140
93	89	4.580	4.196	4.494	4.951	+0.159
150	98	4.940	4.731	4.370	3.828	−0.181
6	288	4.138	3.924	3.748	3.572	0.000
47	84	3.655	3.690	4.080	3.657	−0.813
122	105	4.085	4.066	3.991	3.867	−0.049
131	140	3.679	4.215	3.833	3.839	+0.388
134	105	4.410	4.540	4.186	4.376	+0.544
BS	140	.....	4.729	4.062	4.655	+1.260
Mean		.....	4.494	4.491	4.186	−0.302

[a]A *negative* difference is an advantage for detergent-sanitizer in Group I
A *positive* difference is an advantage for detergent-sanitizer in Group II

that resulted in very high bacterial counts and required immediate correction during the course of the experiment.

Statistical analysis of the data followed the method of Brandt (2). Analyses were made on the mean logarithms of the 5-week or 4-week bacterial counts. Logarithms were used to prevent undue weighting by an occasional very high count. To obtain the results expressed as geometric means of the counts, antilogarithms of the mean logarithms were taken.

From Table 3 it can be observed that the means of the pasteurized milk counts were lower when the producers were using the detergent-sanitizer than when using their regular methods; this difference in the thermoduric counts when the two methods were used was, however, not found to be significant by statistical analysis. The means of the raw milk counts were higher during periods of detergent-sanitizer use, but the difference obtained by the two methods of cleaning and sanitizing again was not significant. From these results it appeared that the detergent-sanitizer was as good as the regular method for cleaning and sanitizing milking utensils.

The average logarithmic bacterial counts of the pasteurized samples from the various farms during the experiment ranged from about 2.2 to 4.2 and the geometric means ranged from about 160 to 16,000. The logarithmic range for raw samples was from about 3.6 to 5.4 and the geometric means ranged from about 4,000 to 250,000. The relation of general level of bacterial count to the difference between detergent-sanitizer and regular

TABLE 3—SUMMARY OF BACTERIOLOGICAL RESULTS COMPARING DETERGENT-SANITIZER AND REGULAR METHODS OF TREATING MILKING EQUIPMENT

Basis of comparison	Pasteurized samples				Raw samples			
	D-S	Regular	Diff[a]	LSD[b]	D-S	Regular	Diff[a]	LSD[b]
Means of log-counts								
All farms	2.670	2.763	−0.093	0.099	4.499	4.328	+0.171	0.228
Omitting farms 121 & 208	2.619	2.686	−0.067	0.100	4.446	4.234	+0.212	0.241
Standard plate counts (geometric means)								
All farms	468	579	−111	119	31,600	21,300	10,300	13,800
Omitting farms 121 & 208	416	485	−69	104	27,900	17,100	10,800	12,300

[a]Difference = count with detergent-sanitizer minus count with regular.
[b]Least difference required for significance at the 5 percent level of probability.

practice was studied, subdividing the farms into high, medium, and low groups with respect to bacterial count obtained in the preliminary test period.

Statistical analyses provided no evidence that the difference between detergent-sanitizer and regular practice was related to the general level of bacteria count. As a further check on this point, the correlations between mean logarithmic bacterial count and advantage for detergent-sanitizer on the individual farms were examined. The correlation coefficients were found to be 0.16 and −0.30 for the pasteurized and the raw samples, respectively. Neither of these values is large enough to be of concern and neither is significant at the 5 per cent level of probability.

Residual quaternary and activity of buttermilk cultures

During Period I out of a total of 60 milk samples from the producers using detergent-sanitizer, 3 contained 5 p.p.m. and 2 contained 2 p.p.m. of quaternary ammonium compound; from a total of 41 samples in period II, 1 showed the presence of 2 p.p.m. and 2 samples showed a slight trace of quaternary; in period III out of a total of 67 samples 1 contained 2 p.p.m. and 4 had a slight trace. In none of these samples was the buttermilk culture inhibited in forming a curd. There was in each period, however, one sample from the group not using the detergent-sanitizer which failed to show rapid curd formation; also, in periods II and III one sample in which no quaternary was found failed to coagulate. These data indicated no deleterious effects by the use of detergent-sanitizer on buttermilk culture activity, although the culture was inhibited at times by other unidentified factors.

Water hardness and the effectiveness of detergent-sanitizer

Water hardness varied from 25 p.p.m. to 702 p.p.m. (Table 2a). The relation of water hardness to effectiveness of the detergent-sanitizer was examined. Little evidence of a relationship was found. For the pasteurized samples the correlation coefficient between water hardness and disadvantage for detergent-sanitizer was −0.30 and for the raw samples 0.25. Neither of these values is large enough to be of importance and neither is significant at the 5 percent level of probability. Thus, there was no indication that water hardness had any deleterious effect on the activity of the detergent-sanitizer.

DISCUSSION

The satisfactory performance of any cleaning and sanitizing procedure involves many factors, such as the removal of milk residue from treated equipment after cleaning, interference in the action of the detergent and/or sanitizer by components in water, and the adaptability of the method to a routine clean-up procedure.

It might seem desirable to compare cleaning and sanitizing procedures on producers having high thermoduric counts. For the evaluation of such procedures by regulatory agencies, however, it is necessary also to obtain data for producers who maintain satisfactory counts using accepted procedures. Therefore, the milk producers chosen for this study constituted a representative portion for a grade A milk supply.

In the present study the milking equipment had a cleaner appearance when the detergent-sanitizer was used. The thermoduric count of the milk produced with this equipment was also a reflection of the satisfactory cleaning and sanitizing performance of the detergent-sanitizer. The failure of the raw milk counts to be significantly different for the 2 types of utensil treatment might be expected since these counts are of secondary importance in regard to equipment sanitation. Unless equipment is grossly contaminated, other factors, particularly improper refrigeration of the milk, can be dominant in affecting raw milk counts.

The hardness of the water on certain farms had no apparent adverse effect on the activity of the detergent-sanitizer. This was rather unexpected since the effectiveness of quaternary-ammonium compounds frequently is lowered by various ions contained in such water. The present findings possibly resulted from the chelating action of certain ingredients in the detergent formulation. The extreme hardness of certain water supplies probably was not typical for these supplies throughout the year, but was a temporary condition aggravated by

negligible rainfall and water shortage during the greater part of the duration of the experiment.

Significant quantities of the quaternary ammonium compound appeared in none of the samples of milk, as shown by direct measurement and by the activity of a buttermilk culture. These results indicated that no deleterious effects should be encountered in the making of fermented milk products from milk produced with utensils cleaned and sanitized with the detergent-sanitizer method as used in this study.

The results obtained show that the detergent-sanitizer treatment used in this study is one easily adopted by the producers. The operations and the instructions for performing them are simple. An advantage is gained by eliminating separate products and treatments for cleaning, disinfection and teat cup storage. It would seem reasonable to expect that a single product, suitable for various cleaning and sanitizing operations, might be more effectively integrated into a routine procedure than the three or four products which are often used for these purposes.

SUMMARY AND CONCLUSIONS

In a field study involving 26 Grade A milk producers a detergent-sanitizer was compared with the customary method of cleaning and sanitizing milking equipment. The producers were divided into two comparable groups and placed on a double-reversal trial with three 5-week periods. In the first period, one group served as a control while the other was on test. In the second period, the treatments of the groups were reversed, and in the final period treatments were again the same as in the first period.

Milking utensils appeared cleaner and milk-stone deposits were reduced when the detergent-sanitizer was used in place of the regular procedure.

The difference between the two methods of cleaning and sanitizing utensils was not statistically significant as measured by thermoduric and raw milk bacterial counts.

The relation between the effectiveness of the detergent-sanitizer and the hardness of water was not statistically significant.

There was no appreciable amount of quaternary ammonium compound in any of the milk samples as determined by direct measurement and by the activity of a buttermilk culture.

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20TH DAIRY INDUSTRIES EXPOSITION, MAJOR DAIRY CONVENTIONS TO RETURN TO ATLANTIC CITY IN FALL OF 1956

The 20th Dairy Industries Exposition in concurrence with conventions of major dairy processor organizations will be held in the autumn of 1956 in Atlantic City, N. J., is a February announcement authorized jointly by International Association of Ice Cream Manufacturers, Milk Industry Foundation, National Association of Retail Ice Cream Manufacturers and Dairy Industries Supply Association. The last named is the organization of dairy industrial equippers and suppliers which sponsors and manages the Show in which its member firms display.

The most recent Dairy Industries Exposition was held last fall in Atlantic City, and there has been some industry speculation as to whether in 1956 it might revert to a mid-Western site, Chicago having been its scene in 1952. A more widespread understanding in the industry, however, has been that the hotel interests in Chicago had failed in a clearing of city-wide accommodations there for the dairy events in 1956 in a week into which the cycle of operations in the dairy processing field would permit the conventions and the Show to fit.

The current four-associations announcement confirms this somewhat general trade-talk supposition.

The annual conventions of Milk Industry Foundation and International Association of Ice Cream Manufacturers will be held in October 1955 in St. Louis without a concurrent Exposition, and with members of DISA in the relative background. National Association of Retail Ice Cream Manufacturers' 1955 annual convention will be held in November in Milwaukee.

Referring to the 1956 arrangements, a DISA spokesman has said: "Officers of the processing associations are aware of the earnest and constant efforts made by DISA to develop, by and through appeals to the civic and commercial interests of Chicago, a suitable opportunity for the great biennially linked dairy industrial events to be scheduled in that mid-continent center with regular four-year frequency. So far hotels' management policies have balked a possible return to Chicago after either a two-year or a four-year gap. The DISA efforts are to be maintained, however, looking to the years beyond 1956."

St. Louis 1955 hotel arrangements involving the needs of Milk Industry Foundation, International Association of Ice Cream Manufacturers and Dairy Industries Supply Association—and National Association of Retail Ice Cream Manufacturers' 1955 Milwaukee convention hotel arrangements — will be announced later by the organizations concerned, jointly or singly as will be appropriate.