BACTERIAL COUNTS OF MILK AS AFFECTED BY INCONSPICUOUS DETERIORATION IN MILKING MACHINE TEAT-CUP LINERS[1]

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Used teat-cup liners, appearing in reasonably good physical condition but having microscopic breakdown of the inside surfaces, were compared with new liners with respect to effect on the bacterial counts of milk. Under similar practical conditions, milk from units equipped with the used liners sometimes had considerably higher counts than milk from the new liner units. When the contamination level was low there was little consistent difference in milk counts.

One of the important factors influencing milking machine sanitation is the presence of inconspicuous cracking and erosion of the inside surfaces of rubber teat-cup liners (2,6). To what extent this condition influences the bacterial count of the milk has not been demonstrated. The factor of dilution during milking may modify the effect of seemingly high contamination of the liners. On the other hand, Jensen (5) has shown that the bacterial content of teat-cup liners may become great enough, as a result of inadequate sanitizing treatments, to considerably increase the bacterial count of the milk. To determine whether microscopic cracking of the liners is of particular influence on the bacterial count of milk, studies were made under practical milking conditions at the College dairy barn.

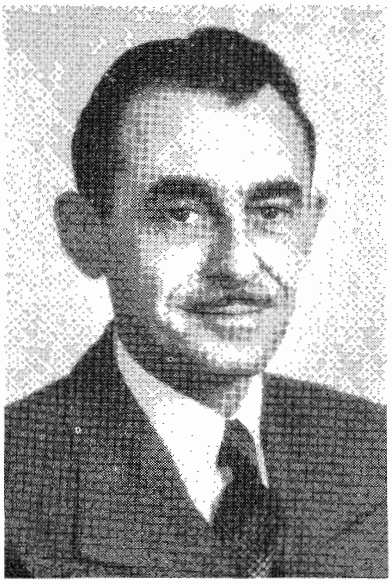
METHODS

Four comparative trials were conducted at different periods of the year and for different lengths of time. In each trial, one milking machine unit was equipped with used teat-cup liners and another unit was fitted with new liners of the same type. The used liners employed were of two common brands and had been currently in service on grade A dairy farms. They appeared to be in reasonably good physical condition but examination with a wide-field microscope at 85X showed cracking and erosion of the inner surfaces. Both milking units were operated at the same time under the same conditions. They received similar treatment and were used in milking approximately the same number of cows daily.

Prior to each comparative trial, the used liners were thoroughly cleaned by soaking in organic acid solution[2], washing, boiling in 2 per cent lye solution and again washing. New liners were washed only. A thorough cleaning was also given to all other parts of the teat-cup assemblies, and to the pail head, pulsator, and stanchion air hose. The milk tubes on each unit were new. Before the initial milking in each trial all parts of the assemblies were steam sterilized. After the original sanitizing treatment, subsequent cleaning during the trials involved routine methods employed at the dairy barn. The usual practices of wiping udders and teats with warm chlorine solution before milking and of dipping teat-cups in chlorine solution between cows were followed.

Under the method of handling milk at the College dairy barn, it was not practical to accumulate the milk from each unit in two separate lots for final sampling. Accordingly, in each trial it was necessary to obtain milk samples directly from the buckets of the units during the 2 to 3-hour milking period. Furthermore, it seemed that such progressive sampling might yield information relative to the trend of contamination during the milking operation. Hand strippings were not included because of the possible effect on bacterial counts of extraneous material sometimes inadvertently introduced at this stage.

Milk samples were obtained from the milker buckets with sterilized pipettes and placed in sterilized containers. In three of the trials, each sample consisted of aliquots from three cows successively milked by the same unit. Five to seven such composite samples for each unit were obtained progressively during the milking period. In the fourth trial, samples were from individual cows. In these cases a preliminary sample was obtained aseptically from the udder to serve as an index of the general level of the bacterial content of the milk before it contacted the milking machine unit. This index sample consisted of several streams of milk from each quarter after about eight previous streams had been drawn into a strip cup and before the unit was applied. All samples were taken during the evening milking, iced immediately and, after the milking period, held in the laboratory refrigerator until morning. Part of each sample was then laboratory pasteurized and immediately cooled. Bacterial counts on both raw and pasteurized milk samples were made by the agar plate method



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[1]Contribution No. 231, Department of Dairy Husbandry, Kansas Agricultural Experiment Station, Manhattan.

[2]Commercial preparation used as directed for removal of milkstone.

TABLE 1—SUMMARY OF BACTERIAL COUNTS ON MILK FROM MILKING MACHINES EQUIPPED WITH NEW VERSUS USED TEAT-CUP LINERS

Trial	Period in operation	Log. av. plate count per ml[a] Raw milk: New liner unit	Raw milk: Used liner unit	Past. milk: New liner unit	Past. milk: Used liner unit
	Assembled flush-washing of liners. Lye solution storage.				
1	1st milking	1,410	3,540	.....	.....
	3 d.	1,260	3,220	.....	.....
	6 d.	3,420	2,800	250	350
	Disassembled brush-washing of liners. Dry storage.				
2	1st milking	8,430	18,010	2,260	5,870
	3 d.	7,270	6,400	1,910	2,320
	7 d.	12,650	41,660	5,990	5,930
	Disassembled brush-washing of liners. Dry storage.				
3	1st milking	1,290	990	120	85
	2 d.	770	800	.....	.....
	7 d.	1,880	2,030	130	500
	10 d.	1,610	1,500	130	65
	14 d.	980	950	75	120
	17 d.	1,550	1,560	140	100
	Assembled flush-washing of liners. Dry storage.				
4	1st milking	2,080	6,470	330	100
	2 d.	1,730	2,920	75	210
	4 d.	1,350	6,730	70	70
	8 d.	950	2,310	55	75
	11 d.	270	3,420	40	50
	15 d.	2,690	7,200	65	300
	19 d.	1,620	34,360	55	3,120

[a]Each value is the log av. of counts on 5 to 7 samples taken progressively during the milking period. In the first 3 trials, each sample was a composite from 3 cows. In the 4th trial, each sample was from a single cow.

using tryptone glucose extract agar.

Bacteriological examinations frequently were made of the liners before and after milking in an effort to correlate contamination at this source with counts of the milk. Teat-cups were removed from the claw for examination. The pulsation-vacuum method previously described (1) was used in most of the examinations. As work progressed, however, it appeared that this procedure applied to liners before milking might remove a sufficient number of bacteria to affect the counts on the milk subsequently obtained. Accordingly, in trial 4, bacteriological examination of liners before each milking was limited to an ordinary rinse count on one liner picked at random from each unit. It was considered that the method would remove a smaller proportion of the contamination than the more thorough pulsation-vacuum procedure and yet would serve as an index of the relative contamination in new and used liners.

Trials 1 and 4, in June and February, respectively, involved long tube machines. Routine cleaning consisted of flush-washing without dismantling the assemblies. In trial 1, lye solution rack storage of assemblies was employed between milkings. In trial 4 dry storage was used. Trials 2 and 3, in July and October, respectively, utilized short tube machines. In both these trials (2 and 3) dismantling and brush-washing of liners was employed after each milking. Liners then were stored dry.

RESULTS AND DISCUSSION

During the study, a total of 242 milk samples were obtained from the milking machine units, with one-half being from units equipped with used liners and the other half, obtained at the same time, from units having new liners. Bacterial counts on raw and pasteurized samples are summarized in Table 1.

Although differences between the bacterial counts of the raw milk from used liner units and new liner units often were negligible, they sometimes were of considerable magnitude, with counts on milk from units with used liners being the higher. In several instances the latter counts were higher than would seem desirable for milk sampled directly from the milker bucket. In trials 1 and 3 log. average counts were relatively low with no practical differences between units in either raw or pasteurized samples. In trial 2 the level of contamination was higher and differences between counts on raw milk from the new liner unit and the used liner unit were more

TABLE 2—BACTERIAL COUNTS ON MILK FROM MILKING MACHINES EQUIPPED WITH NEW VERSUS USED TEAT-CUP LINERS DURING MILKING OF THE FIRST 7 CONSECUTIVE COWS WITH EACH UNIT. (Final period of trial 4)

Unit with new liners: Cow No.	Plate counts per ml.: Milk directly from udder[a]	Milk from unit: Raw	Milk from unit: Past.	Unit with used liners: Cow No.	Plate counts per ml.: Milk directly from udder[a]	Milk from unit: Raw	Milk from unit: Past.
A1	1,300	3,200	180	B1	50	44,000	1,900
A2	150	1,500	60	B2	140	22,000	1,500
A3	2,100	1,200	40	B3	50	19,000	1,800
A4	900	240	30	B4	8,500	32,000	6,400
A5	620	2,400	40	B5	250	120,000[b]	9,000
A6	.....	1,200	.....	B6	350	32,000	.....
A7	9,200	8,800	.....	B7	2,400	25,000	.....
Log Av.	1,300	1,620	55		350	34,360	3,120

[a]As an index for comparison several streams of milk were obtained asceptically from the 4 quarters of each cow after about the first 8 streams had been discarded.
[b]Visible extraneous material in milk.

marked and of practical importance in two of the three examination periods. However, there was little consistent difference in the counts on the pasteurized milk with samples from both units being relatively high. In trial 4 raw milk from the unit with used liners was consistently higher in count than milk from the other unit with differences tending to become greater toward the end of the trial. The last period of this trial showed the greatest differences found in the study. In this case the log. average count of the raw milk from the used liner unit was more than 20 times as high as that from the new liner unit. In the pasteurized samples there were no practical differences except in the last period where milk from the used liner unit was much higher in count than the milk from the new liner unit.

Data from the last period in trial 4 are given in more detail in Table 2. Since it was possible that high count milk from individual cows might be influencing the results, counts of aseptically drawn "index" samples obtained at the same time are shown for comparison. It is recognized that such counts may differ from counts on complete milkings. However, they serve as a measure of any unusual variation. Although there was considerable difference in the count of the milk directly from the udder of the various cows, the consistently higher counts on both the raw and pasteurized milk from the used liner unit could not be attributed to cows giving high count milk. It is significant that although these data were obtained at the end of the trial period and marked contamination had accumulated in the used liners, milk from the new liner unit which received the same treatment had a low bacterial count.

The relative contamination in used and new liners both before and after milking during trial 4 is shown in Table 3. Comparisons should not be made between the data obtained before and after milking since different examination procedures were used as described under "Methods". Pre-milking contamination probably is much greater than indicated by the method used. However, the striking differences between the amount of contamination in the new and used liners is evident. It is possible that the low counts obtained before milking on the eleventh day arose from a temporary change in clean-up personnel which may have resulted in more effective sanitizing of the liners at this period. The tendency for counts to increase as the trial progressed, was more marked in the used than in the new liners. The high counts obtained on the used liners after milking emphasize the sanitation problem involved.

TABLE 3—RELATIVE CONTAMINATION OF NEW AND USED LINERS BEFORE AND AFTER MILKING (TRIAL 4)

Period in operation	Bacterial count per liner			
	Before milking[a]		After milking[b]	
	New	Used	New	Used
1st milking	0[c]	0[c]	22,000	280,000
2 d.	170	49,000	2,450	400,000
4 d.	1,200	160,000	.....	.....
8 d.	980	490,000	.....	.....
11 d.	100	420	31,500	6,700,000
15 d.	1,000	180,000	4,200	1,300,000
19 d.	2,800	320,000	84,000	18,000,000

[a]An index value of relative contamination determined from a rinse count on one liner picked at random from each set and using 35 ml. of sterile water per liner. These counts should not be compared with those obtained after milking, when a different procedure was employed.

[b]Log. av. of counts on 4 separate liners. Pulsation-vacuum method using 35 ml. of sterile water per liner.

[c]Liners were thoroughly washed and steam sterilized in the laboratory before initial milking. For practical purposes counts were recorded as zero.

It was obvious during the study that a relatively high level of contamination in liners was necessary to give practical differences in the counts of the milk. When the pulsation-vacuum procedure was used for bacteriological examination it appeared that a count of less than 500,000 per liner before milking did not have a consistent practical effect on the count of the milk. This generally is in accord with the standard for milking machines suggested by Dahlberg (4) and is further supported by theoretical consideration of the dilution factor. Bacteriological examination of liners before milking removes a considerable proportion of the contamination and subsequent counts on the milk are probably lower than otherwise. When bacteriological examination was made on liners by the pulsation-vacuum procedure both before and after a milking period, the used liners usually increased markedly in bacterial count during milking. If the counts were unusually high at the start, however, they tended to remain about the same. Although several explanations might be offered to account for the frequent increases in counts in the used liners, they do not explain all cases and are mainly speculation. With the new liners, there was much less tendency for counts to increase during milking and often there was a definite decrease.

During none of the trials was there any noticable accumulation of "milkstone" film or obvious evidence of unclean conditions in the liners. At the end of the last trial where the cleaning treatment had involved flush-washing and dry storage, even microscopic examination revealed little accumulated material in either new or used liners.

Although there is a general relation between counts on the liners and counts on the milk, and it is closer under high levels of contamination, there are various complicating factors. Under conditions where used liners accumulate sufficient contamination to have definite influence on the count of the milk, new liners under the same conditions are likely to be much less affected. Where a higher level of liner contamination prevails than occurred in this study it may be that the effect of liner deterioration would be more marked. It would appear that a weekly treatment of liners, such as boiling in 2 per cent lye solution, would be a desirable

precautionary measure to limit accumulation of bacteria in liners that might have inconspicuous deterioration of the surfaces.

SUMMARY

Studies were made of the effect of inconspicuous breakdown of the inside surfaces of milking machine teat-cup liners on the bacterial counts of milk. Under similar practical conditions of machine care and operation, milk from units equipped with used liners appearing in reasonably good physical condition but having microscopic breakdown, sometimes had considerably higher counts than milk from units with new liners having no microscopic deterioration. Frequently, the same conditions that resulted in considerable contamination in milk from the used liner units still produced good results with the new liner units. Relatively high contamination in the liners was necessary to cause a practical increase in the count of milk. Under conditions where the contamination level was relatively low, there was little consistent difference in milk counts. During each trial period, bacterial accumulation increased more rapidly and to a much higher level in used liners than in new liners.

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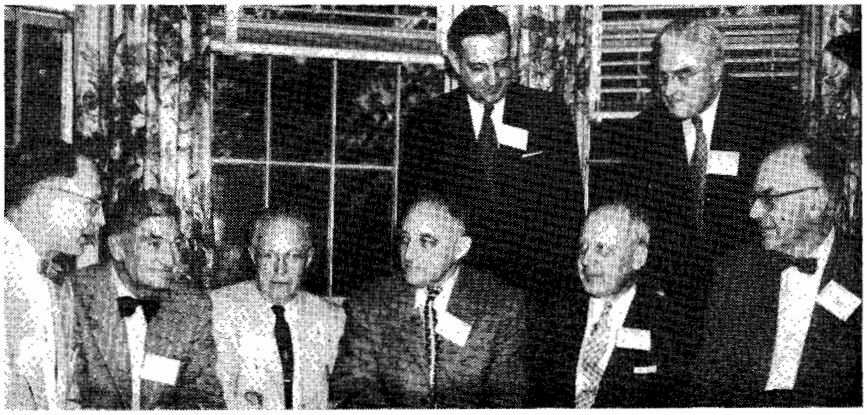
NEWS AND EVENTS

JOINT MEETING OF 3-A SANITARY STANDARDS COMMITTEES CONFERS ON DAIRY EQUIPMENT STANDARDS IN BETHESDA, MD., APRIL 26-28

A semi-annual Joint Meeting of the 3-A Sanitary Standards Committees those groups which formulate 3-A Sanitary Standards for Dairy Equipment — was held April 26 - 28 at the Kenwood Country Club in Bethesda, Md.

Approved by the over-all group were amendments to the existing 3-A Sanitary Standards for Fittings Used on Milk and Milk Plant Equipment and Used on Sanitary Lines Conducting Milk and Milk Products. The amended standards will be published in The Journal of Milk and Food Technology — official publication of International Association of Milk and Food Sanitarians — in the very near future, after which reprints may be obtained from IAMFS and the offices of any national dairy trade association.

Additionally, the conferees made substantial progress in the drafting of amendments to the existing 3-A Sanitary Standards for Farm Holding and/or Cooling Tanks; and in the development of 3-A Sanitary Standards for fillers and sealers of fibre milk containers, and for manually operated bulk milk dispensers. The agreement secured to these three standards was such that it is expected that the few remaining differences can be agreed upon by the principals of the 3-A Sanitary Standards Committees. Such agreements, which it is hoped may be secured before the next semi-annual joint meeting of the committees, will permit the publication of these three standards (for farm holding and/or cooling tanks; for fillers and sealers for fibre milk containers; and for bulk milk dispensers) in the Journal of Milk and Food Technology at an early date.



These are the eight men who comprise the 3-A Symbol Council — the new body which will supervise the use of the "3-A" symbol on dairy equipment which conforms to the 3-A voluntary sanitary standards. The eight came together for their first formal meeting April 25 at Kenwood Country Club in Bethesda, Md. Four members of the council are representatives of International Association of Milk and Food Sanitarians, two are representatives of users of equipment (appointed by Dairy Industry Committee), and two are representatives of fabricators of equipment (appointed by Dairy Industries Supply Association). Seated, left to right, are K. G. Weckel, M. D. Howlett, Jr., C. A. Abele, and Paul Corash, representatives of IAMFS; William A. Dean, Jr. and A. E. Nessler, representatives of users appointed by DIC; and standing are Paul K. Girton and George W. Putnam, representatives of fabricators appointed by DISA.

Interim reports were heard from task groups and special committees working on a tentative 3-A Suggested Method for C-I-P Lines for Farms, tentative 3-A Sanitary Standards for Non-coil Type Stainless Steel Batch Type Pasteurizers, tentative 3-A Sanitary Standards for Portable and Stationary Bucket or