# FATE OF COLIFORMS IN YOGURT, BUTTERMILK, SOUR CREAM, AND COTTAGE CHEESE DURING REFRIGERATED STORAGE[1]

M. C. GOEL, D. C. KULSHRESTHA, AND E. H. MARTH

*Department of Food Science and The Food Research Institute, University of Wisconsin, Madison, Wisconsin 53706*

and

D. W. FRANCIS, J. G. BRADSHAW, AND R. B. READ, JR.

*Division of Microbiology Food and Drug Administration 1090 Tusculum Avenue Cincinnati, Ohio 45226*

(Received for publication September 8, 1970)

ABSTRACT

*Aerobacter (Enterobacter) aerogenes* and *Escherichia coli* were inoculated separately into commercially produced samples of yogurt, buttermilk, sour cream, and cottage cheese. Inoculated products were stored at 7.2 C and were tested daily for up to 10 days to determine changes in numbers of coliforms and in pH values. The number of viable coliforms in yogurt declined dramatically and was markedly different from the initial value after only 24 hr of storage. Usually, survival of coliforms in yogurt did not exceed 3 days of holding. In buttermilk, most often a marked decline in numbers of coliforms was evident after 24 hr of storage. A substantial reduction in numbers (>50% of organisms present initially) of *A. aerogenes* B199 occurred in sour cream during the first 24 hr of storage, but a similar decline in numbers of *E. coli* and *A. aerogenes* FD was not evident until after 3 days of storage. Changes in numbers of *E. coli* and *A. aerogenes* in cottage cheese generally were not as rapid as in other products during the first days of storage. A few cottage cheese samples, however, did support rapid increases in test culture numbers. Because of the rapid decline in numbers of coliforms in yogurt, buttermilk, and sour cream, the provision in *Standard Methods for the Examination of Dairy Products* that permits examination of some of these products for up to 48 hr after manufacture seems inadvisable.

*Standard Methods for the Examination of Dairy Products (1)* specifies that coliform tests on cottage cheese be done within 24 hr after manufacture and that cultured milks be tested for coliforms within 48 hr after pasteurization. This requirement has made it difficult for receiving communities to do meaningful testing on these products when shipping times of more than 24 or 48 hr are involved.

Although it is generally believed that coliforms will be inactivated in acid products such as yogurt, cultured buttermilk, and sour cream, and conversely, will multiply in cottage cheese, definitive data to indicate the rate of death or multiplication are lacking. The present study was undertaken to characterize the growth or destruction of some coliforms when suspended in these foods and held at a refrigeration temperature.

## MATERIALS AND METHODS

### *Cultures*

Two cultures each of *Escherichia coli* and *Aerobacter (Enterobacter) aerogenes* were used throughout this study (*E. coli* H52 and FD, *A. aerogenes* NRRL-B199 and FD). The FD strains were recent isolates from dairy products. Inocula for *E. coli* H52 and *A. aerogenes* B199 were prepared from skim milk cultures. The FD strain inocula were prepared by harvesting growth from 24-hr-32 C-trypticase soy agar slants and then washing it 3 times in distilled water before inoculating the dairy products under test.

### *Products: Selection, inoculation, and examination*

Dairy products used were obtained from grocery stores or the university dairy plant, except some cottage cheese samples which were obtained from processing plants. All samples were pretested for coliforms and only those that had initial concentrations of <10/g were used in this study.

Products other than buttermilk were inoculated and then stirred manually until the inoculum was dispersed homogeneously throughout the food. With buttermilk, the inoculum was mixed into the product by shaking. After inoculation, each sample of product was divided into 2 portions and each portion placed into a sterile beaker covered with aluminum foil. Samples were held at 7.2 C and were tested daily for a 10-day period to determine pH values and numbers of coliforms. Coliform counts were carried out as described in *Standard Methods for the Examination of Dairy Products (1)*. Violet red bile agar was used as the coliform medium throughout this study. Data in tables represent averages of results from tests on the 2 subsamples prepared from each product.

## RESULTS AND DISCUSSION

### *Yogurt*

Data on the behavior of *A. aerogenes* and *E. coli* in yogurt are summarized in Tables 1 and 2. It is evident that all test cultures were rapidly inactivated in this product; in many instances coliforms were essentially undetectable after 24 hr of storage. In fact, inactivation of coliforms in yogurt was so rapid

[1]Published with the approval of the Director of the Research Division of the College of Agricultural and Life Sciences, University of Wisconsin.

TABLE 1. FATE OF *Aerobacter aerogenes* IN YOGURT DURING REFRIGERATED STORAGE.

| Sample | No. *A. aerogenes*/gram after days | | | | | pH values of yogurt after days | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 0 | 1 | 2 | 3 | 4 |
| | | | | | *A. aerogenes* B199[1] | | | | | |
| 1 | 330 | 35 | <1 | — | — | 4.10 | 4.10 | 3.95 | — | — |
| 2[2] | 700 | 420 | 170 | 40 | 7 | 4.40 | 4.40 | 4.25 | 4.20 | 4.18 |
| 3 | 65 | <1 | — | — | — | 4.00 | 4.05 | — | — | — |
| 4 | <10 | <1 | — | — | — | 4.10 | 4.05 | — | — | — |
| 5 | <10 | <1 | — | — | — | 4.00 | 3.90 | — | — | — |
| | | | | | *A. aerogenes* FD | | | | | |
| 1 | 660 | <1 | <1 | 3 | <1 | 3.74 | 3.84 | 3.71 | 3.69 | 3.68 |
| 2 | 950 | 20 | <1 | <1 | <1 | 3.95 | 3.68 | 3.85 | 3.87 | 3.80 |
| 3 | 1000 | <1 | <1 | <1 | <1 | 3.88 | 3.81 | 3.80 | 3.85 | 3.77 |
| 4 | 740 | <1 | <1 | <1 | <1 | 4.00 | 3.90 | 3.98 | 3.85 | 3.95 |
| 5 | 770 | <1 | <1 | <1 | <1 | 3.65 | 3.65 | 3.72 | — | — |

[1]A similar inoculum was used for all samples. Inactivation of *A. aerogenes* in the product was so rapid that only a fraction of the organisms added to some samples could be recovered initially.
[2]Peach yogurt.

TABLE 2. FATE OF *Escherichia coli* IN YOGURT DURING REFRIGERATED STORAGE.

| Sample | No. *E. coli*/gram after days | | | | | pH value of yogurt after days | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 0 | 1 | 2 | 3 | 4 |
| | | | | | *E. coli* H52[1] | | | | | |
| 1 | 1100 | 260 | 23 | <10 | <1 | 4.20 | 4.05 | 4.05 | 4.05 | 4.05 |
| 2 | 110 | 1 | <1 | — | — | 4.35 | 4.19 | 4.19 | — | — |
| 3 | 30 | <1 | — | — | — | 4.04 | 4.00 | — | — | — |
| 4 | 28 | <1 | — | — | — | 4.10 | 4.05 | — | — | — |
| 5 | 410 | 13 | 5 | 1 | <1 | 4.20 | 4.10 | 4.10 | 4.00 | 4.00 |
| | | | | | *E. coli* FD | | | | | |
| 1 | 110 | <1 | <1 | 1 | <1 | 3.75 | 3.75 | 3.67 | 3.70 | — |
| 2 | 600 | 130 | 120 | 38 | 17 | 3.95 | 3.95 | 3.95 | 3.84 | 3.90 |
| 3 | 430 | 60 | 30 | 16 | <1 | 3.91 | 3.88 | 3.88 | 3.77 | 3.79 |
| 4 | 490 | 110 | 20 | 31 | 15 | 3.90 | 3.90 | 3.95 | 3.85 | 3.92 |
| 5 | 150 | <1 | <1 | <1 | <1 | 3.65 | 3.65 | 3.65 | 3.62 | 3.78 |

[1]A similar inoculum was used for all samples. Inactivation of *E. coli* in the product was so rapid that only a fraction of the organisms added to some samples could be recovered initially.

TABLE 3. FATE OF *Aerobacter aerogenes* IN CULTURED BUTTERMILK DURING REFRIGERATED STORAGE.

| Sample | No. *A. aerogenes*/gram after days | | | | | | | | | | | pH values of buttermilk after days | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 0 | 1 | 3 | 5 | 10 |
| | | | | | | | | | *A. aerogenes* B199 | | | | | | | |
| 1 | 890 | 640 | 580 | 420 | 350 | 310 | 280 | 220 | 160 | 65 | 35 | 4.90 | 4.70 | 4.45 | 4.40 | 4.40 |
| 2 | 850 | 670 | 600 | 440 | 420 | 340 | 270 | 250 | 170 | 100 | 33 | 4.85 | 4.65 | 4.45 | 4.45 | 4.40 |
| 3 | 880 | 640 | 520 | 460 | 450 | 345 | 260 | 210 | 170 | 140 | 70 | 4.85 | 4.80 | 4.60 | 4.60 | 4.60 |
| 4 | 750 | 680 | 470 | 380 | 370 | 290 | 170 | 100 | 40 | 18 | 13 | 4.80 | 4.70 | 4.45 | 4.45 | 4.45 |
| 5 | 840 | 690 | 510 | 410 | 380 | 340 | 280 | 200 | 160 | 110 | 130 | 4.70 | 4.60 | 4.40 | 4.40 | 4.40 |
| | | | | | | | | | *A. aerogenes* FD | | | | | | | |
| 1 | 720 | 330 | 150 | 120 | 50 | 25 | 20 | <1 | <1 | <1 | <1 | 4.15 | 4.15 | — | 4.25 | 4.25 |
| 2 | 690 | 210 | 65 | 10 | <1 | <1 | <1 | <1 | — | — | — | 4.12 | 4.10 | — | 4.18 | 4.15 |
| 3 | 650 | 180 | 75 | 30 | 15 | <1 | <1 | — | <1 | <1 | <1 | 4.15 | 4.10 | — | 4.15 | 4.18 |
| 4 | 740 | 320 | 220 | 170 | 160 | 80 | 60 | 25 | 10 | — | <1 | 4.30 | 4.30 | — | 4.40 | 4.35 |
| 5 | 720 | 440 | 280 | 180 | 220 | 200 | 100 | 80 | 20 | 35 | <1 | 4.35 | 4.35 | — | 4.42 | 4.58 |

TABLE 4. FATE OF *Escherichia coli* IN CULTURED BUTTERMILK DURING REFRIGERATED STORAGE.

| Sample | No. *E. coli*/gram after days | | | | | | | | | | | pH values of buttermilk after days | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 0 | 1 | 3 | 5 | 10 |
| | | | | | | | | *E. coli* H52 | | | | | | | | |
| 1 | 1300 | 1100 | 950 | 980 | 780 | 570 | 350 | 260 | 120 | 35 | 17 | 4.30 | 4.30 | 4.30 | 4.20 | 4.20 |
| 2 | 1600 | 880 | 450 | 220 | 65 | 28 | 18 | 10 | 13 | 8 | <1 | 4.80 | 4.60 | 4.55 | 4.55 | 4.50 |
| 3 | 1500 | 1300 | 1100 | 700 | 380 | 170 | 23 | 20 | 10 | <1 | <1 | 4.80 | 4.65 | 4.60 | 4.60 | 4.55 |
| 4 | 1400 | 940 | 750 | 380 | 310 | 100 | 28 | 28 | 25 | 13 | 7 | 4.70 | 4.50 | 4.45 | 4.45 | 4.45 |
| 5 | 1400 | 960 | 650 | 330 | 220 | 110 | 20 | 13 | 15 | <1 | <1 | 4.50 | 4.35 | 4.35 | 4.35 | 4.35 |
| | | | | | | | | *E. coli* FD | | | | | | | | |
| 1 | 920 | 600 | 450 | 310 | 260 | 110 | 70 | 30 | 20 | <1 | <1 | 4.15 | 4.15 | — | 4.28 | 4.22 |
| 2 | 730 | 640 | 370 | 260 | 80 | 110 | 35 | 40 | 20 | 10 | <1 | 4.12 | 4.10 | — | 4.20 | 4.15 |
| 3 | 520 | 380 | 280 | 200 | 170 | 110 | 65 | 210 | 20 | 10 | <1 | 4.15 | 4.10 | — | 4.39 | 4.35 |
| 4 | 670 | 460 | 470 | 360 | 280 | 300 | 180 | 260 | 180 | 95 | 85 | 4.30 | 4.30 | — | 4.39 | 4.35 |
| 5 | 740 | 440 | 450 | 440 | 300 | 170 | 320 | 200 | 230 | 130 | 70 | 4.35 | 4.35 | — | 4.45 | 4.55 |

TABLE 5. FATE OF *Aerobacter aerogenes* IN SOUR CREAM DURING REFRIGERATED STORAGE.

| Sample | No. *A. aerogenes*/gram after days | | | | | | | | | | pH values of sour cream after days | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 0 | 1 | 3 | 5 | 7 | 9 |
| | | | | | | | | *A. aerogenes* B199 | | | | | | | | |
| 1 | 860 | 350 | 210 | 130 | 65 | 55 | 23 | 23 | 3 | <1 | 4.50 | 4.40 | 4.30 | 4.30 | 4.30 | 4.30 |
| 2 | 870 | 550 | 230 | 140 | 50 | 30 | 10 | 5 | <1 | — | 4.70 | 4.60 | 4.55 | 4.55 | 4.60 | — |
| 3 | 780 | 340 | 110 | 13 | <1 | — | — | — | — | — | 4.50 | 4.40 | 4.35 | — | — | — |
| 4 | 780 | 210 | 50 | <1 | — | — | — | — | — | — | 4.60 | 4.50 | 4.40 | — | — | — |
| 5 | 860 | 330 | 140 | 63 | 30 | 8 | 3 | <1 | — | — | 4.65 | 4.55 | 4.50 | 4.0 | 4.00 | — |
| | | | | | | | | *A. aerogenes* FD | | | | | | | | |
| 1 | 1000 | 520 | 180 | 30 | 15 | 25 | 2 | <1 | <1 | <1 | 4.18 | 4.05 | 4.12 | 4.17 | 4.17 | 4.20 |
| 2 | 1400 | 1300 | 640 | 680 | 170 | 160 | 130 | 35 | 20 | 3 | 4.20 | 4.21 | 4.15 | 4.19 | 4.17 | 4.22 |
| 3 | 1000 | 720 | 490 | 280 | 160 | 40 | 5 | <1 | <1 | 1 | 4.25 | 4.25 | 4.19 | 4.20 | 4.25 | 4.35 |
| 4 | 1400 | 860 | 720 | 400 | 200 | 270 | 160 | 140 | 80 | 20 | 4.50 | 4.42 | 4.40 | 4.40 | 4.47 | 4.60 |
| 5 | 770 | 220 | 10 | <1 | 1 | <1 | <1 | <1 | <1 | — | 4.35 | 4.25 | 4.10 | 4.30 | 4.25 | — |

TABLE 6. FATE OF *Escherichia coli* IN SOUR CREAM DURING REFRIGERATED STORAGE.

| Sample | No. *E. coli*/gram after days | | | | | | | | | | | pH value of sour cream after days | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 0 | 1 | 3 | 5 | 7 | 10 |
| | | | | | | | | | *E. coli* H52 | | | | | | | | |
| 1 | 1700 | 1300 | 930 | 500 | 370 | 370 | 300 | 400 | 300 | 180 | 200 | 4.70 | 4.70 | 4.61 | 4.60 | 4.60 | 4.60 |
| 2 | 1700 | 930 | 590 | 260 | 73 | 110 | 85 | 100 | 63 | 85 | 18 | 4.60 | 4.60 | 4.57 | 4.50 | 4.50 | 4.50 |
| 3 | 1700 | 400 | 240 | 95 | 70 | 30 | 23 | 50 | 4 | <1 | — | 4.60 | 4.60 | 4.55 | 4.50 | 4.50 | — |
| 4 | 1500 | 1400 | 1200 | 1100 | 1000 | 1000 | 1000 | 1100 | 1000 | 880 | 830 | 4.69 | 4.65 | 4.65 | 4.70 | 4.70 | 4.70 |
| 5 | 940 | 800 | 680 | 560 | 570 | 370 | 200 | 190 | 110 | 38 | 8 | 4.40 | 4.40 | 4.33 | 4.20 | 4.20 | 4.20 |
| | | | | | | | | | *E. coli* FD | | | | | | | | |
| 1 | 1000 | 520 | 360 | 30 | 30 | 6 | 13 | <1 | <1 | <1 | <1 | 4.18 | 4.21 | 4.14 | 4.15 | 4.15 | — |
| 2 | 1300 | 1600 | 740 | 380 | 260 | 160 | 90 | 25 | 5 | <1 | <1 | 4.20 | 4.25 | 4.10 | 4.10 | 4.15 | 4.15 |
| 3 | 980 | 820 | 550 | 340 | 150 | 170 | 70 | 90 | 50 | <1 | 33 | 4.25 | 4.25 | 4.15 | 4.20 | 4.25 | 4.40 |
| 4 | 1400 | 1000 | 740 | 420 | 600 | 280 | 200 | 200 | 100 | 140 | 200 | 4.50 | 4.50 | 4.40 | 4.45 | 4.55 | 4.80 |
| 5 | 680 | 350 | 60 | 10 | 10 | 4 | 2 | 2 | 1 | 1 | <1 | 4.20 | 4.20 | 4.15 | 4.25 | 4.25 | 4.25 |

with *A. aerogenes* B199 that sometimes an initial number could not be detected and at other times only a limited number of those organisms added were recovered a short time (< 30 min) later. It is noteworthy that 6 samples of yogurt permitted somewhat longer survival of coliforms, but even here the numbers declined markedly during the first 24 hr of storage. The pH value of products in which coliforms survived longer tended to be somewhat higher initially but then dropped during storage. This may have contributed to the demise of the coliforms.

### *Cultured buttermilk*

The behavior of *A. aerogenes* and *E. coli* in butter-

TABLE 7. FATE OF *Aerobacter aerogenes* IN COTTAGE CHEESE DURING REFRIGERATED STORAGE.

| Sample | No. *A. aerogenes*/gram after days | | | | | | | | | | | pH value of cottage cheese after days | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 0 | 1 | 3 | 5 | 7 | 10 |
| | | | | | | | *A. aerogenes* B199 | | | | | | | | | | |
| 1 | 1000 | 1100 | 980 | 700 | 700 | 800 | 550 | 590 | 500 | 410 | 410 | 4.93 | 4.93 | 5.00 | 4.88 | 4.76 | 4.90 |
| 2 | 1100 | 1300 | 950 | 750 | 640 | 690 | 620 | 350 | 250 | 180 | 75 | 4.94 | 4.95 | 5.00 | 4.79 | 4.74 | 4.69 |
| 3 | 1100 | 5900 | 20000 | 16000 | 15000 | 15000 | 13000 | 8200 | 7300 | 7300 | 3300 | 4.94 | 4.90 | 5.01 | 4.83 | 4.94 | 4.87 |
| 4 | 1100 | 960 | 920 | 850 | 800 | 770 | 680 | 590 | 620 | 400 | 370 | 4.94 | 4.95 | 4.93 | 4.83 | 4.81 | 4.78 |
| 5 | 1100 | 900 | 880 | 600 | 600 | 560 | 470 | 340 | 280 | 170 | 130 | 4.94 | 4.95 | 5.03 | 4.90 | 4.81 | 4.59 |
| | | | | | | | *A. aerogenes* FD | | | | | | | | | | |
| 1 | 140 | 130 | 140 | 110 | 120 | 140 | 120 | 120 | 160 | 200 | 340 | 4.80 | 4.80 | 4.80 | 4.80 | 4.70 | 4.75 |
| 2 | 140 | 170 | 160 | 130 | 210 | 330 | 540 | 1200 | 1900 | 3200 | 7100 | 4.85 | 4.80 | 4.85 | 4.70 | 4.75 | 4.83 |
| 3 | 100 | 120 | 260 | 670 | 2600 | 4000 | 3200 | $7x10^4$ | $3x10^5$ | $7x10^5$ | $5x10^6$ | 5.00 | 5.05 | 4.98 | 4.95 | 4.90 | 4.85 |
| 4 | 110 | 130 | 340 | 440 | 1400 | 990 | 1800 | 1300 | 2600 | $2x10^4$ | $2x10^4$ | 4.95 | 4.95 | 4.78 | 4.75 | 4.70 | 4.70 |

TABLE 8. FATE OF *Escherichia coli* IN COTTAGE CHEESE DURING REFRIGERATED STORAGE.

| Sample | No. *E. coli*/gram after days | | | | | | | | | | | pH value of cottage cheese after days | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 0 | 1 | 3 | 5 | 7 | 10 |
| | | | | | | | | *E. coli* H52 | | | | | | | | | |
| 1 | 2200 | 2200 | 2000 | 1900 | 2100 | 2000 | 1700 | 1600 | 1500 | 870 | 500 | 5.10 | 5.00 | 4.84 | 4.76 | 4.73 | 4.61 |
| 2 | 2100 | 2200 | 2200 | 2100 | 2000 | 2100 | 1900 | 1900 | 1700 | 1800 | 1800 | 5.10 | 5.02 | 4.99 | 5.03 | 5.18 | 5.10 |
| 3 | 6400 | 7900 | 8800 | $3x10^4$ | $5x10^4$ | $8x10^4$ | $1x10^5$ | $1x10^6$ | $1x10^6$ | $2x10^6$ | $5x10^5$ | 5.10 | 5.03 | 5.05 | 5.08 | 5.13 | 4.99 |
| 4 | 890 | 830 | 860 | 780 | 730 | 790 | 760 | 720 | 640 | 690 | 610 | 5.06 | 5.01 | 4.93 | 4.75 | 4.72 | 4.67 |
| 5 | 680 | 780 | 750 | 755 | 830 | 790 | 670 | 670 | 690 | 680 | 650 | 5.07 | 5.07 | 5.09 | 5.08 | 5.05 | 5.02 |
| | | | | | | | | *E. coli* FD | | | | | | | | | |
| 1 | 140 | 190 | 180 | 160 | 150 | 190 | 150 | 190 | 260 | 340 | 360 | 4.80 | 4.80 | 4.85 | 4.80 | 4.70 | 4.75 |
| 2 | 140 | 125 | 180 | 170 | 160 | 170 | 140 | 160 | 160 | 180 | 120 | 4.85 | 4.80 | 4.78 | 4.70 | 4.80 | 4.85 |
| 3 | 110 | 85 | 140 | 120 | 150 | 130 | 120 | 140 | 160 | 170 | 120 | 5.05 | 5.02 | 4.85 | 4.95 | 4.85 | 4.80 |
| 4 | 140 | 115 | 140 | 175 | 200 | 150 | 160 | 170 | 140 | 220 | 150 | 4.95 | 4.92 | 4.85 | 4.80 | 4.80 | 4.75 |

milk is detailed by data presented in Tables 3 and 4. Four of the 20 samples produced greater than 50% reduction of the test organism during the first 24 hr of storage. Additional decline in numbers occurred during further storage so that, after 4 days, the population nearly always declined to less than 50% of the number initially present. In general, *E. coli* appeared to be somewhat more sensitive than *A. aerogenes* to the destructive effects of buttermilk.

*Sour cream*

The decline in numbers of *A. aerogenes* and *E. coli* during storage of inoculated sour cream is reported in Tables 5 and 6. In general, *A. aerogenes* appeared slightly more sensitive to the destructive effects of sour cream than did *E. coli*. The number of *A. aerogenes* B199 was nearly always reduced by at least 50% during the first 24 hr of storage, whereas only 2 samples containing *E. coli* exhibited a similar inactivation of the organism. *Aerobacter aerogenes* was not detectable after 7 days in 7 of the 10 sour creams under test. *Escherichia coli*, on the other hand, survived for 10 days in 6 of the 10 samples examined.

*Cottage cheese*

Tables 7 and 8 record data obtained when cottage cheese was inoculated with coliforms and then stored. It is evident that survival of *E. coli* and *A. aerogenes* was greater (both in terms of time and numbers) in this product than in yogurt, buttermilk, or sour cream. In fact, growth of coliforms was evident in some of the samples tested. The pH values of most cottage cheese samples declined during storage, but this change often did not appear related to either survival or demise of coliforms in the product.

The maximum storage time before testing cultured milks and cream for coliforms is designated in *Standard Methods for the Examination of Dairy Products (1)* as 48 hr. Because of the rapid inactivation of the 4 test organisms under study when in yogurt and sour cream, meaningful tests could not be carried out after 24-hr storage. Although the reduction in numbers of test organisms in buttermilk after 24 hr was not as great as in yogurt or sour cream, the reduction was significant. After 48 hr of storage, the test organism concentration averaged one-half of the initial population.

For cottage cheese, *Standard Methods for the Examination of Dairy Products (1)* recommends that the coliform count be carried out within 24 hr after manufacture. Although most counts on cottage cheese

were relatively stable for 48 hr, 2 of the 18 samples tested supported a dramatic increase in test culture numbers within this period. If we could assume the growth of the test organisms studied to be typical of that for coliforms found in cottage cheese, the substantial increase in coliform count within 48 hr after manufacture in about 10% of the lots of cottage cheese could result in an adverse regulatory action being applied unfairly if testing were delayed to 48 hr after manufacture. For this reason, it would seem desirable to continue to test cottage cheese within 24 hr after manufacture.

ACKNOWLEDGMENT

This study was supported in part by Public Health Service Grant 86-68-158 to the American Public Health Association.

REFERENCE

1. Walter, W. G. (ed.). 1967. Standard methods for the examination of dairy products. American Public Health Association, New York.

# ASSOCIATION AFFAIRS

## REPORT OF THE EDITOR JOURNAL OF MILK AND FOOD TECHNOLOGY 1969-1970

REVIEW OF VOLUME THIRTY-TWO

Volume 32 of the *Journal of Milk and Food Technology* was completed with publication of the December, 1969 issue. This was a record-breaking volume in that it contained more pages (624) and more papers (87) than any preceding volume of the *Journal*. Forty-seven research papers and 14 technical papers of general interest were published. This material utilized approximately 45% of the total pages, whereas nontechnical papers of general interest, association affairs, and news and events occupied 30% of the pages. Advertising, covers, index, standards, etc. made up the remaining 25% of volume 32. This distribution, when compared to that of volume 31, reflects an increase (5%) in space devoted to technical material and decreases in space utilized for nontechnical material (2%) and for covers, advertising, etc. (3%). The composition of volume 32 is detailed more completely in Table 1 together with similar information for volumes 30 and 31.

Research papers in volume 32 dealt with a variety of topics including studies on the plate count method, oxidase method, resazurin test, changes during cooking of crab, tests for abnormal milk, composition of apples, egg pasteurization, fat tests for skimmilk, cleaned-in-place systems, coliform bacteria, food-plant wastes, microbiology of meats, microbiology of feedstuffs, methods to enumerate molds, microbial quality of imitation dairy products, Cheddar cheese, low-fat spreads, salmonellae in cheese, methods to measure aflatoxins, salmonellae in butter, and other subjects. General interest papers dealt with such topics as interstate milk shipments, fluorescent antibody technique, imitation foods, methods for detection of viruses and of *Clostridium perfringens*, *C. perfringens* food poisoning, recirculation cleaning, vector control, milk powder, testing of milk, solid wastes disposal, and other topics.

PRESENT STATUS OF VOLUME THIRTY-THREE

The first six issues of volume 33 contained 25 research papers, 7 general interest technical papers, and 8 nontechnical general interest papers. This compares with 24, 7, and 10 papers in the same catagories in the first six issues of volume 32. In addition, 48 pages of E-3A and 3A standards have appeared in volume 33. The first six issues of volume 33 contained 16 more pages than did similar issues of volume 32.

On July 15, 1970 there was a backlog of 48 papers ready for publication. This included 28 research papers and 20 general interest (technical and nontechnical) papers among which are 7 papers from the 1969 annual meeting and 1 from the 1970 annual meeting. In addition, on July 15 there were 16 research papers being reviewed or revised. The backlog would not be as great if 48 pages had not been devoted to standards. As a consequence, it will be necessary to add extra pages to most, if not all, remaining issues in volume 33 so that research papers can be published within six (or less) months after they are received.

REVIEW PAPERS

In the Editor's opinion, review papers are extremely helpful to busy people so they can keep up-to-date on developments in fields which are not their immediate concern. Consequently a number of persons (many suggested by members of the Editorial Board) have been asked to prepare reviews on timely topics. Three such review papers, dealing with activation of bacterial spores, nitrites and nitrates in the environment, and carcinogens in the environment, are awaiting publication. Additional review papers should be received in the near future.

EDITORIALS

Last year the Journal Management Committee suggested that consideration be given to the regular use of editorials. Consequently, the Editor contacted all members of the Editorial Board to determine their interest in and willingness to prepare editorials. There was no ground-swell of enthusiasm for editorials although some members of the Board favored their use. Many board members felt that editorials in technical journals often are a waste of space, especially if one has to appear each month and no one really has anything worthwhile to say. Some Board members felt that the "Letter to the Editor" could serve the same purpose since