

KEEPING QUALITY OF DAIRY PRODUCTS OBTAINED AT RETAIL OUTLETS. I. LOW-FAT MILK, SKIMMILK AND CHOCOLATE FLAVORED MILK^{1, 2}

B. E. LANGLOIS, H. E. RANDOLPH AND NANCY M. CRUME

Department of Animal Sciences
University of Kentucky, Lexington

(Received for publication February 20, 1966)

SUMMARY

A study was made of the bacteriological and keeping quality of low-fat milk, skimmilk, and chocolate flavored milk obtained at retail outlets. Approximately 62% of the low-fat milk samples, 81% of the skimmilk samples, and 93% of the chocolate flavored milk did not have a satisfactory flavor score (36.0 or higher) after storage at 40 ± 2 F for 14 days. The samples ranged in age from 0 to 15 days at time of purchase, the average age being 4.3 days (low-fat milk), 5.3 days (skimmilk), and 5.9 days (chocolate flavored milk). The average days kept at 40 ± 2 F after purchase was 9.5 days (low-fat milk), 7.4 days (skimmilk), and 5.9 days (chocolate flavored milk). Highly significant correlations were observed between: purchase age and initial flavor; days kept and SPC on purchase day, and days kept and SPC after 7 days' storage. The quality of products of an individual brand tended to be similar; whereas, significant quality differences were observed between brands.

EXPERIMENTAL PROCEDURE

Sampling.

One-half gallon samples of low-fat milk and quart samples of skimmilk and chocolate flavored milk representing 12 brands and 9 commercial plants were obtained from supermarket-

type retail outlets in Lexington, Kentucky, between August 1964 and September 1965. Samples were obtained from the front of the display case and taken immediately to the laboratory for examination. From the code numbers on the samples, processing dates were obtained from the plant managers.

Flavor evaluation and keeping quality.

All flavor evaluations were made by a panel of two or more judges experienced in the scoring of dairy products. Samples scoring below 36.0 were considered to be unacceptable. Samples were examined for flavor on the day purchased and after 4, 7, 10, and 14 days' storage at 40 ± 2 F. All flavor evaluations were made on the original container of milk.

Bacteriological examinations.

Official procedures (1) were used for standard plate counts (SPC) with incubation at 32 C, and coliform counts (CC). The samples were plated on the date purchased and again after storage for seven days at 40 ± 2 F.

RESULTS AND DISCUSSION

Low Fat Milk.

Results obtained with the low-fat milk samples are given in Table 1.

TABLE 1. KEEPING AND BACTERIOLOGICAL QUALITY OF LOW-FAT MILK OBTAINED AT RETAIL OUTLETS^a

Brand	Purchase age	Initial flavor	Days kept ^b	Total days kept ^c	Coliform count >10/ml		Standard plate count >30T/ml	
					0 days	7 days ^d	0 days	7 days ^d
← Average →					← Number of samples →			
A	5.8	38.3	6.6	12.4	2	5	4	10
B	5.7	37.6	7.7	13.4	0	1	0	5
C	3.7	38.4	8.4	12.1	1	1	0	4
G	3.3	37.9	10.8	14.1	0	1	1	3
H	5.0	39.0	10.5	15.5	0	1	0	8
I	4.5	39.1	7.0	11.9	0	4	2	10
J	3.4	38.8	13.2	16.6	0	0	0	1
K	3.4	38.9	10.4	13.8	0	0	1	6
L	3.6	38.6	10.8	14.4	0	0	1	6
Avg	4.3	38.5	9.5	13.8	3.3	14.4	8.9	57.8

^aEach brand sampled 10 times.

^bFrom date of purchase.

^cFrom date of processing.

^dAfter seven days storage at 40 ± 2 F.

¹Published with the approval of the Director of the Kentucky Agricultural Experiment Station as Journal Article No. 66-6-18.

²Presented at the Annual Meeting of International Association of Milk, Food and Environmental Sanitarians, Hartford, Conn. Sept. 1965.

The samples ranged in age from 0 to 15 days at time of purchase, the average being 4.3 days. The average age of the individual brands at time of purchase ranged from 3.4 days (Brands J and K) to 5.8 days (Brand A).

Initial flavor scores of the samples on the day purchased ranged from 36.0 to 40.0, the average being 38.5. The average initial flavor score of the individual brands ranged from 37.6 (Brand B) to 39.1 (Brand I). The main flavor defects found in the low-fat milk samples were: cooked, stale, unclean, feed, and "high fortification."

Considerable variation was observed in the keeping quality of the brands of low-fat milk. The average number of days kept after purchase ranged from 6.6 days (Brand A) to 13.2 days (Brand J), the average being 9.5 days. When all of the low-fat milk samples are considered together, approximately 0, 6, 21, 39, and 62% of the samples did not have an acceptable flavor score (36.0 or higher (after storage for 0 (day purchased), 4, 7, 10, and 14 days, respectively).

The variation in keeping quality among the brands is less when determined from date of processing (total days kept), than when determined from date of purchase (days kept). The difference in keeping quality is due to age of the product at time of purchase. In general, the keeping quality decreased with an increase in the age of the sample at time of purchase.

The bacteriological quality showed considerable variation among different brands and also among samples of the same brands purchased at different times. Three out of 90 samples had coliform counts >10 per ml on the day of purchase while 13 samples contained >10 per ml after 7 days storage. Eight samples had initial standard plate counts >30,000 per ml on the day of purchase, while 52 samples contained >30,000 per ml after 7 days storage. A number of samples which had initial SPC's <3,000 per ml spoiled after only 4 to 7 days storage. The pri-

mary spoilage defects were those associated with psychrophilic organisms.

Brand I which had the highest initial flavor had the poorest keeping quality. The poor keeping quality may have been due to the poor bacteriological quality of the product. All of the Brand I samples had SPC's >30,000 per ml after 7 days' storage. This is in contrast to Brand J which had the best keeping quality. Only one sample had a SPC >30,000 per ml after 7 days storage.

The linear correlations obtained for the low-fat milk samples are given in Table 4.

Highly significant correlations were observed between: purchase age and days kept (-0.48); purchase age and coliform count after 7 days' storage (0.30); purchase age and SPC after 7 days' storage (0.41); days kept and total days kept (0.83); days kept and coliform count on day of purchase (-0.35); days kept and coliform count after 7 days' storage (-0.38); days kept and SPC after 7 days' storage (-0.47); and total days kept and coliform count on day of purchase (-0.33). Significant correlations were not observed between: purchase age and initial flavor; purchase age and total days kept; purchase age and coliform count on day of purchase; purchase age and SPC on day of purchase.

Skimmilk.

Results obtained for the skimmilk samples are presented in Table 2.

The samples ranged in age from 1 to 13 days at time of purchase, the average being 5.3 days. The purchase age of Brand E was not known, since the milk containers were not coded. The average purchase age of the individual brands range from 2.5 (Brand J) to 6.9 days (Brand B).

TABLE 2. KEEPING AND BACTERIOLOGICAL QUALITY OF SKIMMILK OBTAINED AT RETAIL OUTLETS^a

Brand	Purchase age	Initial flavor	Days kept ^b	Total days kept ^c	Coliform count >10/ml		Standard plate count >30T/ml	
					0 days	7 days ^d	0 days	7 days ^d
Average					Number of samples			
A	5.6	37.7	8.9	14.5	1	1	1	6
B	6.9	38.6	9.1	16.0	0	1	2	7
C	5.0	38.7	8.0	13.0	0	3	1	7
D	6.8	38.4	7.0	13.8	0	0	1	8
E ^e	—	32.4	1.4	—	2	4	3	7
F	3.9	37.9	10.1	14.0	0	3	2	6
H	6.6	38.4	8.1	14.7	0	2	1	9
I	4.9	38.9	4.5	9.4	0	4	0	10
J	2.5	39.0	12.8	15.3	0	0	0	1
K	5.6	37.5	5.8	11.4	0	3	2	9
L	5.0	38.0	5.7	10.7	1	3	1	9
Avg	5.3	37.8	7.4	13.3	3.6	21.8	12.7	71.8

^aRepresents 10 samples per brand.

^bFrom date of purchase.

^cFrom date of processing.

^dAfter 7 days storage at 40 ± 2 F.

^eProcessing dates not available.

TABLE 3. KEEPING AND BACTERIOLOGICAL QUALITY OF CHOCOLATE FLAVORED MILK OBTAINED FROM RETAIL OUTLETS^a

Brand	Purchase age	Initial flavor	Days kept ^b	Total days kept ^c	Coliform count >10/ml		Standard plate count >30T/ml	
					0 days	7 days ^d	0 days	7 days ^d
Average					Number of samples			
A	5.2	38.0	7.4	12.6	1	1	1	9
B	4.2	37.5	5.3	9.5	1	2	5	10
C	5.9	38.4	8.9	14.8	0	2	1	5
D	9.4	37.0	4.0	13.4	0	1	5	9
E ^e	—	35.9	5.3	—	1	3	3	10
F	4.8	37.8	5.4	10.2	3	6	3	8
H	6.9	37.9	7.9	14.8	1	1	3	10
I	4.8	38.0	4.0	8.8	1	3	3	10
J ^f	3.6	37.9	8.0	11.6	0	0	3	7
K	8.1	36.7	4.5	12.6	1	4	4	10
L	5.8	36.7	4.0	9.8	0	1	3	8
Avg	5.9	37.4	5.9	11.8	8.3	22.0	31.2	88.1

^aEach brand sampled 10 times.

^bFrom date of purchase.

^cFrom date of processing.

^dAfter seven days storage at 40 ± 2 F.

^eProcessing dates not available.

^fOnly sampled 9 times.

The flavor scores of the samples on the day of purchase ranged from 30.0 to 40.0, the average being 37.8. The average flavor score of the individual brands ranged from 32.4 (Brand E) to 39.0 (Brand J). The low flavor score for Brand E was due to oxidized flavor defects. Except for oxidized flavor observed in Brand E, the flavor defects were the same as those noted for low-fat milk. The average days kept ranged from 1.4 (Brand E) to 12.8 days (Brand J), the average being 7.4. The keeping quality of the skimmilk averaged 2.1 days less than that of the low-fat milk. When all skimmilk samples are considered, approximately 10, 16, 32, 60, and 84% of the samples did not have an acceptable flavor score (36 or higher) after storage for 0 (day purchased), 4, 7, 10, and 14 days, respectively.

The bacteriological quality of the skimmilk samples was not so good as that of the low-fat milk samples. The greatest differences existed in the higher number of samples having coliform counts >10 per ml and SPC's >30,000 per ml after 7 days storage. Four out of 110 skimmilk samples had coliform counts >10 per ml on the day purchased, while 24 contained >10 per ml after 7 days' storage. Fourteen samples had SPC's >30,000 per ml on day of purchase, while 79 samples contained >30,000 after 7 days storage.

Brand J, which had the best keeping quality for low-fat milk also had the best keeping quality for skimmilk. Brand I, which had the poorest low-fat milk keeping quality, also had the poorest skimmilk keeping quality. All of Brand I samples had SPC's >30,000 per ml after 7 days' storage.

Table 4 gives the linear correlations obtained for the skimmilk samples. Highly significant correlations

existed between purchase age and initial flavor (-0.35); purchase age and days kept (-0.28); purchase age and total days kept (0.34); purchase age and SPC on purchase day (0.33); purchase age and SPC after 7 days storage (0.34); initial flavor and SPC on purchase day (-0.38); days kept and total days kept (0.81); days kept and SPC on purchase day (-0.41); days kept and SPC after 7 days' storage (-0.46); and total days kept and coliform count after 7 days' storage (-0.27).

When all skimmilk samples purchased from retail outlets are considered together, significant correlations were not observed between: purchase age and coliform count on purchase date and after 7 days' storage; initial flavor and SPC after 7 days' storage.

Chocolate flavored milk.

Results obtained for the chocolate flavored milk samples are given in Table 3.

The samples ranged in age from 1 to 15 days at time of purchase, the average being 5.9 days. The chocolate milk samples had a higher average purchase age than either the low-fat milk or skimmilk samples. The individual brands ranged in average purchase age from 3.6 days (Brand J) to 9.4 days (Brand D).

The initial flavor score of the chocolate milk samples were lower than those of the non-flavored milks. The flavor scores ranged from 30.0 to 39.0, the average being 37.4. Brand C had the highest average flavor score (38.4), while Brand E had the lowest score (35.9). The low flavor score for Brand E was due to oxidized flavor. The major flavor criticisms found were: unnatural chocolate flavor, too sweet,

TABLE 4. LINEAR CORRELATIONS FOR LOW-FAT MILK, SKIMMILK AND CHOCOLATE FLAVORED MILK SAMPLES PURCHASED AT RETAIL OUTLETS

	Initial flavor	Days kept	Total days kept	Colliform count on purchase	Colliform count after 7 days	SPC on purchase day	SPC after 7 days
<i>Low-fat milk</i>							
Purchase Age	-0.05	-0.48**	0.08	0.11	0.30**	0.19	0.41**
Initial Flavor		0.26*	0.27*	-0.12	0.11	-0.23*	0.08
Days Kept			0.83**	-0.35**	-0.38**	-0.24*	-0.47**
Total Days Kept				-0.33**	-0.21*	-0.16	-0.27*
<i>Skimmilk</i>							
Purchase Age	-0.35**	-0.28**	0.34**	0.04	-0.10	0.33**	0.34**
Initial Flavor		0.25*	0.03	-0.10	0.09	-0.38**	-0.06
Days Kept			0.81**	-0.21*	-0.21*	-0.41**	-0.46**
Total Days Kept				-0.18	-0.27**	-0.20	-0.24*
<i>Chocolate flavored milk</i>							
Purchase Age	-0.28**	-0.35**	0.42**	-0.12	-0.10	0.38**	0.22*
Initial Flavor		0.47**	0.24*	0.04	0.06	-0.29**	-0.07
Days Kept			0.71**	-0.19	-0.18	-0.56**	-0.30**
Total Days Kept				-0.27**	-0.26*	-0.26*	-0.12

*Significant at 5% level.

**Significant at 1% level.

lack of flavor, burnt, coarse, and fermented. Ropiness was observed in several samples.

The keeping quality of the chocolate milk samples was poorer than that of the non-flavored milks. The average days kept ranged from 4.0 (Brands D, I, L) to 8.9 (Brand C), the average being 5.9. The total days kept was 2.0 days less than the low-fat milk samples and 1.5 days less than the skimmilk samples. The average total days kept ranged from 8.8 (Brand I) to 14.8 days (Brands C and H). When all the chocolate flavored milk samples are considered, approximately 5, 22, 45, 73, and 93% of the samples did not have an acceptable flavor (36.0 or higher) after storage for 0 (day purchased), 4, 7, 10, and 14 days, respectively.

The bacteriological counts of the chocolate flavored milks were much higher than those of the non-flavored milk samples. Nine out of 109 samples had coliform counts >10 per ml on day purchased, while 24 samples were >10 per ml after 7 days' storage. Thirty-four samples had SPC's >30,000 per ml on the day purchased, while 96 contained >30,000 per ml after 7 days' storage.

As was true of the other milk samples, Brand I had one of the poorest keeping qualities while Brand J, had one of the best. All of the Brand I samples had SPC's >30,000 after 7 days' storage.

Linear correlations for chocolate flavored milk samples are given in Table 4.

Highly significant correlations were found between: purchase age and initial flavor (-0.28); pur-

chase age and days kept (0.35); purchase age and total days kept (0.42); purchase age and SPC on purchase day (0.38); initial flavor and days kept (0.47); initial flavor and SPC on purchase day (-0.29); days kept and total days kept (0.71); days kept and SPC on purchase day (-0.56); days kept and SPC after 7 days' storage (-0.30); and total days kept and coliform count on purchase day (-0.27). Significant correlations were not found between: purchase age and coliform count on day of purchase; initial flavor and coliform count on day purchased; days kept and coliform count on day purchased.

ACKNOWLEDGMENT

The authors gratefully acknowledge the assistance of Mr. Tomnye Cooper of the Department of Dairy Science, in the statistical treatment of the data reported in this paper.

REFERENCES

1. American Public Health Association. 1960. Standard Methods for the Examination of Dairy Products. 11th ed. Am. Public Health Assoc. New York.
2. Elliker, P. R., Sing, E. L., Christensen, L. J., and Sandine, W. E. 1964. Psychrophilic Bacteria and Keeping Quality of Pasteurized Dairy Products. J. Milk and Food Technol. 27:69.
3. Kepner, K. W. and Slatter, W. L. 1964. Empirically Measured Quality Differences Among Brands of Fluid Milk. J. Dairy Sci. 47:684.
4. Randolph, H. E., Freeman, T. R., and Peterson, R. W. 1965. Keeping Quality of Market Milk Obtained at Retail Outlets and at Processing Plants. J. Milk and Food Technol. 28:92.