

Relation of Code Dates to Quality of Milk Sold in Retail Markets

LESTER HANKIN¹, WALTER F. DILLMAN², and GEORGE R. STEPHENS³

*Departments of Biochemistry and Ecology and Climatology,
 The Connecticut Agricultural Experiment Station,
 New Haven, Connecticut 06504 and
 Dairy Division, Department of Agriculture,
 Hartford, Connecticut 06115*

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ABSTRACT

Milk collected at retail markets and in schools in Connecticut in 1970-71, 1974, and 1975 was examined for flavor quality, temperature at collection, code date (last day product is intended to be offered for sale), and age of sample (days from bottling). The relationships between quality and age of sample and the processor's code date were tested. Regression analysis of 1975 samples showed that, on the average, processors overestimated shelf life by about 2 days, but this overestimate varied from 0 to 7 days for individual dairies. Although the temperature of samples collected in 1974 and 1975 was lower than in the 1970-71 sampling, there was no diminution in the percentage of samples of unsatisfactory quality.

To allow consumers to assess the age of products at the time of purchase, a date is placed on the container that indicates either the date of packaging or the last date the product may be sold or offered for sale. The consumer, therefore, expects that a product purchased on any date up to the last date it may be sold or offered for sale is of acceptable quality. Also, if properly treated, it should remain acceptable beyond the last date of sale.

Since January, 1974, Connecticut law has required that the last date that pasteurized milk may be sold or offered for sale to consumers through retail stores (usually called the "code date") be clearly marked on the container. However, each dairy establishes its own code date and can change it without notifying any regulatory agency. Before 1974 some dairies coded their products but usually with a code not recognizable to the consumer.

We investigated the following: (a) What was the actual age of milk offered for retail sale and purchased by consumers? (b) Was the milk of acceptable quality when purchased? (c) What was the relationship between quality and age of sample at purchase? (d) Were the code dates used by processors realistic? Milk samples collected during 1970-71 and in 1974 and 1975 allowed us to investigate these questions. In addition the data

provided a basis for determining the percentage of milk offered for sale after expiration of the code date, and which off-flavors predominated.

METHODS

Milk samples were collected during 1970-71, 1974, and 1975 at retail markets in Connecticut by inspectors of the Dairy Division of the Connecticut State Department of Agriculture. No market was sampled more than once yearly. The temperature of the sample was determined at the time of collection and samples were refrigerated in an insulated container containing ice until delivered to the laboratory within 24 h, where flavor score and criticism were obtained as previously described (2, 3, 4). Scores ranged from 40 to 30; the higher score indicating a sample with no off-flavor. A flavor score of less than 36 was considered unsatisfactory. The number of samples examined were 450 in 1970-71, 528 in 1974, and 864 in 1975. Additionally, in 1975, 192 samples were collected from schools.

In this report "code date" is used to mean the date marked on the container designating the last day on which the milk may be sold or offered for sale. "Code period" is defined as the number of days between the date of bottling and the code date. "Age" means the number of days between bottling and collection, and "day 0" denotes that the sample was collected on the same day it was bottled. Individual dairies provided information on the length of their code period, and this permitted us to calculate the date of bottling, and thus the age of each sample.

RESULTS AND DISCUSSION

Age of retail milk samples

The age of milk collected in retail stores and schools varied from 0 to 16 days (Table 1). The average age of samples in 1970-71 was 4.3 days and in 1974 and 1975, 4.7 days. Also shown in Table 1 is the distribution of age of samples offered for sale. However, age or distribution of age (Table 1), does not provide information on quality. Although the percentage of samples with unacceptable flavor scores increased from 10% in 1970-71 to 15% in 1974-1975 (Table 2), the difference is not statistically significant. The 450 samples of 1970-71 represented mostly large processors and were the only samples with code dates in a larger set of 1180 samples (3). Previously we reported that 16.7% of the 1180 samples collected in 1970-71 had unacceptable flavor scores (3). Thus, the

¹Department of Biochemistry

²Dairy Division.

³Department of Ecology and Climatology.

TABLE 1. Age¹ of milk samples from retail outlets and schools

Age (Days)	Year collected			
	1970-71	1974	1975	1975 schools
0 ²	1.8	2.7	3.2	7.8
1	5.8	4.7	7.1	28.6
2	10.2	11.9	11.7	18.8
3	20.9	12.3	11.1	8.9
4	19.8	16.0	17.0	19.7
5	16.9	18.8	17.2	9.4
6	10.2	15.7	13.9	6.8
7	6.0	8.0	7.2	
8	3.1	3.4	4.9	
9	1.8	3.0	3.6	
10	1.8	1.7	1.4	
11	1.1	0.4	0.9	
12	0.4	0.6	0.3	
13	0.2	0.4	0.3	
14		0.4	0.1	
15		0		
16		0.2		
Total no. of samples	450	528	864	192
Avg. age ¹ of milk collected	4.3	4.7	4.7	2.6

¹Number of days from bottling to collection.

²Day 0 indicates sample collected the same day it was bottled.

TABLE 2. Percentage of samples with unacceptable flavor scores (<36) and of samples beyond code date when collected

Category	Year collected			
	1970-71	1974	1975	1975 Schools
Unacceptable flavor (score <36)	10.4	14.4	15.2	7.8
Past code date	5.1	1.5	0.5	0
Past code date and unacceptable flavor	1.6	1.1	0.5	0

percentage of samples with unacceptable flavor scores remained nearly the same during the 5 years.

The percentage of samples still offered for sale after expiration of the code date declined from 1970-1971 to 1974 and 1975 (Table 2). The decline may be explained in part by a change in the length of the code period for individual dairies. Of the five dairies examined in both 1970-71 and 1974-75, four increased their code period by an average of 2.5 days. Of the 18 sampled in 1974-75, two

TABLE 4. Flavor criticisms of retail and school milk samples

Flavor criticism	Year collected							
	1970-71		1974		1975		1975 schools	
	% of total	% with flavor score < 36 ²	% of total	% with flavor score < 36	% of total	% with flavor score < 36	% of total	% with flavor score < 36
OK (no criticism)	0.2	0	0.2	0	2.0	0	2.6	0
Cooked	23.1	0	2.8	0	3.2	0	4.2	0
Cooked and feed	48.2	0	5.3	0	7.9	0	8.9	0
Feed	3.6	0	71.6	0	57.3	0	66.7	0
Oxidized	4.0	2.9	4.7	3.8	2.7	2.5	0.5	0.5
Lacks freshness (old)	17.3	5.6	10.4	8.0	15.9	9.4	10.9	6.3
Putrid	0.4	0.4	1.5	1.5	1.2	1.2	0.5	0.5
Rancid	0.7	0.2	0.4	0.4	0	0	0	0
Malty	0.9	0.9	0.2	0.2	0.2	0.2	0	0
Chemical	0.2	0	0.2	0	0.7	0.5	0	0
Unclean (barny)	0.4	0	0.4	0	1.0	0.2	0	0
Burnt (scorched)	0.2	0	1.7	0.2	6.5	0.2	3.6	0
Misc. ¹	0.7	0.5	0.6	0.3	1.6	1.0	2.1	0.5
Total no. of samples	450	47	528	76	864	131	192	15

¹Misc. includes the criticisms bitter, sour, fruity, yeasty, curdled, onion, musty and salty.

²A flavor score of <36 is unsatisfactory.

increased their code period by 4 days between 1974 and 1975. The average code period of dairies examined in 1970-71 was 8 days and in 1974-75 the average had increased to just over 10 days.

Refrigeration temperatures of samples

Poor quality milk cannot always be attributed to the processor. Retail stores must adequately protect perishable foods with good refrigeration. Although the average age of all samples from bottling to collection in 1975 was 4.7 days, the average age of samples with an unsatisfactory flavor score was 6.2 days, indicating a longer residence at the market. Temperatures at time of collection are shown in Table 3. Samples above 7.2 C

TABLE 3. Temperature of retail milk samples at collection and relationship to flavor score

Year collected	Temp. at collection	% of Samples	% of Total flavor score < 36	% of Total flavor score ≥ 36
1970-71	< 4.4C ¹	29.1	2.7	26.4
	4.4-7.2C	48.0	5.8	42.2
	> 7.2C	22.9	2.0	20.9
Total no. of samples		450	47	403
1974	< 4.4C	36.0	3.8	32.0
	4.4-7.2C	56.4	8.1	45.8
	> 7.2C	7.6	2.5	7.8
Total no. of samples		528	76	452
1975	< 4.4C	41.2	6.9	34.3
	4.4-7.2C	53.4	7.1	46.3
	> 7.2C	5.4	1.2	4.3
Total no. of samples		864	131	733

¹4.4 and 7.2 C are 40 and 45 F respectively.

(45 F) declined from 22.9% in 1970-71 to 5.4% in 1975. Further, the percentage of samples below 4.4 C (40 F) increased, and the percentage of samples at 10.0 C (50 F) or higher declined from about 4% in 1970-71 to 0.7% in 1975. Even though some samples had a temperature of >7.2 C when collected, they were still of acceptable quality (Table 3). Thus, despite an apparent improvement in milk refrigeration in retail stores, the percentage of samples with unacceptable flavor scores did not decline.

Flavor criticism.

Flavor criticisms changed somewhat from 1970 to 1975 (Table 4). The number of samples criticized as being cooked declined dramatically, probably indicating better control of pasteurization procedures. The largest increase was in samples criticized as having a feed flavor. During 1974-75 there was a substantial increase in feed prices as well as a shortage of some feeds because of drought. Use of alternative feed could have caused the feed flavor. None of the samples criticized only for feed flavor had an unsatisfactory flavor score.

For samples with unsatisfactory flavor scores there was a rise in those designated as lacking freshness or old (Table 4). This may indicate increased activity of psychrotrophic bacteria and especially psychrotrophic pseudomonads (*1, 4*). Samples criticized as being putrid also increased slightly. The increase in these off-flavors could be related to the longer time the sample is held for sale (Table 1) even though temperatures were lower (Table 3), and again may indicate the presence of psychrotrophic organisms. Of interest is the large number of 1975 samples with a burnt or scorched flavor. Just over 75% of these were traced to one dairy. Faulty processing or too high a temperature used in sealing paper cartons is probably the cause.

School samples.

The 192 samples collected from schools in 1975 were somewhat different from those collected at retail markets. Only 7.8% of the school samples had an unacceptable flavor score compared to 15.2% for the samples from markets (Table 2). Essentially the same flavor criticisms were given to both groups of samples and the distribution of collection temperatures was also the same. No samples from schools were past the code date. The largest discrepancy between the two groups was in the average age of the sample (i.e., the days from bottling to collection), 2.6 days for schools and 4.7 days for stores (Table 1), and likely represents a difference in distribution. The average age of school samples below flavor score 36 was 2.9 days compared to 2.6 days for all school samples. Thus the samples were probably unsatisfactory before delivery. The same dairies supplying milk to both schools and retail markets had 13.8% of samples with an unsatisfactory flavor score in schools and 15.5% in retail markets.

Milk presently available to Connecticut consumers is older than in the past. In 1974-75 fewer samples were still offered for sale after the expiration of the code date, but the code period of samples increased an average of 2.5 days. Even though the milk was older when offered for sale, it was not of lower quality since the percentage of unacceptable samples did not increase during 1974-75. If anything, milk appears to be stored at a lower temperature, which shows an awareness of the necessity for proper refrigeration. We have also found that milk from stores chiefly selling dairy products is of a lower average age than from other stores, and that milk from

smaller, local dairies is of a lower age than from larger dairies.

Relation of age to flavor score.

As the age of the milk increased, the flavor score decreased. In all 3 years there was a statistically significant negative correlation of flavor score with age among samples from retail outlets (Table 5). For samples

TABLE 5. Correlation coefficient (*r*) of flavor score and age of milk samples collected at retail markets and schools

Variables	Year collected			
	1970-71 (450 samples)	1974 (528 samples)	1975 (864 samples)	1975 Schools (192 samples)
Flavor score vs. age	-.301***1	-.261**	-.291***	-.128
Flavor score vs. days remaining in sale period	-.381***	.300**	.240***	.194**

1**Significant at 1% level; ***Significant at .01% level.

collected in schools in 1975 there was no significant correlation of flavor score and age (Table 5), probably because of the shorter time between bottling and collection.

The consumer cannot test milk quality before purchase, nor does the consumer know how much time has elapsed since bottling. The only apparent indicator of milk quality is the time remaining before the code date expires. Is this remaining time a reliable indicator of quality? To test this we examined the correlation between flavor score and the time remaining to the code date. As shown in Table 5 flavor score decreased as the time remaining for sale decreased. Thus the longer the time remaining to the code date, the higher the flavor score of the samples.

If we accept a flavor score of less than 36 as indicating milk of unacceptable quality, the question becomes, when during the code period does milk deteriorate to this level? To determine this the regressions of flavor score on days remaining to the code date were calculated for the 3 years of samples from markets and the 1975 school samples (Fig. 1). The intersection of the regression line

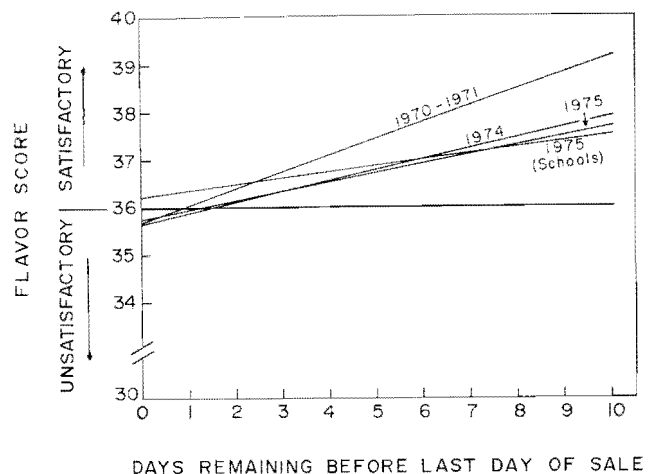


Figure 1. Regression of flavor score on time (days) remaining before last day of sale for all milk samples collected at retail markets in 1970-71, 1974, 1975 and at schools in 1975. R^2 values for each regression are: 0.145 ($P = <.001$) for 1975, .090 ($P = <.001$) for 1974, .058 ($P = <.001$), and .038 ($P = .008$) for 1975 school samples.

and the flavor score line of 36 indicates the number of days overestimated on the code period. On the average in 1974 and 1975, milk with about 2 days remaining to the code date had already reached a flavor score of 36. In 1970-71 the minimum time was about 1 day. Apparently, if the consumer is to obtain milk of acceptable quality at purchase, at least 2 days must remain before the expiration of the code date.

A similar analysis was made on samples from the individual dairies. As examples, the regressions for three major dairies with code periods from 7 to 14 days, are shown in Fig. 2. Overestimates of the code period ranged from less than 1 up to 7 days. Dairy A uses a code period of 12 days, yet the minimally acceptable score is reached in about 8 days. Hence, the code period is over estimated

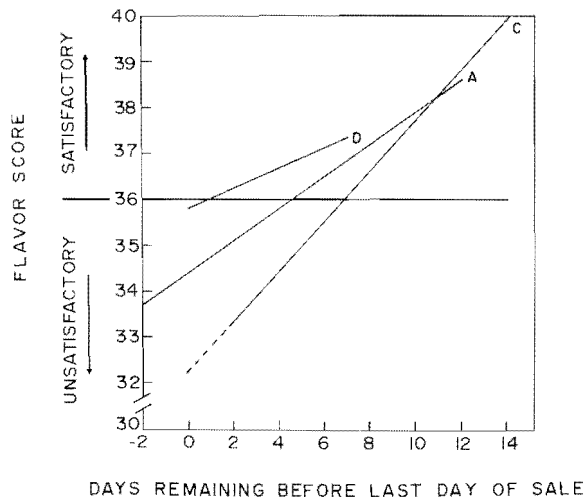


Figure 2. Regression of flavor score on time [days] remaining before last day of sale for milk from three dairies (A, C, D) sampled in 1975. Solid line indicates actual range of values encountered. Dotted portion of line C is an extrapolation. R^2 values for each regression are: .174 ($P < .001$) for A, .359 ($P < .001$) for C, and .071 ($P = .006$) for D.

by 4 days. Dairy C with a code period of 14 days appears to be overestimating its code period by about 7 days. Dairy D with a code period of 7 days appears to be making an accurate appraisal since a flavor score of 36 is reached with 0.8 day remaining in the code period.

Processors in Connecticut generally appear to estimate their code periods better for milk than they do for cottage cheese. We have previously found that processors of cottage cheese overestimated code periods about a third of the time (5). For milk, this value is about 15%.

From the consumer viewpoint, our data (Fig. 1) point out that on the average milk with less than 2 days remaining to the code date may not have an acceptable flavor, but there is great variability among dairies as well as within individual dairies (Fig. 2). This study should enable dairies to assess their quality control programs and if necessary make improvements for the benefit of consumers.

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