Relation of Code Dates to Retail Milk Supply

LESTER HANKIN* and DONALD SHIELDS

Department of Biochemistry & Genetics, The Connecticut Agricultural Experiment Station, P.O. Box 1106, New Haven, Connecticut 06504 and Dairy Division, Connecticut Department of Agriculture, Hartford, Connecticut 06511

(Received for publication June 21, 1982)

ABSTRACT

Milk from major dairies in Connecticut was examined three times over a 2-year period for flavor and bacterial counts immediately after bottling and after storage at 40 and 45°F to the end of the code period. The first two test periods were when processors established their own code periods which ranged from 7 to 14 d, but most were 9 to 12 d. The third test period was after a uniform code period of 10 d became effective, and some processors petitioned for an increase to 12 d. There was no marked improvement over the 2-year test period in keeping quality for milk stored at 40°F, or 45°F (7.2°C) to the code date (last day of sale). In each test, all samples met bacterial standards after bottling but most did not meet the standard after refrigerated storage to the end of the code period. The amount of milk available for sale met keeping quality standards, but only 28 to 42% met bacterial standards. After storage at 45°F, 55 to 87% of milk available for sale met the keeping quality standard but less than 10% met the bacterial standard. Conclusions were that increasing the length of the code period would not be advantageous to consumers.

Beginning in January 1974 Connecticut Statutes required that a code date be placed on cartons of milk showing the last day the product could be offered for sale. Processors established their own code period, the number of days from bottling to the code date. Code periods among dairies ranged from 7 to 14 d, but most were 9 to 12 d (3,4,5). The length of the code period could be changed at any time by the processor and frequently was. For example, it was made longer in winter and shorter in summer, and longer for milk bottled later in the week. These changes were usually about 1 to 2 d.

The Statutes also require a refrigeration temperature of not more than 45°F (7.2°C), and a Standard Plate count (total aerobic count) of not greater than 25,000 and a coliform count of not more than 5 per ml. In addition, there are standards for fat, total solids and vitamin additives, and it is stated that the milk should have no off-flavor.

Starting January 1, 1982, based partly on our findings (3,4,5), a uniform code period of 10 d was established by Connecticut Statutes for all dairies. Changes in the length of the code period could be made provided scientific investigation by the Connecticut Department of Agriculture established that an acceptable flavor was maintained to the proposed code period. Bacterial standards and refrigeration requirements remained unchanged.

Unfortunately, interpretation of the Statute was ambiguous. Some thought changes in code period could be made for individual dairies, while others thought that changes must be uniform for the entire industry. This issue remains unresolved. Within 2 months after the new Statute became effective, requests were made by some dairies to allow them to increase the 10-d uniform code to 12 d. The claims were: (a) an economic disadvantage resulted for those dairies producing milk that could remain at an acceptable flavor past the 10-d code period; (b) milk would have to be delivered more frequently to stores to provide milk with the longest time to the code date, and thus transportation costs would increase and (c) because of the shorter code period more returns would be expected from stores since consumers would reject milk with a code date close to the day of purchase.

Some dairies offered to submit data showing that their products met a 12-d code period, but they did not detail how their tests would be made, or the conditions of storage. All tests, however, were to be based on organoleptic analysis and not bacterial analysis.

The Statutes do not state when or where the milk samples for analysis are to be taken. It is the practice to collect samples for bacterial analysis at the processing plant on the day of bottling but generally not later than 2 d after bottling. Samples for flavor analysis are generally collected at both processing plants and at stores.

To determine if a 12-d uniform code period was appropriate, we examined milk from major dairies in Connecticut for flavor and bacteria. The tests are compared to two test periods 2 years ago when dairies established their own code periods.

---

*Connecticut Agricultural Experiment Station.
1Connecticut Department of Agriculture.
TABLE 1. Percentage of samples and percentage of milk available for sale meeting flavor and bacterial standards.

<table>
<thead>
<tr>
<th>Line No.</th>
<th>Category</th>
<th>Storage temp. (°F)</th>
<th>Test period</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Keeping quality, average no. days</td>
<td>40</td>
<td>17.1</td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>45</td>
<td>10.4</td>
</tr>
<tr>
<td>3</td>
<td>Flavor acceptable last sale day, % of samples collected</td>
<td>40</td>
<td>92.6</td>
</tr>
<tr>
<td>4</td>
<td></td>
<td>45</td>
<td>51.9</td>
</tr>
<tr>
<td>5</td>
<td>SPC&lt;sup&gt;b&lt;/sup&gt; acceptable last sale day, % of samples collected</td>
<td>40</td>
<td>44.4</td>
</tr>
<tr>
<td>6</td>
<td></td>
<td>45</td>
<td>14.8</td>
</tr>
<tr>
<td>7</td>
<td>Coli&lt;sup&gt;c&lt;/sup&gt; acceptable last sale day, % of samples collected</td>
<td>40</td>
<td>85.2</td>
</tr>
<tr>
<td>8</td>
<td></td>
<td>45</td>
<td>59.3</td>
</tr>
<tr>
<td>9</td>
<td>Flavor acceptable last sale day, % of total sales&lt;sup&gt;a&lt;/sup&gt;</td>
<td>40</td>
<td>91.8</td>
</tr>
<tr>
<td>10</td>
<td></td>
<td>45</td>
<td>59.1</td>
</tr>
<tr>
<td>11</td>
<td>SPC acceptable last sale day, % of total sales&lt;sup&gt;a&lt;/sup&gt;</td>
<td>40</td>
<td>42.5</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>45</td>
<td>7.7</td>
</tr>
<tr>
<td>13</td>
<td>Coli acceptable last sale day, % of total sales&lt;sup&gt;a&lt;/sup&gt;</td>
<td>40</td>
<td>80.3</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>45</td>
<td>54.2</td>
</tr>
<tr>
<td>15</td>
<td>Number of dairies</td>
<td></td>
<td>9</td>
</tr>
</tbody>
</table>

<sup>a</sup>Values adjusted to reflect 100% of sales.
<sup>b</sup>SPC = Standard Plate Count.
<sup>c</sup>Coli = Coliform bacteria.

METHODS

Samples were collected in consumer-size containers at dairy plants and stored on ice for delivery to the laboratory. They were collected either on the day of bottling or in a few instances the next morning. Replicate samples of whole, lowfat and nonfat milk were collected and stored at 40 and 45°F (4.4 and 7.2°C) to test for keeping quality (acceptable flavor). For microbial analysis, portions of each sample were transferred aseptically from the original container to sterile bottles which were also stored at 40 and 45°C for testing at the end of the code period. Flavor analysis was made by methods of the American Dairy Science Association modified for use in the Connecticut flavor program (2). Microbial analysis was by Standard Methods (6). The first test period covered January through April 1980, the second August 1980 and the third March 1982.

RESULTS AND DISCUSSION

We have reported on flavor and keeping quality of different types of milk obtained from the same dairy and found no significant difference among types (5). In the present study, we also found no major difference in keeping quality or bacterial counts for whole, lowfat and nonfat milk and thus the data are pooled. The data on keeping quality of milk from the various dairies are also pooled since we found little difference among dairies regarding acceptability to the code date.

In all test periods, samples taken at collection were satisfactory in flavor and bacterial counts (SPC). Only in the second test period (August 1980) did one sample not meet the coliform standard.

Flavor analysis - samples from different dairies

Between 92 and 100% of the samples stored at 40°F remained satisfactory in flavor to the end of the code period (line 3, Table 1). At 45°F only 52 to 68% of the samples remained satisfactory to the end of the code period (line 4, Table 1).

In each test period, there were always a few samples that retained good flavor for an inordinate length of time (over 25 d at 40°F), but these were the exception and were not always from the same dairy.

The average number of days for samples to become unacceptable in flavor is shown in Table 1, lines 1 and 2. In the three test periods, milk kept at 40°F remained acceptable on the average about 17 to 18 d (line 1, Table 1). At 45°F they retained an acceptable flavor for 10 to 12 d (line 2). The number of days for milk to remain acceptable at either temperature of storage did not change substantially among test periods.

Bacterial analysis - samples from different dairies

The data for total aerobic count (SPC) present a far different picture. When tested initially all samples met the bacterial standard. In all test periods, only 33 to 40% of samples stored at 40°F complied with the maximum of 25,000 SPC/ml at the end of the code period (line 5, Table 1). At 45°F, only 7 to 15% met the maximum permitted standard (line 6). Data on coliform bacteria were mixed. In the first two periods, a considerable number of samples, 82 to 85%, stored at 40°F to the code date were below the maximum of 5 coliform bacteria per ml (line 7). At 45°F, the number of acceptable samples at the end of the code period was reduced about half (line 8). In the third test...
period, only about 30% of the milks met the coliform standard when stored at either 40 or 45°F to the end of the code period (lines 7 and 8, Table 1).

Flavor and bacterial analysis - volume of milk

From the consumer's viewpoint it may be helpful to express the results as the percentage of milk available for sale meeting flavor and bacterial standards rather than just the percentage of milk samples from the separate dairies meeting standards. If milk from a dairy with a large share of the market sales fails to meet flavor or bacterial standards then a large proportion of the milk available for sale is unsatisfactory, whereas a small dairy with poor milk would have little overall impact on the total amount of unacceptable milk for sale.

Table 1 (lines 9 through 14) presents data relating satisfactory samples in flavor and bacteria to the supply available to consumers. In some instances there is little difference between the percentage of satisfactory samples from dairies and the amount of satisfactory milk available to consumers (% of total sales). During January to April 1980 there was little difference between the percentage of samples satisfactory (lines 3 and 4) and the percentage of the milk supply satisfactory (lines 9 and 10). In this test period, one dairy accounted for most of the poorly flavored milk after storage at 40°F. At 45°F poor milk was distributed among large and small dairies.

In August 1980, only 68% of samples met the flavor standard when milk was stored at 45°F (line 4), yet 87% of the total milk available to consumers was satisfactory (line 10). In this instance, the poor milk was distributed uniformly among all dairies regardless of sales volume. In March 1982, the volume of milk remaining satisfactory when stored at 45°F (line 10) was lower than the percentage of poor samples (line 4). In this instance, dairies with higher sales volumes had more poorly flavored milk than dairies with low sales volumes.

Total aerobic counts (SPC) were uniformly poor in each test period when the milk was stored at 40 and 45°F to the end of the code period. This is reflected in the data for the percentage of milk offered for sale and meeting the bacterial standard at the end of the code period (lines 5 and 6, Table 1). Only 28 to 42% of the milk for sale to consumers met bacterial standards after storage (lines 11 and 12). Over the 2-year test period the percentage of samples and percentage of milk offered for sale meeting the bacterial standard at either 40 or 45°F declined (lines 5, 6, 11, and 12). This may indicate that the level of contaminating mesophilic bacteria increased in the milk supply.

Relation of time and type of testing to results

We wish to emphasize that all samples were satisfactory at the initial testing. This examination was done on milk collected at the dairy plant and was always less than 3 d old. The current knowledge about the kinds of microorganisms damaged by heat and their rate of recovery (9) may well explain why so few aged samples met bacterial standards. It seems reasonable to suggest that milk stored under ideal conditions should meet both flavor and bacterial standards throughout the entire code period.

The efficacy of the bacterial standards merits consideration. One may ask whether the SPC is sufficiently critical for use with the present milk supply, and whether another bacterial test or tests may be appropriate. Our own work,
for example, has shown little correlation between the SPC and keeping quality of milk (1). We believe that a biochemical test which assays biochemically active psychrotrophic pseudomonads would be extremely valuable in evaluating milk supplies for keeping quality.

**Overall flavor analysis in relation to volume for milk for sale**

Based on the analysis for keeping quality of the samples stored at 40 and 45°F, we projected the results to the volume of milk offered for sale to consumers. The percentage of the volume of milk for sale in each test period that remained acceptable in flavor for a specific number of days was compared (Fig. 1). Thus we could determine in another way how much of the milk offered for sale in the third test period would remain satisfactory longer on storage at 40 and 45°F than did milk collected in the other two test periods and to learn if any difference occurred. In Fig. 1, values of 100% are not plotted. In all instances, all milk was satisfactory for at least 6 d.

An analysis of regressions (7) showed no significant difference (p=.05) in regression between the volume of milk for sale in January to April 1980 and the period March 1982 when the milk was stored at 40°F. Samples collected in August 1980 and stored at 40°F remained acceptable in flavor for a longer time. The regression for August 1980 differed significantly (p=.05) from the regressions of January - April 1980 and March 1982. The reason for the difference is not clear. There was no significant difference (P=.05) in the change of acceptable flavor over time for milk samples stored at 45°F among the three test periods.

Thus we again confirm that no dramatic change in the keeping quality of the milk offered for sale occurred from the time processors set their own code periods to the time they requested changing from the 10-d uniform code period to 12-d code period.

An analysis of market milk in Maryland has resulted in the suggestion for that State that processors should be judged individually for shelf life rather than using a uniform code period (8). They found that over 90% of milk collected at dairies was satisfactory after 7 d of storage at 44.6°F (7°C) but only 78% of these obtained at stores was acceptable. This, of course, may relate to temperature control at stores. We find that most milks remain at an acceptable flavor for a least 7 d if stored properly.

Our original question was whether it would be appropriate as far as flavor is concerned for processors to be allowed to increase code periods from 10 up to 12 d. Our data do not show that dairies with longer codes consistently meet flavor and bacterial standards better than those with shorter code periods. Further there has not been a marked improvement in the volume of milk offered for sale that can meet flavor standards for a longer time.

After the present study was completed, however, a new Statute went into effect in May 1982 allowing dairies to change their code period from 10 up to 12 d if they desired. Testing of their milk for keeping quality was not required. The new Statute also allows for the use of a code period of under 12 d whenever they wish. As soon as regulations are written to implement the new Statute, processors may request changes in code periods for more than 12 d.

**ACKNOWLEDGMENTS**

We thank Michelle Birks for the microbial analyses, Matthew Myers for helping with the flavor analyses and Dr. George Stephens for discussions on the statistical analysis.

**REFERENCES**