Sensory and Shelf-Life Evaluations of Cottage Cheese Treated with Potassium Sorbate

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Abstract

Cottage cheese samples containing 0.025 to 0.20% potassium sorbate were evaluated by a sensory panel of 18 judges, using the duo-trio test method or organoleptically in seven Cottage cheese plants. The samples were then stored at 4 or 7 C and evaluated for shelf-life. The panel did not significantly detect 0.10% or less of potassium sorbate in Cottage cheese by taste or odor. The minimum levels of potassium sorbate detected in the Cottage cheese plants were 0.10% (four plants), 0.05% (two plants), and 0.025% (one plant). Shelf-life was extended in some experiments by 0.05% potassium sorbate and in all experiments by 0.10%. These amounts of potassium sorbate retarded growth of bacteria that produced fruity and putrid odors and slime in Cottage cheese at refrigeration temperatures and bacteria that produced sourness and molds.

This investigation was made primarily to study the effects of potassium sorbate on Cottage cheese flavor and potential consumer acceptance. We tested the ability of a panel of 18 judges to distinguish by flavor or odor the presence of potassium sorbate in Cottage cheese at concentrations up to 0.2%. Effects of the different concentrations of potassium sorbate on shelf-life of the Cottage cheese were determined, and experiments were run in seven commercial Cottage cheese plants to determine the extent of agreement on the detectability of sorbate and its influence on the shelf-life of Cottage cheese.

Experimental Procedures

Preparation of Cottage cheese. Thirty-two kilograms of small curd and 16 kg of dressing cream were purchased for each experiment from a commercial Cottage cheese plant. Sixteen kilograms of the curd and 8 kg of salted cream were mixed, yielding the reference sample (R). The remaining curd and cream were each divided into four or five equal portions, and calculated amounts of potassium sorbate or sorbic acid were dissolved in the cream portions before they were mixed with the curd. One experiment used 0, 0.05, 0.075, and 0.10% potassium sorbate, and 0.075% sorbic acid. A second experiment used 0, 0.075, 0.10, 0.125, 0.15, and 0.20% potassium sorbate. The samples of cream and curd were mixed, refrigerated two days at 4 C, remixed, placed in 2.23-kg (5-lb) cartons, and refrigerated until used.

Sensory evaluation. Each of two sensory-evaluation experiments involved testing a set of samples once each day for four consecutive days. The first day was used for orientation of the judges, and the three following days resulted in three evaluations for each judge for each pair of samples. Seventeen judges participated in the first experiment, and 18 participated in the second. Each judge was experienced in sensory evaluations. Judging sessions were conducted at the same hour each day under 200-W white illumination in individual booths maintained at 21 ± 1 C.

Samples (each 15 to 20 g) were served in coded 50-ml beakers, and the duo-trio test method (8) used. The judges were first provided with a sample of untreated Cottage cheese, marked R for reference, followed by four (five in the second experiment) coded pairs, consisting of
randomized presentations of the reference versus one of the treated samples. The judges selected the sample within each pair that was the same as R. Since one judge in the first experiment indicated that he could detect sorbate by odor, judges were asked in the second experiment to taste each pair of samples first and decide which samples were the same as R and, after recording the decisions, smell each pair and decide again which samples were the same as R. Finally, the judges selected from each pair the one they preferred and wrote the reason for preference. Judges used distilled water for oral rinsing between the pairs and did not swallow the cheese or water. The judges were informed of their results after each session.

Chi-square for one-tailed and two-tailed tests (15) was used to determine the significance of the differences and preferences, respectively, between the paired samples.

**Shelf-life.** The controls and treated samples of Cottage cheese were stored at 4°C, and portions were removed every three to five days for visual examination and organoleptic evaluation by two to five judges.

**Plant experiments.** Each of seven Cottage cheese plants added potassium sorbate dissolved in sterile water, pasteurized milk, or cream to dressing cream. Pint or half-pint cartons with snap-on lids were filled about three-fourths full with the creamed Cottage cheese. One set of samples was refrigerated overnight and evaluated organoleptically. The others were stored at 7°C and, when it was thought from past experience that the control might be approaching spoilage, visually examined and organoleptically evaluated every two or three days. Each plant repeated the experiment at least once.

**Results**

**Sensory evaluations.** The sensory responses of the panel are shown in Table 1. Ability to detect sorbate in Cottage cheese by flavor or odor is expressed as the per cent responses that were correct in selecting the R sample. Preference is given for each sample as the per cent of judgments that favored the sample over the sample with which it was paired. Statistical significance was established according to the method of Roessler et al. (15).

The panel did not significantly detect potassium sorbate in Cottage cheese by flavor or odor at concentrations of 0.10% by weight, or below, or the presence of sorbic acid at a concentration of 0.075% (equivalent to 0.10% of potassium sorbate). Concentrations of 0.125% and greater were significantly detected by both flavor and odor. The results indicating that 0.125% of potassium sorbate was detected by flavor could have occurred by chance alone only once in 1,000 trials, and results indicating detection of this level by odor could have occurred only five times in 100 trials. These results included evaluations by two members of the panel who consistently detected 0.075% or more of potassium sorbate by odor and stated that their flavor decisions were influenced by odor. Results indicated that all of the other members of the panel, except one who consistently detected potassium sorbate concentrations of 0.075% or above, were about equal in sensitivity to the presence of sorbate.

| Table 1. Responses of a sensory evaluation panel to presence of potassium sorbate or sorbic acid in Cottage cheese. |
|---|---|---|
| **Potassium sorbate** | ** Judgment that detected sorbate by difference in** | **Preference on basis of** |
|  |  |  |  |
|  |  |  |  |
| 0.05 | 54.9 | 47.1 |
| 0.075 | 55.8 | 43.1 |
| 0.10 | 58.8 | 43.0 |
| 0.075* | 60.0 | 47.1 |

| **Second experiment** |
|---|---|---|---|
| **Judgments** | **Potassium sorbate** | **Flavor** | **Odor** |
|  |  |  |  |
| 0.075 | 51.9 | 56.6 | 50.9 | 40.8 |
| 0.10 | 62.9 | 61.6 | 47.3 | 39.0 |
| 0 | 74.1*** | 64.0* | 26.9 | 33.4 |
| 0.125 | 74.1*** | 64.0* | 26.9 | 33.4 |
| 0.15 | 88.9*** | 63.2* | 29.6 | 39.0 |
| 0.20 | 94.4*** | 65.6* | 24.1 | 34.3 |

*First experiment: 17 judges, 51 judgments; second experiment: 18 judges, 54 judgments.

* Sorbic acid.

**Respectively significant at P = 0.05, 0.01, and 0.001.
The preference responses of the panel substantiated the responses on difference and were likely influenced by them. There was no significant preference for Cottage cheese lacking sorbate over cheese containing 0.10% of potassium sorbate or less. At concentrations of 0.125% or greater, however, the panel indicated a statistically significant preference for the cheese lacking potassium sorbate. Two to four judges who failed to state preferences were arbitrarily divided equally between the choices, since it was intended that preference be a forced decision (8). Judges objecting to cheese containing the higher levels of sorbate stated that they were off flavor (5 judges), sweet (3 judges), bitter (2 judges), or sour (1 judge).

Four of the seven plants that experimented with potassium sorbate added to Cottage cheese reported that the lowest detectable level was 0.10% and that higher levels were objectionable. The objectionable flavor was described as bitter, pungent, or merely objectionable. Three plants reported that experienced judges could detect 0.05% and that 0.10% was objectionably bitter. One of these plants encountered an oxidized flavor in all hand-mixed samples and reported finding an additional slight off flavor at 0.025% of added potassium sorbate and an objectionable medicinal flavor at higher concentrations.

Shelf-life. The 2.23-kg cartons of Cottage cheese not required for sensory evaluations were stored at 4°C and examined visually and organoleptically every three to five days. The control samples had some slime spots and were slightly sour, slightly fruity, and slightly putrid on the 18th day of the first experiment and the 21st day of the second experiment. Mold spots were observed on the 23rd and 25th days of the two experiments, respectively. None of the samples of the first experiment that contained sorbate (0.05% or more) spoiled during storage for 45 days. The five judges who separately examined the samples of the second experiment on the 39th day rated those containing 0.075, 0.10, and 0.125% potassium sorbate as good, acceptable, or excellent Cottage cheese. Samples containing 0.15 and 0.20% potassium sorbate were slightly bitter or slightly oxidized and slightly bitter. On the 46th day slime spots were observed on the samples containing 0.075% potassium sorbate. Those containing 0.10, 0.125, and 0.15% were observed to have slime spots and slightly fruity, putrid odor at 56, 60, and 68 days of storage, respectively.

Reports from the seven plants regarding the influence of potassium sorbate on the keeping quality of Cottage cheese at 7°C varied considerably. One plant whose control samples soured reported that 0.025% or more of potassium sorbate extended shelf-life of the Cottage cheese at least two weeks, and another plant observed that with this level of sorbate the development of slime spots was delayed about five days. Three plants reported there was no improvement in the shelf-life of Cottage cheese with 0.05% added sorbate. All plants observed some improvement upon addition of 0.10%. Extensions of shelf-life with this amount of potassium sorbate were two days (one plant), six to ten days (five plants), and more than 14 days (one plant).

Discussion

Potassium sorbate (0.05% or more) added to Cottage cheese retarded growth of bacteria that produced slime and fruity and putrid odors at refrigeration temperatures, bacteria that produced sourness (probably lactic streptococci), and molds. In our laboratory, additions of 0.05% or more of potassium sorbate more than doubled the shelf-life of Cottage cheese, but in commercial plants extensions of shelf-life varied from some approximately equal to those we observed, to no improvement with 0.05% added sorbate. The variations in shelf-life emphasized that potassium sorbate (0.10% or less) does not prevent the spoilage of Cottage cheese indefinitely and can be expected to retard spoilage but little under certain conditions. Refrigeration and pH (11) are important, and good sanitation in manufacturing and packaging Cottage cheese must be maintained to ensure low numbers and types of spoilage microorganisms and not seriously limit the advantage gained by adding sorbate.

Concentrations of potassium sorbate above 0.10% resulted in an off flavor detected by the sensory-evaluation panel. The results on detection of 0.125% of potassium sorbate (54 judgments) are statistically significant, and three judges consistently identified 0.075%. Two of these three judges were able to identify 0.05% frequently by odor, but felt they could not have identified low levels by either flavor or odor without a reference for comparison. The third judge stated no criticism of any of the Cottage cheese. Three of the seven plants that experimented with added potassium sorbate reported that some of their experienced judges could detect 0.05% (occasionally,
0.025%) and that 0.10% was objectionably bitter.

The results suggest that concentrations of potassium sorbate of 0.05 to 0.10% by weight might be used advantageously as a way of increasing the shelf-life of commercial Cottage cheese. It is possible that a flavor defect due to the added sorbate would be observed by consumers at concentrations greater than 0.10%. Pangborn and Dunkley (12) arbitrarily decided that a difference in a dairy product detected by 67% of the judgments of an adequately controlled sensory-evaluation panel might significantly influence acceptance by consumers. On this basis, 0.125% potassium sorbate added to Cottable cheese would be expected to influence consumer acceptance significantly (Table 1). Plotting and interpolating the results suggests that 0.11% of potassium sorbate would have been detected by our sensory-evaluation panel with an accuracy of 67%.

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References


