

The Rapid Ripening of Cheddar Cheese Made From Pasteurized Milk*

As a result of experimental work over a period of years before the war, the Bureau of Dairy Industry developed a time-schedule method of making Cheddar cheese which gave more assurance of uniformly high quality in the cheese than the methods previously used. The new method was adopted and used successfully by many cheese makers during the war years. One important way in which the new method differed from previous methods was that the milk was pasteurized.

Many cheese makers, however, have stated that Cheddar cheese made from pasteurized milk frequently does not ripen as rapidly as cheese made from raw milk and that it does not develop sufficient flavor to satisfy some consumers even when the curing period is relatively long.

Accordingly, extensive experiments have been carried out in the Bureau's laboratories in an effort to develop a method for rapidly curing Cheddar cheese made from pasteurized milk and for improving the flavor. This report presents briefly the experimental procedures and a summary of the results obtained on the influence of the curing temperature. A method is suggested for speeding up the ripening time and for improving the flavor of Cheddar cheese made from pasteurized milk.

During the past 4 years, 256 vats of experimental cheese were made, by the time-schedule method (1), from pasteurized milk of good quality and cured at different temperatures. Two vats of cheese were made daily from one lot of milk. Approximately 800 pounds of milk was used in each vat, yielding four "daisies" weighing 21 to 22 pounds each. Usually, one daisy from each vat was cured at 50° F. (10° C.) and one at 60° F. (15.6° C.), but in some instances one from each vat was cured also at either 40° F. (4.4° C. or 70° F. (21.1° C.). The remaining daisies from each vat were used in other experiments. In the curing-temperature studies, 14 daisies (from 7 lots of milk) cured at 40° F., 256 (128 lots) at 50°, 248 (124 lots) at 60°, and 10 (5 lots) at 70°, were tested and graded.

Another series of experiments was made

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in order to compare cheese made from raw and from pasteurized milks of different qualities. To obtain milks of different quality for this series of experiments, some of the raw milks were held for varied periods of time before they were cooled. The quality of these milks was judged, on the basis of bacterial counts and methylene-blue tests, as good, fair, poor, or very poor. For each of nine experiments, the raw milk was divided into two equal parts. One part was pasteurized and the other was not pasteurized. Each part yielded four cheeses, two of which were cured at 50° F. and two at 60°.

Samples of analyses were removed from the cheese in each series described above at the following ages: 1 day, 2 weeks, and 1, 2, 3, 4, and 6 months. During the early part of the experiment, the cheeses were tested regularly at each of the ages indicated. Later, however, the cheeses were tested less frequently, but in all instances at 3 and 6 months of age.

Approximately 1,600 samples of cheese were tested for chemical, bacteriological, and physical properties. The following tests were made: (a) *Chemical*—Extent of proteolysis, as measured by determining total, soluble, non-protein, and amino nitrogen; pH value and titratable acidity; relative amounts of lactose and biacetyl. (b) *Bacteriological*—Numbers and kinds of bacteria. (c) *Physical*—Plasticity, flexibility, and tensile strength.

Analyses were also made of samples from a considerable number of green cheeses to determine the moisture, fat, and salt content, and the results showed that they usually contained from 37 to 38 percent moisture, 50.5 to 52.5 percent fat in dry matter, and 1.65 to 1.95 percent salt.

Each cheese was graded at 3 and 6 months of age for flavor and for body and texture. In addition, many were graded at 1 year of age. Usually, the grading was done by three persons, but it was often done by four persons and in a few instances by two. The graders did not know the identity of the cheese when they graded it.

RESULTS FROM RAPID RIPENING

The influence of curing temperature, quality of milk, and pasteurization on the rate of ripening and on the flavor of the cheese was evaluated on the basis of differences noted in flavor and in body and texture at the time of grading, and also on the basis of differences in the rate of protein break-

down, in numbers and types of bacteria, and in physical properties as measured by the laboratory tests.

The cheese that was cured at 60° F. ripened faster and developed more flavor than the control cheese cured at 50°.

The cheese made from pasteurized milk of good quality was as fully ripened in from 3 to 4 months at 60° F. as that cured for 6 months at 50°, and that held at 60° also developed not only more but also better flavor than that held at lower temperatures. After being cured for 3 months at 60°, the cheese was never curdy or rubbery. It usually had slightly more firmness and a slightly more crumbly, shorter body, at 3 months, than that held at the lower temperatures, but the degree of shortness was not objectionable. In some instances, however, the body became too short, and also somewhat mealy, when curing at 60° was continued longer than 4 to 6 months.

On the other hand, when low-grade milk was used, either raw or pasteurized, the quality of the cheese cured at 60° F. was definitely inferior to that of the cheese cured at 50°. The inferior quality was especially pronounced when the low-grade milk was not pasteurized. Defects such as acid, sour, bitter, unclean, and rancid flavors, gassiness, and short, crumbly body developed to a greater extent at 60° than at 50°.

A curing temperature of 70° F. was found to be too high even when high-grade milk was used. The quality of the cheese cured at 70° was not as good as that of the cheese cured at lower temperatures, except during the first few weeks.

The cheese made from pasteurized milk was consistently better and more uniform in quality than the control cheese made from the raw milk, except when very high-grade milk was used. With high-grade milk, there was very little difference, either in the quality of the cheese or in the rate of ripening and flavor development, between the cheese made from raw and that made from pasteurized milk. However, with medium-grade and with low-grade milk, especially the latter, the raw-milk cheese ripened and acquired flavor more rapidly, but its quality, including flavor, was decidedly inferior to that of the pasteurized-milk cheese.

Gassiness did not develop in any cheese that was made from properly pasteurized milk.

The investigation of a higher curing temperature (as high as 60° F.) for the rapid

ripening of Cheddar cheese is a continuation of earlier work in this Bureau (2) which demonstrated that pasteurization of the milk and the use of a controlled time-schedule which maintains the acidity within the proper limits during manufacture are important steps in producing cheese of uniformly high quality. When cheese is made from good milk and the milk is pasteurized and the cheese is made by the time-schedule method, it can be ripened safely and more rapidly at the higher temperature indicated.

It is important to emphasize that the higher curing temperature (as high as 60° F.) should be used only when the cheese is made from high-grade milk, effectively pasteurized. This conclusion is based on the observation that the defects in cheese resulting from the use of low-grade milk are accentuated by an increased temperature of curing.

The experimental results described here seem sufficiently convincing to refute the belief that Cheddar cheese made from pasteurized milk cannot be ripened rapidly and will not develop a sufficient amount of the characteristic Cheddar flavor.

All of the results are being tabulated and studied in detail so that the correlations among the various chemical, bacteriological, and physical characteristics, the rate of ripening, and the development of flavor can be detected and properly evaluated, and so that the findings can be summarized for publication.

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