New Type of Ripened Low-Fat Cheese

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Abstract

A laboratory procedure for making a new semisoft low-fat cheese containing 5-7% milk fat, 56-59% moisture is described. A manufacturing time schedule and representative analyses of the cheese are given. The procedure lists optional steps and is intended to be a basic one, which may be altered in several respects as needed when converting it to a larger scale.

The consumer demand for fat-free or low-fat ripened cheese has increased suddenly in the past few years. Present indications are that it will continue. The demand is chiefly by people who wish to avoid high calorie foods to control body weight and by those who fear a possible connection between animal fats and circulatory disorders.

In addition to the consumer demand for a low-fat ripened cheese, the cheese industry appears to have sufficient need for an intermediate variety of cheese with characteristics between those of Cottage and semihard varieties such as Cheddar. The intermediate characteristics of primary importance are moisture, fat and protein content, the length of ripening period and the product's shelf life.

Numerous attempts have been made by the cheese industry and others to develop a palatable, ripened skimmilk or low-fat cheese. As a result, several types have been described in the literature (3-5). However, such cheeses in general have failed to receive consumer acceptance and, therefore, their manufacture has been limited or even discontinued.

Even though approximately 5 million pounds of skimmilk cheese and about 6 million pounds of part skim cheese are produced annually in this country, a relatively small amount of it is purchased directly by the consumer. These cheeses are hard, tough and lack flavor and are used almost entirely in the manufacture of other foods.

The present report describes an experimental procedure that was developed for the manufacture of a new type of low-fat ripened cheese. The tentative making procedure as outlined in this report is based on results of an extensive study of the effects of manufacturing variables and factors on cheese quality (2, 6). The cheese produced by this procedure is considered to be an intermediate variety; its manufacture slightly resembles that of Cottage and Colby cheeses. In the cheese vat, the curd looks and tastes very much like Cottage curd; the finished product, however, somewhat resembles Cheddar or Colby. It is easily made and may be marketed after 1 to 2 months. The authors wish to point out that the procedure presented in this paper is not a concrete, cookbook method; it is a basic procedure, several facets of which may be varied as it is adapted to commercial use. These include slight variations in the time schedule, adjustment in the cooking temperature and acid development and the use of supplemental starters or flavor additions. Pilot plant studies on the manufacture of the cheese are in progress at our Beltsville laboratory where a more definite schedule will be worked out for future presentation.

Materials and Methods

Equipment. The laboratory study was conducted in 4 small stainless steel steam-jacketed cheese vats, each having a capacity of 22.7 kg of milk. Thus, 4 variables could be tested simultaneously. The curd from each vat was pressed in a 2.27 kg loaf hoop fitted with a cloth bandage. The curd was pressed with weights rather than mechanically. A small vacuum chamber connected to a vacuum pump was used to vacuum press the cheeses.

Milk processing. The milk was obtained from a dairy herd maintained at the Agricultural Research Center, Beltsville, Maryland. Fresh whole milk was usually cold-separated and the skimmilk was pasteurized by the high-temperature short-time method (72.1 C 15 sec). Sufficient pasteurized whole milk was added to the skimmilk to standardize it to the desired fat content.

Commercial low-heat non-fat dry milk (NFDM) was added to the standardized skimmilk to raise the solids content to 11%.

Cultures. The lactic starters used were multiple-strain cultures obtained from commercial starter laboratories in lyophilized form and

were reconstituted and incubated according to the supplier's instructions. The *Lactobacillus casei* (V333) was from our stock culture collection. Lactic starters were propagated by incubation for 16-18 hr at 22.2 C while *L. casei* was incubated at 31 C for 48 hr.

Chemical analysis. The cheeses were analyzed for fat, salt, and moisture at one week and after 1 to 2 months curing. Fat and moisture were determined by the Mojonnier methods and salt by the AOAC method (1).

Procedure

The method of manufacture as developed by experimental procedure was as follows:

1) *Preparing rancid flavored whole milk to standardize skimmilk.* Fresh raw whole milk was pretreated to develop limited lipolysis prior to cheese manufacture as follows: The milk was forewarmed to 37.7 C, homogenized at 2500 lb psi (double stage) and held at 40.5 C for 1 hr. Further lipolytic activity was stopped by heating at 78 C for 5 min or at 85 C for 15 sec. The milk was cooled to 4.4 C and held for use in adjusting the fat content in the cheese skimmilk. Approximately 1 part of whole milk was required for 5 parts of skimmilk.

2) *Preparing low-fat milk.* Good quality fresh whole milk was cold-separated and the skimmilk was pasteurized at 72.1 C for 15 sec. The skimmilk was then standardized in the vat to between 0.7 and 0.8% milk fat with the specially prepared rancid whole milk.

3) *Fortifying the milk.* The cheese milk was standardized to contain approximately 11.0% solids, either by adding fresh low-heat NFDM or concentrated skimmilk. Usually from 1.5 to 2.0% added solids were required. Non-fat dry milk powder was mixed into the milk in a manner similar to that in making Cottage cheese. Although not essential, it is recommended that addition of solids be made prior to pasteurization.

4) *Adding color (optional).* Cheese color may be added at the rate of 8 to 10 ml/454 kg of milk to give a light yellow color to the cheese.

5) *Preparing lactic starter.* Conventional mixed lactic starters may be used; however, best results were obtained with starters containing mixed strains of *Streptococcus cremoris* and *Leuconostoc.*

Mother and bulk starters were prepared in the conventional manner, that is, 1% inoculation and incubation at 22.2 C for 17-18 hr.

6) *Preparing Lactobacillus casei starter (optional).* Better flavor in the cheese was obtained when 0.2% of *Lactobacillus casei* was added as a supplemental starter. Bulk starter was prepared by inoculating sterile skimmilk with 0.5% of *L. casei* (V333) culture and incubating at 31 C for 48 hr. If the starter is not used immediately it may be stored at 4.4 C until needed.

7) *Adding starter.* Six per cent lactic starter and 0.2% *L. casei* starter were added to milk that had been forewarmed to 32.2 C. Usually the titratable acidity of the inoculated milk was .24 and the pH was 6.35. The milk was stirred for 5 min to distribute the starter uniformly.

8) *Ripening the milk.* A ripening period of 1 hr was required at 31 to 32 C. The titratable acidity at the end of ripening was .28 and the pH was 6.15.

9) *Adding rennet (Setting).* The setting temperature was 32.2 C. Rennet (which had been diluted with water) was added at the rate of 75 cc/454 kg of milk. The milk coagulated (set) into a firm curd that was ready to be cut 20 min after adding the rennet.

10) *Cutting the curd.* The curd was cut into 1.27 cm cubes. A finer cut increases the loss of whey and the curd may become dry. Shortly after the curd was cut, it was stirred slowly to prevent clumping. Extreme care should be taken to avoid shattering the curd particles.

11) *Cooking the curd.* Fifteen minutes after cutting, the steam was turned on and the curd and whey were gradually heated from 32.2 to 43.3 C in 30 min. It was usually drained after cooking or when the titratable acidity of the whey had reached .24, or when the pH had dropped to 5.9.

12) *Draining the whey and washing the curd.* The whey was drained from the curd rapidly and the curds were washed immediately with cold water at 10 to 15.5 C. The temperature of the curd and wash water was adjusted to 26.6 C. The curd in water was stirred to break up any matting that had occurred. The wash water was drained from the curd after 5 to 10 min.

13) *Salting.* Salt was added to the curd, shortly after the water was drained, at the rate of 2.5 kg/454 kg of milk. About one-third of the salt was added in each of three applications. The curd was stirred to distribute the salt uniformly.

TABLE 1

Time schedule for making low-fat cheese

Operation	Time	Temperature C	Acidity TA	Acidity pH	Comments
Add starter	8:00	32.2	0.24	6.34	6% lactic starter (0.2% *L. casei*, optional)
Add rennet	9:00	32.2	0.28	6.20	75 cc/454 kg
Cut curd	9:20	32.2	0.21	6.12	1.27 cm knives, slow agitation
Begin heating	9:35	32.2	0.22	6.05	Raise heat slowly
End heating	10:05	43.3	0.235	5.95	Prevent matting
Draining whey	10:15	43.3	0.24	5.90	Prevent matting
Washing curd	10:20	26.6			10-15 C water to cover curd
Draining water	10:25		0.13[a]	5.96[a]	Stir curd
Salting	10:35				2.5 kg/454 kg
Hooping	10:45				Fill 2.27 kg hoops
Press with weight	10:55				11.35 kg weight/hoop
In vacuum press	11:30				63.5-66 cm vacuum on weighted cheese
Out vacuum press	11:45				
Redressing cheese	11:50				
Press 4.4 C	12:00				11.35 kg weight overnight
Waxing	21 hr			5.6	

[a] Wash water.

14) *Hooping.* The wet curd was hooped immediately after salting. The hoop, with some hand pressing, was filled to the top of the hoop-ring. The curd-filled hoop was removed to the pressing table and pressed with a 11.35 kg weight for 30 min prior to vacuum-pressing.

15) *Vacuum-pressing.* The hoop and weighted cheese was placed in a vacuum chamber and a vacuum of 63.5 to 66 cm applied. The vacuum was held for 5 min and slowly released. The cheese was removed from the chamber and the bandages dressed.

16) *Overnight pressing.* Immediately after vacuum treatment, the cheese was placed at 4.4 C and again pressed with a 11.35 kg weight per hoop. Pressing continued for 21 hr.

17) *Waxing.* At 21 hr, the cheeses were removed from the hoops and bandages removed. The cheeses were waxed with a flexible heavy-duty wax.

18) *Curing.* The cheeses were cured at 4.4 C for 1 to 3 months.

Results and Discussion

The low-fat cheese ripens within 1 to 3 months and has a mild pleasing flavor somewhat like very mild Cheddar. The body is close in texture, resilient and smooth, making it well suited for slicing.

During manufacture, the cheese curd greatly resembles that of Cottage. The significant differences lie in the close control of developed acidity by the use of a short starter-ripening period, cooling of curd with wash water, and pressing at 4.4 C.

The making procedure (Table 1) requires less time for manufacture than is required for Cheddar and Colby cheeses. The significant differences from the manufacturing procedure of those cheeses involve: Pretreatment of whole milk, the amount and type of starter, washing and cooling of the curd, a short vacuum pressing, and overnight pressing at 4.4 C. Laboratory cheeses were usually made on this time schedule; however, it was possible to ignore the schedule and follow the manufacturing operation by pH or titratable acidity alone.

Analytical data for 10 lots of representative cheese are given in Table 2. The protein content and the fat to protein ratio are significant. The cheese provides a very nutritious, high-protein, low-fat food product. The high moisture content is absolutely essential to obtain an

TABLE 2

Representative analyses of low-fat cheese

	Range	Average
Fat, %	6.3-8.8	7.02
Salt, %	2.1-2.6	2.38
Moisture, %	56.9-58.7	57.57
Protein, %	26.7-29.6	28.1
Fat/total solids, %	12.4-21.0	16.2
Fat/protein ratio	1:3.1-1:4.7	1:4
Salt/moisture, %	3.6-4.5	4.13
pH at 21 hr	5.25-5.65	5.5
pH at 1 month	5.1-5.4	5.2

acceptable body and texture and sufficient ripening in 1 to 3 months.

When good quality milk and starter were used, the laboratory procedure resulted in a soft, mild-flavored cheese with excellent body and texture. The authors are aware that certain modifications may have to be made when this procedure is adapted to pilot plant or commercial scale. However, the basic procedure is being presented as a guide for those with a knowledge of cheese manufacture until such time as a more definite schedule is available. It is hoped that the development of this cheese will appeal to diet-conscious consumers and open new markets for surplus nonfat milk.

References

(1) Association of Official Agricultural Chemists. 1960. Official and Tentative Methods Analysis. 9th Ed. Washington, D.C.

(2) Hargrove, R. E., McDonough, F. E., and Tittsler, R. P. 1965. New Type of Ripened Low-Fat Cheese and Factors Affecting Its Quality. J. Dairy Sci., 48: 764.

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(5) le Roux, G. D., and Abbott, C. W. 1962. South Africa's New Low Fat Cheese. Dairy Engineering, 79: 270.

(6) Factors Affecting the Characteristics, Composition and Quality of Low Fat Cheese. (To be published.)

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