tion, and reported that there was no difference in recovery of solids in the cheese between the two methods when proper manufacturing practices were followed. While not specifically stated, it appears that the same size of knife, namely 5/8-in., was used for cutting both types of curd.

7. Fat content of creaming mixture. This factor exerts its effect on the yield of finished creamed cheese obtained from a definite amount of curd. Regardless of the test of the creaming mixture, the finished product must contain not less than 4.0% fat, and if a mixture of a low-fat content is used, more of it is required to obtain the desired amount of fat. Such low-fat creaming mixtures have higher moisture contents and, therefore, the curd must be of lower moisture content than when high-fat creaming mixtures are used. The low-fat creaming mixture increases the amount of finished cheese obtained from the curd and decreases slightly the cost of materials per pound of cheese.

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KEEPING QUALITY OF COTTAGE CHEESE

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The great increase in cottage cheese consumption can be maintained by more uniform quality and extension of shelf-life. Some manufacturers do not realize that although cottage cheese is an excellent food for people, it is a very perishable product and also provides an excellent medium for the growth of many microorganisms. Only fresh, good quality skimmilk should be used and all steps in the manufacturing process must be scientifically controlled. Cottage cheese must be packaged in a room free from contamination by airborne organisms. The cultures must be pure and they must be handled properly. Temperatures must be controlled throughout processing and storing, as well as through all channels to the final consumer. The water supply must be free from spoilage organisms.

CHANCES IN PROCESSING AND PRESENT BLAND FLAVOR OF COTTAGE CHEESE

It is the bland, mild acid, and clean flavored cottage cheese that has increased consumption in western and midwestern states. This type of cheese has resulted from carefully controlled methods, use of coagulating agents to cut the curd and cook at lower acidities (higher pH), and the trend towards making small curd, which makes it easier to remove the whey and to obtain mild-flavored cottage cheese. Some years ago, consumers of cottage cheese and other dairy products expected strong flavors. Cottage cheese was frequently sour, high acid and, at times, had fermented and yeasty flavors.

Research, improved equipment, modern controlled methods, good refrigeration, and better handling made it possible to produce fairly uniform and mild-flavored cottage cheese. The consumer quickly notices any feed, absorbed, chemically produced, or bacterial off flavors, and consumption decreases immediately if these defects are not corrected. One must also consider that the time between actual processing and the time cheese reaches the consumer has increased and that there is very little hope that this condition can be changed in the future.

We must be prepared to produce a dry or creamed cottage cheese that will retain a fresh, clean, mild acid flavor for 7 to 14 days. The following factors will be discussed in some detail.

1. Present methods and practices of cooking cottage cheese curd.
2. Suitable processing and packaging area or rooms for cottage cheese manufacturing.
3. Water supply, pH control, and chlorination.
4. Preparing and handling of cream dressing.
5. Temperature control throughout processing, storage, and delivery.
6. Laboratory control measures.

PRESENT METHODS AND PRACTICES OF COOKING COTTAGE CHEESE CURD

In the days of flake or cube cottage cheese manufacture, where coagulating agents and raw skim were used, operators tried to avoid firm curd. It was the usual practice to finish cooking at 106 to 114° F., with very little or no holding in the whey. Recently, the majority of manufacturers cool the curd in water at 38 to 45° F. The use of lower cooking temperatures left large numbers of starter organisms in the curd which was put into the refrigerator at 60 to 75° F. There was no psychrophilic, slimy, gelatinous type of spoilage that is so common today, as these organisms were inhibited by the lactic acid–producing organisms. The common spoilage then was caused by yeasts, molds, and coliform bacteria.

Pasteurization of skim for cheese became compulsory and required higher cooking temperatures. With better equipment and sanitary practices, and cooling the curd in the vat, more attention was given to air contamination, separate processing rooms, refrigeration, and treatment of water supplies. These changes have affected the microbiological flora of finished cottage cheese curd and creamed cottage cheese, so that we now have more spoilage of the gelatinous, slimy, putrid, fruity, and fermented types.

The data in Tables 2 and 3 express the importance of pure water supplies, sanitation, prevention of contamination, and low temperatures after the whey is removed and the curd is processed and finally packaged. Most microorganisms (Table 1) are easily killed at legal pasteurization temperatures. Although most of these organisms, even the Pseudomonas group which are classed as psychrophiles survived 120° F. for 15 min. in skim at pH 6.7, only one of 17 of these cottage cheese spoilage organisms survived the same heat treatment in whey at pH 4.55. The mold, *Geotrichum candidum,* which survived two out of three trials, might possibly be expected to survive, as molds are more acid-tolerant.

Because most cottage cheese manufacturers cook the curd to 120° F. or higher, and hold it in the whey at a pH of 4.55 to 4.68 for 15 min. or longer, we must assume that the curd at the time of draining the whey is relatively low in microorganisms. The curd must not be

TABLE 1

Ability of organisms that spoil cottage cheese to grow at 120° F. in skimmilk and their inability to grow in whey at pH 4.55 (1)

Microorganisms	Growth in skimmilk	Growth in whey
1. *Achromobacter butyri*	+	−
2. *Achromobacter eurydice*	+	−
3. *Alcaligenes metalcaligenes*	+	−
4. *Escherichia coli*	+	−
5. *Escherichia freundii*	+	−
6. *Micrococcus candidus*	+	−
7. *Micrococcus conglomeratus*	−	−
8. *Micrococcus flavus*	+	−
9. *Pseudomonas desmolyticum*	−	−
10. *Pseudomonas fluorescens*	+	−
11. *Pseudomonas fragi*	+	−
12. *Pseudomonas tralucida*	+	−
13. *Rhotorula flava*	+	−
14. *Torula candida*	+	−
15. *Geotrichum candidum*	+	+*
16. *Mucor plumbeus*	+	−
17. *Penicillium frequentans*	+*	−

+—growth; −—no growth; *—growth in two of three trials.

Numbers 1 to 12 are bacteria, 13 to 14 yeast, and 15 to 17 molds.

TABLE 2

Bacteria counts from samples of pasteurized milk exposed in processing areas

Samples exposed	Coliform	Standard plate count	Psychrophilic count
		(No. per ml.)	
In cheese refrigerator	Less than 1	4	25
On cheese filling machine	Less than 1	11	100 T
Starter processor	Less than 1	15 + mold	TNTC [a]
On cheese dressing vat	Less than 1	6	TNTC
In empty cheese vat No. 2	Less than 1	3	TNTC
Cream dressing	1	1.3 T	110 T
City water, pH 9.3	Less than 1	200	2.3 M

[a] Too numerous to count with the dilutions made.