

# A SURVEY OF COTTAGE CHEESE QUALITY<sup>1</sup>

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Cottage cheese curd and cream cottage cheese production in the United States in 1958 amounted to 549,523,000 and 703,523,000 pounds, respectively (1). Production has more than doubled during the past ten years. State and Federal standards for plain cottage cheese and creamed cottage cheese establish a maximum moisture content of 80 percent and require a minimum fat content of 4 percent in cream cottage cheese (2).

One of the most difficult problems in marketing cottage cheese is maintaining its freshness and desirable qualities. The results of surveys made in Connecticut (3), Iowa (4), Illinois (5), and Michigan (6) indicate that greater care and stricter sanitary precautions are needed in the production and handling of cottage cheese. Many samples of cottage cheese were contaminated with coliform bacteria. It was not uncommon to find slime and mold on the surface of the cheese. Bitter, fruity, yeasty, and other off-flavors were observed in many samples. From a public health standpoint, it is important that cottage cheese be produced and handled so the finished product will be free from harmful microorganisms. There is ample opportunity to contaminate the product from the makers' hands, impure wash water, or added cream. Cottage cheese is very perishable. Losses due to spoilage may result and more severe consequences may occur should any pathogenic bacteria be present.

The survey reported here was to secure information on composition, sanitary quality, and safety of cottage cheese sold in Kansas. Microbiological, chemical, and organoleptic analyses were made on 142 samples of cheese collected from 15 retail stores. Products from 27 manufacturers were examined.

## MICROBIOLOGICAL EXAMINATION

Samples were mixed in the original container with a sterile metal spoon and 11 grams were weighed, aseptically, into a sterile, tared Waring blender; 99 grams of sterile 2% sodium citrate solution were added and agitated for 4- to 15-second intervals with 5-

second interspaced stops to allow curd particles to contact the knife for more effective cutting. This procedure satisfactorily disintegrated the curd. This blended mixture was transferred to a sterile container and plating and tubing procedures were immediately carried out.

## Coliform Counts

Violet Red bile agar (Difco) was incubated at 37°C. for 24 hours. Colonies typical of the group were counted with a Quebec counter. A secondary surface layer of the medium facilitated the development of typical colonies.

## Yeast and Molds

Potato dextrose agar (acidified) (Difco) was used. Incubation was at 25°C. for five days.

## Psychrophiles

Psychrophilic counts were made in tryptone glucose extract agar (Difco). Incubation was at 45°F. (8°C.) for five days. Counts were made using a Quebec colony counter. These plates were also examined for evidence of *Pseudomonas spp.* by observing for (a) the development of a water soluble blue-green pigment and (b) odors (tri-methyl amine, May apple, or pineapple) associated with certain *Pseudomonas spp.*

## Staphylococci

Staphylococcus medium 110 (Difco) was used to search for members of the staphylococcus group which could be potential food poisoning types. Solidified medium was surface inoculated with 0.1, and 0.01 gram of cheese. Incubation was at 37°C. for 48 hours.

## Litmus Milk

Additional evidence of *Pseudomonas spp.* was obtained by inoculation of suitable dilutions into litmus milk. Incubation was carried out seven days at 8°C. Typical fruity (May apple) (pineapple) odor of *Pseudomonas fragi* was taken as additional evidence of *Pseudomonas spp.* Two samples, in litmus milk, gave rise to a "potato-cellar" odor commonly associated with *Pseudomonas graveolens*.

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## CHEMICAL ANALYSES

A 50-gram sample of cheese was taken from the original and mixed on a Waring blender or by using a mortar and pestle. The following determinations were made:

*Fat Content*

The percentage of butterfat was determined by a modified Babcock test described by Tuckey (5). A 9-gram sample of mixed cheese was weighed into a 50-ml. beaker. Two ml. of concentrated ammonium hydroxide was added and thoroughly stirred using a glass rod. Three ml. of n-butyl alcohol was added and thoroughly stirred using a glass rod. Next, 9 ml. of dilute sulphuric acid (3.5 parts acid + 1 part water) was added and mixed thoroughly. The contents of the beaker were poured into an 18-gm. milk test bottle, and the beaker rinsed with 9 ml. of concentrated sulphuric acid (sp. gr. 1.82 - 1.83, acid rinsings added to the test bottle). After centrifuging for 5, 2, and 1 minutes the test was read using glymol and the reading multiplied by two.

*Total solids*

The total solids content was determined by the Mojonnier Method (7).

*Acidity and pH*

Titratable acidity was determined by titrating a 9-gram sample of cheese diluted with 9 ml. distilled water, plus three drops of phenolphthalein indicator to a permanent pink endpoint with 0.1N sodium hydroxide. Duplicate determinations were made. The pH was determined with a Beckman glass electrode pH meter Model H2. Readings were taken in duplicate after immersing the electrodes directly into the sample of triturated cheese.

*Phosphatase*

The New York City field test was used to determine the presence of phosphatase. After allowing the triturated cheese samples to stand over night, 0.5 ml. of supernatant whey was withdrawn with a sterile pipette. Phosphatase determinations were made on the whey from each sample according to standard methods (8). Values equal to or greater than two units were recorded as positive phosphatase tests.

TYPE OF CHEESE, STYLE OF PACKAGE, WEIGHT, SCORE,

## APPEARANCE, AND DEFECTS

The net weight of the cheese was determined by taking the difference between the weight of the full and empty package. After samples were taken the cheese were scored by two or more judges for flavor,

body, texture, color, appearance, and package. The samples were stored and examined after three and seven days for the presence of mold and off-flavors.

## RESULTS

*Microbiological*

Coliform, yeast, and mold counts obtained on 142 samples of cottage cheese were classified into six groups. The number and percentage of samples classified in each group are presented in Table 1.

*Coliform content*

The examination of 142 samples of cottage cheese revealed that 71.2% of the samples were contaminated with 10 or more coliform organisms per gram.

Samples of cheese examined during the summer (100) and spring (42) showed the presence of 10 or more coliforms in 80% and 50% of the samples, respectively.

The number of samples, yielding 100 or more coliform organisms was 89 or 62.4% of all samples examined. More than 100,000 coliform organisms per gram were found in 11 or 7.7% of the 142 samples examined. This is in contrast to 8 (8%) and 3 (7.1%) for the summer and spring samples, respectively (Table 1).

TABLE 1.—NUMBER AND PERCENTAGE DISTRIBUTION OF COLIFORM, YEAST, AND MOLD COUNTS ON 142 SAMPLES OF COTTAGE CHEESE

	Summer 100 samples		Spring 42 samples		All 142 samples	
	No.	%	No.	%	No.	%
<i>Coliform</i>						
2-9	20	20	21	50	41	28.8
10-99	6	6	6	14.2	12	8.4
100-999	27	27	5	11.9	32	22.5
1,000-9,999	22	22	5	11.9	27	18.9
10,000-99,999	17	17	2	4.7	19	13.3
over-100,000	8	8	3	7.1	11	7.7
<i>Yeast</i>						
2-9	26	26	17	40.4	43	30.1
10-99	16	16	4	9.5	20	14
100-999	30	30	4	9.5	34	23.8
1,000-9,999	8	8	10	23.8	18	12.6
10,000-99,999	12	12	4	9.5	16	11.6
over-100,000	8	8	3	7.1	11	7.7
<i>Mold</i>						
2-9	81	81	38	90.4	119	83.3
10-99	8	8	1	2.3	9	6.3
100-999	4	4	2	4.7	6	4.2
1,000-9,999	5	5	0	0	5	3.5
10,000-99,999	1	1	1	2.3	2	1.4
over-100,000	1	1	0	0	1	.7

### Yeast counts

Examination of the 142 samples in this survey revealed that 43 (30.0%) were free of yeast in 1.0 gram amounts. The 99 samples found to contain yeast varied widely in the numbers of yeast present. Fourteen percent (20 samples) contained from 10 to 99 yeast cells per gram, 34 samples gave counts within the 100 to 999 per gram range. Thirty-four samples yielded from 1,000 to 99,000 yeasts per gram and eleven samples contained more than 100,000 per gram. The yeast types present were quite variable as evidenced by differences in pigmentation and colony type (Table 1).

### Mold prevalence

Molds of different types were present in varying numbers. One hundred and nineteen samples (83.3%) were found to contain fewer than 100 molds per gram. The remaining twenty-three samples (16.7%) yielded molds varying in number from 100 per gram to more than 10 million per gram (Table 1).

The mold content of the spring and summer samples of cheese did not vary significantly (Table 1).

### *Pseudomonas*

The presence of species of *Pseudomonas* was noted as previously described. Strong presumptive evidence was found to indicate the presence of one or more species of this genus in 63 (44%) of all the samples examined. The influence of the season of the year on the presence of pseudomonas types is evidenced by the fact that 24% and 53% of the spring and summer samples, respectively, gave strong presumptive evidence of the group (Table 2).

TABLE 2—NUMBER AND PERCENT OF *Pseudomonas*, PSYCHROPHILES, AND STAPHYLOCOCCI FOUND IN 142 SAMPLES OF COTTAGE CHEESE

	Summer 100 samples		Spring 42 samples		All 142 samples	
	No.	%	No.	%	No.	%
<i>Pseudomonas</i>						
Evidence	53	53	10	24	63	44
No evidence	47	47	32	76	79	56
<i>Psychrophiles</i>						
Fewer than 1,000					7	4.9
1 M <sup>a</sup> - 9.9 M					19	13.4
10 M - 99.9 M					11	7.7
100 M - 99.9 M					14	9.9
1,000 M - 9,999.9 M					16	11.3
10,000 M - 99,999.9 M					4	2.8
More than 100,000 M					71	50.0
<i>Staphylococci</i>						
	none		none			

<sup>a</sup>M = thousand

### *Psychrophiles*

At least 100 psychrophilic organisms per gram were found in 135 of the samples examined. The high percentage of samples (95%) that contained this type of organism in various numbers seems rather important from the standpoint of keeping quality. Seventy-one samples (50%) yielded plate counts of over 100 million organisms that would grow at low temperature (Table 2).

### *Staphylococci*

Completely negative results were obtained relative to the presence of staphylococci (Table 2). Only two samples of cheese yielded micrococci which were atypical types.

## RESULTS OF CHEMICAL ANALYSIS AND OTHER ORGANOLEPTIC TESTS

### *Types of Cheese*

The labels on 111 packages identified the type of curd by use of the following terms: Creamed Cottage Cheese (34), Old Fashioned (23), Country Style (10), Creamed Old Fashioned (9), Large Curd (6), Farm Style (5), Small Curd (4), Dutch Style (5), Sweet Curd (6), Rich Curd (2), Velva Whip (1), Grade A Creamed (1), Creamed Country Style (1), Old Fashioned Large Curd (1) and Pasteurized Creamed Cottage Cheese (3). The samples were about evenly divided between large and small curd types with 51 of 99 samples labeled large curd and 48 small curd (Table 3).

### *Weight of Samples*

The number of samples of cheese weighing 12 ounces (340 gm) or more was 61; the number weighing fewer than 12 ounces (340 gm), 81. Of the 81 samples 34 were from 0 to 0.49 ounce underweight and 46 were 0.5 ounce or more underweight. Of the 61 samples, 32 were from 0 to 0.49 ounce overweight and 29 were 0.5 ounce or more overweight (Table 3).

### *Moisture*

The moisture content of the cheese varied from a low of 71.1% to a high of 83.6% with an average of 78.7%. Forty-seven samples (33%) had a moisture content greater than the maximum 80% allowed for legal cottage cheese (Table 3).

### *Fat*

The fat content of the cheese varied from a low of 2.0% to a high of 9.0%, with an average of 3.8%. Sixty-three of the 142 samples were labeled creamed cottage cheese. Thirty-five (55.6%) of the samples labeled creamed cottage cheese contained less than 4% fat, the minimum allowed for legal creamed

TABLE 3—CHEMICAL ANALYSIS OF 142 SAMPLES OF COTTAGE CHEESE

Determination	Range	No. of samples	Percent
Moisture %	71.1-80.0	53	67.0
	80.1-83.6	47	33.0
Fat %	2.0-4.0	77	54.2
	4.1-9.0	65	45.8
Acidity %	.80-1.88	61	43.0
	.36-.75	81	57.0
pH (130 samples)	4.0-4.49	9	6.93
	4.5-4.99	82	63.07
	5.0-5.49	39	30.0
Phosphatase (130 samples)	negative	9.8	75.39
	positive (2 units)	32	24.61
Type of curd (99 samples)	Large	51	51.5
	Small	48	48.5
Weight (gms.)	less than 327	46	32.4
	328-339	35	24.6
	340-355	32	22.5
	356 and over	29	20.5

cottage cheese. Of the 142 samples, 77 (54.2%) contained less than 4% fat and 65 samples (45.8%) contained more than 4% fat (Table 3).

#### Acidity

The titratable acidity of the samples varied from a low of 0.36% to a high of 1.88% with an average of 0.78%. Eighty-one samples (57%) had a titratable acidity of less than 0.8% and 61 samples (43%) had a titratable acidity in excess of 0.8% (Table 3).

#### pH

The pH values of the 130 samples tested varied from 4.0 to 5.49. Nine samples (6.93%) were in the

4 to 4.49 range; 82 samples (63.07%) were in the 4.5 to 4.99 range and 39 samples (30%), 5 to 5.49 (Table 3).

#### Phosphatase

Phosphatase determinations made on 130 of the 142 samples showed that 98 samples (75.39%) were below 2.0 units of phosphatase and 32 samples (24.61%) reacted positively to the phosphatase test (Table 3).

#### ORGANOLEPTIC EXAMINATION

##### Flavor scores and criticisms

Flavor defects found in the cottage cheese and the number of times each flavor defect was found were tabulated.

Twenty percent of the samples were criticized as being too high in acid, 16.4% had a bitter flavor, 11.2% contained some foreign flavor, 10% had an unclean flavor, 9.4% were criticized as being yeasty or fermented, and 7.6% were rancid. In addition to those listed, several other off-flavors were observed (Table 4).

The samples were assigned a numeral score ranging from a low of 35 for samples with a poor flavor to a high of 40 for samples with the most desirable flavors.

Fifty-four (37.9%) of the samples scored below 37 and 62.1% scored higher than 37. Only 40 samples (28.3%) had what would be considered an excellent flavor score of 39 and above, at the time the samples were judged (Table 4).

##### Body and texture scores and criticisms

Fifty-eight (33%) of the samples were criticized as having a tough rubbery texture, 25 samples (17%) had a mealy texture and 26 samples were too firm or too dry. Thirty points were allowed on the score card for body and texture. Fifty-two samples (36.6%) of the samples scored 29 or more; 30.4% scored below 28, the minimum for a satisfactory body and texture score (Table 5).

TABLE 4 — FLAVOR, BODY AND TEXTURE SCORE OF 142 SAMPLES OF COTTAGE CHEESE.

Flavor				Body and texture			
Score	Range	No.	%	Score	Range	No.	%
39	or over	40	28.3	29	or over	52	36.6
38	38.9	22	15.5	28	28.9	47	33.6
37	37.9	26	18.3	27	27.9	26	18.4
36	36.9	21	14.7	26	26.9	17	12.0
35	35.9	33	23.2				

TABLE 5 — FLAVOR AND TEXTURE AND COLOR DEFECTS IN 142 SAMPLES OF COTTAGE CHEESE.

Flavor			Body and texture		
Defect	No.	%	Defect	No.	%
High	34	20	Rubbery	58	53
Bitter	28	16.4	Mealy	25	22.7
Foreign	19	11.2	Dry	26	23.4
Unclean	17	10	Unsatisfactory	1	.9
Yeasty	16	9.4			
Rancid	13	7.6	No. times observed	140	100
Flat	11	6.5			
Musty	10	5.8			
Old cream	9	5.3			
Feed	4	2.4			
Fruity	2	1.2			
Woody	2	1.2			
Salty	2	1.2			
Oxidized	2	1.2			
Cooked	1	1.2			
No. times observed	170	100			

  

Color and appearance		
Defect	No.	%
Unabsorbed cream	51	34.5
Uneven particles	49	33.0
Mushy	21	14.2
Wheyed off	18	12.2
Unnatural color	4	2.6
Lacks cream	3	2.0
Uneven color	2	1.4
No. times observed	148	100

#### Color and appearance

Fifty-one samples (34.5%) contained unabsorbed cream, 49 samples (33%) had uneven curd particles. Twenty-one samples (14.2%) were mushy and 18 samples (12.2%) were wheyed off or had an uneven and unnatural color (Table 5).

#### DISCUSSION OF RESULTS

The results of this survey indicate that there is a serious need for manufacturers of cottage cheese to pay more attention to the details of the manufacturing process to insure the consumer that the composition of the cheese conforms to legal standards and that the cheese is wholesome and palatable. The coliform count of the samples, with 71.2% of the samples containing an excess of 10 or more per gram, is far above the limits generally accepted as satisfactory. Since 44% of the samples contained *Pseudomonas viscosa* which produces a yellowish or brownish colored slime, it is probable that this organism was largely responsible for such flavor defects found as fruity, rancid, bitter, and flat. The presence of yeast and mold in the cheese may not be harmful, however, these organisms influence the flavor of the cheese. Poor keeping quality of the cheese is indicated by the high percentage (95%) of the samples containing these organisms.

No attempt was made to associate the number and type of organism present with the acidity and pH of the samples. Since no staphylococci were found in any of the samples, it may be assumed that they were all destroyed by pasteurization of the milk used in

the manufacture of the cheese, did not grow, or survive at the pH of the cheese, or were not present in detectable numbers.

The data presented indicate that manufacturers should pay more attention to the fat and moisture content of the cheese to avoid the manufacture of an illegal product.

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