A CONSUMER PREFERENCE STUDY FOR SALT CONTENT, RATE OF CREAMING, pH AND CURD PARTICLE SIZE OF COTTAGE CHEESE

by

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INTRODUCTION

The per capita consumption of cottage cheese in the United States is considerably less than that of many other dairy products. Yet its nutritive value is similar to that of whole milk. Because of its high nutritive value and low calorie content, cottage cheese can be of great value in the diet.

The cottage cheese currently on sale varies to a large extent in its physical characteristics. With the exception of flavors, these characteristics involve variations in the salt content, amount of creaming or dressing, pH or acidity and the size of the curd particles.

Recognizing that salt content and pH (acidity) influence do affect the keeping quality of cottage cheese, and all of these factors are rather easily controlled by the manufacturing procedures, this study was undertaken.

The objectives of this study were to determine (1) the salt content most acceptable to the consuming public, (2) the rate of creaming that consumers desire, (3) the pH (acidity) level that is acceptable to consumers and (4) the size of curd particles that consumers prefer.

The author hopes that the results of this study may offer guides to manufacturers in making cottage cheese which is acceptable to the majority of the consuming public, and point out some reasons why it is not included more often in the consumers' dietary.

REVIEW OF LITERATURE

Very little information can be found concerning consumer preference studies for cottage cheese. Information taken from three United States Department of Agriculture reports (13) show that during the period from 1910 to 1919, 0.7 pounds of cottage cheese was consumed per person whereas 4.4 pounds per person is noted in a preliminary survey in 1955. The consumption per person of cottage cheese has increased gradually since 1919 with only a yearly increase of 0.1 pound per person from 1952 to 1955.

The United States Department of Agriculture (11) also reported in the Household Food Consumption Survey that all urban households are using cottage cheese in the amount of 0.43 pounds per household per week, and all rural farm households are using cottage cheese in the amount of 0.39 pounds per household per week.

The American Dairy Association (2) reported in a survey of public attitudes toward dairy products that 74 percent of all the households used cottage cheese. This survey covered 4111 interviews selected at random from 550 sample areas in 55 localities, (110 counties) of the United States. Eighty-three percent of the households in the upper economic group used cottage cheese compared to 63 percent of the households in the lower economic level.

Blakley, McMullin and Boggs (3) interviewed a random 1 percent of the Oklahoma City population in a dairy products and services survey in 1955. The study showed that of the 821 households interviewed, 57.1 percent used cottage cheese during the seven-day period prior to the interview. The

per family cottage cheese consumption of these families was 19 ounces each week.

The American Dairy Association (1) reported in a survey of public attitudes toward dairy products that 23 percent of the individuals in the upper economic level ate cottage cheese compared to 9 percent of the individuals in the lower economic level. This survey also showed that more women ate cottage cheese than men, and more older people ate cottage cheese than younger people.

Harmon, Trout and Bonner (7) made a survey of some characteristics influencing consumer acceptance and shelf-life of cottage cheese. Data obtained in this survey revealed that shelf-life of cottage cheese might be extended by closer supervision of manufacturing, refrigeration, and low-temperature storage. These authors also reported in a study concerning the shelf-life of cottage cheese (8) that organoleptic deterioration, occurring during holding of cottage cheese at 42° F., was influenced by pH. Eleven samples of cottage cheese with a terminal pH above 5.0 had an average shelf-life of only 13 days, while 24 samples with a terminal pH below 5.0 had an average shelf-life of 16.1 days.

Elliker, Smith and Parker (5) reported in a study concerning the control of bacterial growth of cottage cheese that the growth of bacteria was strikingly affected by the pH of the curd. The results of this study indicate that control of the final pH of creamed and uncreamed curd may affect the growth of spoilage bacteria in the final product.

Likewise in a report on cottage cheese spoilage, Holland and White (6) stated that if the pH of cottage cheese can be kept at 5.0 or slightly below, the growth of bacteria is greatly inhibited.

The use of taste panels as one method to determine food quality is pointed out in a report by the Bureau of Human Nutrition and Home Economics, United States Department of Agriculture (12). Food researchers must often rely on sensory methods to determine food quality.

Miller, Nair and Harriman (9) reported that the ability of consumer panels to evaluate preferences of food products may vary with the degrees of differences between the products. Bradley (4) reported that test procedures for consumer panels should be kept simple and the number of items to be compared should be small. He also reported that taste panels for consumer preferences are usually large and untrained, and that usually no standards are provided and the decisions are based on preference alone.

EXPERIMENTAL PROCEDURE

A. PREPARATION OF SAMPLES

The samples of cottage cheese used in this study were prepared in the Dairy plant of Oklahoma State University, Stillwater, Oklahoma. The samples were made from fresh skimmed milk which was fortified with approximately 1 percent of low-heat non-fat dry milk solids. The milk was pasteurized at 143° F. for 30 minutes, cooled to 90° F. and inoculated with 5 percent of a fresh, active lactic culture. Commercial coagulator equivalent to approximately 1 ml. of rennet extract per 1000 pounds of milk was used to assist the coagulation. The curd was cut normally with 3/8 inch knives in about 4 1/2 hours at a whey acidity of 0.54 percent. The curd was cooked to a temperature of 120° F., drained and washed in the usual manner.

1. Salt Content. The samples used for the determination of salt preference were obtained by adding calculated amounts of salt to the creaming mixture, and completely dissolving it in the mixture before adding to the cottage cheese. The salt concentrations in the finished samples were verified by direct titration with mercuric nitrate, as explained by Olson and Bonner (10).

2. Rate of Creaming. The samples used for the determination of creaming preference were prepared in the following manner: The rate of creaming was calculated as the percentage by weight of the drained curd. For instance, a 30 percent creaming content would be obtained by adding 30 pounds of creaming mixture to 100 pounds of drained curd. The creaming

mixtures were made from 18 percent cream and 32 percent to 40 percent cream. They were combined in such proportions that the final fat content on each lot of the finished cottage cheese was 4.1 percent. The curd was allowed contact with the cream for several hours (usually overnight) to allow for absorption of the cream by the curd before being used for consumer preference tests.

The amount of free cream in creamed cottage cheese depends largely upon the amount of cream that is absorbed by the curd, and the amount of cream that is absorbed by the curd depends largely upon the size, firmness and dryness of the curd particles. With the lots of curd used in this part of the study, the relative amounts of free cream when the samples were spooned onto a plate were generally as follows:

20 percent, rather dry; sometimes incomplete coverage of the curd particles; no free cream.

25 percent, curd particles completely covered, but no free cream.

30 percent, curd particles covered with a glistening layer of cream; a little free cream.

35 percent, curd particles completely covered; considerable free cream.

40 percent, curd particles literally swimming in cream; much free cream.

The above descriptions are given to avoid any misunderstanding or mistakes in the amount of cream due to the size and absorptive capacity of the curd particles.

3. <u>pH (acidity)</u>. The samples used for the pH (acidity) preference were obtained by cutting the curd at different whey acidities, varying

the amount of washing of the curd and by adjusting the pH of the creaming mixture with 50 percent aqueous citric acid before it was added to the drained curd.

The acidities at which the curd was cut ranged from as low as practical to as high as practical for satisfactory cutting. This range was generally from 0.47 percent to 0.60 percent whey acidity. The lots of cottage cheese used for the samples with the highest pH were washed four to five times, and the lots used for the samples with the lowest pH were washed two times.

The amount of added citric acid necessary to reduce the pH of the creaming mixture to the estimated levels for the samples was determined by running the pH on small lots of the creaming mixture with various amounts of 50 percent aqueous citric acid added. The pH values were determined with a Beckman Model H-2 pH meter and glass electrode.

4. Curd Size. The samples used for the curd size preference were obtained by cutting different lots of cottage cheese with 1/4 inch, 3/8 inch and 5/8 inch knives. The samples prepared with the 1/4 inch knives were classified as "Small", the ones prepared with the 3/8 inch knives as "Medium" and the ones prepared with the 5/8 inch knives as "Large". The samples used for each trial were prepared from the same milk and culture so that the only variable was the size of the curd particles.

All the samples of cottage cheese were prepared so that they were not over three days old before being examined by the respondents. They were transported in insulated containers to the sampling areas, and were placed under constant refrigeration while there, so that deterioration between preparation and examination were non-existent.

In the preparation of the samples for the Garfield County Survey, four vats of cottage cheese were made from the same lot of milk. Two of the vats were cut at a low acidity (high pH), one with 1/4 inch knives and the other with 5/8 inch knives. The other two vats were cut at a high acidity (low pH) with the 1/4 inch and the 5/8 inch knives. The curd from each of these four vats was sub-divided and various amounts of cream and salt added to give all possible combinations of the following factors:

Acidity, high pH (5.3) and low pH (5.0)

Size of curd, small and large

Rate of creaming, 20 percent, 30 percent and 40 percent

Salt content, 0.8 percent, 1.1 percent and 1.3 percent

These combinations involved 36 lots of finished cheese. The fat content on each lot was calculated at 4.1 percent. The salt contents of the finished samples were determined and were all found to be within 0.1 percent of the calculated amounts. Likewise, the pH values were run and were within 0.1 unit of the levels desired.

Each lot of cheese was dispensed into 2 ounce ice cream cups and identified by a lot number on the lid. Four samples of the cheese, representing 4 different lots, were placed in each of 81 numbered bags according to the design of the experiment so that the inter-relation of the factors studied could be considered. The 81 packages of 4 samples each were then placed in insulated ice cream containers and transported to the city of Enid, Oklahoma where they were placed under refrigeration until needed.

B. SELECTION OF RESPONDENTS

Several groups of respondents were used to evaluate the samples. Semi-trained taste panels were composed of members of the staffs of the Food, Nutrition and Institution Administration Department and the Department of Dairying and advanced students in these two departments at Oklahoma State University, Stillwater, Oklahoma.

A second group of respondents was composed of dairymen (mostly men) attending a dairy meeting on the campus of Oklahoma State University. These respondents were selected at random as they appeared in the lobby of the meeting place.

A third group of respondents was selected at random from shoppers in large food stores in Tulsa, Oklahoma.

A fourth group of respondents was selected from 162 urban and rural non-farm households in Garfield County, Oklahoma. The urban households were located in Enid and the rural non-farm households were located in Covington, Garber, Hunter, Kremlin, Hillsdale, Lahoma and Waukomis, all with populations of less than 2,500.

The households were selected by appropriate statistical procedure as determined by the staff of the Statistical Laboratory at Oklahoma State University. Two-block areas were selected and three households from each area were interviewed. The interval between households interviewed depended upon the estimated total number of households in each area. If a respondent was not at home or refused to be interviewed, an alternate household was selected.

C. EXAMINATION PROCEDURE

Each participant in the first three groups of the preference study was given a paper plate on which about a tablespoonful of each sample had been placed. The number of samples varied from 3 to 5 and were identified only by a random number. The participants were asked to check on a data sheet the term that most nearly described their reaction to each sample. The terms used were too low, slightly low, just right, slightly high and too high. These terms were applied except for the curd sizes which were characterized as too small, just right and too large. A copy of this data sheet is shown on page 11.

In most of the trials with the semi-trained taste panels, each member was given a second set of samples of the same lots of cheese, but on which the numbers had been changed so that two observations on each sample were obtained from each participant.

The Garfield County Survey employed the use of the "confounded statistical design" as explained in the report by the United States Department of Agriculture (12). This design employed the selection of 81 households each in the urban and rural non-farm areas. The housewife of each of the households was given a set of 4 samples to rank according to appearance, taste and overall preference. The respondents were interviewed by the author and two helpers during a two week period (August 8 to August 19, 1958). The procedure used in interviewing was as follows:

The respondents were first asked to rank the samples according to their preference for appearance. Secondly, they were asked to taste the samples and rank them according to their preference for taste. The

COTTAGE CHEESE

TASTE PANEL SCORE CARD

Name_____ Date_____ Variable_____

Sample Number	Too Low	Slightly Low	Just Right	Slightly High	Too High
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					

respondents were then asked to rank the samples for overall preference, considering both appearance and taste.

After the samples had been ranked according to preference, six questions on a questionnaire were read verbatim to each respondent. If any explanation was needed the interviewer attempted to give this in such a way so as not to bias the answer given by the respondent.

Some respondents were unable to answer all the questions on the questionnaire. In these cases these portions were left blank. All of the information received was used in the analysis of the results. A copy of the questionnaire is shown on page 13.

D. DETERMINATION OF CONSUMER PREFERENCE

1. Consumer Score. In order to obtain a preference rating for the samples, a consumer preference rating was calculated from the following values for the descriptive terms used on the data sheets: Too low = 1; slightly low = 2; just right = 3; slightly high = 2; too high = 1. Thus, a sample having the highest number of respondents characterizing the sample as "just right", "slightly low" or "slightly high" would have a higher ranking than samples having a predominance of respondents characterizing the sample as being "too low" or "too high".

As an additional criterion of consumer preference, the numbers and percentages of respondents choosing each of the five descriptive terms were calculated. In those trials where only three samples were employed and the consumers ranked the samples, a value of 3 was given for first place, 2 for second and 1 for third.

2. Direct and Indirect Rankings. The statistical design of the Garfield County Survey called for the submitting of only 4 samples to each

SURVEY OF CONSUMERS' OPINIONS REGARDING COTTAGE CHEESE

Sack No._____ Schedule No._____ Intv._____
Sample No._____ Location_____

I. Rank the samples according to preference:

	APPEARANCE	REMARKS
First	_____	_____
Second	_____	_____
Third	_____	_____
Fourth	_____	_____

	TASTE	
First	_____	_____
Second	_____	_____
Third	_____	_____
Fourth	_____	_____

	OVERALL PREFERENCE	
First	_____	_____
Second	_____	_____
Third	_____	_____
Fourth	_____	_____

II. What do you like about cottage cheese?

_____

_____

III. What don't you like about cottage cheese:

_____

_____

IV. Has the cottage cheese that you have been purchasing been satisfactory?_____ What criticisms do you have regarding the quality (flavor, body and texture, appearance) of the cottage cheese purchased?

_____

_____

V. How do you serve cottage cheese?

_____

_____

_____

VI. Do you use the cottage cheese as it comes from the package?_____
If not, how do you change it?_____

_____

VII. How often do you purchase cottage cheese?_____. Number of packages?_____. Size of packages?_____.

household, so each respondent did not view or taste every combination employed in the survey. Therefore, in order to determine preference rankings for each of the variables, information received from all respondents was tabulated together.

In order to obtain preference ranking for each of the variables, paired samples were employed. That is, samples identical in their composition with the exception of the variable under consideration.

Since only 2 curd sizes and 2 pH (acidity) levels were under consideration, 18 paired samples were employed for each of these. With the 3 salt contents and 3 rates of creaming, 12 paired samples were employed for each of these.

Both direct and indirect rankings of all paired samples for each variable were tabulated. Direct rankings were the preferences shown between each sample pair. Indirect rankings were obtained for each sample pair by tabulating the rankings they received when they occurred in the same group with any of the other samples employed in the survey. Both direct and indirect rankings were totaled and the chi-square test for significance was used for the indirect rankings to determine whether a significant preference was shown. A chi-square below 3.841 is not significant; above 6.635 is usually considered highly significant for 1 degree of freedom.

EXPERIMENTAL RESULTS AND DISCUSSION

A. CONSUMER PREFERENCE FOR SALT CONTENT

A preliminary test with a semi-trained taste panel was run to determine the approximate levels of salt preferred by the respondents. In this trial there were 21 participants, each making observations of duplicate sets of 4 samples with salt contents ranging from 0.6 percent to 2.0 percent, inclusive. The data obtained from this trial is shown in Table I.

The results indicated a decided preference for the samples of cottage cheese with the 1.0 percent and the 1.5 percent salt over those samples with 0.6 percent and 2.0 percent salt. The samples with the 1.5 percent salt received the highest percentage (40.5 percent) of "just right" opinions while the samples with 1.0 percent salt received the next highest percentage (31.0 percent) of "just right" opinions. From these results it appeared that cottage cheese with 1.0 percent to 1.5 percent salt was most acceptable.

Considering the results from the preliminary test, two additional trials were made with semi-trained taste panels to determine salt preference, using concentrations of 0.75 percent to 1.75 percent, inclusive.

These tests were made two months apart and in each one duplicate samples were used. Thirty-four respondents participated in the first trial and 8 respondents participated in the second trial, giving a total of 42 respondents. With the duplicate samples, a total of 84 observations was obtained. The results were calculated separately but since the two

TABLE I

CONSUMER PREFERENCE FOR SALT IN COTTAGE CHEESE

Semi-trained Taste Panel of 21 Participants
Duplicate Samples

Taste Classification	SALT CONTENT							
	0.6 Percent		1.0 Percent		1.5 Percent		2.0 Percent	
	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
Too Low	35	83.3	4	9.5	0	0	0	0
Sl. Low	6	14.3	23	54.8	3	7.1	1	2.4
Just Right	1	2.4	13	31.0	17	40.5	3	7.1
Sl. High	0	0	1	2.4	22	52.4	19	45.2
Too High	0	0	1	2.4	0	0	19	45.2
Total	42	100.0	42	100.0	42	100.0	42	99.9
Score*	50		92		101		68	
Rank	4		2		1		3	

* See method for calculating consumer score.

sets of data indicated the same trend in preference, they were combined and are shown in Table II.

The results show that the samples of cottage cheese with 1.25 percent salt received the highest rating with 47.6 percent of the respondents classifying these as "just right", and 31.0 percent as "slightly high". The samples with 1.0 percent salt ranked second with 29.8 percent of the respondents classifying these as "just right", and 36.9 percent as "slightly low". The samples with the 1.50 percent salt ranked third with only 14.3 percent classifying these as "just right", while 53.6 percent classified them as "slightly high" and 28.6 percent classified them as "too high". It appeared that a salt content of 0.75 percent is too low for the average consumer as 85.7 percent of the respondents classified these samples as "too low" or "slightly low". It was also evident that a salt content of 1.75 percent is too high for the average consumer as a total of 89.3 percent of the respondents classified these samples as "too high" or "slightly high".

A third set of data for salt preference was obtained from a group of adults attending a dairy meeting on the campus of Oklahoma State University. This group was composed largely of men, and were selected at random as they appeared prior to the meeting. In this trial 5 samples of cottage cheese with salt contents of 0.75 percent to 1.75 percent, inclusive, were submitted to each respondent for taste preference. Each of the 64 respondents participating in this trial made one observation on each sample. The results are shown in Table III.

The data received from this trial indicated the same general trend in preference for salt as was obtained with the semi-trained taste panels,

TABLE II

CONSUMER PREFERENCE FOR SALT IN COTTAGE CHEESE

Semi-trained Taste Panel of 42 Participants
Duplicate Samples

Taste Classification	SALT CONTENT									
	0.75 Percent		1.0 Percent		1.25 Percent		1.50 Percent		1.75 Percent	
	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
Too Low	44	52.4	14	16.7	1	1.2	0	0	1	1.2
Sl. Low	28	33.3	31	36.9	9	10.7	3	3.6	3	3.6
Just Right	12	14.3	25	29.8	40	47.6	12	14.3	5	6.0
Sl. High	0	0	10	11.9	26	31.0	45	53.6	30	35.7
Too High	0	0	4	4.8	8	9.5	24	28.6	45	53.6
Total	84	100.0	84	100.1	84	100.0	84	100.1	84	100.1
Score*	136		175		199		156		127	
Rank	4		2		1		3		5	

* See method for calculating consumer score.

TABLE III

CONSUMER PREFERENCE FOR SALT IN COTTAGE CHEESE

Attendants at a Dairy Meeting
64 Participants

Taste Classification	SALT CONTENT									
	0.75 Percent		1.0 Percent		1.25 Percent		1.50 Percent		1.75 Percent	
	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
Too Low	37	57.8	10	15.6	6	9.4	1	1.6	4	6.3
Sl. Low	15	23.4	24	37.5	14	21.9	7	10.9	7	10.9
Just Right	10	15.6	23	35.9	24	37.5	22	34.4	6	9.4
Sl. High	1	1.6	6	9.4	18	28.1	28	43.8	19	29.7
Too High	1	1.6	1	1.6	2	3.1	6	9.4	28	43.8
Total	64	100.0	64	100.0	64	100.0	64	100.1	64	100.1
Score*	100		140		144		143		102	
Rank	5		3		1		2		4	

* See method for calculating consumer score

except there was a tendency for preference for the higher salt contents. The sample of cottage cheese with 1.25 percent salt received the highest percentage (37.5 percent) of "just right" observations, and the sample with 1.0 percent salt received the second highest percentage (35.9 percent) of "just right" observations. On overall ranking the samples were placed from first to fifth as follows: 1.25 percent, 1.50 percent, 1.0 percent, 1.75 percent and 0.75 percent.

The results compared to those obtained with the semi-trained taste panels were more variable with higher percentages indicating that the sample with the lowest salt content (0.75 percent) was too high and the sample with the highest salt content (1.75 percent) was too low. However, it appeared that a salt content of about 1.25 percent was most acceptable.

In a survey among patrons of two food stores in Tulsa, Oklahoma, 75 shoppers were selected at random and asked to rank 3 samples of cottage cheese with salt contents of 0.75 percent, 1.0 percent and 1.25 percent, respectively. The samples were identified by random numbers only. The results of this trial are shown in Table IV.

The results show that the sample with 1.0 percent salt ranked highest with 36 percent selecting it as first place, 50.7 percent as second place and only 13.3 percent as third place. The sample with 0.75 percent salt ranked second with 34.7 percent ranking it first, but with 44 percent ranking it third. The sample with 1.25 percent salt ranked third with only 29.3 percent ranking it first and 42.7 percent ranking it third. These results indicate that a salt content of about 1.0 percent is preferable to a higher or lower salt content.

In the Garfield County Survey samples of cottage cheese with salt contents of low (0.8 percent), medium (1.1 percent) and high (1.3 percent)

TABLE IV

CONSUMER PREFERENCE FOR SALT IN COTTAGE CHEESE

75 Food Store Shoppers

	SALT CONTENT					
	0.75 Percent		1.00 Percent		1.25 Percent	
Placing	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
First	26	34.7	27	36.0	22	29.3
Second	16	21.3	38	50.7	21	28.0
Third	33	44.0	10	13.3	32	42.7
Total	75	100.0	75	100.0	75	100.0
Score*	143		167		140	
Rank	2		1		3	

* See method for calculating consumer score.

were submitted to respondents for their ranking according to taste and overall preference. Since paired samples were employed preference rankings between low and high, low and medium, and medium and high salt contents were obtained.

Results from this survey were obtained by considering the total number of both direct and indirect rankings of the paired samples, and applying the chi-square test for significance to the indirect rankings to determine whether a significant preference was shown. A summary of the overall preference rankings for salt content by both urban and rural non-farm respondents is shown in Table XVI.

Indirect rankings of low versus high salt contents by urban respondents for taste preference yielded a chi-square of .62 in favor of the 0.8 percent salt. Direct rankings, however, resulted in 7 samples with 1.3 percent salt being preferred to 5 samples with 0.8 percent salt. Indirect ranking for overall preference by urban respondents yielded a chi-square of .52 in favor of the 0.8 percent salt. Once again, however, direct rankings resulted in 7 samples with 1.3 percent salt being preferred to 5 samples with 0.8 percent salt. Indirect ranking for taste preference by rural non-farm respondents were the same as for overall preference, and yielded a chi-square of 1.57 in favor of the 0.8 percent salt. Direct rankings resulted in 8 samples with 0.8 percent salt being preferred to 4 samples with 1.3 percent salt.

Since all the chi-squares were below 3.841 no significant preference was shown for either a low (0.8 percent) or high (1.3 percent) salt content. Direct rankings totaled the same for each salt content.

Indirect rankings of low versus medium salt contents for taste preference by urban respondents yielded a chi-square of .98 in favor of the 1.1 percent salt. Direct rankings were the same (6) for both salt contents. Indirect rankings for overall preference by urban respondents yielded a chi-square of .63 in favor of the 1.1 percent salt. Direct rankings resulted in 8 samples with 1.1 percent salt being preferred to 4 samples with 0.8 percent salt. Indirect rankings for taste and overall preference by rural non-farm respondents yielded a chi-square of .92 in favor of the 1.1 percent salt. Direct rankings resulted in 7 samples with 1.1 percent salt being preferred to 5 samples with 0.8 percent salt.

Since all the chi-squares were below 3.841 no significant preference was shown for a low (0.8 percent) or medium (1.1 percent) salt content. However, direct rankings showed a total of 21 samples with 1.1 percent salt being preferred to a total of 15 samples with 0.8 percent salt.

Indirect rankings of medium versus high salt content for taste preference by urban respondents yielded a chi-square of 1.86 in favor of the 1.1 percent salt. Direct rankings, however, resulted in 7 samples with 1.3 percent salt being preferred to 5 samples with 1.1 percent salt. Indirect rankings for overall preference by urban respondents yielded a chi-square of .87 in favor of the 1.1 percent salt. Direct rankings were the same (6) for both salt contents. Indirect rankings for both taste and overall preference by rural non-farm respondents yielded a chi-square of 5.18 in favor of the 1.1 percent salt. Direct rankings, however, resulted in 7 samples with 1.3 percent salt being preferred to 5 samples with 1.1 percent salt.

Since two out of three chi-squares were below 3.841 no real significant preference was shown for the 1.1 percent salt. Direct rankings, however, showed a total of 20 samples with 1.3 percent salt being preferred to 16 samples with 1.1 percent salt.

The results of the four trials and the Garfield County Survey for salt content preference indicate that cottage cheese should have from 1.0 percent to 1.25 percent salt content for greatest consumer acceptance. Since salt has some inhibitory effect on spoilage, it might seem desirable to use the higher amount (1.25 percent). However, since 1.25 percent salt appeared to be too high for many consumers, and since the consumers can easily season the cottage cheese to suit their tastes, it seems more practical for the cottage cheese manufacturers to use 1.0 percent salt or slightly higher in their product.

B. CONSUMER PREFERENCE FOR RATE OF CREAMING

In the first trial with a semi-trained taste panel, 27 respondents examined duplicate sets of 5 samples of cottage cheese for a total of 54 observation. Observations were made both on appearance and flavor of the samples. The creaming rates used ranged from 20 percent to 40 percent, inclusive. The results of the observations on appearance preference are shown in Table V.

From the results, it is clearly evident that a creaming rate of 30 percent with the curd used in these trials was by far the best as 64.8 percent of the observations on this sample were checked as "just right". The sample with the creaming rate of 25 percent was called "slightly low" or "too low" in 61.1 percent of the observations, while the sample

TABLE V

CONSUMER PREFERENCE FOR APPEARANCE OF COTTAGE CHEESE

WITH DIFFERENT RATES OF CREAMING

Semi-trained Taste Panel of 27 Participants
Duplicate Samples

Appearance Classification	RATE OF CREAMING									
	20 Percent		25 Percent		30 Percent		35 Percent		40 Percent	
	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
Too Low	31	57.4	6	11.1	0	0	0	0	0	0
Sl. Low	19	35.2	27	50.0	0	0	0	0	0	0
Just Right	4	7.4	18	33.3	35	64.8	5	9.3	0	0
Sl. High	0	0	3	5.6	19	35.2	29	53.7	1	1.9
Too High	0	0	0	0	0	0	20	37.0	53	98.1
Total	54	100.0	54	100.0	54	100.0	54	100.0	54	100.0
Score*	81		120		143		93		55	
Rank	4		2		1		3		5	

* See method for calculating consumer score.

with the 35 percent creaming was called "slightly high" or "too high" in 90.7 percent of the observations. The sample creamed at a rate of 20 percent was called "slightly low" or "too low" in 92.2 percent of the observations, while the sample with 40 percent creaming was considered "too high" by all except one observation of "slightly high". The overall ranking of the samples from first to fifth was 30 percent, 25 percent, 35 percent, 20 percent and 40 percent, respectively.

The results of the observations of flavor preference of the samples of cottage cheese with various amounts of cream added are shown in Table VI. The flavor preferences were similar to those for appearance. The sample with the creaming rate of 30 percent ranked first in overall rating with 64.6 percent "just right" observations. The sample with the 35 percent creaming rate ranked second with 39.6 percent "just right" observations, and the sample with the 25 percent creaming rate ranked third with 25 percent "just right" observations. The remaining 2 samples of cottage cheese, those with the 20 percent and 40 percent creaming rates, respectively, had only 12.5 percent each of "just right" observations.

From this trial it appeared that a creaming rate of 30 percent was distinctly superior in consumer preference to the samples of cottage cheese with higher and lower percentages of cream added.

A second trial for preference for rate of creaming by a semi-trained taste panel was conducted with 21 participants scoring duplicate sets of 5 samples. The results of the observations in regard to appearance of 20 of the participants are shown in Table VII. As in the first trial, the results show that the samples with the 30 percent and 25 percent

TABLE VI

CONSUMER PREFERENCE FOR FLAVOR OF COTTAGE CHEESE

WITH DIFFERENT RATES OF CREAMING

Semi-trained Taste Panel of 24 Participants
Duplicate Samples

Taste Classification	RATE OF CREAMING									
	20 Percent		25 Percent		30 Percent		35 Percent		40 Percent	
	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
Too Low	26	54.2	12	25.0	1	2.1	0	0	0	0
Sl. Low	16	33.3	22	45.8	7	14.6	7	14.6	3	6.3
Just Right	6	12.5	12	25.0	31	64.6	19	39.6	6	12.5
Sl. High	0	0	2	4.2	8	16.7	16	33.3	17	35.4
Too High	0	0	0	0	1	2.1	6	12.5	22	45.8
Total	48	100.0	48	100.0	48	100.1	48	100.0	48	100.0
Score*	76		96		125		109		80	
Rank	5		3		1		2		4	

* See method for calculating consumer score.

TABLE VII

CONSUMER PREFERENCE FOR APPEARANCE OF COTTAGE CHEESE

WITH DIFFERENT RATES OF CREAMING

Semi-trained Taste Panel of 20 Participants
Duplicate Samples

Appearance Classification	RATE OF CREAMING									
	20 Percent		25 Percent		30 Percent		35 Percent		40 Percent	
	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
Too Low	16	40.0	5	12.5	1	2.5	2	5.0	2	5.0
Sl. Low	10	25.0	7	17.5	6	15.0	1	2.5	0	0
Just Right	14	35.0	13	32.5	18	45.0	2	5.0	0	0
Sl. High	0	0	14	35.0	15	37.5	15	37.5	5	12.5
Too High	0	0	1	2.5	0	0	20	50.0	33	82.5
Total	40	100.0	40	100.0	40	100.0	40	100.0	40	100.0
Score*	78		87		97		60		35	
Rank	3		2		1		4		5	

* See method for calculating consumer score.

creaming rates ranked first and second, respectively, with "just right" classifications by 45 percent and 32.5 percent of the respondents. In this trial, however, the sample with the creaming rate of 20 percent ranked third with 35 percent of "just right" observations. The sample with the 35 percent creaming rate was ranked fourth with only 5.0 percent "just right" observations. As in the first trial, the sample with the 40 percent creaming rate ranked last with no observation of "just right". It should be noted that the observations appeared to be much more erratic than in the first trial, but the general trends in the two trials are similar and indicate that a creaming rate of 30 percent is the most desirable.

The preferences for flavor by 21 participants in this second trial are shown in Table VIII. The ranking of the samples for flavor was the same as that for appearance with the 30 percent creaming placing first; the 25 percent creaming, second; the 20 percent creaming, third; the 35 percent creaming, fourth; and the 40 percent creaming, fifth. Here again it may be noted that the observations appear to be somewhat erratic. However, the sample with the 30 percent creaming received the highest percentage (52.4 percent) of "just right" observations, and the sample with the 25 percent creaming received the next highest percentage (45.2 percent) of "just right" observations. Both of these percentages were much larger than those received by the other samples.

A third trial to determine preference for the rate of creaming of samples of cottage cheese was conducted among people attending a dairy meeting on the campus of Oklahoma State University. Five samples were

TABLE VIII

CONSUMER PREFERENCE FOR FLAVOR OF COTTAGE CHEESE

WITH DIFFERENT RATES OF CREAMING

Semi-trained Taste Panel of 21 Participants
Duplicate Samples

Taste Classification	RATE OF CREAMING									
	20 Percent		25 Percent		30 Percent		35 Percent		40 Percent	
	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
Too Low	9	21.4	1	2.4	3	7.1	0	0	2	4.8
Sl. Low	20	47.6	12	28.6	8	19.0	4	9.5	2	4.8
Just Right	11	26.2	19	45.2	22	52.4	7	16.7	6	14.3
Sl. High	2	4.8	7	16.7	8	19.0	16	38.1	11	26.2
Too High	0	0	3	7.1	1	2.4	15	35.7	21	50.0
Total	42	100.0	42	100.0	42	99.9	42	100.0	42	100.1
Score*	86		99		102		76		67	
Rank	3		2		1		4		5	

* See method for calculating consumer score.

scored for appearance in relation to the rate of creaming by 63 respondents. The results of this trial are shown in Table IX.

Results of this trial showed a tendency by the respondents to favor lower percentages of creaming than the two previous trials with the semi-trained taste panels. The respondents in this trial ranked the sample with the 25 percent creaming first with 50.8 percent classifying it as "just right". The sample with the 20 percent creaming ranked second with 34.9 percent classifying it as "just right", and the sample with the 30 percent creaming, third with 30.2 percent classifying it as "just right". The samples with the 35 percent creaming and the 40 percent creaming placed fourth and fifth, respectively, with each receiving only 4.8 percent of the observations as "just right".

A fourth trial to determine creaming preferences was conducted among food shoppers in Tulsa, Oklahoma. Three samples of cottage cheese with creaming rates of 20 percent, 30 percent and 40 percent were ranked according to appearance. Seventy-seven food shoppers participated in this trial, and the results are shown in Table X.

The data show that the sample of cottage cheese with the 40 percent creaming received the highest percentage (45.4 percent) of first placings compared to 28.6 percent and 26.0 percent, respectively, of first placing for the samples with 30 percent and 20 percent creaming rates. However, the sample with the 30 percent creaming had the highest overall ranking, largely because it was placed second in 70.1 percent of the observations. Furthermore, this sample was ranked third in only 1 observation. In overall ranking the sample with the 40 percent creaming ranked second and the samples with the 20 percent creaming ranked third.

TABLE IX

CONSUMER PREFERENCE FOR APPEARANCE OF COTTAGE CHEESE

WITH DIFFERENT RATES OF CREAMING

Attendants at a Dairy Meeting
63 Participants

Appearance Classification	RATE OF CREAMING									
	20 Percent		25 Percent		30 Percent		35 Percent		40 Percent	
	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
Too Low	16	25.4	10	15.9	1	1.6	0	0	0	0
Sl. Low	20	31.8	19	30.2	6	9.5	2	3.2	0	0
Just Right	22	34.9	32	50.8	19	30.2	3	4.8	3	4.8
Sl. High	5	7.9	2	3.2	33	52.4	22	34.9	4	6.4
Too High	0	0	0	0	4	6.4	36	57.1	56	88.9
Total	63	100.0	63	100.0	63	100.0	63	100.0	63	100.1
Score*	186		196		184		122		77	
Rank	2		1		3		4		5	

* See method for calculating consumer score.

TABLE X

CONSUMER PREFERENCE FOR APPEARANCE OF COTTAGE CHEESE

WITH DIFFERENT RATES OF CREAMING

77 Food Store Shoppers

	RATE OF CREAMING					
	20 Percent		30 Percent		40 Percent	
Placing	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
First	20	26.0	22	28.6	35	45.4
Second	15	19.5	54	70.1	8	10.4
Third	42	54.5	1	1.3	34	44.2
Total	77	100.0	77	100.0	77	100.0
Score*	132		175		155	
Rank	3		1		2	

* See method for calculating consumer score.

In the Garfield County Survey samples of cottage cheese with creaming rates of low (20 percent), medium (30 percent) and high (40 percent) were submitted to the respondents for their ranking according to appearance, taste and overall preference. With the use of paired samples, preference rankings between low and high, low and medium, and medium and high creaming rates were obtained.

Results from this survey were obtained by considering the total number of both direct and indirect rankings of the paired samples, and applying the chi-square test for significance to the indirect rankings to determine whether a significant preference was shown. A summary of the overall preference rankings for rate of creaming by both urban and rural non-farm respondents is shown in Table XVI.

Indirect rankings of low versus high creaming rates by urban respondents for appearance preference yielded a chi-square of 3.784 in favor of the 40 percent creaming. Direct rankings were the same (6) for both creaming rates. Indirect ranking for appearance preference by rural non-farm respondents yielded a chi-square of 3.83 in favor of the 20 percent creaming. Direct rankings resulted in 7 samples with the 20 percent creaming being preferred to 5 samples with the 40 percent creaming. Indirect rankings for taste preference by urban respondents yielded a chi-square of 2.72 in favor of the 20 percent creaming. Direct rankings were the same (6) for both creaming rates. Indirect rankings for overall preference by urban respondents yielded a chi-square of 2.969 in favor of the 20 percent creaming. Direct rankings were the same (6) for both creaming rates. Indirect rankings for taste and overall preference by rural non-farm respondents yielded a chi-square of 6.49 in favor of

the 20 percent creaming. Direct rankings resulted in 8 samples with the 20 percent creaming being preferred to 4 samples with the 40 percent creaming.

Since 4 of the chi-squares for preference ranking between these two creaming rates were below 3.841 and only one (6.49) was above, no real significant preference was shown. Direct rankings were also very close with a total of 33 samples with 20 percent creaming being preferred to 27 samples with 40 percent creaming. However, the chi-square of 6.49 does show some indication that the respondents did prefer a low creaming rate to a high creaming rate.

Indirect ranking of low versus medium creaming rates for appearance by urban respondents yielded a chi-square of .06 in favor of the 20 percent creaming. However direct rankings resulted in 8 samples with the 30 percent creaming being preferred to 4 samples with the 20 percent creaming. Indirect ranking for appearance by rural non-farm respondents yielded a chi-square of 2.67 in favor of the 30 percent creaming. Direct rankings resulted in 7 samples with 30 percent creaming being preferred to 5 samples with 20 percent creaming. Indirect rankings for taste preference by urban respondents yielded a chi-square of .045 in favor of the 30 percent creaming. Direct rankings resulted in 7 samples with 30 percent creaming being preferred to 5 samples with 20 percent creaming. Indirect rankings for overall preference by urban respondents yielded a chi-square of .89 in favor of the 30 percent creaming. Direct rankings resulted in 7 samples with 30 percent creamings being preferred to 5 samples with 20 percent creaming. Indirect rankings for taste and overall preference by rural non-farm respondents yielded a chi-square

of .89 in favor of the 20 percent creaming. However direct rankings resulted in 7 samples with 30 percent creaming being preferred to 5 samples with 20 percent creaming.

Since all the chi-squares are below 3.841 no significant preference is shown between low and medium rates of creaming. However, direct rankings showed a total of 36 samples with 30 percent creaming being preferred to 24 samples with 20 percent creaming.

Indirect rankings of medium versus high creaming rates for appearance by urban respondents yielded a chi-square of 1.17 in favor of the 40 percent creaming. Direct rankings resulted in 7 samples with 40 percent creaming being preferred to 5 samples with 30 percent creaming. Indirect rankings for appearance preference by rural non-farm respondents yielded a chi-square of 3.57 in favor of the 30 percent creaming. However, direct rankings resulted in 7 samples with 40 percent creaming being preferred to 5 samples with 30 percent creaming. Indirect rankings for taste preference by urban respondents yielded a chi-square of less than .01. Direct rankings were the same (6) for both creaming rates. Indirect rankings for overall preference by urban respondents yielded a chi-square of .16 in favor of the 30 percent creaming. Direct rankings resulted in 7 samples with 30 percent creaming being preferred to 5 samples with 40 percent creaming. Indirect rankings for taste and overall preference by rural non-farm respondents yielded a chi-square of 3.34 in favor of the 30 percent creaming. Direct rankings were the same (6) for both creaming rates.

Since all the chi-squares were below 3.841 no significant preference was shown between medium and high rates of creaming. Direct rankings

were also very close with a total of 31 samples with 40 percent creaming being preferred to 29 samples with 30 percent creaming.

Considering the data received from the four trials and the Garfield County Survey, it appears that some consumers prefer a rather low rate of creaming and many prefer a rather high rate, but that a medium rate (30 percent) is most acceptable to the largest number of consumers.

C. CONSUMER PREFERENCE FOR pH (ACIDITY)

Various investigators have found that the pH (acidity) of the finished cottage cheese has a profound influence on the keeping quality, with a high acidity (low pH) delaying spoilage. Two trials and the Garfield County Survey were made involving consumer reactions to the taste of samples of cottage cheese with different pH (acidity) levels.

In the first trial, an attempt was made to have the final pH values ranging from 5.2 to 4.8 in increments of 0.1 pH units. However, the actual values obtained were somewhat different. They ranged from 5.12 to 4.83, but did represent a rather wide range. Duplicate sets of 5 samples of cottage cheese with pH values of 5.12, 5.05, 4.95, 4.88 and 4.83 were submitted to a semi-trained taste panel of 32 participants, for a total of 64 observations on each sample. The participants were asked to taste the samples for acid content and score them accordingly. The results of this trial are shown in Table XI.

The results show a tendency for consumers to prefer a low pH (high acidity) in cottage cheese, as the sample with the pH value of 4.88 received the highest percentage (35.9 percent) of "just right" observations. The samples with the 4.83 pH value and the 4.95 pH value were placed as a

TABLE XI

CONSUMER PREFERENCE FOR pH (ACIDITY) LEVEL OF COTTAGE CHEESE

Semi-trained Taste Panel of 32 Participants
Duplicate Samples

	pH VALUE									
	5.12		5.05		4.95		4.88		4.83	
Taste Classification	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
Too Low	9	14.1	17	26.6	4	6.3	5	7.8	5	7.8
Sl. Low	14	21.9	22	34.4	13	20.3	17	25.5	10	15.6
Just Right	17	26.5	17	26.5	20	31.3	23	35.9	21	32.8
Sl. High	16	25.0	8	12.5	20	31.3	12	20.3	19	29.7
Too High	8	12.5	0	0	7	10.9	6	9.4	9	14.1
Total	64	100.0	64	100.1	64	100.1	64	100.0	64	100.0
Score*	128		128		137		140		135	
Rank	4		4		2		1		3	

* See method for calculating consumer score.

close second and third, as they received 32.8 percent and 31.3 percent, respectively, of "just right" observations. The samples with the 5.05 pH value and the 5.12 pH value tied for fourth place as each received 26.5 percent of "just right" observations. The overall ranking of these samples of cottage cheese was 4.88, 4.95, 4.83, 5.05 and 5.12, respectively.

The data obtained from this trial were scattered over a rather wide range, indicating the consumers vary considerably in the degree of acid preferred in cottage cheese.

The second trial to determine consumer preference for pH (acidity) of cottage cheese was conducted among 74 food shoppers in Tulsa, Oklahoma. The food shoppers were asked to rank according to taste preference samples of cottage cheese representing three levels of pH (acidity). It was planned to have the pH levels at 5.2, 5.1 and 5.0, but through an error in preparation of the samples these values were not obtained. The final pH values of the samples used in this trial which represented high, medium and low were 5.25, 5.20 and 5.0. The results of this trial are shown in Table XII.

The results are similar to those obtained in the first trial, as the respondents showed a tendency to prefer a low pH (high acidity) in cottage cheese. The sample of cottage cheese with the pH value of 5.20 received the highest percentage (44.6 percent) of first placings and the sample with the pH value of 5.0 received the second highest percentage (33.8 percent) of first placings. The sample with the pH value of 5.25 received the lowest percentage (21.6 percent) of first placings. However, the sample with the lowest pH value (5.0) had the highest overall ranking, largely because it was placed second in 50.0 percent of the observation.

TABLE XII

CONSUMER PREFERENCE FOR pH (ACIDITY) LEVEL OF COTTAGE CHEESE

74 Food Store Shoppers

	pH VALUE					
	5.25		5.20		5.0	
Placing	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
First	16	21.6	33	44.6	25	33.8
Second	21	28.4	16	21.6	37	50.0
Third	37	50.0	25	33.8	12	16.2
Total	74	100.0	74	100.1	74	100.0
Score*	127		156		161	
Rank	3		2		1	

* See method for calculating consumer score.

Furthermore, this sample was ranked third in only 16.2 percent of the observations.

As noted in the first trial, the results are rather widely scattered which may indicate that people are less sensitive to acidity (pH) than they are to some of the other factors which affect the quality of cottage cheese.

In the Garfield County Survey samples of cottage cheese with two pH levels (low and high) were submitted to the respondents for their ranking according to appearance, taste and overall preference. Since the pH levels employed in this survey did not affect the appearance of the samples, only the taste and overall preferences are being considered in this discussion.

Results of this survey were calculated by considering the total number of direct and indirect rankings of the paired samples, and applying the chi-square test for significance to the indirect rankings to determine whether a significant preference was shown. A summary of the overall preference rankings for the two pH levels by both urban and rural non-farm respondents is shown in Table XVI.

Indirect rankings between the two pH levels (low and high) for taste preference by urban respondents yielded a chi-square of .618 in favor of the high pH level. Direct rankings, however, resulted in 11 samples with the low pH level being preferred to 7 samples with the high pH level. Indirect rankings for overall preference by urban respondents yielded a chi-square of 6.00 in favor of the high pH level. Direct rankings were the same (9) for both pH levels. Indirect rankings for taste and overall preference by rural non-farm respondents yielded a

chi-square of 5.5 in favor of the low pH level. Direct rankings resulted in all 18 samples with the low pH level being preferred to the samples with the high pH level.

The results of this survey are similar to those of the previous trials, in that the respondents were somewhat erratic in their rankings. The chi-square of 6.00 for overall preference by urban respondents showed a significant preference for a high pH level, while the chi-square of 5.5 for taste and overall preference by rural non-farm respondents showed a significant preference for a low pH level. Direct rankings showed a preference for a low pH level as 38 samples with a low pH level were preferred to only 16 samples with a high pH level.

From the results of the two trials and the survey it appears that a low pH level in cottage cheese is desirable from the standpoint of consumer acceptance. The value of a low pH is further enhanced by the changes for improvement in keeping quality of cottage cheese. It must be recognized, however, that low pH values (or high acidity) developed during manufacturing tend to make a soft, pasty body in cottage cheese. From the practical standpoint, a rather low pH of about 5.0 can be attained by using manufacturing procedures that will give a fairly low pH on the finished curd particles to the point where the body is not impaired, and then adjusting the pH on the creaming mixture by adding some acid such as citric.

D. CONSUMER PREFERENCE FOR SIZE OF CURD PARTICLES

In the first trial to determine consumer preference for different size curd particles of cottage cheese, three samples were ranked by 65

respondents who were in attendance at a dairy meeting on the campus of Oklahoma State University. The three samples of cottage cheese used in this trial had curd sizes of small (cut with 1/4 inch knives), medium (cut with 3/8 inch knives) and large (cut with 5/8 inch knives). Of the 65 respondents participating in this trial, 63 of them indicated their opinions of the samples as too small, slightly small, just right, slightly large or too large, and all 65 of them ranked the samples according to preference. The results of this trial are shown in Tables XIII and XIV.

The results show a tendency by the consumers to prefer a cottage cheese with medium sized curd particles. The sample with the medium curd particles received the highest percentage (44.4 percent) of "just right" observations. The sample with the small curd particles received the second highest percentage (39.7 percent) of "just right" observations, and the sample with the large curd particles received third highest percentage (20.6 percent) of "just right" observations. Furthermore, the sample with the medium curd particles was ranked as "slightly large" in 33.3 percent of the observations and as "slightly small" in 19.1 percent of the observations. This sample was ranked as "too small" in only 3.2 percent of the observations and as "too large" in none of the observations.

Ranking of the samples according to preference also showed a tendency for the consumers to prefer cottage cheese with medium sized curd particles, as this sample received the highest percentage (40.0 percent) of first placings. The sample with the small sized curd particles received the second highest percentage (36.9 percent) of first placings, and the sample with the large sized curd particles received third highest percentage

TABLE XIII

CONSUMER PREFERENCE FOR SIZE OF CURD PARTICLES OF COTTAGE CHEESE

Attendants at a Dairy Meeting
63 Participants

Curd Size Classification	SIZE OF CURD PARTICLES					
	Small (1/4 inch)		Medium (3/8 inch)		Large (5/8 inch)	
	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
Too Small	17	27.0	2	3.2	0	0
Sl. Small	21	33.3	12	19.1	0	0
Just Right	25	39.7	28	44.4	13	20.6
Sl. Large	0	0	21	33.3	15	23.8
Too Large	0	0	0	0	35	55.6
Total	63	100.0	63	100.0	63	100.0
Score*	134		152		104	
Rank	2		1		3	

* See method for calculating consumer score.

TABLE XIV

CONSUMER PREFERENCE FOR SIZE OF CURD PARTICLES OF COTTAGE CHEESE

Attendants at a Dairy Meeting
65 Participants

	SIZE OF CURD PARTICLES					
	Small (1/4 inch)		Medium (3/8 inch)		Large (5/8 inch)	
Placings	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
First	24	36.9	26	40.0	15	23.1
Second	17	26.2	37	56.9	11	16.9
Third	24	36.9	2	3.1	39	60.0
Total	65	100.0	65	100.0	65	100.0
Score*	130		154		106	
Rank	2		1		3	

* See method for calculating consumer score.

(23.1 percent) of first placings. Furthermore, the sample with the medium sized curd particles was placed second in 56.9 percent of the observations and third in only 3.1 percent of the observations. Overall ranking of the samples from first through third was medium, small and large, respectively.

In the second trial 77 food shoppers in Tulsa, Oklahoma ranked three samples of cottage cheese with curd sizes of small, medium and large according to appearance preference. The results of this trial are shown in Table XV.

These results differ from those of the first trial as the sample with the small curd particles received the highest percentage (39.0 percent) of first placings. The sample with the large curd particles received the second highest percentage (33.8 percent) of first placings and the sample with the medium curd particles received third highest percentage (27.3 percent) of first placings. However, the sample with the medium curd particles received the highest overall ranking, largely because it was placed second in 63.6 percent of the observations and third in only 9.1 percent of the observations. The overall ranking of the samples from first through third was medium, small and large curd particles, respectively.

In the Garfield County Survey samples of cottage cheese with small and large curd particles were submitted to the respondents for their ranking according to appearance, taste and overall preference. Results of this survey were calculated by considering the total number of direct and indirect rankings of the paired samples, and applying the chi-square test for significance to the indirect rankings to determine whether a significant preference was shown. A summary of the overall preference

TABLE XV

CONSUMER PREFERENCE FOR SIZE OF CURD PARTICLES OF COTTAGE CHEESE

77 Food Store Shoppers

	SIZE OF CURD PARTICLES					
	Small (1/4 inch)		Medium (3/8 inch)		Large (5/8 inch)	
Placings	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents	Number of Respondents	Percentage of Respondents
First	30	39.0	21	27.3	26	33.8
Second	20	26.0	49	63.6	8	10.4
Third	27	35.0	7	9.1	43	55.8
Total	77	100.0	77	100.0	77	100.0
Score*	157		168		137	
Rank	2		1		3	

* See method for calculating consumer score.

rankings for the two sizes of curd particles by both urban and rural non-farm respondents is shown in Table XVI.

Indirect rankings between the small and large curd particles for appearance preference by urban respondents yielded a chi-square of 9.89 in favor of the small curd particles. Direct rankings resulted in 10 samples with small curd particles being preferred to 8 samples with large curd particles. Indirect rankings for appearance by rural non-farm respondents yielded a chi-square of 4.22 in favor of the small curd particles. Direct rankings resulted in 11 samples with small curd particles being preferred to 7 samples with large curd particles.

Indirect rankings for taste preference by urban respondents yielded a chi-square of 14.83 in favor of the small curd particles. Direct rankings resulted in 10 samples with small curd particles being preferred to 8 samples with large curd particles. Indirect rankings for overall preference by urban respondents yielded a chi-square of 12.50 in favor of the small curd particles. Direct rankings were the same as for taste preference (10 to 8). Indirect rankings for taste and overall preference by rural non-farm respondents yielded a chi-square of .61 in favor of the large curd particles. However, direct rankings resulted in 11 samples with small curd particles being preferred to 7 samples with large curd particles.

Since four of the five chi-squares were above 3.841 a real significant preference was shown for cottage cheese with small curd particles. The direct rankings also showed a preference for small curd particles as 52 samples with the small curd particles were preferred to 38 samples with the large curd particles.

TABLE XVI

SUMMARY OF THE GARFIELD COUNTY SURVEY

Overall Preference Rankings

	Total Number of Rankings	DIRECT		INDIRECT	
		Number of Rankings	Number of Rankings	Chi-square In favor of:	Chi-square In favor of:
		URBAN	RURAL	URBAN	RURAL
A. SALT CONTENT					
Low vs. High	12	5 7	8 4	.52 (low)	1.57 (low)
Low vs. Medium	12	4 8	5 7	.63 (medium)	.92 (medium)
Medium vs. High	12	6 6	5 7	.87 (medium)	5.18 (medium)
B. RATE OF CREAMING					
Low vs. High	12	6 6	8 4	2.969 (low)	6.49 (low)
Low vs. Medium	12	5 7	5 7	.89 (medium)	.89 (low)
Medium vs. High	12	7 5	6 6	.16 (medium)	3.34 (medium)
C. pH (ACIDITY) LEVEL					
Low vs. High	18	9 9	18 0	6.00 (high)	5.5 (low)
D. SIZE OF CURD PARTICLES					
Small vs. Large	18	10 8	11 7	12.50 (small)	.61 (large)

The results of the two previous trials and the survey indicate that many consumers prefer the small curd particles and some prefer the large curd particles, but that cottage cheese with medium curd particles (cut with 3/8 inch knives), if made available, would be the most popular for the largest number of consumers.

E. CONSUMERS' OPINIONS OF COTTAGE CHEESE

A questionnaire was prepared and included as a part of the Garfield County Survey. The 162 respondents participating in this survey were read each question and their answers recorded by the interviewers. The questions asked and the responses received are given in the order in which they appeared on the questionnaire.

1. What do you like about cottage cheese? In answer to this question, 8 respondents stated that they did not care for cottage cheese. Among the remainder of the respondents, the most common replies were the high nutritive value and the pleasing flavor of cottage cheese. Other replies were the low calorie content and the versatility of cottage cheese.

2. What don't you like about cottage cheese? To this question, 133 respondents stated that there was nothing that they disliked about cottage cheese. The remaining respondents listed their dislikes as poor keeping quality, sourness, poor flavor and 4 other miscellaneous replies.

3. Has the cottage cheese that you have been purchasing been satisfactory? Of the total number of respondents participating, 75.3 percent answered "yes" and 24.7 percent answered "no". What criticisms do you have regarding the quality of the cottage cheese purchased? The criticisms offered were poor keeping quality, sourness, oldness, poor flavor,

dryness and moldiness. Each of these criticisms were listed several times, with oldness and sourness being the most prevalent.

4. How do you serve cottage cheese? The most popular way to serve cottage cheese was plain as it comes from the package, as 138 respondents stated they served it most usually in this manner. Eighty-seven respondents stated they used cottage cheese in salads and 47 respondents served it with fruit.

5. Do you use the cottage cheese as it comes from the package? If not, how do you change it? Ninety-six of the respondents stated that they always used the cottage cheese as it came from the package and the remaining 66 respondents stated that they modified it before using. The most common modification was the adding of salt and pepper as indicated by 51 respondents. Sixteen respondents added cream before using, 11 respondents added sugar and 3 respondents stated they drained the curd before using.

6. How often do you purchase cottage cheese? Five of the 162 respondents indicated that they never purchased cottage cheese. Of the remaining 157 respondents, 10 percent purchased cottage cheese two to three times a week, 50.3 percent purchased it once a week, 19.7 percent purchased it every two weeks, 17.7 percent purchased it once a month and 2.3 percent purchased it only occasionally. Ninety-four percent of the cottage cheese buyers purchased one package at a time. Also, 77 percent purchased the 12 ounce package compared to 23 percent for the 2 pound package.

From the above data it appears that most families used cottage cheese for the principal reasons that it is high in nutritive value, has

a pleasing flavor, is low in calories and is versatile and easy to serve. The most common objections to it are poor keeping quality and lack of desirable flavor. It appears that much of the cottage cheese purchased in food stores had undergone deterioration, as evidenced by the remarks on quality.

Cottage cheese may be served in a variety of ways, the most popular of which are plain, in salads and with fruit. About half of the purchasers of cottage cheese modify it before using, by seasoning or by adding cream. Most users purchased it once a week or more often, usually 1 package at a time and preferred the 12 ounce package to the 2 pound package.

SUMMARY AND CONCLUSIONS

A study was conducted to determine consumer preferences for salt content, rate of creaming, pH (acidity) and size of curd particles of cottage cheese.

The respondents participating in this study consisted of semi-trained taste panels made up of the faculty and advanced students in the Department of Food, Nutrition and Institution Administration and the Department of Dairying at Oklahoma State University, attendants at a dairy meeting on the campus, food shoppers in two food stores in Tulsa, Oklahoma and urban and rural non-farm residents of Garfield County, Oklahoma.

The samples of cottage cheese used for this study were prepared in the dairy plant at Oklahoma State University. They were submitted to the respondents for appearance, taste and overall preference. Additional information was gained by interviewing the participants in the Garfield County Survey regarding their opinions of cottage cheese currently on the market.

A total of 364 respondents participated in four trials and the survey to determine preference for salt content of cottage cheese. The results indicate that a salt content of from 1.0 percent to 1.25 percent is preferred by most consumers. In the trials that included samples of cottage cheese with salt contents of 1.0 percent and 1.25 percent, the percentage of respondents indicating preference for these samples was only slightly different. Although salt helps to delay spoilage in cottage cheese, it appears that cottage cheese with a salt content of 1.0 percent

or slightly above would be most acceptable to consumers, as additional salt may be easily added if desired.

Preference for rate of creaming of cottage cheese was determined for appearance, taste and overall preference. A total of 364 respondents participated in five trials and the Garfield County Survey. In both the trials and the survey, the samples of cottage cheese creamed at the rate of 30 percent of the weight of the curd had the highest preference ranking. The amount of free cream in creamed cottage cheese depends largely upon the amount of cream that is absorbed by the curd, and the amount of cream that is absorbed by the curd depends largely upon the size, firmness and dryness of the curd particles. In this study the 30 percent creaming for the samples resulted in the curd particles being covered with a glistening layer of cream and little free cream flowing from the mass of cheese when spooned onto a plate.

A total of 268 respondents participated in two taste trials and the Garfield County Survey to determine pH (acidity) preference for cottage cheese. The samples of cottage cheese with the lower pH values (high acidity) were preferred over the samples with the higher pH values (low acidity). Since a low pH value also has a protective effect against spoilage in cottage cheese, it appears advisable to market cottage cheese with a relatively low pH level.

Preferences for size of curd particles of cottage cheese were determined by 304 respondents participating in two trials and the Garfield County Survey. Samples of cottage cheese with curd sizes of small (cut with 1/4 inch knives), medium (cut with 3/8 inch knives) and large (cut with 5/8 inch knives) were ranked according to appearance preference.

It was found that the medium size curd had a higher preference ranking than either the small curd or the larger curd. It should be noted, however, that both the small and large curd sizes were given top ranking by many consumers. However, it appeared that the medium curd size would be most acceptable to consumers if only one curd size was produced by any plant.

The consumers' opinions of cottage cheese indicate a rather high regard for this product. The principal reasons given for using cottage cheese were high nutritive value, pleasing flavor, low calorie content and versatility and ease of serving. The principal objections to cottage cheese were poor keeping quality and lack of distinctive flavor.

The majority of consumers purchased cottage cheese once a week or more often, but 5 of the 162 respondents indicated that they never purchased this product. The majority of the consumers purchased one package at a time, and the 12 ounce package was more popular than the 2 pound package.

A summation of the results showed that the average consumer in Oklahoma preferred a salt content in cottage cheese of slightly above 1.0 percent, a rate of creaming of 30 percent of the weight of the curd, cottage cheese with a pH of about 5.0 or slightly lower and with a medium size curd (cut with 3/8 inch knives).

LITERATURE CITED

1. Alfred Politz Research, Inc. Highlights From a Study of Public Attitudes Towards Dairy Products. Amer. Dairy Ass'n. 1955.

2. Alfred Politz Research, Inc. Highlights From a Study of Public Attitudes Towards Dairy Products. Amer. Dairy Ass'n. 1956.

3. Blakley, Leo V., L. Don McMullin and Kenneth B. Boggs. Consumer Preferences for Dairy Products and Services in Oklahoma City, Oklahoma. Okla. Agr. Exp. Station Bul. B-464 1955.

4. Bradley, R. A.. "Some Statistical Methods in Taste Testing and Quality Evaluations". Biometrics. 9:22-38 1956.

5. Elliker P. R., V. N. Smith and R. B. Parker. "Controlling Bacterial Spoilage of Cottage Cheese". Milk Plant Monthly. 40:24-26 1951.

6. Holland, Robert F. and James C. White. "Cottage Cheese Spoilage". American Milk Review. 14:40 1952.

7. Harmon, L. G., G. M. Trout and M. D. Bonner. A Market Survey of Cottage Cheese. I. Some Characteristics Influencing Consumer Acceptance and Shelf-life. Michigan Agr. Exp. Sta. Quarterly Bul. 38-17:146 1955.

8. Harmon, L. G., G. M. Trout and M. D. Bonner. "Increase Shelf-life of Cottage Cheese". Milk Plant Monthly. 45:14-16 1956.

9. Miller, P. G., J. H. Nair and A. J. Harriman. "A Household and a Laboratory Type of Panel for Testing Consumer Preference". Food Technology. 9:445-9 1955.

10. Olson, H. C. and M. D. Bonner. Methods for Analysis of Cottage Cheese. Okla. Agr. Exp. Sta. Tech. Bul. T-71 1957.

11. U.S.D.A. Food Consumption of Households in the United States. U.S.D.A. 1955.

12. U.S.D.A., Bureau of Human Nutrition and Home Economics. Sensory Methods for Measuring Differences in Food Quality. Agr. Inf. Bul. No. 34 1951.

13. U.S.D.A., A.M.S.. Supplement for 1954 Consumption of Food in the United States. 1955; U.S.D.A., A.M.S. The Dairy Situation 1956; U.S.D.A. Dairy Statistics and Related Series 1956.

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