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"Sweet Acidophilus Lowfat Milk" is a cold lowfat milk product to which Lactobacillus acidophilus has been added. Taste tests have indicated that consumers find this milk an acceptable product. Much of the research pertaining to the milk has been conducted in the field of medicine. Due to the effects of high heat on the viable organism, little work has been conducted using Sweet Acidophilus Lowfat Milk in food preparation. The purpose of this study was to determine if baked custards made with Sweet Acidophilus milk were considered acceptable when compared to baked custards made with other lowfat milk.

Ten summer school students and staff members selected from the University of North Carolina at Greensboro were used as judges. Each panel member evaluated four custards made from four different milks on each of five afternoons during a period of two weeks. Milks used were Acidophilus Lowfat, Nonfat Dry, Light n' Lively, and Evaporated Skimmed milks.

A Likert-type acceptability scale was used for scoring appearance, flavor, and overall acceptability of custards made from each type of milk. Chi square analysis was used to determine if a difference existed between samples evaluated by the panel members. Objective tests were analyzed by the one way analysis of variance to determine if there was a significant difference between the samples.

Results of the study showed significant difference in the responses of taste panel members when evaluating appearance, flavor, and overall acceptability of the custards. Evaporated skimmed milk products were rated

significantly lower in all areas. There was no significant difference between Sweet Acidophilus lowfat milk and the other two milks. Objective tests to measure stability and drip loss showed significant difference between the custards. Custards made from evaporated skimmed milk were the least stable of the four custards.

Sweet Acidophilus lowfat milk products were as acceptable as custards made from Light n' Lively and nonfat dry milks. In addition, objective tests indicated that custards made from Sweet Acidophilus lowfat milk were as stable as custards made from nonfat dry and Light n' Lively milks.

A COMPARISON OF BAKED CUSTARDS MADE WITH SWEET
ACIDOPHILUS LOWFAT MILK AND OTHER LOWFAT MILK

by

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APPROVAL PAGE

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CHAPTER I

INTRODUCTION

The beneficial effects of Lactobacillus acidophilus in the gastrointestinal tract have been recognized for years; therefore, the need for a palatable product which contains sufficient viable L. acidophilus was established. It has been a general consensus that milk is a favorable medium for the growth and viability of L. acidophilus, but success in producing a palatable and viable acidophilus milk was minimal until 1975. Modification of the production process led to a milk that contained viable L. acidophilus, and was accepted by the consumer. The name of the product is "Sweet Acidophilus Lowfat Milk."

Attempts to produce a satisfactory acidophilus milk began as early as 1931. However, such products were not readily accepted by the consumer. They were used only as therapeutic agents when other medicinal treatments failed. Studies indicated that acidophilus milk was not accepted because of its unappetizing flavor. The high heat treatment of the milk before inoculation caused unsavory flavor to develop, which resulted in a product with a cooked flavor. After the culture had grown in the milk, an acid taste also developed (Speck, 1975).

"Sweet Acidophilus Lowfat Milk" is a cold lowfat milk product to which L. acidophilus, grown and concentrated separately, is added. Taste tests have indicated that this fluid milk is an acceptable product. However, little work has been conducted on the milk in food preparation, probably due to the effects of high heat on the viable organism. The researcher questions if the lactic acid bacteria in the milk, even though destroyed at a specific temperature, affects the flavor of a cooked product. Interest in the topic was stimulated when the researcher learned that some users of the milk thought they noticed a difference when cooking with this milk as compared to other milks. Preliminary experimentation with the researcher's family indicated that a difference was detectable in the flavor of baked custards and yellow cake layers made with "Sweet Acidophilus Lowfat Milk" at 1% milkfat and Sealtest Light n' Lively Milk at 1% milkfat. Therefore, this study was conducted to determine the overall characteristics and acceptability of baked custards made with "Sweet Acidophilus Lowfat Milk" as compared to other lowfat milk products.

CHAPTER II

REVIEW OF LITERATURE

The commercial production of an acidophilus milk containing viable L. acidophilus has perplexed processors for a number of years. Changes occurring in the viability of the organism in the milk, the palatability of the milk, and the therapeutic value of the product have been investigated extensively. The modification of the production process resulted in an acceptable acidophilus milk in 1975.

An association between lactobacilli, other lactic acid bacteria, and man has been recognized for centuries. Studies of this intestinal microflora have focused on the intestinal Lactobacilli acidophilus. Therapeutic use of lactobacilli to aid in the cure of a variety of gastro-intestinal disorders has also been considered. It was reported that individuals who consumed milk fermented by lactobacilli, especially L. acidophilus, experienced improved health (Speck, 1975). Before the existence of the bacteria was recognized, soured milks such as yogurt were used therapeutically in Europe and Asia. This represented some of the early attempts to implant lactobacilli in the intestine and to treat gastro-intestinal disorders. In 1922, Cheplin and Rettger gave full details of methods used, cases treated, and results obtained in relation to L. acidophilus. This was followed by the marketing of valueless lactobacillus preparations which resulted in negative lactobacillus therapy.

Work conducted by Stark, et. al (1934) showed that of the 74 subjects who completed his experiment, approximately two-thirds of those suffering intestinal difficulties were benefited by acidophilus therapy. Gillespie, et. al. (1956) noted that L. acidophilus therapy relieves at least 75% of persons suffering from uncomplicated chronic constipation, constipation accompanied by biliary symptoms, "mucous colitis," and chronic ulcertive colitis. Additional research studies (Haenel, 1970, Sandine, et. al., 1972, and Speck, 1976) have contributed information concerning the mechanisms of Lactobacillus in the gastro-intestinal tract.

Much of the research pertaining to L. acidophilus has centered on its therapeutic value and its relationship to the gastro-intestinal tract. Therefore, viable methods of implanting the bacteria in the diet became necessary (Hawley, et. al. 1959). Kulp (1931) stated that milk constitutes a favorable medium for the growth and viability of the organism. He noted that acidophilus milk should contain a minimum of 100 million viable organisms per c.c. when the consumer receives it. Maximum viability of L. acidophilus was evident in freshly prepared products. However, a rapid decrease occurred within any storage period. Kulp (1931) found that viability was restored for as long as 2 to 3 weeks without harm to the product, if rules related to proper preparation and storage were followed. The work conducted by Kulp indicated that to keep the commercial acidophilus milk viable for as long as a week, it should be stored at 5 C, with an acidity of not more than 0.65%. In relation to palatability, some factors that affected the storage life of L. acidophilus were initial acidity, a related metabolic substance and storage temperature (Kulp, 1931).

Duggan, et. al. (1959) stated that the L. acidophilus was not viable in tablet preparations. Furthermore, viability in the cultures in liquid acidophilus milk declined rapidly due to the acid produced. A whey medium that supports growth and permits efficient recovery of the cells by centrifugation was developed by Duggan, et. al. (1959). These cells could be "quick-frozen" and stored. Neutralization of the concentrate prior to freezing aided in dispensing and minimizing the acidic flavor. To eliminate daily preparation of the product, enough concentrate could be made and frozen in one day to last for several months. The thawed acidophilus concentrate could then be added to liquid milk and stored in the refrigerator for one week.

Gilliland and Speck (1974) noted that a batch procedure was the most effective method for growing cell crops in relation to concentrated starters. A growth medium should contain the nutrients needed for growth of the bacteria and have a composition similar to the food to be bioprocessed to maintain proper biological activity in the concentrated cultures. Concentrated culture products were found to be equal to or better than culture products manufactured with the traditionally prepared milk cultures. Activity of the culture should be maintained throughout its preparation, shipment, and storage. Evidence indicated that storage of concentrated cultures in liquid nitrogen (-196 C) was the best means to preserve the starters.

Although it is possible to manufacture satisfactory products which contain high levels of the lactobacilli, Speck (1975) has noted that the flavor of acidophilus milk had no appeal to consumers. The unsavory flavor developed due to the high heat treatment of the milk before inoculation resulted in a product with a cooked flavor. An acid taste also developed after the culture had grown in the milk.

Speck (1976) found little had been done to include this bacteria in the diet. The bacteria was essentially unavailable to the consumer, except in products sold as pharmaceuticals. In Japan, a successful product which contained large numbers of lactobacilli, including L. acidophilus, was marketed. Milk containing 1%, 1.5%, and 2% milkfat is the only product containing the organism in the United States (Dairy Council-Greensboro). Speck (1975) also noted that dietary changes have occurred in the last two decades, due to less home preparation of meals and greater consumption of manufactured and fabricated foods. Foods consumed contain almost no viable bacteria. Successful work conducted by Speck and his associates at North Carolina State University proved it is possible for consumers to get the desired L. acidophilus into the system by the consumption of the product "Sweet Acidophilus Lowfat Milk." The L. acidophilus is grown and concentrated separately, then added to cold lowfat milk. When inoculated at 2 1/2 million per ml., this bacteria does not affect the flavor of milk, the bacteria remains dormant at temperatures below 66 F., and implants in the gastro-intestinal tract (*T.M. North Carolina State Dairy Foundation).

Studies have been conducted using other types of lowfat milks in food preparation. Thomas and Coulter (1970) demonstrated the value of nonfat milk solids in helping to control the texture of a prepared milk and egg custard which was frozen and later thawed for consumption. Seventy-five percent of the consumers who rated the product rated it as excellent. Hanning, et. al. (1955) noted that the quality of starch puddings was improved by the substitution of 25% whey for nonfat milk solids. Puddings were of superior quality due to better flavor, appearance, consistency, and structure. Morse, et. al. (1950) conducted a study to determine the effect of nonfat dry milk in food mixtures containing a series of pastes. Results indicated that "nonfat dry milk solids increased the viscosity or gel strength of these pastes in proportion to the amount of dry milk preparation used." Atwood and Ehlers (1933) compared foods made with evaporated milk to those made with market milk. Market milk is a term used for homogenized whole milk. Evidence revealed that creamed soups and creamed vegetable dishes were judged superior when made with evaporated milk than with market milk. Meat dishes were superior in appearance and consistency when made with evaporated milk. There was little difference in escalloped dishes, breads, quick breads, butter cakes, and puddings made with evaporated and market milks. This study indicated that the use of evaporated milk would be valuable to institutions in improving quality of some foods and reducing costs. However, little work has been conducted on the effect of milk containing L. acidophilus in food preparation, probably due to the effects of high heat on the viable organism. Taste tests have been conducted which indicated that consumers detect no difference in the flavor of "Sweet Acidophilus Milk" from regular milk (*T.M. North Carolina State Foundation). Due to advanced technology this milk is now commercially available.

Taste Panels

"Sensory analysis, a branch of analytical science, may be defined as the science of measuring and evaluating the properties of products by one or more of the several human senses" (Tilgner, 1971). Nonhuman evaluation techniques are made difficult due to a six-step pattern usually followed in sensory evaluation. These steps are as follows: 1-perception, 2-awareness, 3-classification, 4-remembrance (retention), 5-description (reproduction), and 6-judgment (evaluation). Due to the difficulty of nonhuman evaluations, man will continue to depend on his sensory abilities even when objective measurements are made possible (Tilgner, 1971). However, Boggs and Hanson (1949) noted that by the use of physical, chemical, and sensory tests, better results can be obtained than might have been if only one of the methods were used in the evaluation of foods. Kramer (1969) stated that if certain conditions are met, the correlation between subjective and objective scores may indicate the accuracy of objective methods.

The use of a taste panel has proven to be of importance in relationship to consumer acceptance of a food product. It has been acknowledged that the success of a food product depends on consumer acceptance (Amerine, et. al., 1965), therefore Foster (1954) introduced the idea of standardization in panel studies of foods to obtain more accurate results from taste panels. Foster (1954) further noted that for specific measurement applications, panel members should meet all requirements for standardization.

Members on the taste panel may be trained or untrained. Griswold (1962) stated that all judges should be trained before starting the experiment. It was further noted that a small, well-trained taste panel is preferable to a large, untrained one. Bennett, et. al. (1956) found that a three-week training period improved consistency of performance of sensory test panel members when scoring varying concentrations of rancid beef for flavor and aroma. They found that the ability to discriminate and to reproduce judgments resulted in training the judge. Krum (1955) recommended that panel members be trained on the products to be tested. In addition, Foster (1954) indicated that a month of constant training was necessary for a panel member to level off at his peak performance. However, if simulation of consumer reaction is of primary importance, Kramer, et. al. (1961) recommend a non-trained panel. In relation to panel selection, Pangborn (1964) emphasizes the fallacy of substituting judges within a study.

Griswold (1962) advised that the size of the panel be as large as possible to reduce experimental error. It had been recommended that a panel of four to twelve members, with three to four replications made in the scoring during an experiment was satisfactory to obtain necessary results. Boggs and Hanson (1949) found that differences in odor, flavor, texture, and other qualities of samples could be estimated by a small panel of five to ten judges. Krum (1955) suggested that a panel size of ten to thirty persons would suffice in routine investigations. However, he recommended that if only a small number of judges could be obtained, that it was possible to get satisfactory results by sufficient replications of the tests.

Foster (1954) indicated that the most important factor in selecting an optimum panel was motivation. Henderson and Vaisey (1970) stated that scores from personality tests might be helpful in the selection of panel members. They found that when high school students were given a Personality Research form, that the high achievers or the students in the need to achieve area correlated well with the ability to be good discriminators of foods.

Certain characteristics of judges can affect their responses on taste tests. Krum (1955) indicated that panel members should be between the ages of twenty and fifty, due to the belief that sensory abilities decrease with age. He further noted that both sexes can be utilized, because taste and odor discriminations are not sex-linked (Krum, 1955). Boggs and Hanson (1949) also indicated that age was thought to affect sensory perception. Other factors that should be considered in relationship to judges are attitude, health, smoking habits, and prejudices. Krum (1955) stated that no substantial evidence was available to prove that smoking dulls the senses of odor and taste. However, Afrmann and Chapanis (1962) found that smokers rated varying strengths of vanilla concentrations lower than did the non-smokers. Griswold (1962) reported that judges should not smoke for at least thirty minutes before tasting.

Environmental factors are of importance when conducting taste tests. Boggs and Hanson (1949) noted that of primary importance was the avoidance of distractions to judges during tasting and suggested the use of individual booths. Boggs and Hanson (1949) considered temperature, humidity, and suitable lighting to be important in controlling the environment of the taster.

Sensory evaluations have proven to be important in judging the value of food products. It is obvious that carefully controlled test situations are imperative in the collection of valid and useable data. Though researchers disagree on some factors that affect taste studies, progress is being made toward controlled test situations.

CHAPTER III

METHODOLOGY

Tests have indicated that consumers detect no difference between "Sweet Acidophilus Lowfat Milk" and regular milk. However, possible effects of high heat on the viable organism have minimized work conducted on the effects of milk containing the bacteria in food preparation. Therefore, the purpose of this study was to determine if subjects consider baked custards made with Sweet Acidophilus Lowfat Milk as acceptable as custards made with other lowfat milk.

Baked custards containing Acidophilus, skim, nonfat, dry, and evaporated skim milks were prepared on each of five days during a period of two weeks. Exact commercial classifications of the milks are as follows:

Sealtest® Acidophilus Lowfat Milk

Sealtest® Light n' Lively

Pet® 99% Less than 1% Butterfat Evaporated Skimmed Milk

Pet® Instant Nonfat Dry Milk manufactured by the spray process

Products containing the four different milks were prepared for panel members to judge whether one custard was more acceptable than the other. All milks had a milkfat content of 1% or less. The custards were made according to the recipe and procedures of Griswold (1962). To eliminate biased evaluations by the panel members, a three digit random number was assigned to each custard at all scoring sessions. Preliminary tests were conducted to determine the cooking times for each custard in accordance with the type of milk and the oven used. For the purposes of this study, five electric ovens were utilized. Each oven was regulated to 350 Fahrenheit by the use of oven thermometers, all of which were tested for accuracy. To eliminate variables due to differences in oven performance, custards made from each type of milk were cooked in a different oven for each testing session.

Certain procedures were followed respectively throughout the preparation period. When practical, ingredients were obtained from a common well. Acidophilus Lowfat Milk, Lowfat Skim Milk, and eggs were purchased on each day preceding actual preparation of the custards. All other ingredients were purchased in bulk before the experiment began. Instruments for measuring the ingredients remained constant throughout the experimentation period. A double beam gram trip balance was used to weigh the eggs, and standard measuring cups and spoons were used to determine the amounts of additional ingredients needed. Preparation of the custards occurred on the day before the actual scoring took place. Following the cooking process, all custards were allowed to cool. They were then placed under refrigeration for the next day. The samples were allowed to stand at room temperature for one hour before serving.

A randomly selected taste panel composed of ten students and staff members from the University of North Carolina at Greensboro evaluated the custards. The panel was made up of one lab technician, one housekeeping assistant, four undergraduate students, and four graduate students. Five of the taste panel members were associated with the area of foods and nutrition. The remainder of the members were associated with other areas of study. All five testing sessions held between June 1 and June 14, 1977 were attended by each of the panel members.

A foods laboratory in the School of Home Economics was the location for evaluation of the custards. The testing took place on each of five days between June 1 and June 14, 1977, with an additional day for training taste panel members. The time selected for tasting was at 3:30 p.m. on each of the days. All panel members came to evaluate the products at the same time on each occasion. No time limitation was imposed on the tasters when scoring the custards.

Each panel member was seated at a table alone. At each scoring table were four custards, four evaluation sheets for scoring, four white spoons for tasting, and a cup of water. The custards were placed on white plates with code numbers, which were randomly selected each day. The evaluation sheets had corresponding random numbers.

A Likert-type acceptability scale with values of five to one was used for rating the samples. Five designated very good and one designated very poor. Appearance, flavor, and overall acceptability were the characteristics under consideration. Space was provided for additional comments by the panel members at the end of the evaluation form (Appendix A).

The researcher conducted a training period before the actual scoring began. Background information pertaining to the research topic was supplied to the panel members to stimulate interest. The panel members were further instructed as to procedures that should be followed throughout the testing period (Appendix A). A condensed typewritten form of the instructions was given to each taste tester (Appendix A). At the training period, one custard was presented to the panel for practice purposes. After the instructions were administered, time was allowed for the tasters to ask questions and discuss procedures. The researcher was available at all testing sessions to answer any questions.

Objective tests involved determination of percentage of sag and synersis of the samples. Both tests aided in the measurement of the stability of custards made with each type of milk. Percentage of sag is equated with stability, while synersis is equated with drip loss. The custards used for the objective tests were made concurrently with the custards evaluated by the panel members. However, these custards were allowed to stand at room temperature for two hours before testing. The percentage of sag was determined by inserting a skewer through the center of the custard. The depth of penetration was measured in centimeters. The custard was then loosened from the cup and turned out on a plate. A skewer was inserted through the custard at its highest point and the depth of penetration again measured in centimeters. Calculations for percentage of sag are as follows: Griswold (1962)

$$\text{Percentage sag} = \frac{\text{height in cup} - \text{height outside cup} \times 100}{\text{height in cup}}$$

For results on statistical analysis see Appendix C.

Custards that were used for percentage of sag were also utilized for synersis evaluations. Each custard was inverted on a wire sieve covered with cheesecloth. The sieves were placed over large bowls and custards were allowed to drain for one hour. The amount of drip loss was then measured in millimeters (Appendices B and C).

The taste panel data were treated by chi-square analysis. Objective test results were analyzed by one way analysis of variance.

CHAPTER IV

RESULTS AND DISCUSSION

Ten students and staff members from the University of North Carolina at Greensboro participated in the evaluation of custards prepared from four different lowfat milk products. Each custard had a milkfat content of 1% or less. Milks used in the experiment were as follows:

Sealtest ® Acidophilus Lowfat Milk

Sealtest ® Light n' Lively Milk

Pet ® 99% Less than 1% Butterfat Evaporated Skimmed Milk

Pet ® Instant Nonfat Dry Milk manufactured by the spray process

Of major importance to the researcher was the comparison of the custards made from "Sweet Acidophilus Lowfat Milk" to the other custards. Characteristics evaluated were appearance, flavor, and overall acceptability. Objective tests measured stability and drip loss.

Taste panel evaluations were treated by chi square analysis, which showed a significant difference ($p \leq 0.05$) in the responses of the judges when evaluating of appearance, flavor, and overall acceptability (Appendix C). The taste panel rated Sweet Acidophilus lowfat milk custards higher in appearance than those made with the evaporated, nonfat dry, or Light n' Lively skim milks. The Sweet Acidophilus lowfat milk custards were rated as very good in appearance on 26.0% of the responses. Panel members rated custards made with nonfat dry milk very good in appearance 24.0%, those made with Light n' Lively milk 20.0%, and evaporated skimmed milk custards 2.0% of the time. Chi square analysis showed that the evaporated skimmed milk products were rated significantly lower ($p \leq 0.05$) by the panel members in relationship to appearance. Mean scores for the four custards further indicated that the evaporated skimmed milk custard was rated the lowest in appearance, whereas the three remaining products showed little difference in mean values (Table 2). Taste panel members commented that

Table 1--PERCENTAGE OF RESPONSES FOR TASTE PANELS

Sample	Very Poor	Poor	Fair	Good	Very Good
Sweet A.					
Appearance	0.0	6.0	34.0	34.0	26.0
Flavor	0.0	0.0	26.0	52.0	22.0
Overall Acceptability	0.0	4.0	20.0	56.0	20.0
Evaporated					
Appearance	2.0	26.0	32.0	38.0	2.0
Flavor	2.0	20.0	56.0	10.0	12.0
Overall Acceptability	2.0	20.0	54.0	12.0	12.0
Nonfat Dry					
Appearance	2.0	6.0	24.0	44.0	24.0
Flavor	0.0	2.0	24.0	50.0	24.0
Overall Acceptability	0.0	4.0	20.0	58.0	18.0
Light n' Lively					
Appearance	0.0	4.0	18.0	58.0	20.0
Flavor	2.0	2.0	20.0	54.0	22.0
Overall Acceptability	0.0	4.0	20.0	58.0	18.0

n = 50

Table 2--TASTE PANEL EVALUATION MEAN SCORES FOR EACH MILK

Sample	Type of Milk Acidophilus	Evaporated	Nonfat Dry	Light n' Lively
Appearance	3.92	3.12	3.90	3.92
Flavor	3.96	3.22	3.96	3.90
Overall Acceptability	3.70	3.18	3.82	3.92

n = 50
Rating scale: 5=very good, 4=good, 3=fair, 2=poor, 1=very poor

the color of the custards made from the evaporated skimmed milk was different from the other three custards, thus suggesting a possible reason for rating this product low in appearance. "Off color," "too dark," and "dull yellow" were included in comments made by panel members about the appearance of the evaporated skimmed milk custards. Mean scores pertaining to the three remaining custards were similar, with indications that all had an acceptable appearance.

Panel members rated the nonfat dry milk custards higher in flavor than the evaporated skimmed, Sweet Acidophilus, lowfat, or Light n' Lively custards. The flavor of nonfat dry milk custards was rated very good on 24.0% of the 50 responses. Taste panel members rated custards made with Sweet Acidophilus lowfat and Light n' Lively skim milks as very good in flavor on 22.0% and evaporated skimmed milk products on 12.0% of the responses. The custard made with evaporated skimmed milk was rated significantly lower ($p \leq 0.05$) in flavor than the other three products, as was also noted for this custard in the area of appearance. Mean scores substantiated the low rating of the evaporated skimmed milk product in flavor. It had a mean value of 3.22 as compared to the higher values of the Sweet Acidophilus lowfat, nonfat dry, and Light n' Lively milk custards (Table 2). Mean values indicated that there was little difference in flavor between the three remaining products.

Taste panel members commented that the flavor of custards made with evaporated skimmed milk was "too strong," "too sweet," or had a "caramel or chalky aftertaste." Such characteristics contributed to this product's low rating in flavor. Responses by the judges indicated that custards made from the other three milks were similar, signifying that they were all acceptable with respect to flavor.

The taste panel members scored Sweet Acidophilus lowfat milk custards higher in overall acceptability than they scored the other lowfat milk products. The Sweet Acidophilus lowfat milk custards were rated as very good in overall acceptability on 20.0% of the responses. Judges rated custards made with nonfat dry and Light n' Lively milks very good in overall acceptability 18.0% of the time. Evaporated skimmed milk products were rated very good on 12% of the responses (Table 1). These products were rated significantly lower ($p \leq 0.05$) by judges in relationship to overall acceptability. The mean value for the overall acceptability of custards made from evaporated skimmed milk was 3.18; significantly lower ($p \leq 0.05$) than means for custards made with Sweet Acidophilus lowfat, nonfat dry, and Light n' Lively milks (Table 2). Such findings supported evidence that products containing evaporated skimmed milk were the least acceptable of the four custards. Mean scores supported the results from chi square analysis, by showing that custards made from the three remaining milks were equally acceptable in overall acceptability (Table 2).

Panel members noted that custards made from evaporated skimmed milk were "too watery," "had a soft consistency," and "were not a natural sample." These characteristics resulted in the low rating of this product in overall acceptability. The characteristic flavor and color of these custards were considered to be unpleasing to the taste testers, thus affecting their total overall acceptability rating. Taking all factors into consideration, the Sweet Acidophilus lowfat, nonfat dry, and Light n' Lively milk products were judged to be acceptable custards.

Objective tests were analyzed by the one way analysis of variance. Mean scores for the stability tests indicated that the evaporated skimmed milk custard was the least stable product (Table 3).

Table 3--MEANS FOR PERCENTAGE OF SAG

	Sweet Acidophilus	Lowfat Evaporated	Nonfat Dry	Lowfat Skim
Means (CM)	10.04	13.70	8.08	1.82

Number of tests per sample = 5

Sweet Acidophilus lowfat milk custards received the second highest ranking in stability, whereas the nonfat dry and Light n' Lively custards were ranked the most stable. This ranking difference was highly significant ($p \leq 0.01$). Such differences can be accounted for by the characteristics of each kind of milk (Table 4).

Table 4--ANALYSIS OF VARIANCE FOR STABILITY

Source	D. F.	SS	MS	F Ratio
Between milks	3	370.8892	123.6297	9.991**
Within milks	16	197.9885	12.3743	
Total	19	568.8777		

**$p \leq 0.01$

In a second objective test, synersis of the custards was measured. Mean scores showed that the evaporated skimmed milk custard had the largest amount of drip loss. Therefore, these results also indicated that this milk made the least stable custard (Table 5). Nonfat dry milk custards received the second

Table 5--MEANS FOR SYNERSIS

	Acidophilus	Evaporated	Nonfat Dry	Light n' Lively
Means (Ml)	2.80	5.68	3.44	2.32

Number of tests per sample=5

highest score in drip loss, while the Sweet Acidophilus lowfat and Light n' Lively milk custards were ranked the most stable. Major differences in ranking were between the evaporated skimmed milk custards and the three remaining custards. This ranking difference was significant ($p \leq 0.05$). Characteristics of the milks account for the differences represented in the drip loss of the custards.

Table 6--ANALYSIS OF VARIANCE OF DRIP LOSS

Source	D. F.	SS	MS	F Ratio
Between milks	3	33.1199	11.0400	3.689*
Within milks	16	47.8882	2.9930	
Total	19	81.0080		

*$p \leq 0.05$

As shown in Tables 3 and 5, the evaporated skimmed milk products received the highest scores in relationship to mean values. Such results indicate that custards made from evaporated skimmed milk are the least stable of the four custards. The lowest mean values for both objective tests were found in the Light n' Lively custards, thus showing that custards made from this milk were the most stable. When the two objective tests were compared for the Sweet Acidophilus lowfat and nonfat dry milks, results showed that the stability of custards made with these two milks were approximately the same.

There were significant differences ($p \leq 0.05$) in taste panel members' responses to appearance, flavor, and overall acceptability of custards made with the four milks. Evaporated skimmed milk products were rated significantly lower ($p \leq 0.05$) in all areas. There were no significant differences between Sweet Acidophilus lowfat milk custards and the other two lowfat milk custards. Objective tests indicated that the custards made from the evaporated skimmed milk were the least stable products. Comparisons of the mean scores of percentage of sag and drip loss substantiates these findings. Final evaluation of the results indicates that the panel members found custards made with evaporated skimmed milk the least acceptable of the four products. Further observations reveal that Sweet Acidophilus lowfat milk products are as acceptable as custards made from nonfat dry and Light n' Lively milks.

CHAPTER V

SUMMARY AND CONCLUSIONS

In its cold fluid form "Sweet Acidophilus Lowfat Milk" has been acknowledged as an acceptable product by consumers. However, a minimal amount of work has been conducted on the effects of milk containing the bacteria in food preparation, probably due to the effects of high heat on the viable organism. The purpose of this study was to determine if baked custards made with Sweet Acidophilus lowfat milk were as acceptable as other lowfat milk products when judged by an untrained taste panel.

A Likert-type acceptability scale was used for scoring custards made from each type of milk. Factors under consideration were appearance, flavor, and overall acceptability. Chi square analysis was applied to ascertain any significant differences between the samples. There was a significant difference ($p \leq 0.05$) in the areas of appearance, flavor, and overall acceptability. However, this difference was between the evaporated skimmed milk and the other three milks. Panel members rated the evaporated skimmed milk custards significantly lower ($p \leq 0.05$) in the areas of appearance, flavor, and overall acceptability. The characteristic color and flavor of custards made from this milk contributed to its lower rating. There was no significant difference between Sweet Acidophilus lowfat milk and the nonfat dry or Light n' Lively milk products with respect to appearance, flavor, and overall acceptability. Indications were that custards that were made with Sweet Acidophilus lowfat milk were as acceptable as custards made with nonfat dry and Light n' Lively milks in all areas under consideration.

Objective tests were analyzed by the one way analysis of variance. Comparison of results from the stability and drip loss tests showed that custards made from evaporated skimmed milk were the least stable of the four custards. This difference was highly significant ($p \leq 0.01$). Major differences in rating were between the evaporated skimmed milk custards and the three remaining milk products. A significant difference ($p \leq 0.05$) was found in relation to drip loss. The evaporated skimmed milk custard had the largest amount of loss. The Sweet Acidophilus lowfat, nonfat dry, and Light n' Lively milk products had similar drip losses. Indications are that custards made with Sweet Acidophilus lowfat milk are as stable as custards made from nonfat dry and Light n' Lively milks.

It has been noted that consumers detect no difference between "Sweet Acidophilus Lowfat Milk" and regular milk (*T.M. North Carolina State Dairy Foundation). Further research is needed to determine if baked custards made from Sweet Acidophilus lowfat milk are comparable to custards made from whole milk. In addition, research is needed to determine if other types of cooked products made from Sweet Acidophilus lowfat milk are comparable to the same products made from whole milk. The use of Sweet Acidophilus lowfat milk of other fat contents need consideration in food preparation comparisons. Additional research should be conducted to evaluate consumer acceptance of this milk product.

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*T. M. North Carolina State Dairy Foundation. The acidophilus story.

APPENDIX A

INSTRUCTIONS FOR JUDGES, SCORE SHEET AND RECIPES

INSTRUCTIONS FOR TASTE PANEL TRAINING SESSION

I appreciate each individual's time in helping me collect the data necessary for my research work. Today is strictly a trial run. It is intended to acquaint you with the procedures you should follow throughout the test period.

To begin with, you need some background information on my research topic. Presently, the title of my thesis is "A Comparison of Baked Custards Made With Sweet Acidophilus Lowfat Milk and Other Lowfat Milk." This is a relatively new product on the market and to date, much of the research related to the milk has been conducted in the field of medicine. Dr. Marvin Speck and his associates at North Carolina State University are responsible for the appearance of the milk on the market beginning in 1975. The milk contains the bacteria L. acidophilus, which occurs naturally in the gastro-intestinal tract. The bacteria aids in alleviating gastro-intestinal disorders such as upset stomachs and diarrhea. The use of this milk is a step toward including the bacteria in the diet and replacing it in the intestine. However, it is not to be thought of as a medicine.

My main emphasis is the acceptability of Sweet Acidophilus Milk in a baked product as compared to three other milks of approximately the same milkfat percentage. The other milks being used for comparison are lowfat skim, evaporated skimmed, and nonfat dry milks. The baked product being used is custards. The characteristics of a standard baked custard are as follows:

1- the top should be even in color, little to no browning

2- should be easy to cut and leave sharp angles

3- should be no sign of separation (*note: anytime you break a protein gel you will see some weeping due to cutting across the cells of the gel)

4- the finished product is a delicate gel which may or may not hold its shape if turned from the baking dish.

You will be presented with one custard made from each of the four milks on five different occasions. On each occasion you will also be presented with four score scheets which have been coded with three digit random numbers. When scoring each custard, make certain that the number on the custard corresponds with the number on the score sheet.

More accurate comparisons can be obtained if the sample tasted is taken from approximately the same place in each custard. Between tasting samples, it is to your advantage to drink some water. This aids in clearing the palate of the previous custard tasted. Score one custard, then proceed to the next one. Talking during scoring should be avoided, since judges could be influenced by the opinions of others. Facial expressions should also be avoided. Panel members who smoke should try to abstain from smoking for at least thirty minutes before the testing period. If desired, you may finish eating the remainder of your custard after scoring has been completed.

DISCUSSION OF SCORE SHEET

The score sheet is designed according to a Likert-type acceptability scale. On each score sheet write your name and the date. Three characteristics will be scored for each custard. These are appearance, flavor, and overall acceptability. Values of five to one appear on the score sheet; five designating very good and one designating very poor. Circle the number that best describes the custard you are tasting. Make certain that only one number is circled for each characteristic. When scoring has been completed, score sheets should be left on your table for collection by the researcher.

BRIEF REMINDERS FOR TASTE PANEL MEMBERS

CHARACTERISTICS OF A STANDARD BAKED CUSTARD: 1-the top should be even in color, little to no browning; 2-should be no sign of separation (*note: anytime you break a protein gel you will see some weeping due to the cutting across cells of the gel; 3-should be easy to cut and leave sharp angles; 4-the finished product is a delicate gel which may or may not hold its shape if turned from the baking dish.

1. Make certain that the number on the custard corresponds with the number on the score sheet.

2. More accurate comparisons can be obtained if the sample tasted is taken from approximately the same place in each custard.

3. Score one custard, then proceed to the next one.

4. Between tasting each sample, drink some water to clear the palate of the previous custard tasted.

5. Talking during scoring should be avoided, since judges could be influenced by the opinions of others.

6. Please do not smoke for at least thirty minutes before the testing period.

7. You may eat the remainder of your custards after the scoring has been completed.

Thank You For Your Time And Effort!

TASTE PANEL SCORE CARD

NAME______________________________ DATE____________________

BAKED CUSTARDS

Indicate your response by circling the number that best describes the factor being evaluated. Place any comments on the bottom.

Sample No.	Factor	Very Good	Good	Fair	Poor	Very Poor
	Appearance	5	4	3	2	1
	Flavor	5	4	3	2	1
	Overall Acceptability	5	4	3	2	1

COMMENTS:

CUSTARD

BASIC RECIPE

Milk	244 gm. or 237 ml.	(1 cup)
Egg	48 gm.	(1 egg)
Sugar	25 gm.	(2 tbsp.)
Salt	1/16 tsp.	(1/6 tsp.)
Vanilla	1.2 ml.	(1/4 tsp.)

PROCEDURES

BAKED CUSTARD

1. Set oven at 350 F. Scald milk over boiling water. Boil additional water.
2. Beat egg slightly; add sugar and salt. Add milk very slowly at first, then more rapidly, stirring constantly. Strain. Add vanilla.
3. Pour into custard cups, which should be about 7/8 full. Place cups in bread pan, set pan on oven rack, and pour in boiling water until it reaches almost the level of the custard mixture.
4. Bake at 350 F. until a knife that is inserted in the custard comes out clean.
5. Remove from water at once and allow to cool on a rack at first, then in refrigerator.

CUSTARD

REVISED RECIPE

Milk	1,464 gm. or 1,422 ml.	(6 cups)
Egg	288 gm.	(6 eggs)
Sugar	290 gm.	(12 tbsp.)
Salt	3/8 tsp.	(3/8 tsp.)
Vanilla	7.2 ml.	(1 1/2 tsp.)

PROCEDURES

BAKED CUSTARD

1. Set oven at 350 F. Scald milk over boiling water. Boil additional water.
2. Beat egg slightly; add sugar and salt. Add milk very slowly at first, then more rapidly, stirring constantly. Strain. Add vanilla.
3. Pour into custard cups, which should be about 7/8 full. Place cups in bread pan, set pan on oven rack, and pour in boiling water until it reaches almost the level of the custard mixture.
4. Bake at 350 F. until a knife that is inserted in the custard comes out clean.
5. Remove from water at once and allow to cool on a rack at first, then in refrigerator.

APPENDIX B

OBJECTIVE AND SUBJECTIVE EVALUATIONS

Table 1--TASTE PANEL EVALUATION COMPILATION OF JUDGES' SCORES

Sample	Code No.	Appearance	Flavor	Overall Acceptability
		June 2, 1977		
Sweet A.	226	41	42	43
Evap.	983	34	35	35
Nonfat dry	176	28	37	34
Lowfat skim	759	44	39	41
		June 7, 1977		
Sweet A.	129	32	36	38
Evap.	011	35	30	30
Nonfat dry	868	42	41	40
Lowfat skim	661	37	37	38
		June 8, 1977		
Sweet A.	538	36	41	37
Evap.	008	31	39	33
Nonfat dry	706	41	40	40
Lowfat skim	922	39	39	37
		June 9, 1977		
Sweet A.	441	41	40	39
Evap.	628	29	28	28
Nonfat dry	951	39	41	41
Lowfat skim	723	39	39	39
		June 14, 1977		
Sweet A.	886	35	39	39
Evap.	474	30	29	30
Nonfat dry	201	41	39	40
Lowfat skim	542	37	41	41

Each code number represents 10 servings.
Rating scale: 5=very good, 4=good, 3=fair, 2=poor, 1=very poor.

Table 2--TASTE PANEL EVALUATION MEAN SCORES OF JUDGES

Sample	Code No.	Appearance	Flavor	Overall Acceptability
		June 2, 1977		
Sweet A.	226	4.1	4.2	4.3
Evap.	983	3.4	3.5	3.5
Nonfat dry	176	2.8	3.7	3.4
Lowfat skim	759	4.4	3.9	4.1
		June 7, 1977		
Sweet A.	129	3.2	3.6	3.8
Evap.	011	3.5	3.0	3.0
Nonfat dry	868	4.2	4.1	4.0
Lowfat skim	661	3.7	3.7	3.8
		June 8, 1977		
Sweet A.	538	3.6	4.1	3.7
Evap.	008	3.1	3.9	3.3
Nonfat dry	706	4.1	4.0	4.0
Lowfat skim	922	3.9	3.9	3.7
		June 9, 1977		
Sweet A.	441	4.1	4.0	3.9
Evap.	628	2.9	2.8	2.8
Nonfat dry	951	3.9	4.1	4.1
Lowfat skim	723	3.9	3.9	3.9
		June 14, 1977		
Sweet A.	886	3.5	3.9	3.9
Evap.	474	3.0	2.9	3.0
Nonfat dry	201	4.1	3.9	4.0
Lowfat skim	542	3.7	4.1	4.1

Each code number represents 10 servings.
Rating scale: 5=very good, 4=good, 3=fair, 2=poor, 1=very poor.

Table 3--TASTE PANEL EVALUATION MEAN SCORE FOR EACH MILK

	Sweet Acidophilus	Evaporated	Nonfat Dry	Liquid Skim
Appearance	3.92	3.12	3.90	3.92
Flavor	3.96	3.22	3.96	3.90
Overall acceptability	3.70	3.18	3.82	3.92

Table 4--PERCENTAGE OF SAG FOR EACH DAY (cm)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5
Sweet Acidophilus	13.0	9.5	9.1	9.1	9.5
Evaporated	15.4	18.2	9.1	16.7	9.1
Nonfat dry	12.5	9.1	9.5	4.8	4.5
Liquid skim	0.0	0.0	0.0	9.1	0.0

Table 5--PERCENTAGE OF SAG MEAN SCORES FOR EACH MILK

	Sweet Acidophilus	Evaporated	Nonfat Dry	Liquid Skim
Sag (ml)	10.04	13.7	8.08	1.82

Table 6--SYNERSIS DAILY DRIP LOSS (ml)

Sample	Day 1	Day 2	Day 3	Day 4	Day 5
Sweet Acidophilus	1.6	1.4	2.4	4.0	4.6
Evaporated	6.0	4.1	3.8	6.5	8.0
Nonfat dry	0.6	1.8	4.4	3.6	6.8
Lowfat skim	1.4	2.6	1.5	2.1	4.0

Table 7--SYNERSIS MEAN SCORES FOR EACH MILK

	Sweet Acidophilus	Evaporated	Nonfat Dry	Liquid Skim
Synersis (ml)	2.80	5.68	3.44	2.32

APPENDIX C

STATISTICAL ANALYSES

Table 1--CHI SQUARE ANALYSIS FOR DATA FOR TASTE PANEL

Milk	Very Poor	Poor	Appearance Fair	Good	Very Good
Sweet Acidophilus	0	3	17	17	13
%	0.0	6.0	34.0	34.0	26.0
Evaporated S.	1	13	16	19	1
%	2.0	26.0	32.0	38.0	2.0
Nonfat dry	1	3	12	22	12
%	2.0	6.0	24.0	44.0	24.0
Light n' Lively	0	2	9	29	10
%	0.0	4.0	18.0	58.0	20.0

Number of responses=50
Chi Square=34.22249 with 12 degrees of freedom
Significance=$p \neq 0.05$

Table 2--CHI SQUARE ANALYSIS FOR DATA FOR TASTE PANEL

Milk	Very Poor	Poor	Flavor Fair	Good	Very Good
Sweet Acidophilus	0	0	13	26	11
%	0.0	0.0	26.0	52.0	22.0
Evaporated S.	1	10	28	5	6
%	2.0	20.0	56.0	10.0	12.0
Nonfat dry	0	1	12	25	12
%	0.0	2.0	24.0	50.0	24.0
Light n' Lively	1	1	10	27	11
%	2.0	2.0	20.0	54.0	22.0

Number of responses=50
Chi Square=55.23605 with 12 degrees of freedom
Significance=$p \leq 0.05$

Table 3--CHI SQUARE ANALYSIS FOR DATA FOR TASTE PANEL

Milk	Very Poor	Poor	Fair	Good	Very Good
	Overall Acceptability				
Sweet Acidophilus	0	2	10	28	10
%	0.0	4.0	20.0	56.0	20.0
Evaporated S.	1	10	27	6	6
%	2.0	20.0	54.0	12.0	12.0
Nonfat dry	0	2	10	29	9
%	0.0	4.0	20.0	58.0	18.0
Light n' Lively	0	2	10	29	9
%	0.0	4.0	20.0	58.0	18.0

Number of responses=50

Chi Square=48.05191 with 12 degrees of freedom

Significance=$p \leq 0.05$

Table 4--ANALYSIS OF VARIANCE FOR PERCENTAGE OF SAG

Source	D. F.	SS	MS	F Ratio
Between milks	3	370.8892	123.6297	9.991**
Within milks	16	197.9885	12.3743	
Total	19	568.8777		

**$p \leq 0.01$

Table 5--MEAN SCORES FOR PERCENTAGE OF SAG

Group	C	M	SD
Sweet Acidophilus	5	10.0400	1.6667
Evaporated skimmed	5	13.7000	4.3145
Light n' Lively	5	1.8200	4.0696
Nonfat dry	5	8.0800	3.3974
Total	20	8.4100	5.4718

cells=5
n=20

Table 6--ANALYSIS OF VARIANCE FOR SYNERSIS

Source	D. F.	SS	MS	F Ratio
Between milks	3	33.1199	11.0400	3.689*
Within milks	16	47.8882	2.9930	
Total	19	81.0080		

*$p \leq 0.05$

Table 7--MEAN SCORES FOR SYNERSIS

Group	C	M	SD
Sweet Acidophilus	5	2.8000	1.4353
Evaporated skimmed	5	5.6800	1.7456
Nonfat dry	5	3.4400	2.3975
Light n' Lively	5	2.3200	1.0569
Total	20	3.5600	2.0648

cells:5
n:20