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New Spread Type Dairy Product

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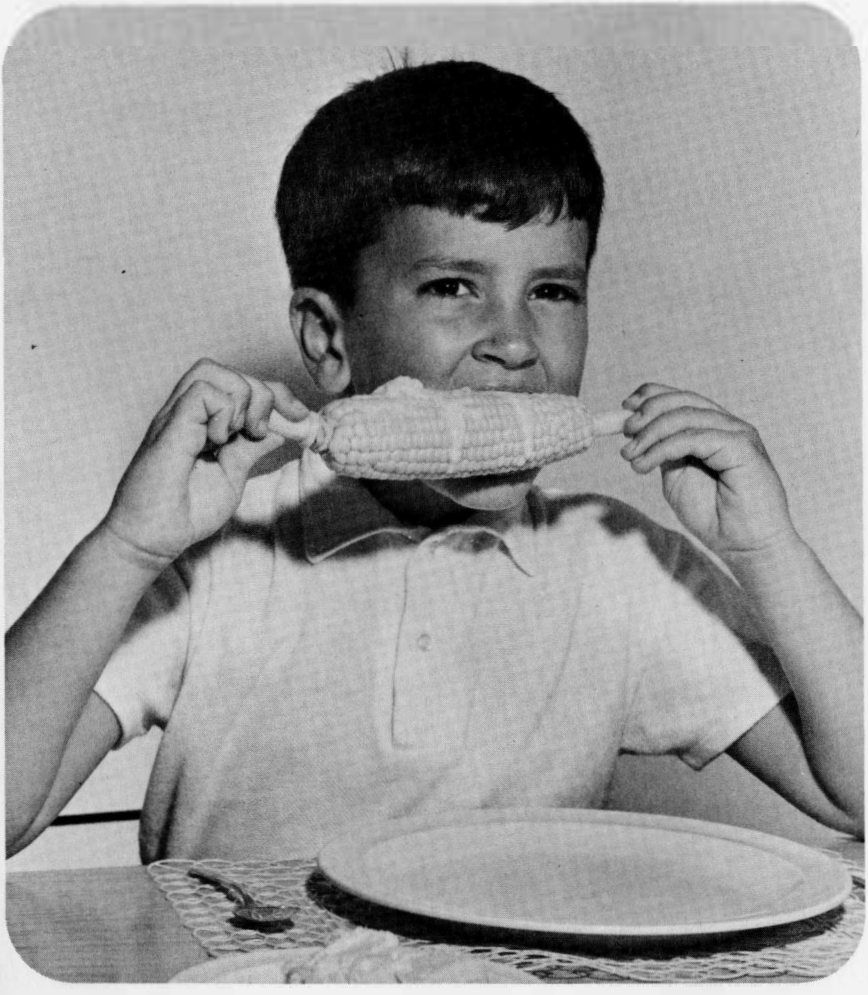
NEW!

Spread-Type Dairy Product



Development * Manufacture * Uses

Dairy Science Department
Agricultural Experiment Station
South Dakota State University

New Spread-Type Dairy Product

CONTENTS

Examples of recipes developed and tested at South Dakota State University and which can be used with this product appear in the back of this publication.

SUMMARY

A spread-type dairy product with about half the milk fat content of traditional spreads and with a substantial nonfat milk solids content has been developed by the Dairy Science Department of the Agricultural Experiment Station at South Dakota State University. The product meets a need as indicated from consumer-preference studies for a food item with spreadable consistency over a wide range of temperatures and, moreover, is in keeping with the trends to convenience foods and the lower consumption of visible fat and calories. It is hoped that such a product will add both to better nutrition and provide a new outlet for milk ingredients. Inquiries from about two dozen states and six overseas countries as well as generally good acceptable of the product by nearly 100 families have proven the concept to be sound.

Is Unique

The product as developed and processed at South Dakota State University appears to be unique in these respects:

(1) It contains an optimum blend of a special synthetic butter flavor formulation and a high acid starter distillate for flavor. (The synthetic flavor is from Dairyland Food Laboratories and is a modified version of the formula developed by Oregon State University.)

(2) No cultured dairy products are used in it.

(3) It contains a combination of gelatin and sodium carboxymethylcellulose as a stabilizer. This combination—indeed, the use of carboxymethylcellulose in low fat spreads—has not been reported in the literature reviewed.

(4) The 14% to 16% content of natural milk solids-not-fat is higher than other workers have reported. (The tendency has been to use sodium caseinate or calcium-reduced skim milk powder.)

(5) It can be stored 90 days or longer at ordinary refrigeration temperatures without marked deterioration. (There is a slight staling, but this is not generally noticeable unless the stored product is compared to freshly made product.)

(6) It can be used in many ways other than as a spread, as shown by numerous recipes developed by the Nutrition and Food Science Department at SDSU.

Desirable Characteristics

The product has several desirable attributes including:

- Ready spreadability over a wide range of temperatures, including ordinary household refrigerator temperatures.
- Easy blending with other foodstuffs and cookery ingredients, thus making for many uses.
- A pleasing flavor largely characteristic of high quality butter, although with some undertaste of nonfat milk solids. This flavor is complementary to many foodstuffs—again lending the product many uses in cooking and serving.
- About half the fat and three-fifths the calorie content of the higher fat spreads.
- It does not melt like butter or margarine. For this reason, it is not suitable for direct heating in cooking utensils or to flavor popcorn.

ACKNOWLEDGMENTS

The authors wish to express appreciation for help in various phases of their work by the late Dr. D. F. Breazeale, former Head of the Dairy Science Department; Dr. J. O. Young, present Head of Dairy Science; Dr. R. J. Baker, Professor of Dairy Science; Dr. W. F. Stoll, formerly Assistant Professor of Dairy Science; and B. D. Alfke and Susan Cooper, formerly Assistants in Dairy Science; as well as Dr. G. G. Quackenbush and D. H. Jacobsen of American Dairy Association; Philip Dwoskin and Herbert Moede of Economic Research Service, U.S.D.A.; Dr. Robert Beck, Economics Department, S.D.S.U.; Dr. W. L. Tucker, Agricultural Experiment Station Statistician, S.D.S.U.; Dr. K. C. Schneider, Associate Professor, and Rena Wills, Associate Professor, Nutrition and Food Science Department, College of Home Economics, S.D.S.U.; and other personnel in the respective departments.

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New Spread-Type Dairy Product

SHIRLEY W. SEAS and KENNETH R. SPURGEON*

INTRODUCTION

The increasing competition of other foods and beverages, many of which are newly developed, puts a growing pressure on the dairy industry to make traditional dairy products more appealing and to develop palatable new products to please consumers – thus helping sales of milk and milk constituents. A calorie- and cholestrol-conscious populace has shown a marked tendency to reduce intake of visible fats, especially those of animal origin. This provides a place in the diet for a dairy product with most of the uses of butter but with a lower fat content than margarine, mayonnaise, and butter. It also affords a new outlet that would increase appreciably the sales of milk constituents. The consumer, for convenience, undoubtedly would also welcome a product that could be spread with equal ease immediately after removal from refrigeration or at relatively high temperatures.

Weckel (9) defined a low fat dairy spread as a product which contains only dairy ingredients and, as the name implies, contains less fat than the commonly used spreads, butter and margarine.

The Dairy Science Department at South Dakota State University, with assistance from the Economics and Home Economics Departments of the Agricultural Experiment Station, the American Dairy Association, and the Economic Research Service of U. S. Department of Agriculture, has developed a low fat spread which has several desirable attributes. These include:

(1) Ready spreadability over a wide range of temperatures, including ordinary household refrigerator temperatures.

(2) Easy blending with other foodstuffs and cookery ingredients, thus making for many uses.

(3) A pleasing flavor largely characteristic of high quality butter, although with some

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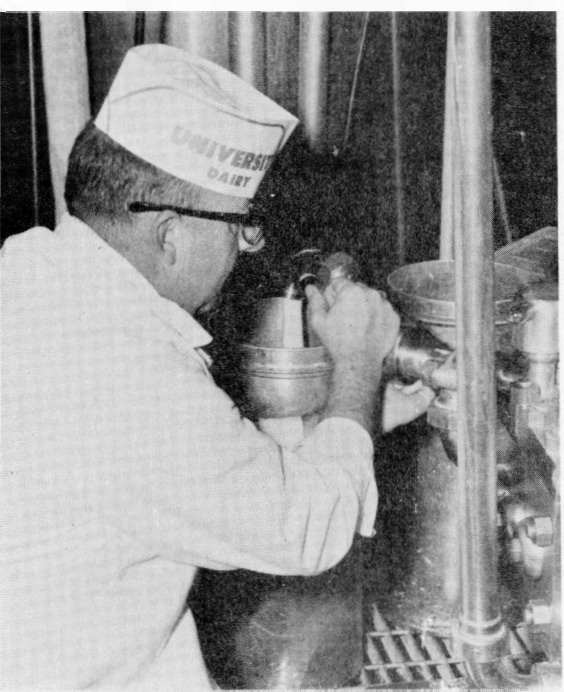
undertaste of nonfat milk solids. This flavor is complementary to many foodstuffs—again lending the product many uses in cooking and serving.

(4) About half the fat and three-fifths the calorie content of the higher fat spreads.

HISTORICAL

Actually, a number of workers have developed such "low fat" dairy products, placing primary emphasis on their usage as spreads. However, various problems, including limited storage quality in several instances, prevented the products from achieving the hoped-for acceptance and/or remaining long on the market. Hence, while considerable groundwork had been established, there appeared to be need for further developmental work. Too, it was felt that such a product would, in fact, have uses in addition to that as a spread and that these should be developed and promoted in order to enlarge the sales potential of the product.

The product comes from homogenizer in a soft plastic state.



The approaches, procedures, and composition of the end products of previous workers have varied considerably. For instance, Leopold (3) in 1930 patented a procedure for concentrating buttermilk and sugar to make a spread containing about 5.5% total milk solids. A year later Parsons (4) prepared a product by adding emulsifying salts to concentrated milk or skimmilk and heating until the product had a brown color and a "roast beef" odor. The product was described as being suitable for use as a spread, sandwich filling, or salad dressing when mixed with cheese, fats, or condiments.

According to Whittier and Webb (11), a blend of concentrated whole milk, cream, salt, vegetable gum, acetic acid, and artificial flavor and color was produced and sold during World War II as a bread spread. It was slightly acid to the taste and had a mild milk flavor.

Weckel (7) developed a product known as Dyne Spread in 1943. (The word Dyne is the collective trademark of the Wisconsin Alumni Research Foundation.) Dyne spread contained 26% to 28% milk fat and 19% to 20% by weight of cultured buttermilk. It also contained salt, acetic acid, starter distillate, and vitamin concentrates.

Subsequently Weckel (8,9) modified the product so that with slight formula changes it could be made to contain 40%, 45%, or 50% milk fat. Milk fat and nonfat milk solids could be derived from several dairy products sources. Cultured butter-

milk, starter distillate, and lactic acid were used for flavor. Weckel stated that the lactic acid also aided coalescence of the fat globules and promoted the development of a gel structure upon cooling. Weckel (10) described the product as having satin-smooth texture, excellent plastic spread qualities, quite bland flavor, and the perishability characteristics of Cottage cheese.

Tobias and Tracy (6) in 1958 reported on products made by modifications of Weckel's procedure. They found a 40% milk fat content to be most feasible. A somewhat better body in the product resulted when high testing cream, rather than butter, was used as a fat source. Cultured buttermilk afforded a desirable aroma; but the judges in this study preferred a low acid product, so Tobias and Tracy used only 1% starter culture. Gelatin as a stabilizer gave some advantage, but there was some tendency to a crumbly body when it was used. They found that starter distillate could be used in lieu of starter culture; moreover, they found the use of an antioxidant (nordihydroguaiaretic acid) to be desirable, as was the use of 0.1% sodium benzoate as a preservative. Families who participated in an acceptance study generally rated the product highly; however, many objected to the use of the product in cooking because of its failure to melt.

Roberts (5) obtained a patent in 1959 for the manufacture of a dairy spread. The suggested composition included about 25% fat and 15% milk solids-not-fat. The latter contained 50% sodium caseinate and 30% lactose. The product was reported (2) to have a gummy consistency and a flavor characteristic of a weak sodium hydroxide solution. While Roberts did not indicate factors involved, he stated that homogenization was not required in order to produce a stable emulsion.

Bullock (2) in 1966 reported a low-fat spread made from butter or butteroil, milk, calcium-reduced skimmilk powder, and regular nonfat dry milk. Spreads with both 35% and 40% fat levels were found to be satisfactory. These had total solids contents of 52.5% and 55.9%, respectively. The use of artificial butter flavors was not found to be advisable. When butteroil was used as the fat source, the spread tended to be granular. Bullock emphasized the statement that **low-fat spreads cannot be made to fully duplicate the properties of butter and margarine, so that the spreads must be accepted and sold on their own merits as new products.**

EXPERIMENTAL

The SDSU Dairy Science Department started exploratory research on spread-type products during the 1950's. Several runs were made and the products examined before a research project finally was set up in 1962. The early batches were made in a small (10-pound capacity) churn by adding different ingredients to butter granules in order to reduce the total milk fat content to approximately 40%. Some of the lots were made by adding nonfat dry milk and cultured buttermilk to butter. The body texture was smooth, in most cases, when the product was fresh but was very leaky and granular after 24 hours at 38° F.

Many different batches were made using the above ingredients at different levels. Condensed skimmilk and instantized nonfat milk powder were also used in a few different batches. In these batches the mixtures worked together very rapidly, but the finished product was very soft and contained lumps of powder. A smoother body in the fresh product was achieved by blending the condensed skimmilk and instantized nonfat milk powder together and then adding to the butter granules. This finished product had the best body and texture after 24 hours of refrigeration, but it was still leaky.

Since working ingredients into butter did not seem to be a feasible approach, the SDSU workers decided to try methods involving melted fat. Feeling that, if possible, the processing should be done on traditional dairy equipment and that perhaps the presence of some stabilizer might help to preclude wheying off during storage, in July 1963 the workers prepared a batch using unsalted butter, nonfat dry milk, a commercial ice cream stabilizer, starter culture, salt, and water.

The butter was taken from frozen storage, tempered, and cut into 8 to 12 chunks per pound. Nonfat dry milk and the stabilizer were mixed dry, then the water added, and mixing continued for some minutes. Some lumps persisted. This mixture was added to the butter in a stainless steel 10-gallon can which was immersed in water in a culture cabinet. The water was heated by stages to 170° F. Total heating time was about 35 minutes on the product, which was at 150° F. for about 14 minutes of this time. Salt was added during heating; starter culture was added at the end of heating; and the product promptly was homogenized at 2,100 p.s.i. pressure in a Creamery Package single stage (with multiflo cone) homogenizer.

The product appeared curdy by visual inspection, with a bit of butter oil on the surface. However, after a couple minutes of stirring it seemed quite homogeneous. The product was packaged in plastic one-pound Cottage cheese cartons and placed in a walk-in refrigerator. After 3 hours it was at 48° F. and still quite workable. The initial taste was not unpleasant, although it was strongly cooked, and to at least one judge it was high in salt. The body seemed somewhat pasty.

Modifications of this basic formula and procedure were investigated during the next 3 months in making several batches. Different stabilizers and/or emulsifiers were used, with variable success. Some of the emulsifiers came in a fat base which, it was found, was oxidized readily and so transmitted an undesirable flavor to the product. Various dairy ingredients were used as the sources of milk fat and nonfat solids. More comment will be made on ingredients later.

Equipment Used

Moving to other equipment, in October, 1963, a Lanco Likwifier was tried for emulsifying at 100° F. and 140° F. constituent temperature, respectively. At the lower temperature the product was so plastic that it would not pass through the opening from the Likwifier; at the higher tempertaure the emulsion broke with resultant oiling off.

In the manner of Weckel's procedure (9), all lots subsequent to October, 1963, have been homogenized following pasteurization of blended constitutents.

A Creamery Package *homogenizer* has been used for all homogenized lots. A better bodied product with less tendency for the emulsion to break has resulted from the use of a two-stage valve rather than the original single-stage multiflo cone valve. With the latter, it usually was necessary to pass the product through twice. With the two stage valve, best body in the product has resulted with the use of 1,000 p.s.i. pressure on the second stage and 1,500 p.s.i. total pressure. Constant pressure with uniform setting was essential for uniform body and texture.

More than 200 lots were made by combining the ingredients in *10 gallon stainless steel culture cans* and pasteurizing by immersion of the cans in hot water in a culture cabinet. The product was poured from the cans into a funnel to feed to the homogenizer. Since October 1965 most lots have been blended and pasteurized in a *20-gallon processing vat.* The latter provided better temperature control with changes made more rapidly. The product has been pumped to the homogenizer with a ¼ hp. centifugal pump.

Pasteurization at temperatures above 160° F. in the cans invariably resulted in oiling off of the milk fat and a failure to get a homogeneous plastic product. (Instead, the product remained liquid when warm; and layered into liquid serum and crystalline fat when cooled.) So for about 3 years during the research most of the lots were pasteurized at 145° F. for 15, 20, or 30 minutes.

Most of the processing through the early months was in relatively small batches of 20 or 30 pounds, with some being as much as twice this amount. When the first 150-pound batch was made there was no mechanical difficulty; but it was felt that factors such as the longer holding time between starter culture additon and homogenization resulted in a considerable culture flavor loss, thus permitting the milk solids flavor to assume a more dominant role. Subsequent batches of the same or larger size have been made using DCF-85B (a synthetic flavor supplied through courtesy of Dairyland Food Laboratories, Waukesha, Wis.) and commercial starter distillate. These batches came through with a pleasing degree of desirable flavor. Some did show a slightly greater degree of age softening subsequent to the first month of storage than did the whey-free batches of smaller size.

From the inception of this project one aim was ultimate manufacture of the product on large-scale continuous processing equipment—as a matter of both economics and for best product quality. An experimental batch of this spread was run through the *high - temperature-short-time plate pasteurizer* in August, 1966. The 200-pound batch was mixed in a *100-gallon processing vat.* The temperature was run up to about 120° F. for mixing of ingredients. The product was then pushed through the plate pasteurizer sections and holding tube to the homogenizer by a timing pump. The temperature of pasteurization was

188° F. for 36 seconds. The product went through the HTST very well and looked excellent after homogenization. Flavor-wise it was quite acceptable, although evidently some flavor loss occurred during holding in the vat.

The flow (figure 1, page 17) was from the balance tank to the timing pump, to regeneration section, to heating section, to holding tube, to flow diversion valve, to regeneration section, to cooling section (with no cooling water), to homogenizer, and packaging.

Seeking a more nearly sterile product and aware that regulatory officials might desire a more rigorous pasteurization treatment than previously used with the product, the feasibility of various treatments was checked further. Some earlier difficulties were eliminated and a treatment of 165° F. for 30 minutes was found to be suitable, giving no deleterious effect to the product but yielding a product of low viable bacteria count. Temperatures as high as 178° F. for 30 minutes were found to be possible, although the product needed to be cooled to 160° F. for homogenization in order to promote proper structure and body. Three trials with ultra-high temperature pasteurization at 280° F. for 4 seconds yielded an essentially sterile product; however, it failed to develop plasticity upon cooling, so more work must be done.

Experience indicated that the mixing vat should have scrapers on the sides, with very good agitation. The strong agitation is necessary to get all ingredients into solution. Alternately, a reconstituting arrangement such as published by American Dry Milk Institute (1) should be used. Also, with experience the pasteurization could be done on high-temperature-short-time equipment quite successfully. Eventually an entirely continuous process should be developed.

Ingredients

Different combinations of various kinds and amounts of ingredients were tried in the search for best formulation. Experimental lots of the product made with milk fat contents below 40% were weak in body and of inferior spreading quality. On the other hand, economic considerations as well as the general goal of developing a product of much lower fat content than butter dictated against going higer than 40% fat. At least 12% to 15% nonfat milk solids levels were found to be necessary for good product body. In early lots the body tended to crumbliness if the nonfat solids exceeded 15%; but in subsequent series up to 18% nonfat solids were found to be possible. Because of excess sweetness, the higher levels were discontinued, however.

Butter was used in most of the early trials and is a concentrated source of fat which would be available to most dairies. However, if butter contained salt and/or color, these of course went into the spread and made control of the levels of these two ingredients more difficult. Moreover, in the SDSU trials, butter was found to be more likely to oil off during pasteurization.

High fat cream (65%-78%) prepared by reseparation of fresh sweet cream, pasteurized 30 minutes at 160° F., was used in approximately 300 lots of product. This cream mix-

ed well with other ingredients, had less tendency to oil off, could be held frozen for extended periods, and could be prepared more readily than butter. It was necessary to add whole milk, or water plus nonfat dry milk to batches made with this high fat cream. Fresh sweet cream containing 45% fat provided the proper fat level and obviated the need for milk and second cream separation.

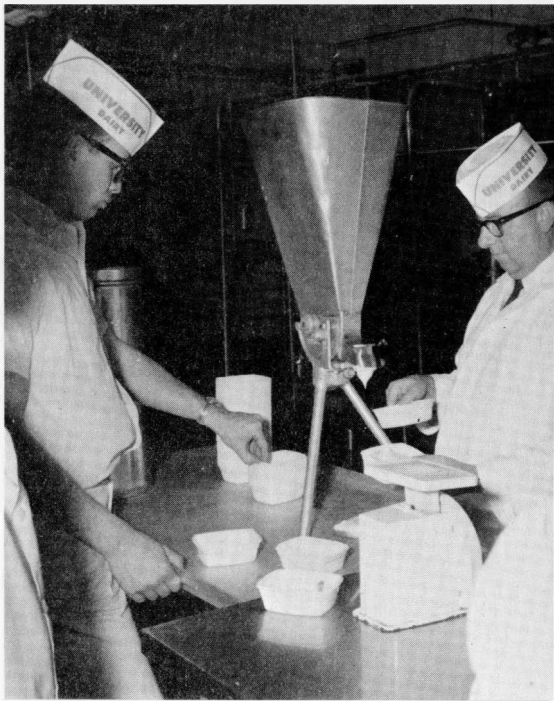
Condensed skimmilk, condensed whole milk, and *nonfat dry milk* were used as sources of serum solids. Nonfat dry milk was used in most lots, since it could be stored and hence was more readily at hand as well as providing continuity between series. Both low heat and high heat products were used; no marked differences on spread-type product were noted.

For many months dried *Cheddar cheese whey solids* were used as a constituent of the spread. The reasons were two fold: it was thought that the lactose in whey, being soluble, would contribute to fluidity and thus permit a higher total solids; and, since development of the product was begun for the purpose of finding new outlets for dairy products, it was thought desirable to include whey which is a by-product of the South Dakota cheese industry. However, a rather persistent criticism of excessive sweetness was expressed by several who tasted the product. Moreover, the lactose crystallized in several lots, causing a graininess of texture and/or undesirable surface appearance. Substitution with Cottage cheese whey solids lent some additional tartness which in part counteracted, but did not reduce, the sweetness. However, criticisms were not reduced appreciably by this approach. Finally the whey solids were omitted and a like amount of additional nonfat dry milk added. Apparently this resolved satisfactorily the problems resulting from high lactose content. Substitution of milk protein concentrates as sodium caseinate, calcium caseinate, or coprecipitated milk proteins for the whey solids did not give the hoped-for decrease in sweetness, but did give a less desirable body and texture.

In some lots, to overcome the criticism of excessive sweetness, the acidity was increased by adding *edible lactic acid*. However, in 14 lots with pH below 5.6, the product was too soft and sticky. Again, there was little reduction in the degree of sweetness apparent—notwithstanding the additional tartness.

Stabilizers and *emulsifiers* of various types were tried. *Monoglycerides* and their carriers appeared to be prone to oxidation and to cata-

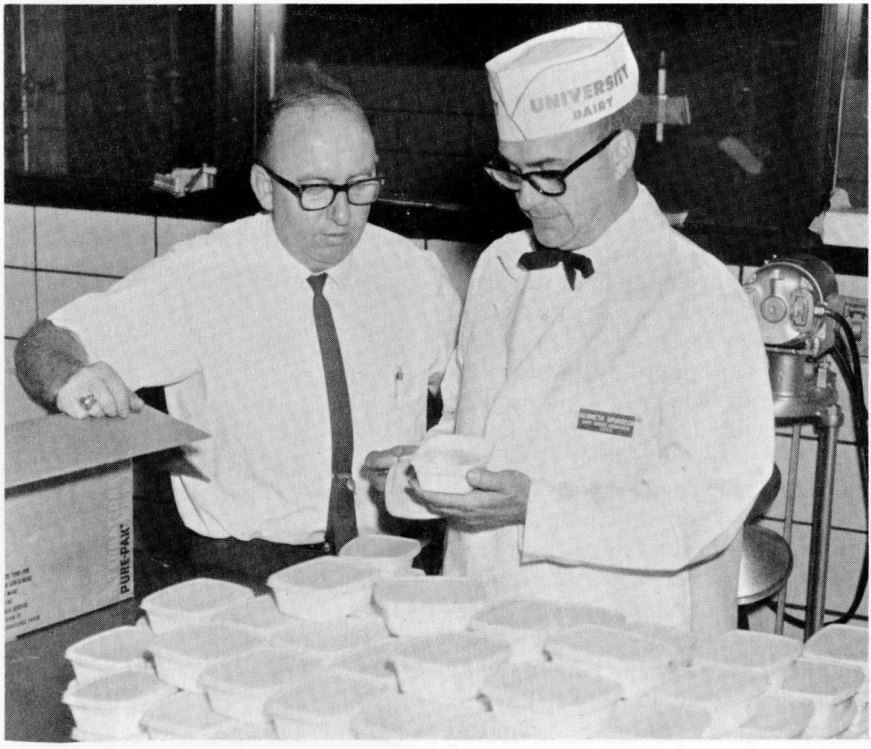
Tubs being filled with the product.



lyze this change in the entire product. Too, they did not do an adequate stabilizing job. *Locust bean gum, carrageenin,* and *blends of sodium citrate and citric acid* seemed to enhance destabilization in the amounts used. Some *proprietary stabilizer and emulsifier blends* did a fairly good job, but it was thought unwise to tie to a proprietary preparation. Some of the new food starches gave a weaker, somewhat leaky, body. A blend of *gelatin* and *sodium carboxymethylcellulose* was found to lend desirable properties and has been used for nearly 2 years. Without stabilizer the product had poor body and tended to whey off. Indeed, many of the earlier lots with stabilizer also showed this defect, especially after freezing and thawing; but this problem has not been especially evident for several months.

Cultures, the primary source of flavor, were made with commercially pasteurized whole milk which also had been steamed for 45 minutes. Two cultures were used: H-5, a mixed-strain cheese and butter culture containing S. *lactis* and *Leuconostoc* organisms; and KF, a single strain *Leuconostoc* species which required acidification of the culture (with citric acid) after growth in order that flavor constituents be formed. The latter culture seemed not to give enough product flavor advantage to merit the extra work.

Chilled tubs packed in containers for shipment.



Apricot filled cookies and peanut butter cookies, made from the product, fresh from the test oven.

In most lots the culture was added following pasteurization and preceding the homogenization step in an effort to minimize volatilization of flavor and aroma ingredients, consistent with a fairly complete kill of culture microorganisms. In some half dozen lots the culture was stirred into the other ingredients after homogenization and cooling; but the mixture was not homogeneous or smooth and counts of viable bacteria were quite high. Similarly, high counts were found when the product was cooled to 100-110° F. prior to culture addition and homogenization.

Starter distillate was added to several lots (in addition to culture) and in some instances perceptibly enhanced the flavor. Some of the tasting panel thought this good; others thought it too intense. All agreed that *diacetyl, per se,* lent an unnatural harsh flavor.

The early work on the spread-type dairy product was initiated in part and based in large measure on the experience and knowledge which personnel of the Dairy Science Department had gained in research on the use of cultured milk or skimmilk to increase the flavor

and other desirable attributes of butter. Accordingly, for about 3 years such cultured product was the primary, often the sole, source of added flavor for the spread-type dairy product. Cultures contributed a fineness of flavor that synthetic flavors historically have not. However, many factors render uncertain the amount of acid and/or flavor compounds that will be produced in cultures from one time to another. Fluctuations in these constituents will, of course, affect both the flavor and body of the spread-type product.

Reluctant to give up use of culture, yet aware of problems in using them, the researchers started preliminary trials in January, 1966 using a *synthetic butter culture flavor* which had been developed at Oregon State University. This flavor was supplied through courtesy of Dr. Robert C. Lindsay, Department of Food Science and Technology, Oregon State University, Corvallis, Ore. In these trials there were some difficulties with body, which were attributed to some unknown factor involved in the substitution of fresh whole milk plus the Oregon formula for the cultures. It was felt, too, that the flavor left something to be desired. The Oregon formula has been used in most lots of spread made since April of 1966 and, contrary to the early results, both flavor and body have been quite good. It was found that the addition of some commercial starter distillate as well as the Oregon formula has seemed to lend a bouquet of flavor not achieved with either product alone. A commercial version of the Oregon formula, obtained from Dairyland Food Laboratories, and called DCF-85B, has given results very much the same as were obtained with the formula from Oregon State University. Further trials are being made to determine a modification of DCF-85B that will give the desired flavor without added starter distillate.

The use of *annatto cheese color* resulted in an unnatural orange-pink which was not desirable. Beta-carotene alone gave too-orange color; *annatto butter color*, too light yellow. *A blend of butter color and beta-carotene* gave what the panel thought to be the most desirable color. (Roche 10% Beta-carotene beadlets were furnished through courtesy of Fine Chemicals Division Hoffman-LaRoche, Inc., Nutley, N. J.) Beta-carotene offered the further advantage of contributing vitamin A potency.

Butter salt was tried at levels ranging from 0.5% to 2.0% of finished product. For a time it appeared that about 0.75% of finished product was most satisfactory, but a consumer preference trial (12) involving 50 Brookings, S. D. families indicated that 1.25% was most preferred.

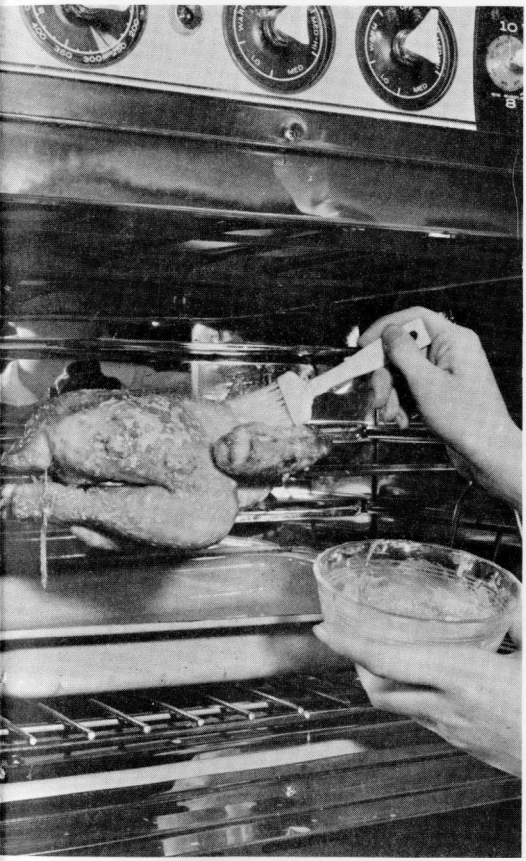
CONSUMER PREFERENCE SURVEYS

Valuable guidance was obtained through a 10-week consumer preference test with 50 Brookings families (12) and through a 150-family household placement in Chicago. As an outgrowth of these consumer tests, modifications were made which tended to make the product less likely to be confused with cheese spreads. Many of the families objected to the fact that the

product was not suitable for frying.

Samples of the product were sent to three dairy industry firms for evaluation during the summer of 1967. As a result of comments from these firms, the formula was modified by reducing the level of nonfat milk solids (and, hence, total solids) to make a somewhat softer product. Also, the level of flavor ingredients was reduced, since indications were that the flavor was too strong—so strong that it even dominated rather than complemented the natural flavor of foods with which the spread was used in cooking and serving.

Basting barbecued chicken with product.



CURRENT FORMULA AND PROCESS

A typical formula and making procedure that is being used currently for the control lots that are deemed to be most satisfactory in light of the foregoing surveys is given on pages 18 and 19.

PACKAGING

It was determined from results of the 50-family survey that an 8-ounce package likely would be best for marketing the spread-type product. Round, 8-ounce, white opaque plastic tub containers generally have been used for the product, including that distributed to the 50 families. These packages have sufficient rigidity for good filling and handling but are somewhat brittle. SDSU workers have found that a rectangular package offers more advantages, and package manufacturers generally agree.

Packaging generally has been done by simply dipping the spread into containers. A few batches were packaged using a hand-cranked ice cream filler. This worked well for small packages and indicated that the use of automated packaging equipment would be feasible. It would probably be necessary to heat the hopper to keep the product flowable.

KEEPING QUALITY

The keeping quality of this product has been quite good in recent months. Samples have been held for 7 months with no mold or marked off flavor defects. A slow staling occurs in time. There appears to be little problem as far as microbiologi-

cal keeping quality is concerned if proper sanitary techniques are practiced.

It has been observed, and documented by tests made with a penetrometer, that there is a tendency for the product to become softer during extended storage. Happily, eliminating whey solids from the formula appears to have reduced this softening considerably in most lots. The causative factors as well as reasons for differences of this softening tendency among lots have not been determined.

It has also been observed that the pH of the product tends to shift upward during storage. A theory is that this may be a result of shifting of mineral salts between colloidal and soluble states. Whether this shift in pH causes or merely attends the softening phenomenon is not yet known.

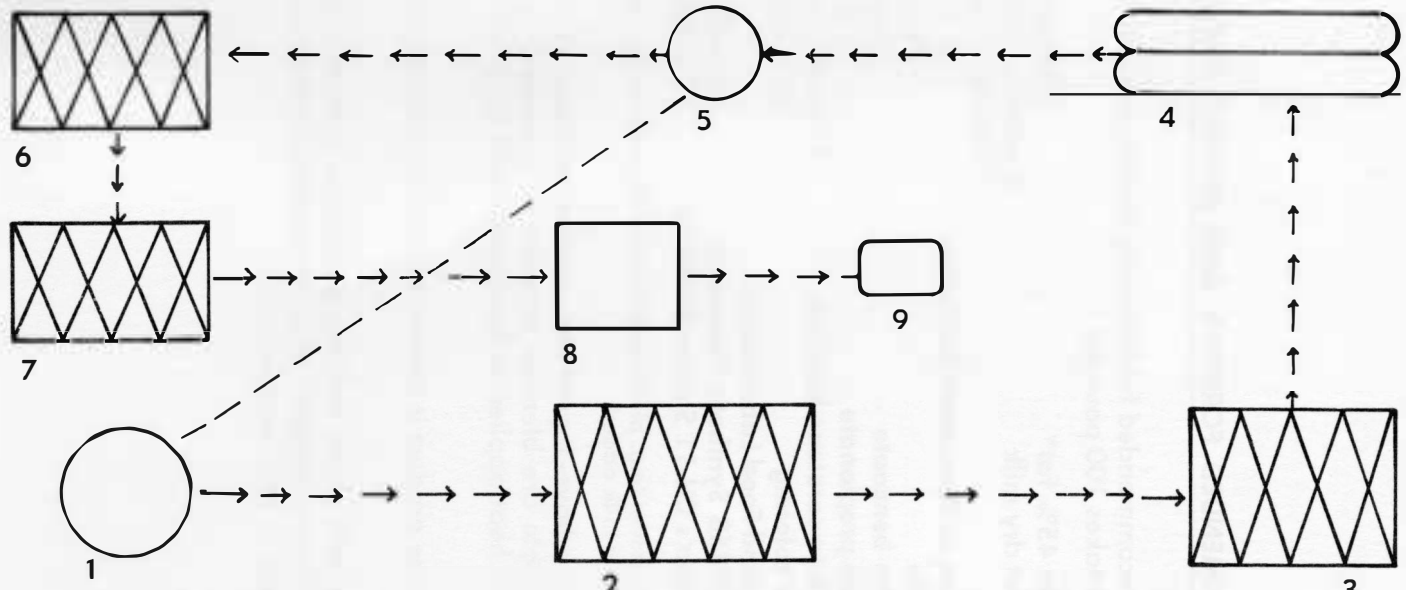
USES AND RECIPES

Researchers in nutrition and food science of the SDSU College of Home Economics investigated various possible uses of the spread-type product. Approximately 90 recipes were developed using the dairy spread on sandwiches; for sandwich fillings; in baked goods; in confections; in waffles; and as sauces on hot vegetables. Some of these recipes appear in the back of this publication. The properties of the spread in these and other culinary uses are being examined. A separate manuscript on this work is in preparation.

Baking powder biscuits and eggs a la goldenrod made from product.

Figure 1

Flow Diagram for HTST Pasteurization for Spread Type Dairy Product



1–Balance Tank
2–Regeneration Section
3–Heating Section
4–Holding Tube
5–Flow Diversion Valve
6–Regeneration Section
7–Cooling [without coolant]
8–Homogenizer
9–Packaging

RECOMMENDED FORMULA AND MAKING PROCEDURE

The recommended formula and making procedure is as follows (this makes 100 pounds):

Cream 45% fat*	**90.0 pounds**
Nonfat dry milk	**8 pounds, 2 ounces**
Salt	**1 pound, 4 ounces**
Sodium carboxymethylcellulose	**43 grams**
Gelatin	**43 grams**
Sodium benzoate	**28 grams**
Sodium propionate	**14 grams**
10% Beta carotene beadlets	**1170 milligrams**
Butter coloring	**67 milliliters**
Dairyland Food Laboratories DCF-85B Synthetic Flavoring	**18 milliliters**
Chumlea's CH-11 Starter Distillate	**70 milliliters**

*High testing cream (e.g. plastic cream) may be used and an appropriate amount of fluid milk added.

All the above ingredients except synthetic flavoring and starter distillate are blended together in a processing vat with enough mild heat applied to liquefy the milk fat in the milk and cream.

Next, the product is heated to 165° F. and held for 30 minutes.

At the end of the holding period the synthetic flavor and starter distillate are added and the product pumped with a centrifugal pump to the homogenizer.

Alternately, the synthetic flavor and starter distillate can be added after the other ingredients are blended and the product pumped to a plate heat exchanger to be pasteurized at 188° F. for 36 seconds. The flow would be from the balance tank to the timing pump, to regeneration section, to heating section, to holding tube, to flow diversion valve, to regeneration section, to cooling section with no cooling water, to the homogenizer.

The entire mixture is homogenized in a two-stage homogenizer, using 1,000 p.s.i. pressure on the second stage and 1,500 p.s.i. total gauge pressure.

Packaging is done immediately after homogenization, while the product is hot and possessed of a low degree of plasticity. (This hot packing aids in promoting good keeping quality, also.)

The packaged product is stored in a refrigerated room at 38° to 40° F. Desirably, the packages should be rather dispersed to facilitate cooling. Several hours are required for fat crystallization and the achievement of the final body character of the product.

The final product will contain approximately 40% milk fat, 44% moisture, 16% nonfat milk solids, 1.25% salt, 0.1% preservatives, and 0.2% stabilizers.

Permission is granted for use of the statement that the "original formula for this spread-type dairy product was developed and tested by South Dakota State University."

RECIPES

SANDWICH SPREADS

These sandwich fillings can be used in sandwiches or on canapes with attractive garnishes. Combine the ingredients and spread on bread or crackers. No butter or margarine is necessary.

Cheese Spread

¼ cup grated sharp cheese
¼ cup dairy spread
½ tsp. prepared mustard

Combine ingredients and heat at low temperature until well blended. Used hot this also serves as quick and easy Welsh Rarebit or as a hot sauce for vegetables.

Peanut Butter Spread

¼ cup dairy spread
¼ cup peanut butter

Garlic Spread

½ cup dairy spread
¼ tsp. garlic salt or a dash of garlic powder

This can also be used in making garlic bread.

Olive Spread

¼ cup dairy spread
¼ cup finely chopped olives

Chip Dips

2 oz. cream cheese
½ cup dairy spread
¼ tsp. curry powder
2 slices bacon, cooked and chopped
Pinch of salt and pepper

Combine ingredients. Chill thoroughly. Serve with crackers and chips.

Barbecue Dip

2 oz. cream cheese
⅓ cup dairy spread
2 Tbsp. barbecue sauce
1 Tbsp. chopped onion
4 drops Worcestershire Sauce
6 drops Tabasco Sauce
½ tsp. sugar

Combine ingredients. Serve with crackers and chips.

SAUCES

Honey-Orange Sauce

¾ cup honey
¼ tsp. cinnamon
Dash salt
½ cup dairy spread
½ cup whipping cream
½ tsp. orange extract

In small sauce pan carefully warm honey, cinnamon, and salt. Blend in dairy spread and let mixture cool slightly. Whip the cream and stir into mixture until smooth. Add orange extract and serve. Serve on ice cream, waffles, or cakes.

Baked Potato Topping

¼ cup sour cream
½ cup dairy spread
2 Tbsp. chopped chives

Combine ingredients and serve with baked potatoes.

BAKED GOODS

Banana Bread

¾ cup dairy spread
1 cup sugar
2 eggs
1 cup mashed bananas
1 tsp. lemon juice
2 cups sifted flour
3 tsp. baking powder
½ tsp. salt
1 cup chopped nuts

Cream dairy spread and sugar together. Beat the eggs until light and add to the creamed mixture. Mash bananas and add lemon juice. Blend flour, baking powder and salt. Mix quickly into banana mixture. Add nuts. Bake in greased loaf pan at 350° for 1 hour and 20 minutes. Makes 1 loaf.

Orange Oatmeal Cookies and Icing (4 dozen cookies)

1 cup sifted flour
1 tsp. baking powder
½ tsp. salt
¾ cup dairy spread
1 cup brown sugar
2 eggs
1 tsp. vanilla
⅓ cup milk
3 cups uncooked oatmeal
2 Tbsp. grated orange rind

Sift together flour, baking powder, and salt. Add dairy spread, egg, sugar, vanilla and about half of the milk. Beat until smooth. Fold in remaining milk, rolled oats, and orange rind. Drop from a teaspoon onto a greased baking sheet. Bake at 350° for 12 to 15 minutes. Remove from cooky sheet and frost with orange icing made from recipe below under "Icings."

Ginger Chewies (4 dozen cookies)

¾ cup dairy spread
1 cup sugar
¼ cup light molasses
1 beaten egg
2 cups flour
¼ tsp. salt
2 tsp. soda
1 tsp. cinnamon
1 tsp. cloves
1 tsp. ginger

Cream dairy spread and sugar; add molasses and egg. Beat well. Add sifted dry ingredients; mix well. Batter may be slightly thin so chill until firm enough to roll into balls. Roll in small balls, dip in sugar, place 2 inches apart on greased baking sheet. Bake in moderate oven (350°) for 12 minutes.

Brownies

½ cup dairy spread
1 cup sugar
2 eggs, beaten
2 envelopes pre-melted unsweetened chocolate
¾ cup flour
½ tsp. baking powder
½ tsp. salt
1 tsp. vanilla
1 cup chopped nuts

Cream together dairy spread and sugar. Add beaten egg and pre-melted chocolate. Blend well. Add sifted dry ingredients, vanilla and nuts. Bake at 350° for 35 minutes in a greased and floured 8-inch pan.

(Recipes for Icings, next page)

ICINGS

Creamy Cherry Icing

⅓ cup dairy spread
3 cups confectioners' sugar
¼ cup maraschino cherry juice

Blend dairy spread and sugar. Stir in cherry juice. Makes frosting for *two* 9-inch layers or a 13x9-inch oblong pan.

For strawberry icing, use ¼ cup crushed fresh or frozen strawberries in place of the maraschino cherry juice.

Thin Chocolate Icing

1 square semi-sweet chocolate
1 tsp. dairy spread
2 tsp. cream
1 tsp. water

Melt chocolate and blend in dairy spread over low heat. Add cream and water. Stir until smooth and creamy. Dribble around edge of cake and let it run down the edges.

Orange Icing

1 cup confectioners' sugar
1 Tbsp. orange juice
1 tsp. orange rind
2 Tbsp. dairy spread

Combine half of the sugar with juice, rind and dairy spread. Add remaining sugar and blend to desired consistency. Spread while baked items are still warm.

Additional recipes developed by the SDSU College of Home Economics are contained in "Recipes Using a New Spread-Type Dairy Product," AES Info Series No. 1, Agricultural Experiment Station, South Dakota State University, Brookings, S. Dak., 57006.

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Use of a trade name does not indicate endorsement of one product over another.