

New Dairy Product Development¹

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Introduction

During the last 50 years research on the development of new dairy products has been carried out under Federal and State auspices as funds would permit. New product development work has also been conducted by industry, especially the larger companies that have established research laboratories. Much information has been developed on utilization of milk and on the making of new products, but more than new product research is needed. The production and marketing of a new product is a two-step process. The first step involves research to produce a prototype; the second step is concerned with getting the product into the hands of the consumer.

Research to develop a new product must start with a concept of the product to be created. The concept should be studied and tested to determine whether the product can be produced successfully, then whether the economics of production may be favorable, and whether there will be success in marketing it. After being satisfied that the proposed product concept is sound, there must be laboratory work to consider the best ingredients to use, the optimum processing and, finally, pilot-plant production of the item.

The second step involves taking the new product from the pilot plant to production, packaging, and final distribution. Many apparently excellent products have been developed in the laboratory, only to fail in the marketplace. It is said that to take an idea through research and marketing to final national distribution may cost a million dollars per product. The research and development costs are probably less than half this amount.

Federal and State Responsibilities

Let us consider who should be responsible for these research, development, and marketing jobs on new dairy products. Both the public and private sectors of our economy are concerned. From the time when the Department of Agriculture and the land-grant colleges were established in the last half of the

19th Century, research on dairy products became a possibility. Research on product improvement and new product development actually began in both the state institutions and the Department of Agriculture shortly after the turn of this century. Today, research effort on new dairy product development is about equally divided between the colleges and the Federal Government in terms of scientific man-years engaged in the work. Some figures prepared by a joint task force of the U.S. Department of Agriculture and the state universities and land-grant colleges, released in November, 1968, as A National Program of Research for Dairy, are of interest. Of the 540 scientist man-years devoted to research pertaining to the dairy industry, three-fourths was conducted by the state experiment stations and one-fourth by the U.S. Department of Agriculture. The research emphasis by components of the dairy industry, state and federal combined, for 1966 based on total expenditures is given as: protection research 26%, production research 44%, product development and quality 25%, efficiency in marketing 5%. The Task Force on Dairy Research recommended that there be an increase in 1972 to 624 man-years and in 1977 to 733 man-years. These increases may or may not be carried out depending upon Congressional and state appropriations. Considering the country's need for increased research in the dairy industry, it is to be hoped that there will be approval for the increases.

Research in the universities is done in the dairy and food departments of the several institutions, while the government research is done by the Agricultural Research Service, Eastern Utilization Research and Development Division in the Dairy Products Laboratory in Washington, D.C., and in the Milk Properties Laboratory and the Engineering and Development Laboratory at Wyndmoor, Pennsylvania. In addition to research conducted in the public sector, some half-dozen of the largest milk handling companies conduct their own research activities. Since private industry must be profit-conscious, it is interested in applied research. The development of basic facts and of new products that will be useful for the whole dairy industry can perhaps best be done in the public sector.

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Marketing of Laboratory Products by Industry

New products are not of much use standing on laboratory shelves, and every state and federal dairy research laboratory has such products which seemed to the researcher developing them to have great promise. But while the public sector can do some market research, in the final analysis it must be up to individual companies to manufacture, promote, and sell the new products. Private dairy research laboratories are usually fully occupied with adapting concepts and prototypes that they develop or that come to them from outside sources. This is a critical and time-consuming job and can spell the difference between a successful product and a failure. Perhaps there should be a closer liaison between the public and private sectors. If industry could furnish some guidance to the public research laboratories, as to its conception of the kind of products it believes could be sold, then these could be developed, readied for test marketing and final production. Industry emphasis is and should be on the production and selling of the products rather than on research to develop them. A problem for both sectors is that industry is seldom willing to stake large amounts of marketing money on products developed in public laboratories, because competitors can sometimes reap a quick harvest from someone else's marketing dollars. The company originally marketing the product must rely on brand names and lead time as a justification for its market investment. Success for the researcher and maximum benefit to the dairy industry comes when the product is produced by many companies and attains national distribution.

New Products Needed to Stimulate Sales

Let us consider now the need for new product development. In terms of raw materials, no segment of the food industry can surpass the dairy industry; we obtain from the dairy cow food components second to none in flavor appeal and nutritional value. But we have not taken advantage of this by developing the new and attractive dairy products that would prevent our per capita milk consumption from dropping. The auto industry is an outstanding example of what new product development will do for sales. How would you sell a 1920 model car today except as an antique? There is no market for antique foods. The mass market for the Model T Ford is gone, just as it is for butter and evaporated milk which are little different than in 1920. To

show the effect of new product development on per capita consumption of dairy products in the last 30 years, some figures are given in Table 1. The per capita consumption of the various classes of our dairy products has ranged over the last 30 years from an increase of 195% for nonfat powder to a decrease of 67% for butter. The middle column of the table shows the new products with which you are familiar in each area. Condensed and evaporated milk, which have suffered a great per capita decrease in consumption, are much the same as they were years ago. Margarine has taken two-thirds of the butter market, which butter gave up without any attempt at new product development. Therefore, at this late date we must look for new products that

TABLE 1. Effect of new product development on per capita consumption of dairy products in the last 30 years.

Product	Volume savers Relatively new products	Change in U.S. per capita consumption 1937 to 1967 (%)
Dry milks	Instant nonfat dry milk, new dry ingredient for food	+195
Cheese	Process cheese, individual wraps, dips and snack items, improved cheese quality	+79
Ice cream	Novelties, new flavors, ice milk, shake mix	+71
Fluid milk and cream	Cultured butter-milk, yoghurt, fortified low fat, and skimmilk	-14
Condensed and evaporated milks	None	-45
Butter	None	-67

can be made with milk fat to compensate for our losses in butter sales.

Stabilization of Flavor and Body in New Dairy Products

Research problems that must be overcome to develop successful new products are concerned with the characteristics and stability of each of the principal milk components. There must be stability of flavor during the life of the product. Oxidized and stale flavors must be controlled. Dairy products have a very attractive, delicate flavor that cannot be chemically duplicated, but it is fleeting where we need permanence. We actually develop desirable flavors in cheese with help from bacteria and their enzymes. Cheese flavors have been so attractive that we should exploit this approach as we have done to a very limited extent in some of our cultured products.

Stability of body and texture is hard to attain in a dynamic milk system. Lactose in a fluid product may have to be forced out of solution as fine crystals; in a powder it is hygroscopic in the amorphous form and must be crystallized to retard moisture absorption. But we are fortunate to have lactose; it can adsorb flavor and color, contribute to a desirable body and to good nutrition. The milk proteins are the real builders of body and texture and much research centers around getting them to do a proper job. Milk fat, of course, contributes to body and texture but it is our flavor component par excellence. Much of our flavor research must be directed toward making the best use of milk fat.

New Product Suggestions

In the following series of tables, I shall mention briefly new products in each of the major dairy product areas. In our product development work we should probably consider carefully various of these new products,

TABLE 2. New dried products.

Coffee whiteners with stable milk fat
Fruit-flavored milk powders
High-protein whey, milk and soy blends
Flavored, instant beverage mixtures from skimmilk and whey
Stable dried whole milk
Instant powders for food manufacture and institutional feeding

TABLE 3. New cheese products.

Semisoft skimmilk cheese
Spreads, dips, fluid concentrates
Whipped Cottage cheese with sour cream body
Long-life Cottage cheese
Fresh curd, high flavor cheese
Stable cheese solids and protein-fat blends for food manufacture
Newly developed varieties

concept-test them, and conduct research to develop them. Much of the product development work can be done by the public sector, but it will be the responsibility of private industry to look over the researchers shoulder and select products which seem to fit his processing and marketing conditions.

Dried products. Some new dried products are suggested in Table 2. We could greatly improve the flavor of vegetable fat coffee whiteners by putting some milk fat into them. But we would have to find a way to prevent milk fat from deteriorating. Versions of the other dried products have been made, but more research is needed to attain commercial

EUDA
SKIM MILK CHEESE
SEMI-SOFT
MADE FROM
PASTEURIZED SKIM MILK

MADE BY
USDA - ARS
BELTSVILLE, MD.

FIG. 1. Label for Semi-soft Skimmilk cheese developed in the Dairy Products Laboratory of the United States Department of Agriculture.

TABLE 4. Analyses of Cheddar, Cottage, and EUDA cheese.

Constituents	Cottage		EUDA
	Cheddar	(creamed)	
Fat (%)	33	4.2	6
Moisture (%)	38	78.3	56
Protein (%)	24	13.6	30
Salt (%)	1.7	1.0	2.4
Calories per 100 g	398	106	185

success. The whey-soy blend is being developed for a food supplement in the developing countries.

Cheese products. Some new cheese products appear in Table 3. One of these, semi-soft skimmilk cheese developed in the Dairy Products Laboratory, has proceeded through the pilot plant and to store tests. The label used in the store testing is shown in Figure 1. We have called the cheese EUDA for Eastern Utilization, Department of Agriculture. The composition of Euda cheese compared to Cheddar and Cottage cheese is shown in Table 4.

Whey products. In every cheese operation whey is discarded. We produce 22 billion pounds of it each year in the United States. For 30 years, researchers in the colleges and in our Dairy Products Laboratory have been concerned with the disposing of whey. Many answers have been found and today we are using perhaps half of the whey we produce, in human or animal food. This is not enough. Eleven billion pounds is still a waste disposal problem. Some new approaches to whey utilization that might justify further research are suggested in Table 5. Sweetened condensed whey is not new, but we believe its full potential has not been exploited.

TABLE 5. New whey products.

Whey protein concentrates by concentration/fractionation a) reverse osmosis b) gel filtration c) electrodi- alysis
Sweetened condensed whey products
a) Mixtures for whips and spreads with fruit, peanut butter
b) Raw material for food manufac- ture
New uses for lactose
Whey-based beverages with CO ₂ , al- cohol, fruit
Fermentation products for food and pharmaceuticals

One direction the Dairy Products Laboratory has taken is to look at the application of reverse osmosis for removal of water and salts from whey. This is especially applicable to small cheese operations that cannot afford to install condensing equipment. Some figures are shown in Table 6. We have concluded on the basis of our preliminary research that reverse osmosis will be very useful in whey utilization projects, especially if its potential for concentrating lactose and protein proves to be economically sound.

Ice cream products. Table 7 suggests some new ice cream products. The ice cream industry has worked hard in improving processing, packaging, and novelties. But there can still be improvements in body and texture and in flavor.

Fluid milk products. New fresh milk and cream products are indicated in Table 8. Half of the milk produced and sold in the United States can be classified in this group. Of

TABLE 6. Fractionation and concentration of Cottage cheese whey by reverse osmosis.^a

Analysis	Original ^b whey	Solids content of fractions		
		Concentrate	Permeate	Loss in permeate
		(%)		
Total solids	6.53	32.7	.30	3.7
Ash	.61	2.5	.18	23.7
Lactose	4.39	22.2	.07	1.3
Nitrogen	.13	.6	.014	7.3
Protein (N × 6.38)	.86	4.0	.089	

^a Membrane type, 75% NaCl rejection.

^b Estimated cost of water removal to 32.7% total solids = 0.82 cents/pound water.

^c Estimated cost of water removal to 20% total solids = 0.5 cents/pound water.

TABLE 7. New ice cream products.

New novelties and stick items.
Body and texture improvement through fast freezing
New and improved flavoring ingredients
Ice milks to compete with Mellorine
Ready-to-serve frozen whipped topping

the three classes of products listed, perhaps the most opportunity for innovation exists with the fermented products. Fresh milk custards and puddings are beginning to attract attention. Some imaginative research could do much for the fluid milk industry.

Sterilized products. Table 9 is concerned with new heat-sterilized products. Research on sterilized fluid milks and concentrates has been conducted for many years, but we still do not have products that will keep at room temperature without flavor deterioration. Sterilized puddings and sauces are beginning to appear, but research should be done to develop better sterile coffee creamers and whippable toppings containing milk fat.

Milk fat products. We come now to new high-fat products suggested in Table 10. This is a most difficult area, largely because of adverse economic factors. Perhaps some of the approaches in Table 10 will help to relieve our fat surplus problem. One approach taken by the Dairy Products Laboratory involves the preparation of a heat-treated milk fat which has an intense though somewhat different flavor from normal milk fat. Heat treatment not only intensifies flavor but it also increases keeping quality. The fat is useful for spraying on popcorn, as a source of fat, for can-

TABLE 8. New fresh milk and cream products.

Fermented products
Improved yoghurt, Kefir milk, Koumis
Cultured creams, salad dressings, and dips
Carbonated fermented milks
Low-fat milks
Improved, intensified flavors
Fruit flavors, diet milks
Refreshing cola-type drinks
Novelty fresh milk products
Milk puddings and desserts, milk shakes
Fresh milk soup mixes

TABLE 9. New heat-sterilized products.

Storage-stable 3:1 UHT ^a concentrate
Canned puddings, diet milks
Milk-cola high protein beverage
Butter, Hollandaise, and cheese sauces
Coffee creams and whippable toppings
Aseptic packaged fluid milks

^a Ultrahigh temperature.

dies, as a frying and a baking fat, and for other cooking uses.

In a day when we are becoming increasingly conscious of good nutrition, and when we are trying to improve nutrition of our own disadvantaged people, one wonders whether we should not look at milk-vegetable fat mixtures as a means of lowering costs and stretching our food supplies. One might ask whether we could regain some of the markets we have lost from those who have cut milk usage for dietary reasons, if we produced nutritionally acceptable mixtures of milk and vegetable products. Some day research may show that certain ratios of milk and vegetable fat may be nutritionally desirable. Advantages have been claimed for polyunsaturated vegetable oils, but there is some evidence that excessive amounts are harmful. Some day one answer may be to replace half of the vegetable fat in margarine with butter. This might produce a very acceptable nutritional spread, but there would be economic and legal questions to be resolved.

Areas of Need for New Dairy Products

We are told that there are still pockets of hunger in the United States. These might be partly filled with dairy products. We have

TABLE 10. New high-fat products.

Milk fat spreads, whippable milk fat topping
Milk fat fractions
Full-flavor liquid fraction, solid fraction
Heat-treated high-flavor milk fat
Milk-vegetable blends modified for optimum nutrition
Stable anhydrous milk fat
Milk fat-based salad dressing
Special-purpose milk fats for confections, baking, food uses, institutional use

few products really suitable for distribution and storage in such areas. We need products with storage stability formulated and packaged to meet the requirements of the segments of our population who are undernourished or on relief.

The food service business has expanded into a \$30 billion market, or nearly one-third of the whole food industry. There are predictions that the away-from-home eating market will equal retail food store volume within a decade. Institutional food emphasis will be

on high quality, with greater variety, built-in convenience, and portion control. New product development will be needed to satisfy the growing markets of those concerned with institutional feeding, and those in the food service business who are engaged in providing food for hospitals, schools, industrial plants, and restaurants. One must conclude that we have only begun the job of research and development that must be done to produce and distribute an adequate supply of dairy products for our growing population.