

Use of Soy Products in Dairy Product Replacement¹

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ABSTRACT

Soy protein products can be used to replace or supplement dairy products in many food products. Several such applications are described.

INTRODUCTION

Dairy products in the form of fluid milk and cheese products are used widely throughout the world. However, nonfat milk solids and whey solids from cheese production have not been used widely as ingredients in foods in many areas of the world. In Europe, most nonfat milk solids are still used as animal feed rather than as an ingredient for human food. With the great need for good quality protein, it would seem that it should be only a matter of time before these products now being used for animal feed will be produced in a manner to be acceptable for human food. In recovering dried whey from cheese manufacture, we have an excellent protein source, which, when recovered, in combination with vegetable protein products, will help solve the environmental problems and contribute to the total food supply.

Notwithstanding the price situation during the past year on soybeans and soybean products, soy protein products offer an economical source of a large volume of good quality nutritional protein. However, if soy protein containing products are going to be acceptable for use in foods, they must possess certain functional characteristics, so that, if they are used as replacement for dairy products, either partially or completely, the handling characteristics of the foods during processing must not be essentially different from those obtained by the ingredients which they are intended to replace. Further, the flavor, aroma, and physical characteristics of the finished food must not be altered appreciably. In those countries where dairy products have not been available for general consumption, the problem of introducing certain soy products for use in manners similar to dairy products is not the same as in those countries where dairy products have made up an important part of the diet.

In the U.S. and in some other areas of the world, nonfat dried milk is used in the production of many processed food products.

With the great demand and higher prices for nonfat milk solids, the interest in soy protein containing products to be used in combination with cheese whey, nonfat milk solids, sodium caseinate, etc., has increased greatly. Defatted soy flour produced by solvent extraction processes, lecithinated defatted soy flour, full-fat soy flour, low-fat expeller-type soy flour, soy protein concentrates, and isolated soy proteins all are being used either singly or in blends, containing varying amounts of sweet cheese whey, sodium caseinate, and nonfat milk solids. These products may be produced by dry blending of the ingredients or wet blending in the proper concentration followed by spray drying. Generally, the dry blended products are lower in cost but, in many applications, do not have the same functional characteristics or flavor as those which are wet blended and spray dried. The choice of which product to use would be dictated by the end result where they are used as ingredients.

It should be pointed out that, within each category of the soy protein containing products mentioned, a variety of different products exists. While there are similarities in each of the general classes of products produced by different manufacturers, it also should be pointed out that, in each

class, depending upon the producer and application, there also may be differences. With the soy flour products, functionality of the protein can be changed, depending upon the degree of heat processing given to the materials at some stage of the processing whereby some protein denaturation and other changes take place which will influence the functionality of the total blend. Soy flour products may be ground to different degrees of fineness, and a given product may have a wide range of particle size distribution, which also can influence functionality. Therefore, care should be taken in selecting and determining which types of soy protein containing products will best serve to give a blend with functional characteristics to do the job desired by the processor using these blends in his final formulated product.

Currently, there must be 30 or 40 companies producing blends of various types, which they, in turn, are selling to food manufacturers as ingredients. Some of these blends may contain ingredients other than soy and dairy protein products, such as emulsifiers, other cereal grain flours, certain chemical additives, etc., depending upon the intended use of the final product and economic considerations. The protein content of the various products may vary from as low as 20% and up to 40% or higher. These blends often are combined in such a way as to have protein content similar to milk, with lactose equal to or lower than milk, depending upon the type of soy protein containing product and other ingredients used. The different blends are being used as replacement for nonfat milk, either completely or partially, in baked goods, sauces, meat products, various fabricated foods, etc.

SOY MILK PRODUCTS

For many years, soy milk products have been available as dry and canned or liquid products for feeding babies who are allergic to cows' milk and for others, such as vegetarians and certain religious groups, who do not desire animal protein.

It has been estimated that, in 1973, ca. 10% of the infants in the U.S. will be fed formulas based upon soy (1). Ca. 25 or 30 years ago, infant formulas were developed based upon producing soy milk directly from beans and with full-fat soy flour and low-fat expeller-type soy flour. Although these products still are being produced, it became possible in the 1960's when isolated soy proteins as proteinates were available, to make a nicer looking product with good color and better general acceptability, insofar as the mother was concerned. These products are formulated in such a way as to give good caloric distribution, insofar as protein, fat, and carbohydrates are concerned, with the addition of methionine, minerals, and vitamins.

The soy milk products based upon isolates, for feeding infants, result in better formed and less odorous stools. In the soy flour products, the presence of stachyose and raffinose results in the development of microbial flora in the gut, different from that produced if these carbohydrates are not present. In manufacturing of the soy protein isolates, these carbohydrates are removed.

In the beverage product area, sterilized soy milk products have been sold for many years in Asian countries. In Hong Kong, a product known as "Vitasoy" and produced by Hong Kong Soyabean Products Co. reportedly outsells carbonated beverages. It was projected that, in 1973, ca. 150 million bottles were sold (1). These products are made from whole soybeans with sugar, flavor, vitamins, and minerals added.

¹One of 13 papers presented in the symposium, "Soy Protein," at the AOC'S Spring Meeting, Mexico City, April 1974.

For a number of years, the U.S. government has purchased a product known as "CSM," which is a corn-soy-nonfat milk product, but, with the shortage of nonfat milk and the high prices, a new product has been formulated based upon sweet cheese whey and ca. 36.5% full-fat soy flour along with other additives, which is intended for use as a beverage in the Agency for International Development program. This project is just now getting underway, and governmental purchases have been projected at ca. 1 million lb a month during the next year, with an eventual growth to ca. 10 million lb a month in the next 2 or 3 years.

For at least 25 to 30 years, soy flour products have been used as a partial replacement for milk in milk replacer products for feeding young animals, with perhaps 95% of this type of product being used for feeding calves. (T.C. Foin, New Zealand Milk Products, Inc., private communication). Soy protein concentrates also are used widely in calf milk replacer products, and there is a limited amount of isolated soy protein used in such products. The isolates are not used so much for nutritional value, but rather to take advantage of certain functional characteristics in producing these products.

In feeding baby calves for herd replacement, generally soy flour is used up to levels of ca. 10%. Baby calves are allowed to feed on the mother cow for 2 or 3 days and then fed on milk replacer products for ca. 3-4 weeks, at which time they begin to get solid feed. In the case of calves raised for veal, it is desirable to get a fast wt gain, so the animals essentially are force fed for 10-12 weeks, but, up until recently, very little soy protein was used in feeding veal animals. However, it is reported that, due to the high prices for nonfat milk, small amounts of soy flour are used in some products.

In the case of herd replacement animals, there is not as much interest in rapid gain, but bone structure is most important, so the mineral content, particularly calcium, is of importance.

Some milk replacer products are used for feeding baby pigs, where they are fed on colostrum for ca. 3 days and then may be fed a milk replacer. After ca. 2 weeks they are switched to a high milk pellet which will contain whey and nonfat milk and may contain up to 5-10% soy flour.

There are some liquid products fed to dogs which may consist of combinations of whey, sodium caseinate, and soy flour, but these are special products usually sold through veterinarians (T.C. Foin, New Zealand Milk Products, Inc., private communication).

Cheese-type products are being produced in Hong Kong which are made entirely from soy-based materials. Thus far, most of the work on cheese-type products has been based upon the use of soy products for complete replacement of milk, but it will be only a matter of time before someone will develop a cheese product with only partial replacement of milk with soy protein products.

In the U.S., vegetable proteins or soy protein isolates are permitted in margarine, "in amounts not greater than reasonably required to accomplish the desired effect" (2).

Attempts have been made to use isolated soy proteins instead of sodium caseinate in dry coffee whitener products. However, there have been problems of flavor and what is known as feathering. It has been suggested that, in dry nondairy coffee whiteners, it will be necessary to modify the soy protein isolate either chemically or enzymatically to be successful. In liquid-type nondairy coffee whiteners, soy protein isolates do function satisfactorily at low protein levels. Frozen coffee cream-type products are available on the market where isolated soy protein is used for its functional characteristics and gives a satisfactory

product for use in coffee and on cereals.

Whipped toppings in the dried state can be formulated using small amounts of soy protein isolates along with other protein materials, but it is reported that the best whipped toppings are made by using modified soy protein products. Enzymatically treated soy protein products are said to function well, except there is a flavor problem. With some of the newer processes and products being developed, there is hope that some of the flavor and functionality problems may be overcome (3).

Bread still remains one of the most important foods throughout the world, but there are some major differences in the way various breads are prepared. Not only are there differences in shape, but the characteristics of the flour and other ingredients will be quite different in many areas of the world.

In the U.S., most of the popular white breads have been prepared using nonfat dried milk. Nonfat milk results in desirable flavor characteristics and also helps with shelf-life. It also increases the nutritional value of the bread in that the milk protein will supply needed additional lysine to the wheat protein. Although soy flour has been used for many years in breads, with the increasing prices for nonfat dried milk, there has been a tendency to use more soy. Many breads contain from 1.5-2.0% soy flour based upon the wheat flour. In some cases, soy flour is used directly, but, in many cases, the blends referred to earlier are used.

When soy flour is used, either separately or in blends at levels of below 3%, there is not much change in the amount of water absorption, mixing time, or the amount of oxidants required in comparison to nonfat milk. However, at higher levels, adjustments in the formulas must be made (4).

Over the past years, one of the major problems with soy protein containing products has been flavor. In the case of defatted soy flour and grit products, improvements have been made, so that somewhat higher levels of soy flour now can be used in food products without a flavor problem. Full-fat soy flour and low-fat expeller soy flour, when properly processed, overcome much of the flavor problem associated with defatted products, but at a sacrifice of functional characteristics for some applications. Soy protein concentrates have less flavor than soy flour, and soy isolates now are being produced that are relatively bland. While progress has been made in improving soy protein containing products from the standpoint of functionality and flavor, further improvements will be made. It is now possible to prepare soy protein containing products which give reasonable good flavor for use in beverages, frozen desserts (with characteristics similar to ice cream), yogurt-type products, etc.

While at certain times, we may see some lowering of prices for dairy products used as ingredients in food, the general trend over the years will be for higher prices and shorter supplies. Existing types of soy protein products and new soy products yet to be developed with better flavor and tailor-made functional properties will play an increasingly important roll in helping to fill the ingredient supply gap at lower ingredient cost.

REFERENCES

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