Introduction to Round-Table Discussion on Soy Protein in Dairy-type Foods, Beverages, Confections, Dietary, and Other Foods

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Despite the intensity of current interest in soy proteins for the extension of meat and for the fortification of cereal-grain foods, we must recognize that these vegetable protein products also are being used to manufacture diverse processed food products, as illustrated by the title of this round-table discussion. We can expect substantial growth in this particular area of soy protein utilization, if the current pace of technological development continues and economic factors remain favorable. Obviously, the economic interplay among the several available protein sources is a vital factor in their utilization for food production.

This session provides a forum for the discussion of the use of soy protein products in specific foods such as: infant formulations and baby foods; coffee whiteners; whip toppings; cheese-like foods; frozen and chilled desserts; margarine and other spread products; beverages, including dietary or nutritional beverages of the carbonated, still, or milk-like varieties; confections, including candies; imitation nut meats and nut butters; whipping agents; and dietary foods, including calorie-reduced foods.

With reference to the foods to be discussed in this round-table, both the functional and nutritional qualities of their protein ingredients are of much concern. In a number of instances, these are indivisible qualities, for there is need for adequate function with good nutrition. It should be understood that the term "function" includes both the flavor and texture contributions of the protein ingredient to the food product. These qualities dictate the suitability of a given protein ingredient for use in a specific food item. Functional value and nutritional quality have been the subjects of some controversy. We expect that these concerns will be voiced in these proceedings.

The panelists of this round-table have been requested to present summary statements regarding specific or general aspects of the foods of concern to this discussion. No effort has been made to prevent duplication in these remarks, since varying viewpoints have been solicited. A frank exchange of ideas and viewpoints is fundamental to achieving the objectives of this Conference.

Soy Products in Other Applications

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INTRODUCTION

In an attempt to stay within the short time allotted, I would like to discuss briefly the various aspects of the use of soy products in whip toppings, coffee whiteners, and beverages.

Of the three classes of soy products currently available, soy flours, soy concentrates, and soy protein isolates, my comments will be directed primarily to the use of soy protein isolates in the three product categories. The uses of soy flours with ca. 50% protein and soy concentrates at 60 or 70% protein undoubtedly have been studied in these three product categories; but, because the problems are so large and numerous, no attempt will be made here to discuss them at this time.

The functional properties of isolates are especially important and appear to be more critical for these product applications than their applications in meat and bakery products. In my opinion, the functional properties are several times greater in their effect than they are for meat or in bakery products.

The important functional properties of soy protein isolates for coffee whiteners, whip toppings, and nutritional beverages are as follows: wetability, dispersibility and solubility, flavor (taste and aroma), pH, ash content, viscosity, color, nutritional considerations, protein-protein interaction, protein-lipid interaction, emulsifying characteristics, particle size, and uniformity of product. They are not listed in order of importance, however. There may be other functional properties, but certainly this is an impressive list which must be considered to achieve good performance from soy protein isolates. I will discuss briefly some of the functional properties as they apply to each of these product categories.

COFFEE WHITENERS

To the best of my knowledge, it is essential that a modified soy protein isolate be used in dry nondairy coffee whiteners. This modification may be either chemical or enzymatic. So called native or normal protein isolates containing 90% protein or more do not function with satisfaction in dry coffee whiteners. In liquid type nondairy coffee whiteners, at low protein levels, native soy isolates can function satisfactorily. There is considerably more stress put upon the dry coffee whitener than a liquid coffee whitener prepared either as a refrigerated product or as a sterile product. The use of a dry coffee whitener when added to coffee involves factors such as wetability, reconstitutability, whitening characteristics, and a whole host of other factors which are not as greatly stressed as in a liquid type coffee whitener. A suitable chemically modified soy protein isolate can function satisfactorily in coffee whiteners. Flavor, color, and freedom from feathering or precipitation can be obtained. Some coffees currently on the market have a lower pH than other coffees; this low pH in coffees accentuates the problems that pertain to dry or liquid coffee whiteners. It is obvious that these factors, as well as many others, need careful study before they can be of good application of soy protein isolates in this area.

WHIP TOPPINGS

Whip toppings in the dried state can be formulated using small amounts of soy protein isolates with other protein sources; but to date the best whip toppings are made by

using modified soy protein products. The enzymatically prepared soy protein products, except for a flavor problem, function well; and this is, of course, a prominent use for such products. It has been learned that dry toppings when reconstituted and used as a creamer, for example on fruits, have led to some adverse stability reactions. The functional factor of flavor is extremely important in whip toppings and the soy may cause the green and soybean flavor notes to appear in this type of product.

NUTRITIONAL BEVERAGES

In this application, the functional properties of soy protein isolates are extremely critical. Even when soy protein isolates are used in this type of product, either with or without other protein sources, practically all the functional properties mentioned above take on considerable significance. In dry nutritional type products, wetability and dispersibility of the proteins and the finished product are of considerable importance. Likewise in those products that require hot water for reconstitution, the aroma and taste contribution of the soy protein becomes exceedingly important. Attempts have been made to use soy proteins in such products, but the aroma of the soy definitely was detected by the consumer. Another important consideration in the use of soy isolates in nutritional products is the contribution a soy isolate can make to the flavor notes of the particular product under consideration. Experience has shown that some soy isolates can amplify a cereal note, for example, if that happens to be the basic flavor note in the finished product. Where fruit flavors are involved soy protein isolate must be used at the minimum level with other protein sources to prevent a green or adverse flavor note appearing in the finished reconstituted beverage.

Time will not permit a discussion of all the other factors that are involved in using soy isolates in nutritional beverages because each type of beverage has particular and specific requirements. I would like to emphasize, however, in closing that another one of the critical factors is uniformity of the soy protein isolate from lot to lot. Differences in isolate manufacture can and do have effects upon performance.

Soy Proteins in Dairy-type Foods, Beverages, Confections, Dietary, and Other Foods

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This section deals with beverages, simulated sweet and sour creams, margarine, cheese-like foods, frozen desserts, whipped toppings, substitute nuts and fruits, table vegetables (green or immature beans and sprouts), and soups, based upon soybeans and soybean protein derivatives.

I. Beverages. These fall into several categories.
   A. Traditional soy milks, unfermented.
      1. Starting with uncomminuted full-fat beans.
         a. Oriental process. The beans are soaked in water overnight, then ground in hot water, cooked at boiling, and filtered through cloth. May be refrigerated or retorted.
         b. Contemporary processes. The flavor of above may limit acceptance. Several recent reports indicate that lipoxygenase and perhaps other enzymes in the raw bean may be responsible for off-flavors. Enzyme activity may be diminished at the outset by heating the intact beans either dry (roasting or IR heating) or by cooking them after immersion in various aqueous solutions of salts, alkalies, or acids. Wet cooking may be atmospheric steaming or boiling, or may be under pressure, followed by comminution and filtration. These beverages may be fortified with vitamins, minerals, and other additives. They can be purveyed in wet or dry forms. This type of processing retains the oligosaccharides.
      2. Starting with full-fat or defatted soy flours, precooked, with or without filtering. Fat is added to the defatted flour-based product. Both types have been made commercially.
      3. Starting with soy protein concentrate, full-fat or defatted. These are devoid of oligosaccharides. Some calf milk replacers are of this type.
   B. Traditional fermented. Yogurt-like milks have been studied both in the Far East and the U.S. (using *Lactobacillus bulgaricus* and *L. acidophilus*).
   C. Simulated milks (neutral pH). These are based usually on soy protein isolate, without or with bovine milk ingredients (lactose, non-fat dry milk, cheese whey, caseinates, etc.)
      1. Dairy-type, fluid single strength. Problems with flavor, color, viscosity, mouth feel, etc. Some have appeared on market. Fresh vs. sterilized types. Also concentrated (simulated evaporated milk).
      2. Non-fat dry milk replacers. Soy protein isolate or soy flour mixed with dairy whey and other ingredients.
      3. Infant-feeding beverages to simulate human milk.
      4. Fermented yogurt-like types.

      In the U.S. the Filled Milk Act was declared invalid after 50 years, although there are still some legal restrictions at the state level. There is renewed interest in imitation milks, but there may be requirements for nutritional adequacy and performance equal to dairy milk, from the regulatory standpoint. Possibility exists for extending supplies of dairy milk by admixture.
   D. Still beverages simulating or extending fruit juices (citrus, pineapple) and vegetable juices (tomato, carrot, etc.) or other flavors. These may be acid or neutral. Also protein fortification of natural fruit or vegetable juices. Problems of solubility and mouth-feel on contact with saliva. May require modification of soy protein isolate.
   E. Carbonated beverages (acid). Solubility, mouth feel, and flavor even more of a problem, in addition to problem of clarity. Extensive modification of protein (by hydrolysis) may affect nutritive value.

II. Simulated sweet creams. Includes category of coffee whiteners. Latter requires tolerance to hardness of water and acidity of coffee.

III. Sour cream. Based on milk caseinates or non-fat dry milk, but can be made with soy protein isolate.

IV. Margarine and spreads. Pareve on market; margarine standard permits use of soy flour; can be based upon