Vegetable Protein Application in Yogurt, Coffee Creamers and Whip Toppings

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ABSTRACT

Soy proteins and, in particular, isolated soy proteins are being used in coffee creamers and whip toppings. With the increasing cost of traditional protein sources, more food manufacturers are investigating and utilizing soy proteins in other dairy type products. Isolated soy protein added as a replacement for the nonfat dry milk in the production of yogurt increased the viscosity and gel strength to a greater amount than nonfat dry milk and sodium caseinate added on an equivalent protein basis.

Food manufacturers throughout the world have developed many dairy-related products that contain vegetable fats and sodium caseinate. With the increasing cost of sodium caseinate, many manufacturers are investigating the use of isolated soy protein in these products. Also, dietary, religious, and ethnic constraints have become increasingly important considerations in the formulation and market of these foods.

Isolated soy proteins have many of the chemical and physical properties required for use in the dairy industry. These products have functional properties not available from other vegetable protein sources and have improved flavor characteristics in comparison to the soy proteins that were available several years ago. The improved flavor profile is especially important in dairy products which normally have bland to delicate flavors. Significant progress has been made in developing specific isolated soy proteins for application in dairy type products. These proteins provide functional properties such as whipping, viscosity control, emulsification, and emulsion stability, which are important in dairy-related products.

COFFEE CREAMERS

Historically, cream or milk products were added to coffee to develop a creamy white appearance and to alter the acid or bitter flavor characteristics of coffee. Later, coffee creamers based on sodium caseinate and vegetable fats were developed. For several years, isolated soy proteins have been used in coffee creamers and infant formulas to replace milk proteins. The common ingredients for coffee creamers are corn syrup, vegetable fat, protein (sodium caseinate or isolated soy protein), emulsifiers and stabilizers.

A typical formula for a liquid coffee creamer containing isolated soy protein is shown in Table I. These products are popular because of their low cost and convenience in handling and storage. In addition to use in coffee, they are frequently used in cooking, cream sauces, cocoa mixes, and flavored drinks. Coffee creamers or similar products are used in baking applications as a source of emulsified fat.

Coffee creamers are generally grouped into three categories: liquid, frozen and dry. In all of these, the protein, fat, and emulsifiers are primary ingredients and dramatically influence the performance of the creamer in coffee. A coffee creamer with superior whitening power must be formulated and processed properly so that a stable emulsion can be maintained when added to coffee. Coffee varies greatly in properties such as acidity, concentration of coffee, and mineral content of water used for brewing. All of these affect the performance of a coffee creamer.

The primary function of the protein is to assist in the formation of an emulsion and to stabilize the emulsion especially when added to coffee. The emulsified fat contributes to the whitening power, body, and viscosity. The whitening effect in coffee is primarily due to the scattering of light from the surface of the emulsified fat globules. It has been found that fats with low melting points interact with isolated soy proteins to produce excellent emulsions. The performance of coffee creamers are also influenced by the type of emulsifiers employed. Polysorbate 60 or related emulsifiers are important in formulating coffee creamers with a minimum of feathering and maximum whitening power.

The method of processing will have an effect on the performance of coffee creamers. Homogenization is important since it assists in the preparation of an emulsion having fat globules of 0.2 to 0.4 microns in diameter. Rapid cooling of the emulsion immediately after homogenization assists in producing a stable emulsion. These are two of the many parameters to consider in the manufacturing of a creamer.

Frozen coffee creamer emulsions are more difficult to stabilize than liquid coffee creamers. The frozen creamers must have excellent emulsion stability since the product must be able to undergo two or three freeze-thaw cycles before being added to the coffee. Isolated soy protein has the capability of sustaining the stress of freezing and thawing. The optimum concentration of isolated soy proteins in liquid or frozen coffee creamers is 0.8-1.0%. Dry coffee creamer systems undergo more stress than the frozen or liquid coffee creamer systems, since they go through additional dehydration and rehydration steps.

Coffee creamers prepared with isolated soy protein have whiteness values equal to coffee creamers manufactured with sodium caseinate when measured on the L-scale (lightness or whiteness evaluation) of the Hunter Color difference meter.

TABLE I

Formulation for Liquid Coffee Creamer

Ingredient	Weight basis (%)
Corn syrup solids	15.0
Vegetable fat	10.1
Protein (isolated soy protein)	0.8
Mono- and di-glycerides	0.5
Sodium stearoyl-2-lactylate	0.2
Polysorbate 60	0.2
Dipotassium phosphate	0.2
Water	73.0

[1]Speaker.

TABLE II

Formulations for Liquid Nondairy Topping and Frozen Prewhipped Topping

Ingredient	Liquid nondairy topping weight basis (%)	Frozen prewhipped topping weight basis (%)
Water	55.25	53.40
Palm kernel oil	25.00	26.00
Sucrose	18.00	18.00
Isolated soy protein	0.40	1.20
Sorbitan monostearate	0.30	0.35
Flavor	0.30	0.30
Lecithin	0.20	—
Mono- and di-glycerides	0.20	—
Polysorbate 60	0.20	0.30
Disodium phosphate	0.15	0.15
Guar gum	—	0.30

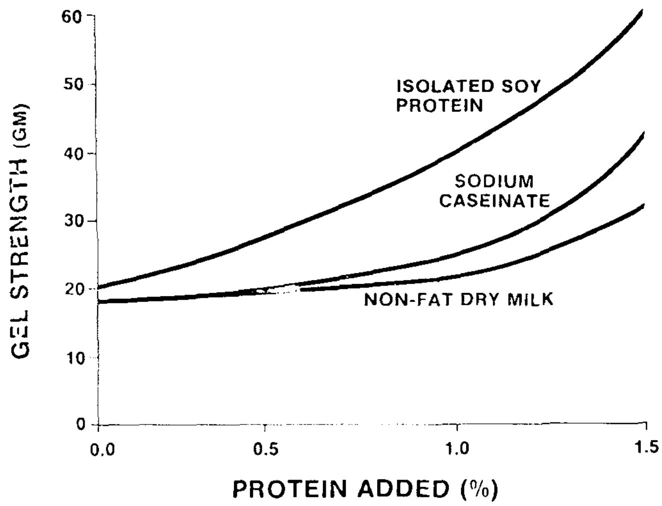

FIG. 1. Effect of added proteins and textural properties of Yogurt.

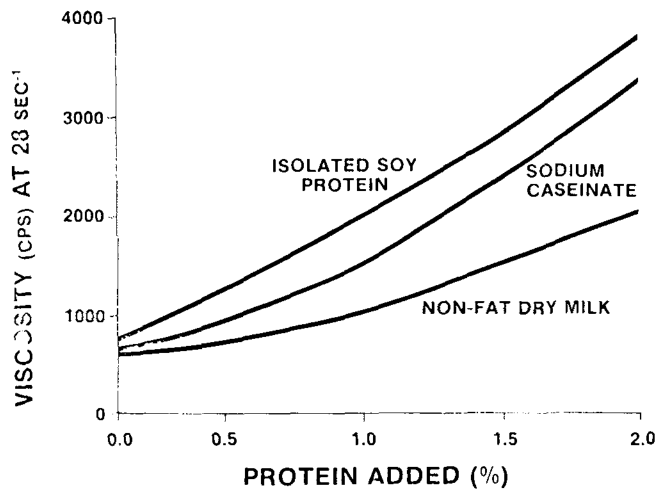

FIG. 2. Effect of added proteins on viscosity of yogurt.

WHIP TOPPINGS

Traditionally, whipped toppings have been prepared by the mechanical whipping of dairy cream. This has resulted in finished products of variable quality since composition of the cream varies depending upon the source of the cream, its age, fat content, seasonal variation, cow's diet, etc. Because of this variability, this has led to the practice of adding gums and other stabilizers to cream used for whipping.

Many nontraditional whip toppings have become widely used and accepted in the U.S. These toppings were originally developed using nonfat dry milk or sodium caseinate as a source of protein and vegetable fat as a source of fat. With these products the quality of the finished product is more uniform from batch to batch, and higher overruns can be achieved. These toppings have excellent flavor and are lower in fat content than the traditional cream-based products. Thus, a product with reduced calories is available. In the U.S., both manufacturer and consumer of these products realize cost savings, since a less expensive fat source is used.

Isolated soy proteins are being used in the manufacture of four types of whip toppings: 1) aerosol, 2) liquid, 3) frozen, and 4) frozen, prewhipped toppings.

The major purpose of protein in whip toppings is to aid in the formation of an emulsion and assist in the incorporation of air during whipping. During the process of whipping the product, a stable film is developed which will hold the incorporated air or gas. An emulsion which is highly stable will not whip or may allow only slight incorporation of air, thus resulting in a low overrun. At the same time, a protein-fat film must be produced that is stable enough to hold the incorporated air until the product is consumed. In the case of frozen, prewhipped toppings, the film must be sufficiently stable to undergo several freeze-thaw cycles.

In most whip topping formulations, isolated soy protein is used at a lower level than sodium caseinate because of its higher viscosities and the excellent emulsifying properties of soy protein.

A typical liquid nondairy topping and frozen, prewhipped topping formulations are shown in Table II. Overrun yields of 350 to 400% are obtained routinely with liquid nondairy whip toppings. Another popular form of nondairy whip topping is sold as a liquid and whipped with a household type mixer equipped with rotary beaters or a wire whip. This product is commonly sold at retail as a refrigerated product. Retail bakers and institutions use considerable quantities of liquid toppings in their food products. For added convenience and shelf life, these liquid toppings are frequently sold in frozen form. Aerosol toppings will generally be formulated in a similar manner.

In the case of the frozen, prewhipped topping, the emulsion is prepared using this typical formulation, cooled and whipped in a continuous mixer or whipper, and an inert gas is incorporated into the whipped emulsion. Overruns of 250 to 400% are generally attained with this type of product. The whipped product is packaged and frozen immediately. The product is thawed prior to consumption.

YOGURT

Yogurt is one of the fastest growing items in the U.S. food market. For example, yogurt consumption increased 20% from 1974 to 1975. The production of yogurt in its various forms has been recognized on a world wide basis.

Yogurt had its early beginning in the Balkans. Even though it has achieved widespread popularity, few countries have established standards of identity for yogurt. However, many countries are considering establishing such standards. Traditionally, yogurt is a food produced by culturing milk or milk with reduced fat levels using a mixed culture of *Lactobacillus bulgaricus* and *Streptococcus thermophilus.* However, this can vary from country to country. Cow's milk is generally fermented, although goat and mare milks are used in some countries. In general, three types of yogurt are widely produced: yogurt incubated in the retail container; yogurt incubated in bulk and then mixed and packaged in the retail container; and a yogurt produced with low viscosity. Two styles of yogurt are popular in the U.S. These are Swiss and sundae styles. The Swiss style is a stirred yogurt incubated in bulk. Fruit and flavorings are commonly combined with the yogurt before packaging. The sundae style is produced by the addition of fruit and flavoring to the retail cup followed by the addition of an inoculated milk to the container. In both cases the products have a high viscosity and generally set up in a curd or gel-like texture.

With the increased popularity of yogurt, it is now being used as an ingredient in further processed foods, dessert type products, candy bars, and as a frozen soft-serve type product.

Traditionally, milk is concentrated or nonfat dry milk added to the milk before it is processed to increase the solids content which contributes to increased gel and viscosity properties of the finished product. In addition, some manufacturers add stabilizing agents to modify the consistency of a finished product and reduce syneresis in the milk portion of the yogurt product. The stabilizers employed are gelatin, and many of the plant hydrocolloids such as locust bean gum, guar gum, carrageenan, and xanthan products.

In the United States, it is common practice to add ca. 4% nonfat dry milk to low fat milk to increase the total solids before inoculation and fermentation to yield a product with desirable body and textural properties. Sodium caseinate has been added to yogurt to increase the solids content and contribute to the textural properties of a finished yogurt in a similar manner as nonfat dry milk. However, with increasing levels of addition on a protein basis, the sodium caseinate will increase the textural properties of the yogurt to a greater extent than nonfat dry milk. Research has been conducted to investigate the potential use of isolated soy proteins as replacement of some of the stabilizer products such as plant hydrocolloids and sodium caseinate. The addition of isolated soy protein contributes to increased viscosity and gel strength and will contribute to the protein content while many of the stabilizer products do not.

Investigations conducted in our laboratories indicate that isolated soy protein may be used to replace the nonfat dry milk or sodium caseinate that is added to milk to improve viscosity and texture of yogurt. In addition, the isolate is effective in reducing syneresis or whey separation from the gel structure of the yogurt.

The effect of added nonfat dry milk, sodium caseinate and isolated soy protein on the textural property and gel strength of yogurt is shown in Figure 1. The gel strength of yogurt increased with increasing level of nonfat dry milk, sodium caseinate and isolated soy protein, with the isolated soy protein being the most effective in improving or increasing the gel strength per unit of added protein.

Addition of nonfat dry milk, sodium caseinate and isolated soy protein to milk for production of yogurt also increases viscosity. Again, the isolated soy protein on a protein or weight basis was most effective for increasing viscosity of yogurt as shown in Figure 2. Addition of these protein materials also reduces syneresis or whey separation of yogurt. Increasing the protein content reduced the amount of whey separation. With specific processing conditions, the isolated soy protein was most effective in reducing whey separation followed by nonfat dry milk and then sodium caseinate.