Soy Protein Foods in U.S. Assistance Programs

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ABSTRACT

Soy protein food products occupy an important place in both U.S. overseas and domestic food assistance programs. In the overseas food donation program the products serve as the source of protein for the fortification of conventional processed commodities—wheat flour, corn meal, rolled oats, bulgur, and sorghum grits—and as a major source of protein in several cereal soy products designed for special use as child food supplements. Acceptance of these products has been good and more than 1 billion lb. of soy-fortified foods were distributed in the overseas program during July 1, 1972-June 30, 1973. In domestic food assistance programs, soy protein foods which meet U.S. Department of Agriculture requirements have been introduced into both school lunch and breakfast programs and also are distributed to needy families. Two products, textured soy protein and protein-fortified enriched macaroni, are permitted to meet part of the meat requirement in the Type A school lunch. In the school breakfast program, soy protein is a permitted ingredient in protein-fortified foods such as doughnuts, cake-like baked products, and cereal-fruit products. They were introduced primarily to meet the need for nutritious food items that require no kitchen facilities to prepare and are convenient to serve in schools that lack food service facilities. Specifications for the various food products are presented.

INTRODUCTION

For many years the U.S. government has had domestic and foreign assistance programs for providing food to needy people. This paper concerns the role of soy protein products in contributing to the improved nutritional value of foods distributed in these programs.

FOREIGN FOOD ASSISTANCE PROGRAMS

Original authorization for the foreign food donation program was given by an Act of Congress in 1949. The authority was extended by Public Law 480 in 1954, which was subsequently amended through the Food for Peace Act of 1966. These Acts gave responsibility to the U.S. Department of Agriculture (USDA) for purchase of commodities and processed foods for distribution in the foreign donation program. Donated foods have been distributed by the U.S. Agency for International Development (AID) through the U.S. Voluntary Agencies, through government-to-government bilateral agreements, and through contributions to the World Food Program of the Food and Agricultural Organization of the United Nations (1). More than 100 million people in about 90 developing countries are reached.

Soy protein products were introduced into the overseas donation program in 1966 as a component of foods formulated to meet special needs of certain population groups. Chief among these were children in the developing nations, especially the weanling infant and preschool child whose requirements for growth put special demands on the composition of their diet. Pregnant and lactating mothers also had dietary needs frequently not met in countries where food supplies were marginal. Beyond these needs there were nutrient deficiencies in large population groups which could be best overcome by enrichment or fortification of commonly eaten foods.

Shortage in the domestic supply of nonfat dry milk, developed in 1965, stimulated the development of high-protein formulated foods which would serve as supplements in the diets of the children or in the emergency feeding of adults. Certain guidelines or ingredients, nutrient composition, and properties of these formulated foods were developed (2,3). The ingredients needed to be readily available at reasonable costs. As a supplementary food, one serving or 100 g should supply one-half of the National Academy of Sciences-National Research Council (NAS/NRC) recommended daily dietary allowance for protein, vitamins, and minerals for the 6- to 8-year old child. A like amount would provide two-thirds of the recommended dietary allowance for these nutrients for the 1- to 2-year old child. Vitamin B_{12} was an exception. Because of the probable lack of animal products in the diet of the target group, the full recommended daily allowance of this vitamin was provided in 100 g.

Many individuals in USDA, AID, industry, and the voluntary agencies have contributed to the design, production, distribution, and successful use of formulated foods developed under these guidelines.

The first formulated food product (Table I) to be widely distributed which met the above requirements was a blend of precooked cornmeal, defatted soy flour, nonfat dry milk, and soy oil, supplemented with all vitamins and minerals for which the NAS/NRC had published recommended dietary allowances (2). The product was designated Child Food Supplement, Corn-Soy-Milk Mix, but is commonly known as CSM.

The combination of cereal, soy, and milk proteins in CSM gives a protein of relatively high nutritional quality.

TABLE I

Child Food Supplement, Corn-Soy Milk

Ingredient	Percent
Cornmeal, precooked	63.8
Soy flour, defatted	24.2
Nonfat dry milk	5.0
Soy oil, refined	5.0
Mineral-vitamin premix	2.0
Total protein, minimum, dry basis	19.0
Total lipid, minimum, dry basis	6.0

TABLE II

Child Food Supplement, Corn-Soy Blend (CSB)

Ingredient	Percent
Cornmeal, precooked	63.7
Soy flour, defatted	22.0
Soy oil, refined	5.5
Vitamin and mineral premix	2.8
Total protein, minimum, dry basis	16.7
Total lipid, minimum, dry basis	6.0

TABLE III

Child Food Supplement, Wheat-Soy Blend (WSB)

Ingredient	Percent
Wheat fractions, precooked (Wheat protein concentrate and wheat flour or bulgur flour)	73.4
Soy flour, defatted	20.0
Soy oil, refined	4.0
Mineral and vitamin premix	2.6
Total protein, minimum, dry basis	20.0
Total lipid, minimum, dry basis	6.0

TABLE IV

Special Supplemental Foods Distributed in U.S. Overseas Food Assistance Program

Food	Protein content percent	Protein efficiency ratio
Regular CSM	19	2.3-2.4
Instant CSM (fully precooked)	19	2.3-2.4
Instant sweetened CSM	19	2.3-2.4
Wheat-soy blend	20	2.1-2.3
Corn-soy blend	16.7	2.2-2.3

The protein efficiency ratio of CSM as determined by the standard American Association of Analytical Chemists rat feeding test has a value of 2.3-2.4 compared to a value of 2.5 for casein.

More than 2.8 billion lbs of CSM have been purchased by the USDA for distribution by AID since 1966. CSM has had good acceptance despite the fact that its major component, cornmeal, was not a familiar food in many recipient countries.

Two modifications of the basic formulation for CSM have been introduced for special feeding situations. One, designated Instant CSM, is a product which requires no cooking before serving. The other is Instant Sweetened CSM which contains 15% sucrose. The sugar was added to improve acceptance of the product by adults and older children in emergency feeding situations.

During the past summer a formulation (Table II) containing precooked cornmeal and soy flour as its principal ingredients was included in the overseas program. This product was intended for distribution to older children and other population groups for whom the somewhat lower protein content of 16.7%, as compared to 19% for CSM, would be adequate.

Another formulated food developed primarily as a child food supplement has precooked wheat fractions as its cereal component. The product is commonly called WSB, indicating it is a wheat-soy blend. Proportions of ingredients, protein, and fat content, are given in Table III.

Specifications for protein, fat, vitamin, and mineral content of WSB are similar to those for CSM (2). WSB has a smaller particle size than CSM and this is reflected in the texture and consistency of the cooked product. WSB is more fluid than CSM at a given solids level and for this reason may have advantage for serving as a beverage rather than as a porridge or gruel. It also may be preferred in countries where wheat is a staple food (4).

Protein efficiency ratios as determined for WSB in rat feeding tests average about 2.1-2.3 as compared to 2.5 for casein. As in the case of CSM, child feeding tests showed that WSB maintains children in nitrogen balance when fed as a primary source of protein.

Table IV presents a listing of special supplemental foods fortified with soy protein which have been distributed in our overseas food distribution program.

These formulated foods have been designed for, and have reached, children through special programs such as school lunch programs. Many children, as well as adults, who need additional proteins, vitamins, and minerals are not reached by these programs but may receive commodities such as cornmeal, bulgur, rolled oats, and wheat flour under family food distribution or other types of assistance programs. To provide additional protein and better quality protein, these cereal products, fortified with soy flour, flakes, or grits, have been made available to U.S.-AID for distribution in the overseas food donation program. Table V lists these cereal products, the form in which soy protein is added, and the proportions of the components. Soy-fortified grain sorghum grits were included on this list in September 1973. Cornmeal and wheat flour are fortified not only with protein but also with vitamins A, B_1, B_2, and niacin and the minerals iron and calcium. An emulsifier, sodium stearoyl-2-lactylate, is added to wheat flour in order to improve loaf volume and crumb texture of yeast-leavened baked products, particularly at the higher level of soy fortification (5,6).

TABLE V

Soy-Fortified Commodities Distributed in U.S. Overseas Food Assistance Program

Commodity	Soy component	Proportion
Cornmeal	Soy flour	85:15
Bulgur	Soy grits	85:15
Rolled oats	Soy flakes	85:15
Wheat flour	Soy flour	94:6
Wheat flour	Soy flour	88:12
Sorghum grits	Soy grits	85:15

TABLE VI

Quantities of Soy-Fortified Foods Distributed in U.S. Overseas Assistance Programs-July 1, 1972-June 30, 1973

Food	Quantity million lb
Soy fortified bulgur	296.6
Wheat-soy blend (WSB)	111.7
Sweetened WSB	55.4
Corn-soy-milk (CSM)	277.4
Instant CSM	64.1
Instant sweetened CSM	101.1
Soy-fortified cornmeal	22.3
Soy-fortified rolled oats	21.8
Soy-fortified bread flour	52.1
Total	1002.5

Quantities of soy-fortified food products distributed in U.S. assistance programs in fiscal year 1973 are given in Table VI. More than 1 billion lb of protein-fortified food products were purchased for overseas distribution by the AID.

DOMESTIC FOOD ASSISTANCE PROGRAMS

Soy protein products play an important role in domestic food assistance programs. Soy protein foods have been introduced into school lunch and breakfast programs for which federal assistance has been given in the form of a subsidy administered by the USDA. Soy-fortified foods also are distributed to needy families through the Department's family food distribution program. About 26 million children are reached in the school feeding programs.

Textured soy protein products in their use as meat alternates have become increasingly popular in the school lunch program since their introduction into this program in February 1971. In order to qualify for federal subsidy, schools must serve an assortment of foods which meet certain basic requirements set by the USDA. Among the requirements of the Type A lunch is that 2 ounces of lean

TABLE VII

Specifications for Textured Vegetable Protein[a]

	Minimum	Maximum
Protein[b], wt %	50.0	—
Fat, wt %	—	30.0
Magnesium, mg/100 g	70.0	—
Iron, mg/100 g	10.0	—
Thiamin, mg/100 g	0.30	—
Riboflavin, mg/100 g	0.60	—
Niacin, mg/100 g	16.0	—
Vitamin B_6, mg/100 g	1.4	—
Vitamin B_{12}, μg/100 g	5.7	—
Pantothenic acid, mg/100 g	2.0	—
Biological value of protein,		
PER[c] of textured vegetable protein	1.8	
PER of meat-textured vegetable protein combination	2.5	

[a]Values for nutrients expressed on moisture-free basis.

[b]Nitrogen times 6.25.

[c]PER = Protein efficiency ratio.

meat, poultry, or fish, or specified alternate shall be served. These requirements were revised to permit textured vegetable protein products, which meet certain nutrient compositional specifications, to serve as alternates for part of the meat requirement (3). Requirements to be met included: (A.) Protein, vitamin, and essential mineral content of textured vegetable protein shall be equal to that supplied in significant amount by good quality lean meat. (B.) Hydrated textured vegetable protein can satisfy up to 30% of the meat requirement. (C.) Textured vegetable protein shall be served in combination with meat, poultry, fish, or cheese. (D.) Nutritional quality of the protein contained in the combination of textured vegetable protein and meat shall be at least equal to that of casein as measured by protein efficiency ratio.

Quantitative specifications for the nutrient composition of textured vegetable protein are given in Table VII. Specifications are for the product on a moisture-free basis. When hydrated for use, the moisture content is required to be in the range 60-65% which is comparable to that of meat. Specifications are currently being revised to include fortification with zinc, folacin, phosphorus, calcium, and vitamin A.

Two specifications apply to the biological quality of the protein. The first is that the protein efficiency ratio of the textured protein product, as the sole source of protein, shall be at least 1.8. The second is that the protein efficiency ratio of the combination of meat and textured vegetable protein shall be at least 2.5, equal to that of the milk protein, casein.

It should be noted that use of textured vegetable proteins in the school lunch program is not mandatory but is by choice of the school. Products available commercially which meet USDA specifications can be purchased and served as meat alternates at the option of the school. The wide and increasing usage of textured soy products in schools attests to the quality and acceptability of this new food.

Another class of protein-fortified foods permitted as an alternate to meet part of the minimum requirement for meat in Type A School Lunches and other child nutrition programs is protein-fortified, enriched macaroni-type products. These include macaroni, spaghetti, noodles, and similar formed products made from cereal flours or meals, alone or in combination with one or more ingredients having a high protein content, such as soy flour or soy protein concentrates. The product is enriched with vitamins

TABLE VIII

Specifications for Protein-Fortified Enriched Macaroni-Type Products for Use as Meat Alternate in School Lunch Program (moisture-free basis)

	Minimum	Maximum
Protein, %	20.0	25.0
Moisture, %	—	13.0
Iron, mg/lb	13.0	16.5
Thiamin, mg/lb	4.0	5.0
Riboflavin, mg/lb	1.7	2.2
Niacin, mg/lb	27.0	34.0
Protein efficiency ratio, cooked product	2.4	

and minerals. Specifications for the nutrient composition of the protein-fortified macaroni-type product are given in Table VIII.

Protein content, dry basis, is required to be at least 20%. Vitamin and mineral enrichment includes niacin, thiamin, riboflavin, and iron. Protein efficiency ratio of the cooked product must be at least 90% of that of casein.

One ounce dry macaroni as the cooked product serves as an alternate for 1 oz of cooked meat when served in combination with 1 oz of cooked meat, poultry, fish, or cheese.

Soy-fortified enriched macaroni-type products meeting USDA specifications are available to schools from several U.S. macaroni manufacturers.

In the school breakfast program, soy protein is an ingredient permitted and used in protein-fortified foods which was introduced primarily to meet the need for nutritious food items that required no kitchen facilities to prepare and thus were convenient to serve in schools which lacked food service facilities. Examples of such items are doughnuts, cake-like baked products, and cereal-fruit products which are fortified with protein, vitamins, and minerals such that a single ready-to-eat item when served with milk provides a relatively complete breakfast. Nutrient requirements for these protein-fortified enriched foods have been issued by the USDA (7).

Finally, in the family food assistance program, a soy-fortified macaroni is one of the food items that has been distributed for several years by the USDA. Specifications for this product are embodied in a federal standard of identity issued by the Food and Drug Administration. This standard requires that the macaroni contain at least 12.5% soy flour. Acceptance of soy-fortified macaroni has been good and more than 100 million lb have been distributed.

In conclusion, soy-protein products occupy an important place in both U.S. domestic and overseas food assistance programs. They serve as the source of protein in the fortification of conventional processed commodities—wheat flour, cornmeal, rolled oats, and bulgur—and in the fortification of conventional prepared foods, such as macaroni and doughnuts. Soy flour is a major source of protein in several products designed for special use as child food supplements in the overseas food assistance program. Textured soy protein products, introduced into the domestic school lunch program as a meat alternate to meet part of the meat requirement, have found increasing use during the past 2 years.

REFERENCES

1. Johnson, P.E., Cereal Sci. Today 18:138 (1973).
2. Senti, F.R., in "Protein Enriched Cereal Foods for World Needs," Edited by Max Milner, American Assocation Cereal Chemists, St. Paul, Minn., 1969.
3. Senti, F.R., Cereal Sci. Today 17:157 (1972).
4. Horan, F.E., Ibid. 18:11 (1973).
5. Finney, K.F., and M.D. Shogren, Baker's Dig. 45:40 (1971).
6. Tsen, C.C., W.J. Hoover, and D. Phillips, Ibid. 45:20 (1971).
7. Federal Register 38:9234 (1973).