DEVELOPMENTS IN FOOD SCIENCE 5B

PROGRESS IN CEREAL CHEMISTRY AND TECHNOLOGY

PART B

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Organizing Committee: Chairman: M. Velebil
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CEREAL-BASED FOODS FOR INTERNATIONAL FEEDING PROGRAMS: PROCESSING, CHARACTERISTICS, AND USES

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The mention of firm names or trade products does not imply that they are endorsed or recommended by the U.S. Department of Agriculture over other firms or similar products not mentioned.

SUMMARY

Cereal whole grains, flakes, grits, and flours are provided by international sponsors for use in food assistance programs. The cereal products may be partially or fully precooked to reduce food preparation time and fuel demands. The uncooked or cooked cereal products may be combined with soybean products, dairy components, vitamins, and minerals to improve nutritional quality to meet needs and preferences of populations ranging from preschool children to adults. These commodities are used in feeding programs that focus on maternal/child health, school children, food for work projects, and disaster relief.

INTRODUCTION

Humanitarian food assistance to alleviate hunger has been undertaken by many throughout man's recorded existence, as documented in several books of the Bible. However, formalized international food assistance programs on a global basis are a 20th century phenomenon.

The major international food relief programs are the World Food Program (WFP), the International Emergency Food Reserve, and the U.S. Food for Peace Program. Allocations of food aid in cereals through these programs for 1981/82 from all known sources are estimated at 8.8 million metric tons.

The United States provides food assistance to other countries through the Food for Peace Program, which is also known as Public Law 480. Three programs are authorized under PL 480 to provide aid to needy people. Under Title I, loans are provided to developing countries on concessional sales
at low interest rates with long repayment terms for purchasing U.S. agricultural commodities. Title II provides food donations to meet famine or other urgent relief needs, combat malnutrition, and promote economic and community development. Title III programs are similar to Title I, but provide for forgiveness of the original loan if the country uses the local currencies for development programs in nutrition, health services, and population planning. Food commodities supplied under Titles I and II of PL-480 contribute to meeting the 1980 United States pledge of 4.5 million metric tons of wheat or other food grains to the Food Aid Convention of the International Wheat Agreement.

FOOD TYPES AND PROCESSING

The U.S. donates food through government-to-government, WFP, and voluntary relief agencies under Title II, with a major priority to help meet nutritional needs of vulnerable groups.

Whole commodities exported under Title II include wheat, corn, sorghum, and dry peas. The whole commodities must meet official U.S. Standards. In 1981, 744 thousand metric tons of whole commodities was exported to alleviate hunger.

Title II processed foods are provided to needy people who do not have adequate manufacturing facilities, technical expertise, or energy. These foods may be consumed directly or after minimum preparation to the desired food product. In 1981, 809 thousand metric tons of processed foods was donated for international feeding programs. Bulgur and wheat flour dominated, but milled rice, vegetable oil, and nonfat dry milk also accounted for substantial tonnage. Processed foods must meet various applicable USDA quality standards.

Prior to 1966, the principal commodities exported for food assistance programs were wheat and other cereal grains, nonfat dry milk, and edible oil. In 1966, the amended PL 480 provided for enrichment and fortification of commodities to improve their nutritional value. Through research studies and cooperative efforts between USDA, trade groups, UNICEF, private industries, and others, two distinct types of formulated foods emerged. Blended Food Supplements were engineered to meet the nutritional requirements of preschool children. A second group known as Fortified Processed Foods was intended for dietary improvement of the general population.

Requirements for the Fortified Processed Foods include soy-fortification at levels to improve nutritional value without changing functional properties.
They are to perform in traditional food applications, essentially undetected (Table I). Cereals in the form of flakes, grits, or flour are combined with the same physical form of soy to maintain homogeneity and texture in the food.

Table I. Fortified Processed Foods—Formulations and Processing

<table>
<thead>
<tr>
<th>Soy-fortified commodity</th>
<th>Cereal component, % (form, processing)</th>
<th>Soy component, % (form, processing)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulgur</td>
<td>85 (grit) F</td>
<td>15 (grit) DT</td>
</tr>
<tr>
<td>Bread Flour²,³</td>
<td>88 (flour) U</td>
<td>12 (flour) LT</td>
</tr>
<tr>
<td>Cornmeal²</td>
<td>85 (meal) U</td>
<td>15 (flour) DT</td>
</tr>
<tr>
<td>Sorghum Grits</td>
<td>85 (grit) U</td>
<td>15 (grit) DT</td>
</tr>
<tr>
<td>Rolled Oats</td>
<td>85 (flake) P</td>
<td>15 (flake) DT</td>
</tr>
</tbody>
</table>

¹F = fully cooked; U = uncooked; P = partially cooked; DT = defatted, toasted; LT = lightly toasted. ²Contains vitamins A, B₁, B₂, niacin and minerals Fe and Ca. ³Contains sodium stearyl-2-lactylate and KBA.

Fortified Processed Foods are manufactured to comply with applicable USDA quality standards. Moisture levels of various products range from 11.5 to 13.5%. Moisture is lower on products that contain cooked cereals, such as bulgur or rolled oats. Moisture control, except for bulgur or soybean products, is dependent upon added moisture during tempering or other milling conditions, because drying equipment is not always available. Protein requirements range from 13% for SFCM to 20% for SFRO, which reflects the
protein content of the cereal and soy components. Crude fat requirements range from 1.5 to 5%. Fat contents of the SFCM and SFSG are kept low to minimize the effect of lipase activity, because these cereal components are not cooked. Higher fat contents are permitted for SFB and SFRO, because these products are cooked to destroy lipase. Crude fiber contents range from 2 to 3% and ash contents from 1.6 to 2.6%, which are indicative of normal milling controls. Performance tests are required for these products. SFB, SFSG, and SFRO require the cereal and soy particles to remain intact after 15 minutes boiling in water. This test serves to show any tendency of grit or flaked particles to disintegrate during cooking and change the expected texture of the food preparation. A baking test must be carried out for the SFBF. The finished bread must meet a minimum loaf volume of 2550 cc/lb, in addition to having good grain and texture properties. Each of the products must comply with a specified range of particle sizes. Granulation ranges from very coarse for SFRO to very fine for SFBF. Maximum bacteria count is 50,000/g for SFB and SFRO. Each product must have normal odor, color, and flavor characteristics. In 1981, 189 thousand metric tons of Fortified Processed Foods was donated for food assistance programs.

Blended Food Supplements are shown in Table II. These products contain: processed cereal meal, defatted toasted soy flour, nonfat dry milk or dry

Table II. Blended Food Supplements-Formulations (%) and Processing

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Cereal meal, processed³</th>
<th>Soy flour, defatted toasted</th>
<th>Nonfat dry milk or dry whey</th>
<th>Refined soy oil⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corn-Soy-Milk (CSM)</td>
<td>59.2 P</td>
<td>17.5</td>
<td>15 NFDM</td>
<td>5.5</td>
</tr>
<tr>
<td>Instant CSM</td>
<td>63.0 F</td>
<td>23.7</td>
<td>5 NFDM</td>
<td>5.5</td>
</tr>
<tr>
<td>Wheat-Soy Blend (WSB)</td>
<td>73.1°F</td>
<td>20.0</td>
<td>-</td>
<td>4.0</td>
</tr>
<tr>
<td>Whey-Soy-Drink Mix</td>
<td>(9.1 CSS)</td>
<td>29.7</td>
<td>41.3 DW</td>
<td>19.0 PH</td>
</tr>
</tbody>
</table>

¹Contains vitamins A, B₁, B₂, B₆, niacin, pantothenate, folic acid, B₁₂, C, D, E. ²Contains Ca, P, Zn, Fe, I, Na. ³P = partially cooked, F = fully cooked, CSS = corn syrup solids. ⁴Contains 0.0025% butylated hydroxy anisole and 0.0025% butylated hydroxy toluene; PH = partially hydrogenated. ⁵Contains 53.1% bulgur flour and 20% wheat protein concentrate.
whey, vitamins and minerals. In addition, each of the separate ingredients must meet certain requirements. For example, soy flour must meet processing and analytical requirements for moisture, protein, fat, fiber, ash, granulation, nitrogen solubility index, urease activity, and total bacterial count. The formulation for CSM currently contains 15% nonfat dry milk; it also is sometimes specified at 0 and 5% milk solids, depending upon the supply situation for milk solids. The formulation with no milk is called Corn-Soy Blend (CSB). Soy flour is increased as milk is decreased to achieve the same protein level and quality. Whey-Soy Drink Mix (WSDM) was formulated to match the nutritional balance of whole milk; it contains corn syrup solids instead of cereal meal. The cereal meals are either partially or fully cooked in extruders or roll-cookers as described by Bookwalter (1981). Cooking is carried out to destroy lipid enzymes and extend shelf life, to simplify food preparation, and to improve digestibility. The processed cereal component for WSB contains a combination of either cooked bulgur flour or cooked straight grade flour and cooked wheat protein concentrate. Instant CSM contains corn meal that is fully cooked in an extruder to achieve a high degree of shear. This results in a food material that constitutes low-viscosity, high-caloric-density gruels or highly soluble beverages. Clinical studies with young children by George Graham at the British-American Hospital, Lima, Peru, concluded that instantizing resulted in a greatly improved nitrogen digestibility and retention. The soy flours are defatted and toasted by methods described by Bookwalter (1981) to ensure destruction of anti-nutritional factors. Refined soybean oil is used, except for WSDM, which requires partially hydrogenated soybean oil to provide maximum stability. The added vitamins and minerals shown are stable forms that do not interact with other components of the food system.

Blended Food supplements are manufactured to comply with USDA quality standards. Product requirements are similar for the corn and wheat-based blends: 10 or 11% moisture, 19 or 20% protein, 6% fat, and 2 to 2.5% fiber. Particle size is slightly finer for Instant CSM and WSB than for CSM. WSB also limits ash content and requires a minimum 0.9% available lysine content to minimize heat damage. CSM and Instant CSM must also meet consistency requirements to ensure proper degree of cooking. The protein and ash requirements for WSDM are about the same as for the other three; fat is 19% and fiber is slightly lower. WSDM contains 3.25% maximum moisture to minimize changes that could result from nonenzymatic browning. All of these products must have normal odor, color, and flavor; are readily dispersible; contain
not more than 50,000 bacteria/gram and be salmonella negative. In 1981, 197 thousand metric tons of Blended Food Supplements was donated for international feeding programs.

DISTRIBUTION AND UTILIZATION

Annual Title II food donations currently go to about 80 countries in Africa, Asia, and Latin America. Among the largest recipients have been India, Bangladesh, Egypt, and the Philippines. Recent large-scale food shortages due to drought and refugee-related disasters have also resulted in large requests for emergency food assistance, primarily in Somalia, Kampuchea, and Pakistan. In 1982, approximately 1.7 million metric tons of food will be exported under the Title II donation program.

International food aid has several forms, such as relief to victims of natural disasters or feeding programs targeted toward small children and pregnant or nursing mothers who may have special nutritional needs. School feeding programs that promote education are also important recipients. Food assistance supports food-for-work projects with benefits in the form of roads, schools, health clinics, or irrigation projects to support agricultural productivity.

The beneficial impact these products have had on overcoming malnutrition and health-related disorders have not gone unnoticed by governments of the more developed countries. Protein Grain Products International (PGPI, 1982), a non-profit organization based in Washington, D.C. represents the manufacturers and suppliers of these products. Food technologists, nutritionists, and government officials in a number of countries are working closely with PGPI to incorporate processed, fortified, and blended foods in a variety of government-sponsored nutrition programs.

In Chile, the Government contracts with local food companies to supply school feeding and other institutional feeding programs. These firms are importing CSM and USB from the United States. Both products have high nutritional value and proven acceptability records during the years when they were a regular part of the food donation program.

In Syria, laboratory and commercial baking tests utilizing 10% Instant CSM in biscuits were recently carried out with excellent results. The Government of Syria now plans to produce the ICSM-fortified biscuits in volume. This program is part of a concerted effort to nutritionally upgrade the diets of the Syrian people. If large-scale production and sales are successful, marketing will be expanded to include exports to neighboring
countries in the Middle East. Similarly, the governments of Kuwait, Yemen, and Egypt will be kept appraised of the Syrian nutrition project to determine whether the ICSM biscuit should be produced for local consumption in these countries.

For a number of years, a nutri-bun made from SFBF has been the cornerstone of the Philippines school lunch program. Served daily, each 150 gram nutri-bun provides 500 calories, 18 grams of protein, plus vitamins and minerals. The popularity of the nutri-bun is enhanced by the ease with which it is baked and distributed.

In Jamaica, the Government has given high priority to a national nutrition policy aimed at improving the diets of school children and the health and well being of malnourished children and pregnant and lactating mothers. To accomplish their goals, SFBF is being imported to produce a baked roll for daily mass distribution to the nation’s schools. CSB, SFB, and SFQM are also imported for distribution to government health clinics.

REFERENCES