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INFANT CEREAL FROM QUALITY PROTEIN MAIZE

by Ricardo Bressani, Ph.D.

Quality protein maize (QPM) was the name given to a genetically improved maize because of the nutritional quality of its protein(1). Common maize is an important cereal grain for many people in Latin America and Africa. It contains, on average 9.5% protein, 4.5% fat, 70% total carbohydrate, and 350 calories per 100 g. The protein in common maize contains an average of 170 mg lysine/g N and 48 mg of trytophan per g N. These amino acids have been shown to be deficient in studies of children.

In contrast, QPM has a gross chemical composition similar to that of common maize, but the levels of lycine and tryptophan are much higher. QPM contains 256 mg of lysine/g N and 78 mg of tryptophan/g N. Besides the significant increase in both essential amino acids, the essential amino acid pattern of QPM is superior to that in common maize. The significant difference in the content of both lysine and tryptophan as well as the better essential amino acid balance are the reasons why when fed to children at physiological levels of protein and energy intake, QPM has resulted in improved biological quality over common maize in all metabolic studies which have been conducted (2). From the result of these studies, a weaning food can be formulated consisting of processed QPM 90-95% and 5-10% vegetable oil. While QPM's protein content (8.5% to 9.0%) is less than some commercial infant cereal foods (16% protein; 370/100g calories), it is still superior in nutritional value to common maize. Infant foods should also be supplemented with Ca, P, Fe, B-vitamins, and Vitamin A.

As early as 1959, a number of high quality protein foods were developed and tested by INCAP to be used to feed children and eventually produced industrially. These foods were made from balanced mixtures of cottonseed flour (CSF) or soybean flour (SBF) with 50% protein and common maize, as well as with other ingredients so as to maximize that essential amino acid content and balance from the ingredients. They have been produced in Guatemala since 1960 and are known by the name of INCAPARINA.

Studies have been conducted to learn of the effect of replacing common maize with opaque-2 maize in the INCAPARINA mixtures(3). For mixture of maize and human-grade CFS, the protein value when using common maize was 64% of the value of casein and with QPM this value increased to 75%. The mixture containing 38% SBF and 58% maize has the protein value of 80% for common maize and 78% for QPM. These values were expected due to the fact that soybean protein, as in QPM, is a rich source of the essential amino acid lysine. A mixture containing 19% CSF and 19% SBF with 58% maize showed a protein quality of 72% with common maize and 89% with QPM. Other studies showed for example a mixture of 22% CSF, 50% QPM, and 28% sugar to have a protein value of 88% of casein (an international protein standard) with 16% protein. Likewise, a mixture of 19% SBF, 76% QPM, and 14% sugar with 16% protein had a quality equal to that of casein. One made with dehulled beans 20% and 80% QPM for a 12% protein mixture had a quality about 92% of casein.

Processed QPM has also been studied when mixed with milk (4). In one study for example, QPM had a protein value of 62% milk protein. However, when mixed in blends in which QPM provided from 20-60% of the protein of the blend and milk from 40-80%, the protein quality value increased to 92% of the value of milk. From these studies, various blends were formulated. For example, one contained QPM flour 69%, skim milk 26%, and 5% vegetable fat; another blend was made up of 45% QPM flour, 50% skim milk, and 5% fat; and a third, 29% QPM flour, 66% skim milk, and 5% vegetable fat.

These three formulations, in practical terms, had the same protein digestibility and protein quality, but with 15.5, 21.7, and 25.8% protein respectively. All had the same energy content but lactose levels were lower with lower levels of milk. All needed to be fortified with minerals and vitamins. Mixtures of 50% rice, barley, and wheat flour with 50% QPM flour have a higher protein quality than the cereals fed alone to the contribution of lysine and of theronine of QPM to the mixture. Lysine will increase about 17% for rice, 31% for barley, and 42% for wheat flour.

The greater benefit of QPM in weaning food formulations will be achieved when mixed with protein sources low in lysine. However, the protein content can be increased through mixtures with other high protein sources. Finally, QPM lines are available for production with yields not different from those obtained with similar common maize varieties.

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SRI LANKA: CARE-THRIPOSHA PROGRAM

by Carol Chang

The nutritional supplement, "Thriposha" is a household word to virtually all Sri Lankans. Since the introduction of the product almost 20 year ago, the name has become synonymous with good nutrition and maintains a strong positive image as an inexpensive, convenient and popular food product. This image has been further strengthened by education and health services which have been incorporated into the program to achieve a beneficial nutritional impact.

HISTORY

In the early 1970s, a nutritional survey was conducted in Sri Lanka which documented the health status of the country's women and children. The study's findings highlighted the seriousness of malnutrition in Sri Lanka: 425 of all preschool age children suffered form moderate (Grade II) or severe (Grade III) malnutrition. Additionally, at least one-fourth of the country's pregnant and lactating women were classified as anemic. The Thriposha Program began as a joint effort by Sri Lanka's Ministry of Health and CARE to combat such nutritionally-at-risk infants, preschoolers, and pregnant and lactating women. The U.S. Government provided support in the form of PL-480 commodities. Moreover, the program sought to incorporate an entire package of services, including nutrition education and a health program to control infections and combat the country's nutritional problems.

THRIPOSHA COMPOSITION

Initially, 95% of the ingredients in Thriposha were donated by the U.S. government under PL-480's Title II. Over the years, the formula has been modified several times to improve its quality and to increase locally produced components of the product. As of 1990, Thriposha's formula consisted of 52% PL-480 commodities, 47% locally produced maize and rice, and 1% vitamins and minerals.

The product is distributed principally to pregnant and lactating mothers, medically selected undernourished children up to 5 years, and infants between 6-12 months. When the program began in 1973, only 75,000 recipients were reached. Today, 580,000 malnourished mothers and pre-school children receive Thriposha monthly as part of several services provided at local health clinics in rural and urban areas.

INCREASE IN PRODUCTION

The use of extruders in the production of Thriposha enabled the program to grow to its present dimensions. The low-cost extruder technology reduced processing costs of this distinctive product and produced a centrally processed blended product with excellent acceptability. After the feasibility of the extrusion cooking process was demonstrated, the Sri Lanka government (GOSL) and CARE decided in 1980 to build a factory near Columbo. At present, 870 MTs per month are produced to meet the 580,000 target beneficiary level.

ASSISTANCE FROM SUSTAIN

To avert a shortfall of the product in coming years, CARE proposed that the cooking capacity of the factory be expanded. CARE asked SUSTAIN to furnish a technical consultant to evaluate the factory expansion plans, including checking and commissioning the new extruder and associated machinery. SUSTAIN identified a technical consultant to perform these duties. In November 1990, Mr. Don Bittner (Bittner Engineering International, Irvine, TX), an expert in extrusion systems, was sent to review the factory plans and install an Anderson 8" extruder. The consultant was commissioned by CARE, with travel expenses paid by SUSTAIN. Due in large part to Mr. Bittner's work and professionalism, improvements on the factory's processing capability have been successfully completed.

FUTURE

The Thriposha Program has evolved from a feeding program which relied exclusively on U.S. donated commodities to a program where a substantial contribution to the product is locally grown and processed foods. CARE is presently turning over its involvement in the Thriposha Program into the capable hands of the GOSL and the Ceylon Tobacco Company. CARE has tried to ensure the successful continuation of the project by completing basic plant improvements, training factory personnel, and by providing a supply of critical spare parts to ensure smooth operation of the plant in coming years. Furthermore, CARE has helped improve the Ministry of Health/CIC monitoring and reporting capability by providing computer hardware for Thriposha Unit offices.

CONCLUSIONS

Since the GOSL-CARE collaboration began almost 20 years ago to produce Thriposha, the program has had both successes and difficulties. Overall, the program has demonstrated the feasibility of incorporating local commodities and processing in a supplemental feeding program. Further, the Sri Lankan experience shows that low-cost, easy-to-operate technology that is compatible with a country's capabilities, can make a significant contribution to reducing malnutrition.

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Perspectives

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base and blended with malted flour or green gram. Vitamin and mineral premix is added in required quantities. The protein content can be improved by adding non-fat milk powder, depending upon the intended use (target population).

In Ghana, fermentation of maize dough has been demonstrated to be an effective method to reduce bacterial contamination of weaning foods. This technique is being explored as a means of improving preservation of weaning foods. It is believed that the diarrhea-causing bacteria cannot survive the acidic environment formed during the fermentation process. This reduces the risk of contamination by germs and prolongs the storage period of the foods.

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