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REVIEW OF THE FOOD TECHNOLOGY FOR DEVELOPMENT
(RSSA #BST-0831-R-AG-4207-00)

February 1990

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Bureau for Science and Technology
Office of Nutrition

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List of Acronyms and Abbreviations

The following acronyms and abbreviations are used throughout this report. They are presented alphabetically for convenience.

Agency for International Development	AID
Asia/Near East Bureau	ANE
Catholic Relief Services	CRS
Ceylon Tobacco Company	CTC
Colorado State University	CSU
Corn-soy-blend	CSB
Corn-soy-milk	CSM
Food & Agricultural Organization of the United Nations	FAO
Food for Peace and Voluntary Assistance	FVA
Food Science and Technology	FST
Government of Sri Lanka	GOSL
Helen Keller International, Inc.	HKI
Low-cost extrusion cooking	LEC
Mother and Child Health Center	MCHC
Paddy Marketing Board	PMB
Participating Agency Services Agreement	PASA
Project Paper	PP
Policy Planning and Evaluation	PPE
Resources Support Services Agreement	RSSA
Bureau for Science and Technology	S&T
Soybean Foods Research Center	SFRC
Texas A&M University	TAMU
United Nations Children's Fund	UNICEF
A Mission to Agency for International Development	USAID
USDA/Office of International Cooperation and Devel.	USDA/OICD
Victoria Associated Products	VAP
World Health Organization	WHO

1.0 BACKGROUND AND OBJECTIVES

1.1 Introduction

In 1966, a Resources Support Service Agreement (RSSA No. BST-0831-R-AG-4207-00) was established between the Bureau for Science and Technology, Office of Nutrition (S&T/N) and the USDA, Office of International Cooperation and Development (USDA/OICD) to assist the Agency for International Development (AID) to solve nutrition problems in developing countries by providing scientific, technical and planning expertise. The general purposes of the RSSA were:

> to provide technical assistance to AID field missions, private voluntary organizations, and others in support of the utilization of food technology in nutrition-oriented activities, and
>
> to develop new food technologies for use in priority AID-supported programs.

Specifically, the agreement stated that the purpose of the RSSA was:

> "to assist the developing countries in identifying developing and introducing indigenous low-cost nutritious foods, and improving the feeding practices of children, and pregnant and lactating women. . . The technical assistance effort has been designed to provide support to the USAID Missions and the developing countries they serve in: (1) identifying and advising on specific food science and technology problems; (2) identifying associated problems in consumption behavior; and (3) assisting in the design of the projects in these areas."

The project activities have emphasized technical assistance for the development, production, distribution and utilization of processed low-cost nutritious weaning foods; and the fortification of foods with vitamins and minerals (particularly, with vitamin A). Other activities were also undertaken for the development of new products and processes. A number of requests have been received and assistance delivered by USDA/OICD to:

(1) formulate and test food products;

(2) establish manufacturing facilities and procedures for developing target foods; as well as,

(3) develop marketing and evaluation strategies to promote food.

An evaluation of the management processes and program achievements under the USDA/OICD Food Technology Branch (FTB) RSSA was undertaken between May and August of 1989. This evaluation covers the period FY1983 through FY1988. As seen in the scope of work of the evaluation given in Appendix A, the evaluation was intended to:

(a) Assess the compliance with the objectives stated in the RSSA agreement;

(b) Identify the tangible and intangible final results achieved, including (1) reductions in the problem(s) being addressed, and (2) observable impacts on AID field mission programming, and on host country institutions and programs; and

(c) Assess the managerial and technical effectiveness of the entities involved in providing technical assistance, R&D, training and the like under the terms of the RSSA.

The basic questions which were to be answered by the evaluation were:

--Has the RSSA been designed, implemented and managed effectively by S&T/N and USDA/OICD to achieve the stated project objectives, and

--Is this approach focusing on the promotion of AID nutrition objectives through the application of food technology, the most effective way for AID to help meet the food science and technology needs of developing countries and simultaneously help achieve the Agency's nutrition objectives?

In addition, the evaluators were asked to prepare recommendations for a possible follow-up project that is attuned to current needs in developing countries.

1.2 The Evaluation Process

The evaluation was undertaken through a careful review of the project documentation such as RSSA agreements and amendments, project quarterly reports, AID strategy documents dealing with nutrition, technical reports prepared by the collaborators, trip reports, cable traffic, and selected memos and correspondence. A

major part of the evaluation was conducted through personal interviews with the project cooperators (USDA/OICD and its subcontractors), AID/W personnel in the Regional Bureaus, the staff of the Office of Nutrition, and Mission personnel who coordinated the efforts of the USDA/OICD staff and the host country institutions. The evaluation also included two overseas field trips and two domestic trips to review documentation and conduct interviews with representative program cooperators and participants (AID staff, host government agencies, private voluntary organizations, and private sector entities). The site visits which were selected by the Office of Nutrition to be reviewed for the period FY 83 through FY 88 were:

1. Sri Lanka (assessment of the production and distribution of the weaning food, Thriposha);

2. Indonesia (assessment of the vitamin A fortification of monosodium glutamate (MSG); its acceptance and distribution); and

3. Texas A&M and Colorado State Universities (assessment of the compliance with and effectiveness on established subcontracts with USDA/OICD for technical assistance).

These particular sites were selected because many of the activities of the project were centered around three general areas: (1) the development and manufacture of cereal-based weaning foods; (2) the design of new processes to fortify food products with vitamins and minerals; and (3) the research and development of the technological methods of food fortification. For example, throughout the project the USDA/OICD Food Technology Branch (FTB) assisted in the development of low-cost extrusion cookers which were adopted in a number of countries (Sri Lanka, Guyana, Guatemala, Colombia, Tanzania, Mexico and India) for the production of weaning foods for infants and young children. These foods are being marketed and distributed through private and public sector outlets (dependent on the particular country). The addition of vitamins and minerals to processed foods has been accomplished through iron and nutrient supplementation of wheat flour in Bangladesh and through the vitamin A fortification of food products (particularly monosodium glutamate) in Indonesia. Many of the research and development activities related to the fortification of food products were undertaken by university and private sector subcontractors to USDA/OICD.

1.3 Review Team

The evaluation team which was selected by the Office of Nutrition consisted of the following external reviewers:

1. Malcolm C. Bourne
   Professor, Cornell University
   Agricultural Experiment Station
   Geneva, New York 14456

2. John W. Erdman, Jr.
   Professor, University of Illinois
   Department of Food Science
   Urbana, Illinois 61801

3. Miriam H. Thomas
   Retired, US Army Natick Research & Development Laboratory
   57 Eaton Road
   Framingham, Massachusetts 01701

The team coordinated their efforts in Washington DC at an initial debriefing meeting with the staff at the Office of Nutrition, met jointly and separately with the USDA/OICD cooperators, conducted site visits separately and coordinated their efforts in finalizing their conclusions, recommendations and final report in a joint session. Professor Bourne was responsible for the site visit to Sri Lanka. Professor Erdman travelled to Indonesia to observe the impact of the technical assistance on Vitamin A fortification efforts. Mrs. Thomas conducted interviews with the university subcontractors to USDA/OICD, specifically Texas A&M University and Colorado State University. Throughout this work, the major responsibilities of the review team were to (a) assess the managerial and technical effectiveness of the cooperators in providing the assistance required, (b) determine whether private voluntary organizations were effective in providing assistance, and (c) evaluate the competence of the cooperators for developing tangible results and ability to provide technology transfer.

2.0 PROJECT GOALS AND ACCOMPLISHMENTS

This section contains a brief description of the objectives of the RSSA being reviewed as well as a synopsis of the technical assistance which was provided during the time period being reviewed(FY83-88).

2.1 Projects Goals

The broad project goals of the RSSA were to provide technical assistance to USAIDs, PVOs, and others to utilize food technology in nutrition-oriented projects; and to new food technologies for use in priority AID supported program. The original project paper was not available for review by the reviewers, so these goals were ascertained through the RSSA agreement and amendments. The majority of amendments 2-6 provided additional funding with little, if any, changes in the scope of work. Amendment #7 of the RSSA did restate specifically the scope of work for the time period FY87/88. The specific undertakings during these recent years were to place emphasis on the following subject areas:

(1) Weaning Foods

Provide technical assistance to USAIDs, PVOs and other entities to develop, produce and distribute processed low-cost nutritious weaning foods

(2) Food Supplements to Accelerate catch Up Growth after Episodes of Diarrhea

Undertake research and development for special processed supplements which potentially could promote rapid growth and reduce mortality rates following diarrheal episodes

(3) Vitamin A Fortification of Foods

Develop and test new technologies for fortifying foods with vitamin A; and provide assistance for the development and implementation of new operational programs

(4) Rice Bran Stabilization and Edible Oil Extraction

Conduct R&D on the extrusion cooker method of stabilization for rice bran as a method of recovering edible rice bran oil for food; and summarize results in the form of guidelines for rice processors.

(5) The Prevention of Diarrhea with Selected Food Ingredients

Conduct R&D on food ingredients and additives which held promise of providing effective and safe foods for the prevention of diarrhea in children

(6) Explore New Technologies

Identify new technological approaches to attacking priority food and health-related problems which are amenable to nutrition and food science applications

(7) Provide Ad Hoc Technical Assistance

Provide technical reviews and other forms of technical assistance in response to various USAID units, PVOs, and other entities in developing countries, in so far as these requests relate to AID priorities.

2.2 Project Accomplishments

During the time period under review(FY83 through FY88) and the time prior to 1983, the USDA/OICD staff assisted USAID Missions and host country institutions in five key areas:

(1) Processed Weaning Foods - to promote the use of weaning foods as dietary supplements for infants and young children(FY72--)[1]

(2) Vitamin A Fortification - to develop new methods to fortify food(including MSG, salt, etc.) with Vitamin A(FY73--)

(3) Rice Bran stabilization - to develop and field test extrusion-stabilizers to recover edible rice bran as a new food source(FY79--)

(4) Solar Box Cookers - to develop and test solar box cookers as means of cooking and preparing potable water using solar energy(FY84--)

(5) Child Survival - to identify innovative food technology approaches to support AID's Child Survival program(FY86--).

Examples of the above assistance are summarized briefly in the following pages. The

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[1] time period when the activity began to the present

synopsis is presented by technological area and geographical region and wherever possible, the synopsis has been presented chronologically.

Processed Weaning Foods

Africa

Zaire - advised the Organization for Rehabilitation through training and Victoria Assorted Products concerning manufacture and marketing of processed weaning foods(1986-87)

Sudan - advised the Food Research Center of the Ministry of Agriculture regarding the potential use of technology development for the manufacture of cereal-based weaning foods(1987)

- staff from Colorado State University travelled to the Sudan to assist in a study of the feasibility of producing a commercial weaning food using extrusion-cooking technology(1988)[2]

Asia/Near East

Kiribati - advised the Foundation of Peoples of the South pacific concerning weaning practices and the use of home prepared weaning foods (1983)

Egypt - assisted the USAID and Government of Egypt(GOE) to develop a project to produce weaning food supplements(1983-84)[2]

Sri Lanka - advised CARE concerning the production and marketing of Thriposha (1983-86) and advised USAID/Colombo and CARE regarding the expansion of the Thriposha factory to solve production problems(1987)

India - advised the Government of India concerning the processes for the manufacture of weaning foods in regional factories(1985)[2]

Latin America and the Caribbean

Costa Rica - advised CARE on the formulation of processed foods and operations of the LEC factory (1983)

Vitamin A Fortification

Africa

Zaire - provided information regarding the technology for fortification of salt with iodine to the Centre de Development Integral since the

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[2] partially funded by the Regional Bureau or the USAID Mission

Centre had identified goiter as a nutritional problem in rural areas (1986)

Asia/Near East

Indonesia - advised the Government of Indonesia to develop and implement a program to fortify Monosodium Glutamate(MSG) with Vitamin A (1983-86) and assisted in the first phase of implementation of the MSG fortification project in coordination with Helen Keller International(HKI)(1987-88)

Egypt - advised the USAID and Government of Egypt(GOE) concerning the feasibility of fortifying wheat flour with iron to help overcome iron deficiency anemia and to help design an AID-funded project to do so(1983-85)[3]

Bangladesh- assisted the Helen Keller International staff to review options to reduce vitamin A deficiency through fortification of food(1986-88)

Nepal - assisted the Seva Foundation to review options for reducing vitamin A deficiency through fortification of food (1986)

Philippines - sent samples of a rice enrichment premix for use in a proposed rice fortification project to the Food and Nutrition Research Institute in Manila(1987-88)

Latin America and the Caribbean

Jamaica - developed a proposal for fortifying wheat flour and corn meal with iron (1984)[3]

Haiti - provided information concerning the feasibility of wheat flour fortification to the Faculte d'Agronomic et de Medecine

Guyana - designed weaning food factory for Guyana Pharmaceutical Corporation,assisted in the procurement of equipment, and assisted with installation of equipment and training of operators (1986)[3]

Other activities

Wisconsin - a prototype for "white" Vitamin A to fortify MSG was developed by The Coating Place, Verona, Wisconsin. This product helps to prevent the discoloration of MSG by the normal, "yellow" colored vitamin A. This work was done in conjunction with one of the key subcontractors, Iowa State University. (87)

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[3]partially funded by the Regional Bureau or the USAID Mission

Salt Fortification - technology to fortify salt with vitamin A have been unsuccessful because the Vitamin A loses its potency rapidly when mixed with salt. Samples of vitamin A encapsulated lipid materials were studied at Iowa State University

Botswana - assisted the World Food Program in a study to undertake the feasibility of domestic production of corn-soy-milk(CSM) to replace imported CSM which is now being provided through the PL480, Title II program.(1988)

Rice bran Stabilization

Asia/Near East

Philippines - evaluated the technical and financial feasibility of rice bran stabilization using extrusion cookers and transferred stabilization technology to the National Food Authority (1983-87)

- advised termination of the effort due to major changes in the government, particularly within the host country institution, the National Food Authority(1987)
- prepared a report on the lessons learned from the limited work in the Philippines concerning rice bran stabilization (1987-88)

Solar Box Cookers

USAID Missions/PVOs- made contacts to assist in the development of the R&D required to demonstrate technology in field tests(1986-87)

Southern University of Baton Rouge- USDA/OICD staff assisted in the preparation of a proposal to design a project to adapt the use of solar box cookers for use in developing countries as a means of cooking food and destroying pathogens in drinking water. Southern University submitted the proposal to AID for funding consideration to be tested in Sierra Leone on a pilot basis.(1987)

- the adaptability of solar box cooker technology is being tested in the Sierra Leone under funding by AID/S&T/RUR

Child Survival Activities

Bangladesh- discussed alternatives to improvement of oral rehydration solutions with the International Center for Diarrheal Disease Research(1986)

Virginia PolyTechnic Institution(VPI) - as a subcontractor to USDA, the Department of Food Science and Technology of VPI reviewed the literature, contacted experts, and prepared a report concerning

the potential for preventing diarrheal disease through the use of food ingredients(1986)

USDA/OICD - prepared a concept paper outlining the need for and potential benefits for a processed catch-up food for malnourished children who are recovering from diarrheal diseases (1987)

Other areas of development

Pakistan - a consultant from Colorado State University travelled to Pakistan to provide technical advice related to freeze drying and other methods of food dehydration(1987)

Workshops and Seminars

Table 1 summarizes the workshops and seminars which were attended by at least one staff member at USDA/OICD during the time period under review. The table also includes the presentations which were delivered at each workshop or seminar.

Table 1. Workshops and Seminars attended by USDA/OICD staff

DATES	WORKSHOP
Jan. 20-Feb. 3, 1983	International Vitamin A Consultative Group Dakar, Senegal Presentation:Update on Vitamin A Fortification of Food
Oct. 10-13, 1983	Iron Deficiency Anemia Workshop Cairo, Egypt Presentation:Potential for overcoming iron deficiency anemia by fortification of wheat flour
June 19-22, 1984	International Vitamin A Consultative Group Geneva, Switzerland Presentation-Working Group on Food Intervention
Nov. 15-17, 1984	Pan American Conference on Food Extrusion Chihuahua, Mexico Presentation:Worldwide Application of LEC to the Manufacture of Inexpensive Foods Presentation:Alternative Processing Technologies for Producing Precooked Foods
Dec. 10-14, 1984	OAS Technical Coordination Meeting Campinas, Brazil Presentation:The Role of Food Technology in International Development
Jan. 14-18, 1985	ACC/SCN Workshop on Food Aid Annapolis, Maryland Presentation:Phase Over of Food Aid Programs -Self-Targeting Foods -- A suggestion to improve effectiveness
Oct. 11-18, 1985	International Vit. A Consultative Group Hyderabad, India
Sep. 28-Oct. 2, 1986	International Vit. A Consultative Group Brasilia, Brazil Presentation:Cost-Effectiveness Analysis of Vitamin A Intervention
May 24-25, 1987	Catch-up Food Requirements Workshop

3.0 SITE VISITS

This chapter presents in detail the information which was gathered by the reviewers during their site visits to Sri Lanka, Indonesia, Texas A and M University and Colorado State University. These sites are intended to serve as illustrative examples of the technical assistance given by the USDA/OICD staff in support of the RSSA activities. The two international sites could be denoted as a "success case" (Sri Lanka) where the production of the weaning food has been taken over by the host country, and an "as yet to be determined" case (Indonesia) where the fortification product has been tested and determined to need additional testing prior to launching a large scale fortification program due to the product's imperfections. As noted in the previous section, these sites are by no means exhaustive of the accomplishments of the project in the time period being reviewed. They are presented in detail for illustrative purposes.

3.1 Sri Lanka

Prior to departure for Sri Lanka, briefings were given by senior personnel in S&T/N, USDA/OICD, Food for Peace (FVA) and CARE. Telephone briefings were given by Drs. Harper and Nichols from Colorado State and Texas A&M Universities respectively. Upon arrival at Sri Lanka, briefings were continued by officials in AID, CARE, Ministry of Health and the Ceylon Tobacco Co. Subsequently, visits were made to the Thriposha factory (twice), Mother and Child Health Centers (MCHC), clinics in a Colombo slum, (in the Kandy area), and a tea estate.

The Manufacturing Process of Thriposha

The procedure for making Thriposha (a weaning food for infants and young children) has been developed over the years; it is well known and needs no elaboration. Briefly, the plant is well laid out and appears to be operating well. The cleaned corn and soybeans are mixed and fed into two Brady extruders to cook the product and inactivate the antinutritional factors before grinding into a powder. The temperature of the material at the exit of the Brady extruder is 163°C. In the conventional process the powder is mixed with an equal quantity of imported corn-soy milk, and a vitamin-mineral mix is added. At present, the corn-soy-milk has been replaced by milk powder and the vitamin-mineral mix is not being added. The product is packed by hand into 750g polyethylene bags and thirty polyethylene bags

are packed into three-ply Kraft paper sacks for distribution. The outer paper sacks should be stamped with the date of packing and a batch number corresponding to the bin from which the finished product was drawn. This is a safety precaution. If ever a batch needs to be recalled for any reason, the code identifies exactly which sacks need to be returned and the remaining sacks can continue to move along the distribution system.

The quality control laboratory tests each batch for moisture, bulk density, consistency (after mixing with water), and particle size. The bulk density test would be more precise if the cup was overfilled with Thriposha, then levelled off by wiping a large spatula or other straight edge across the rim. The consistency test should use the USDA Consistometer because of its simplicity and cleanliness. Further, it will be easier to read from the concentric circles printed on the base of the equipment than from the ruled paper presently in use. The USDA consistometer can be purchased from J.B. Technology, P.O. Box 625, Vienna, VA. 22183 for $105.

The microbiology laboratory performs routine tests for molds, yeasts, and coliform organisms. If the coliform count is high a second test for Escherichia coli is performed. The technician in the microbiology laboratory reported that thus far all samples have tested negative for E. coli. The laboratory was established about three years ago in response to consternation about high counts of coliform organisms found in the imported corn-soy-milk (CSM) that was blended on a 50/50 basis with the material coming from the Brady cookers. This discovery of coliforms was distressful to all parties involved in the Thriposha program. The temporary substitution of milk powder for the imported CSM has resolved this problem for the time, and the plan to use corn-soy blend (CSB) instead of CSM in the near future is expected to prevent further problems.

The high level of concern about coliform organisms is not surprising. Coliform organisms in water indicate fecal pollution from human or animal sources that has been washed into the reservoirs with the rain. While most coliforms do not cause disease, they are probably accompanied by other pathogenic microorganisms that do cause disease. Coliform counts are therefore used as an indicator of fecal contamination in water and a high count is cause for concern. What is not so well known is that coliform organisms of non-fecal origin commonly occur in foods and hence the coliform count is not as reliable an indicator of fecal contamination in

foods as it is in water. For example, cereal grains, onions, and other foods frequently have high natural coliform counts from non-fecal sources.

Raw Materials

Thriposha is manufactured through a process of low-cost extrusion cooking using four key ingredients: maize, soybeans, milk powder and a vitamin-mineral mix.

Maize

The maize grown in Sri Lanka is procured through the Paddy Marketing Board. When it arrives at the factory, it is put through cleaning equipment to remove clumps of dirt, pieces of cob, stalk and leaves and any other foreign material and then stored in sacks. It is passed through additional cleaning equipment before going to the Brady extruder. There are two problems with the quality of the maize. The first problem is insects. The stacks of maize were infested with beetles, (probably the lesser grain borer) and there were swarms of moths hovering over some of the stacks. The stacks of maize were covered with tarpaulins and fumigated with Phostoxin (aluminum phosphide) periodically which is a good recommended practice. However, after the tarpaulin is removed, the swarms of moths will fly over to the just fumigated stack and reinfest it with their eggs. Consideration should be given to adding fogging to the godown(the storage facility) at the time of fumigation to reduce the level of flying insects and to prevent rapid re-infestation of the fumigated grain.

There is also a high incidence of insects (probably granary weevils) and insect-damaged grain in the light cull fraction coming from the vibrating stoner table. This fraction was re-worked and added back to the incoming stream. In view of the high number of insects, insect-damaged kernels and black kernels (see below), this fraction should be destroyed, not recycled.

The second problem is mold. Although there was no moldy grain, some of the kernels of maize are black in color. Black kernels could mean that mold had grown on the kernels at some earlier time even though no mold mycelia are presently visible. The presence of mold-contaminated kernels suggests the question of whether the mold might have been Aspergillus flavus, which could introduce a potent liver

carcinogen called aflatoxin. Aflatoxin is resistant to heat and it is unlikely to be destroyed when the maize passes through the Brady extruder. Since aflatoxin is such a serious health problem it is recommended that immediate steps be taken to survey Sri Lanka maize for aflatoxin levels. If the levels are found to be high, a comprehensive program of surveillance and testing for aflatoxin, and teaching farmers how to reduce the opportunities for growth of Aspergillus on their maize crop is paramount. As a first qualitative step, the maize should be inspected under ultraviolet light as a preliminary screening procedure because aflatoxin fluoresces greenish-yellow under UV light. The Seedburo Equipment Company, (1022 West Jackson Blvd., Chicago, IL. 60607-2990, tel: 312-738-3700) supplies a convenient laboratory unit about 2 ft. long x 1 ft. wide x 1 ft. high for inspecting corn on a white conveyor belt under a UV hood. The cost for the complete unit is $415.

The aforementioned procedure will have to be followed by chemical analysis for aflatoxin level. There are test kits for assaying aflatoxin. A number of consulting laboratories are equipped to perform aflatoxin assays. The corn should be tested for aflatoxin at the following points:

(i) at the point of receival
(ii) the main stream that comes from the scalper and stoner
(iii) after visually removing all the discolored kernels
(iv) after visually removing all fluorescent kernels
(v) the light cull stream that comes from the stoner.

The reason for testing the maize after it leaves the stoner is that there appeared to be a higher incidence of black kernels and damaged kernels in the light cull stream than in the main stream. When present, aflatoxin usually occurs in very high concentration on a few kernels and very low concentration on the rest of the kernels. Therefore, a representative sample of maize needs to be taken for aflatoxin assays to ensure there is a correct representation of the heavily contaminated kernels.

Soybeans

The soybeans are also procured through the Paddy Marketing Board. They are split and dehulled before going to the Brady extruders. There was no evidence of

insects, insect damage or discolored soybeans. However, there is a serious shortage of soybeans in Sri Lanka. On the first visit, the plant was not operating because there were no soybeans. On the second visit, the plant was operating with a 96% maize / 4% soybean mix instead of the targeted 70% maize / 30% soybean mix. Apparently an 85% maize / 15% soybean mix had been used over the last few months to extend the limited quantity of available soybeans. Mr. Adeyanayake, Coordinator of the Thriposha factory for the Ceylon Tobacco Company (CTC) said that he had recently been given permission by the government to buy up to 100 tons of soybeans on the open market. Because of the soybean shortage some experiments had been performed using maize only, and maize mixed with mungbeans, cowpeas, and other legumes. Since soybeans have twice the protein content, a higher grade of protein, and about ten times the fat content of other legumes, a strenuous effort is needed to procure adequate supplies of soybeans if the nutritional quality of the Thriposha is to be maintained. The winged bean is similar in composition to the soybean. If the winged bean ever becomes available in commercial quantities, it might be considered as a substitute for soybeans. Although mungbeans, cowpeas, and other legumes are beneficial they are poor alternative choices for soybeans in the Thriposha formula.

In a meeting with representatives from AID and CARE, it was calculated that 340 tons of soybeans are needed to keep the factory running on the 70% maize / 30% soybean formula until September. A small crop of soybeans is harvested in September but it will be insufficient to satisfy the requirements of the Thriposha operation. It was calculated that an additional 575 tons of soybeans will be needed for the period September, 1989 through March, 1990 at which time the major soybean crop will be harvested.

Milk powder.

Nonfat milk powder normally constitutes a small percentage of the Thriposha formula, but presently it comprises fifty percent of the formula because of problems experienced with the corn-soy-milk imported through the Food For Peace program. The powder is packed in 4 lb. cartons with a polyethylene liner. These cartons in turn are packed in larger cartons. The cartons and liners are opened by hand and the milk powder dumped into a hopper. This is a chore compared with using 50 lb. or 100 lb. multiwall paper sacks but it was the only available source of milk powder.

There was a dust problem when the 50% milk powder formula was first used but this problem is now under control. The empty milk powder cartons are bundled, stacked and stored in the godown awaiting resale. This large pile of empty cartons still containing traces of milk powder makes an excellent harbor for insects and rats to breed and infest the maize and soybeans stored in the godown. The empty containers should be disposed of promptly, or stored in another building.

Vitamin-mineral mix.

This mix is supposed to be added to the Thriposha to provide up to 100% of the daily requirement for a number of essential vitamins and minerals that are generally low in the normal diet. It is an important component of the total nutritional value of Thriposha. Currently, vitamin-mineral mix is not being added to Thriposha at the present time and it has not been added for several months. This is a serious debasement of the intended nutritional value of Thriposha and immediate attention should be given to procuring the vitamin-mineral mix and restoring Thriposha to its intended level of nutrients. It is hoped there will be no downgrading of the vitamin and mineral level of Thriposha when the manufacturing operation reverts to local control next year.

The Thriposha Factory and its Management

The factory which produces Thriposha is located at Ja-Ela which is a few miles out from downtown Colombo. The buildings are well constructed. The working floor is concrete about three feet above ground level. The walls are sealed to the floor and the roofs are adequate to keep out rodents and birds. There are no openings in the walls or floor that would allow rodents to enter. The grounds were clear of trash and other material that would form a nesting site for rats and no evidence of rat nests or rat holes on the property was seen. The general housekeeping at the factory is good.

The manager of the factory indicated that they occasionally have a problem with termites burrowing through the joints in the concrete floor and damaging the maize and wooden pallets. When this happens, they chip the cracks open, poison the termite nest and reseal the joints. No termites were seen during the visit.

In the godown (the storage facility), jute sacks of maize and soybeans are stacked directly on the concrete floor. Wooden pallets are needed to keep the sacks off the floor and thereby prevent moisture migration through the floor into the product and the free space would provide better penetration of the fumigant into the stored grain whenever fumigation was needed. It was stated that the boards on the pallets are narrow and spaced too far apart and this causes many of the jute sacks to be torn open when pallets are used.

Since it is recommended storage practice to keep the material off the floor for the reasons outlined above, it was suggested that the pallet construction be modified to prevent tearing of the sacks and that a sufficient number of pallets be provided to store all incoming material off the floor.

The Ceylon Tobacco Company (CTC) provides the management for the Thriposha factory under a contract with the Ministry of Health. Mr. Vernon Rodrico of CTC has been manager for some years. Though he has been praised for the quality of his management, he has been transferred to another operation effective June 1, 1989, and Mr. Kingsley Weerasinghe is the new manager. Mr. Raja Adeyanayake is the coordinator of the Thriposha program for CTC.

Mr. Adeyanayake stated that the Company considered the Thriposha program an important project for nutrition and national service and was happy to continue providing the management. The importance of the project in the thinking of CTC is attested to by the fact that all three persons (Rodrico, Weerasinghe, Adeyanayake) are among the most highly experienced and senior managers in CTC.

Distribution of Thriposha

A visit was made with Mr. Chandra Ranawickrama, a Field Coordinator for Thriposha, and Mr. Mohamed Zuhyle of CARE to clinics and small hospitals in the central mountain area. Mr. Ranawickrama coordinates the supply of Thriposha to 185 hospitals, 600 polyclinics, 200 tea estates and 40 non-government organizations that serve 200,000 recipients. Presently there are three field coordinators in Sri Lanka. A fourth coordinator is expected to be appointed in the near future.

Medical officers Drs. R.M.S.K. Amunugama, L.G.A. Dissanayaice, D.H.O. Wattegama, as well as nurses and other staff, operate a small rural hospital and a health clinic. Dr. Amunugama reported their surveys show that 23% of the population spend 80 percent of their income on food and still get less than 80% of the calories of the World Health Organization standard. Therefore, the free distribution of Thriposha makes a strong contribution to the health of poor mothers, their babies and preschool children. The clinics encourage mothers to come in when they know they are pregnant. If undernourished, the mother is given Thriposha throughout her pregnancy and lactation period. Many mothers are also given iron tablets because of widespread iron deficiency anemia. The mother is given Thriposha for her baby when it is weaned. Thriposha is provided to the child until it is 5 years old if necessary. Each 750g packet of Thriposha provides a 50 gram serving for 15 days for one child. The child is brought in every two weeks for another packet of Thriposha. Each month the child is weighed, and a weight chart is kept for each child for 5 years. The child is given shots and any other medical services deemed necessary. If the growth rate of the child slows down or the actual weight falls below a danger point,the mother is instructed how to feed the chiid to make it return to normal weight and rate of weight increase.

When the mothers come into the clinic, they are taught about nutrition, health care, child care and sanitation. Dr. Dissanayaice said it is difficult to get the mothers to come to the clinics without the reward of a packet of Thriposha. Their program uses Thriposha to improve nutritional status and also as an attraction to bring them in for training in health care. The instruction programs would reach far fewer mothers if Thriposha were not available.

In one clinic Thriposha was given to children about 2 to 4 years old. The dry powder was mixed with enough water to make a stiff dough, rolled into balls of 50 grams (dry weight). One ball in a small plastic bowl was given to each child. Each one ate the whole ball and gathered up any crumbs with their fingers. It was obvious they were used to eating Thriposha and liked it.

Mr. Denis Perera, Regional Welfare Coordinator for the Janatha Estate Development Board (JEDB) arranged a visit to the Hintane Group Tea Estate near Kandy. The manager, Mr. N. Wickramasinghe escorted us to a maternity hospital and two creches on the estate. This tea estate comprises approximately 2,500 acres. The

small children received their Thriposha in the form of a moist ball, and again each child ate it all. The mothers are given checkups and Thriposha during their pregnancy until the baby is weaned. The Thriposha is delivered once per month to the maternity hospital. The paper sacks are opened and plastic bags are distributed to the creches every two or three days.

The paper sacks of Thriposha were stacked on a simple woodframe with a slatted top about 15 inches off the cement floor. This is good storage practice because it prevents moisture diffusing through the floor into the product.

Mr. Wickramasinghe commented on how plump and healthy the children looked. He said that before the Thriposha program they were just skin and bone and 30% of the them died. The head nurse at the maternity hospital said they had delivered 101 babies in the previous twelve months and only one died.

Dr. Beatrice De Mel, Supervisor of the Thriposha Program for the Ministry of Health was escort to the Lasallian Community Education Services Center in Colombo, and to a clinic in a Colombo slum area. Again, children ate Thriposha with relish. Mothers had come to the clinic to get Thriposha and were weighed, given medical checkups, and instruction in nutrition, child care, and health care. Dr. De Mel said that mothers are encouraged to breast feed their infants for several months. They also encourage mothers to plan four years between births. They are given contraception services by injection every three months. After the birth of two healthy babies they are encouraged to have their tubes tied.

Before these health services were provided, the average poor woman would deliver seven to ten babies of whom half would die in infancy. Certainly, the health services i.e. Thriposha, medical care, and training, are having a beneficial effect on the health of the poor.

Future Plans

The capacity of the plant is scheduled to increase threefold in 1990 by installing new equipment. Mr. Henry, Director of CARE/Colombo said that a local contractor will be given the contract to install the new equipment. The contractor will be required to import three key items: 1) extruder; 2) the proportioner mill; and, 3)

two hammermills. The rest of the equipment will be fabricated in Sri Lanka. Mr. Henry said the tender for the new equipment will be finalized in July 1989 and the equipment installed and ready to operate by July or August, 1990.

The Government of Sri Lanka Tender Board has appointed a technical committee to advise it on awarding the contract for the expansion of the Thriposha plant. This committee is comprised of three representatives from the Ministry of Health, one from the Paddy Marketing Board, three from the Ceylon Tobacco Company and two from the Department of Agriculture. There are no representatives from CARE or AID on the technical committee. However, Mr. Henry said that CARE will review the contract before releasing the funds.

Mr. Henry said he would like to have the experience of the LEC group at Colorado State University available to help with the initial phase of design of the new plant and for the start-up of the new extruder. He pointed out that CTC is quite familiar with the operation of the Brady extruder but will have limited experience with the new extruder (which will not be a Brady).

Conclusions

The emphasis on the Thriposha program evaluation centered on the food technology component. The program was found to be successful in producing at low unit cost a highly nutritious food deliverable to the poorest undernourished segment of the Sri Lanka population. The food technology services provided by USDA/OICD's RSSA has been the key element to successful implementation of the Thriposha program. It is quite clear that many elements were needed for Thriposha to succeed and that the program would not have gotten off the ground without the inputs of the OICD food technologists, cooperators and contractors recruited to develop the process of the production and the marketing strategy. And so, this concept for simple low cost processing of inexpensive local agricultural commodities has resulted in an acceptable, nutritious food which eventually will be produced commercially on a large scale.

Interesting enough, no complaints were received about the color, flavor, texture, acceptability, functionality, packaging, off-flavors, insects, or spoilage of the product.

The Thriposha program has taken root and has become an acceptable part of the food culture of Sri Lanka.

The Thriposha program has made a formidable contribution to the nutritional status of poor pregnant and lactating women, infants' and preschool children. It provides a considerable incentive for mothers to report for prenatal care and checkups, and, to bring their babies for weighing, checkups and shots. Additionally, it provides an opportunity for MCHC to teach and give information on nutrition, health and sanitation. The fact that it has established a steady market for soybeans grown in Sri Lanka should not be overlooked.

Prior to the take-over of the Thriposha factory by the local management and the utilization of raw materials locally grown, certain strategies must be developed to prevent technical problems which may occur, as follows:

a) establish a tolerance level for the presence of aflatoxin in Sri Lanka maize used to manufacture Thriposha.

b) develop a recall procedure such as stamping each outer multiwall paper bag with the date and shift of manufacture in order to be able to withdraw contaminated batches and allow uncontaminated batches to continue along the distribution system.

c) provide short-term technical assistance when problems arise.

3.2 Indonesia- Vitamin A Fortification Program

One of the key areas of technical assistance provided by the USDA/OICD staff was in the development of Vitamin A fortified monosodium glutamate (MSG) in Indonesia. This site was also selected by the Office of Nutrition because the technical assistance had been given in the years between 1983 and 1989. The program encompasses several aspects of technical assistance; notable among them are assistance to USAID/Jakarta, collaboration with PVOs (Helen Keller International), development of a laboratory prototype conducted at Iowa State University and Wisconsin and the implementation of a large scale fortification program

At the request of the USAID Mission to Indonesia, the reviewer's trip was scheduled to coincide with the midterm evaluation of an implementation plan for fortifying MSG with vitamin A (Phase II being conducted by Helen Keller

International (HKI)). The HKI evaluators were: Dr. James Olson of Iowa State University; Susan Eastman, Director, Vitamin A Programs, HKI/New York; and Sukarno Noer, Division of Nutrition, Department of Health, Government of Indonesia. The local office of HKI arranged the schedule for the evaluator's visit in conjunction with the HKI evaluation.

During the site visit, interviews were conducted with personnel from HKI/Indonesia, the Government of Indonesia and the USAID Mission and the Maternal and Child Health Nutrition Unit. A side trip to the village of Cianjur, south of Jakarta was taken to observe MSG distribution in food stalls. The Miwon and Ajinomoto MSG factories were visited in Surabaya to observe plant operations and to receive feedback on the processing of the fortified MSG product (now called MSG-F by the manufacturers).

The MSG fortification program is a currently being implemented by the Nutrition Directorate in the Government of Indonesia with technical support from the National Nutrition Center in Bogor. Technical assistance and program assistance is being provided by Helen Keller International, with funding from AID/S&T/N and technical support from the staff from USDA/OICD, Iowa State University through the RSSA mechanism. The project is designed to produce and deliver vitamin A fortified MSG to up to 3 million Indonesians living in rural areas as an initial stage of a national program. The involvement of three manufacturers from the private sector, namely Ajinomoto, Sasa, and Miwon is essential to the success of the program. The RSSA has provided support for the development of the technology to be used in the fortification.

After many years of development, largely through the technical efforts of OICD and their subcontractors, and with considerable cooperation between HKI, the Government of Indonesia, the three MSG manufacturers, USAID, and Hoffmann-La Roche Inc., a prototype white MSG product was formulated. Phase I of the project, which was completed in 1986, demonstrated that fortification of MSG with vitamin A was feasible and effective. This phase was conducted in a small field in Bogar. Phase II expanded the target population to three districts, Cianjur in West Java, Bone in South Sulawesi and Sambas in West Kalimantan. Phase II is currently a feasibility study designed to identify technical aspects of the fortification process that would require modification prior to implementing the full national program.

Data are being collected from food stalls in all three districts to ascertain the effectiveness of the MSG-F distribution program and the stability of the product during actual market conditions. Prior to the implementation of Phase III, the data will have to be carefully evaluated to determine, what, if any, further development of the product needs to be undertaken. In 1989, an agreement was signed by the manufacturers to proceed to Phase III of the MSG fortification program.

In April of 1989, the initial packets of MSG-F were produced following successful installation of Patterson-Kelley blenders at each of the MSG plants. The distribution of MSG-F to food stalls began in June of the same year. At the time of the site visit, the reviewer observed that some of the MSG-F had reached local food stalls in Cianjur on July 11, 1989. The MSG-F in this survey region were primarily produced by the Sasa manufacturer. The reviewer observed that the quality of the product appeared to be excellent at this point, as determined by the appearance of the product, although they had not been in the market very long.

In some areas of the country, the Ajinomoto manufacturer received complaints related to "yellowing and clumping" of the product. Upon review of a few small samples, it was found that the Ajinomoto product did pick up moisture and yellow after 2-4 months. The product did not, however, lose its vitamin A potency. Given the current state of this technology, it should be recommended that the product not remain in the food stalls for more than one month (though this may not be feasible).

In order for the fortification activity to be a true success, the following technical areas need to be improved:

(1) Define quality standards for "whiteness" and conduct inspection at the Coating Place in Wisconsin prior to shipment of "white" vitamin A to Indonesia;

(2) Assess the exposure conditions (light, humidity, and temperature) in the local food stalls;

(3) Assess time that any single packet of MSG would remain on the shelf in each of the three provinces selected for Phase II;

(4) Assess the stability of MSG-F under food stall conditions as a function of exposure time for all three manufacturers' products;

(5) Conduct laboratory testing of the stability of the packaged product

determine by simulating the local market conditions of temperature, light and humidity;

(6) Reassess the technological methods of preparing "white" vitamin A particularly with regard to the "whiteness" and stability of the product;

(7) Study the water permeability of the sealed packages; and

(8) Explore alternative modes of packaging and sealing which might reduce the exposure of MSG-F to light and moisture.

Summary

This section presents some conclusions related to the specific food technology services provided under the RSSA by USDA/OICD. First, given the complexity of the management of this project through multiple agencies, notably, AID/S&T/N, USAID/Jakarta, HKI, the government of Indonesia, USDA/OICD, Iowa State University, and The Coating Place), the project is on schedule with respect to the objectives set forth by HKI. The reviewer did assess that improvements could be made in the strengthening of communications, particularly related to highly technical issues. Perhaps periodic meetings of the key technical and management staff and the technical advisors from Iowa State and The Coating Place would help to circumvent the technological problems prior to implementation of Phase III of the program (i.e. full scale national dispersement of the fortified MSG).

It is very clear that without OICD, and in particular Dr. Rod Crowley's persistent efforts, the white vitamin A fortified MSG product for Indonesia would not have reached its advanced stage of development; it may well have been substantially delayed, if not abandoned, along the way. The technical staff at OICD doggedly pursued the technical advancement of a difficult problem and facilitated the production of the prototype white vitamin A MSG which is now being tested in the field.

There are still some technical problems related to the stability of the product under field conditions to be resolved. This is not unexpected since the high temperatures, high humidity and light intensity in Indonesia are harmful to this labile vitamin. There is a need for continued technical assistance for this endeavor. The staff at OICD would be the most logical source of this assistance because of their long history of involvement in Indonesia. Setbacks may occur if the USDA/OICD

cooperators are not available for further assistance during the next 6 to 12 months, which is perceived as a critical time for the overall success of the program. With or without direct help from OICD, technological assistance must be provided by a donor agency during this development period. It is advantageous that in response to the above technical concerns, a team of three Food Technologists: Dr. Patricia Murphy (Iowa State), Harlan Hall (The Coating Place in Wisconsin), and Benjamin Borenstein (formerly of Hoffman La Roche/Nutley) were scheduled to travel to Indonesia between August and September 1989.

3.3 Texas A&M University (TAMU), College Station, Texas

Dr. John P. Nichols, Professor of Agricultural Economics and of Food Science and Technology, was the point of contact at TAMU and has been involved with USDA/OICD-RSSA's as early as 1974. Earlier studies in which he has been involved took place in Korea, Tanzania, Sri Lanka, and Guyana. These earlier studies have provided models for the integration of marketing and market research in nutrition intervention programs. Although these projects were initiated earlier, they have required recurring review and evaluation. As a cooperator, he participated in a study with Colorado State University (CSU) and the Food Research Centre (FRC) Khartoum, Sudan to investigate the expanded use of locally grown foods to replace imported products. His expertise was utilized to:

1) provide an assessment of market conditions for packaged consumer food products in Sudan,

2) develop the essential elements of a marketing plan for a proposed weaning food, and,

3) identify and define further consumer and marketing research required to improve and direct both product and market development efforts.

The conclusions drawn are summarized in a report dated 15 March-3 April 1988 entitled Feasibility of Production and Marketing of Indigenous Nutritious Foods by the Private Sector in Sudan by Harper, Jansen, Redenius and Nichols. They are as follows:

> "A significant commercial market potential exists. Its initial size may range from 1000 MT to 1500 MT per year once full production and distribution is achieved. Expansion beyond this level is possible but depends on many economic and marketing conditions.

"No clear product concept for a centrally processed, locally-produced, weaning food exists in Sudan. Development will require concerted marketing and consumer education efforts.

"The recently tested weaning food provides many desirable consumer characteristics. However, further testing of the refined product is recommended with a consumer acceptance test and in-house placement of a product in a representative sample of households large enough to identify differences among major market segments.

"An appropriate name for the product is needed and it is recommended that the name "Nasha" not be used because the current product concept has significantly different characteristics.

"It is recommended that the marketing plan for the product include the following considerations:

> Position the product as a relatively low cost nutritious cereal-based weaning food for infants and children from six months to 5 years.
>
> An integrated advertising and promotion program is needed with linkage to package design and overall product concept development. Instructions for preparation and use need to be developed and incorporated into the packaging design and advertising messages.
>
> Set the retail price at approximately LS 5.0 per 500g package.
>
> Develop a package with a high quality appearance consisting of paperboard exterior and a polyethylene bag insert; graphic design and printing should be consistent with the best domestically available in Sudan.
>
> Select distribution channels to insure a positive sales effort through extensive direct distribution.
>
> Further dimensions of the marketing plan should be developed by the private sector entity which is selected to carry out the project."

From 1983-1986, Dr. Nichols managed a contract (in consultation with Dr. Robert Weil (OICD/USDA)) with Kolassa & Associates to determine the available experience, the theoretical basis and behavioral and educational concepts required to design foods intended primarily for weaning age children. The results assisted in solving the problem of consumption of specialized weaning foods by non-target members of the household.

A similar analysis was proposed and planned by Dr. Weil in 1984 to utilize consumption data previously collected in Calcutta, India on a specialized dietary food with characteristics of a traditional self-targeting food. Again, Dr. Nichols was involved in evaluation of the proposal, providing suggestions on methods of analyzing household consumption data, examination of questionnaires and negotiating a contract with CARE to obtain partial analysis of the data. After examination of sample questionnaires from India, it was determined that the existing format would not provide the necessary information.

During the period 1985-1988 (under the direction of Dr. Fred Barrett, OICD/USDA), a survey was conducted on legume cooking and consumption. TAMU provided assistance in designing the questionnaire, the interviewer instruction sheets, and the Spanish and French translation for same. The purpose of the survey was to obtain information on the use of time and energy sources for cooking legumes in developing countries. The results would be used to design efficient cooking stoves and methods of preparation for legumes so that their consumption could be encouraged where energy sources are limited. A total of 210 household units were surveyed in five countries. Field work was performed by Catholic Relief Services (CRS) volunteers in each country and though responses were limited, the data were of good quality. TAMU edited and analyzed the data and now the information is being prepared for publication by Dr. Barrett.

For the period 1986 and 1987, meetings were held at TAMU with Dr. Nichols and management personnel from Victoria Associated Products (VAP), in Zaire regarding their investment, production, and marketing plans for a commercial fortified weaning food. Materials and an outline for a marketing guide were prepared by Dr. Nichols for the project personnel at VAP and the associated private voluntary groups. Interim reports on the project were reviewed and evaluated. Based on reports received, it was determined that VAP had a reasonable marketing plan and were following appropriate marketing practices to develop the weaning food, Cerevap.

TAMU participated in the development of the scope of work for low-cost extrusion cooking (LEC) to stabilize rice bran. Special concern was the inclusion of analyses of potential animal feed markets for defatted bran and the consumer market

for rice bran oil in the Philippines. However, domestic problems developed in the Philippines which resulted in the termination of studies of market and economic feasibility.

A current study is underway to identify recent trends in the movement of processed cereal-based infant foods into developing countries. Earlier studies have shown that import statistics are not always reliable, but are important in assessing the current and potential size of the market for LEC weaning foods. The data will be useful as a bench-mark against which internal statistical information can be evaluated. The analysis will be based on secondary data for the appropriate Standard Trade Identification Codes (S.T.I.C.) from the United Nations.

3.4 Colorado State University (CSU), Fort Collins, Colorado

Dr. Judson M. Harper and Dr. G. Richard Jansen are the responsible cooperators at CSU. Dr. Harper is Vice President for Research and Dr. Jansen is Head of the Department of Food Science and Human Nutrition. CSU is responsible for the development of low-cost extrusion cooking (LEC) and through USAID supported projects they have provided plant design, training and other technical assistance for LEC factories to make Thriposha in Sri Lanka, Cerex in Guyana, Lisha in Tanzania, and Nutrisoy in Costa Rica. The manufacture of Cerevap--a commercially distributed weaning food in Zaire and the development of an inexpensive sorghum-based weaning food in Sudan are based on LEC.

The Research Foundation and the Department of Agricultural and Chemical Engineering at CSU publishes a LEC Newsletter of which Dr. Harper is the editor. The Newsletter "summarizes activities on the testing and application of low-cost extrusion cooker for the production of nutritious foods and other food applications." The publication is made possible by a cooperative agreement between CSU Research Foundation and USDA/OICD, with funding provided by the AID/S&T/N. It is circulated all over the world on a twice-per-year basis. Articles focus on LEC technology developments and applications, extrusion type equipment and its costs and maintenance, alternative processing technologies and production of nutritious foods.

CSU has a new pilot plant, 1500 sq. ft. of floor space, designed to accommodate the operation of any type of extruder. The pilot scale extruders that are available

for testing include the Brady, Insta-Pro 500 and 2000, and the Anderson 4.5" extruder. The new facility was partially supported by USDA/OICD to further develop the concept of LEC technology. It will provide a more complete and typical process system for demonstrations and testing. CSU also offers short courses on extrusion and extrusion technology.

As indicated earlier, TAMU and CSU collaborated as a team, consisting of Drs. J.M. Harper, G.R. Jansen, J.P. Nichols and Mr. R.J. Redenius. The objectives were to:

1) "To estimate plant capital and operating costs and raw material requirements; and to describe operational planning, quality control and training procedures.

2) To evaluate the product's nutritional characteristics, potential product usages including its incorporation into an integrated maternal childcare program and product acceptability.

3) To develop a marketing strategy; to estimate potential sales, sale margins, distribution procedures, advertising and promotion activities and market research needs.

4) To determine conditions necessary for private sector interest in product manufacture, government position on investment and business incentives, general business climate and capabilities, and interest of private sector."

The team concluded that "there may be market potential for centrally processed weaning food if a concerted marketing program was undertaken. Special effort will be required to identify or establish a private sector firm, develop alternate products which can be produced in the LEC plant, design the plant, and develop the consumer weaning food market."

CSU has been exploring development of a prototype catch-up food to assist in rehabilitation of malnourished children following a diarrhea episode. The product being researched could possibly serve as a model for production in the U.S. for overseas distribution as well as for manufacture in developing countries, using locally available commodities. The product would be a precooked, cereal-based dry powder, intended for distribution in dry form for reconstitution as an instant gruel by adding potable water. A relatively high level of fat would be required to obtain a caloric density of 15 to 25% of the mixture's dry weight. Full-fat soy flour hydrogenated oils, addition of antioxidants, and the use of a carrier such as maltodextrins to

which oil would be added to create a more stable form of fat are other alternatives being considered to result in an acceptable product.

The Government of Sri Lanka (GOSL) has published a tender requesting equipment for expansion of the processing capability within the existing Thriposha factory. CSU has prepared a complete engineering design and specification document for use as an example. Four bids, at least, were submitted to GOSL on the project from engineering companies and suppliers of extrusion equipment from around the world. No specifics on the bids or when a decision is to be made are known.

Technical assistance was provided by CSU to the Cerex weaning food project in Guyana to enable the manufacturer to utilize locally grown corn and soybean in Cerex. Assistance included equipment to clean and dehull corn and soybeans, operator training, and spare parts for the new equipment. CSU has shown that extrusion is an appropriate technology. Costs of plant construction and production can be estimated to determine their feasibility for the area being considered. CSU's pilot plant can be utilized for training personnel. CSU strongly urges that market studies be performed before initiating production on a commercial scale. Additionally, nutritional standards must be considered if emphasis is placed on weaning foods.

Conclusions

A substantive evaluation has been made of the agreement between USDA/OICD and their cooperators at TAMU and CSU. Drs. Nichols, Harper, Jansen and associates have combined their special knowledge when appropriate to perform and accomplish the objectives stated in the RSSA. Problems have been experienced in some countries but even negative results can have a positive effect when lessons are learned.

Lacking in some countries was the capability to increase the production of a developed product for commercialization and/or the ability to provide adequate distribution to the target population. Further, the political climate was not always conducive to supporting the production and distribution of a successfully developed new food.

The design of the RSSA between USDA/OICD and S&T/N is intended to circumvent government bureaucracy and thereby allows USDA/OICD to have the capability to respond adroitly, properly, and promptly to requests, (particularly from the field). During the years the RSSA has functioned, USDA/OICD has established numerous contacts with professionals who are recognized in their fields and are willing to work with USDA/OICD to accomplish its mission. These conditions result in reducing the turn-around time for results.

Succinctly, there is an acute need for improved communication among the participants; i.e. within and among the Bureaus of the AID structure and between S&T/N and USDA/OICD. Improved monitoring of amendments to the RSSA is essential to prevent "overkill" and repetition of previous studies.

4.0 EVALUATION OF THE MANAGEMENT PROCESSES AND PROGRAM ACHIEVEMENTS

The evaluation section of this report has been divided into four subsections; compliance, responsiveness, tangible and intangible results and effectiveness.

4.1 Compliance with objectives of the RSSA

From what was available to and observed by the review team, it was felt that there has been compliance with the overall objectives of the RSSA Agreement. Four areas for special attention were listed in the extension document of the RSSA for the FY 1983 through 1985. (No document succeeded that Project Paper Revision No. 7 which was entitled "Nutrition and Food Technological Services Project for 1983 through 1985"). Those four special implementation initiative areas were: 1) Weaning foods, 2) Processed fortified foods and appropriate food technology, 3) PVO programs support and 4) Private sector involvement in nutrition activities.

The OICD staff seems to have provided appropriate support for each of these four areas. During any time point in the evaluation period the OICD food technology branch staff was active in numerous projects in several countries. For example, during the latest reporting period (July 1, through December 31, 1988) technical advice was provided to seven different countries on a variety of different technological subjects. In addition, solicited private companies assistance was ongoing to attempt to solve problems with rice, wheat, salt and MSG fortification. Other activities included production of solar box cookers, development of special catch-up foods and a more controversial project exploring the use of Streptoccus faecium M74, a probiotic microorganism, as a food ingredient to help prevent diarrhea in children. Thus, at any point projects were being initiated, ongoing or technical assistance support of some the programs was being terminated.

4.2 Responsiveness

A particularly effective attribute of the RSSA arrangement is the ability to obtain rapid response to food technological needs from S&T/Nutrition, AID Missions, PVO's and others. Not only was the food technology group from OICD responsive when needs appeared, all efforts were used to reply as quickly as possible to all the

requests. The OICD staff clearly placed priority on and took pride in rapid, clear and competent response upon inquiry or request. Clearly the line of communications were effective in this regard.

It was not possible to determine the timeliness of the reports since a delivery schedule of reports was not in the original RSSA nor its amendments. Given the documents that were given to the evaluation team, it appeared that the trip reports were written on schedule and many other reports were often printed without dates.

4.3 Tangible and Intangible Results Achieved

Much of the impact of the technology component on the overall program is not easy to quantify. In some cases, such as the Thriposha project, success is clear - a high quality, low-cost, nutritious food product is now available to numerous young children and poor mothers in Sri Lanka.

In other cases success is probable but not yet assured. For example, a white vitamin A premix was formulated to be blended with MSG to reduce vitamin A deficiency in Indonesia. This was a difficult project that required years of persistent efforts by the OICD's staff and consultants. The product is presently in test market in three provinces. Despite some technical problems, the chance for full success is very good.

Technical support efforts do not always succeed. Some projects are so novel and complex that technical solutions cannot be found within a reasonable time frame. Other projects do not reach successful completion because of non-technical constraints arising from political, economical, marketing, managerial and other reasons despite appropriate technical assistance. The list of unqualified successes during the period of this review is shorter than desired. Nevertheless, the team sensed an overall high level of competent advice in technical support for S&T/Nutrition, Country Missions, PVO's and others seeking support from the OICD/Food Technology Branch (FTB).

4.4 Technical and Managerial Effectiveness

The technical effectiveness of the OICD/FTB is perceived to be quite good. They have sought advice from appropriate private sector companies and individuals as well as from educational institutions. There is a pattern of seeking advice from the same educational institutions on several projects; however, those institutions have been responsive, productive and produce good results. In the future, some broadening of the resource base would be appropriate when seeking technical advice. Specific technical advice provided by OICD/FTB staff is viewed overall to have been of high quality.

The managerial effectiveness of the program is more difficult to assess. A new director was appointed last year following a period with an acting director. In recent years, intercommunications between S&T/N and the OICD/FTB were minimal and working relationships were sometimes strained. This has partly resulted from the loose management structure of the RSSA.

Regular meetings to allow planning between the grantee and the grantor were not held. No independent advisory committee was responsible for facilitating the smooth operation of the RSSA.

The last review of the program was conducted in 1985 and that was an internal review. No external review seemed to have been conducted on this RSSA. More external reviews and advice from advisory committees should occur in the future.

It is the impression of the review team that OICD/FTB and Rod Crowley in particular doggedly pursued the resolution of seemingly intractable food technology problems. They are perceived as being dedicated, honest and quick to react. On the other hand, the approach given to some issues has been single-minded and unyielding. In some cases this approach overcame road blocks and hurdles and led to success. In other cases, this approach was not successful. One must maintain sensitivity to people, ideas, and issues and be flexible in approaches to problem solving.

The value of continuing to work with the same groups or individuals because of their experience and historical perspective on the special problems of developing

countries is recognized. However, bringing new people into the problem-solving process could provide new advances and ideas.

5.0 FUTURE NEEDS AND RECOMMENDATIONS

Based on the conclusions drawn in the two preceding chapters, the reviewers saw immediate needs that should be taken into consideration by the Office of Nutrition and long term needs that should be addressed in the future. This section presents these needs and the recommendations made by the reviewers.

5.1 Immediate Needs

The Office of Nutrition has effectively used the food technology services provided under this RSSA to deliver nutrients in an acceptable form to many undernourished people in developing countries. It will continue to need food technology expertise if it is to maintain the momentum of the present intervention programs and continue the development of new programs.

The present RSSA terminated on September 30, 1989 and therefore the food technologists in USDA/OICD and outside contractors who have worked under this RSSA were seeking employment elsewhere. This reservoir of experience with LDCs and professional contacts throughout the U.S. will soon dissipate. Once dissipated, considerable time will be required to reassemble a team with equivalent experience which can tackle problems with a minimum of briefing and preparation. The devastating result will cause the Office of Nutrition to have no readily available expertise to resolve problems that have a food technology component.

Therefore, a bridging mechanism is needed to hold on to the present food technology expertise until a permanent in-house structure should be established.

5.2 Long-term Needs

AID is deeply concerned with essential human needs which include food, shelter and health. Food technology can provide substantial help in achieving the goals of delivering more food, better quality foods, safer foods, lower cost foods, acceptable and functional foods for specially targeted recipients, developing small scale industries for preserving perishable foods and processing convenience foods, and assisting food exporters to expand sales by achieving internationally recognized standards of quality.

Food technology expertise is needed all through AID, including:

Office of Nutrition (S&T/N)

Achieve functionality and acceptability in processed foods targeted for special groups; for example, weaning foods, "catch up" foods, and foods fortified with specific nutrients such as iron and vitamin A. Nutritionists can identify specific nutritional deficiencies in a given segment of the population but food technologists have the expertise to process, package and deliver a product that is acceptable, functional, safe and economical.

Office of Agriculture (S&T/AGR)

Reduction of post-harvest loses in perishable foods (fruits, vegetables, fish), semi-perishable foods (roots and tubers), and stable foods (cereals, legumes). The reduction of post-harvest food loses has the potential to make more food available throughout the country, keep the cost of food low, and reduce the need for imported food.

Directorate of Health (S&T/H)

Food microbiologists and toxicologists have the expertise to make fresh and processed foods safer by reducing microbial hazards and toxicants in foods. They provide an essential component in developing foods that alleviate diarrhea or compensate for diarrhea - induced malnutrition.

Office of Energy (S&T/EY)

Improve energy efficiency of food preservation and processing industries and home preparation of food.

Bureau of Private Enterprise (PRE), and Office of Rural and Institutional Development (S&T/RD)

Make food processing establishments viable by providing the necessary technical expertise thus adding value to rural agricultural products and creating jobs.

Office of Education (S&T/ED), and International Training (OIT)

Many people need to be trained in food technology to upgrade the quality of the food supply in LDCs.

Food for Peace (FVA/FFP)

Ensure that FFP commodities are adequately processed and packaged to provide food in a safe and acceptable condition.

Regional Bureaus

Each bureau and mission needs food technology expertise in every project that involves food.

In view of the extensive needs for food technology expertise throughout the Agency, the review team believes it is time to establish a central food technology group within the Agency that can communicate with all branches of AID. Because food technology is a broad field, it will be necessary to bring aboard a group of food technologists with expertise in different subfields to provide the knowledge and resource base adequate to fulfill the complex and varied objectives of the Office of Nutrition and the goals of AID.

5.3 Recommendations

The review team recommends for the consideration of S&T/N the following:

a) Provide staff capability in food science and technology on a permanent basis to maintain all inclusive responsibility for technical assistance to the AID missions.

b) Establish contacts with competent agronomists, agricultural economists, agricultural engineers, and other areas requiring specific professional assistance on an "as needed" basis.

c) Promote, plan, organize, and contribute to nutrition, food science and technology seminars which would provide new contacts, more positive visibility for S&T/N, and possibly result in new, fresh, viable ideas from peers.

d) Establish an Advisory Committee comprised of carefully selected persons, capable of contributing practical, realistic solutions and ideas in today's climate.

e) Provide time for "brain storming" and discussions of critical concerns with staff members within S&T, as well as other Bureaus of AID which may allow for better communication and develop indivisibility among staff members.

APPENDIX A SCOPE OF WORK FOR EVALUATION

A. The Contractor shall complete the following activities:

(1) Prepare a detailed draft evaluation protocol for review and approval by AID. The team shall participate in an orientation briefing with the AID Office of Nutrition prior to commencing the evaluation.

(2) Review project documentation, such as RSSA agreements and amendments.

(a) The most important recent amendment includes funding, under the Congressionally-mandated vitamin A earmark, to:

"Develop and test new technologies for fortifying foods with vitamin A and provide assistance for the development and implementation of new operational programs to utilize food fortification as a means of reducing child morbidity and mortality."

(b) AID policy and strategy papers dealing with Nutrition
(c) Project quarterly reports
(d) Technical reports
(e) Commissioned studies
(f) Activity concept papers
(g) Trip reports
(h) Selected memos and correspondence
(i) Cable traffic
(j) Project papers for 931-0831 and 936-5114
(k) Project paper for 936-5116 - Vitamin A.

(3) Conduct interviews with:

(a) Relevant staff in S&T/N and USDA/OICD
(b) Relevant staff at Colorado State, Texas A&M, and other universities, and cooperating institutions
(c) Key personnel in collaborating USAID field missions and host country institutions
(d) Key personnel in AID/W, the function of whose offices are pertinent to food science and technology, such as, selected members of the AID Nutrition Sector Council and Agriculture Sector Council

(4) Travel to visit U.S. cooperators such as Colorado State University, Texas A&M, and others, as necessary, for the purpose of conducting interviews and reviewing documents.

(5) Undertake two overseas field trips to Sri Lanka (production and distribution of the weaning food, "Thriposha", as an example) and Indonesia (the fortification of monosodium glutamate with vitamin A, as an example) to review documentation and conduct interviews with representative program cooperators and participants (i.e. AID staff, representatives of host government agencies, private food processors, private voluntary organizations, and others).

(6) Prepare and submit an evaluation report that includes the matters listed above.

(7) Discuss the evaluation findings with the AID Office of Nutrition.

APPENDIX B. PERSONS CONTACTED

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