SCN Working Group on Micronutrients: Information Sharing Template for 2006 and Earlier Activities

Table 1: Demographic Information

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Position	Staff Assistant

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Table 2: Measurement, assessment, monitoring and reporting micronutrient deficiencies

Geographic area(s) covered by this table	Thailand
Project Name (if relevant)	Efficacy of Elemental Iron Powders Used for Food Fortification

	Micronutrients															
	Iodine	Iron	Folate	Zinc	Calcium	Vit A	Vit B-12	Vit C	Vit D	Vit B-1	Vit B-2	Vit B-3	Vit B-6	Vit K	Vit E
Activities																
Fortification Technology Improvement for Nutritional Impact		x														

In January 2004, SUSTAIN, in collaboration with the Swiss Federal Institute of Technology - Laboratory for Human Nutrition (ETHZ) and Mahidol University, Bangkok, initiated a human efficacy study to compare the efficacy of a fortified wheat-based snack containing electrolytic iron, hydrogen-reduced iron, or ferrous sulfate monohydrate in improving iron status in Thai women with low iron stores. This efficacy study was the final phase of a comprehensive evaluation of iron powder efficacy carried out by SUSTAIN. The feeding trials were completed in 2005 and a report on the trial was published in the American Journal of Clinical Nutrition. Trial results are also presented in a Task Force Report on our iron powder efficacy evaluations, scheduled to appear in the International Journal of Vitamin & Nutrition Research early in 2007.

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Table 3: Food Fortification

	Micronutrients														
	Iodine	Iron	Folate	Zinc	Calcium	Vit A	Vit B-12	Vit C	Vit D	Vit B-1	Vit B-2	Vit B-3	Vit B-6	Vit K	Vit E
Commodities															
A. Enhancing the quality and formulation of blended/fortified cereal/legume products															
Wheat	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Maize	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Cooking Oil						X									
Complementary foods	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Milk (As part of Corn Soy Milk, Instant Corn Soy Milk, & Wheat Soy Milk)	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Soy	X	X	X	X	X	X	X	X	X	X	X	X	X		X
Bulgur		X			X	X				X	X	X			
Sorghum		X			X	X				X	X	X			
Activities															
Improving Delivery of Micronutrients in Fortified Products ***Strengthening Quality Assurance/ Quality Control*** ***Stimulating Industry Innovation***															
SUSTAIN is currently implementing a project to enhance the quality and nutrient profile of blended and fortified food aid products sent overseas through the U.S. government's Food for Peace program (PL 480). The two primary objectives for this project are to strengthen food aid commodity quality control and assurance systems, and to identify nutritional and functional parameters for commodity reformulations/new products that better address the needs of today's food aid recipients. As part of this effort SUSTAIN, with its team of nutrition, food science, quality assurance/control and product development specialists and advisors, is collaborating with stakeholder agencies to strengthen quality oversight in commodity manufacture, procurement and distribution. We have worked collaboratively with USDA to add rigor to product specifications as quality assurance tools, and are addressing problems with the multiplicity and precision of analytical methods used to test product compliance to specifications. Assays for vitamin A (a marker vitamin to assure correct addition of the vitamin premix) are particularly															

problematic. SUSTAIN conducted a round robin study of vitamin A assays (with 16 participating labs) and is evaluating options for improving precision and accuracy within and among labs, as well as the potential for combining the now separate vitamin and mineral premixes into one premix. A combined premix would require only one marker to verify premix addition, improving quality control and reducing associated manufacturing costs. Additionally, activities are underway to assess the quality of certain premix components.

As part of our work to improve nutrient delivery to vulnerable populations, we are evaluating the nutritional and functional parameters of fortified and blended commodities. Current formulations are decades old, and have not been updated to capture innovations in food science that might better address needs in the field. While the blended and fortified products were originally designed for young children, their impact has never been assessed. We surveyed private voluntary organizations and the World Food Programme about key factors influencing their selection of P.L. 480 Title II food aid commodities, their experience and satisfaction with commodities, and areas of interest for new products. We are assessing how common preparation and cooking practices affect the retention of micronutrients in fortified and blended food aid commodities and how dilution impacts energy and nutrient density (particularly for infants and young children). Based on this and other information we are generating recommendations on how fortified and blended commodities can be better formulated and/or how the current array of commodities can be expanded upon to better meet the needs of targeted vulnerable groups (i.e. infants and young children, pregnant and lactating women, and people living with HIV/AIDS). In addition to food aid programming, this information is expected to have relevance for the broad range of commonly consumed products in developing countries that are typically based on a fortified cereal, legume blend.

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Table 3 (continued): Food Fortification

	Micronutrients														
	Iodine	Iron	Folate	Zinc	Calcium	Vit A	Vit B-12	Vit C	Vit D	Vit B-1	Vit B-2	Vit B-3	Vit B-6	Vit K	Vit E
Activities															
B. Tortilla Project: Mexico & Central America															
Fortification & Dosification Technology Development															
Quality Assurance/ Quality Control		X	X	X						X	X	X			
Advocacy/Consumer Awareness															
Stimulating Industry Innovation															

SUSTAIN has been providing technical support and working collaboratively with stakeholders in Mexico and Central America to develop and introduce viable technologies for micronutrient fortification of tortillas, a major staple in the region. These technologies are designed for the fortification of tortillas made either with nixtamal flour or fresh masa, or a combination of the two. With the rapidly growing and now substantial market position of fresh masa (dough) production, SUSTAIN and its partners launched an initiative to develop fortification technology appropriate for the range of fresh masa production systems. This project has addressed the technical barriers to fresh masa tortilla fortification through the evaluation of liquid and dry premix options, research on micronutrient stability and organoleptic analyses of fortified tortillas. Micronutrient dosing systems appropriate (and affordable) for small-scale mill operations were developed and evaluated in scale-up trials in Mexican tortilla mills; the fortified products' nutrient profiles and acceptability to consumers were assessed with excellent results. With initial lab, pilot, and plant tests complete, we now have plans underway to run short-term and extended plant capability trials to fully evaluate the fortification technology, quality assurance and training methodologies in the small-scale mill operations. Additionally, to help stimulate consumer awareness and demand for fortified tortillas, we are working with local partners to develop and secure support to pilot a youth-oriented consumer awareness campaign on the benefits of micronutrient-fortified food. Through this campaign, we hope to improve the nutritional status of Mexico's children and youth, as well as aid small business development by increasing demand for fortified tortillas.

C. Iron Enhancing Technologies															
Fortification Technology Improvement/Development Stimulating Industry Innovation		X													
SUSTAIN assessed the nutritional impact and commercial potential of ingredient technologies that enhance iron absorption in milled grain products and other food staples. We commissioned scientific papers on five iron enhancing technologies: 1) sodium iron EDTA, 2) amino acid chelates, 3) encapsulated iron compounds, 4) phytate degradation, and 5) ascorbic acid. These papers were presented at a SUSTAIN hosted workshop in Washington DC in March 2003 and subsequently revised. The scientific papers, and a summary of workshop and other expert consensus on the iron enhancing technologies, were published in a Task Force Report, "Enhancing the Absorption of Fortification Iron," in the November 2004 issue of the International Journal for Vitamin and Nutrition Research (Vol. 74, No. 6). The report summarizes key issues associated with each enhancer as well as consensus recommendations about appropriate food vehicles for each enhancing technology. In addition, a cost analysis model was developed and published in the same issue.														

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D. Evaluation of the Bioavailability of Elemental Iron Powders Used for Food Fortification															
Fortification Monitoring and Evaluation Quality Assurance/ Quality Control Stimulating Industry Innovation		X													

This project was launched to address contradictory data on the efficacy of elemental iron powders—the most commonly used iron fortificants worldwide. Previously reported relative bioavailabilities for iron powder products ranged from 5-145%. These discrepancies and failures to identify samples studied discouraged fortification initiatives as planners grappled with question of which iron powder fortificants would be effective in alleviating iron deficiency. To address these concerns, SUSTAIN and its research partners rigorously evaluated the bioavailability of elemental iron powder fortificants in commercial use worldwide relative to ferrous sulfate (the standard most commonly used in iron bioavailability studies). SUSTAIN assembled a pool of all commercial elemental iron fortificants (available at the start of this project) allocated to the five different powder types based on production method. Structure by scanning electron microscopy and physical properties (particle size distribution, surface area, Fisher subsieve size, apparent and pycnometric density) were determined on all samples. Selected samples (one or more of each type depending on the cost of the assay) were then subjected to five screening procedures that have previously been advocated for predicting bioavailability in humans. Finally SUSTAIN, in collaboration with the Swiss Federal Institute of Technology - Laboratory for Human Nutrition (ETHZ) and Mahidol University, Bangkok, conducted a human efficacy study in Thailand to assess the impact of fortified snacks on iron status in women with low iron stores. This project demonstrated significant differences among iron powder products and yielded new information on the screening methods used to measure bioavailability. A Task Force report on project results was accepted for publication in the International Journal for Vitamin and Nutrition Research in November 2006 and will appear in early 2007.

In addition to the bioavailability study carried out by ETHZ and Mahidol partners in Thailand, SUSTAIN provided iron powder from its sample pool for human studies in China (Institute of Nutrition and Food Safety – CDC China in collaboration with ILSI) and for USDA (ARS Grand Forks - Human Nutrition Research Center). The feeding intervention for the China study was conducted among anemic school children in Nanyang City (Hunan Province). The USDA study was designed to assess whether the bioavailability of commercial elemental iron powders could be estimated by an isotope displacement method. The use of a common set of samples in different studies allows direct comparisons of research results.

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Table 7: Other Activities

	Micronutrients														
	Iodine	Iron	Folate	Zinc	Calcium	Vit A	Vit B-12	Vit C	Vit D	Vit B-1	Vit B-2	Vit B-3	Vit B-6	Vit K	Vit E
Activities															
Operational Research: Development of SUSTAIN dissolution method to predict the bioavailability of iron fortificants		X													
Data on human absorption of iron fortificants is difficult, expensive, and time-consuming to generate. Consequently, there is a critical need for a rapid, affordable, and replicable bioavailability screen that can accurately predict how well iron fortificants are likely to be absorbed from fortified food staples. Based on the findings from our Elemental Iron Powders studies, we developed a rapid laboratory screen for distinguishing potentially effective iron food fortificants from products unlikely to be adequately bioavailable. Preliminary data indicates that SUSTAIN's dissolution test has the potential to help identify optimal products; it would also have applications in manufacturing quality control. In the fall of 2006, SUSTAIN presented the dissolution method to an accrediting organization for validation and standardization. As response was favorable, further work will be undertaken to secure support needed to finalize the parameters of the method.														
Operational Research: Use of stable iron isotopes to evaluate the bioavailability of elemental irons		X													
Radioactive and stable isotopes are frequently used in applied nutrition studies as tracers to measure the absorption of minerals and trace elements in the human body. These isotopes have been used successfully to evaluate the bioavailability of soluble forms of iron fortificants, such as ferrous sulfate. Isotopes have also been used to evaluate the bioavailability of elemental irons, but questions have been raised about this application, as the isotopes are physically different from the commercial forms of poorly soluble iron they are used to assess. These differences (in particle size, shape, porosity and surface area) could potentially lead to differential absorption rates. Using scanning electron microscopy, SUSTAIN explored how stable iron isotopes may differ from commercial powders. SUSTAIN's findings suggest that results obtained from stable isotope studies which measure the absorption of elemental iron powders should be interpreted cautiously.														