

Soy Protein

Applications in Nutrition & Food Technology

Dr. Karl Weingartner and Bridget Owen

National Soybean Research Laboratory

University of Illinois at Urbana-Champaign



National Soybean Research Laboratory (NSRL) Vision

- University of Illinois
- Research Facility for the Industry
- Public and Private Partnerships
 - Managed Research Areas (MRAs)
 - Education and Training
- International Outreach
 - Fulfilling the service mission of the University
 - Research-based outreach when international is the unit of analysis
 - Malnutrition, economic development, and sustainable value chains



Training and Education

Soy Processing

Soy Dairy

Entrepreneurship

Nutrition Education

Soy in Meat Applications

Soy in Baking Applications

Biodiesel

Soy in Local Cuisine



Soybean Processing and Utilization Training



- University of Illinois
- Soybean Processing
- Soy in Meat, Dairy,
- Baking Applications
- Extrusion Technology
- Consumer Marketing



Email: nscates2@illinois.edu

Web: www.nsrl.uiuc.edu

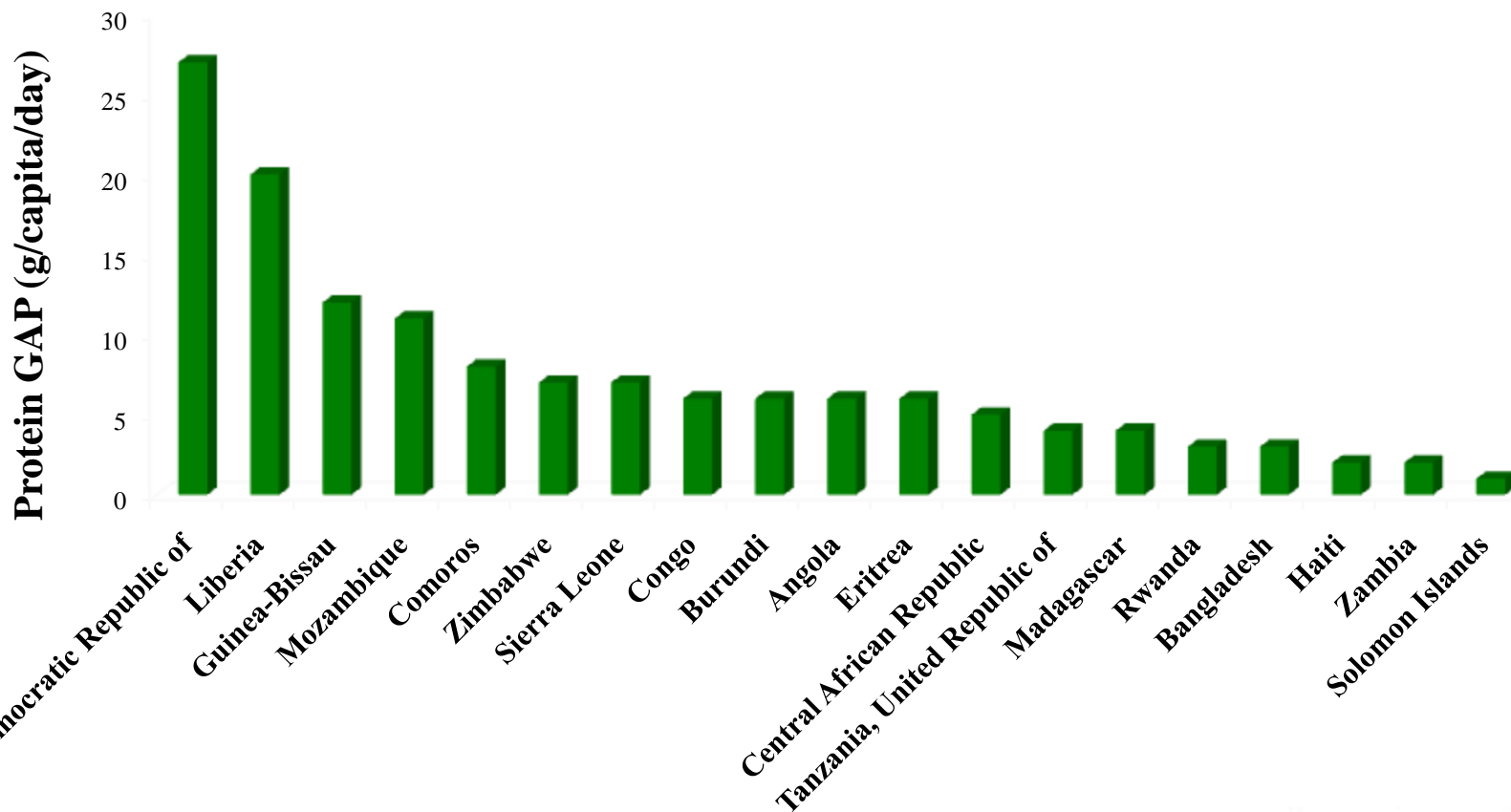
WISHH and NSRL



- Technical Resource for WISHH
- Provide training in processing, nutrition education, and develop culturally-appropriate soy applications for human nutrition
- Support for sustainable solutions
- Support for microenterprise development

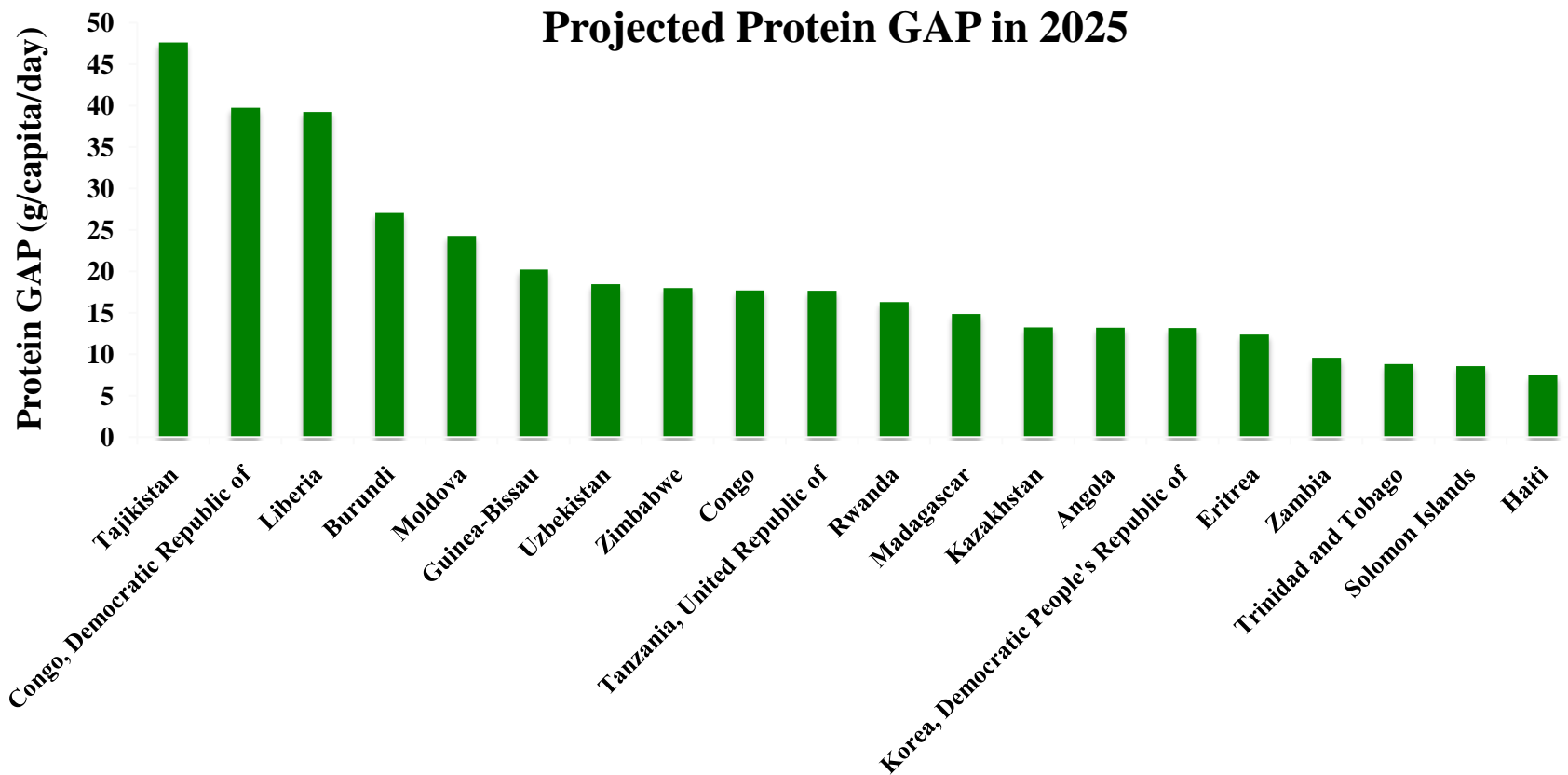
Protein GAP Across Countries

The Largest "Protein GAP" Countries in 2003



Sources: FAO, UN

What Is the Forecast for 2025?



Sources: FAO, UN

The Importance of Protein

- Maintenance of Body Functions
- Growth, Development at Crucial Points (Pregnancy and Lactation and the First Year of Life)
- Source of Essential Amino Acids
 - Change in Amino Acid Profile Affects Effectiveness of Dietary Protein Intake to Maintain Nitrogen Balance
- Health Maintenance and Disease Management
- RDI is Established Using Highly Digestible and High Quality Protein
 - Lower Quality Protein Means Higher Protein Requirements

Health Benefits of Soy Protein

Chronic Disease Prevention

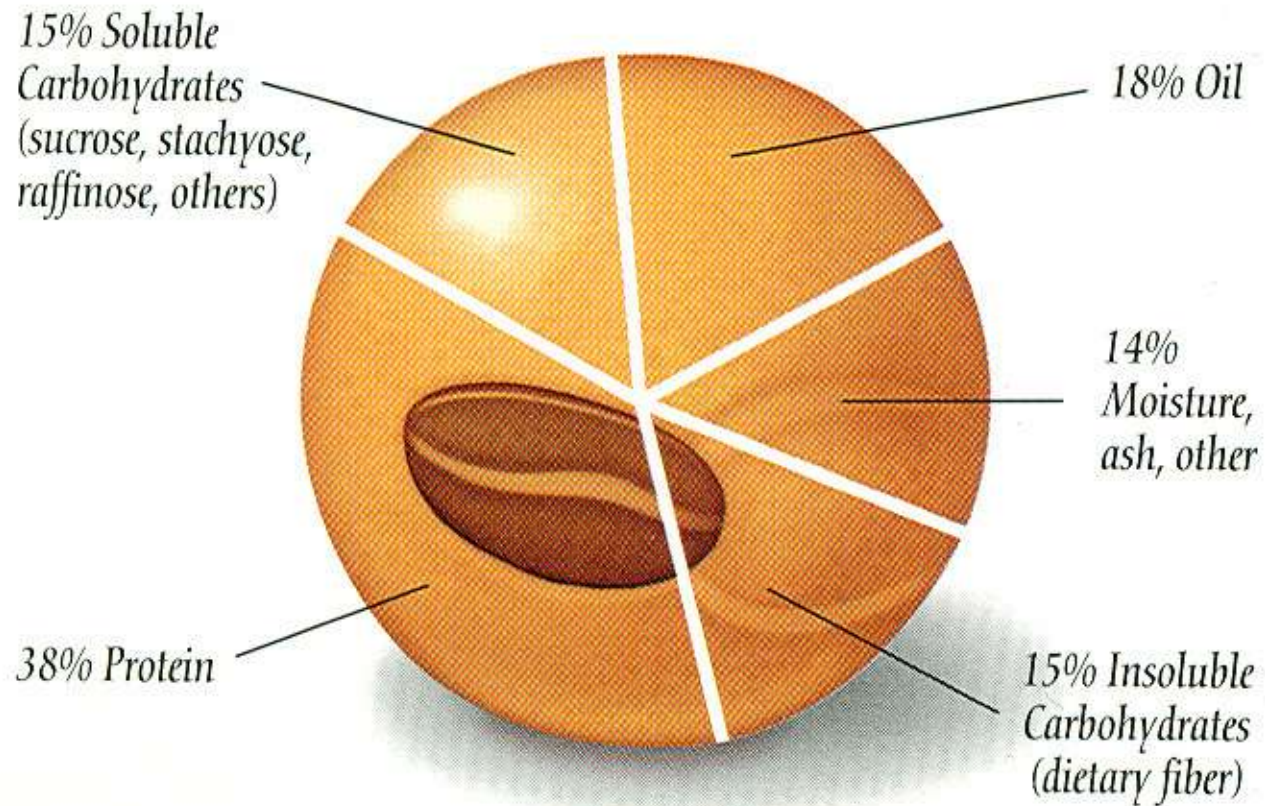
- Cholesterol – Heart Disease
- Hypertension
- Certain cancer
- Diabetes
- Menopause
- Osteoporosis
- Weight Loss



Soy Health Claims

- Heart Health (October 1999)
 - Diets low in saturated fat and cholesterol that include 25 grams of soy protein a day may reduce the risk of heart disease.
 - A serving of soy milk has 7 grams of soy protein
 - A serving of textured soy protein has 12 grams of protein
 - A serving of soy flour in a muffin has 15 grams of protein

Soybean Composition



Why Soy

Complete Vegetable Protein

Contains all Three of the Macro
Nutrients Required for Good Nutrition

Adaptable and Economical

Multiple Product Options

Soy Flour

Textured Soy Protein

Soy Milk

Whole Soy

Soy Protein Concentrate

Soy Protein Isolate



Why Consume Soy Foods

- Health
 - Nutrition and growth
 - Disease prevention
- Functional properties
 - Water absorption
 - Emulsification
 - Texture



Soy Improves Functional Properties of Foods

- Bland
- Absorbs Flavor
- Conditions Dough
- Emulsifies
- Increases Whiteness
- Improves Texture
- Retains Moisture
- Absorbs Fat
- Keeps Product Fresh for a Longer Time

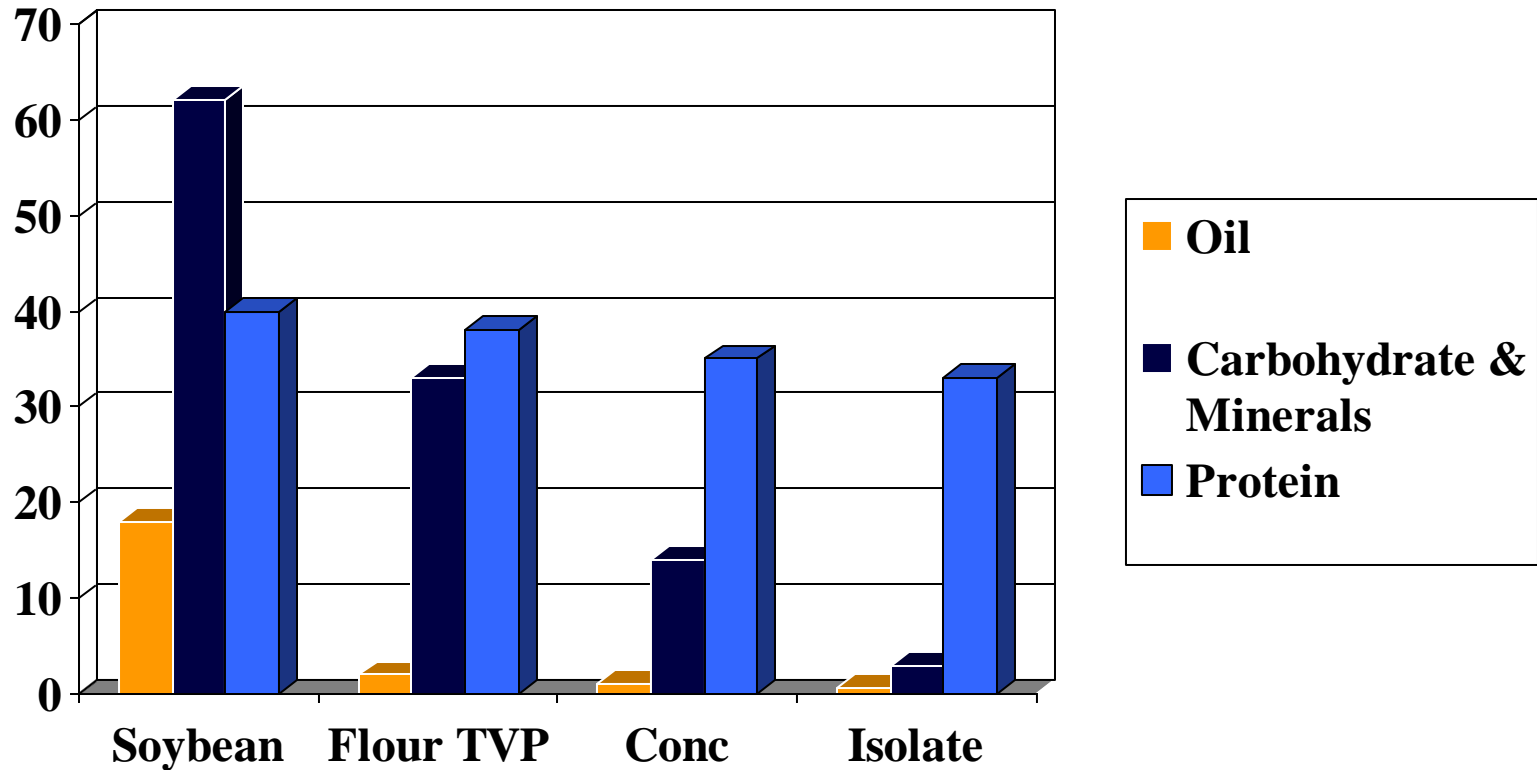


Soy Protein Products

- Soy Flour
- Textured Soy Protein
- Soy Protein Concentrate
- Soy Protein Isolate
- Soy Milk



Soy Protein Products



Soy Protein Products

Soy Flour



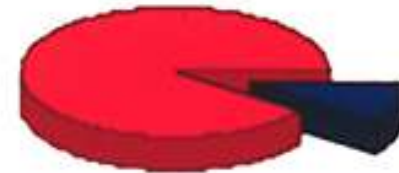
50% Protein

Soy Protein Concentrate



70% Protein

Isolated Soy Protein



90% Protein

Protein (moisture free basis)

Carbohydrate, lipid, vitamins, minerals

American Baked Products



Soy Protein
Ingredient:

- Soy flour

Functional
Properties:

- Improves whiteness
- Dough conditioner

Defatted Soy Flour

- Applications:
 - Weaning Foods
 - Cookies
 - Muffins
 - Cereals
 - Doughnuts
 - Dry mixes
 - Nan and Flat Breads
 - Ground Meat
 - Porridge and Gruel
 - Crackers
 - Breads
 - Cakes
 - Pastas
 - Tortillas
 - Soups and Sauces
- Shelf Life (minimum) of One Year



Textured Soy Protein

- Applications as an ingredient with:
 - Ground meat for patties
 - Sausage
 - Meat Loaf
 - in Vegetarian Foods
 - in Stews and Soups
- Shelf Life of One Year



Soy Protein Concentrate

- Applications in:
 - a Variety of Meat Systems
 - Baked Goods
 - and Specialty Items
- Shelf Life of One Year



Soy Protein Isolate

- Applications as an Ingredient in High Protein Foods Including:
 - Dairy Foods
 - as a Milk Replacer
 - Nutritional Supplements
 - Meat Systems
 - Infant Formulas
 - Nutritional Beverages
 - Cream Soups and Sauces
 - Snacks
- Shelf Life of One Year



Soy Milk

- Applications:
 - Beverage
 - to Produce Yogurt
 - to Produce Ice Cream
 - to Produce Tofu
 - in Soups and Sauces



Benefits of Soy Milk

- No Lactose
- No Cholesterol
- Low in Saturated Fat
- Low in Sodium



Composition of Soy Milk, Cow's Milk and Mother's Milk

Item/100 g	Soymilk	Cow's Milk	Mother's Milk
Calorie	44	59	62
Water (g)	90.8	88.6	88.2
Protein	3.6	2.9	1.4
Fat	2.0	3.3	3.1
Carbohydrates	2.9	4.5	7.1
Ash	0.5	0.7	0.2
Minerals (mg)			
Calcium	15	100	35
Phosphorus	49	90	25
Sodium	2	36	15
Iron	1.2	0.1	0.2
Vitamins (mg)			
Thiamine (B1)	0.03	0.04	0.02
Riboflavin (B2)	0.02	0.15	0.03
Niacin	0.50	0.20	0.20
Saturated Fatty Acids (%)	40-48	60-70	55.3
Unsaturated fatty acid (%)	52-60	30-40	44.7
Cholesterol	0	9.24-9.9	9.3-18.6

Quantity: Higher Protein

Commodity	Protein per 100 gms (in gms)	Calories per 100 gms (in Kcal)
Soy Flour (defatted)	52	290
Textured Soy Protein	52	270
Wheat Flour	10	360
Corn meal	8	370
Rice	7	360
Wheat Soy Blend	22	360
Soy Bulgur	18	340
Corn Soy Blend	17	380
Lentils	28	340
Peas	25	340

Protein Quality – Why Soy

Product	PDCASS Score
Egg White	1.00
Milk (Casein)	1.00
Beef	0.92
Soybean	0.90 – 1.00
Pea	0.73
Kidney Bean	0.68
Chickpea	0.66
Oats	0.57
Peanut Meal	0.52
Lentils	0.52
Rice	0.47
Corn	0.42
Whole Wheat	0.40
Wheat Gluten	0.25

Soy Added to Cereal Grains Improves Growth¹

Protein Efficiency Ratio

Cereal	Without Soy	With Soy ¹
Maize	1.0	2.2
Rice	1.9	2.9
Wheat Flour	0.7	2.0
Whole Wheat	1.3	1.9

¹Soy flour added to maize, rice, wheat flour, and whole wheat diets at a level of 8%, 8%, 10% and 8%, respectively.

Soy Protein Products: Cost

Product	Price (pound)
Soy Flour (defatted)	\$0.28
Textured soy protein	0.35
Soy protein concentrate	0.86
Soy protein isolate	2.00

Price Ratio

Product	Ratio (pound)	Ratio (pound protein)	
Soy Flour (defatted)	1.0	1.0	
Textured Soy Protein)	1.2	1.2	
Soy protein concentrate	3.0	2.4	
Soy protein isolate	7.1	4.3	

Reduced Cost

Product	Price (ton)	Price (pound protein)	Price (1000 Kcals)
Soy Flour (defatted)	\$620	\$0.54	\$0.21
Textured Soy Protein	\$770	\$0.67	\$0.28
Wheat Flour	\$230	\$1.02	\$0.06
Corn Meal	\$173	\$1.97	\$0.11
Rice	\$560	\$3.80	\$0.16
Soy Bulgur	\$360	\$0.90	\$0.11
Wheat Soy Blend	\$360	\$1.42	\$0.13
Peas	\$240	\$0.77	\$0.12
Lentils	\$435	\$1.16	\$0.22

Practical Applications of Soy Protein in WISHH Programs

- India
 - Textured Soy Protein in Rice Dishes
 - Soy Flour in Indian Breads and Sambar
- Mozambique
 - Textured Soy Protein as a Microenterprise Product
- Vietnam
 - Soy Milk and Tofu Production
- Tajikistan
 - Soy Flour in Flat Breads

Practical Applications of Soy Protein in WISHH Programs

Soy Flour with Micronutrients in FortiSoy™

Complementary Micronutrient Food for Infants and Children in Central America

Methods:

- Two products were developed containing calcium, iron, zinc, folate, vitamin C, and vitamin A.
- Soy flour was added to one of the products, while the other (the control) contained maltrin at similar caloric content.
- 2 scoops (26 grams) daily per child.
- Children aged 6 to 30 months were randomly assigned to the treatment group (n= 136) or control group (n=140).

Practical Applications of Soy Protein in WISHH Programs

Soy Flour with Micronutrients in FortiSoy™

Complementary Micronutrient Food for Infants and Children in Central America

Results:

- Both supplements were easily administered and acceptable to most participants.
- At one month, 87% of children on the control supplement and 88% of those on the soy supplement reported ongoing daily use.
- No allergic reactions were reported.
- Study to be completed this month and repeated in Summer of 2009.

Practical Applications of Soy Protein in WISHH Programs

- South Africa
 - Soy Protein Isolates in a Beverage
- Uganda
 - Soy Protein Concentrates in Baked Goods
- Haiti
 - Soy Milk and Mango Juice Beverages
- Ghana
 - Soy Milk in School Lunch Program

Thank You



National Soybean Research Laboratory

*Research, Outreach and Education supporting Soybean
Production and Nutrition*