HarvestPlus: Breeding Roots and Tubers for Better Nutrition

The needs and focus of human nutrition and biofortification: minerals and pro-vitamin A

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Shift of Focus from Energy to Micronutrients

1974 World Food Conference
1990 World Summit for Children
1992 International Conference on Nutrition
1996 World Food Summit
2002 World Food Summit: Five Years Later

Hidden Hunger Micronutrient deficiencies

- 250 million children worldwide are at risk of vitamin A deficiency
- 200 million people have goitre, 20 million are retarded as a result of iodine deficiency
- Nearly 2 billion people are iron deficient
- (Zinc deficiency)





Food intake in rural Bangladesh





Commonly Consumed Foods

- Poor population groups vulnerable to micronutrient deficiencies
- Food consumption patterns seasonality in food intake
- Increasing the micronutrient densities of the commonly consumed foods



HarvestPlus China

- Rice
- Wheat
- Wheat
- Orange fleshed sweet potato

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Nutrient Content in Foods as Eaten Bioavailability in Humans

Iron Content in Different Forms of BR11 Rice Variety

Rice forms	μg Fe/g
Paddy, non-parboiled	37.1
Paddy, parboiled	81.4
Brown rice, parboiled	9.0
Milled rice , parboiled	4.5
Cooked rice, parboiled, milled boiled in excess water	2.7

Factors related to nutrient bioavailability

- Forms of nutrient in a single food
- Processing
- Storage
- Content of nutrients and other components in a single cooked food, as eaten
- Bioavailability of nutrient in a single food in the everyday diet in population groups with micronutrient deficiencies
- Body store vitamin A

Components Affecting Bioavailability of Iron and Zinc

Enhancers of Bioavailability:

- Vitamin A
- Carotenoids?
- Inulin?

From other foods in the meal – vitamin C, animal protein

Inhibitors of Bioavailability:

- Phytic acid
- Polyphenols

Affects biofortification strategy

Methods to determine bioavailability

- Chemical analyses of nutrients, enhancers, inhibitors and other components in foods as eaten
- In vitro absorption studies
- Animal studies
- Test meal studies in humans
- Efficacy studies
- Effectiveness studies

Biochemical Indicators for Nutrient Bioavailability

- Blood haemoglobin concentration
- Serum ferritin concentration
- Serum retinol concentration
- Relative dose response and use of staple isotopes for vitamin A stores

High Iron Rice Efficacy Trial

- 9 months feeding trial in the Philippines completed
- Non-anaemic, iron deficient women
- Intervention (high iron rice) and control (low iron rice) groups
- Intervention: +1.5 mg Fe per day using undermilled rice basal intake of 8.5 mg Fe per day





Human nutrition studies: Bioavailability/Bioefficacy

1. Absorption of zinc from high zinc wheat

- Mexican women
- Two levels of extraction/ high and low zinc wheat
- 2. Bioavailability and efficacy of beta-carotene from orange flesh sweet potatoes
 - Bangladeshi women

 - Boiled vs. fried sweet potatoes (vs. beta-carotene capsule)
 Interactions: Effects of beta-carotene and change in vitamin A status on iron and zinc absorption
- 3. Bioavailability of iron from beans • Rwandan women

Acceptability and Preferences of **Commonly Consumed Foods**





Focus on the whole meal and everyday diet

Improving Human Nutrition

- Cognitive development in children
- Learning ability
- Pregnancy outcomes
- Work capacity



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