Challenges in the Development of Micronutrient-rich Food Ingredients from Soyabean and Moringa Oleifera Leaves

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Micronutrients Malnutrition

- Micronutrients are food ingredients needed by the body in small quantities for growth and functioning of the immune and reproductive systems.
- Micronutrient malnutrition = hidden hunger.
Causes of Micronutrient Malnutrition

- No single food contains all of the micronutrients
- Cereals are major staple food ingredients
- Cereal foods are generally low in micronutrients
Solutions for combating micronutrient malnutrition?

- Fortification of flours with micronutrients, e.g. iron, vitamin A, iodine
- Agricultural based therapies as cheap and sustainable methods
- Soya beans and moringa oleifera
  - *Could be best alternatives for combating Micronutrient Malnutrition and Protein/Energy Malnutrition?*
Which nutrients are in soya beans and moringa oleifera leaves?

<table>
<thead>
<tr>
<th></th>
<th>Protein</th>
<th>Fat</th>
<th>Vitamins</th>
<th>Minerals</th>
<th>Phyto-chemicals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soya beans</td>
<td>ca. 40% with all 8 essential amino acids</td>
<td>ca. 20% fat with high %-ge polyunsaturated FAs</td>
<td>Vitamin A (β-carotene), B-vitamins, E and K</td>
<td>sodium, potassium, magnesium, manganese, iron, copper, zinc, phosphorus, iodine, and selenium</td>
<td>Phyto-estrogens, isoflavones</td>
</tr>
<tr>
<td>Moringa leaves</td>
<td>ca. 6.7% (fresh); 27% (dry leaves) all 8 essential amino acids</td>
<td>ca. 1.7% (fresh); 2.3% (dry leaves) high %-ge polyunsaturated fatty acids (FAs)</td>
<td>Vitamin A (β-carotene), B-vitamins - B1, B2, B3, B6, choline, vitamin C, D, E and K</td>
<td>potassium, magnesium, calcium, manganese, iron, copper, zinc, phosphorus, iodine, sulphur and selenium</td>
<td>Phenolic antioxidants, e.g. flavonoids</td>
</tr>
</tbody>
</table>
Protein/Calorie of soya and moringa in comparison to other foods

Moringa and other highly nutritious plant resources: Strategies, standards and markets for a better impact on nutrition in Africa. Accra, Ghana, November 16-18, 2006
R&D Activities on: Development of Foods rich in micronutrients

- Aims to develop functional foods from indigenous plant materials
- Targeted plant materials are *soya beans*, *moringa oleifera*, and other indigenous underutilized plants
Targeted consumer groups

- All people, but especially risk groups
  - young children
  - pregnant and lactating mothers
  - People living with HIV/AIDS (PLWHA)
Can these plants provide required micronutrients?

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>1 - 3 yrs (RNI/day)</th>
<th>Pregnant (RNI/day)</th>
<th>Lactating (RNI/day)</th>
<th>Soya beans (100g)</th>
<th>Moringa (100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>10mg</td>
<td>27mg</td>
<td>15mg</td>
<td>7-8.6mg</td>
<td>7mg</td>
</tr>
<tr>
<td>Vitamin A, carotene</td>
<td>400µg</td>
<td>700µg</td>
<td>950µg</td>
<td>263-380µg</td>
<td>6800µg</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>30mg</td>
<td>50mg</td>
<td>70mg</td>
<td>0</td>
<td>220mg</td>
</tr>
</tbody>
</table>
Is it possible to produce foods rich in micronutrients from these plants?

<table>
<thead>
<tr>
<th></th>
<th>Soya beans (100g)</th>
<th>Moringa (100g)</th>
<th>Soymilk (100g)</th>
<th>Soya-moringa foods (100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>7-8.6mg</td>
<td>7mg</td>
<td>0.58mg</td>
<td>???</td>
</tr>
<tr>
<td>Vitamin A, carotene</td>
<td>263-380µg</td>
<td>6800µg</td>
<td>3µg</td>
<td>???</td>
</tr>
<tr>
<td>Vitamin C</td>
<td>0</td>
<td>220mg</td>
<td>0</td>
<td>???</td>
</tr>
</tbody>
</table>
The processing should satisfy the conditions that the nutrients are not damaged and the food quality is preserved during processing and storage.
Required qualities for SoyaMoringa food products

- Solid foods (powder/flour, etc.)
- Beverages/drinks

Qualities for Consumers
- Safe
- Nutritious
- Tasty
- Stable shelf-life
Impact of Processing Operations on Food Quality

- Loss of sensory characteristics (texture, flavour, aroma, shape and colour)
- Loss of water-soluble nutrients (minerals, water-soluble vitamins and sugars)
- Degeneration of lipids to form a wide variety of undesirable or toxic compounds
- Destruction of heat-labile vitamins, amino acids and lipids
- Destruction of oxygen-sensitive vitamins
Challenges - **General**

- Variability of soya and moringa leaves off-notes
- Interaction of soya and moringa leaf compounds (Biochemistry of soya and moringa)
- Geographic / origin of soya and moringa leaves
- Food formulations and process
- Packaging
- Acceptability by consumers
Challenges ➔ Stability of minerals

- Minerals relatively stable than vitamins
- Their bioavailability affected by heat, light and air
- Copper, iron and zinc react with protein and carbohydrates
- Minerals lost in soaking and blanching processes
Challenges ➔ Stability of vitamin A

- Vitamin A sensitive to atmospheric oxygen in the presence of trace minerals
- Unstable at acidic conditions (pH < 5)
- Susceptible to oxidation in air
- Inactivated by UV light
- Relatively stable in heat processing
Challenges ➔ Stability of vitamin C

- Unstable in air in the presence of moisture and metal ions e.g. Cu, Fe, Zn
- Unstable in alkaline conditions (pH > 7)
- Unstable in acidic conditions (pH < 4)
- Lost during blanching (up to 30%)
- Lost during pasteurization (up to 25%)
Approaches

- Study the effects of processing methods on the nutritional and sensory qualities of soya-moringa foods (flours and beverages)
- Study the influence of acidity (pH) on the stability of vitamins A and C in soya-moringa beverages
- Initiation of the collaborating partnership between SMEs, government and university to commercialize and transfer technology
Effects of processing methods on the beverages

- Variability in nutritional composition
- Variability in sensory qualities
  - Texture, flavour, aroma, colour
- Variability in shelf-life
Effects of processing methods on the flours

- Variability in nutritional composition
- Variability in sensory qualities
  - Texture, flavour, aroma, colour
- Variability in shelf-life
Studied Processing methods

- Drying by biomass dryers
- Soaking soya beans
- Blanching
- Grinding and mixing conditions (co-grinding)
- Pasteurization
Dar es Salaam Functional Foods and Nutraceuticals Cluster

- Micro, small and medium scale food processors
- Farmers
- Government ministries, municipal councils
- Equipment manufacturers
Food products by cluster members

- **Functional foods**
  - Flour, powder, beverages (juices, milkshakes, breakfast cereals, pasta, instant porridge, nutritious bars).

- **Nutraceuticals**
  - Extracts
  - Tablets, capsules
Collaborators

- University of Dar es Salaam – Chemical & Process Engineering Dept., Applied Microbiology Unit
- Department of Pediatric Muhimbili Health Centre
- Tanzania Food and Nutrition Centre
- SMEs – StayFit Nutrisupplies, Abantu Foods, Tupo Women Group
- Crop Promotion Dept. Ministry of agriculture food security and cooperatives
Opportunities for SoyaMoringa Foods

- Increasing health consciousness among consumers and concern about their dietary intake;
- New research on the links between diet and health, including the prevention of chronic disease;
- Ageing populations in many countries prone to degenerative disorders such as cancer, heart disease, osteoporosis, diabetes and stroke;
- Growing pressure on public health spending, leading to a greater emphasis on prevention and more individual responsibility for health;
- Changes in the regulatory framework.
Thank you!