



**Formulation of Quality Protein Maize (QPM) Based Nutritionally Improved Complementary Food (CF): The case of Shebedino Woreda, Southern Ethiopia**

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**Abstract**

**Background:** Protein Energy Malnutrition (PEM) and micronutrient deficiencies are the most common forms of under nutrition in children in Ethiopia. The purpose of this study was to assess indigenous knowledge on CF preparation and formulation of nutritionally improved QPM based CF.

**Methodology:** Fifty six households with children aged 6-24 months selected purposely from Shebedino woreda, SNP were studied. The households were producing maize, teff, sweet potato and legumes. Two focus group discussions were conducted to assess the knowledge gap with local mothers and experts. Before CF development, flavor optimization was done in seven different blending proportion of QPM: chickpea using sensory evaluation. Porridge prepared from 50:50 and 60:40 QPM and chick pea blend were selected using 30 panelists. Based on that, 72gm of 50:50 or 60:40 blend of raw, germinated or soaked QPM and chick pea, 18gm of OFSP and 10gm of red teff were used for CF formulation. The 72:18:10 formulations were based on the Recommended Daily Allowances (RDA) for children aged 6-24 months. The 2x3 factorial design was used and the effect of blending proportion and processing method on nutrient composition, anti-nutrients and functional properties were studied. Sensory evaluation of porridge was done at the community and laboratory level and viscosity was measured at 15%w/w concentration.

**Results:** Traditionally, CFs are prepared from maize and ensent (bulla) in the form of thin porridge. A knowledge gap on nutritionally improved CF preparation was observed. Addition of 50% chick pea on QPM is accepted using a flavor optimization test at the laboratory level. Increment in chick pea content in 72:18:10 formulated complementary flour, slightly increased protein, fat, zinc and iron contents and reduced viscosity of complementary porridge. Germination and soaking improved CF by reducing phytate, tannin and viscosities. All CFs prepared in this study are accepted at laboratory (6.25 to 6.80) and community (3.47 to 4.20) level using nine point and five point hedonic scales respectively, but lower acceptability was observed in CFs prepared from germinated or soaked QPM and chick pea.

**Implications for policy and practice:** All CFs prepared in this study satisfy the minimum RDA for energy, protein and 2/3 of RDA for iron and zinc. QPM based CFs prepared from 72:50:50 of germinated QPM and chick pea is best on nutrient content, bioavailability and functional properties. Nutritionally improved CFs can be prepared from a blend of QPM, chickpea, Orange Flesh Sweet Potato (OFSP) and red teff.

**Introduction**

Women, children and elderly are most frequently observed to be malnourished. The most common forms of malnutrition in Ethiopia are protein energy malnutrition (PEM), vitamin A deficiency, Iodine deficiency disorders, and iron deficiency anemia.

The weaning period is the most critical period in a child's life as infant's transfer from nutritious and uncontaminated breast milk to the regular family diet; they could become vulnerable to malnutrition and disease.

According to preliminary study made on some households of Shebedino woreda, Sidama zone, complementary foods are prepared from cereals and/or root crops in the form of thin porridge which limits the total food intake by the children. Furthermore, Foods prepared from cereals or legumes are high in anti-nutrients which can decrease nutrient availability.

The current price of cereal based commercially produced complementary food (CF) is beyond the purchasing power of most of the population in Ethiopia.

Hence, this study focused on surveying indigenous knowledge and skills at Shebedino woreda related to CF preparation and formulating nutritionally dense locally available CF in order to minimize PEM, vitamin A deficiency and iron deficiency anemia.

**General objective**

To develop complementary food from blend of quality protein maize, orange fleshed sweet potato, chickpea and red teff.

**Methodology**

Phase I: fifty six mothers-child pairs purposively surveyed from remeda and tereessa kebeles which was supported with two focus groups in Shebedino woreda, southern Ethiopia from June 1 to July 30, 2012.

Phase II was focused on laboratory and community based experiments to formulate QPM based nutritionally improved CF in two parts from September 1 to December 30, 2012.

The first part was optimization of QPM-chickpea blending of flours using sensory evaluation (flavor parameter) tools at Hawassa University, SNFST laboratory using nine point hedonic scale.

The second part was formulation of QPM based CF preparation by taking 72% of selected (50:50 or 60:40) of raw, soaked or germinated QPM-chickpea blending proportion, 18% OFSP and 10% red teff.

The composition (72:18:10) of QPM-based complementary food ingredients for this study was based on the minimum RDA of energy (370kcal/100gm), protein (10.9gm/100gm), 2/3 of the daily requirement for iron (4.67g/100g) and vitamin A (270µg/100g) for children aged 6-23 months old respectively.

The analysis were carried out at Ethiopian Public Health Institute, Hawassa University and at Shebedino Woreda, Southern Ethiopia.

**Experimental design & Data analysis**

Factorial (Completely randomized design for proximate, anti-nutrients, β-carotene, minerals and functional properties data and randomized completely block design for sensory evaluation data) experimental design 2x3 (blending x processing) was used to formulate QPM based complementary foods.

The data collected from complementary flours and porridges were subjected to two way analysis of variance (ANOVA) by using SAS 9.1 software. The mean separation values were determined using Fischer LSD test. Significant differences were defined at p<0.05.

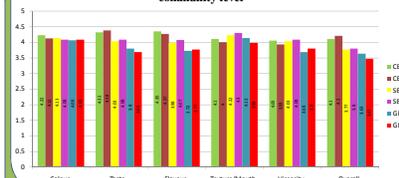
**Results**

- The proportion of mother's illiteracy on this study was 48.2%.
- In the present study, 80.4% of mothers were housewives, 46.4% of families owned 0-0.5 hectare land and 32.1% of families had monthly income within range of 500-1000 Ethiopian birr.
- A range of crops were either grown or accessed in this study area including fruits and vegetables.
- Among traditional processing methods roasting, boiling and fermentation were commonly used to prepare family foods like roasted (kollo) and boiled (nifro) grains and kocho/enset.
- Only 1.78% of mothers gave formula food for their children.
- Higher number of children in this study started complementary feeding at the age of six months.
- Provision of effective health education by health extension workers which covered 82.14% among the reasons for introduction of complementary food in the study area.
- In this study cereals (maize) and root crops (ensent) were the main food groups for preparation of complementary food in the form of porridge.

**Table 3. Results for functional properties of complementary flours and porridge**

Sample Code	BD (mg/100g)	WAC (ml/100g)	DAK (ml/100g)	Viscosity (cpa)
CB1	1.11 <sub>ab</sub>	131.50 <sub>2.12a</sub>	88.75 <sub>1.06a</sub>	4289.00 <sub>12.73a</sub>
CB2	1.19 <sub>ab</sub>	135.50 <sub>0.71a</sub>	98.00 <sub>1.43a</sub>	4116.00 <sub>5.60a</sub>
SB1	1.06 <sub>ab</sub>	139.50 <sub>2.12a</sub>	92.00 <sub>1.43a</sub>	3113.50 <sub>4.95a</sub>
SB2	0.91 <sub>ab</sub>	144.00 <sub>4.41a</sub>	101.50 <sub>2.12a</sub>	2987.50 <sub>10.61a</sub>
GB1	0.91 <sub>ab</sub>	141.50 <sub>0.71a</sub>	108.50 <sub>4.95a</sub>	2580.00 <sub>12.73a</sub>
GB2	0.92 <sub>ab</sub>	147.50 <sub>2.12a</sub>	101.50 <sub>2.12a</sub>	2571.00 <sub>11.31a</sub>

**Table 4 Sensory evaluation result for complementary porridges at community level**



**Conclusions**

- In the study area a range of cereals, legumes, fruits and vegetables are grown and/or accessible in the market.
- But maize and ensent/bulla are the main food items used for preparation of complementary foods in the form of thin porridge.
- Health/nutrition education has great impact on mothers to start complementary foods at age of six months.
- Mothers have limited knowledge on the benefits and preparation techniques on complementary foods.
- Mothers in the area are willing to accept and prepare nutritionally improved complementary food if it is less costly and easy to process.
- Substitution of QPM with chick pea improved fat, protein, zinc and iron contents of complementary foods.
- Germination and soaking of cereals and/or legumes
  - Slightly affected the overall acceptability
  - increased bio-availability by reducing phytate and tannin contents.
  - increased the nutrient density by decreasing viscosity complementary foods.
- Complementary flours prepared in the present study fulfill the minimum RDA for energy and protein (10.9gm and 370kcal per 100gm).
- The amount of iron and zinc is higher than 2/3 of minimum RDA for children aged 6-24 months old.
- The contribution of vitamin A in this complementary flours is less than 25% of RE per 100gm.
- Hence, QPM based CFs prepared from 72 (50:50):18:10 of germinated QPM and chick pea is best on nutrient contents, bioavailability and functional properties.

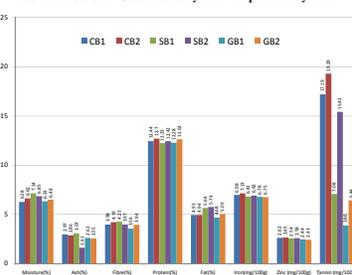
**Recommendations**

- Health/nutrition education has to be given to mothers to formulate less costly, easy to process and nutritionally improved complementary food to utilize cereals, legumes, fruits and vegetables existing in the area.
- Incorporating de-hulling and roasting processing techniques with soaking and germination of cereals and legumes is important to enhance the overall acceptability of complementary foods.
- It is recommended to perform in vivo protein digestibility test using animal trials or feeding of children and growth monitoring using anthropometric indices in order to evaluate further the quality of complementary foods developed.

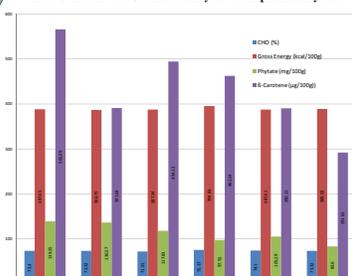
**Acknowledgment**

This study was financed by American people through the United States Agency for International Development (USAID) for their financial support under Agreement No.AID-663-A-11-00017 USAID/ENGINE project in Ethiopia and Norwegian Government support Project at Hawassa University in Ethiopia. The authors are thankful to those who participated in laboratory and field works.

**Table 1. Results for Chemical analysis of complementary flour**



**Table 2. Results for Chemical analysis of complementary flour**



CB1 (raw QPM 43gm+raw chickpea 29gm+red teff 10gm+OFSP 18gm), CB2 (raw QPM 36gm+raw chickpea 36gm+red teff 10gm+OFSP 18gm), SB1 (soaked QPM 43gm+soaked chickpea 29gm+red teff 10gm+OFSP 18gm), SB2 (soaked QPM 36gm+soaked chickpea 36gm+red teff 10gm+OFSP 18gm), GB1 (germinated QPM 43gm+germinated chickpea 29gm+red teff 10gm+OFSP 18gm), GB2 (germinated QPM 36gm+germinated chickpea 36gm+red teff 10gm+OFSP 18gm).