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# Sensory Evaluation Acceptability for a Food Supplementary Chickpea-Based Ready-to-Use among Moderately Malnourished Children Aged 6-59 Months

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**Abstract:** The objective of this study was to assess sensory acceptability of locally-produced chickpea-based ready-to-use supplementary foods (RUSF) among moderately malnourished children (6-59 months). A quantitative descriptive analysis using a five point hedonic scale among a total of 140 mother-baby pairs was conducted in five hotspot priority one district. The target groups were sampled from 10 sites of five districts (2 sites per district). The child-mother pairs per district were selected through systematic random sampling. The selection criteria included children aged 6-59 months with moderate acute malnutrition (MAM) and not suffering from any illness. Half of the respondents (46%) were farmers, while 29% were housewives; only 21% had formal education. Both sexes were equally represented in the sample size among children with 46% being males while 54% females. About half (46%) of households had four or more children with median maternal age during child birth reported at 28.6 ± 5.9 years. About 89% of children consumed complementary food from starchy staple food; 17% consumed from vitamin A rich foods; 57% consumed from dark green leafy vegetables; no child consumed meat, fish and eggs; 49.3% consumed legumes, nuts and seeds; 36.4% consumed milk and milk products and the mean dietary diversity was rated at two out of the nine food groups. The amount of RUSF consumed by children from 48-59 months was higher than children who were 6-11 months. Amhara region had accepted chickpea only and chickpea + maize+ soy the two products more than the other four regions with an average mean value of 4.8 and 4.6 by mother/caregiver and interviewer, respectively. Mothers' perception of the appearance of the products and their overall acceptability was similar in most regions except South Nation Nationality People Region (SNNPR) where the rating of the two products was low with an average mean value of 4.6. Two of the products were well accepted by the study of the participants. The purchase for progress (P4P) programme could utilize this opportunity to support cooperative unions to make chickpeas available on the market given importance to.

**Key words**: Acceptability, supplementary products, sensory evaluation.

## 1. Introduction

Ready-to-use foods (RUF) are lipids-based, high-energy density, fortified foods that require no preparation or cooking and are therefore "ready-to-eat" [1]. RUF are fortified with the quantities of micronutrients required to promote growth and recovery in malnourished children. RUF can be further categorized as: (1) ready-to-use therapeutic foods (RUTF), (2) ready-to-use supplementary foods (RUSF) or (3) ready-to-use complementary foods (RUCF), based on the composition of RUF and its intended usage. The key nutrition messages provided to caregivers and families state that RUF are a food and medicine for sick children and are not to be shared with other family members. It is expected that the promotion of these key nutrition messages will reduce the incidence of intra-household food sharing and

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therefore improve the targeting of RUF to the malnourished child [2].

The considerable evidence supporting the use of RUTF for the treatment of severe acute malnutrition has also led to the consideration of these RUF for the treatment of moderate malnutrition in supplementary feeding programs. The success of the community-based management of acute malnutrition (CMAM) approach (increased coverage associated with decentralizing community-based care) suggests that it could be used for supplementary feeding programs which have larger and more widespread programmatic applications. Several studies have also proven the effectiveness of RUTF (with adjusted dosage for a supplementary ration) for the treatment of mild or moderate acute malnutrition [3-6]. The design in the majority of these studies includes a comparison of RUTF and corn-soy blend (CSB) as treatment interventions in moderately malnourished children 6-60 months of age.

In a study conducted in Malawi [5] after discharge from an inpatient rehabilitation unit, 282 HIV-negative children aged 12 months or older were enrolled and randomly assigned to one of three treatment groups, which were provided with 175 kcal/kg/d RUTF, 500 kcal/d RUTF supplement, or enough CSB to feed the entire family, respectively. Time-to-event analysis showed that 95% of the children received 175 kcal/kg/d RUTF to reach their discharge target weight, while only 78% of the children received the 500 kcal/d RUTF supplement or CSB to reach their discharge target weight. Children receiving 175 kcal/kg/d RUTF also gained weight, height and mid upper arm circumference (MUAC) more quickly than the other groups. Both RUTF groups gained weight significantly more quickly compared to the CSB group [5].

Another study in Malawi [6] compared three interventions (RUTF-soy, RUTF-milk and CSB), and each was provided with 75 kcal/kg/d over a period of eight weeks for the treatment of moderate acute malnutrition in children ($n$ = 1,362) through a supplementary feeding program. Children receiving the RUTF-soy and RUTF-milk had significantly higher recovery rates (80% and 79%) compared to the children receiving the CSB (72%) ($P < 0.01$). Children in the RUTF groups also had significantly higher weight gain in the first two weeks of supplementation (2.4 g/kg/d and 2.6 g/kg/d) compared to the children in CSB group (2 g/kg/d) ($P < 0.05$).

In a study conducted in Pakistan [7] on sensory evaluation of chickpea-based ready-to-use food for children (RUFC) for healthy infants, young children aged 6-24 months and their mothers, the average consumption of ready-to-use complementary foods (RUCF) was 38.21 g/feed, and the mean consumption for the three age groups included: infants aged 6-11 months 38.66 g/feed (210 kcal), young children aged 12-17 months and 18-24 months 36.83 g/feed (200 kcal) and 38.97 g/feed (212 kcal), respectively. There was also noted the improvement in weight and MUAC during the period. The chickpea-based RUFC was well accepted by mothers and their children, based on sensory testing of taste, colour and odour as well as consumption. It was however noted that the distribution of RUFC required to be done in a comprehensive manner under supervision with proper monitoring and evaluation. The study recommended the need to verify the efficacy on children to evaluate the impact of RUFC on child nutritional and micronutrient status, in order to ensure the wider acceptability of RUFC in addressing malnutrition in Pakistan.

In another study on the acceptability test of RUFC by mothers and children in India by world food program (WFP), the quantity of RUFC consumed by both infants and young children was quite good, although there was noted variability in the quantity consumed every other day, which could have been based on the changed season patterns. The study reported that the incidence of cough and cold increased, while diarrhea and vomiting decreased at

end line compared with baseline. The caregivers reported that the sensory qualities of RUFC were very favorable from the 1st day to 20th day, and the rating of RUFC sensory evaluation was better at end-line compared to baseline. The mothers perceived their children's appreciation of the quality of the RUFC, and the mother's perception of their child's response to RUFC was more positive in the end-line than baseline. The study therefore recommended that RUFC should be distributed in programs under controlled conditions—careful monitoring and evaluation; in addition, in an effective study, the evaluation of the impact of RUFC on growth, micronutrient status and functional outcomes should be conducted.

In another study, the acceptability test was conducted in Indonesia as an intervention of WFP to combat malnutrition using a lipid nutrient supplement (LNS) product. The aim of the study was to examine the consumption of LNS by infants and children aged 6-24 months, in comparison with the fortified blended food (MP-ASI) commonly consumed and commercially available in the market. The results of the study indicated that both LNS and MP-ASI products had high acceptance among children aged 13-24 months; however, based on facial expressions of children aged 6-12 months, 27% preferred LNS and 6% preferred MP-ASI. Around 64% of children aged 13-24 months liked LNS more than MP-ASI (41%). Furthermore, the difficulty of swallowing LNS particularly in infants aged 6-12 months (73%) was higher than those aged 12 months (34%). The study therefore suggested that it would be more appropriate to feed LNS to children above the age of 12 months, while the MP-ASI could be given to those aged 6-12 months. The compliance results showed that during phase I and II, children aged 6-12 months were able to consume approximately 28 g LNS/d, 29 g LNS/d, 75 g MP-ASI/d and 100 g MP-ASI/d, respectively; while children aged 13-24 months were able to consume 26 g LNS/d, 55 g LNS/d, 236 g MP-ASI/d and 135 g MP-ASI/d, respectively. Water consumption was higher during LNS consumption compared to MP-ASI. The duration of MP-ASI consumption was relatively longer than LNS, possibly because the amount of MP-ASI consumed was higher than LNS. The study concluded that most of the children aged 6-24 months preferred consuming LNS to MP-ASI, and therefore a recommendation was made to feed LNS to children older than 12 months.

As part of the continuing efforts to improve the nutritional status of vulnerable populations, WFP is increasingly using innovative food commodities, such as micronutrient powders (MNP), LNS and $CSB^{++}$, targeting at specific groups, such as young children and pregnant and lactating women. Due to the lack of program experience with the distribution and use of the new commodities, in many settings, a debate still exists with regards to which specific commodity to be chosen, promoted and utilized. In addition, these products are new to most populations, as well as to the WFP staff and local implementing agencies. Hence, a proper and careful introduction of the product to the target population is warranted. This can be achieved through a combination of strategies, such as sensory acceptability studies, careful formative research, successful social marketing and communications activities as well as appropriate product packaging and effective training of program implementers.

Chickpeas, already widely grown in Ethiopia, are part of the local diet, and are rich in proteins, unsaturated fats, calcium, zinc, folate and iron. By using chickpea in the RUSF formula, WFP expects that the acceptability will be better than other types of existing RUSF. Furthermore, by relying on local manufacturing and using as many local raw materials as possible instead of importing finished goods, WFP expects to access a more competitive product while enhancing the economic impact on the Ethiopian agriculture sector and industrial processors. WFP also expects that the price of the locally-produced RUSF will be cheaper than the imported one. The study is

also expected to strengthen the existing implementation modalities of the targeted supplementary feeding (TSF) programme by strengthening on the weakness realized through its overall integration into the CMAM approach and the use of a cost-effective RUSF which could easily be incorporated in the national medicine list.

## 2. Materials and Methods

The acceptability trial was conducted within the outpatient therapeutic care services at 10 selected health posts. According to the CMAM coverage report 2009 by United Nations Children's Fund (UNICEF) [7], there were around 13,658 health posts, of which 8,600 were providing outpatient therapeutic program (OTP) services. Based on the report, Oromia had the biggest number of OTPs (2,717), followed by SNNPR (2,573) and Amhara regions (2,106), respectively. Considering the fact that Oromia, Amhara, SNNPR, and Tigray had the highest share of the country's population size and consequently the biggest share of OTPs sites, the trial took this into consideration to obtain the required sample size. Furthermore, given that there is a diverse cultural, ecology and food consumption pattern across the different regions, there was a need to conduct the trial in the regions to find out whether this had any effect on the sensory analysis of individuals.

At least two OTP sites from one woreda were randomly selected to represent the region. The selection of woredas from each of the five regions was based on hotspot priority number as per the Integrated Food Security Phase Classification (IPC) by FAO [8]. The study was therefore conducted in the woredas of Omonada (Oromia), Borecha (SNNPR), Jamma (Amhara), Enderta (Tigray) and Afdem (Somalia). The trial was conducted from the March 25 to April 22, 2012.

The sample size estimation was based on the study design that compared two groups by the Eq. (1):

$$N = (Z_\alpha + Z_\beta)^2 \cdot (SD/D)^2 \quad (1)$$

where, power of test ($\beta$) = 90%; non response rate = 10%; $Z_\alpha$ is $Z$-score for level of significance at $\alpha$ = 0.05; $Z_\beta$ is $Z$-score for power of the test, $SD$ = 0.9 is standard deviation and $D$ = 0.5 is the delta/effect achieved at the end of the study.

The level of significance used in this study was 95% and the power of the study was 90%. A 10% non response rate was also calculated. This gave an overall sample size of 133 mother-baby pairs for the five regions. This sample size provided a total of 524 and 774 tests for the preference and acceptability test phases of the study, respectively.

The study design took the form of a quantitative descriptive analysis, where a 5-point facial hedonic scale was used to assess the preference and acceptability of RUSF by both the mothers/caregivers and the children. The responses were recorded by marking a position on a facial expression to be used as measure with scores of 1-5, where 1 indicates dislike very much; 2 indicates dislike a little/slightly; 3 indicates not sure/neither like or dislike; 4 indicates like a little/slightly; 5 indicates like very much. This was based on a study conducted by Bovell-Bejnamin et al. [9] about the acceptability of a fortified cereal meal food among toddlers by the primary caretaker (typically) or mother to interpret the behaviour of child when he/she tasted the food and rated acceptance on a 5-point facial hedonic scale.

WFP of Ethiopia developed four chickpea-based RUSF formulae: chickpea only, chickpea + soy, chickpea + maize + soy and chickpea + maize, and they were produced by Guts Agro Industry, which had been approved by WFP for production capacity according to food safety quality management standards. All the four formulae went through quality assurance and safety testing for macro- and micro-nutrient composition, as well as microbial contamination at an independent internationally accredited lab. They also received certification from the Food, Medicine and Health Care Administration and Control Authority (FMHACA) and subsequently

approval of its suitability for sensory acceptability testing on those malnourished children.

The formulae contained raw materials: chickpeas, soy, maize, soya bean oil, palm olein oil, hydrogenated vegetable fat, sugar, skimmed milk powder, emulsifier and vitamin and mineral premix. The details are indicated in Table 1.

For the preference test, panellists received one sachet of approximately 100 g of chickpea only, chickpea + soy, chickpea + maize, chickpea + maize + soy per day for four days; while for the acceptability trial, they received one sachet every other day for six days. In order to avoid bias among the enumerators, the sachets of the four products were coded with numerals and they had no details on a particular product: 183 (chickpea only), 385 (chickpea + soy), 587 (chickpea + soy + maize) and 789 (chickpea + maize).

In each of the five selected study sites, subjects selected to participate in the study were mostly mobilised from the community, while others had been recently discharged from OTP. Given that 10 sites participated in the trial, at least 28 children and 28 mothers were selected from each site. After the mobilisation, the moderately malnourished children were registered and each child was allocated a unique number on the list, where systematic random sampling method was used to select the first child. The total number of children was then divided by 28 (required study subject per health post) to get the sampling interval for selection of subsequent children. The process continued until the required sample size was obtained. The mothers of the selected children were, by design, qualified for the trial. In particular, the following selection criteria included: (1) any child aged 6-59 months without sever acute malnutrition (SAM) and not suffering from any illness and (2) mothers/caregivers of children aged 6-59 months, regardless of their nutritional status.

In collaboration with the Federal Ministry of Health and UN WFP, the Ethiopian Public Health Institute (EPHI) conducted the trial. At the field level, six researchers from the EPHI teamed up with the health extension workers at each of the OTP sites and supported the implementation of the trial. The trial team was comprised of one overall coordinator, one principal investigator (team leader), five co-investigators, five supervisors and 20 interviewers, giving a total of 32 that participated in the study. The officials from WFP worked hand in hand with the team in the provision of technical and financial assistance.

Training and piloting of the questionnaire were conducted in a four days' training workshop at EPHI premises. A training guide, which was adapted from the national protocol on management of acute malnutrition and sensory evaluation manuals including the guidance on conducting acceptability trials from different countries, was employed. The training entailed classroom presentation for 10 days included one-day practical orientation in one of the OTP sites in Addis Ababa. Members were trained jointly on the rationale for the study, sampling, sensory evaluation, consent, questionnaire administration, interviewing, anthropometric measurements and referral.

**Table 1 Nutrient composition per 100 g for RUSF products.**

| Supplementary feed | Proportion of ingredients (%) per 100 g | | | | | | | | Kcal | Protein | Fat | Iron | Cost/ton |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Chickpeas | Maize | Soy flour | Soy oil | Palm olein oil | Dry skim milk | Sugar | Premix | | | | | |
| Chickpea | 32.8 | - | - | 9.0 | 19.0 | 20.0 | 15.0 | 1.75 | 611.0 | 13.0 | 29.0 | 10.2 | 2,023 |
| Chickpea + soy | 31.8 | - | 23.6 | 15.0 | 9.8 | 7.9 | 9.9 | 1.75 | 589.0 | 13.7 | 30.1 | 10.7 | 1,506 |
| Chickpea + maize | 31.3 | 24.1 | - | 18.3 | 6.5 | 7.9 | 9.9 | 1.75 | 549.0 | 11.8 | 33.8 | 11.5 | 1,497 |
| Chickpea + maize + soy | 31.3 | 16.1 | 8.0 | 16.9 | 7.8 | 7.9 | 9.9 | 1.75 | 595.0 | 13.7 | 31.3 | 12.1 | 1,499 |

A single structured questionnaire with described variables, which was translated into Amharic, was used to collect the data from all the panellists. The study was conducted over a period of 18 days when mothers were instructed to come to the health post (OTP) based on the central location assessment system which offers enormous flexibility in opportunities for panellists' contact [10].

Information on the name of the child, date of admission, age in months, actual date of birth, sex, residence in terms of kebele and specific community, name of the caregiver and contact as well as the programme/service the child referred from, was recorded by the interviewers.

Preference assessment (employing the basic principles of an acceptability test using 5-point hedonic scale) among children was conducted with the aim of identifying children's favourite RUSF among the four formulae presented in Ref. [11]. The two most preferred formulae were then used in the follow-on acceptability trial. During the preference assessment, no demands or restrictions were placed on the child. Each formula was given for one day to avoid the chance of skewing the results by sampling on the wrong days. Each child had to come back to the OTP site four times on consecutive days with no break for the weekend. The 28 children expected from each site were divided into four sub-groups of seven children each, who were offered with the RUSF formulae in a different sequence as shown in Table 2.

From the preference test, two products were selected out of the four products. These were then taken through the acceptability test for a six day repeated testing. Although acceptance tests do not commonly involve replicated testing on the same products by the same consumers, this particular test was anticipated to assess the possible increment or decrement of the consumption share of the children on the subsequent sitting for the following study days based on Byer and Saletan [12]. In addition, the replication helped to act the possible less predictive judgment behaviour of the panellist compared to later judgments [13].

Interviewers gave caregivers instruction on the benefits of trial, irrespective of the feed types which the children were randomly fed. The instructions also included: to feed the formulae only to the enrolled child and not allow sharing; to feed it in addition to their usual diets at home; and how to discard unfinished portions. Enrolled children were fed with a test dose of the food product, to which they were assigned in order to assess acute allergic reactions, and mothers were instructed to report all rashes to the health extension workers for examination and suggestion.

In the child RUSF test, the mothers were taken through the 5-point facial hedonic scale for both preference and acceptability test, using graphics to explain the meaning of the scale and their expected responses during the study [14]. The study team tasted the RUSF before starting the test as a way of assuring mothers of its safety. This was then followed by each mother being given a sachet of the RUSF and emptied into a container for observation on texture, smell, consistency and appearance of the product as well as eventual taste prior to feeding their children.

In both the preference and acceptability test, the mothers were instructed to introduce the RUSF to their children. The interviewer observed the child and mother's reactions. The children's reaction was in the

**Table 2 Sequence for offering RUSF to children at each site.**

| No. of children in group | Day 1 | Day 2 | Day 3 | Day 4 |
|---|---|---|---|---|
| Group A (7) | RUSF 1 | RUSF 2 | RUSF3 | RUSF 4 |
| Group B (7) | RUSF 2 | RUSF 3 | RUSF 4 | RUSF 1 |
| Group C (7) | RUSF 3 | RUSF 4 | RUSF 1 | RUSF 2 |
| Group D (7) | RUSF 4 | RUSF 1 | RUSF 2 | RUSF 3 |

form of facial expressions, lateral tongue movements, spitting and/or complete refusal of the RUSF. The mother was then asked to comment based on her observation on the degree of her child's acceptability of the product and the results were recorded. The interviewer then independently evaluated the child's acceptability of the product by the same 5-point scale and subsequently recorded in the questionnaire.

During the four days of preference test and six days of acceptability test, a digital scale (sensitive to 0.01 g) was used to measure the weight of the sachet prior to feeding as well as after the feed was completed, and the difference between the weight of the sachet before and after consumption was used to determine the exact amount of RUSF consumed by the child. Furthermore, direct observation was done when the child was presented with the RUSF formulae, and recorded the amount of time that the child was engaged with the product. The more time a child spent to eat the formula, the stronger preference on formula was presumed.

One focus group discussion per region was conducted for mothers/caregivers on the last day of the study to attain qualitative information in order to complement the findings from the quantitative study. The discussions covered about 12 women per group and the main objective was to assess their knowledge, attitudes and actual daily practices regarding infant and young child feeding practices, consumption patterns of basic food groups, and explore the acceptability of these mothers towards using RUSF for the treatment of acute malnutrition among 6-59 months children. Other topics included the acceptance of RUSF by their child, how well the child ate and whether the child consumed the typical amount of food as well as the idea of purchasing the product if made available on the market. The possible name to be given to the product was also explored during these sessions.

The nutrition and health data were entered in Epi data, microsoft excel and SPSS version 17.0 for windows, by which the calculation and analysis of anthropometry indices, the demographic and nutritional information of the RUSF product and the sensory evaluation of the RUSF product were done. The arithmetic mean and standard deviation were determined with SPSS 17.0. For the anthropometric measurements, demographic and socioeconomic data as well as individual dietary diversity score (IDDS), SPSS were also used to do ANOVA analysis to summarize.

All mothers/caregivers received verbal explanation of the study, including testing and anthropometric assessments. Interviewers were provided with a paragraph about their guide requirements from the interviewee. The consent or refusal was recorded on the form by the interviewer. Mothers/caregivers were also informed that the survey was confidential and their responses would not affect any food or non-food distributions. Participation was voluntary and the mothers/caregivers had the right to refuse answering any or all questions as well as taking anthropometric and testing assessments. The study was approved by the scientific and ethical review of the committee of EPHI.

## 3. Results and Discussion

### *3.1 Socio-Demographic Information*

The socio-demographic characteristic of trial respondent is summarized in Table 3. In total, 140 mothers/caregivers (respondents) were interviewed with a response rate of 100%. Farming was the major income sources in Agrarian [1] communities, and therefore land ownership was noted to be an important socio-economic indicator. In most sampled woredas, about half (46%) of the mothers were farmers and the majority of them had their own farm land (owned land) except Afdem woreda where all the study participants were pastoralists. Just less than one-third (29%) of the

[1] An agrarian society is a society that depends on agriculture as its primary means for support and sustenance.

**Table 3 Socio-Demographic characteristics of mothers/caregivers among study participants in five regions in Ethiopia, April 2013.**

| Variables | Tigray *n* =33 | Amhara *n* = 29 | Somali *n* = 22 | Oromia *n* = 28 | SNNPR *n* = 28 | Total *N* =140 |
|---|---|---|---|---|---|---|
| | *n* (%) | *n* (%) | *n* (%) | *n* (%) | *n* (%) | *n* (%) |
| Maternal occupation | | | | | | |
| Housewife | 6 (18) | 17 (59) | 0 | 5 (18) | 13 (46.4) | 41 (29) |
| Farmer | 22 (67) | 9 (31) | 0 | 21 (75) | 13 (46.4) | 65 (46) |
| Petty trader | 0 | 2 (7) | 0 | 1 (4) | 0 | 3 (2) |
| Daily laborer | 3 (9) | 0 | 0 | 1 (4) | 2 (7.2) | 6 (4) |
| Pastoral | 0 | 0 | 22 (100) | 0 | 0 | 22 (16) |
| Do you have farm land? | | | | | | |
| Yes | 23 (70) | 26 (90) | 0 | 24 (86) | 28 (100) | 101 (72) |
| No | 10 (30) | 3 (10) | 22 (100) | 4 (14) | 0 | 39 (28) |
| Marital status of mother | | | | | | |
| Single | 1 (3) | 0 | 0 | 0 | 0 | 1 |
| Married | 27 (82) | 27 (93) | 20 (91) | 27 (96) | 28 (100) | 129 (92) |
| Separated | 3 (9) | 2 (7) | 0 | 1 (4) | 0 | 6 (4) |
| Widowed | 1 (3) | 0 | 2 (9) | 0 | 0 | 3 (2) |
| Educational status of mother | | | | | | |
| No formal education | 18 (55) | 18 (62) | 21 (95) | 24 (86) | 18 (64) | 99 (71) |
| Grade 1-4 | 9 (27) | 5 (17) | 1 (5) | 4 (14) | 5 (18) | 24 (17) |
| Grade 5-8 | 4 (12) | 6 (21) | 0 | 0 | 5 (18) | 15 (11) |
| High school 9-10 | 2 (6) | 0 | 0 | 0 | 0 | 2 (1) |

mothers/caregivers were housewives and an average proportion of mothers with no formal education was 71%. The higher proportion of respondents with no formal education was observed to be from Afdem woreda (Somali) at 95% and followed by Enderat woreda (Tigray region) at 55%. About 92% of the study participants were married.

Of the 140 respondents interviewed, about 46% were farmers and the majority were owned land; however, this did not translate into a variety of food to the children, based on the dietary diversity information and the fact that the children they cared for were malnourished. The findings also indicated that 71% of the respondents did not have any formal education and this could have partly contributed to the inadequate knowledge and skills of feeding their children appropriately, thus leading to malnutrition. There will be a need to identify and support targeted behavioral change communication (BCC) materials and/or messages to such individuals, especially when it comes to the use of chickpea-based RUSF in the treatment of moderate acute malnutrition.

Given that 92% of the respondents were married, the need to promote male involvement in the interventions to prevent and treat malnutrition is of paramount importance, as this would make a great impact as experienced in most of the health and HIV/AIDS related interventions in some countries, including Ethiopia.

### *3.2 Child Diet Diversity*

IDDS is often used as a proxy measure of the nutritional quality of an individual's diet. This is also a proxy measure of a socio-economic level of the household. Foods and drinks consumed by children in the 24 h preceding the survey are presented in Table 4. IDDS for study participants was calculated based on the FAO guidelines for measuring individual dietary diversity [8]. The median (25th and 75th percentile) diet diversity score for the study participants was two (2, 3) out of the nine food groups, implying that the diets of these children were less diversified, which

could further affect their nutritional status and more specifically micronutrient levels.

The majority (89%) of respondents in the study reported that their children mainly consumed complementary foods made from starchy staple food. Consumption of vitamin A rich fruits and vegetables by children was reported to be very low (17%), but dark green leafy vegetables consumption was reported to be high at 57%. Surprisingly, no children consumed meat, fish, poultry and eggs in all the regions (Table 4). Specific to children in Boricha woreda (SNNPR region), consumption of vitamin A rich foods increased with age (from 16% at 6-8 months to 31% at 18-23 months). Non breastfeeding children were more likely than breastfeeding children to consume foods rich in vitamin A (34% compared with 25%).

### *3.3 Consumption of Chickpeas*

Table 5 shows that only 12% of children aged 6-59 months had been fed on foods prepared from chickpeas in the last four weeks prior to the study. The proportion of children who consumed food prepared from chickpeas was highest in Enderta (Tigray) and Boricha (SNNPR) woredas.

**Table 4 Child diet diversity among study participants in five regions of Ethiopia, April 2013.**

| Variables | Tigray *n* = 33 | Amhara *n* = 29 | Somali *n* = 22 | Oromia *n* = 28 | SNNPR *n* = 28 | Total *N* = 140 |
|---|---|---|---|---|---|---|
| | *n* (%) | *n* (%) | *n* (%) | *n* (%) | *n* (%) | *n* (%) |
| Starchy staples | 33 (100) | 29 (100) | 10 (45.45) | 25 (89.28) | 27 (96.42) | 124 (88.6) |
| Dark green leafy vegetables | 4 (12.12) | 0 | | 2 (7.14) | 16 (57.14) | 22 (15.7) |
| Other vitamin A rich fruits and vegetables | 8 (24.24) | 4 (13.79) | 0 | 4 (14.28) | 5 (17.85) | 21 (15) |
| Other fruits and vegetables | 24 (72.72) | 23 (79.31) | 2 (9.09) | 9 (32.14) | 18 (64.28) | 76 (54.3) |
| Organ meat | 0 | 0 | 0 | 0 | 0 | |
| Meat and fish | 0 | 0 | 0 | 2 (7.14) | 0 | 2 (1.4) |
| Eggs | 0 | 0 | 0 | 0 | 0 | |
| Legumes, nuts and seeds | 23 (69.69) | 26 (89.65) | 0 | 14 (50) | 6 (21.42) | 69 (49.3) |
| Milk and milk products | 13 (39.39) | 6 (20.68) | 17 (77.27) | 10 (35.7) | 5 (17.85) | 51 (36.4) |
| Median dietary diversity | 2 (2, 3) | | | | | |
| Range | 0-5 | | | | | |

**Table 5 Consumption of chickpeas among sampled children.**

| Did your child ever fed chickpeas food in last four weeks? | Tigray *n* = 33 | Amhara *n* = 29 | Somali *n* = 22 | Oromia *n* = 28 | SNNPR *n* = 28 | Total *N* = 140 |
|---|---|---|---|---|---|---|
| | *n* (%) | *n* (%) | *n* (%) | *n* (%) | *n* (%) | *n* (%) |
| Yes | 8 (24) | 1 (3) | 0 | 1 (4) | 7 (25) | 17 (12) |
| No | 25 (76) | 28 (97) | 22 (100) | 27 (96) | 21 (75) | 123 (88) |

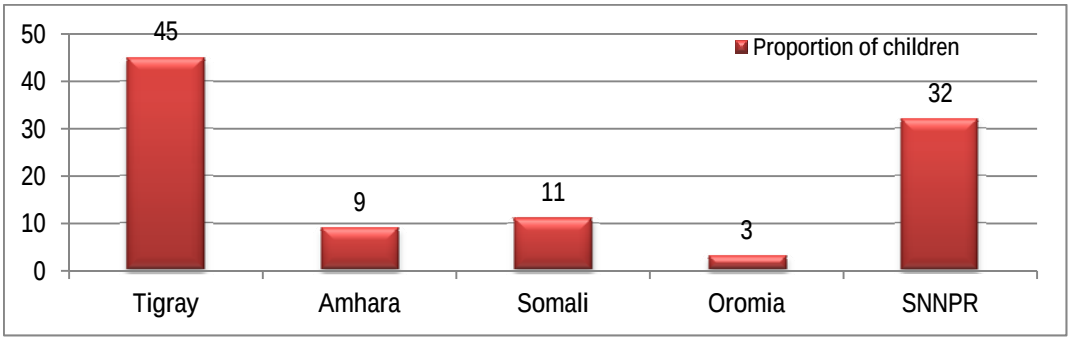


**Fig. 1 Proportion of children ever fed on therapeutic and supplementary food among the study subjects.**

*3.4 Consumption of Therapeutic and Supplementary Feeds*

The overall proportion of children ever fed on any therapeutic or supplementary feed in their entire lives was 47%, with the highest proportion of these children in the Enderta woreda (Tigray region) at 45% compared with those in the other woredas (Fig. 1). This is in line with the recently released hotspot priority report (April, 2013) that indicated that TSF coverage was 100% in the hotspot priority one woreda of Tigray.

*3.5 Preference Test*

Preference testing refers to tests in which the consumer is given a choice and asked to indicate their most liked product, usually from a pair. There were a total of nine variables used to determine the most preferred chickpea RUSF among the four formulae by the panelists. The two most preferred products out of the four were then taken through an acceptability test by the children and mothers to find out the most acceptable.

*3.6 Preference Evaluation by Product Type*

Children are not able to indicate their preferences as well as dislikes, and caregivers cannot simply assume that their favorite things and activities may also be preferred by children. Based on this, an assessment was conducted with the aim of identifying children's favorite RUSF product among the four formulae, using both the mother's and interviewer's responses based on a 5-point face hedonic scale. In addition, the amount of RUSF consumed and the time by the child spent while eating the food were used as a proxy to track the response of the child. These are detailed in Table 6.

3.6.1 Child Response by the Mother and Interviewer

Table 7 shows that there was no significant difference in preference among the four products by the child based on both the mothers'/caregivers' and interviewers' judgment of the child response ($P > 0.05$). However, there was a numerical difference between the mothers/caregivers and the interviewer at 4.03 ± 0.05 and 3.68 ± 0.06, respectively; both scores were categorized in the like slightly range based on the hedonic scale. Furthermore, considering the numerical scores, for all the four products, product 183 scored the highest, followed by product 789 and then product 385, and product 587 scored the least.

3.6.2 Amount of Chickpea-Based RUSF Consumed

The amount of chickpea-based RUSF consumed was also measured in order to complement data obtained from the mother's and interview's response. Table 7 also shows the average amount taken by the children for each of the four products. There was no significant difference in the amount taken by the children for each of the four products ($P > 0.05$); however numerically, product 183 (32.58 ± 3.22) was consumed much more than the other products. This was closely followed by product 385 (29.40 ± 3.12).

3.6.3 Amount of Time Spent by Child Consuming Chickpea-Based RUSF

The amount of time spent by the children consuming

**Table 6 Preference results by product type among sampled participants, April 2013.**

| Product code | *N* | Child response (by the mother) | Child response (by the interviewer) | Consumed RUSF amount (g) | Time spent with RUSF (min) |
|---|---|---|---|---|---|
| | | Mean values ± SE | | | |
| Chickpea only (183) | 131 | 4.07 ± 0.10 | 3.77 ± 0.11 | 32.58 ± 3.22 | 7.04 ± 0.49 |
| Chickpea + soy (385) | 131 | 4.00 ± 0.10 | 3.78 ± 0.16 | 29.40 ± 3.12 | 7.60 ± 0.44 |
| Chickpea + soy+ maize (587) | 131 | 4.00 ± 0.10 | 3.68 ± 0.09 | 26.04 ± 2.58 | 6.82 ± 0.38 |
| Chickpea+ maize (789) | 131 | 4.05 ± 0.10 | 3.48 ± 0.11 | 29.00 ± 3.57 | 6.97 ± 0.53 |
| Total | 524 | 4.03 ± 0.05 | 3.68 ± 0.06 | 29.26 ± 1.57 | 7.11 ± 0.23 |

**Table 7 Preference evaluation among sampled participants by region, April 2013.**

| Region | *N* | Child response (mother) | Child response (interviewer) | Consumed RUSF amount (g) | Time spent with RUSF (min) | Taste (mother) | Smell (mother) | Texture (mother) | Appearance (mother) | Overall acceptability (mother) |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean values ± SE | | | | | | | | |
| Tigray | 112 | $3.83^{a} \pm 0.10$ | $3.41 \pm 0.12$ | $18.70^{a} \pm 1.78$ | $8.75^{b} \pm 0.56$ | $4.41^{b} \pm 0.07$ | $4.28^{b} \pm 0.07$ | $4.25^{b} \pm 0.07$ | $4.21^{b} \pm 0.07$ | $4.36^{b} \pm 0.06$ |
| Amhara | 124 | $4.01^{ab} \pm 0.12$ | $3.70 \pm 0.11$ | $16.89^{a} \pm 1.57$ | $4.63^{a} \pm 0.24$ | $4.58^{b} \pm 0.07$ | $4.52^{c} \pm 0.07$ | $4.34^{b} \pm 0.07$ | $4.47^{c} \pm 0.07$ | $4.54^{b} \pm 0.07$ |
| Oromiya | 108 | $4.10^{ab} \pm 0.10$ | $3.75 \pm 0.18$ | $19.77^{a} \pm 1.56$ | $5.42^{a} \pm 0.29$ | $4.39^{b} \pm 0.06$ | $4.41^{bc} \pm 0.06$ | $4.17^{b} \pm 0.06$ | $4.39^{bc} \pm 0.06$ | $4.33^{b} \pm 0.06$ |
| Somalia | 76 | $4.27^{b} \pm 0.09$ | $3.80 \pm 0.09$ | $21.40^{a} \pm 2.21$ | $4.60^{a} \pm 0.27$ | $4.59^{b} \pm 0.07$ | $4.23^{b} \pm 0.10$ | $4.23^{b} \pm 0.08$ | $4.43^{bc} \pm 0.08$ | $4.46^{b} \pm 0.07$ |
| SNNPR | 104 | $4.00^{ab} \pm 0.10$ | $3.78 \pm 0.10$ | $70.94^{b} \pm 5.42$ | $11.88^{c} \pm 0.61$ | $4.07^{a} \pm 0.08$ | $3.94^{a} \pm 0.08$ | $3.65^{a} \pm 0.09$ | $3.96^{a} \pm 0 .08$ | $4.00^{a} \pm 0.08$ |
| Total | 524 | $4.03 \pm 0.04$ | $3.68 \pm 0.05$ | $29.25 \pm 1.57$ | $7.11 \pm 0.23$ | $4.40 \pm 0.03$ | $4.29 \pm 0.03$ | $4.13 \pm 0.03$ | $4.29 \pm 0.03$ | $4.34 \pm 0.03$ |

[a-c]Any two means in the same column not followed by the same letter are significantly different.

the RUSF products was recorded. There was no significant difference in time spent by children consuming all the four products; however numerically, the children spent more time on consuming product 385 followed by product 183. The results therefore indicate that generally the higher the amount of RUSF was consumed by the children, the more time it took.

### *3.7 Sensory Test as Evaluated by the Mother/Care Giver*

The sensory characteristics of the food such as taste, aroma/smell, texture, appearance and overall acceptability were used to choose the two most preferred products out of the four by the mother/caregivers.

Taste: there was a significant difference in taste among the four products ($P < 0.05$) with product 183 scoring significantly higher than the other products 385, 789 and 587. There was however no significant difference among the three other products 385, 789 and 587 in terms of taste as perceived by the mother/caregiver ($P > 0.05$). This could be partly be explained by the higher quantity of sugar and milk in the product.

Aroma/smell: it was found that there was no significant difference among the four products in terms of aroma/smell ($P > 0.05$); however, numerically, product 183 ($4.39 \pm 0.07$) scored higher and was followed by product 789 ($4.29 \pm 0.07$).

Texture: the study found that there was a significant difference among the products in terms of texture ($P < 0.05$) with product 183 scoring significantly higher than the other three products ($P < 0.05$) 385, 587 and 789. There was however no significant difference among the other three products.

Appearance: according to the results of the study, the appearance of the four products was significantly different from each other as perceived by the mother/caregiver ($P < 0.05$). Whereas, there was no significant difference between products 587 and 789; but products 183 and 385 had significant difference ($P < 0.05$). Numerically, product 183 scored highest in appearance as compared to the others, followed by product 789. Product 385 scored the least in appearance, given that it was a little darker than the other products.

Overall preference: the final sensory analysis conducted by the panelist was the overall preference of the four RUSF products. The overall preference of product 183 was found to be significantly different from the others ($P < 0.05$). There was however no significant difference among the other three products 385, 587 and 789.

### *3.8 Preference Evaluation by Region Based on Mother/Caregiver's Evaluation*

Table 7 shows the rating of the child's response by the mothers/caregivers based on the five regions. Somali region rated the RUSF products higher than the other regions at 4.27, while Tigray region had the lowest rating of 3.83.

The mean values for Amhara, Oromia and SNNPR

were not different from those of Tigray and Somalia regions' ratings. Unlike the child's response as perceived by the mother, the child response as perceived by the interviewers did not show any statistically significant difference in the study areas (regions). The amount of RUSF consumed by the children in SNNPR (70.94 g) was statistically significantly different from the other four regions ($P < 0.05$); moreover, sampled children from SNNPR (11.88 min) and Tigray (8.75 min) had spent more time on the RUSF products compared to other three regions of Amhara, Oromiya and Somali. This could partly be explained by the fact that these two regions had the highest proportion of sampled children on therapeutic and supplementary feeding programmes and therefore may have been more used to some of the products being provided under these programmes.

With respect to the mothers' response based on their perception about the products, it was observed that it was only in SNNPR where they rated the products lower in terms of appearance, smell, taste, texture and overall acceptability than the other four regions. This could have been attributed to the fasting period, in which the study was conducted as observed and reported by the interviewers. Surprisingly, although the mothers rated the products low in this region, the amount consumed by the children in this region was higher than the other regions. Compared to SNNPR, the mothers/caregivers in Amhara rated the appearance and smell of the products higher than the other four regions.

*3.8 Preference Evaluation by Age Group*

Table 8 shows the mean value of child RUSF intake by the mothers' and interviewers response, amount of RUSF consumed by the child and time spent while consuming the RUSF by age category.

Mean value of age group 6-11 months based on response by the mother/caregivers' was statistically significantly different from 48-59 months and 36-47 months age group. Fig. 2 shows that as the age increases, the amount of RUSF consumed by the child also increases. Similar trend was observed for the time spent with the RUSF.

*3.9 Preference Evaluation by Sex*

Table 9 shows that out of a total of 524 tests, 296 were from females. To determine whether there was a sex difference between the four parameters (child responses by mother and interviewer, amount consumed and time spent), one way ANOVA analysis was done to compare means.

The analysis of variance and a post-hoc test indicated that there was no statistically significant difference between the sex of child and the four parameters. In general, sex did not have any effect on the above four parameters.

*3.10 Preference Evaluation by Feeding Time before Test*

Table 10 summarizes the mean value of the difference between the child's last meal and time of the

**Table 8 Preference evaluation by age category among sampled participants, April 2013.**

| Age (month) | *N* | Child's RUSF intake (mother's response) | Child's RUSF intake (interviewer's response) | Amount of RUSF consumed (g) | Time spent by the child while eating the RUSF (min) |
|---|---|---|---|---|---|
| | | Mean values ± SE | | | |
| 6-11 | 200 | $3.86 \pm 0.08^{a}$ | $3.45 \pm 0.08^{a}$ | $16.22 \pm 1.26^{a}$ | $6.12 \pm 0.36^{a}$ |
| 12-23 | 168 | $4.06 \pm 0.09^{ab}$ | $3.81 \pm 0.13^{ab}$ | $22.26 \pm 1.52^{a}$ | $6.88 \pm 0.35^{a}$ |
| 24-35 | 104 | $4.07 \pm 0.12^{ab}$ | $3.73 \pm 0.13^{ab}$ | $44.92 \pm 4.78^{b}$ | $7.90 \pm 0.52^{ab}$ |
| 36-47 | 36 | $4.42 \pm 0.11^{bc}$ | $3.97 \pm 0.14^{ab}$ | $69.31 \pm 8.21^{c}$ | $10.29 \pm 1.03^{c}$ |
| 48-59 | 16 | $4.69 \pm 0.15^{c}$ | $4.31 \pm 0.22^{b}$ | $73.75 \pm 15.93^{c}$ | $9.67 \pm 2.13^{c}$ |
| Total | 524 | 4.03 ± 0.05 | 3.68 ± 0.06 | 29.26 ± 1.57 | 7.11 ± 0.23 |

[a-c]Any two means in the same column not followed by the same letter are significantly different.

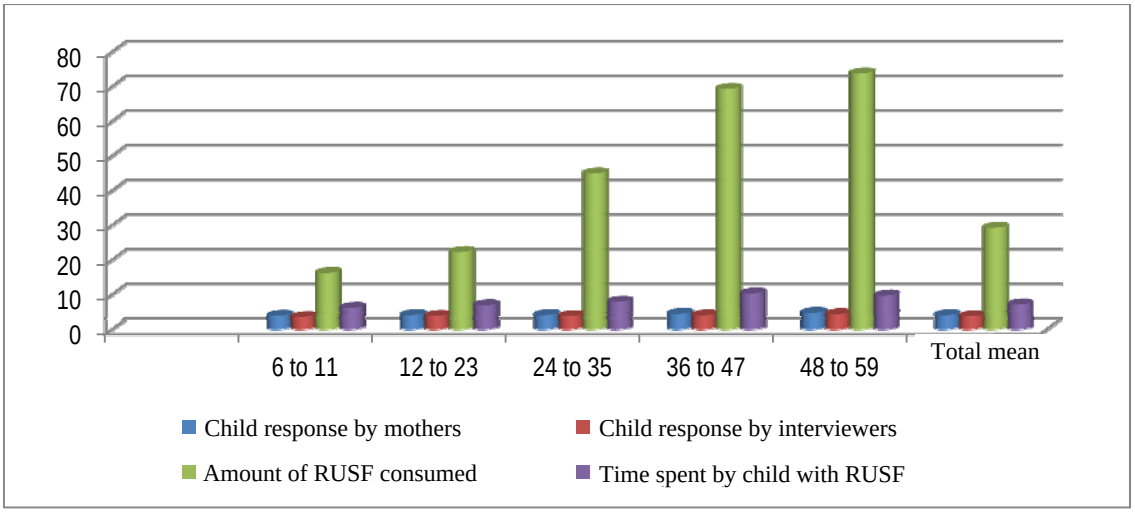


**Fig. 2 Preference test by age category among sampled participants, April 2013.**

**Table 9 Preference evaluation by sex among sampled participants, April 2013.**

| Sex | *N* | Child response (by mother) | Child response (by interviewer) | Consumed RUSF amount/100 g | Time spent with RUSF |
|---|---|---|---|---|---|
| | | Mean values ± SE | | | |
| Female | 296 | 3.98 ± 0.06 | 3.58 ± 0.07 | 27.14 ± 2.08 | 6.87 ± 23.03 |
| Male | 228 | 4.10 ± 0.08 | 3.81 ± 0.10 | 32.01 ± 2.38 | 7.43 ± 27.32 |
| Total | 524 | 4.03 ± 0 .05 | 3.68 ± 0.06 | 29.26 ± 1.57 | 7.11 ± 26.17 |

**Table 10 Preference evaluation by time prior to the test sessions, April 2013.**

| Time prior to the test | *N* | Child response (By mother) | Child response (By interviewer) | Consumed RUSF amount/100 g | Time spent with RUSF |
|---|---|---|---|---|---|
| | | | Mean Values ± SE | | |
| 0-1 h | 56 | 3.98 ± 0.16$^{ab}$ | 3.54 ± 0.15$^{ab}$ | 25.84 ± 3.75$^{a}$ | 5.64 ± 0.58$^{a}$ |
| 1.1-2 h | 114 | 3.94 ± 0.11$^{ab}$ | 3.70 ± 0.10$^{ab}$ | 35.54 ± 3.65$^{a}$ | 7.86 ± 0.48$^{a}$ |
| 2.1-3 h | 162 | 4.19 ± 0.09$^{ab}$ | 3.75 ± 0.09$^{ab}$ | 31.02 ± 3.13$^{a}$ | 7.08 ± 0.37$^{a}$ |
| 3.1-4 h | 113 | 4.04 ± 0.11$^{ab}$ | 3.73 ± 0.18$^{ab}$ | 23.16 ± 2.42$^{a}$ | 6.45 ± 0.44$^{a}$ |
| 4.1-5 h | 39 | 3.67 ± 0.20$^{a}$ | 3.56 ± 0.18$^{ab}$ | 31.69 ± 7.70$^{a}$ | 7.22 ± 1.05$^{a}$ |
| 5.1-10 h | 31 | 3.97 ± 0.18$^{ab}$ | 3.32 ± 0.24$^{a}$ | 24.29 ± 5.79$^{a}$ | 6.84 ± 0.76$^{a}$ |
| > 10 h | 9 | 4.33 ± 0.44$^{b}$ | 4.22 ± 0.43$^{b}$ | 22.44 ± 5.24$^{a}$ | 16.28 ± 4.29$^{b}$ |
| Total | 524 | 4.03 ± 0.05 | 3.68 ± 0.06 | 29.27 ± 1.57 | 7.12 ± 0.23 |

$^{a, b}$Any two means in the same column not followed by the same letter are significantly different.

sensory analysis. The one way ANOVA analysis revealed that the overall impact of the time difference was minimal in the four test parameters conducted, especially considering the amount of RUSF products consumed by the children during the study.

It was observed that there was no statistically significant difference between children who had a meal 1 h before or more than 10 h before. The child's response by the mother/caregiver and interviewer was observed to have higher mean value for children who had their meal more than 10 h prior to the test than children who had their last meal less 10 h before the sensory analysis session.

## 4. Conclusions

According to the one way analysis done to compare means of the four products on nine different parameters, there was no statistically significant difference among the five parameters of child response as perceived by the mother, child response as

perceived by the interviewer, amount of RUSF consumed by the child during the test period, time spent with the food by the child during the study period and smell of the RUSF product as tested by the mother. There was however a statistically significant difference among the RUSF products with respect to the rest of the study parameters. Chickpea only product was rated higher than the other three products with respect to the taste of products when perceived by the mother with a mean value of 4.64, while the other three products remained statistically equal. Similarly chickpea only product was better rated with respect to the texture (4.34) as tested by the mothers, while all the other three did not have a significant difference among themselves. Chickpea only product also had statistical edge over chickpea + soya product with respect to the appearance as tested by the mother, although both products did not have a significant difference with the other two products which were statistically equal between each other.

With respect to the overall acceptability of the products as perceived by the mother, the most preferred RUSF product was chickpea only product with a mean value of 4.58, whereas all the other three were statistically equal. With this conclusion, chickpea only product was qualified for the acceptability trial; however, given that the other three were statistically equal, chickpea + soya was selected through a lottery method from the other two that are chick + soya + maize and chickpea + maize products.

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## References

[1] Nutriset Group. 2008. “Nutriset Briefing Documents for Ready-to-Use.” Accessed October 11, 2010. www.nutriset.fr.

[2] Valid International and Concern Worldwide. 2006. *Community Based Therapeutic Care (CTC) Field Manual.*

[3] Patel, M. P., Sandige, H. L., Ndekha, M. J., Briend, A., Ashorn, P., and Manary, M. J. 2005. “Supplemental Feeding with Ready-to-Use Therapeutic Food in Malawian Children at Risk of Malnutrition.” *Journal of Health, Population and Nutrition* 23 (4): 351-7.

[4] Galpin, L., Thakwalakwa, C., Phuka, J., Ashorn, P., Maleta, K., Wong, W. W., and Manary, M. J. 2007. “Breast Milk Intake Is not Reduced More by the Introduction of Energy Dense Complementary Food than by Typical Infant Porridge.” *Journal of Nutrition* 137 (7): 1828-33.

[5] Manary, M., Ndekha M., Ashom, P., Maleta, K., and Briend, A. 2004. “Home-Based Therapy for Severe Malnutrition with Ready-to-Use Food.” *Archives of Disease in Childhood* 89 (6): 557-61.

[6] Matilsky, D. K., Maleta, K., Castleman, T., and Manary, M. J. 2009. “Supplementary Feeding with Fortified Spreads Results in Higher Recovery Rates than with Corn/Soy Blend in Moderately Wasted Children.” *Journal of Nutrition* 139 (4): 773-8.

[7] UNICEF. 2009. *Report on Tracking Progress on Maternal Nutrition: A Survival and Development Priority.*

[8] FAO and IPC Global Partners. 2008. “Integrated Food Security Phase Classification (IPC).” Technical Manual Version 1.1. Accessed May 2008. http://www.fao.org/docrep/010/i0275e/i0275e.pdf.

[9] Bovell-Benjamin, A. C., Allen, L. H., and Guinard, J. X. 1999. “Toddlers’ Acceptance of Whole Maize Meal Porridge Fortified with Ferrous Bisglycinate.” *Food Qual. Pref.* 10 (2): 123-8.

[10] Lawless, H. T., and Heymann, H. 2010. *Sensory Evaluation of Food: Principles and Practices,* 2nd ed.. New York: Springer, 125-36.

[11] Cooper, J. O., Heward, W. L., and Heron, T. E. 2006. *Applied Behaviour Analysis,* 2nd ed.. New Jersey, USA: Prentice Hall Publishing.

[12] Byer, A. J., and Saletan, L. T. 1961. “A New Approach to Flavor Evaluation of Beer.” *Proc. Amer. Soe. Brewing Chemists* 5: 120-35.

[13] Koster, E. P., Couronne, T., Leone, F., Levy, C., and Marcelino, A. S. 2003. “Repeatability in Hedonic Sensory Measurement: A Conceptual Exploration.” *Food*

*Quality and Preference* 14 (2): 165-76.

[14] Kimmel, S. A., Sigman-Grant, M., and Guinard, J. X. 1994. "Sensory Testing with Young Children." *Food Technology* 48: 92-9.