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Published in:
Appetite

DOI:
10.1016/j.appet.2015.12.030

Publication date:
2016

Document version
Publisher's PDF, also known as Version of record

Appetite 99 (2016) 34–45

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

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ARTICLE INFO

Article history:
Received 13 September 2015
Received in revised form
28 December 2015
Accepted 29 December 2015
Available online 2 January 2016

Keywords:
Acceptability
Supplementary food
Lipid-based nutrient supplement
Corn soy blend
Moderate acute malnutrition

ABSTRACT

The objective of this study was to evaluate, within the context of a randomized controlled trial of product effectiveness, the acceptability of new formulations of six corn-soy blended flours (CSB) and six lipid-based nutrient supplements (LNS) with different quantities of milk and qualities of soy for the treatment of children with moderate acute malnutrition (MAM).

Our study included 1546 children aged 6–23 months and involved questionnaires after one month of supplementation home visits and interviews with a sub-sample of 20 trial participants and their caretakers, and nine focus group discussion.

All 12 products were well accepted in terms of organoleptic qualities and received good ratings. However, LNS were more appreciated by caretakers and children. Additionally, an effect of soy isolate was detected on child appreciation where products with high milk content also received better ratings. CSB were not consumed as readily; 33.9% (n = 257) of children receiving CSB were reported to have leftovers compared to 17.3% (n = 134) of children receiving LNS (p= < 0.001). Both CSB and LNS were referred to as foods with medicinal properties and perceived as beneficial to child health. They were both reported to have high priority in the daily feeding of the child.

In conclusion, there were minimal differences in acceptability of the various CSB and LNS formulations, although CSB were less readily consumed and required smaller meal volumes. Since all products were well-accepted, decisions regarding whether the more expensive products should be used for the treatment of MAM will need to be based on their effect on child nutrition, growth and health. Future supplementary feeding programs in similar contexts could furthermore consider introducing supplementary foods as a medical treatment, as this may increase adherence and decrease sharing.

Abbreviations: MAM, moderate acute malnutrition; CSB, corn-soy blends; LNS, lipid-based nutrient supplements; WHO, World Health Organization; DS, dehulled soy; SI, soy isolate; DSM, dry-skimmed milk; MUAC, mid-upper arm circumference.

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http://dx.doi.org/10.1016/j.appet.2015.12.030

1. Introduction

Moderate acute malnutrition (MAM) defined as a weight-for height z-score (WHZ) between −2 and −3, affects around 33 million children and is a major global health problem, causing increased morbidity and mortality and delayed cognitive development (M.M Black et al. 2008; R.E Black et al. 2013; Lenters, Wazny, Webb, Ahmed, & Bhutta, 2013). Despite the development of lipid-based nutrient supplements (LNS) and enhanced versions of corn-soy blends (CSB) in recent years, there is currently no standardized practice for the management of MAM. A larger evidence base to ensure informed policies on efficacious treatment of MAM is therefore needed (Kennedy, Branca, Webb, Bhutta, & Rebecca, 2015; World Health Organization, 2012).

The development of new supplementary foods for the treatment of MAM is challenged by many uncertainties which may affect the acceptability of the foods, due to difference in formula, organoleptic qualities and flatulence factor (Briend, AkomoBahwereDe PeeDibariGolden, Manary, & Ryan, 2015). Poor acceptability may lead to suboptimal use, thus rendering nutritional interventions less beneficial in terms of growth and repletion of nutritional deficiencies (Flax et al. 2010; Santos et al. 2005). An understanding of factors affecting acceptability is therefore essential for an effective provision of supplementation programs.

Soy isolates and dairy products represent first choice in terms of quality and low levels of anti-nutrients in supplementary foods, but are expensive ingredients. The formulation of alternative foods with more crude, less expensive soy products or with lower quantities of milk could improve coverage of treatment of MAM but would be worth implementing only if both efficacy for child health and acceptability of the products was not compromised by using cheaper versions. Acceptability of soy vs milk-based foods for the management of MAM have so far also only been compared in a few studies, and only in LNS, where both were reported to be well-accepted (Kuusipalo, Maleta, Briend, Manary, & Ashorn, 2006; Mangani et al. 2013; Matilsky, Maleta, Castleman, & Manary, 2009). The acceptability of CSB vs LNS has also previously been investigated, with results indicating similar acceptability (Flax et al. 2009; Matilsky et al. 2009). However, CSB were more likely to be shared (Wang et al. 2013) and LNS were less likely to be left-over (Flax et al. 2010; Iuel-Brockdorf et al. 2015). To our knowledge, no studies have assessed and compared the acceptability of CSB vs LNS, both with different quantities of milk and different qualities of soy.

The objective of our study was to evaluate the acceptability of new formulations of CSB and LNS with different quantities of milk and with soy isolates or soy flour developed for the management of MAM. Acceptability was assessed based on general appreciation and organoleptic qualities, the recommended quantity consumed, perceptions about the supplements, their perceived ease of use and sharing practices, which are indicators of acceptability previously used (Adu-Afarwuah et al. 2008; Bahwere, Sadler, and Collins 2009; Cohuet et al. 2012; Rowe, Brodegard, Pike, Steele, & Dunn, 2008). A mixed approach of quantitative and qualitative methods was applied to obtain detailed and nuanced information concerning factors that could affect acceptability.

2. Methods

2.1. Study setting

The study took place in the Province du Passoré in the Northern region of Burkina Faso between September 2013 and February 2015. The prevalence of severe acute malnutrition (SAM) defined as a weight-for-height of less than −3 z-scores or a mid-upper arm circumference (MUAC) of less than 115 mm and of MAM in the area were 1.4% and 9%, respectively (Ministere de la Santé, Burkina Faso, Direction de la Nutrition 2013). A 3–5 months long hunger-gap – a period of seasonal scarcity between harvests – usually starts from June (Famine Early Warning Systems Network, 2014) and coincides with the rainy season.

The study was conducted at five sites, all established as part of governmental health centres (Gomponsom, Latoden, Bagaré, Bokin and Samba), where research activities were managed by locally recruited staff from the non-governmental organization *Alliance for International Medical Action* (ALIMA).

2.2. Intervention

The supplementary foods included six CSB and six LNS with either dehulled soy (DS) or soy isolate (SI) and with 0%, 20% or 50% of total protein as dry-skimmed milk (DSM). All supplements were manufactured by GC Rieber Compact A/S (Bergen, Norway) and had similar micronutrient content provided by a pre-mix of vitamins and minerals designed according to a WHO Technical Note on supplementary foods for the management of MAM (World Health Organization, 2012) (Table 1). A daily ration of LNS (92 g, 60 ml volume) and CSB (120 g, 600 ml volume) provided 500 kcal per child. LNS were packed in 92 g foil sachets containing a daily ration and did not require any preparation. Caretakers were advised to serve one sachet of LNS in one or more meals throughout the day. If the child was not able to complete one sachet in one day, discarding the sachet was instructed and starting with another one the next day.

CSB supplements were packed in foil bags of 1.7 kg, corresponding to 14 days of daily rations. The CSB flours were recommended to be cooked with water and served as porridge. Individual dose cups (per meal) were provided and caretakers were instructed how to prepare the porridge with a CSB-water volume ratio of 1:4. They were advised to serve the porridge in 3 meals per day, giving 40 g of CSB (167 kcal) per meal. This corresponded to around 200 ml per meal, in order not to exceed the gastric capacity of the child (Pan American Health Organization, World Health Organization 2003). Caretakers were advised to discard leftovers.

Caretakers were informed that their children were malnourished. All supplements were introduced as a medical treatment to treat malnutrition and to be exclusively consumed by the child included in the study in addition to family foods (Box 1).

The study was conducted as part of a randomized controlled trial investigating the effectiveness of the 12 new formulations of CSB and LNS for the treatment of MAM. The trial is registered at www.controlled-trials.com (ISRCTN42569496). Effectiveness results for the trial will be reported separately. The study included questionnaires for all trial participants, as well as individual interviews, focus group discussions (FGD) and home visits with structured observations on a subsample of trial participants.

2.3. Quantitative assessment: questionnaire-based evaluation after one month of supplementation

2.3.1. Participants

Children were screened by MUAC in villages by community health workers or by designated screening teams using both MUAC and WHZ. Additionally, caretakers could bring children to the study site, or be referred from a health centre. Final assessment of study eligibility was performed at sites.

Children aged 6–23 months with MAM, defined as MUAC ≥115 mm and <125 mm and/or WHZ ≥ −3 and < −2 based on WHO growth reference (WHO | WHO Child Growth Standards,

Table 1
Food composition table of the 12 experimental supplementary foods.

Nutrient	Unit	Recommended composition[a]	Corn soy blend (CSB) per 120 g[b]						Lipid-based nutrient supplement (LNS) per 92 g					
			1	2	3	4	5	6	7	8	9	10	11	12
Energy	Kcal	500 kcal	500 kcal						500 kcal					
Fat	g	12.5–32.5	11.4	11.7	11.4	11.4	11.4	11.4	31.6	31.5	32.1	31.4	31.5	31.4
Protein	g	10–21.5	16.8	16.5	16.5	15.9	16.2	16.5	13.5	13.5	13.1	12.5	12.8	13.1
Soy quality[c]			Flour	Flour	Flour	Isolate	Isolate	Isolate	Flour	Flour	Flour	Isolate	Isolate	Isolate
DSM[d]	%		0	20	50	0	20	50	0	20	50	0	20	50
Calcium	mg	500–700	600						600					
Iron[e]	mg	9–15	12						12					
Magnesium	mg	140–210	175						175					
Phosphorus[f]	mg	425–700	563						563					
Potassium	mg	750–1100	925						925					
Sodium	mg	max 250	<250						<250					
Zinc	mg	10–17.5	14						14					
Copper	mg	0.5–1.8	1.15						1.15					
Manganese	mg	0.5–1.0	0.75						0.75					
Selenium	µg	17.5–45	31.5						31.5					
Iodine	µg	75–175	125						125					
Vitamin C	mg	>75	188						94					
Thiamin B1	mg	>0.5	1.0						0.65					
Riboflavin B2	mg	>2.0	3.0						2.5					
Niacin	mg	>12.5	20.2						15.5					
Pantothenic acid	mg	>2.5	4.5						3.2					
Vitamin B6	mg	>1	1.8						1.25					
Folate[g]	µg	>200	510						425					
Biotin	µg	>10	13.8						12.5					
Vitamin B 12	µg	>2.5	4.1						3.15					
Retinol	µg	1000–1500	1375						1250					
Vitamin E	mg	>15	22.8						19					
Vitamin D	µg	10–30	22.0						20					
Vitamin K	µg	>25	34.7						31.5					

[a] WHO | Technical Note: supplementary foods for the management of moderate acute malnutrition in infants and children 6–59 months of age, 2012.
[b] The content of some of the water soluble vitamins have been increased to compensate for degradation during cooking of CSB.
[c] Flour = Dehulled soy flour; Isolate = Soy protein isolate.
[d] Dry Skimmed Milk, presented as percentage of total protein.
[e] Range of recommended values based on 10–5% bioavailability (WHO, 2012).
[f] Excluding Phosphorus from phytate as it is not bioavailable (WHO, 2012).
[g] Dietary folate equivalent.

2014) and resident in the catchment area were randomized to participate in the study. If more than one child from the same family (same mother and same father) were eligible, only the first child assessed was randomized. However, to prevent mixing or sharing of the supplements, twins without malnutrition and siblings aged 6–23 months with MAM received the same supplement. The caregivers gave verbal and written consent by thumb print prior to enrolment.

2.3.2. Design

Children were randomised to one of the 12 different supplements according to a blocked randomisation list using http://www.randomization.com, with varying blocks of 12 or 24 and stratified by site. After one month of supplementation, caretakers gave verbal answers to a structured questionnaire conducted by a research assistant dedicated specifically to this task. The questions were asked and answered in the local language and included questions

evaluating the appreciation, taste, colour, odour and texture of the supplements according to the child's reaction as perceived by the caretaker and caretaker's own perception, based on a 5-point hedonic scale, where 1 = very good, 2 = good, 3 = neutral, 4 = bad and 5 = very bad. The scale was illustrated in a series of human face symbols with varying degrees of smile or discontent, which is a method previously used to measure food acceptability in illiterate populations (Cohuet et al. 2012; Hess et al. 2011). Additionally, questions related to the management of the supplementary foods and perceptions of their utilisation and effects were included. The questionnaire was developed together with a local research assistant and piloted prior to the study (Iuel-Brockdorf et al. 2015).

Box 1
Educational messages about the use of the products.

General
- The supplement is a treatment to treat malnutrition
- The supplement should not be shared with others
- For breastfed children, breastfeeding should be continued on demand. Children <12 months should be breastfed prior to supplementation.
- The supplement should not replace local foods but be given in addition to them.

CSB
- The porridge should be given 3 times a day
- Use clean water for the preparation of the porridge
- Take four cups of water for one cup of flour. Water can be reduced or increased depending on desired viscosity of porridge.
- Once water is boiling, add the flour and boil for a minimum of 5 min and a maximum of 10 min.
- Porridge should cool of for a few minutes before giving it to the child.
- Use a separate plate to feed the child to make sure he or she eats all the food given, and that it is not shared with others
- Porridge should be eaten immediately after being prepared. Uneaten porridge must not be saved for later. Porridge that is kept for too long can make the child sick
- The porridge may not be shared with other children or adults

LNS
- One sachet per child per day – this can be divided in several meals
- Before opening the sachet, squeeze the content around and ensure that it is mixed well
- Before opening the sachet, wash it with water and soap
- The supplement does not require any preparation, but can be given straight from the sachet or on a finger or a spoon
- If the child cannot finish the supplement in one take, close the sachet carefully and keep it stored in a clean, dry and cool place. Then try again later.
- If the supplement is not eaten by the end of the day, do not save it for the next day
- Offer plenty of clean water to drink when the child is eating the supplement, the child will need to drink more water than usual
- The supplement must not be shared with other children or adults

Following the pilot study, few adjustments in terms of modification and rephrasing of certain questions were made.

2.4. Qualitative assessment: home visits and focus group discussions

2.4.1. Participants

Purposive sampling was used for this part of the study by including a subsample of participants from the main trial, recruited at three of the five research sites (Gonponsom, Latoden and Bokin). The study was conducted both during the dry and rainy season as seasonality was considered to influence feeding practices and food availability which could affect acceptability. Study participants from each of the main supplemental food categories (CSB and LNS) were selected, but as the trial was blinded, other aspects of the food composition (quality of soy and quantity of milk) were not considered in the selection.

2.4.2. Design

A subsample of 20 caretakers and their children were observed during home visits for three consecutive days during daytime (from 7-8 am to 5–6 pm) by a trained female local research assistant. The observations took place after a minimum of one month of supplementation. The assistant followed a structured observation schedule with the aim of assessing feeding behaviours in relation to supplementary feeding and also took notes throughout the day. Additionally, the number of daily rations of supplement left in the household was assessed at the first day and compared to number of days until next supplementation visit. Finally, caretakers were asked to evaluate the health status of their child every day during the three days of observation on a scale from one to ten, where one was perfectly healthy and ten was as sick as could be imagined.

Individual interviews were carried out with the 20 caretakers at the second day of the home visits. Additionally, nine FGDs were carried out at the research sites with caretakers of other participants from the main trial, in groups of five to seven participants per group. Both methodologies were used to explore perceptions about the supplements. The number of interviews/FGDs was based on the principle of data saturation, including new participants as long as new themes emerged, so that emerging information would be comprehensive, saturated and account for deviant cases, with the aim of achieving analytical generalization. The interviews and FGDs were carried out in the local language Mooré by two research assistants trained for the purpose by the first author. The interviews and FGDs lasted between 20 and 45 min and were carried out following a semi-structured interview guide using mainly open-ended questions. The interview guide was carefully discussed and developed with the research assistants prior to the study, to ensure semantic coherence and relevance to the context. All interviews and FGDs were recorded, transcribed and translated from Mooré to French by the research assistants and from French to English by the first author. The analysis of the data was done using the English translation.

3. Data analysis

Quantitative data including data from the structured questionnaires and the home visits were doubly entered into Epidata 3.1 Software (Epidata Association, Odense, Denmark) and analysed using Stata 12 (StataCorp, College Station TX, USA).

For continuous outcomes (*appreciation, organoleptic qualities of the supplementary foods* and *frequency of feeding*), linear mixed models were fitted; supplements as well as adjustment for age, sex, and season were fixed effects and sites were included as random

effects to account for clustering effects. Model checking was based on visual inspection of residual and normal probability plots.

Reported *leftovers* (yes/no) were treated as binary outcome and analysed using logistic mixed-effects regression including adjustment for age and sex and random effects for sites. Additionally, the interaction between product groups (CSB and LNS) and age groups (2 intervals: 6–11 months and 12–23 months) was investigated in a separate analysis, also using logistic mixed-effects regression. Specifically for the continuous outcomes pertaining to *appreciation* and *organoleptic qualities* as well as for the binary outcome (*leftovers)*, differences between the 12 supplements were evaluated in terms of the three-way interaction between CSB/LNS, soy quality, and quantity of milk. Likelihood ratio tests were used for this evaluation. If significant, pairwise comparisons between supplements were carried out. Otherwise each of the three factors (main effects) was evaluated separately by means of pairwise comparisons of factor levels.

For the ordered multinomial outcomes related to *the perception and management* of the supplements, ordered logistic regression models were fitted. These models also included adjustment for age, season, and sex. To account for clustering effects due to the sites, robust standard errors were used. For these outcomes, only the main effect of CSB/LNS was considered, and reported as percentages. T-tests were used to compare LNS and CSB.

The analysis of the qualitative data was done manually by the first author, using principles of Qualitative Content Analysis as described by Graneheim and Lundman (2004). First, each interview and FGD was kept intact and read through several times in both French and English to obtain a general sense of the content, searching for common themes and identifying manifest and latent content pertaining to the aim of this study. From the English text, condensed meaning units or portions of the text that were connected to a central meaning were formed and coded for that specific meaning and classified into categories (more than one per unit was permitted) from where themes emerged. Finally, findings from each of the interviews/FGDs were compared with the aim of exploring similarities, differences and patterns in the acceptability of CSB and LNS, with a focus on the subject and the context. Other aspects of the composition of the products, such as the quality of soy and quantity of milk, to which the participants were blinded, were not considered in the analysis of the findings.

4. Ethical approval

As part of the main trial, this study was approved by the Ethics Committee for Health Research in Burkina Faso (2012-8-059) and consultative approval was obtained from the Danish National Committee on Biomedical Research Ethics (1208204).

5. Results

5.1. Characteristics of participants from the questionnaires

During the course of nine months, 1.613 children were included in the main study. Of these, 1.546 (95.8%) children, who had completed one month of supplementation, were included in this analysis (Fig. 1). The mean age (SD) was 13.3 (4.8) months and 94.6% (n = 1460) of the children were breastfed at the time of inclusion. The ethnicity of caretakers was Mossi for 94.1% (n = 1512). The majority, 59.0% (n = 949), were Muslim, 23.7% (n = 381) were Catholic, 6.2% (n = 99) were Protestant and 11.1% (n = 178) had traditional beliefs. Randomization generally resulted in baseline equivalence, except that proportion of males ranged from 41.5 to 51.9% (Table 2).

5.2. Characteristics of participants from the home visits/interviews and FGDs

For the observational visits, the 20 children and their caretakers from the main trial recruited had baseline characteristics similar to the larger group in the questionnaire component of the study. Ten of the children received CSB and ten received LNS. Eighteen of the children were living with both parents, while one lived with only the mother and one lived with the grandmother. The mean health status score (SD) was 1.9 (1.7) for children receiving CSB and 1.4 (0.5), for children receiving LNS on the health status score from one to ten, with one being the most healthy. The mean duration of the home visits (SD) were 9.4 h (0.7), and children had completed an average (SD) of 6.5 (2.2) weeks of supplementation at the time of the visit. A total of 95 meals with the supplementary foods were observed during the home visits: 48.4% (n = 46) were CSB meals and 51.6% (n = 49) were LNS meals. Fifty percent (n = 30) of the home visits were conducted during the rainy season.

Eight of the FGDs were with caretakers of children receiving only one of the product types (CBS or LNS) and one mixed FGD with caretakers of children receiving either CSB or LNS. A total of 51 female caretakers participated in the FGDs and the mean (SD) age was 30 years (7.2).

5.3. Questionnaire-based evaluation

The mean rating in terms of appreciation and organoleptic properties ranged from 1.74 to 2.02 on a scale from one to five, with one being very good and five being very bad (Table 3).

When evaluating three way interactions between CSB/LNS, soy quality, and quantity of milk, we found no interaction, except in terms of child appreciation, where an effect of soy isolate was detected; CSB with soy isolate received 0.15 (95% CI -0.07; 0.24) poorer (higher) ratings than CSB with dehulled soy ($p = 0.001$) and LNS with soy isolate received −0.06 (95%CI -0.15; −0.03) better (lower) ratings than LNS with dehulled soy ($p = 0.190$). Products with high milk content received −0.08 (95% CI -0.16;−0.01) better (lower) ratings on this parameter ($p = 0.025$) (Table 3).

In terms of both child and caretakers appreciation, LNS showed lower (better) ratings compared to CSB (est. diff. −0.16, 95% CI -0.22; −0.10, $p < 0.001$ and est. diff. −0.06, 95% CI -0.09; −0.02, $p = 0.004$, respectively) (Table 3). Lastly, although differences were small, there was an association between season and rating with lower (better) ratings during the rainy season (June–October) than during the dry season (November–May) in terms of child appreciation (−0.13 (95% CI -0.20; −0.07), $p < 0.001$), odor (−0.07 (95% CI -0.12; −0.01), $p = 0.015$), and texture (−0.04 (95% CI -0.07; −0.003), $p = 0.030$).

The daily recommended ration to consume was reported to be adequate by the majority of caretakers, although, there were differences between CSB and LNS ($p = 0.029$) (Table 4). Leftovers at the end of the day were more frequently reported in the CSB group compared to the LNS group (33.9% vs 17.3%, $p < 0.001$) and were less likely during the rainy season (OR = 0.66, $p = 0.05$). There were no interaction between age group and CSB/LNS ($p = 0.80$). However, younger children (6–11 months) were more likely to have leftovers compared to older children (12–23 months) (31.4% vs 20.1%, $p < 0.001$). Finally, the quantity of and management of leftovers differed between CSB and LNS as described in Table 4.

The majority of caretakers said that they perceived the supplements mainly as medicine for children (54.8%, n = 845) or vitamins (32.2% n = 497), that the supplement should be distributed to malnourished children (84.6%, n = 1305) and given to treat children from malnutrition (87.2%, n = 1.345) (Table 5).

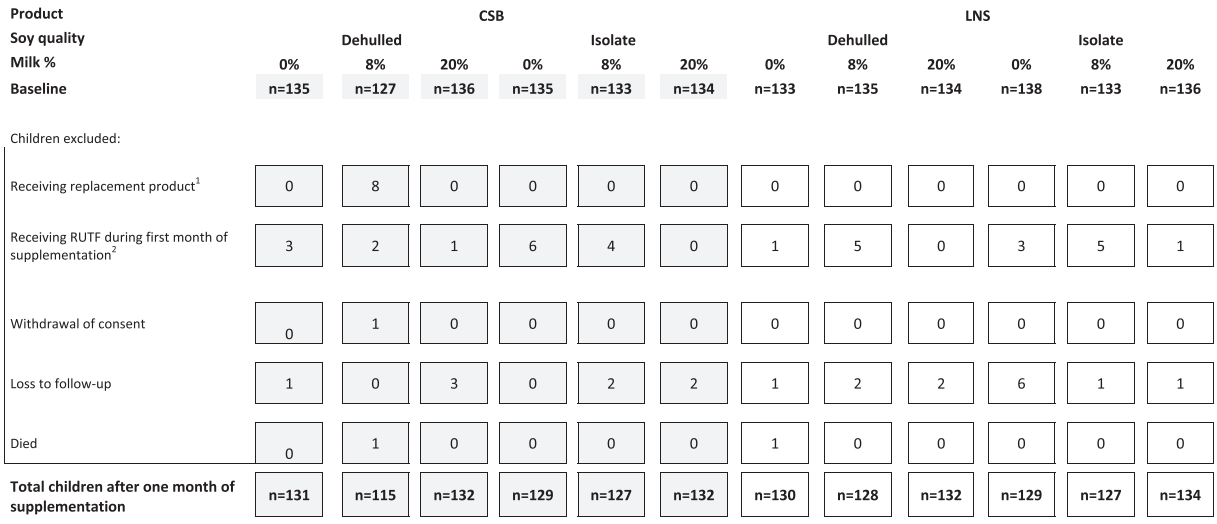

Fig. 1. Flowchart of participants from baseline to one month of supplementation.

Table 2
Baseline characteristics of participants (n = 1.609) by intervention group.

Product	CSB						LNS					
Soy quality	Dehulled			Isolate			Dehulled			Isolate		
Milk %	0%	8%	20%	0%	8%	20%	0%	8%	20%	0%	8%	20%
n of children	135	127	136	135	133	134	133	135	134	138	133	136
Age of children (months), mean (SD)	11.8 (4.7)	12.9 (4.7)	13.1 (5.0)	12.3 (5.0)	12.3 (4.3)	11.5 (4.6)	13.0 (4.7)	12.5 (5.2)	12.2 (4.4)	12.1 (5.0)	12.3 (5.1)	12.8 (5.1)
Sex, masculin % (n)	41.5 (56)	44.9 (57)	48.5 (66)	44.4 (60)	44.4 (59)	43.3 (58)	51.9 (69)	46.7 (63)	46.3 (62)	42.2 (61)	46.6 (62)	41.9 (57)
W/H Zscore at admission, mean (SD)	−2.2 (0.6)	−2.3 (0.5)	−2.2 (0.5)	−2.2 (0.5)	−2.2 (0.5)	−2.2 (0.4)	−2.3 (0.5)	−2.2 (0.5)	−2.2 (0.5)	−2.3 (0.5)	−2.2 (0.5)	−2.1 (0.5)
MUAC at admission, mean (SD)	121.8 (4.1)	122.8 (4.1)	123.0 (4.1)	122.4 (3.9)	122.8 (3.7)	122.7 (3.9)	123.1 (4.7)	122.7 (3.5)	122.3 (3.7)	122.5 (3.8)	122.5 (3.9)	122.9 (3.9)
Breastfeeding at admission % (n)	96.3 (130)	93.7 (119)	92.6 (125)	95.6 (129)	95.5 (127)	93.3 (125)	95.5 (126)	91.1 (123)	98.5 (132)	94.2 (130)	93.2 (124)	96.3 (131)
Age of caretaker (SD)	26.9 (6.4)	27.5 (6.2)	27.6 (6.3)	27.4 (6.3)	26.1 (6.5)	27.2 (5.6)	27.6 (5.6)	27.4 (6.9)	28.0 (7.0)	26.5 (6.7)	27.4 (5.9)	26.9 (6.1)
Mother absent % (n)	3.0 (4)	0.8 (1)	3.0 (4)	0.8 (1)	1.5 (2)	2.3 (3)	0.8 (1)	2.3 (3)	0	0.7 (1)	1.5 (2)	0.7 (1)
Educational level of mother % (n)												
No education	84.5 (114)	88.2 (112)	87.4 (118)	83.0 (112)	76.7 (102)	83.6 (112)	89.5 (119)	79.3 (107)	88.8 (119)	84.8 (117)	88.7 (118)	91.9 (124)
Primary	9.6 (13)	7.9 (10)	9.6 (13)	10.4 (14)	15.0 (20)	14.9 (20)	6.8 (9)	13.3 (18)	6.0 (8)	9.4 (13)	7.5 (10)	5.9 (8)
Secondary	5.2 (7)	3.9 (5)	2.2 (3)	6.7 (9)	8.3 (11)	1.5 (2)	3.7 (5)	5.9 (8)	5.2 (7)	5.1 (7)	3.8 (5)	2.2 (3)
> Secondary	0.7 (1)	0	0	0	0	0	0	0	0	0.7 (1)	0	0
Unknown	0	0	0.8 (1)	0	0	0	0	1.5 (2)	0	0	0	0
Household members, mean (SD)	12.8 (8.2)	13.3 (8.4)	13.8 (7.7)	13.6 (9.5)	12.8 (8.0)	13.7 (9.6)	13.7 (9.3)	12.9 (9.6)	13.2 (6.9)	12.9 (7.9)	13.4 (8.2)	12.1 (7.0)

5.4. Findings from the home visits

There was no difference between CSB and LNS in terms of amount of excess or shortage of daily rations (p = 0.99). A mean (95% CI) number of 0.5 (−0.9; 2.8) of excess ration was found, corresponding to 3.6% of the fortnightly ration.

Leftovers were registered after the meal with the supplementary foods in 84.8% (n = 39) of the CSB meals (serving 40 g, 1/3 of a daily ration) and in 77.6% (n = 39) of the LNS meals (serving 92 g, one daily ration) (p = 0.04). Younger children (6–11 months) were more likely to have leftovers (data not shown), but there was no interaction between product groups and age groups (p = 0.22). Half or more than half of the CSB supplement was left in 66.7% (n = 26) of the observed meals and in 68.4% (n = 26) of the LNS meals.

Leftovers of CSB were either thrown out (41%, n = 16), consumed by another child (30.8%, n = 12) or saved for later (23.1% n = 9). Leftovers of LNS were mainly observed to be saved for later (89.5%, n = 34), and reported to be consumed in the evening or thrown out (7.9%, n = 3). In one LNS meal (2.6%), leftovers were observed to be consumed by another child.

Sharing of the supplementary foods was observed in 37.0% (n = 17) of the CSB meals and in 36.7% (n = 18) of the LNS meals, predominantly with another child in the household (CSB: 82.4% (n = 14), LNS: 94.4%, n = 17). Caretakers were recipients of the remaining shared meals. Whereas sharing of LNS was mainly done during the supplementary meal (88.9%, n = 16), sharing of CSB was primarily done afterwards (76.5% n = 13).

5.5. Interviews and focus group discussions

Some of the main themes emerging from the interviews and FGDs were *perception* and *acceptability* of the supplementary foods as well as *adherence* to treatment and *sharing* of the foods. As findings did not differ much, the presentation of data from both interviews and FGDs has been combined.

5.5.1. Perceptions and organoleptic qualities

The supplementary foods were referred to as “Yombdo” in

Table 3
Estimated appreciation and organoleptic ratings of the supplements on a 5-point hedonic scale[a] 1 = very good, 2 = good, 3 = neutral, 4 = bad, 5 = very bad.

	Child appreciation[b]			General appreciation			Taste			Smell			Texture			Colour		
	Est diff	95%CI	P-value	Est diff	95%CI	P-value	Est diff	95%CI	P-value	Est diff	95%CI	P-value	Est diff	95%CI	P-value	Est diff	95%CI	P-value
Product																		
CSB	.			.			.			.			.			.		
LNS	- 0.16	−0.22; −0.10	*<0.001*	−0.06	−0.09; −0.02	*0.004*	0.03	−0.02; 0.07	0.275	−0.02	−0.07; 0.03	0.367	−0.002	−0.03; 0.03	0.913	−0.02	−0.05; 0.01	0.146
Soy																		
Dehulled	.			.			.			.			.			.		
Isolate	0.05	−0.02; 0.12	0.139	−0.003	−0.04; 0.03	0.855	0.02	−0.02; 0.07	0.329	0.03	−0.02; 0.08	0.211	0.003	−0.03; 0.03	0.847	0.01	.0.02; 0.04	0.666
Milk																		
0%	.			.			.			.			.			.		
20%	−0.04	−0.12; 0.04	0.289	−0.04	−0.08; 0.01	0.129	0.04	−0.02; 0.09	0.224	0.03	−0.03; 0.09	0.360	−0.02	−0.05; 0.02	0.381	−0.01	−0.05; 0.02	0.509
50%	−0.08	−0.16; −0.01	*0.025*	−0.05	−0.10; −0.01	*0.030*	0.03	−0.03; 0.08	0.328	−0.002	−0.06; 0.06	0.926	0.002	−0.03; 0.04	0.891	−0.002	−0.04; 0.03	0.875

Italics are used to highlight results with p-values < 0.05.
[a] Mean ratings (SD): Child appreciation; 1.84 (0.70), General appreciation; 1.74 (0.50), Taste; 1.90 (0.50), Smell; 2.03 (0.55), Texture; 1.92 (0.35), Colour; 1.90 (0.35).
[b] A product–soy interaction was found: CSB/soy isolate: est. diff; 0.15 (95% CI -0.07; 0.24), p = 0.001. LNS/soy isolate: est. diff. −0.06 (95%CI -0.15; −0.03), p = 0.190.

Mooré which means “child with wrinkled skin”, and is also a word used to describe malnutrition. They were said to be given to treat children from malnutrition and/or illness or to strengthen the health of the child, and caretakers expressed a high level of trust in the abilities of the supplements.

If he eats it [LNS] and it enters into his body, the power of the supplement eliminates the disease that is in his body and cures him. (33-year old caretaker of 7-months old child)

The CSB is really good. The day of my inclusion my child was really doing badly. When they placed him on his back, he couldn't even roll over on his stomach, he couldn't even open his eyes, and at the blood samples the nurse searched in vain. He was really malnourished, almost dying. But when I came back two weeks later, he was in good shape, you would almost say that he was re-born (laughing). (FGD, Latoden)

As such, the supplements were most often referred to as food with medicinal properties or medicine and the medicinal qualities of both types of supplements were often highlighted. Some said that the supplements were more medicine than food or could not be compared to food, because of their medicinal effect.

Yes, it [CSB] is medicine; it is not to be compared to other foods. (29-year old caretaker of 16-months old child)

The CSB mostly treats, so it is medicine. (FGD, Latoden)

I think that it [LNS] is medicine, even though it is a food, it is more medicine than a food … .. Because it cures, it gives good health. He was also eating before the inclusion, but his health wasn't as good as it is today. (33-year old caretaker of 7-months old child)

Other caretakers believed that the supplements were a combination of medicine and vitamins.

The [CSB] flour is a mix of medicine and vitamins that give the child appetite so that he eats well. (FGD, Gonponsom)

I think it [LNS] is medicine; it is also vitamins, which make children fit and healthy when they eat it. (27-year old caretaker of 7-months old child)

Nevertheless, some of the caretakers did refer to the CSB as food, mainly due to their ability to keep children full and their hunger satisfied.

It [CSB] is a food because if the child is eating it well, he is fed, he is full and he breastfeeds less. (30-year old caretaker of 22-months old child)

Still, the majority believed that the CSB could not be compared to normal foods.

I am saying that it [CSB] is a mix [of food and medicine], because you would say that it is flour, even though you have flour at home, but they are not comparable. The flour of CSB ensures health. (FGD, Gonponsom)

When LNS were referred to as food, it was as “food that treats” and “modern food” mainly aimed at children, because they did not resemble the local food.

You know, the supplement [LNS] is for the “white” children [children of modern times], the elderly they don't know about these types of foods. It didn't exist before. If you give the supplement to an

Table 4
Management of supplements, questionnaires 1546 participants.

Product	CSB (n = 766)	LNS (N = 780)	P-value
Reported leftovers at the end of the day, % (n)	33.9 (257)	17.3 (134)	*<0.001*
Quantity leftover % (n)			
< half	62.0 (155)	74.4 (96)	*<0.001*
half or more	37.2 (93)	25.6 (33)	
don't know	0.8 (2)	0	
Management of leftovers			
thrown out	56.2 (146)	28.8 (38)	*<0.001*
eaten by another child	39.2 (102)	63.6 (84)	
eaten by mother	3.5 (9)	3.0 (4)	
other	1.1 (3)	4.6 (6)	
Quantity to consume % (n)			
Too much	2.7 (21)	2.6 (20)	*0.029*
Just enough	94.5 (724)	88.7 (689)	
Too little	2.7 (21)	8.6 (67)	
Don't know	0	0.1 (1)	

Italics are used to highlight results with p-values < 0.05.

Table 5
Perceptions of the supplement, questionnaires 1546 children and caretakers.

Product	CSB (N = 766)	LNS (n = 780)	P-value
How to characterise the supplement % (n)			
food for children	12.9 (99)	10.0 (78)	0.148
medicine for children	53.9 (413)	55.7 (432)	
food for family	0.3 (2)	0.1 (1)	
medicine for family	0.4 (3)	0.8 (6)	
vitamins	31.9 (244)	32.6 (253)	
other/don't know	0.6 (5)	0.8 (6)	
The supplement should be distributed % (n)			
only for children	15.0 (115)	13.9 (108)	0.245
only for malnourished children	84.2 (644)	85.1 (661)	
for the entire family	0.5 (4)	0.6 (5)	
don't know	0.3 (2)	0.4 (3)	
Reason for giving the supplement % (n)			
to feed children	12.1 (93)	10.9 (85)	0.256
to feed the family	0.8 (6)	1.2 (9)	
to treat malnourished children	86.8 (664)	87.6 (681)	
don't know	0.3 (2)	0.3 (2)	

old woman, she would tell you that she doesn't want it. It is the children today that eat (32-year old caretaker of 17-months old child)

The taste of the LNS was said to suitable to children.

… … it [LNS] is not to my taste, but it [LNS] is suitable for my child (32-year old caretaker of 9- months old child)

Contrarily the taste of CSB was said to indicate that it contained medicine.

yes, when tasting it [CSB], you know that it contains a lot of medicine to help the child to recover (25-year old caretaker of 11-months old child)

Some caretakers said that they added sugar to the CSB porridge to increase the child's consumption of the products, and that the sweetness of the flour disappeared when adding water. Others said that the taste of the CSB porridge was too sweet for their child. Caretakers of children receiving LNS said that the supplements were both sweet and salty.

A few of the caretakers of children receiving LNS, commented on the odor, but said that it did not affect the consumption, while some of the caretakers of children receiving CSB said that the odour of CSB was very strong and similar to that of medicine. However, while some said that the strong odour of medicine prevented the children from consuming the supplement, others said that it disappeared when making the porridge.

My child is eating it [LNS] without any problems. The smell doesn't bother her; she also thinks that the taste is good. (29-year old caretaker of 20-months old child)

My child does not want to drink the [CSB] porridge … ... She only eats a little when I give it to her to suck on [flour un-prepared]. And when we asked her why, she said it was because it smelled. When I tasted it, I sensed that the smell of medicine was stronger than the smell of the fl (FGD, Gonponsom)

Occasionally, a bitter smell upon reception of some of the rations of CSB was reported both by the site staff and by several of the caretakers of children receiving CSB. This did not pertain to a particular supplement or batch of supplement. Most of the caretakers said that it did not affect the taste of the supplements and continued feeding the CSB to their children.

A few caretakers described that their children were refusing the supplements, whether it was CSB or LNS. However, refusal was reported to be due to the child rather than the qualities of the supplements.

I don't know if his [the child) body is wrong for this food [LNS].(20-year old caretaker of 8-months old child)

Madam, the child is too complicated (laughing). It is not just the [CSB] porridge that he refuses, he even refuses to eat other foods. (22-year old caretaker of 18-months old child)

The overall appreciation of the supplements seemed to be influenced by the fact that many of the caretakers had seen other children recovering from malnutrition when receiving the supplements and that treatment was free and supported by international partners.

It was a luck that my child was selected for free care, so it was very good for me. (30-year old caretaker of 19-months old child)

… . It is a great opportunity to participate in this kind of program, where white people are responsible. There is nothing we can do if the child is ill, there is nowhere to go, and there is nothing to do if the child is ill. But if the child is so lucky to be selected for the program of the white people, and if God extends his hands of grace, the child will surely recover and the mother can continue with her chores. (32-year old caretaker of 19-months old child)

5.5.2. Perceived ease of use

Both CSB and LNS were described as easy to use by the majority of the caretakers. The LNS were highly appreciated due to the fact that they could be consumed in one single meal or saved for later and the preparation of the CSB was described as simple. Some mentioned the workload of preparing the CSB, but said that the efforts were worthwhile, considering the purpose.

It is not tiresome [using the LNS]. When I want to give him something to eat, I sit down and take my time to encourage him to eat, and when he is full, I save the rest until it is time to eat again. (34-year old caretaker of 7-months old child)

It is simple to use and simple to prepare, four cups of water and one cup of flour, make it boil some time, it is easy to prepare … … (29-year old caretaker of 16-months old child)

No, it [preparation of CSB] is ok, as it is a question of health; you have to do it, so that our children are in good health. (28-year old caretaker of 23-months old child)

Nevertheless, caretakers mentioned difficulties managing the CSB while also having to attend the daily chores especially in comparison to LNS and especially during the season of field work. Some also reported that they served the flour unprepared to the child, for him/her to suck on (the unprepared flour had a texture like cookie crumbs), which reduced the need for preparation.

It [the preparation of CSB] is not difficult, but compared to the LNS it is not the same. During the work in the fields you have to interrupt your work, to make the porridge. But with the LNS, all you have to do is to wash the hands of the child and make a hole in the sachet and give it to him or if you want to feed him yourself, you sit down and you give it to him. With the LNS you can go to the mass at church or to the market, you can bring the sachet in your bag and give it to the child when you want to. But with the CSB you can't go anywhere; you have to respect the feeding hours and make the porridge for the child.(FGD, Latoden)

Additionally the perceived ease of use of the CSB was affected by the child's consumption of the supplement.

Especially when the child refuses to eat, you tell yourself, that if he is not eating it, and you don't have much time, you will not go through the trouble of making the porridge, as he will not even eat it. (33-year old caretaker of 18-months old child)

If the child wants to drink the porridge, making the porridge is not a big problem. (FGD, Latoden)

The supplements had high priority in the daily diet of the child, due to their perceived medicinal effect.

Because it [LNS] is medicine. First you have to give him the medicine that treats him before giving him other meals. (30-year old caretaker of 19-months old child)

It is imperative that he takes his [CSB] porridge every day, because it is medicine. You first have to treat before thinking of giving other foods. (22-year old caretaker of 18-months old child)

As soon as I wake up, I start making the [CSB] porridge, before doing anything else. Only after having served the porridge, I start to do the household chores. (FGD, Gonponsom)

However, in some cases it also affected the consumption of especially CSB in a negative way, as children would refuse them, because they thought that they were medicine. This was mainly due to the fact that the porridge was served with a spoon, which the child associated with medicine.

No it is good, she has to taste the porridge to know that it is food, if not, she will not take it, because she thinks that it is medicine, especially because it is served with a spoon …. She was sick, and she took a lot of medicine. This made her not like medicine. You have to struggle to get her to taste, so that she knows that it is porridge, before she accepts to eat it. (33-year old caretaker of 11-months old child)

The daily quantity to consume was perceived as adequate. Yet, some caretakers reported having difficulties getting their child to finish their meals. Many caretakers of children receiving CSB reported leftovers, while the majority of caretakers of children receiving LNS said that their children were able to finish their daily ration in one or several meals throughout the day.

It is a lot, she has not been able to finish the quantity I prepare for her. (33-year old caretaker of 11-months old child)

He finishes the sachet [of LNS] everyday … ….. he has never had any difficulties finishing the supplement (42-year old caretaker of 18-months old child)

In order to reduce leftovers of especially CSB, many caretakers reported serving the CSB flour unprepared for the child to suck on or by preparing the CSB as what they called “couscous”, meaning a more viscous porridge (less water added).

My child does not manage to finish the [CSB] porridge, but once you give him the flour plain to eat, he can eat more than one measure of flour. (FGD, Gonponsom)

When they gave me the CSB flours, he would not eat it when I made it. But if it is made like a couscous he eats non-stop. But if I make it as porridge, it will last all day. (FGD, Latoden)

Reasons for having leftovers were reported to be mainly due to illness and thereby reduced appetite or because the child disliked the supplement.

5.5.3. Sharing of the supplements

A majority of the caretakers said, that they did not share the supplement. However, some admitted to giving the leftovers to other children in the household, if the child refused to finish the ration. Only a few admitted to sharing the supplement with other children if they were around during feeding time.

Yes, when there are leftovers after the meal, I give him [the big brother] the remaining [of CSB]. (33-year old caretaker of 18-months old child)

… ..Sometimes I take a sachet and give it to the child of my co-wife, because she gives her sachet [of LNS] to my girl. But other than that I don't give it to anyone. (29-year old caretaker of 20-months old child)

The main reasons for sharing was not to throw away food or if other children were crying and wanting the supplement. When asked if it was culturally acceptable not to share the supplements, most of the participants said, that not sharing was acceptable or at least a necessity, in order to ensure the recovery of the child. This was mainly due to the fact that the supplements were perceived as medicine or a medical treatment.

It is ok not to share with other people. Because you have to give one sachet of supplement per day to the child, and if you shared it with other people, there would be some sachets missing, which will decrease the quantity of the supplement that the child should take in order for him to recover. (29-year old caretaker of 20-months old child)

It is ok [not to share], because it is a treatment. It is because it is flour, what if it was syrup or tablets, would you then give it to other children? (FGD, Bokin)

6. Discussion

The quantitative part of the study shows that there was only small variability between the supplements in terms of ratings of the organoleptic properties and overall, all 12 supplements received good ratings on all parameters. Previous studies on acceptability have indicated that caretakers may have been reluctant to give poor ratings if engaging in socially desirable responding (Adu-Afarwuah, Lartey, Zeilani, & Dewey, 2011; Young, Blanco, Hernandez-CorderoPelto, & Neufeld, 2010). Nevertheless, findings from the qualitative part of the study shows that some of the caretakers receiving CSB reported a bitter odour from some of the rations received. Although the reported odour could not be traced back to specific supplements or batches of supplements, CSB with DSM has previously been reported to have a "broth-like" odour compared to other CSB formulations (Kehlet, 2011). This could be a potential explanation to the described odour, which was reported not to affect consumption. In terms of taste of the supplements, some caretakers said that they added sugar to the CSB while others said that the CSB were too sweet. CSB without animal protein has previously proven to be bitterer in taste than CSB with animal protein (Kehlet, 2011). A sweeter flavour is often more palatable to young children (Lawless, 1985) and could therefore increase children's' consumption of foods. This may also explain why products with high level of milk received better ratings in terms of child appreciation and why some caretakers added sugar to the CSB. The fact that LNS received better ratings than CSB in terms of child and caretakers appreciation may also be related to the sweetness of the products, but also the perceived ease of use.

Organoleptic preferences can be difficult to assess in small children, as findings often reflect the taste and food preferences of the caretakers, which may be different from those of the child. The quantity of left-over, which is associated with child refusal (Wang et al. 2013) has therefore previously been used as an indicator of acceptability (Seth Adu-Afarwuah et al., 2011; Flax et al. 2010; Owino, Irena, Dibari, & Collins, 2014). Caretakers of children receiving CSB were more likely to report leftovers by the end of the day, compared to caretakers of children receiving LNS, which was also information emerging from interviews and FGDs. Observations made during home visits indicated a high occurrence of leftovers of both products after each meal. In this regard, it is important to consider that observations were only made during day-time and that the CSB meal consisted of 1/3 of a daily ration to be consumed in one meal according to recommendations as opposed to the LNS meal, which was served directly from the sachet containing one daily ration. Due to the latter, leftovers of LNS would be more likely. These findings indicate that the proposed single meal portion size of CSB was difficult to consume. Similar results were found in other studies comparing CSB with LNS (Flax et al. 2010; Nackers et al. 2010) and are also supported by findings from the pilot study (Iuel-Brockdorf et al. 2015). Despite both reported and observed leftovers, the majority of caretakers in all groups reported that the daily ration was adequate and that refusal of the supplement was mostly due to illness or attributed to the child, and not, as such, the qualities of the supplements. Nevertheless, foods with low energy are more satiating, but less palatable compared to high energy foods which are more palatable but less satiating (Drewnowski, 1998). The fact that CSB were less readily consumed compared to LNS is therefore likely due to the fact that they are less energy dense, and have high volume compared to the high-energy dense and low volume LNS (de Pee & Bloem, 2009). For this reason, children have to eat several times the mass of food than if they were treated with LNS (LaGrone et al. 2012). This may also be one of the reasons why many caretakers reported serving the CSB flour plain or with a higher viscosity, as this could be a way of reducing the volume. In order not to exceed the gastric capacity of the children, smaller and more frequent meals of semi-solid blended foods have previously been recommended (Brown et al. 1995). However, preparation of CSB is time and resource-consuming, so recommendations made by the research team was a compromise between promoting regular and smaller meals and to reduce the burden on caretakers and household. Although both supplements were described as easy to use, caretakers of children receiving CSB acknowledged the workload of preparing the CSB, especially during the season of fieldwork. Increasing the frequency of feeding to reduce the volume per meal may therefore be difficult for caretakers in this context.

A certain degree of household sharing took place, mainly with another child in the household. During the home visits, more than one third of all observed meals were shared with other household members. This contrasts with the interviews and FGDs where the majority of caretakers said that the supplements were not shared. Similar discrepancy between observed and reported rates of sharing has been reported previously (Abbeddou et al. 2014; Flax et al. 2010). This could be due to participants engaging in socially desirable responding or due to difference in the perception of sharing as reported previously in a study from Niger: Here, caregivers believed that sharing did not include giving supplements to children less than 5-years old (Cohuet et al. 2012). In this context, sharing of leftovers may not have been perceived as sharing, but rather as a way to avoid food wastage. We acknowledge that discarding food in a food insecure area was a controversial recommendation. However, it was made following careful discussions with the local research team, to emphasize the fact the supplements were an individual medical treatment and to prevent sharing. While it has previously been suggested that CSB were more likely to be shared, than LNS (Karakochuk, Briel, Stephens, & Zlotkin, 2015; Wang et al. 2013) this was not reflected in our study. This could be due to the fact that both products were presented as a medical treatment and were perceived to have medicinal effects. However, while CSB were mainly shared after the meal, LNS were shared during the meal, and caretakers said that sharing was predominantly done to avoid food waste of leftovers or because it was difficult to resist the pressure from the other children. However, not sharing the supplements seemed to be culturally accepted, as they were perceived as medicine or as having medicinal effect, and sharing was therefore perceived as having consequences for the health of the child. Seasonal variations have previously been suggested to also influence factors such as sharing, because of reduced food accessibility within the household (Collins & Sadler, 2002). In our study, leftovers were less likely during the rainy season, where food availability is reduced. This could indicate a decrease in the consumption of other foods and thereby an increase in the consumption of supplementary foods and in the frequency of sharing. Furthermore, supplementary foods may to a higher extent replace family foods during this period of time. Reduced food availability could also explain the

association between seasonality and ratings, as supplements may have been more appreciated during this period of time.

Despite high occurrence of leftovers of especially CSB and a greater appreciation of LNS likely due to their ease of use, there was an overall high level of appreciation of both types of supplements. Both were perceived to provide health and strength to the child, and there was a strong confidence in their abilities. This confidence may not only be due to the qualities of the supplements but also the provenance, as suggested earlier (Whyte, van der Geest, and Hardon 2002). The fact that the supplements were free of charge and that the project was supported by international partners seemed to have a positive impact on their perceived efficacy. This may not be applicable to other contexts where trust in western medicine may be different.

The name of the supplements in the local language was an image of and similar to the local name of malnutrition. This way of assembling cause, effect and cure is often used by the Mossi people to conceptualize an illness (Sjaak van der Geest and Meulenbroek, 1993). Both categories of supplement were referred to as food with medicinal properties or medicine/vitamins and described to be different from local foods. Previous studies have shown that in Niger, LNS were mainly considered as medicine (Cohuet et al. 2012), while in Malawi both CSB and LNS were considered as foods (Flax et al. 2009) as well as medical treatments (D. Matilsky et al. 2009). The perception of the supplements as having medicinal properties is likely to have an impact on the acceptability. It may confirm the condition of the child as being ill, which enhances the care and adherence to the treatment and can promote the good intentions of the mother to ensure the health of her child (Whyte, van der Geest, and Hardon 2002). In this study, it meant that caretakers reported to give high priority to the supplement in the daily feeding of the child.

We believe that the combination of quantitative and qualitative data used for the purpose of this study provides a detailed and nuanced picture on the acceptability of the different formulations of supplementary foods in this context. However, we acknowledge that the study had certain limitations. Community-sensitization and communication regarding the project and the introduction of the non-local research team to the local community may have influenced participants to respond more positively, and may also have had an impact on the perception of foods as having medicinal qualities. Additionally, the analysis of qualitative data usually involves some degree of interpretation, while the translation from Mooré to French to English may have involved some loss of meaning. Moreover, no back translation was carried out. However, the translations and interpretations were carefully and continuously discussed with and between the two research assistants. Also, the analysis of the interviews and FGDs was done only by one person, which is a limiting factor in the systematic classification process of coding and identifying themes pertaining to qualitative content analysis. Finally, the duration of the home visits were limited to daytime and information on supplementary meals in the morning- and evening hours is therefore lacking. Participants may also have been affected by the presence of the research assistant during the home visits and may have altered their behaviour. To account for this, observations were carried out for three consecutive days, allowing for participants to get used to being observed. The similarities between many of the reported and observed findings suggest that behaviours observed were not much influenced by the presence of the research assistant.

7. Conclusion

In summary, results from this study suggest that there were minimal differences in acceptability of CSB and LNS with different qualities of soy and quantities of milk. Thus, decisions regarding whether more expensive foods with high content of milk and improved soy quality should be used for the treatment of MAM will need to be based on their effect on child nutrition, growth and health. Our findings suggest that CSB were less readily consumed than LNS. We therefore believe that smaller meal volumes are necessary – either by preparing a more concentrated, viscous porridge or by increasing meal frequency. Finally, future supplementary feeding programs in similar contexts could consider introducing supplementary foods as a medical treatment, as this may increase adherence and decrease sharing.

With these finding, we have not only been able to evaluate whether supplementary foods for the treatment of MAM are accepted in the given context, but also how and for what reasons they are well-accepted. We believe that this is crucial information for the planning of future nutritional interventions as these are factors affecting consumption and adherence to treatment and thereby the effect of an intervention.

Conflict of interest

None declared. Neither the funders nor the manufacturer of the experimental food supplements had any role in the design, implementation, analysis or reporting of the results from this study.

Acknowledgements

We are grateful to the study participants and their families, our research assistants Ms Albertine Ouédraogo and Mrs Adja Belem and the rest of the staff of the Alliance for International Medical Action (ALIMA) for their valuable contribution to this study. We thank the Ministry of Health in Burkina Faso, the health and village authorities in Province du Passoré, and the staff at the health centers for their support to this study. We furthermore thank GC Rieber Compact A/S for their contribution to the development and production of the experimental supplementary foods. Finally, we thank Médecins Sans Frontières in Norway and Denmark, the Danish International Development Assistance (09-097 LIFE), The Arvid Nielsen Foundation, The European Commission for Humanitarian Aid and Civil Protection (ECHO), in partnership with Action Contre la Faim and the World Food Program for funding this study as part of the TreatFOOD project.

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