Anthrologica

Micronutriments, Santé de la mère et de l'enfant III **(MISAME III):**
Testing the impact of nutritional supplements for women in pregnancy in Burkina Faso.

July 2018

Content

Tables

Abbreviations

BEP	Balanced energy-protein
BMGF	Bill and Melinda Gates Foundation
BMI	Body Mass Index
DHS	Demographic Health Survey
FANTA	Food and Nutrition Technical Assistance
MISAME	*Micronutriments, Santé de la mère et de l'enfant*
PAF	Product Acceptability Form
PRF	Product Ranking Form
RCT	Randomized controlled trial
SGA	Small-for-gestational-age
WDDP	Women's Dietary Diversity Project
WHO	World Health Organization

Introduction

Background

Although Burkina Faso has seen significant improvements in maternal and infant health over the last 25 years, the infant mortality rate remains high at 53 per 1000 live births in 2016 (Hug, Sharrow and You 2017). Low birth weight is a significant risk factor for neonatal death, estimated to account directly or indirectly for 60-80% of neonatal deaths worldwide (Katz et al. 2014). According to the 2010 Burkina Faso Demographic Health Survey (DHS), 13.1% of babies were estimated by their mothers to have been either 'very small' or 'smaller than average' at birth (INSD and ICF Intl. 2012). Of those with a reported birth weight (63.6% of all births), 13.9% were less than 2.5 kg (INSD and ICF Intl. 2012). The number of infants who are small for gestational age (SGA) – those with a birth weight below the 10th percentile for gestational age – is more difficult to assess, as it is dependent on accurate reporting of gestational age at birth, which is often unavailable in resource-challenged settings. Studies in the Houndé district of Tuy Province, the location of the *Micronutriments, Santé de la mère et de l'enfant III* (MISAME-III) study, found levels of SGA at 35% and 29% (Roberfroid et al. 2008, Huybregts et al. 2009).

Poor nutrition, including energy and micronutrient deficiencies, is known to contribute to poor birth outcomes (Gernand et al. 2016, da Silva Lopes et al. 2017, Fall et al. 2009). Women who enter pregnancy with low Body Mass Index (BMI) or short stature are at increased risk of adverse health outcomes (Rahman et al. 2015) as well as SGA births (Kozuki et al. 2009). According to the 2010 Burkina Faso DHS, 15.7% of all women in the country are underweight, with BMI less than 18.5 kg/m^2. Rural women are more than twice as likely as urban women to be underweight (18.7% and 7.8% respectively).

Women's micronutrient needs increase during pregnancy to meet the needs of the growing foetus, and multiple rather than single micronutrient deficiencies affect women of reproductive age, particularly in low-income countries (Christian 2010). The 2010 DHS reports that 49% of women, and 58% of pregnant women, are anaemic to some degree (INSD and ICF Intl. 2012). A survey conducted among women in Ouagadougou in 2006 as part of the Food and Nutrition Technical Assistance (FANTA) project's Women's Dietary Diversity Project (WDDP) found multiple micronutrient deficiencies (Becquey, Capon and Martin-Prével 2009). A subsequent analysis of the WDDP datasets found that the customary diet was inadequate to meet the micronutrient needs of Burkinabé women (Arimond et al. 2017). In 2009, another study concluded that women in Houndé were deficient in nine of the eleven nutrients studied, all except phosphorus and zinc (Huybregts et al. 2009).

Current World Health Organization (WHO) antenatal care guidelines recommend provision of balanced energy-protein (BEP) supplements in populations where the prevalence of undernourished pregnant women (low BMI) is greater than 20% (WHO 2017). They also recommend provision of iron folic acid (IFA) supplements to all pregnant women (WHO 2016) but further note that some countries may decide to switch to the provision of multi-micronutrient (MMN) instead of IFA supplements. This is particularly the case where multiple deficiencies are the rule rather than the exception, as MMN supplements have been shown to result in better birth outcomes than IFA alone (Haider and Bhutta 2017). However, since the WHO antenatal care guidelines mention this as an option, rather than a recommendation, use of MMN instead of IFA supplements is not yet widespread. The Bill and Melinda Gates Foundation (BMGF) convened a consultation to discuss the content and possible forms of BEP supplements; the outcome was the recommended distribution of fortified BEP supplements and proposed macro- and micronutrient content for these food supplements.

The prevalence of underweight in women of reproductive age in Burkina Faso is 15.7%, although prevalence rises as high as 31.1% in some regions. The prevalence of underweight among 15-19-year-olds is 23.5% (INSD and ICF Intl. 2017).

Aims and objectives of research

BMGF commissioned the three-phase research study '*Micronutriments, Santé de la mère et de l'enfant III* (MISAME III)*: Concevoir et tester l'impact d'un complément alimentaire nutritif pendant la grossesse afin d'en améliorer l'issue au Burkina Faso'*. The overall study seeks to evaluate the preferred product type for the provision of fortified BEP supplements and its impact on pregnancy outcomes. In Phase 1, 12 products of different types and flavours were rapidly assessed in terms of short-term acceptability. In Phase 2, the two most acceptable BEP supplements identified in Phase 1 will be tested for longer-term acceptability and home consumption for a period of eight weeks. The BEP supplement selected from the formative research will then be administered to pregnant women in Phase 3, a randomized controlled trial (RCT) designed to test the efficacy of the BEP supplement during pregnancy and lactation on pregnancy and child health outcomes. The nutritional composition of the specific BEP supplements was established during an expert consultation convened at the BMGF in September 2016. The form of BEP supplements selected for Phase 3 may be modified if necessary according to the preferences of the target population. The research partners, including BMGF, have liaised with private sector partners to request supplements in the selected forms with the recommended nutrient composition for the formative research in phases 1 and 2.

Report structure and outputs

This draft report synthesises findings from Phase 1 of the formative research study. The data collected comprised two related components: a quantitative survey and qualitative data collection using open and inductive methods. Adopting a mixed methods approach allowed for triangulation of material and for increased validity of findings. The study was able to provide insight to inform the selection of two products for Phase 2 of the project.

Following the introduction, the study's methods are outlined in detail. The subsequent three chapters present the study's core findings: (1) the overall assessment of product preferences; (2) the detailed analysis of sweet products; (3) the detailed analysis of savoury products. The discussion chapter draws out six cross-cutting themes identified in the product analysis: the impact of the perceived health benefits on product preferences and use; the influence of odour on product acceptability; the relevance of ease of use, preparation and portability; the reliability of consumed weight as a measure of product acceptability; perceptions and intentions of product sharing; and the significance of familiarity to product acceptability. The final chapter presents the study's conclusions and key recommendations.

Prior to its finalisation, colleagues from AFRICSanté, Ghent University and Harvard University colleagues had the opportunity to provide written and verbal feedback, which was incorporated into the final report as appropriate. The report is structured to be of operational use in Phase 2 and Phase 3 of the MISAME III project.

Methodology

The research was conducted in line with prevailing ethical standards that seek to protect the rights and welfare of all participants (Graham et al. 2013). Ethical permission to undertake the study was granted by Ghent University Ethics Board, the *Comité d'éthique institutionnel du Centre Muraz* in Burkina Faso and the Harvard T.H. Chan School of Public Health Institutional Review Board. The research was a collaboration between the Department of Food Safety and Food Quality, Ghent University, and the Harvard T.H. Chan School of Public Health working with Anthrologica. Phase 1 of the formative research study ran from October 2017 to July 2018, including a period of intensive data collection in Burkina Faso in May-June 2018.

Research team

The overall research for Phase 1 was managed by Sheila Isanaka (SI) and Saskia de Pee (SdP) from Harvard, and Juliet Bedford (JB), Leslie Jones (LJ) and Katie Moore (KM) from Anthrologica. The Ghent University team was led by Patrick Kolsteren (PK), Carl Lachat (CL) and Nathalie de Cock (NdC) with support from Katrien Vanslambrouck (KV), Brenda de Kok (BdK) and Laeticia Toe (LT).

With technical oversight from the core team, LJ and KM led the qualitative research. They developed the qualitative research tools, analysed the qualitative data, synthesised it with the quantitative analysis, and drafted the Phase 1 report. The quantitative tools were designed by SI with input from the core team. Ghent University collaborated with the national research organisation AFRICSanté to conduct in-country data collection, transcription and translation. Their six-person research team was led by Moctar Ouédraogo (MO), and included four data collectors and one data manager, Henri Somé. Additional support and supervision was provided by AFRICSanté Executive Director Rasmané Ganaba. LJ and KM provided project-specific training to the data collectors in Burkina Faso who were then supported in the field by NdC, KV and BdK. The analysis of quantitative data was undertaken by Ghent University under the guidance of SI.

Study sites

Data were collected in Houndé, the district capital of the province of Tuy in the Hauts-Bassins region of Burkina Faso. The province of Tuy is characterised by its cereal production, and a major cotton fibre production plant has been established at the centre of Houndè. The research site was selected by AFRICSanté in collaboration with Ghent University as both had conducted previous research in the locale which had been well accepted by the local community.

The district has one district hospital and 27 health centres. Seven health centres were identified for potential inclusion in the study, of which five were selected for Phase 1 on the basis that the facility catchment areas were easily accessible throughout the year, regardless of seasonal variations. The five centres were: *Centres de Santé et de Promotion Sociale* (CSPS) [Health and Social Promotion Centre] at Bouéré; CSPS Boni; CSPS Karaba; CSPS Kari and CSPS Dougoumatato II.

Participants and sampling

The officers-in-charge of the five health facilities worked with the research team to identify pregnant women in the catchment areas to be included in the research. Pregnant women aged between 15 and 35 years and of varying gestational age were invited to participate. Exclusion criteria focused on food allergies (to soy, dairy products, eggs, gluten and nuts) but no other socio-demographic or marital characteristics

due to the homogeneity of the context. All pregnant women who participated were recruited through service delivery points during the May-June data collection.

Data collection in Houndé was conducted over three weeks from 17 May to 7 June 2018. Data collection activities sought to:

- Assess the hedonic properties of twelve formulations of fortified BEP supplements amongst pregnant women in the target area;
- Identify the preferred product type(s) for the provision of fortified BEP supplements; and
- Assess the acceptability, general preferences, advantages and barriers across product types.

Of the twelve products, seven were characterised as sweet and five as savoury. All of the products in the sweet grouping are low in sugar, in conformity with BMGF standards for nutritional supplements, but were grouped as 'sweet' in order to distinguish them from those with a savoury taste profile. Nine were produced by Nutriset, two by Mars and one by World Food Programme and DSM (see Table 1 below). Each product's nutrient content was fully or almost in line with the guidance for composition of fortified BEP supplements from the Gates Foundation. Depending on product selection for phase 2, further development may be needed on the two chosen supplements.

Table 1. Product groupings and manufacturers

Product Name	**Product grouping**	**Product manufacturer**	**Product name (used in the field)**	**Product short name (used throughout the report)**
Plumpy Mum	Sweet	Nutriset	Sweet Plumpy Mum	Plumpy Mum
Mango bar	Sweet	Nutriset	Sweet bar	Sweet Bar
Vanilla Filled sticks	Sweet	Nutriset	Filled sticks	Filled sticks
Vanilla biscuits	Sweet	Nutriset	Sweet biscuits	Vanilla biscuit(s)
Vanilla drink	Sweet	Nutriset	Sweet drink	Vanilla drink
Unseasoned pillows	Sweet*	Mars	Unseasoned pillows	Unseasoned pillow(s)
Fermented drink	Sweet	WFP	Fermented drink	Fermented drink
Plumpy Mum tomato and onion	Savoury	Nutriset	Savoury Plumpy Mum	Savoury Plumpy Mum
Tomato and onion bar	Savoury	Nutriset	Savoury bar	Savoury Bar
Tomato and onion biscuits	Savoury	Nutriset	Savoury biscuits	Savoury biscuit(s)
Chicken soup	Savoury	Nutriset	Chicken Soup	Chicken Soup
Seasoned pillows	Savoury	Mars	Seasoned pillows	Seasoned pillow(s)

* Although the unseasoned pillow is not a sugary product, it was categorised as a sweet product for purposes of the tasting and ranking, both in order to distinguish it from the seasoned pillows and because it was perceived by the study team as having a primarily sweet flavour profile, particularly in contrast to the seasoned pillow.

In total, 85 data collection activities were conducted with 40 participants: 40 Product Acceptability Form (PAF) questionnaires (one per participant); 40 Product Ranking Form (PRF) questionnaires (one per participant); and five focus group discussions (eight participants per group discussion). The timeline for the administration of the tools is shown below in Table 2, and the tools are described in greater detail in the following sections.

Consent

Informed consent was obtained prior to each data collection activity. Researchers provided a full explanation of the study and emphasised the voluntary, confidential and anonymous nature of participation. Participants were told that the research involved development of a food supplement to be used during pregnancy and lactation in order to improve birth outcomes and infant growth. It was explained that participants would be given different formulations to taste and that they would be asked questions about their preferences. It was made clear that participants would be remunerated for their

Table 2. Schedule for administration of tools

	Day 1: Savoury Product Tasting	Day 2: Sweet Product Tasting	Day 3
Morning Session	Group 1 PAF - Savoury Products	Group 1 PAF - Sweet Products	Groups 1 and 2 Focus Group Discussion
	Group 1 PRF -Savoury Products	Group 1 PRF - Sweet Products	
		Group 1 PRF - Overall Top 3 Ranking	
Afternoon session	Group 2 PAF - Savoury Products	Group 2 PAF - Sweet Products	
	Group 2 PRF - Savoury Products	Group 2 PRF - Sweet Products	
		Group 2 PRF - Overall Top 3 Ranking	

travel, that their participation would not affect any medical service required or provided during their pregnancy and after the birth of their child, and that they were free to withdraw at any time without giving a reason. The study's consent form was explained in detail in order to ensure that all participants, including illiterate women, understood the form before giving consent. All participants were given the opportunity to ask questions and seek further explanation. Participants willing to take part completed the consent form with a signature or thumbprint. Informed assent was obtained from participants under the age of 18, and consent of participants' husband or guardian was also acquired. At the conclusion of the fieldwork, all completed consent and assent forms were retained in hard copy by AFRICSanté.

Data collection

Desk review and tool development

Anthrologica conducted a desk review of maternal nutrition, related programmes and research at the national level and in the broader West Africa region. Material reviewed included analyses of qualitative and quantitative data, literature provided by Ghent University, and published and grey literature. Following this, a topic guide was developed to highlight key themes emerging from the literature. This formed the basis for the design of country-specific tools including quantitative product acceptability and product ranking forms and focus group frameworks for pregnant women. The tools were pre-tested by AFRICSanté in Houndé from March 24-28, after which they were refined based on feedback provided by MO. Further revisions were made during the training of the national team and piloting the tools with pregnant women in Bobo Dioulasso in May 2018.

Quantitative Tools

- Product Acceptability Form

The hedonic testing tool administered to women was called the Product Acceptability Form (PAF). Developed in a questionnaire format, the tool asked each woman a series of questions about the 12 products in turn, using a 7-point Likert scale to answer from 1 (I detest it) to 7 (I like it very much). The women were then presented with a series of statements regarding their potential use of the product and willingness to consume it during pregnancy, and the responses were scaled from 1 (I don't agree at all) to 7 (I agree completely). The 7-point scale was graphically depicted using a range of emoticon faces (very unhappy to very happy). Using a 7-point scale allowed participants to make more fine-grained distinctions between answer options (Krosnick and Presser, 2010). PAFs for savoury products were administered to women on day one of data collection, and sweet products were administered on day two.

For the hedonic tasting, products were introduced by their french product type or name, for example 'Plumpy Mum *sucré*' or '*biscuit salé*'. The soup was identified as '*soupe au poulet*' ('chicken soup') but data collectors explained that it was made from a powdered mix. Test portions for each product were calculated as 25% of the weight of a full portion. The products were pre-portioned by MO and provided to

each data collector in a randomised sequence within product type (sweet or savoury) in order to avoid possible bias due to order of presentation. For the vanilla beverage, the 25% test portion of the powdered mix was combined by MO with 50 ml of cold water immediately prior to serving to the participant. For the fermented beverage, the 25% test portion of the powdered mix was combined by MO with an average 45 ml[1] of cold water immediately prior to serving to the participant. For the chicken soup, the powdered mix was combined with 50 ml of hot water immediately before serving. The weight of the test portion of each product was again measured before the participant was invited to eat and after she was finished. If the participant did not finish the test portion in 20 minutes, the uneaten remainder was weighed and the net weight consumed was calculated. The consumption time was measured by recording the time at the start and end of each taste session. The end was recorded when the participant finished the product within 20 minutes, or at 20 minutes if the participant did not finish the test portion. The PAF for each product lasted approximately 30 minutes (20 minutes for product tasting and 10 minutes for administering the questionnaire).

- Product Ranking Form

In addition to the hedonic scales of the PAF, participants were administered a Product Ranking Form (PRF) in which they were asked to rank products in order of preference from 'most liked' to 'least liked' for each of taste, texture, smell, colour, portion size, ease of use and overall preference. The PRF was administered to participants after the PAF had been completed for all savoury products on day one of tasting, and then following the completion of the PAF for sweet products on day two of tasting, thus presenting a 1-5 preference range for savoury products across seven variables, and a 1-7 preference range for sweet products across the same metrics. The PRF activity for each product group (savoury and sweet) took approximately 15 minutes. Following the tasting, evaluation and ranking of the savoury products on day one and the sweet products on day two, participants were also asked individually on day two to identify their overall 'Top 3' products out of all twelve products sampled. The overall ranking activity took approximately 5 minutes.

In both the PAF and the PRF data entry tools, open dialogue boxes were created for facilitator notes, comments and observations.

Qualitative tools

- Focus group discussions

Complementary qualitative data was also collected in a series of five focus group discussions, each comprising eight pregnant women. The aim of this activity was to better understand factors influencing acceptability and consumption of flavour profiles, as well as sharing dynamics, local food practices and (potential) supplement utilisation. Focus groups generated data that enabled viewpoints for understanding social norms to be compared. An additional ranking exercise was included in the focus group discussion to elicit further narratives around characteristics affecting the (potential) use of the products and how those characteristics related to each other. Participants were then asked to discuss and reach consensus on their top three products, as a group.

Each focus group was led by a facilitator, assisted by a moderator who took notes and helped to track the discussion. The research team ensured all key themes were covered in order to facilitate across-group analysis, but within each section of the focus group, participants led the direction of discussions. This allowed for the co-production of knowledge, whereby researchers and the community work together in the shared exploration of questions in order to obtain deeper and more collaborative understandings of experiences and context . Follow-up prompts and probes were used to obtain greater detail and clarity when necessary.

[1] Because of variations in the viscosity of the product when mixed, the amount of water added varied between 44 and 46 ml.

Efforts were made to ensure the space used for data collection activities was as private and neutral as possible. All activities were conducted at one of the five health centres, but the actual location of each activity within the health centre depended on what was available and appropriate in each study site (e.g. at the health center in Bouéré, the tasting sessions and group disucssions were conducted in an open area outside the health facility). The majority of the data collection activities were conducted in a mixture of local languages (Dioula and Mooré) and French. The national research assistants were familiar with the local context of each field site, and participants were encouraged to use the language in which they were most comfortable and confident. Each focus group discussion lasted between two and a half to three and a half hours, and all were audio recorded.

Data management, transcription and translation

All PAF and PRF data were collected electronically using the Census and Survey Processing System (CSPro) data management programme. The programme is widely used for data entry, editing, tabulation, and dissemination of survey and questionnaire data. Data was entered into the programme on laptop computers directly by the national research team, who input participants' answers to the PAF and PRF in real time. The data was saved in the programme and stored on password-protected computers used only by the research team. Quantitative data collection and management using the programme was overseen in the field by the AFRICSanté Data Manager Henri Somé and team leader MO. Through the programme each individual was allocated a unique code for identification across each data collection session to ensure that participant anonymity was maintained. A code was also generated for each data collector and for each field site to corroborate data collection activities per location. The CSPro data files were exported to STATA 14 (64 bit) for further statistical analysis.

Focus group discussions were audio recorded, and each data collection session was given a unique identification code to ensure that participant anonymity was maintained. During fieldwork, audio files and field notes were uploaded onto password-protected computers used only by the research team and backed-up in Dropbox by MO on a daily basis. The audio files, researchers' field notes and paper consent forms were stored securely and confidentially. On conclusion of data collection, the focus group discussions were transcribed by the national research team from local languages (Dioula and Mooré) into French. MO was responsible for overseeing the transcription and translation of data. LJ and KM reviewed each transcript for quality assurance and any inconsistencies were reviewed and resolved.

Data analysis

Preliminary analysis of qualitative data was conducted throughout the data collection process by LJ and KM. On conclusion of the data collection, full analysis of the qualitative data was conducted using thematic analysis. Dominant themes were identified through the systematic review of focus group discussions and field notes and a thematic framework was iteratively developed. Salient concepts were coded and their occurrence and recurrence labelled. KM coded the transcripts of the five focus group discussions by hand and LJ coded them in the software Dedoose. The emerging trends were critically analysed according to the research objectives to assess which product types and varieties were preferred and why, what factors affected women's choice of preferred products, how those products would be incorporated into the current local diet, the acceptability of snacking and sharing, and the acceptability of at-home consumption of products.

Deductive analysis of the transcripts was conducted by KV and BdK using the framework developed by LJ and KM in the Dedoose programme. The transcripts were cross-referenced with the original coding and triangulated by KM.

The analysis of quantitative data was conducted by KV and BdK. The 7-point Likert scale used for quantification of product acceptability and perceptions was treated as continuous variable. The mean (± SD) was calculated for the themes 'acceptability', 'perception of product use' and 'willingness to use for 12 months'. Answers to the questions on the 'amount of money willing to pay' and 'perception of portion size' were treated as categorical variables and displayed in numbers and relative percentages.

For the overall ranking exercise, a product was awarded three points every time it was ranked first, two points every time it was ranked second, and one point every time it was ranked third. If a product was not included in the top 3, it received zero points. The maximum possible score was therefore 120 points (40 participants x 3 points maximum) and the minimum was 0 (for a product that was never ranked in the 'Top 3').

Ranking exercises were analysed in Excel using the sum of ranks method. This method gives the highest points to the product that is ranked first, the second highest points to the product that is ranked second etc. The points are then summed.

Methodological limitations

It was possible that participants may have expressed answers they perceived to be appropriate or socially desirable. This is an inherent risk in rapid qualitative data collection. However, participants were encouraged to speak openly and honestly, and the frank and sincere dialogue elicited from participant discussions suggested that such socially desirable bias was minimised. Findings were also triangulated across participant groups to test the validity of answers.

To be responsive to the local environment, activities at the community level were conducted in local languages (Dioula or Mooré) or a mixture of local language and French, as preferred by participants. Risks associated with mistranslation or miscommunication were minimised by thoroughly briefing the national research team, agreeing to use short phrases of speech, and repeating specific sections of narrative back to participants to ensure colloquialisms and meaning had been well captured. However, some exchanges amongst focus group participants were conducted in Bwamu/Bwaba, a local language spoken by virtually all of the women for which no translator was available. The majority of these brief exchanges took place outside the context of the discussion of the products but were instead primarily during the tasting, when the women talked amongst themselves in their local language. These exchanges were relatively limited in number and of very short (a few seconds) duration, and were not thought to be significant to the study's findings.

The volume of products and the speed at which the facilitator moved through each of the product discussions led, in some cases, to quite long interactions. In pre-testing, the group discussions had been designed to last between one and a half and two hours, but in the field most were closer to three hours in duration. Answers to questions became shorter and more repetitive after each product and despite the efforts of the facilitators, levels of participation engagement diminished as the discussion continued. Completing focus group discussions with women who were pregnant was challenging, as long periods sitting made many uncomfortable and tired. Observations from focus group facilitators included references to women yawning and sleeping during the sessions. Where possible, focus group discussions were held in the morning to overcome issues of tiredness and fatigue.

Findings 1. Overall assessment of product preferences

In order to assess product preferences, individual study participants were asked to complete three product ranking activities: they were asked to rank the sweet products along a variety of characteristics and overall; they were asked to perform the same ranking for the savoury products; and they were asked to rank their overall 'Top 3' preferred products (e.g. including both savoury and sweet products) in order of preference. In addition to these individual ranking activities, focus group participants were asked to rank the top three products as a group. Participants were also asked, as part of the administration of the product acceptability form (PAF), to assign a score on a 7-point Likert scale to each product for a number of variables including overall liking for the product.

The results for the top five products in any of the three overall rankings are presented in Table 3 below. These results will be discussed in detail in the following sections. As is immediately clear, however, there is relative consistency across all overall ranking activities. The Plumpy Mum and the vanilla biscuit were the top two products according to every measurement, and the fermented drink, vanilla drink and filled sticks were, for the most part, consistently in either third, fourth or fifth place. The filled sticks were tied with the vanilla biscuit for second place in the focus group discussion ranking and in the ranking of mean Likert scale scores for overall preference.

Table 3. 'Top 5' products across all metrics

	Vanilla biscuit	Plumpy Mum	Fermented drink	Vanilla drink	Filled sticks	Unseasoned pillow
Individual Product Ranking Form ALL PRODUCTS 'Top 3' ranking (points)	1 (55)	2 (50)	3 (39)	4 (33)	5 (26)	9 (5)
Focus Group Exercise ALL PRODUCTS Group 'Top 3' Ranking (points)	2 (6)	1 (12)	4 (5)	N/A	2 (6)	5 (1)
Product Appreciation Form ALL PRODUCTS Overall appreciation ranking (avg score on 7-point scale)	2 (6.4)	1 (6.5)	5 (6.0)	4 (6.1)	2 (6.4)	7 (5.7)

PRF and focus group discussions: overall product rankings

On the second day of product tastings, after their ranking of the sweet products, participants were also asked individually to identify their 'Top 3' overall products out of all twelve products tasted. Points were again assigned to each rank and the points were summed. The results of this ranking exercise are presented in Table 4 (below) and support the conclusion that study participants strongly favoured sweet products. All of the top five products in this ranking analysis were sweet, and it can be seen clearly that the savoury products were rarely chosen among the top three products overall. The most preferred product, with 55 points, was the vanilla biscuit, followed by the Plumpy Mum, with 50 points. The fermented drink (39 points), vanilla drink (33 points) and the filled sticks (26 points) rounded out the top five.

Participants were also asked to decide as a group on the 'Top 3' products overall during the focus group discussions and points were assigned to each position as with the other ranking activities. Only five products were ever named in the 'Top 3' and all were sweet products. In this ranking, the Plumpy Mum finished in first position with 12 points, followed by the vanilla biscuit and the filled sticks, each of which

had 6 points. The fermented drink was in the fourth position (5 points) followed by the unseasoned pillow, which finished third in one focus group's ranking, garnering 1 point. Interestingly, the vanilla drink was not selected by any focus group as a 'Top 3' product, although it finished in the top five products during the sweet product ranking (183 points, third highest) and in the overall product ranking (33 points, fourth highest.) The results of the focus group ranking activity are presented in Table 5 below.

Table 4. 'Top 3' overall product ranking, sum of ranks

	Sum of ranks*
Sweet Products	
Vanilla biscuit	55
Plumpy Mum	50
Fermented drink	39
Vanilla drink	33
Filled sticks	26
Mango bar	8
Unseasoned pillows	5
Savoury Products	
Chicken soup	9
Seasoned pillow	8
Savoury bar	4
Savoury Plumpy Mum	3
Savoury biscuit	0

* Products were assigned points based on rankings: 3 points for the most preferred product, 2 points for the second most preferred, 1 point or the third most preferred. Points were then summed. For reference, the maximum available score was 120 (3 x 40) and the minimum available score was 0 (if the product was never named in the 'Top 3').

Table 5. Focus group ranking of 'Top 3' products by location

	Top choice overall	**2nd CHOICE OVERALL**	**3rd CHOICE OVERALL**
Boni	Plumpy Mum	Vanilla biscuit	Filled sticks
Bouéré	Plumpy Mum	Filled sticks	Vanilla biscuit
Karaba	Plumpy Mum	Fermented drink	Seasoned pillow
Kari	Plumpy Mum	Filled sticks	Vanilla biscuit
Dougoumato	Fermented Drink	Vanilla biscuit	Filled sticks
CUMULATIVE	**Plumpy Mum (12 points)**	**Filled Sticks tied with Vanilla Biscuit (6 points)**	

Hedonic testing: Likert scale mean scores

As outlined in the methodology, the PAF was based on 7-point Likert scale designed to elicit reactions to a series of product characteristics and statements related to product use. The results of this analysis for the sweet and savoury products are presented in chapters 2 and 3 below.

The results of this analysis are broadly aligned to the other rankings but the differences between products are smaller. Plumpy Mum had the highest mean score of 6.5 for overall appreciation of the product, followed by both the vanilla biscuit and the filled sticks at 6.4. The standard deviations for each mean score were identical at 0.7, reflecting the relatively low variation in answers. The vanilla drink had the fourth highest mean Likert score for overall likeability at 6.1 (SD=1.1) and the fermented drink was in fifth place with a mean Likert score of 6.0 (SD=1.4). As the standard deviations indicate, there was more variation in the scores for these two products. The remaining two sweet products, the sweet mango bar and the unseasoned pillows, followed behind the others. The sweet bar had a mean score of 5.8 (SD=1.1) and the pillows had a mean score of 5.7 (SD=1.4), both products again showing greater variance than the top three

finishers. As was the case with the PRF overall and sweet rankings, the products can be broadly viewed as falling into three tiers: Plumpy Mum at 6.5 and the vanilla biscuit and filled sticks at 6.4; the sweet vanilla and fermented drinks at 6.1 and 6.0 respectively, and the sweet mango bar and the unseasoned pillow, both at 5.8.

As the above discussion demonstrates, the results are relatively consistent across the study. The top two products across all metrics, making up the first tier, are the vanilla biscuit and the Plumpy Mum. The second tier consists of the filled sticks, the fermented drink, and the vanilla drink (although the filled sticks were tied for second place in the focus group discussion ranking and in the comparison of mean Likert scores in the PAF, it placed fifth in the PRF top three rankings). The savoury products all fall in the bottom tier; they were the least liked, with none appearing in the top five of any ranking activity.

Findings 2. Sweet product grouping

The sweet products scored much higher then savoury products in all study tools and along nearly every metric. Sweet products were consistently chosen among the top three products in ranking exercises, including individual ranking, overall ranking and in the focus group discussion ranking exercises (see Table 2).

In the sweet product PRF, the vanilla biscuit scored highest of all the sweet products in overall likeability, with 217 points (see table 6), as well as for every individual product characteristic except portion size, where it placed second. The Plumpy Mum product received the second highest cumulative score for overall likeability with 193 points, and its scores for individual characteristics were also consistent; it placed second for every characteristic except portion size, where it placed third. The scores for the third and fourth (tie) place products in the sweet rankings were closely grouped together: the third place vanilla drink received 183 points, followed by the fermented drink (170) and the filled sticks (170). The remaining products in the sweet group, the mango bar and the unseasoned pillows, trailed far behind with 96 and 91 points respectively.

Mean Likert scores for sweet products were frequently over 6 points (see Table 7). The Plumpy Mum, vanilla biscuit, filled sticks and the vanilla drink were awarded scores of 6.0 or higher for all product characteristics including overall appreciation. For the overall appreciation category only two products, the unseasoned pillow and the sweet mango bar, had a mean Likert score of under 6.0, scoring 5.7 (SD=1.4) and 5.8 (SD=1.1) respectively.

Table 6. Sweet Product Ranking, sum of ranks

	Sweet Products*						
	Taste	**Texture**	**Smell**	**Colour**	**Portion**	**Ease**	**Overall**
Vanilla biscuit	203	214	199	212	195	229	217
Plumpy Mum	199	196	197	200	176	195	193
Vanilla drink	181	175	192	175	148	167	183
Fermented drink	169	180	164	157	146	151	170
Filled sticks	175	168	166	168	198	160	170
Sweet bar	100	97	111	90	84	99	96
Unseasoned pillow	93	90	91	118	173	119	91

* Sweet products were assigned points based on rankings, from 7 for a first place ranking to 1 for a last place ranking. Points for each product and each characteristic were then summed. For reference, the maximum available score for a sweet product was 280 (7 points x 40 participants) and the minimum available score was 40 (1 point x 40 participants).

Qualitative data gathered during the group discussions corroborated the quantitative findings regarding participants' preference for sweet products. Study participants overwhelming favoured the sweet products over the savoury and this preference was most apparent during direct comparisons between sweet and savoury products. When asked specifically to compare the sweet versus the savoury bar, biscuit and Plumpy Mum, the women were virtually unanimous in expressing a preference for the sweet versions of each product (only one woman in one focus group preferred the savoury bar to the sweet). Similarly, the sweeter unseasoned pillow was preferred over the seasoned product by a wide margin, with 27 of 31[2] (87%) participants preferring the unseasoned version. In two of the focus groups, women were asked whether they preferred sweet or salty products in general, and they unanimously expressed a preference for the sweet. During focus group discussions women frequently commented on a product's 'sweet taste' as one of its most favourable aspects, and they often said they disliked salty tastes and related products.

[2] Not all of the 40 participants expressed an opinion on the unseasoned versus the seasoned pillow.

Table 7. Hedonic testing, acceptability of sweet products, mean (standard deviation)

	Plumpy Mum	Vanilla biscuit	Filled sticks	Vanilla drink	Fermented drink	Sweet bar	Unseasoned pillow
Net weight consumed (g)	24.6 (0.9)	17.7 (0.8)**	24.6 (0.7)	67.0 (4.9)	63.5 (14.6)	15.4 (3.6)	15.2 (4.2)
Proportion of test portion consumed (%) *	98.4	98.3	98.4	95.7	90.7	96.3	89.4
Duration of consumption (min)	3.6 (1.6)	4.0 (1.4)	4.5 (1.4)	3.0 (3.0)	3.8 (4.1)	5.6 (4.5)	7.7 (5.5)
	Appreciation of Product (1= Dislike very much to 7= Like very much)						
Colour	6.7 (0.5)	6.5 (0.7)	6.5 (0.6)	6.3 (1.2)	6.3 (1.1)	6.0 (1.3)	6.2 (1.2)
Taste	6.5 (0.9)	6.6 (0.6)	6.6 (0.5)	6.3 (1.1)	5.9 (1.5)	6.2 (1.0)	5.8 (1.6)
Texture/consistency	6.4 (0.8)	6.4 (0.7)	6.2 (1.0)	6.2 (1.2)	5.9 (1.6)	5.8 (1.2)	5.8 (1.5)
Smell	6.2 (1.0)	6.3 (0.9)	6.2 (0.9)	6.0 (1.4)	6.2 (1.2)	5.5 (1.6)	5.5 (1.6)
Overall appreciation	6.5 (0.7)	6.4 (0.7)	6.4 (0.7)	6.1 (1.1)	6.0 (1.4)	5.8 (1.1)	5.7 (1.4)
Perceived child likeability	6.6 (0.6)	6.7 (0.5)	6.5 (0.6)	6.3 (0.9)	6.2 (1.2)	6.1 (1.0)	5.7 (1.2)
Perceived adult likeability	6.3 (0.7)	6.3 (0.8)	6.1 (0.8)	6.1 (0.9)	6.0 (1.2	5.9 (1.0)	5.8 (1.1)
	Perception of product use (1= Not at all in agreement to 7= very in agreement)						
Product is convenient to eat	6.3 (0.9)	6.5 (0.7)	6.1 (1.0)	6.2 (1.1)	5.9 (1.5)	5.8 (1.5)	5.7 (1.6)
Product is convenient to eat between meals	6.4 (0.7)	6.6 (0.5)	6.3 (1.0)	6.2 (1.3)	6.0 (1.5)	6.2 (1.1)	5.8 (1.5)
Product is medicine	5.4 (1.8)	5.5 (1.8)	5.5 (1.7)	5.4 (1.8)	5.4 (1.8)	5.5 (1.8)	5.3 (1.7)
Feel full after full portion	5.0 (1.8)	5.1 (2.1)	5.3 (1.7)	4.9 (1.9)	4.7 (2.1)	5.3 (1.7)	5.1 (1.8)
Would share with others	3.4 (2.3)	3.4 (2.2)	3.5 (2.3)	3.4 (2.2)	3.5 (2.2)	3.4 (2.1)	3.6 (2.3)
	Willingness to use daily for 12 months (1= Not at all in agreement to 7= very in agreement)						
Would use daily if provided	6.3 (1.0)	6.4 (0.8)	6.2 (1.2)	6.0 (1.5)	6.0 (1.6)	5.6 (1.5)	5.7 (1.7)
Would use daily if purchased	5.8 (1.4)	5.8 (1.3)	5.6 (1.5)	5.5 (1.8)	5.5 (1.9)	5.2 (1.8)	5.1 (2.0)
Would pay how much (CFA) 1-100	23 (57.5%)	21 (52.5%)	21 (52.5%)	21 (52.5%)	22 (55%)	23 (57.5%)	24 (60%)
101-200	11 (27.5%)	12 (30%)	12 (30%)	11 (27.5%)	11 (27.5%)	11 (27.5%)	8 (20%)
201-300	4 (10%)	3 (7.5%)	4 (10%)	2 (5%)	1 (2.5%)	2 (5.0%)	1 (2.5%)
301-400	1 (2.5%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	1 (2.5%)	1 (2.5%)
401-500	0 (0%)	2 (5%)	1 (2.5%)	5 (12.5%)	3 (7.5%)	2 (5.0%)	5 (12.5%)
> 500	1 (2.5%)	2 (5%)	2 (5%)	1 (2.5%)	3 (7.5%)	1 (2.5%)	1 (2.5%)
	Acceptability of portion size (for a snack), n (%)						
Portion size is acceptable	39 (97.5%)	34 (85%)	37 (92.5%)	38 (95%)	34 (85%)	34 (85%)	37 (92.5%)
Too small	1 (2.5 %)	5 (12.5%)	1 (2.5%)	2 (5%)	5 (12.5%)	3 (7.5%)	0 (0%)
Too big	0 (0%)	1 (2.5%)	2 (5%)	0 (0%)	1 (2.5%)	3 (7.5%)	3(7.5%)

*net weight consumed/sample weight X 100.
**n=38 for weight/duration of consumption for the vanilla biscuit.

Women occasionally made favourable comments about salty flavours (notably in the context of the soup and the savoury Plumpy Mum) but they were in the minority. In comments recorded by the data collectors in connection with the PAF administration, three participants also noted an unpleasant aftertaste in the savoury products. Only one participant remarked on an aftertaste in the sweet products (the Plumpy Mum and the vanilla drink). In-depth analyses of each of the sweet products is presented below according to product characteristics, use during pregnancy, and sharing and food allocation.

Vanilla biscuit

Product characteristics

The vanilla biscuit was tied for highest mean scores on taste (with the filled biscuit), and texture (with the Plumpy Mum), 6.6 (SD=0.6) versus 6.6 (SD=0.5), and 6.4 (SD=0.7) versus 6.4 (SD=0.8) respectively. The vanilla biscuit's odour received the highest mean score of all sweet products. Product ranking data also suggested that the biscuit was the highest ranked sweet product in six of the seven ranking categories including overall preference. For the size of portion category, the vanilla biscuit fell three points below the filled sticks (at 195 points compared to 198 points). Across all twelve products the vanilla biscuit ranked in first place as the overall preferred product with 55 of a possible 120 points. In the group discussions, there was relative uniformity in participants' comments on what they liked and disliked about the vanilla biscuit, and in the qualitative ranking exercise, the biscuits ranked in the 'Top 3' products in four of the five group discussions, and ranked second overall. During the PAF participants ate 98.3% of the net weight of the biscuits in an average consumption time of 4.0 (SD=1.4) minutes. The volume eaten was the third highest among all sweet products, following Plumpy Mum and the filled sticks at 98.45.

Women appeared to like the product's taste, colour and texture, and participants frequently noted *'I like everything about it'*. Disparity emerged, however, in discussions about the product odour. During focus group discussions in Karaba and Kari, participants reported negatively on the smell of the vanilla biscuit. One suggested '*It's good when we eat it, but it contains an odour that I do not like'* and another confirmed *'It's as if we have put in garlic'*. The Likert data indicated that smell was the lowest ranking characteristic of the vanilla biscuit. As outlined above, however, it was the highest ranking smell of all sweet products with a mean score of 6.3 (SD=0.9).

All women agreed that children would like to eat the vanilla biscuit. Reasons cited for its expected appeal were primarily linked to the resemblance of the product to other biscuits with which children were familiar and which were available in local shops (Boni, Karaba, Dougoumato) but also because of the *'nice'* and *'sweet'* taste (Boni, Bouéré, Kari, Dougoumato). In the quantitative data, the vanilla biscuit also scored highest in terms of its appeal to children 6.7 (SD=0.5). One woman in Dougoumato confirmed, *'Its sweet, so it can't not please children. Ourselves, we really liked it, we ate it all. If we give it to children, they will eat it all too'*. It was suggested that children would like the product because of the positive influence of their mothers. As a number of participants in Bouéré confirmed, *'If the mothers like it, the children will like it too'*.

In addition to considerations of taste and the similarity to other known biscuits, it was also suggested that ease of consumption and the perception of the product as a medicine with vitamins were key factors influencing the likelihood that adults would appreciate the vanilla biscuit.

Use during pregnancy

Women consistently reported that they would eat the product throughout pregnancy, although the factors that influenced why they would consume the product differed within and across locations. In Bouéré, daily consumption in pregnancy was directly linked to taste, whilst in Boni and Karaba reasons cited were related

to the fact the vanilla biscuit was perceived to be medicine with health benefits. Participants expressed a willingness to use the vanilla biscuit daily during pregnancy even if they had to pay for it. The quantitative Likert score for willingness to use daily if provided was 6.4 (SD=0.8); for willingness to use daily if they had to pay for it, the mean score was 5.8 (1.3). Both of these are the highest scores received by any sweet product (the latter in a tie with the Plumpy Mum). Regarding the amount they would be willing to pay for the product, 82.5% of women expressed a willingness to pay between 1 and 200 CFA, with the remainder willing to pay even more; ten percent of the women were willing to pay 400 CFA or more for it.

The quantitative Likert score for ease of consumption of the vanilla biscuit was higher than any other product at 6.5 (SD=0.7). When discussed during focus groups, ease of consumption was found to relate specifically to the association of the vanilla biscuit with familiar products and to the health benefits perceived by the participants. In Boni, for example, where all women agreed that the vanilla biscuit would be easy to consume, one participant explained, *'It would be easy to eat because it resembles a biscuit and there are vitamins in it. It's good to eat'*. In the product acceptability data, the perception of the vanilla biscuit as a medicine was tied for highest score with the filled sticks and the sweet mango bar, with a mean score of 5.5 and standard deviations of 1.8, 1.7 and 1.8 respectively. Similarly, ease of transportation was also linked to the size and weight of the product, and to the health benefits of consumption.

Information about how the vanilla biscuit would be consumed was varied. All participants agreed that the product would supplement their normal food intake, and there was a general consensus that the biscuits would not or could not replace a *'normal meal'*. Participants in Dougoumato all suggested they would consume the vanilla biscuit as a snack in between meals, with one women specifying that she would eat it at breakfast time. In Bouéré, some suggested they would eat the product as a snack after a meal, whilst others suggested they would eat it prior to a normal meal. One participant associated when she would consume the vanilla biscuit with its medicinal properties, explaining, *'I would eat this product as a snack before my normal meal because it is a medicine'*.

Sharing and food allocation

All participants in Boni suggested that people within their households might expect them to share the products, though in Bouéré participants had contrasting opinions on whether sharing would be expected. Regardless of family expectations, however, women from Boni, Bouéré and Dougoumato all confirmed that they would not share the product. The majority of women in Kari also suggested that they too would not share the vanilla biscuit with others in their household, but were more inclined to share it with other pregnant women. In Karaba, women also suggested that they would share it with children.

No participant in any of the five focus groups believed that their meal portion or share of the normal household food would be diminished as a result of having the supplement. The following statement from a participant in Bouéré was representative, *'It's not going to make me lose my share of family food because we know that it's because of the pregnancy that we were given* [the vanilla biscuit]'.

Plumpy Mum

Product characteristics

The Plumpy Mum received the highest mean Likert score amongst sweet products on overall appreciation (6.5, SD=0.7), finishing just slightly ahead of the filled sticks (6.4, SD=0.7) and the vanilla biscuit (6.4, SD=0.7). It had similarly high scores on all product characteristics with little variance among scores given for colour (6.7, SD=0.5), taste (6.5, SD=0.9), texture (6.4, SD=0.8) and odour (6.2, SD=1.0). For taste and odour, the Plumpy Mum had the second highest Likert scores and it received the highest scores for all other product characteristics. The mean percentage of the test portion of Plumpy Mum consumed was

98.4%, tied with the filled sticks for the highest proportion consumed of any sweet product. The Plumpy Mum portion was eaten in a mean time of 3.6 minutes (SD=1.6), second only to the vanilla drink which was consumed in 3 minutes (although the standard deviation was greater at SD=3.0).

The favourable reaction to the Plumpy Mum product was confirmed in the sweet product ranking, where it received the second highest number of points (193), following the vanilla biscuit (217 points). In fact, Plumpy Mum ranked second in all categories with the exception of the 'portion' category where it placed third with 176 points, following the filled sticks (198 points) and the vanilla biscuits (195 point). The PAF data on portion size, however, indicated that 97.5% (n=39) of participants found the portion size to be acceptable, with only one participant responding that it was too small. On the measure of 'satiety after consumption' Plumpy Mum scored the third lowest of all sweet products, indicating that women may be less likely to use it to replace other foods and less likely to leave it unfinished.

In the overall product ranking the Plumpy Mum received the second highest number of points (50) in the 'Top 3', placing after the vanilla biscuit (55 points). In the focus group ranking activity, the Plumpy Mum product received the most points (12) and was ranked first of all products in focus group discussions in Boni, Bouéré , Karaba, and Kari. In the group discussions, the product was uniformly liked. Participants referred particularly to its sweet taste (*'When you put it in your mouth its sweet and there is a good smell'*) and its 'milky' taste (*'I like it, its as though they've put milk inside'*). In contrast to many of the other products, a large number of participants spoke positively about the smell of Plumpy Mum, whilst others commented favourably on its colour or texture. The majority of participants had no changes to suggest and reported that the product was very good as currently formulated. As one woman in Bouéré concluded, '*When I eat it, I like the smell, the taste, I like everything in this product*'. Participants noted a similarity to peanut butter as well as to milk, and one participant in Karaba mentioned a similarity to *koumbètè* (in Bwamu) or *lidèguè* (in Dioula), a local food made of fried corn flour sweetened with honey or sugar. None of the participants indicated that they knew this type of product (note that no question was asked about prior familiarity).The association with these food stuffs that were well known to the participants was viewed as a positive factor and many said the association would make them more likely to eat Plumpy Mum during pregnancy.

The majority of participants concluded that both adults and children would like the product due to its taste and sweetness, because the women liked it, and because it was a medicine. A few noted that some adults might not like the product if they found it to be too sweet. Likert data indicated that the perceptions of child and adult appreciation of the Plumpy Mum were high. Children's perceived appreciation scored a mean 6.6 (SD=0.6), the second highest across all products, and adult appreciation (6.3, SD=0.7) shared the top position with the vanilla biscuit (6.3, SD=0.8).

Only a small number of women highlighted negative reactions to certain characteristics. One of the women who did not like the product found it too sweet, and suggested reducing the sugar, whilst another said it made her feel as if she may vomit.

<u>Use of product during pregnancy</u>

The majority of focus group participants confirmed that they would eat Plumpy Mum every day during pregnancy. Although they mentioned the health benefits of the product, many also explained that they would eat it because they liked it and enjoyed its sweet taste. Women were likely to use the product daily if provided for free; the mean Likert score was 6.3 (SD=1.0). As was the case with the vanilla biscuits they were also likely to use the product if they had to purchase it themselves (mean Likert score = 5.8, SD=1.4). The amount they were willing to pay was also similar to the vanilla biscuits, with 85% of participants willing to pay between 1 and 200 CFA. Their willingness to pay comparatively high amounts was slightly less than was the case for the vanilla biscuits; only 2.5% were willing to pay 400 CFA or more. The product was uniformly viewed as easy to use and to carry, including for consumption away from home. In Boni and Bouéré , women associated ease of use (inside or outside the household) with the product's health

benefits. The portion size was regarded as exactly right, with only one participant suggesting the full serving size was too small.

Participants differed about whether they would eat the product as part of normal meals, after meals, or as a snack. Most said their use of the product would not reduce or replace their normal meals and many observed that it was insufficient to satisfy them without eating their normal meals. Likert responses generally confirmed of these observations. When asked whether they agreed that they would feel full after having eaten the product, the mean response from participants was 5.0 ('somewhat agree') (SD=1.8).

Sharing and impact on food allocation

Participants were divided as to whether household members would expect to share the Plumpy Mum, and whether the women would indeed share the product. The quantitative data indicated a mean Likert score of 3.4 (SD=2.3); sharing scores varied little across the sweet products, with all Likert scores ranging between 3.4 and 3.6.

In Dougoumato, participants stated that sharing would not be expected, whilst in Boni and Bouéré, participants suggested that they might be expected to share but would not do so. Some participants in Karaba and Kari said that they would or might share the product, particularly with children, other pregnant women, and adults who asked for it. A number of women in Bouéré and Kari anticipated having to 'hide' the product from children in order to avoid sharing. A participant in Kari described the intra-household sharing dynamic that she would face, explaining, '*If it's me, you can't hide even if you're at home. There are people who if they see you eat, they will of course want it. There will be some who understand, they see the 'burden' that you carry* [i.e. that you are pregnant]*, and at that time they'll think of that. But there are some who won't think, if they see you eat they'll think that it's for pleasure and they'll ask you. For me, that is the situation*'. As with the other products, however, there consensus amongst participants that they would not be expected to reduce their share of the household's foods.

Filled sticks

Product characteristics

During PAF tasting sessions, a mean net weight of 24.6g (SD=0.7) of the filled sticks were eaten, representing 98.4% of the test portion. Participants took an average of 4.5 minutes (SD=1.4) to eat their sample. Amongst the sweet products, the filled sticks were in the top-three highest mean Likert scores for all product characteristics, receiving the tied highest mean score for taste (along with the vanilla biscuit) of 6.6 (SD=0.5), and tied second-highest mean score for overall appreciation of 6.4 (SD=0.7).

The PAF data on portion size indicated that 92.5% (n=37) of participants thought that the portion size was acceptable with 2.5% (n=1) responding that it was too small and 5% (n=2) stating that it was too large (see Table 7).

Despite this, the filled sticks finished tied with the fermented drink for fourth place in the sweet product ranking exercise with 170 points, behind the vanilla drink with 183 points. There was a 74-point gap between the filled sticks and the sixth ranking product, the mango bar (96 points). In the overall ranking of all products, the filled sticks also ranked in fifth place.

During the focus group discussion ranking exercise, however, the product came in joint second place with the vanilla biscuit, and during the discussion women's opinions about the filled sticks were broadly positive. The majority of women spoke favourably about the product's sugary/sweet taste. One woman in Boni concluded, *'It's the sweet taste that I like'*. In Bouéré and Karaba, participants were positive about the

product's smell, while a small number of women discussing having enjoyed the texture. One participant in Kari affirmed, *'I like it because it is dry'*. When it was mentioned, colour was noted as a positive characteristic.

A small number of participants in in Boni, Karaba and Dougoumato found the sweetness of the product to be too much, and as such, it led them to comment negatively on the taste. One participant in Dougoumato concluded, *'Its too much, too much sugar in the mouth'*, whilst another participant in Boni suggested that *'one should reduce the sugar a little'*. These finding were consistent with product ranking data in which the filled sticks received relatively low scores and were ranked fourth for taste (175 points) and smell (166 points), and fifth out of seven sweet products with regard to texture. Asked about how the product could be improved, most participants had no suggestions. One participant in Bouéré concluded, *'For me, it's perfect as it is'*, and another in Karaba confirmed, '*All is good for me, it's not necessary to change anything, I like it all* [everything about it]'.

Participants associated the filled sticks with a number of other familiar foods, particularly biscuits. In Bouéré, women compared the product to milk biscuits filled with chocolate. In Karaba, women recognised a resemblance to popcorn and to a local peanut butter-based product called '*crocro*', or *'koura koura'*; a participant in Kari also likened the filled sticks to *koura koura.* A participant in Dougoumato suggested the product resembled biscuits that women were familiar with buying for *'chewing'* and confirmed that *'When you eat that* [the filled sticks]*, you recall those biscuits. What's more, is they* [the filled sticks] *have advantages* [benefits] *for us'*. Associations between the filled sticks and other foods were uniformly positive and were found to favourably influence the women's decision to consume the product. Similarly, participants thought such positive associations would also influence other adults and that children were likely to enjoy eating the product, mainly due to its taste: *'because it is sweet'*. This was verified in the quantitative data, where the filled sticks had a mean Likert value of 6.1 (SD=0.8) for expected adult appreciation of the product and a high mean Likert score of 6.5 (SD=0.6) for children's perceived appreciation, ranking in the top three products that women perceived children to appreciate. In Boni, participants suggested that sweet taste may encourage children to eat too much of the product.

<u>Use during pregnancy</u>

For ease of consumption of the filled sticks had a mean Likert score of 6.1 (SD=1.0), and women in all focus group discussions agreed that they would eat the product during pregnancy. In Karaba, Kari and Dougoumato, women stated that they '*could'* eat the product. In Bouéré, factors that influenced women's use were primarily linked to taste (*'Because I like it'*) and the product's perceived benefits ('*It does me good'*). In Boni, however, the majority of women confirmed that the main driver for eating the product during pregnancy was the fact that it was a 'medicine'. This was corroborated by the quantitative data in which the perception of the product as a medicine scored 5.5 (SD=1.7) on the Likert scale.

All participants said that filled sticks would be easy to use and to carry with them elsewhere. It was noted that the sticks were *'not heavy'* and *'could easily be put into a bag'*. Again, participants often cited the health benefits, as opposed to product-specific factors, as reasons that it was easy to use and transport. For example, one woman in Boni linked the ease of portability to the medicinal component of the product, suggesting *'It is easy to take away as there are medicine and vitamins inside it'*. In the same group a number of women also linked the ease of consumption to the product's perceived medical properties. Only one participant suggested that the health benefits of the product would make it more difficult to consume.

Sharing and food allocation

In reporting when they were likely to consume the filled sticks, participants' answers were varied and included between meals as a snack, as part of a meal, or immediately before or after a meal. A number of women indicated that they would consume the product throughout the day, and one woman in Dougoumato suggested it would *'calm her cravings',* noting that she would eat the biscuits without adjusting her normal food intake. The product acceptability data verified the ease of consumption of the filled sticks between meals, with a mean score of 6.3 (SD=1.0). Two women confirmed that they would choose to eat the product at breakfast time, although one added that this would impact the time she was likely to eat again, *'If I eat, if I get up in the morning to eat that* [the filled stick]*, I will have to wait until around 10 am to eat something else, but it can not be my lunch'*. In Dougoumato and Karaba a minority of participants reported that supplementing their daily diet with the filled sticks would likely decrease their intake of other foods. Data from the product acceptability form found that only 5% of women perceived the size of the daily portion of the filled sticks to be too big.

Participants in all focus groups acknowledged that some adults within their households might expect to have a portion or taste of the filled sticks, but all women agreed that they would not routinely share the product. In Boni and Bouéré, women confirmed, *'Some would expect that I share but I will not share because it is reserved for pregnant women'.* In contrast, women in Kari suggested that they would share the product with children.

Vanilla drink

Product characteristics

The vanilla drink ranked third amongst all sweet products in taste, smell, colour and overall preference in the sweet product classification exercises (see Table 7). In the overall product ranking, the drink received 33 of a possible 120 points, making it the fourth most popular product, just behind the fermented drink which was given 39 points. In the focus group discussion ranking exercises, the vanilla drink never placed among the 'Top 3' products in any of the five fields sites. In contrast, the fermented drink was ranked in shared fourth place in focus group ranking exercises, although Likert scale data for global appreciation placed the vanilla drink above the fermented drink, with average scores of 6.1 (SD=1.1) and 6.0 (SD=1.4), respectively.

Colour, taste and smell, were favourable characteristics of the vanilla drink in all field sites. In Boni and Dougoumato, the majority of women repeatedly asserted '*I like all of them* [characteristics]'. Colour was particularly referenced in Bouéré and in Karaba. The perceived presence of milk contributed to the '*good taste'* of the product, and in Kari women reported that they enjoyed the taste, smell and resemblance of the product to milk or powdered milk. As one participant in Boni concluded, *'When you drink it, it's as if there is milk inside. That's why it's good'*.

Few participants commented negatively on the vanilla drink, and only one of the 40 participants suggested that she did not like the product. This participant, like the others, highlighted her enjoyment of the milk taste, but this was the only aspect which she reported on positively. She remarked, '*I don't like the other aspects, you must reduce the smell*'.

Consistent with Likert data, where expected child appreciation of the product received a mean score of 6.3 (SD=0.9), participants in the focus group discussions confirmed that children were likely to enjoy the vanilla drink for reasons related to the taste, primarily its sweetness and the taste of milk. In Boni it was suggested that children would like the drink because it is '*like a medicine'*, although the nuances of this association were unclear. Participants appeared less confident in whether other adults would appreciate the vanilla drink and it scored 6.1 (SD=0.9) in the Likert data. Participants suggested that adults may like

the product because of its taste, because it is healthy and easy to eat and because of its good smell, although some participants suggested that the product may be too sweet for all adults.

Use of product during pregnancy

A majority of focus group participants said that they would consume the vanilla drink every day during pregnancy. Although they mentioned the health benefits of the product, many also said that they would drink it because they liked it and enjoyed its sweet taste and because of its ease of consumption. The vanilla drink placed third amongst products for being 'easy to eat' with a mean Likert score of 6.2 (SD=1.1), despite the fact that the product required sourcing drinking water and mixing. All participants said that drink would be easy to use and to carry with them. As one woman explained, '*The preparation is easy, you take clean water and you mix with the powder and you have your drink, and you drink it. It's easy to take elsewhere too. It's not heavy, if you put it in a bag you attach it to your bike and you take it wherever you want'.*

Again, ease of consumption and portability were linked by many women to the anticipated health benefits of the vanilla drink and in some cases corresponded to how much she 'liked' the product. There was a similar correlation when women did not like the product, for as one participant in Bouéré explained, *'It would be difficult for me to take it elsewhere. Because I don't like it I can't take it away with me'***.**

Mean Likert scores for the 'utilisation of the product between meals' was high with a measure of 6.2 (SD=1.3). In focus group discussions, there were variations in when the women said they would consume the vanilla drink -- between meals as a snack or as part of a meal. In Boni, women disagreed over the most suitable time to drink the supplement with responses including immediately before, during and after a meal. One women asserted, *'Its like a medicine, you take it after having eaten*'. Whilst participants in Kari did not find the product to be filling, all the participants in Dougoumato agreed the vanilla drink was sufficiently filling that it might replace all or part of their breakfast.

Sharing and impact on food allocation

Sharing the product did not pose a problem for women in three of the five focus group discussions. In Boni, participants explained that they would be expected to share the vanilla drink women but, as with participants in Bouéré and Kari, they agreed that they would not give the product to other adults '*Because it is a medicine'* and '*It's reserved for pregnant women'*. Likert data reflected a similarly low likelihood of sharing with a mean of 3.4 (SD=2.2). Only one woman indicated that she would share the product with others in her household if they asked. Participants appeared more likely to share the vanilla drink with children. Where asked, all 40 participants indicated that their share of the normal household meals or food would not be affected as a result of her drinking the vanilla drink.

Fermented Drink

Product characteristics

The mean proportion of the test portion of the fermented drink consumed was 90.7%, and it was consumed by participants in an average of 3.8 minutes (SD=4.1). The product placed amongst the lowest mean Likert scores for sweet products for each characteristic except odour, where it was in a three-way tie for second place at 6.2 (SD=1.2) alongside the filled sticks (6.2, SD=0.9) and the Plumpy Mum (6.2, SD=1.0). It was the fifth most liked product in the overall appreciation measure, second lowest of products on taste (5.9, SD=1.5) and third from last on texture (5.9, SD=1.6). Despite this, the fermented drink was ranked in third place in the sweet product ranking exercise with regard to texture (180 points) and tied for fourth

overall (170 points), thirteen points behind the vanilla drink (183 points). The fermented drink received its most favourable scores during the 'Top 3' overall product ranking exercise where it placed third with 39 points, and in the focus group ranking activity, the drink appeared in the 'Top 3' in two of the five groups and was ranked in fourth place overall.

Although participants in Dougoumato agreed in their overall liking for the fermented drink, such consensus was not reached in the other focus group discussions. The greatest divide regarding the likability of the product related to its sour, fermented taste. Where women disliked the drink, it appeared that this was related to their dislike for sour tastes generally rather than a specific dislike of the product type itself. Hedonic test scores from the PAF confirmed these findings, and the taste of the fermented drink was the second-to-least liked amongst all products in the sweet grouping; it scored only marginally higher than the least liked product in the group, the unseasoned pillow, with scores of 5.9 (SD=1.5) and 5.8 (SD=1.6) respectively.

Despite the fermented drink's fourth place ranking and its double appearance in the group discussion ranking exercises, the participants were more divided in their impressions during group discussions. Although many women expressed favourable opinions of the drink and its various aspects (sour taste, texture, colour), it elicited strong reactions from those who did not like it. Several women stated that the sour taste was too much, and some women had an aversion to the odour. In Boni and Bouéré, many enjoyed the taste of the product but disliked the odour, and women in both groups suggested, *'The odour should be decreased'*. The majority of women elsewhere, however, suggested there was no need to change the product and no suggestions as to how to improve it were made.

None of the participants in Boni and Dougoumato noted a resemblance between the fermented drink and other familiar foods, although in Kari, participants commented positively that the drink resembled curd, and in both Bouéré and Karaba it was likened to local foods made with couscous. One woman in Bouéré explained, *'It resembles a food that we make. We transform flour and couscous in a jar overnight and we add water. When it mixes it becomes sour, we call that Gafini in Bwamou'*. Other similarities were drawn with sour pancakes and fermented plain and millet flour. For women in Bouéré the association between the fermented drink and products they were more familiar with was found to seen to have a positive influence. Similarity to other known products was also found to be primarily positive in Karaba.

<u>Use during pregnancy</u>

Because of the fermented drink's sour taste, participants were divided as to whether the product would be well perceived by other adults and children. Women in Karaba indicated that the sour taste was a positive factor that would make children more likely to consume the product, but suggested that adults would dislike the sour taste. This was verified by the quantitative data, where the drink had a mean Likert value of 6.0 (SD=1.2) for expected adult appreciation of the product and a higher mean Likert score of 6.2 (SD=1.2) for children's perceived appreciation. In contrast, participants in Kari suggested that children were less likely than adults to like the taste, but participants in Dougoumato noted that children '*refuse nothing'*.

Most women agreed that the product was easy to consume and transport. The ease of consumption of the fermented drink had a mean of 5.9 (SD=1.5) in the Likert data, and a willingness to drink the fermented product throughout pregnancy was displayed across the field sites. All but one woman agreed that they would use the product daily during pregnancy. Women in Boni, Bouéré and Karaba confirmed that they would consume the drink because they liked it and enjoyed its taste and smell, and because they perceived it to have medicinal benefits and liked the idea that *'It does us good'*. The one woman in Bouéré who had an aversion to the product affirmed that she would be unable to consume the drink during pregnancy because of its smell.

When women highlighted specific intentions about when they would consume the fermented drink, it was most frequently linked to breakfast, and it was suggested that the drink would be consumed before or

alongside their normal breakfast routine. A number of women in Karaba suggested they would drink it after or between meals. In Kari, the timing of consumption was not indicated, but women suggested that they would consume the product *'little by little'*. A number of participants agreed that the fermented drink would supplement their normal daily food intake. More than in reference to other solid products, half of the participants in Karaba and one woman in Bouéré suggested that the drink would replace some elements of their daily diet, and all of the women in Dougoumato stated that the drink could replace their breakfast.

Sharing and food allocation

As with many of the other products, participant views regarding household expectations of sharing the fermented drink varied. In Boni and Kari women suggested that household members may want to share the product, but in Bouéré women were confident that others in the household would not ask them to share, explaining, '*They would not expect us to share because its reserved for pregnant women'*. All women agreed that regardless of expectations, they would not share the product with others in their household. In both Boni and Dougoumato reasons cited for not sharing were associated with the medicinal and health benefits of the drink. One woman in Boni suggested, *'It's like a medicine for pregnant women so we are the ones to drink it, we can't just give it to anyone'*. In the quantitative metrics, data showed a mean Likert score of 3.5 (SD=2.2), tied with the filled sticks (3.5, SD=2.3) for second highest likelihood of sharing. There was consensus amongst participants that the provision of the fermented drink to pregnant women would not adversely impact their share of family meals and foods.

Sweet bar

Product characteristics

The sweet mango bar received low scores in the mean Likert rankings for all characteristics and its scores were consistently amongst the lowest three in the sweet product group. The percentage of portion consumed was the fourth highest at 96.3%, and the product was consumed in the second longest mean time of 5.6 minutes, with a notably high standard deviation, compared to other products, of 4.5. The colour and taste were the highest ranking characteristics of the sweet mango bar with mean scores of 6.0 (SD=1.3) and 6.2 (SD=1.0) respectively. Taste and colour were also identified by participants in the focus group discussions as the preferred characteristics of the mango bar. Women in Boni commented positively on the sweet taste of the bar, whilst in Kari, women referenced enjoying the texture and dryness of the bar.

The bar was ranked second last in the sweet product overall ranking, its score of 96 not far above that of the lowest ranking product (the unseasoned pillow at 91) (see Table 4). The sweet mango bar ranked lowest on colour, size of portion and on ease of consumption with 90, 84 and 99 points respectively out of a possible 280 points.

Many women had negative reactions to the smell of the product, and as such, odour prevailed as the most disliked characteristic in both the focus group discussions and on the Likert-scaled questions, and in the sweet product ranking exercise it ranked second lowest for odour with 111 of a possible 280 points. Despite the product's sweet flavour and positive responses to its taste, participants concluded that its negative odour outweighed these characteristics and made the product unappealing. Although women didn't specify what they specificially disliked about the smell, women agreed that the odour would impact their ability to consume the product during pregnancy. One woman in Karaba explained, *'because of the smell, we could not eat it every day'*. Improvements were suggested by a small number of participants and focused on the '*reduction'* of product's odour, with participants stating that adults would be more likely to eat the bar if its smell was improved. A small number of women also suggested that the sugar content should be decreased.

In focus group discussions, the product was found to bear a resemblance to peanuts (the product's ingredients include nuts). In Karaba, it was further suggested that the product resembled a mix of products including peanuts, sesame and pearl millet. Although not appreciated by all participants, many noted a positive correlation between the appearance of peanuts in the sweet mango bar and their likelihood to eat the product, due to their familiarity with eating nuts. Across all field sites, no reference was made to the mango flavour of the bar. The Likert score for the perceived adult appreciation of the product had a mean score of 5.9 (SD=1.0). Factors associated with potential child consumption were not linked to smell. Rather, in Karaba, participants suggested that children would like the peanuts and sesame in the bar, whilst in Kari they highlighted that children would enjoy the sugar content. This was reflected in the higher Likert score received for participants' perceptions of child appreciation of the product, with a mean of 6.1 (SD=1.0).

Use during pregnancy

Despite their strong opinions on the smell of the bar, the majority of women said they would, or in some cases would at the very least '*try'* to, eat the product during pregnancy. Participants suggested they would overcome their dislike of its odour and still consume the product because they liked it overall, because they perceived it to have health benefits, and because they regarded it to be a medicine. Only women in Bouéré affirmed that they would be unable to overcome the smell to eat the product. Quantitative data also indicated a relatively strong level of agreement that the women would eat the sweet mango bar daily for 12 months if it were given to them, with a Likert score of 5.6 (SD=1.5). However, of all the products sampled, the sweet mango bar ranked the least likely to be eaten during pregnancy regardless of whether it was provided for free (5.6, SD=1.5) or had to be purchased (5.2, SD=1.8).

Across all field sites, the majority of pregnant women agreed that the sweet mango bar would supplement their normal food intake and would be eaten as a snack between meals. Most women noted that they would simply eat the product between normal meals, although a number had specific ideas about when they would most likely eat the product, including the time of day and before or after which meal. One participant in Boni, for example, suggested that she would consume it after breakfast. Only one of the 40 participants suggested that consuming the sweet mango bar would likely reduce her intake of other foods.

The mean Likert score for 'product is easy to eat' was 5.8 (SD=1.5), and its mean score for 'product is convenient to eat between meals' was 6.2 (SD=1.1). Most women agreed that the product was easy to consume and transport, and, as with other products, its ease of consumption was often linked to the product's health benefits.

Sharing and food allocation

Across all field sites participants agreed that they would not share the sweet mango bar with others. In Karaba, women suggested that household members were unlikely to ask to taste the product because it was not a *'normal food*', whilst in Kari they confirmed that they would not share the product as it *'contains vitamins for pregnant women*'. In Dougoumato, participants explained that to overcome any issues with expectation to share, they would eat the product alone. This was consistent with the product's mean Likert score on 'likelihood of sharing' of 3.4 (2.1).

Only two participants (one in the Boni, the other in Bouéré) suggested there would be an obligation to share the sweet mango bar with other family members. The participant in Boni noted that regardless of such expectations, she would not share the product, although in Bouéré the participant explained, *'They* [others in the household] *would expect that we share with them so that they can taste it. If you give us the product and we do not like, we can give it to someone who loves it'*.

Unseasoned pillow

Product characteristics

The unseasoned pillow received the lowest mean Likert score, 5.7 (SD=1.4) for overall product appreciation for the products in its tasting group. The product underperformed in all categories: the pillows were the least liked amongst the group's products in terms of taste at 5.8 (SD=1.6); and were in the lowest three product scores for all other characteristics. The total proportion of the pillow eaten during the PAF tasting sessions was 89.4%, the lowest percentage of product consumed in its group, and it took the longest mean amount of time of, 7.7 minutes (SD=5.5). The product was named only once in the 'Top 3' group ranking during the focus group discussion, and received a single point for its third place finish. The standard deviations across the Likert hedonic scores for the unseasoned pillow were amongst the highest registered for non-savoury products, indicating greater variability in the responses for the majority of characteristics. The unseasoned pillow ranked at or near the bottom for every product characteristic in the sweet product ranking exercise: it was last in taste, texture, odour, and overall (at 91 out of 280 possible points) and second-to-last for color and ease of use. It did score in fourth place for one characteristic, portion size, with 173 points, just behind Plumpy Mum with 176.

Different views about the product were clear when comparing focus group discussion data. In Dougoumato, for example, all the participants liked the product, and commented positively on its colour and ease of consumption. As one women described, *'The colour is beautiful, you have no problem to crunch that, you have no problem to swallow it too'*. In Boni, however, there was near equal divide between participants, with around half of the women explaining that whilst they liked the texture of the product, the odour was too strong.

As with other products, the smell of the unseasoned pillow was a significant factor for many women and elicited most negative responses. In Karaba, one participant noted that the smell of the product 'resembles meat'. The data from the focus group discussions was supported by the quantitative data in which the mean Likert score for the product's odour was 5.5 (SD=1.6). Odour was the lowest scoring characteristic of the unseasoned pillow, and the product was the lowest scoring product in its tasting group in terms of smell.

Data from the PAF indicated that the scores for the 'perception of the appreciation of children' question were the lowest of any product in the sweet group. In the focus group discussions, however, most participants agreed that children would be likely to enjoy the product, although the justification for why they would or would not was not always made clear. The focus group in Kari was the only discussion in which participants highlighted why the product would not appeal to children, suggesting the unseasoned pillow lacked sugar, was too dry and had an odour that would be unpleasant to children. Participants were divided as to whether other adults would appreciate the product or not, and they suggested a range of factors that could positively influence their consumption, including its health and medicinal benefits as well as product specific characteristic such as texture.

Use of product during pregnancy

In spite of the low ranking scores of the product across the quantitative tools, in the focus group discussions, many participants suggested that they would eat the unseasoned pillows during their pregnancy primarily due to the product's perceived health benefits for participants and their babies. When discussed, the characteristic that would be difficult for women to overcome if they were to consume the product on a daily basis was its smell. Some women suggested that they would have to eat the unseasoned pillow *'little by little'* whilst others said they would not want to because of its odour, '*The smell is as if we put Maggi or something other inside, I don't know why. But that's why I cannot eat it. It is like there are onions'*.

There was a high level of consistency among participants confirming the ease of use at home and ease of transportation for the unseasoned pillow. Participants forwarded different ideas about when they would eat the product, however. Some said they would expect to eat it as a snack in between meals, whilst others thought they were likely to eat it with other meals. The product's mean score for 'easy to eat' was the lowest of all products in the sweet group at 5.7 (SD=1.6) as was its mean score for 'convenient to eat between meals' 5.8 (SD=1.5).

Sharing and impact on food allocation

As with other products, some participants expected other adults and children to want to share the product, but most said that they would not do so. A small number of women said that they would share the product with children. One participant in Kari said that the portion size was sufficient to share, but that she would not because of '*vitamins inside*'. In the PAF, only three women in total (7.5% overall) found that the portion size of the pillows was too big. The other 37 participants (92.5%) found the size to be acceptable. Although the mean Likert response for likelihood to share was in the lower 'unlikely' range at 3.6 (SD=2.3), it scored highest of all of the products in its tasting group, and third over all products, indicating that participants were more likely to share this product than the others. (The variability of responses for 'likelihood to share' was relatively uniform across sweet products, with standard deviations ranging from 2.1 to 2.3 on scores of 3.4 to 3.6.)

Findings 3. Savoury product grouping

In general, the savoury products scored lower than the sweet products along nearly every metric (see Table 8 below). None were chosen among the 'Top 3' products (Table 9) during the individual ranking or during the group ranking. For the savoury products, the mean Likert scores for overall product appreciation were all less than 6 (with all but one ranked at 5.5 or lower). This is in contrast to the products in the sweet group, of which all but two (the bar and the unseasoned pillows) had a mean Likert score of 6 points or over.

This disparity was also reflected in the head-to-head comparison between similar products (sweet vs. savoury bars, biscuits and Plumpy Mum and seasoned vs unseasoned pillows). In focus group discussions, participants expressed a strong preference for sweet rather than savoury versions of the same products. The scores for all characteristics (colour, taste, texture, odour) were uniformly lower for the savoury products than for the sweet products. Even for texture, which was similar between the sweet and savoury versions of the same product, mean Likert scores for the sweet products were 0.4 to 1.2 higher than the scores of their savoury counterparts.

In the overall product ranking for savoury products, Plumpy Mum (154 points) was most preferred followed by the chicken soup (140). The remaining three products trailed these two by an important margin, with the savoury bar receiving 116 points, the savoury biscuit receiving 99 and the seasoned pillow receiving 91 points. In-depth analysis of each of the savoury products is presented below according to product characteristics, use during pregnancy, and sharing and food allocation.

Savoury Plumpy Mum

Product characteristics

The savoury version of Plumpy Mum was the most highly rated savoury product along all sensory metrics, receiving the highest mean Likert score of all savoury products in terms of colour, taste, texture, smell, and overall (see Table 7 below). The savoury Plumpy Mum also stood out from the other savoury products more than did the Plumpy in its product group: The savoury product's score of 154 out of a possible 280 means that it received 77% of the maximum score; the sweet product received 193 out of 280, or 68.9% of the maximum score.

The savoury Plumpy Mum's mean Likert score of 5.9 (SD=1.5) for overall appreciation of a product put it slightly ahead of both the sweet bar and the unseasoned pillows, which received mean Likert scores of 5.8 (SD=1.1) and 5.7 (SD=1.4) respectively (see Table 6 above). The savoury version of Plumpy Mum was also the most preferred savoury product during the product classification activity, overall and for each individual product characteristic (see Table 3 above). During administration of the PAF, the savoury Plumpy Mum was eaten the fastest of any savoury product at 5.8 minutes (SD=5.2) and participants consumed an average of 91.6% of the amount served. However, it received only 3 points in the 'Top 3' PRF overall ranking exercise, indicating that at most three women selected it among their three most preferred products overall (see Table 4 above). The savoury Plumpy product never ranked amongst the 'Top 3' products in group discussions and participants who expressed a preference between the sweet and savoury versions of the product unanimously chose the sweet over the savoury.

Comments during focus group discussions were largely favourable, with women making various positive comments about the flavour, colour and smell of the savoury Plumpy Mum. Women in Dougoumato commented on the sweetness of the savoury Plumpy Mum product as something they liked, and suggested adding some sugar to improve it. Participants in Bouéré liked the colour, taste and/or smell of the savoury Plumpy Mum and most women in Boni liked the product overall as well.

Table 8. Hedonic testing, acceptability of savoury products, mean (standard deviation)

	Savoury Plumpy Mum	Chicken soup	Bar	Biscuit	Seasoned pillow
Net weight consumed (g)	22.9 (5.7)	56.8 (22.6)	14.1 (4.7)	13.1 (5.6)	13.3 (6.0)
Proportion of test portion consumed (%) *	91.6	81.1	88.1	77.1	78.2
Duration of consumption (min)	5.8 (5.2)	6.8 (6.9)	8.3 (6.6)	9.4 (6.9)	10.5 (6.7)
	Appreciation of Product (1= Dislike very much to 7= Like very much)				
Colour	6.4 (1.0)	6.0 (1.5)	6.0 (1.2)	6.2 (1.4)	6.0 (1.6)
Taste	6.1 (1.4)	5.7 (1.7)	5.5 (1.6)	5.2 (1.7)	4.8 (2.1)
Texture/consistency	6.0 (1.3)	5.5 (1.8)	5.3 (1.5)	5.2 (1.8)	5.0 (2.1)
Smell	5.7 (1.8)	5.1 (2.2)	5.0 (2.0)	4.9 (2.1)	4.5 (2.4)
Overall appreciation	5.9 (1.5)	5.5 (1.8)	5.3 (1.8)	5.0 (2.1)	5.0 (2.2)
Perceived child likeability	6.2 (1.1)	5.8 (1.4)	6.1 (1.0)	5.9 (1.3)	5.7 (1.7)
Perceived adult likeability	6.0 (1.1)	5.8 (1.2)	5.8 (1.0)	5.5 (1.6)	5.3 (1.8)
	Perception of product use (1= Not at all in agreement to 7= very in agreement)				
Product is convenient to eat	6.1 (1.1)	5.8 (1.4)	5.6 (1.5)	5.7 (1.6)	5.5 (1.9)
Product is convenient to eat between meals	6.3 (1.2)	6.0 (1.5)	6.0 (1.4)	5.9 (1.6)	5.4 (1.8)
Product is medicine	5.5 (1.7)	5.5 (1.8)	5.2 (1.8)	5.4 (1.7)	5.1 (1.8)
Feel full after full portion	5.2 (1.6)	5.1 (1.7)	5.2 (1.6)	5.0 (2.0)	5.5 (1.7)
Would share with others	3.4 (2.2)	3.4 (2.2)	3.2 (2.2)	3.7 (2.3)	3.7 (2.4)
	Willingness to use daily for 12 months (1= Not at all in agreement to 7= very in agreement)				
Would use daily if provided	5.9 (1.4)	5.5 (1.9)	5.7 (1.6)	5.5 (1.9)	4.9 (2.2)
Would use daily if purchased	5.5 (1.6)	5.1 (2.1)	5.1 (2.0)	5.0 (1.8)	4.5 (2.3)
Would pay how much (CFA) 0	0 (0%)	0 (0%)	1 (2.5%)	2 (5%)	1 (2.5%)
1-100	18 (45%)	15 (37.5%)	22 (55%)	17 (42.5%)	14 (35%)
101-200	11 (27.5%)	15 (37.5%)	7 (17.5%)	13 (32.5%)	14 (35%)
201-300	4 (10%)	3 (7.5%)	2 (5%)	5 (12.5%)	6 (15%)
301-400	0 (0%)	0 (0%)	1 (2.5%)	0 (0%)	0 (0%)
401-500	4 (10%)	3 (7.5%)	4 (10%)	2 (5%)	2 (5%)
> 500	3 (7.5%)	4 (10%)	3 (7.5%)	1 (2.5%)	3 (7.5%)
	Size of portion (for a snack or portion), n (%)				
Portion size is acceptable	35 (87.5%)	32 (80%)	33 (82.5%)	29 (74.3%)	27 (67.5%)
Too small	4 (10%)	4 (10%)	2 (5%)	3 (7.7%)	3 (7.5%)
Too big	1 (2.5%)	4 (10%)	5 (12.5%)	7 (18%)	10 (25%)

*net weight consumed/sample weight x 100

Table 9. Savoury Product Ranking, sum of ranks

	Savoury Products*						
	Taste	**Texture**	**Smell**	**Colour**	**Portion**	**Ease**	**Overall**
Plumpy Mum savoury	164	155	148	141	148	153	154
Chicken soup	135	133	125	117	116	129	140
Bar	111	109	115	102	96	105	116
Biscuit	97	109	106	117	116	109	99
Seasoned pillow	93	94	106	123	124	104	91

* Savoury products were assigned points based on rankings from 5 for a first place ranking to 1 for a last place ranking. Points for each product and each characteristic were then summed. For reference, the maximum available score for a savoury product was 200 (5 points x 40 participants) and the minimum available score was 40 (1 point x 40 participants).

Participants noted similarities between the savoury Plumpy Mum and a number of familiar foods: peanut butter was frequently mentioned; milk, sesame, beef, sardines and *Namatou,* a local food made with peanuts, were identified as well. All viewed these associations as positive and likely to favourably influence their consumption of the product.

The savoury Plumpy Mum had a mean Likert value of 6.0 (SD=1.1) for expected adult appreciation of the product and a mean Likert score of 6.2 (SD=1.1) for child appreciation. This was confirmed in the focus group discussions, where most participants agreed that adults and children would like the product, mainly due to its taste (and its similarity to peanut butter) though some noted that the lack of sweetness might prevent children from liking it. The colour, ease of consumption and fact that the women like it were also mentioned as factors influencing adult and child perceptions of the product. Another recurring reason that both children and adults would like the product was its health benefits -- the fact that it is a '*médicament*'. The precise association between adults' or children's liking the product and its health benefits was unclear.

These positive perceptions were not uniform, however. For example, some participants in Kari liked the colour of the savoury Plumpy Mum but disliked the odour of onions and garlic that they perceived. Across the focus group discussions, some women liked the salty flavour whilst others identified it as something that should be reduced in order to improve the product. In Boni, the saltiness of the savoury Plumpy Mum was identified both as the most liked and the least liked characteristic of the product. One woman in Bouéré explained, '*It's good but it's the salty taste that makes it so that I can't eat it*'.

A number of women had very strong negative reactions to aspects of the savoury Plumpy Mum. In both Bouéré and Dougoumato, women indicated that the product made them vomit or want to vomit; the participant in Bouéré attributed this to the taste of the product, while the participant in Dougoumato said that she didn't like the smell (of garlic and seasonings) or anything about it and couldn't eat it. A participant in Dougoumato didn't like the smell of '*nare'*, or fermentation, that she detected in the product. Another Dougoumato participant objected to the texture/consistency, which she found too heavy: '*When you eat, it stays in your throat, it doesn't go down'*.

<u>Use during pregnancy</u>

Apart from those women who said they were unable to tolerate the product, participants uniformly said that they would eat savoury Plumpy Mum during pregnancy. Some said that they would eat it because they liked it, but even women who did not affirmatively like the product said that they would eat it because of its health benefits. In Boni, where all of the women liked the product, every participant suggested health factors as the reason they would consume it, and none suggested taste as a driving factor. Those who were asked confirmed they would use the product daily during pregnancy.

Participants broadly agreed that savoury Plumpy Mum would be easy to use and to carry with them. Ease of consumption and portability were linked by many women to the anticipated health benefits/medicinal

properties of the product. One participant in Boni explained, '*It will be easy to consume because it's a vitamin'*, whilst a participant in Bouéré concluded, '*Me, I can take it with me, even if I go to the fields or on a trip. Because it helps me, there's no problem*'.

When participants said they would eat savoury Plumpy Mum varied: between meals as a snack, as part of a meal, or immediately before/after a meal. In Bouéré and Dougoumato, women discussed their intention to eat the product between meals, and some participants in Dougoumato suggested that the product could only be eaten between meals, in contrast to other products which could be consumed as part of a meal or immediately before/after a meal. In Boni most participants concluded that they would eat it as part of a meal, and in Karaba opinions were mixed as to when they would eat it.

Sharing and food allocation

Participants in all focus groups acknowledged that some people within their households might expect to share the products, although others said that no sharing would be expected. Regardless of family expectations, however, only three women in the five focus groups (from Karaba and Kari) suggested that they would or might share, and one said she would share only with another pregnant woman in her family compound. This was also reflected in the mean Likert scores for likelihood of sharing; the mean for savoury Plumpy Mum was 3.4 (SD=2.2), reflecting a relatively low likelihood of sharing. However, the scores do show greater variability than any of the other response categories for this product (see Table 7 above).

Nearly all participants said that the savoury Plumpy Mum would supplement and not reduce their normal diet. Only in Karaba did women say that the product might reduce their normal intake of foods. No one in any of the five focus groups said that their share of normal household meals or food would be diminished as a result of having the supplement. As one participant in Boni put it: '*This* [savoury Plumpy Mum] *can't cause a reduction in my share of the family's food'*.

Chicken soup

Product characteristics

The chicken soup was the only product served hot. Participants consumed a mean of 81.1% of the product (placing it third among savoury products) and they consumed it more quickly (6.8 minutes, SD=6.9) than any savoury product besides the Plumpy Mum. Among savoury products, the chicken soup received the second-highest mean Likert scores for every product characteristic except colour, where it was in a three-way tie for third (last) place (see Table 7). It also finished in second place in the savoury product ranking exercise with 140 points, just behind the savoury Plumpy Mum with 154 points. It finished in second place in the rankings for all of the individual characteristics as well, except for colour and portion size, where it tied for third place (see Table 3). The PAF data on portion size, however, indicate that 80% (n=32) of participants thought that the portion size was acceptable with 10% (n=4) responding that it was too small and an equal number stating that it was too large (see Table 7). The chicken soup, like all of the savoury products, received only a small number of points (9) in the 'Top 3' overall ranking exercise (see Table 4). It did not appear in the 'Top 3' in any of the focus group discussion ranking exercises.

Although many women expressed favourable opinions of the chicken soup and its various aspects (taste, texture, colour and odour) during the focus group discussions, it elicited strong reactions from those who did not like it. Several women stated that the product made them nauseous, with aversion to the odour being the primary driver. In Dougoumato, for example, most women liked the chicken soup, including its odour, although one participant stated that the odour made her want to vomit. In Boni and Kari, many enjoyed the taste of the chicken soup but again disliked the odour. A participants in that group also

referred to the smell making her nauseous, '*What I didn't like, there's a little odour that makes it so that if you eat it, it doesn't sit well. And you want to vomit*'.

A number of participants suggested that the chicken soup evoked the taste of beans, whilst others suggested it tasted like a mixture of '*soumbala'* (a west African condiment) and fish powder or like soy. Most women, however, did not identify the product with any foods they recognised. Those who identified the product with other foods were divided about whether the association was positive or negative.

Most participants expected that both adults and children would like the chicken soup, for a variety of reasons: because the women themselves liked it, because it tasted/smelled good, and/or because it was seen to be a medicine. In both Dougoumato and Boni, women noted that tastes differ between people, so some household members might like the product whilst others might not. Mean Likert scores for both adult and child appreciation of the chicken soup were 5.8 (SD=1.4 for children and SD=1.2 for adults).

Use during pregnancy

Except for those who said that they were unable to eat the chicken soup because it made them feel ill, most participants agreed that they would eat the product daily, even if they did not like it, for the health of their baby. As one participant in Dougoumato stated, '*Oh, I'm going to drink it in any case, if I know that it's given me to drink and I know that it can have benefits for my health I'm going to do everything [I can] to drink it*'.

Most suggested that the chicken soup was easy to prepare and consume both at home and when away from home, though this was sometimes linked with their like/dislike of the product. One participant in Bouéré suggested, for example, '*It would not be easy for me. Even if I were given this food, I couldn't prepare it to eat because I don't like it*'. Others linked ease of use to the fact that the product was healthy. The mean Likert score for 'easy to eat' (5.8, SD=1.4) and the mean Likert score for use between meals (6.0, SD=1.5) were both the second highest of all savoury products.

Despite the fact that preparation of the chicken soup requires a pregnant woman to have access to hot water, this was not perceived as a barrier to use, even when consuming the product outside the home. As one participant in the focus group discussion in Karaba concluded, '*It's easy, when leaving the house you have a bag where you put the powder, you heat the water which you put in a thermos. [On] arrival you put the hot water in a glass and you prepare your soup*'.

Most participants agreed that they would eat the chicken soup between meals, although some suggested they would eat it after a meal instead. More than the other products, the chicken soup was perceived by a number of women as being sufficiently filling that it might replace all or part of a meal (as discussed in Boni, Karaba and Dougoumato). Other participants did not find the product filling and a participant in Kari concluded that she would consume it as an '*amuse-bouche*'.

Sharing and food allocation

Although in Karaba the majority of participants believed that household members would want to taste the soup, most women suggested that sharing the product would not be expected. Despite this, most expressed a greater willingness to share the soup than they had for most other products. In Karaba, several women were willing to share at least a taste with friends or children. In Bouéré, some participants linked their willingness to share with the degree they liked/disliked the product. As one woman concluded, '*Because I don't like it, if nevertheless someone wanted it, I would give it to them*'.

In relation to household allocation of food and the impact supplements may have on consumption, it is worth noting that participants in Dougoumato suggested that women had a high degree of agency over the food (type and quantity) they ate. One participant explained, '*All of us, we each keep a home, each of us prepares* [meals] *in her house, thus what you want to make, you make. With us, it's like that'.* This view was echoed by another participant who concurred, '*We prepare our own meals in our house, you can't reduce your own meal, you make what you want to make'*, and a third participant agreed, '*They can't reduce our meals. We eat the portions we want to eat'.*

Savoury bar

Product characteristics

On average, participants consumed 88.1% of the test sample of the savoury bar in a mean time of 8.3 minutes (SD=6.6). This placed the savoury bar in second place among the five savoury products for amount consumed and third place for the time in which it was eaten. The mean Likert scores for the savoury bar's colour, taste, smell and odour all rested in the middle score range for savoury products, and the savoury bar was positioned at number three amongst the five products for those variables. The mean score for overall appreciation was 5.3 (SD=1.8). The savoury bar received relatively high mean scores on colour (6.0, SD=1.2) and taste (5.5, SD=1.6), with a slightly lower score on texture (5.3, SD=1.5). The mean score for odour was the lowest score the product received (5.0, SD=2.0). The bar was ranked third overall in the savoury product ranking exercise, although its score of 116 was relatively far behind the savoury Plumpy Mum, with 154 points, and the chicken soup, with 140 points (see Table 3). The savoury bar received only 4 points in the individual overall 'Top 3' product ranking (see Table 4), and it never appeared in any focus group's 'Top 3' ranking exercise. As with other products, there was virtually unanimous preference for the sweet over the savoury version. Of the 24 focus group members who stated a preference, only one chose the savoury version.

Conflicting and often strong opinions were expressed about the savoury bar during the focus group discussions. In most of the focus group discussions, opinion of the product was divided: some women liked the product and others did not; some liked certain characteristics, including taste, whilst others did not. Texture and colour were identified as positive characteristics irrespective of opinion on taste. Participants noted the presence of peanuts and/or peanut butter in the product as a positive factor and one that made it more likely that children and other adults would like it. Others noted the resemblance between one of the bar's ingredients and '*petit mil*' [pearl millet], a common local food. Although some participants thought that the salty taste would be unpalatable for children in particular, but also for adults, most thought that children and adults would like the product, in part due to the peanuts. This is consistent with the relatively high Likert scores received for participants' perception of adult and child appreciation of the product: the savoury bar received a mean score of 6.1 (SD=1.0) for child appreciation and 5.8 (SD=1.0) for adult appreciation, both of which were the second-highest mean scores among savoury products.

The most frequently mentioned negative characteristic was the smell. In Dougoumato, women said the smell reminded them of unspecified seasonings they did not like, and of soy. A number of women commented negatively on the salty taste, and removal of the salty flavour and the smell were suggested as ways to improve the product.

Use during pregnancy

Quantitative data suggested that women would eat the savoury bar daily for 12 months if it were given to them, with a mean Likert score of 5.7 (SD=1.6). This was confirmed in the focus group discussions. In Dougoumato, even those women who disliked the product said they would eat it during pregnancy because of the health benefits for their babies. In Boni, all women stated an intention to eat it daily, although one

said she would do so only if the odour were changed. There, as in Dougoumato, use was tied to the product's health benefits. The savoury bar received a mean Likert score of 5.6 (SD=1.5) for the statement that the 'product is a medicine', indicating a moderate level of agreement with that statement.

In the other focus group discussions, responses were more varied and were more closely associated with participants' like/dislike for the product. Some women said that they would have difficulty eating the product, particularly at one sitting, and one participant concluded, '*If I ate it all at once, it would make me want to vomit*'. The participants in Karaba who disliked the product said that they would be unable to eat it during pregnancy, although some said they would try to eat it from time to time because it was a medicine, '*I'll manage because it's a medicine'.* The responses suggest that some of those who were unable or unwilling to eat the product during pregnancy were driven by their strong negative reaction to the product's smell or taste.

For the savoury bar, the mean Likert score for the statement the 'product is easy to eat' was 5.6 (SD=1.5), and the mean score for 'product is convenient to eat between meals' was 6.0 (SD=1.4). Most women agreed that the savoury bar was easy to consume and transport, with ease of consumption often linked to the product's health benefits. Across the focus groups most women stated that they would eat the product between meals as a snack, although a few would eat it either during or after meals. Participants broadly agreed that the savoury bar would be eaten in addition to normal meals and would not replace them.

Sharing and food allocation

As with most other products, many participants recognised that others might wish or expect to share the savoury bar, whilst some stated that sharing would not be expected. Very few stated an intention to share regardless of household members' expectations, consistent with the product's mean Likert score of 3.2 (SD=2.2) on 'likelihood of sharing.' This score was the lowest of all of the savoury products. One participant in Bouéré suggested, however, that she would share the product if she did not like it. There was widespread agreement that provision of the savoury bar to pregnant women would not adversely impact their share of family meals and foods.

Savoury biscuit

Product characteristics

The savoury biscuit, together with the seasoned pillow, received the lowest mean Likert score (5.0, SD=2.1) on overall product appreciation. The biscuit slightly outperformed the pillow along all hedonic characteristics but nonetheless was in the bottom two for all characteristics other than colour, for which it received the second highest mean Likert score (6.2, SD=1.4) amongst savoury products (see Table 7). The savoury biscuit was ranked overall fourth amongst the five savoury products during the product classification activity, and third for colour, texture, portion size and ease of use. It was ranked fourth among the savoury products for both taste and odour (see Table 3). The product was never named in the 'Top 3' products in the overall individual rankings (see Table 4) or in the 'Top 3' group ranking during the focus group discussion (see Table 5). As was the case with the Plumpy Mum, focus group participants expressed a unanimous preference for the sweet over the savoury version of the biscuit. The mean consumption time for the savoury biscuit was 9.4 minutes (SD=6.9) and the mean percentage of the sample consumed was 77.1%, the lowest of all savoury products. (In contrast, the mean consumption time for the vanilla biscuit was just 4.0 minutes with a comparatively very low standard deviation of 1.4; the mean amount consumed was 98.3%.)

The standard deviation (2.1) of the overall product appreciation score (5.0) was higher for the savoury biscuit than any other savoury product except the seasoned pillow, indicating greater variability in the responses for that characteristic. In two of the focus group discussions (in Bouéré and Dougoumato),

responses appeared quite uniform within a specific group, but whilst in Bouéré all but one participant liked the product, in Dougoumato all but one participant disliked it ,with many suggesting that although they liked the colour of the product, '*it doesn't sit well'.* (As noted in the methodological limitations, the responses of participants within each focus group may be influenced by those of their peers).

Responses were more divided in the other three focus groups. Participants in Boni, for example, were evenly divided between those who liked and those who did not like the product overall. Those who disliked the savoury biscuit suggested a number of reasons including the smell, texture and taste, with smell being a significant factor for many. Most participants discussed disliking the odour of seasoning or, in the case of participants from Boni, the smell of potatoes. Participants in Kari specifically noted the smell of onion, garlic and Maggi stock cubes as negative factors in their dislike of the smell. Intolerance to smell reoccurred as a theme across the study. As one participant from Karaba stated, '*I like the colour* [of the savour biscuits] *but the smell makes me want to vomit*'. A participant in Kari also suggested that the smell of the product would make it difficult to eat. The negative perceptions expressed during the focus group discussions are consistent with the quantitative data. The mean Likert score for the savoury biscuit's odour was 4.9 (SD=2.1).

Several participants also remarked on the saltiness of the savoury biscuit as a significantly negative factor. One participant in Karaba concluded, '*It has a good taste but when I put it in my mouth I want to throw up because of the salt*'. Although some participants were happy with the product as formulated, the main suggestions to improve the savoury biscuit were to change or remove the odour, to reduce its saltiness and to add sugar.

The salty flavour of the savoury biscuit also emerged as a factor influencing adult and child acceptability. In some focus groups, the saltiness was identified as something adults or children would like, whilst in other groups participants suggested the inverse. The smell was identified by several women as a likely negative factor for others' enjoyment of the product as well as their own.

In addition to its taste, colour and texture, other positive factors identified in the focus groups included the resemblance of the product to a *biscuit*, a food stuff with which participants and their families were familiar (in Boni). In Karaba, the product was thought to resemble a local snack made of pearl millet, salt and peanuts, an association that was positive for some participants but negative for others. The health factors (the product being good for pregnant women or perceived as a medicine/vitamin) were also identified as a factor influencing others' willingness to eat the product. In the PAF, mean scores for others' appreciation of the savoury biscuit were 5.9 (SD=1.3) for children and 5.5 (SD=1.6) for adults.

Use during pregnancy

As outlined, many women suggested that they would be unable to eat the savoury biscuit or would find it difficult to consume because of its saltiness or odour. Even among those who did not like the product, however, there was broad agreement that they would eat it daily for the benefit of their baby. This was in line with findings for other disliked or marginally disliked products that women were willing to consume regardless of personal preference if they were perceived to be beneficial for their baby. In Boni, for example, where only half of the participants liked the product, all agreed that they would eat it daily, for as one woman concluded, '*A medicine can't always have a good taste*'. In this focus group, one participant said she would only consume it daily if the odour were changed. A number of participants in Kari noted, however, that they were not likely to be able to eat the savoury biscuit every day, but rather would eat it little by little. In the quantitative metrics, the savoury biscuit was viewed as slightly more of a medicine than a food, with a median Likert score of 5.4 (SD=1.7). This placed it in the middle of savoury product perceptions which ranged from 5.1 to 5.5 (with relatively consistent standard deviations).

There was also a high level of consistency in participants' statements regarding how easy the savoury product was to use at home and to transport for use elsewhere. It was noted that the product was not

heavy and was easy to transport. Again, participants often cited health benefits, as opposed to product-specific factors, as reasons explaining why it was easy to use, although some specifically noted the taste as a positive influence. Some participants suggested that they would expect to eat the savoury biscuit as a snack between meals, whilst others would eat it during or with meals. The mean Likert scores for 'easy to eat' and 'convenient to eat between meals' were 5.7 and 5.9 respectively, each with a standard deviation of 1.6.

Sharing and food allocation

Although a number of women stated that their consumption of the savoury biscuit might cause them to eat less, most stated that they would eat the product in addition to their normal diets. All agreed that they would not be expected to reduce the share of household food they consumed as a result of the product. In Boni, some participants anticipated that family members would want or expect them to share, but most said they would not do so. In Kari, participants suggested that they would be likely to share with other pregnant women although not with others. In Karaba, participants stated that they would be more likely to share with children. Although the mean Likert response for likelihood to share was still in the 'unlikely' range at 3.7 (SD=2.3), it was the highest (along with the seasoned pillow) of the savoury products, indicating that participants were marginally more likely to share this product than the others. (The variability of responses for 'likelihood to share' was relatively uniform across savoury products, with standard deviations ranging from 2.2 to 2.4 across all savoury products.)

Seasoned pillow

Product characteristics

The seasoned pillow received the lowest Likert scores of all savoury products for every characteristic, although in some cases it was in a two- or three-way tie for lowest score (see Table 7). It also finished in last place in the overall savoury product ranking activity, although it received the second-highest score for portion size and colour. It was last in terms of ease of use, taste and odour (the latter in a tie with the savoury biscuit) and second-to-last in terms of texture (see Table 3). Consistent with this, it was the product with the second-lowest percentage consumed during testing (78.2%) of all savoury products and with the longest consumption time, 10.5 minutes (SD=6.7). Despite this, the product did appear in a small number of individual 'Top 3' overall rankings, however, as it received a total of 8 points (see Table 4). It was not, however, named in the 'Top 3' ranking exercise during the focus group discussions (see Table 5). An overwhelming majority of those who expressed a preference during focus group discussions chose the unseasoned pillow rather than the seasoned variety.

The majority of participants in Bouéré liked the seasoned pillow, including its taste, texture and smell. This group was in the minority, however, for although a number of women in each group liked the product, most participants in the other four groups responded very negatively to it, particularly to its smell. As one participant from Dougoumato concluded, '*When you put it in your mouth, it doesn't sit well*'. Several women in that group had expressed similar reactions, which they attributed mainly to the smell of the product, suggesting its odour was '*Like a mix of spices'*. In Boni and Kari, the majority of participants also disliked the smell of the product, as did many in Karaba. In Kari, participants went so far as to conclude that the odour of the seasoned pillow was the worst of all the products, and as one woman emphasised, '*It's the smell that makes me hate it*'. Another participant in the same group remarked, '*It's the smell. They put in garlic, Maggi cubes and onion. That is why it doesn't smell good*'. For the seasoned pillow, the Likert scale response for odour had the lowest mean value of any product at 4.5 (SD=2.4). Participants in all groups identified its smell as a factor they would like to be changed. In Dougoumato, participants admitted that they ate the product during the savoury tasting session not because they liked it but because either the facilitator was watching or because they perceived it to be good for their baby.

Certain product characteristics were regarded favourably even among those who disliked the seasoned pillow overall or were repelled by its smell. The colour and the texture were identified as positive characteristics in most focus groups and in Bouéré, participants commented specifically on its 'crunchiness' as a positive attribute. This was reflected in the quantitative data. For texture (5.0, SD=2.1) and colour (6.0, SD=1.6), the seasoned pillow received the highest mean Likert scores of all the individual characteristics.

Most participants said that the seasoned pillows did not resemble any familiar foods, although one participant in Karaba suggested that it reminded her of meat, and another of popcorn. Some participants in Bouéré identified familiar flavours within the product, including *piment* (pepper/spice) and milk. These were considered positive associations.

Despite the explicit dislike for its smell, most participants in the focus groups suggested that both adults and children would like the seasoned product. This was consistent with the mean positive Likert scores for adult (5.3, SD=1.8) and child appreciation (5.7, SD=1.7). A number of participants suggested that children might not like the product because of its dry texture.

Use during pregnancy

As a consequence of their strong dislike of the smell of the seasoned pillow, many women concluded that they could not use the product during pregnancy as currently formulated. If the product were changed, particularly if the smell was removed or altered, then most women suggested they would consume it during pregnancy. Participants in Bouéré, many of whom responded more favourably about the product or its specific components, said that they would eat it because they liked it and because of the health benefits. Those who were asked agreed that they would eat it daily if provided. Most participants agreed that they would eat it as a snack at varying times, with only a few suggesting they would eat it before or after meals. The mean score for 'easy to eat' was the lowest for the seasoned pillow of all products at 5.5 (SD=1.9), as was its mean score for 'convenient to eat between meals' at 5.4 (SD=1.8). Participants agreed that the product was light and therefore easy to transport. In Bouéré, ease of transport was linked to how much the participant liked the product and in Boni, ease of use in the household was linked to the degree the product was perceived to be a medicine.

Sharing and food allocation

As with other products, some participants expected other adults and children would want to share the seasoned pillow, but most said that they would not do so. A small number of women said that they would share the product if asked. One participant in Dougoumato said that it would be difficult to eat the product in front of her child without sharing it, '*If he's sitting next to me I will share with him, if he has gone elsewhere it can be done* [eaten without sharing]'. The low overall likelihood of sharing was reflected in the mean Likert score of 3.7 (SD=2.4). All participants who expressed a view said consuming the seasoned pillow would not adversely affect their normal share of their family's daily food.

Discussion

This chapter examines key cross-cutting themes that emerged during the product analyses and the triangulation of the quantitative and qualitative data. Exploring factors relevant for product selection and use, the discussion addresses: the impact of the perceived health benefits on product preferences and use; the influence of odour on product acceptability; the relevance of ease of use, preparation and portability; the reliability of consumed weight as a measure of product acceptability; perceptions and intentions of product sharing; and the significance of familiarity to product acceptability.

Health benefits and product use and preferences

The quantitative and qualitative data both supported the notion that women consider the products, in general, to be a medicine. It appears this is an important factor driving their responses on questions related to product use. The mean Likert score for agreement with the statement that the product was more a medicine than a food indicated moderate agreement, ranging between 5.1 and 5.5 for all products. In focus group discussions, women repeatedly characterised the products as a medicine or a vitamin, and they gave health factors as reasons why a product was easy to use, easy to prepare, and easy to transport. One participant in Bouéré, explaining why she liked the savoury Plumpy Mum, reflected the views of many when she concluded, '*Because it's going to help us, that is what makes me like everything* [about it]'. Similarly, in Boni, a participant discussing the seasoned pillow confirmed, '*Because it's a medicine, I like it*'.

Often women did not raise hedonic characteristics such as the taste or smell of the product as a driver to use, or mentioned them only secondarily. In Boni, when participants were asked if they would use the vanilla drink during pregnancy and if so, why, it was notable that only one of all the women who liked the product mentioned taste as a driver of her willingness to use it.

Participant 6:	*Because it's a medicine, I will eat it during my pregnancy.*
Participant 4:	*I will eat it during my pregnancy because it's like a vitamin.*
Participant 7:	*I will eat it during my pregnancy because it will /take care of my baby*
Participant 1:	*For me, it's because it has a good taste.*
Participant 2:	*What will make me eat it during my pregnancy is that it will take care of my baby and make it strong.*
Participant 3:	*I will eat it during my pregnancy because it will make the baby in my belly grow.*

In the focus group discussions, participants also indicated that they would use the product even if they disliked it (provided they were able to tolerate it), because they perceived it to be good for the baby. For example, a participant in Kari explained that she would eat the savoury bar despite her dislike of the odour, '*I can eat it little by little…because it has vitamins*'. Similarly, a participant in Dougoumato who had difficulty in swallowing the chicken soup because of its odour said that she would nonetheless consume it, '*I will drink it in any case…if I know that it could have some advantages for my health situation, I will do everything to drink it*'.

Participants also associated a product's health benefits with ease of preparation and home use. In Boni, participants explained that the vanilla drink was easy to prepare and use at home *'Because it's a medicine that's going to take care of the baby in my belly*'. Regarding why they thought the chicken soup would be easy prepare and eat at home, women in the same focus group also concluded, '*Because it's a medicine*', '*Because it can take care of my baby',* and '*Because it can take care of someone, it's for that reason'.*

The same health factors were raised as an explanation why it would be easy for women to take products with them to eat outside the home. For the Plumpy Mum, which requires no preparation and was well liked by participants, women in Bouéré again referred to the product's health benefits as the main driver

influencing their consumption, not its ease of preparation or likeability. The following statements were representative, '*I can take it with me even if I go to the fields or on a trip. Because it helps me, it's not a problem*', '*Everywhere I go, I can take it to eat because it's a good thing*', '*When going to the field, I can take it with me to eat because it's a medicine*'.

Odour and product acceptability

In the focus group in Dougoumato, participants discussed pregnant women's sensitivity to smells agreeing, *'The smells that pregnant women smell other adults do not smell'.* Increased olfaction during pregnancy has been documented in the literature (see for example, Cameron 2014). During the focus group discussions the odour of a product emerged as a significant determinant of whether participants would like (or even be able to tolerate) it. Many women raised the smell of a product as the reason why they disliked or could not eat several products, notably the seasoned and unseasoned pillows, the savoury bar, the savoury Plumpy Mum and the savoury biscuit. The most frequently identified negative odours were garlic and onion, but other unidentified seasonings and the smell of 'Maggi' stock cubes were also highlighted by some women. Other odours identified included cotton, beans, bay leaves, '*féfé'* (a local seasoning), soya, and potatoes.

Physiologically, smell is closely linked to taste, and in discussing the seasoned pillow, a participant in Kari concluded, '*The odour makes it so that I can't even perceive the taste*'. Several women stated that the smell and/or taste of certain products made them nauseous. When asked what she disliked about the smell of the chicken soup, one participant in Dougoumato explained, '*It's everything about the smell of the soup….when you swallow it, you want to vomit*'. The same participant made similar comments about the savoury Plumpy Mum, stating that she had vomited after eating it on the first day of tasting because of the odour of the product.

For every product except one (the fermented drink), odour was the lowest mean Likert score for a hedonic characteristic. Odour was also the only characteristic for which some products received scores of less than 5.0. The seasoned pillow, which was widely disliked and had the lowest product ranking score of any savoury product, also had the lowest mean Likert score for its smell (4.5, SD=2.4).

Ease of use, preparation and portability

Ease of use, preparation and portability of the products did not appear to be very significant characteristics for study participants. It was very rare that any participant reported a product to be difficult to prepare or take with them, except if they didn't like the product. Similarly, most of those who said a product would not be easy to use or would be challenging to use daily during pregnancy attributed any difficulties to their dislike of the product or inability to tolerate it. As noted above, the health benefits of the products were frequently mentioned as the driving factor behind perceptions of product use and portability. Issues more directly impacting ease of use and portability, such as the need to find potable water to mix with the product, did not appear to influence women's responses. Even the soup, which requires the powder to be mixed with hot water, was perceived to be easy to prepare both at home to transport to consume elsewhere. The following discussion, from the focus group in Dougoumato, was representative.

Participant 3:	*It's very easy, if you know why you do it, what could be hard for you then, nothing at all. You know how to do it. Wherever you go, you can do it.*
Participant 5:	*Since it's prepared with hot water, even if we are going to heat the water, put it in a thermos, one can take it elsewhere to prepare it and drink it.*
Participant 8:	*We can heat the water, take it to the fields to prepare it and drink*

The mean Likert scores for 'product is easy to eat' corresponded reasonably closely to the global appreciation scores irrespective of actual preparation required. For example, the vanilla drink placed third

among the sweet products for 'overall appreciation' with a mean of 6.1 (SD=1.1) and also placed third amongst sweet products for 'easy to eat' with a mean score of 6.2 (SD=1.1), despite the fact that the product requires sourcing drinking water and mixing prior to consumption. Similarly, the chicken soup had the second highest mean score (5.5, SD=1.2) for overall appreciation and the second highest score for 'easy to eat' (5.8, SD=1.4) despite the preparation required. This may further indicate that hedonic factors are more important than ease of preparation in women's assessments of whether a product is easy to eat. The scores for 'convenient to eat between meals' were also relatively closely aligned with products' 'overall appreciation' scores.

Weight as a reliable measure

Of the metrics collected in the quantitative data, the first measure calculated was the weight of the product pre- and post-tasting. The weight of each product sample (25% the standard portion) was measured before the 20-minute tasting session, and the weight of the remaining product was measured at the end of the session, either when a woman had finished the product or when the 20 minute tasting window had elapsed (whichever came first). The net amount consumed was then divided by the weight of the sample to determine the percentage of the sample consumed. The data was collected as a means to assess how much of the product the woman had consumed. It was thought this would serve as a proxy indicator for how much a participant liked the product.

For savoury products, the percentage of the test samples consumed ranged from a low of 77.1% for the savoury biscuit to a high of 91.6% for the savoury Plumpy Mum. For the products included in the sweet tasting category, the percentages consumed were higher, ranging between 89.4% for the unseasoned pillow and 98.4% for the filled sticks and the Plumpy Mum

Despite the high percentages of test product consumed, findings from the focus group discussions suggest this may not be a reliable indicator of how much the product was liked. Women in several groups reported that they ate the product because they *'were being watched'*. During the PAF in Bouéré, one participant suggested to the moderator that she was eating all of the product, because if she did not it would '*take too long'* to get through all of the questions. Many women consumed the products because they perceived them to be *'good'* for their babies, rather than because they actually liked or enjoyed eating the product per se. This was emphasised in Dougoumato when one participant suggested during the PRF ranking exercise that she was willing to consume the products even if she didn't like them because she had previously given birth to two preterm neonates who had not survived and thought the samples would be beneficial to her and her baby during her current pregnancy.

Perceptions on sharing

The likelihood of sharing a product with others in the household represented a significant factor in intra-household food dynamics and was crucial for understanding the pregnant woman's perception of use of a product, particularly when likelihood to share would affect daily consumption.

Sharing was measured in the PAF using the 7-point Likert scale. Participants were asked to take into account the fact that the product was a nutritional supplement uniquely for pregnant women and were subsequently asked to what extent they agreed or disagreed that they were likely to share the product with other people. Mean sharing scores were significantly lower than all other scores within the 'perceptions of use' category. The lowest recorded mean was registered for the savoury bar at 3.2 (SD=2.2) and the highest recorded was for the savoury biscuit and seasoned pillows at 3.7 (SD=2.3 and 2.4 respectively). Standard deviation measures across sweet and savoury products were high, indicating high levels of variation within the answers. None of the top five products had notably lower mean sharing scores (all ranged between 3.4 and 3.5). In addition, none of the top five products was unlikely to be appreciated by

children; all of the top 5 products had high mean child appreciation scores between 6.2 and 6.7. (A lower child appreciation score might have indicated lower likelihood of sharing).

Qualitative responses to questions on sharing focused on both the expectation to share and the likelihood of sharing. Despite widespread reference to household members' expectations that the pregnant woman would share her food, the majority of women reported that they would not in fact share. Reasons cited for why included '*because it's reserved for pregnant women'*, because '*it's not a normal food'* and '*because it has vitamins*' for pregnant women. Only a small minority of women revealed that they would share the product with others, and of those many suggested sharing 'only' with other pregnant women or with children. One mother in Dougumato said that children would think she was 'bad' if she didn't share.

It is noteworthy that the theme of sharing emerged frequently in the facilitator field notes and directly contradicted a number of participant responses presented in the focus group discussions. When reviewing the vanilla drink, one participant in Dougoumato, for example, explained *'I can consume this without sharing with children'* and then in discussing the unseasoned pillows concluded, *'I can eat this alone without sharing with children'*. During the administration of the PAF, however, the moderator noted qualitative feedback from the woman suggesting *'She is in agreement to share the products that she doesn't like'*. In Karaba, another participant was reported as stating that she intended to share products with her children, although in their notes, the moderator recorded that the woman had suggested she would only share the food if people were to ask her directly. While there is little information in the published literature about conventions around sharing of food in Burkina Faso, findings from other studies have indicated that the estimated energy intake from supplements was at times lower than anticipated when sharing with other family members appeared to be the norm (e.g. from Cambodia, see Janmohamed et al. 2016).

Resemblance to familiar products as an influencing factor

Focus group discussions revealed an overwhelmingly positive correlation between the resemblance of a supplement to a known product and the appreciation the women had for that supplement as a result of the similarity. Some participants mentioned associations between products and other specific foods such as couscous, porridge or local foods such as *'soumbala'* (a west African condiment) in Bouéré, *'koumbètè'* (a dish made with fried corn flour and honey or sugar) in Karaba, and *'gafini'* (sour pancakes) in Karaba. In all these cases, the resemblance of products to familiar foods was perceived as a positive influence. In Karaba, for example, one participant confirmed that the unseasoned pillow reminded her of popcorn, stating *'It's because of that, that I like it'*. In Boni, another participant explained that her association between the salty biscuits (the least liked of all of the products in the overall ranking) to a familiar product *'signifies more of a chance that I will it eat it during my pregnancy'.*

In other scenarios, women were unable to liken the supplements to specific products, but instead identified the presence of a recognised flavour within the product. For example, the perceived milk flavour in the vanilla drink and the yoghurt flavour in fermented drink positively influenced the women's appreciation of the product. Some participants also found similarities between the supplements and a 'mix' of other products, like *'milk and chili'*, *'sesame and peanuts'* and *'peanuts and milk'.* In some cases, the resemblance of a product to a mix of other known food stuffs was found to have a negative impact on account of the unusual mix of products. In Bouéré, for example, one participant commented, *'When I taste the product, it resembles food that I have already eaten. It's a mix of ingredients. Its a bad influence for me because I do not like the mix'*.

Conclusions and recommendations

Based on the analysis of qualitative and quantitative data, two products were identified as the preferred fortified BEP supplements for use in Phase 2 of the study: the Plumpy Mum and the vanilla biscuits.[3] These products were consistently ranked as the top two products during all ranking exercises and they received consistently high scores in the hedonic testing and across other quantitative measures of product acceptability. In the focus group discussions, participants expressed favourable opinions about both products, including their taste, smell, texture, and other factors related to product preference and product use during pregnancy. These factors are summarised below.

Vanilla biscuit

The vanilla biscuit was the top-ranked product in the sweet product overall preference ranking (217 points) and in the 'Top 3' all-product ranking (55 points). It was also the highest ranked sweet product on all of the individual product characteristics except portion size. Further, it received the second-highest number of points during the focus group ranking (6, tied with the filled sticks) and had the second-highest mean Likert score for overall product appreciation (6.4, SD=0.7) (tied with the filled sticks). Its other Likert scores were consistently the highest or second highest amongst all sweet products (although sometimes tied with the filled sticks).

Focus group comments largely confirmed the quantitative data. A number of women disliked the smell of the product, although at least some women disliked the smell of virtually every product, due perhaps to their heightened sensitivity of smell during pregnancy. Participants confirmed that they would easily use the vanilla biscuit throughout pregnancy, both because they liked the product and because it was seen as a something that would benefit their babies. This was confirmed in the quantitative data where the women indicated strong agreement that they would consume vanilla biscuits every day if they were given to them (6.4, SD=0.8). There was general agreement that the sweet vanilla biscuit would supplement, and not replace, their normal meals. No participant said it would reduce her share of normal household food.

The product was perceived as appealing to adults and children. Despite this, however, in the focus group discussions most participants suggested that they would be unlikely to share the sweet vanilla biscuits with others, regardless of their family's expectations. Only a small number indicated that they may share the product with their children. There was no indication in the quantitative data that women were more likely to share the sweet vanilla biscuits than other products. Likert scores for likelihood of sharing ranged from 3.4 to 3.6 (with SDs ranging from 2.1 to 2.3) and the sweet vanilla biscuit scored 3.4 (SD=2.2).

Plumpy Mum

The Plumpy Mum was the second-ranked product in the sweet product overall preference ranking (193 points) and in the 'Top 3' all-product ranking (50 points). It was also the second highest ranked sweet product on all of the individual product characteristics, except portion size. During the group ranking exercise, there was consensus that Plumpy Mum was the top choice with 12 points, and it was selected as the most preferred product in all but one focus group. Its mean Likert score for overall product appreciation was the highest of all products at 6.5 (SD=0.7), and its scores for individual characteristics were either the highest or second-highest across the board.

[3] Although the filled sticks also received very high scores on nearly all of the Likert-scaled product acceptability questions, in many cases receiving the highest or second-highest scores, its product ranking scores were notably lower than the Plumpy Mum and the sweet vanilla biscuits, at 170 points for the sweet product ranking (tied for 4th place) and 26 points for the overall top 3 ranking (5th place). The filled sticks did not place among the top three products on any individual product characteristic ranking (taste, colour, etc.) except portion size.

There was a high degree of agreement between the quantitative and qualitative data. In the focus group discussions, participants confirmed Plumpy Mum was well-liked and very few women made negative comments about it. Participants concluded that they liked the smell, colour, texture and taste, referring to its sweet and milky flavour and its similarity to peanut butter, a positive association for those who raised it. Participants agreed that they would eat the product daily during pregnancy because they liked it and because of its perceived health benefits. Willingness to use the product was also reflected in the product's mean Likert score of 6.3 (SD=0.9), the second-highest among all products. Participants viewed it as easy to use and to carry with them outside the home, and these factors were sometimes associated with the product's health benefits.

Women did not anticipate that the product would replace normal meals, nor would it reduce their share of foods available to the family. Sweet Plumpy Mum was perceived to be appealing to adults and children, although it was noted that some adults might not like its sweetness. Some women said they might share Plumpy Mum with others, particularly with children and other pregnant women. However, the quantitative data did not indicate an elevated score for the likelihood of sharing, and Plumpy Mum scored exactly the same (3.4, SD=2.3) as the sweet vanilla biscuit.

Product recommendation for Phase 2

Given these relatively clear results and the difference in perceptions of acceptability and use between the top two products and the remainder, it is recommended that the sweet vanilla biscuit and the Plumpy Mum be selected for use in Phase 2.

Data gathered during Phase 2 can be expected to provide additional insights into factors affecting product use as well as any product modifications that may be needed before the commencement of Phase 3 of the MISAME III study.

References

Arimond, M., B.S. Vitta, Y. Martin-Prével, et al. 2018. 'Local foods can meet micronutrient needs for women in urban Burkina Faso, but only if rarely consumed micronutrient‐dense foods are included in daily diets: A linear programming exercise'. *Maternal & child nutrition* 14, no. 1.

Becquey, E., G. Capon, and Y. Martin-Prével. 2009. 'Dietary diversity as a measure of the micronutrient adequacy of women's diets: results from Ouagadougou, Burkina Faso Site'. Washington, DC: Food and Nutrition Technical Assistance II Project, Academy for Educational Development.

Cameron, E. L. 2014. 'Pregnancy and olfaction: a review.' Frontiers in psychology 5: 67.

Christian, P. 2010. 'Micronutrients, birth weight, and survival'. Annual review of nutrition 30: 83-104.

Da Silva Lopes, K., E. Ota, P. Shakya, et al. 2017. 'Effects of nutrition interventions during pregnancy on low birth weight: an overview of systematic reviews'. *BMJ global health* 2, no. 3: e000389.

Fall, C., D.J. Fisher, C. Osmond et al. 2009. 'Multiple micronutrient supplementation during pregnancy in low-income countries: A meta-analysis of effects on birth size and length of gestation'. *Food and nutrition bulletin* 30 (4 suppl 4):s533-s546.

Gernand, A.D., K.J. Schulze, C.P. Stewart, et al. 2016. 'Micronutrient deficiencies in pregnancy worldwide: health effects and prevention'. *Nature Reviews Endocrinology* 12, no. 5: 274.

Haider B.A. and Bhutta Z.A. 2017. Multiple-micronutrient supplementation for women during pregnancy. *Cochrane Database of Systematic Reviews* Issue 4. Art. No.: CD004905. DOI: 10.1002/14651858.CD004905.pub5

Hug, L., D. Sharrow, and D. You. 2017. 'Levels & trends in child mortality: report 2017. Estimates developed by the UN inter-agency Group for Child Mortality Estimation (2017)'. New York: UNICEF.

Huybregts, L., D. Roberfroid, H. Lanou et al. 2009. 'Prenatal food supplementation fortified with multiple micronutrients increases birth length: a randomized controlled trial in rural Burkina Faso'. *The American journal of clinical nutrition* 90, no. 6: 1593-1600.

Imdad, A., and Z.A. Bhutta. 2011. 'Effect of balanced protein energy supplementation during pregnancy on birth outcomes'. *BMC public health* 11, no. 3: S17.

INSD and ICF International. 2012. *Burkina Faso Enquête Démographique et de Santé et Indicateurs Multiples (EDSBF-MICS IV) 2010*. Calverton, Maryland, USA: Institut National de la Statistique et de la Démographie - INSD/Burkina Faso and ICF International.

Janmohamed A., C.D. Karakochuk, S. Boungnasiri , G.E. Chapman, P.A Janssen, R. Brant. 2016. 'Prenatal supplementation with Corn Soya Blend Plus reduces the risk of maternal anemia in late gestation and lowers the rate of preterm birth but does not significantly improve maternal weight gain and birth anthropometric measurements in rural Cambodian women: a randomized trial. *The American journal of clinical nutrition*, 103(2):559-66.

Katz, J., L.A. Wu, L.C. Mullany, et al. 2014. 'Prevalence of small-for-gestational-age and its mortality risk varies by choice of birth-weight-for-gestation reference population'. *PloS one* 9 (3):e92074.

Kozuki,N., J. Katz, S. LeClerq et al. 2015. 'Risk factors and neonatal/infant mortality risk of small-for-gestational-age and preterm birth in rural Nepal'. *The Journal of Maternal-Fetal & Neonatal Medicine* 28, no. 9: 1019-1025.

Rahman, M., F.T. Jhohura, S.K. Mistry et al. 2015. 'Assessing Community-Based Improved Maternal Neonatal Child Survival (IMNCS) Program in Rural Bangladesh'. PloS one 10 (9:)e0136898

Roberfroid, D., L. Huybregts, H. Lanou, et al. 2008. 'Effects of maternal multiple micronutrient supplementation on fetal growth: a double-blind randomized controlled trial in rural Burkina Faso'. *The American journal of clinical nutrition* 88, no. 5: 1330-1340.

World Health Organization. 2017. WHO e-Library of Evidence for Nutrition Actions (eLENA), 'Balanced energy and protein supplementation during pregnancy.' http://www.who.int/elena/titles/energy_protein_pregnancy/en/

World Health Organization. 2016. 'WHO recommendations on antenatal care for a positive pregnancy experience'. World Health Organization.