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Ayiti Pi Djanm: Optimizing the Nutritional Quality of Blended Porridges Final Report

WASHINGTON UNIVERSITY IN ST. LOUIS | 22 DECEMBER 2023

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Acronyms

ACF	Action Contre la Faim (Action Against Hunger)
ApD	Ayiti Pi Djanm
BHA	Usaid Office of Humanitarian Affairs
CRS	Catholic Relief Services
DRI	Dietary Reference Intake
FAQEP	Food Aid Quality Enhancement Project
FAQR	Food Aid Quality Review
FBF	Fortified Blended Food
FGD	Focus Group Discussion
GAPL	Garanti Production Locale
IRB	Institutional Review Board
IYCF	Infant and Young Child Feeding
LMIC	Low-and-Middle-Income Country
MAM	Moderate Acute Malnutrition
PL480	US Public Law 480
PRISMA	Preferred Reporting Items for Systematic Reviews and Meta-Analyses
SBC	Social Behavior Change
SILC	Savings and Internal Lending Communities
TOC	Theory of Change
UPNCH	Université Publique du Nord au Cap Haitien
USAID	United States Agency for International Development
WashU	Washington University in St. Louis



Executive Summary

One in five children in Haiti have stunted growth (22%), while wasting prevalence reaches 4% and underweight 10% (Institut Haïtien de l'Enfance 2018). Nutrient deficiencies related to poor quality diets and infectious disease persist across all phases of the life course particularly affecting young children and pregnant and lactating women. Blended flours (referred to as “blended porridges” in this report) including locally available nutritious ingredients, offer the opportunity to meet critical gaps in public health nutrition and support economic and natural resource development. Food aid products provided under Title II of The Food for Peace Act can offset the costs of blended porridge production. This research informed pathways within the Ayiti Pi Djanm’s Theory of Change (TOC) related to access to and availability of nutritious foods (O2.1.1.3.3.1 and O2.1.1.3.3) and response to nutritional needs of target groups (O2.1.2.2).

Objectives

The overall goal was to assess the acceptability, feasibility, shelf-life/product stability, and nutritional quality of sustainable, locally-sourced blended porridges for nutritionally vulnerable target groups: children less than five years; and pregnant and lactating women. Specific objectives were:

1. Conduct a scoping review (literature review, discussion with technical experts, etc.) to synthesize past lessons on nutrition and blended porridges.
2. Identify optimal blended porridge recipe options using local flours considering the following outcomes: acceptability (including characteristics most important to acceptability); nutrition; time-saving; and options to sustainably source ingredients locally.
3. Select processing options to improve maternal and young child health and conserve time in food preparation, specifically to: 1) optimize bioavailability of nutrients and overall digestibility; and 2) allow for convenient and feasible reconstitution (e.g. nutritionally-dense porridges).
4. Identify optimal blended porridges with local products meeting the criteria for affordability for nutritionally vulnerable groups, availability in terms of production volume, and profitability for local producers and private sector actors involved in producing the foods.

Methodology

A mixed methods approach was applied to accomplish the objectives set forth under this SOW. First we conducted a comprehensive desk review of the literature to examine evidence for blended porridges and to inform recipe development and the qualitative research, consistent with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. Next for the optimal recipe design, a series of activities were undertaken by the partners – WashU, CRS, and GAPL. Using a Matrix Scoring Exercise, partners prioritized ingredients by scoring according to agreed upon criteria: processing feasibility; young child and maternal nutrition; preparation time; opportunity for local farmers; local availability; and cost. Once prototype recipes were finalized, we analyzed nutrient composition with USDA FoodData Central.


Focus group discussion were employed to understand current practices, attitudes, and behaviors related to blended porridges. We conducted six focus group, each with 10 caregivers of young children (ages 1-3 yr) and pregnant/lactating women. There was one group carried out per community in the North East (Carice, Mont Crochu, Mont Organisé, and Sainte-Suzanne) and South (Chardonnières and Roche-à-Bateau). All focus groups were audio-recorded, transcribed and de-identified, and translated into English for analysis. Themes were identified by three separate investigators, recorded in Excel and later analyzed using NVivo software. Due to the severity of the security situation and logistical constraints in Haiti, the fieldwork was scaled back.

Findings

Scoping Review. Haiti has experienced a confluence of conditions - political instability, climate change and environmental disasters, inflation and economic hardships - leading to dire food insecurity. Historically, fortified blended foods (FBF) using PL480 commodities represents the main food aid used for nutritional purposes, explicitly for vulnerable groups such as young children. In 2021, Food Aid Quality Review project and USAID Bureau for Humanitarian Assistance convened experts, ultimately calling for research and innovation around food assistance on: cost-effectiveness; field-feasible metrics for effects on cognition and immune function; sustainable change through food assistance; knowledge about delivery channels; products for child development; effectiveness at scale; and animal source foods.

Optimal Recipe Design. Results from the Matrix Scoring Exercise showed fish (2.95) and milk (2.9) powders received the highest average score followed by insect powder (2.8) and eggs (2.55). Among the carbohydrates, corn (2.4) and cornmeal (2.35) ranked high and secondarily breadfruit and sweet potatoes. Sweet potato leaves (2.3), spinach (2.1), and carrots (2.0) were the higher scoring vegetables. Fruits came in lower, with on dried mangos (1.95) and fresh mangos (1.55) making the list. Insect powder was removed due to cultural reasons and eggs too challenging to source on a regular basis. A decision was made to mix leaves from various plants to ensure regular availability. The porridge (sweet) recipe product (145g) contains: 50% corn; 30% sorghum; 10% sweet potato; and 10% milk powder. The preliminary recipe for the savory product (146g) contains: 50% corn,; 30% fish powder (herring or cod); and 20% leaves (sweet potato, cassava, and spinach). Fish powder was later deemed to be too expensive at these levels.

Focus Groups. Blended flours (manje melanje in Haitian Kreyol) are commonly consumed across the study communities. In both the South and North East, carbohydrate-rich staples are the basis for the flours including corn, plantain, cassava, potato, sweet potato, yams and other tubers and rice. There were cultural preferences for particular ingredients in types of blended porridges falling into the general categories of porridge (sweet) and soups (savory). Attitudes were generally positive towards these products, and caregivers recalled and articulated MSPPP messages from the Haitian food pyramid: konstwi ko (animal foods for body building); bay fòs (starch foods for energy); and pwoteje kò (fruits and vegetables for protection). There was also the concept of balance communicated with a variety of ingredients or colors used in flours.



The most commonly mentioned price of blended porridges from the market was 100HTG (US\$ 0.76). Across all communities, mothers expressed a desire to purchase blended porridges, but high prices and lack of financial means were barriers. Foods and spices added to blended porridges were for health and palatability reasons. Assorted leaves were the most frequently mentioned vegetable followed by carrots and spinach more specifically. Fruits were not as common and only mangos and bananas were mentioned. Among the animal source food group, milk was most often reported followed by fish and herring. A common theme across all study communities was use of sugar, salt, and cinnamon to increase palatability and consumption by young children. Most of the caregivers responding to this question reported receiving information about FBF at health centers and rally posts, delivered by nurses and community health workers, care groups, and radio.

Recommendations

Optimal Recipe

- Increase the percentage of animal source food content if cost permits or subsidized by developmental aid.
 - In the sweet recipe, increase the milk powder from 10% to 20%.
 - In the savory recipe, increase content of fish powder from 20% to 30% (as a widely acceptable ingredient), to the extent allowable by price point.
- Increase the percentage of fruit and vegetable content.
 - In the sweet recipe, increase the fruit powder from 0% to 20%. Use mango and/or carrots for vitamin A and citrus for vitamin C and increase absorption of iron.
 - In the savory recipe, increase content of vegetable powder from 20% to 30% (as a widely acceptable ingredient). Use a mixture of different leafy greens (sweet potato, cassava, spinach, and moringa leaves).
- Reduce the percentage of corn ingredient and replace with breadfruit or tuber powders to reduce starch and phytate content.
 - Use other starchy fruits (banana or plantain) or tubers (potatoes, sweet potatoes, cassava) to replace some portion of corn content.
 - Explore use of amylase and other fermentation products to increase bioavailability.
- Packaging should clearly communicate ingredients, preparation (limit added water as per viscosity guidelines), and shelf life.
 - Preparation guidelines should: 1) specify exact quantity of clean water; and 2) recommend to reduce or eliminate added salt, sugar, and cinnamon.
 - Careful messaging (without making unsubstantiated claims) could be used in promotional materials - building from the MSPP messages - such as: good nutrition boosts child growth and development; good nutrition gives your child energy and strength for healthy growth and development; good nutrition protects your child from infection and keeps them healthy.

Messaging in Integrated Care Groups

- Promote use of FBF for pregnant and lactating women as well as for children
- Encourage reducing or eliminating added ingredients of sugar and salt.
 - Replace with sweet fruits or honey.
 - Make linkages of excess sugar consumption to later risk of diabetes; and excess salt consumption to hypertension.
- Reinforce MSPP messages:
 - 1) food pyramid roles of building, energy, and protection;
 - 2) balance and variety of healthy foods for health
- Leverage foundation understanding of links to health
 - Promote healthy foods for child growth and brain development

Gender & Time-Saving Linkages

- Blended porridges have the potential to save mothers time and labor if accessible (low cost) and received with the assurance of high quality ingredients and food safety.
- Direct FBF vouchers to pregnant/lactating women and women with young children to ensure access.
- Identify low-cost technologies to increase the feasibility of preparation; consider as a possible business idea for youth entrepreneurs and use of borrowed funds for Savings and Internal Lending Communities (SILC) groups.

MEL & Sustainability

- Evaluate blended porridges with strong MEL to examine:
 - Health impacts—growth, anemia, and neurodevelopment
 - Cost-effectiveness
- Collaborate with universities such as UPNCH in Haiti to foster a culture of evidence-based decision-making and programming.
- Source ingredients from farmers using sustainable food production practices (e.g., native plants, cover crops, terracing and mounds)
- Minimize food waste and spoilage to lower greenhouse gas emissions



Fresh food vendor participating in the voucher program, Nord Est, Haiti. Photo by CRS staff

Introduction

1.1 Background

One in five children in Haiti have stunted growth (22%), while wasting prevalence reaches 4% and underweight 10% (Institut Haïtien de l'Enfance 2018). Nutrient deficiencies related to poor quality diets and infectious disease persist across all phases of the life course particularly affecting young children and pregnant and lactating women. Nearly half (49%) of all women of childbearing age and two-thirds of young children ages 6-59 months suffer from anemia, in part due to nutrient deficiencies. Political strife and natural calamities have further disrupted the agrifood system in Haiti and heightened problems of poverty and food insecurity.

Food aid products provided under Title II of The Food for Peace Act are comprised of US commodities. The foods, including blended flours and fortified products, range in ingredients - cereals (corn, wheat, rice), legumes (peas, soy), and oils - and vary in nutritional quality (USAID 2020). Blended porridges are available currently on the local market but may be expensive, have low nutritional value, and/or require long preparation time. Within Ayiti Pi Djanm's Theory of Change (TOC), this research is critical to causal pathways related to access to and availability of nutritious foods (O2.1.1.3.3.1 and O2.1.1.3.3). Identifying alternatives that appeal to local taste preferences and priorities (such as cooking time and cost) and that respond to nutritional needs of target groups is also critical (O2.1.2.2).

Blended flours (hereafter referred to as “blended porridge”¹ to differentiate from blended wheat/sorghum flours used in other ApD programming) offer the opportunity to meet critical gaps in public health nutrition and food insecurity. These products—if affordable, accessible, and formulated appropriately—can both contribute to the nutritional needs of vulnerable populations and support local economic and natural resource development. In Haiti, there is an information gap for the appropriate formulations of blended porridges with locally sourced, sustainable nutritious foods to address malnutrition in vulnerable groups: pregnant and lactating women and young children less than five years. Here, we apply mixed methods to understand the attitudes, behaviors and perceptions around blended porridges and optimal recipe designs.

¹ We use “blended porridge” throughout this report to refer to all blended flour mixes using local ingredients considered in the research - both savory and sweet. This phrase was selected by CRS to distinguish from the blended wheat and sorghum flours used by LCH. Technically, in Haitian culture, porridge is the sweet recipe generally given to children. In the formative research, the phrase “manje melanje” in Kreyol was applied encompassing both sweet and savory.



1.2 Research Objectives And Questions

Overall Objective

Assess the acceptability, feasibility, shelf-life/product stability, and nutritional quality of sustainable, locally-sourced blended porridges for nutritionally vulnerable target groups: children less than five years; and pregnant and lactating women.

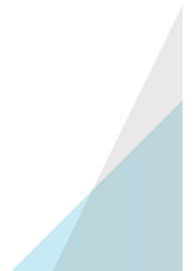
Specific outcomes: 1-4 optimal blended porridges with local ingredients identified that are acceptable, feasible, and of high nutritional quality (R&I); increased consumption of new recipes by young children and pregnant/lactating women with associated improved health outcomes (ApD).

Sub-Objectives

1. Conduct a scoping review (literature review, discussion with technical experts, etc.) to synthesize past lessons on nutrition and blended porridges.
 - *Specific outcomes: summary report of evidence-base for blended porridges and nutrition (R&I)*
2. Identify optimal blended food recipe options using local flours considering the following outcomes: acceptability (including characteristics most important to acceptability); nutrition; time-saving; and options to sustainably source ingredients locally.
 - *Specific outcomes: 5-10 optimal blended porridges recipe options tested with local ingredients (R&I); increased consumption of new recipes by young children and pregnant/lactating women (ApD)*
3. Select processing options to improve maternal and young child health and conserve time in food preparation, specifically to: 1) optimize bioavailability of nutrients and overall digestibility; and 2) allow for convenient and feasible reconstitution (e.g. nutritionally-dense porridges).
 - *Specific outcomes: 1-4 processing options for blended porridges with local ingredients (R&I); increased consumption of new recipes and consequent improved nutritional status of young children and pregnant/lactating women (ApD)*
4. Identify optimal blended porridges with local products meeting the criteria for affordability for nutritionally vulnerable groups, availability in terms of production volume, and profitability for local producers and private sector actors involved in producing the foods.
 - *Specific outcomes: 1-4 optimal blended porridges for affordability and profitability (R&I); increased production by private sector and access on the part of nutritionally vulnerable groups to new blended food products (ApD)*

Research Questions

1. What are some optimal recipe options using local flours considering the following outcomes: acceptability; nutrition; time-saving; and options to sustainably source ingredients locally?
 - A. “Optimal” recipes may be defined as nutritionally and energy dense, shelf-stable and with adequate nutrient bioavailability (digestible and low anti-nutrients), that can be produced reliably using locally grown ingredients, acceptable by local population and become available in significant amounts to sustain a nutrition program.
2. What processing options would simultaneously improve maternal health and conserve time in food preparation? Is it possible to create an affordable ‘instant’ porridge mix that would not require much cooking time?
3. What local product flours would be profitable for local producers? How would this influence affordability for consumers?
4. How do gender norms or other factors determine the adoption and use of new nutritional products by caregivers? How does the link between time burden and ICYN practices affect interest in trying new products? How does age affect adoption? Are young/adolescent mothers more or less likely to be interested in/able to try new products?
5. How do gendered patterns in production decisions affect local flour options?





Methodology

A mixed methods approach was applied to accomplish the objectives set forth under this SOW. A comprehensive literature review was carried out to contribute to the scoping review and optimal recipe design processes. The ongoing optimal recipe design was largely done in partnership with local food producer, GAPL, and aimed at deriving template recipes with representative food group proportions. Finally, qualitative community-based research delved deeper into a range of issues for ApD target populations including affordability, processing or preparation techniques, and palatability.

2.1 Literature Review

We conducted a comprehensive desk review of the literature to examine evidence for blended porridges and to inform recipe development and the qualitative research. Consistent with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines, we triaged high quality evidence (PRISMA 2020). Key words and phrases (Box 1) were compiled and searched in partnership with the lead librarian at the Brown School, Washington University in St. Louis. The data bases searched were: Medline, PubMed, Global Health, Global Health Archive, Academic Search Complete, Academic Search Premier, CINAHL Plus, Scopus, JSTOR, and AnthroSource. A preference was given to systematic reviews and meta-analyses followed by studies with experimental design and rigorous methods. Observational studies and evaluation reports were also reviewed and incorporated where relevant.

The USAID Food Aid Quality Review (FAQR) project at Tufts University Friedman School of Nutrition Science and Policy operated from 2009-2021. Initially contracted to generate evidence-based recommendations for more nutritionally appropriate and cost-effective formulations, there were two additional phases of FAQR to also examine programming from procurement to delivery and food matrices, bioavailability and packaging (Ignowski et al. 2021). Our literature review drew heavily from the FAQR database of synthesized evidence on food aid products and identified priority research gaps.

2.2 Optimal Recipe Design

To accomplish this sub-objective - identify optimal blended food recipe options using local flours - a series of activities were undertaken by the partners, WashU, CRS, and GAPL. Criteria for recipes were first considered, including those

Box 1. Search Terms

Haiti* (Optional) -> OR “port au prince” OR “Cap Haiten” OR Carrefour OR “Port de Paix” OR Delmas OR “Croix des Bouquets” OR “Petion Ville”

Blended Food* OR “Food fortification” OR “fortified food*” OR “Fortified Blended Food*” OR “Food Aid” OR “Food Aid Program*” OR “Food quality” OR “Food assistance” OR “food supplementation” OR “food system*”

Porridge OR Cereal* OR “management grain” OR “edible grain” OR “whole grain” OR “multi grain” OR “dietary supplement*” OR “whey protein” OR micronutrient OR macronutrient OR “edible plant*”

specified in the sub-objective (acceptability, nutrition, time-saving, and options to sustainably source) and others. As well, the team compiled a list of potential ingredients to be assessed using the criteria. Then a Matrix Scoring Exercise was undertaken to prioritize the ingredients meeting scoring high for the agreed upon criteria: processing feasibility; young child and maternal nutrition; preparation time; opportunity for local farmers; local availability; and cost (**Supplemental Table 1**). These ingredients were then discussed over regular meetings between the partners to advance progress on prototype development. Marketing of products, including packages, label content, and messaging for promotion, was discussed. A marketing expert was hired as a consultant from FEJEG to support this effort.

Once prototype recipes were finalized, the WashU team analyzed nutrient composition with *USDA FoodData Central*, an integrated comprehensive database providing nutrient profiles on a broad set of foods. Laboratories for testing final products were also identified in this process.

2.3 Focus group discussions & key stakeholder interviews

Focus group discussion and key stakeholder interviews were employed to understand current practices, attitudes, and behaviors related to blended porridges. We conducted six focus group, each with 10 caregivers of young children (ages 1-3 yr) and pregnant/lactating women. There was one group carried out per community in the North East (Carice, Mont Crochu, Mont Organisé, Sainte-Suzanne) and South (Chardonnières, Roche-à-Bateau). The survey instrument questions (**Box 2**) were initially posed though enumerators probed and allowed conversations to flow in different directions as need.

Human Subject Research and Ethics

Once protocols and survey instruments were finalized including translation into French and Haitian Kreyol, two IRB processes were initiated. In Haiti, a complete packet of materials was submitted to the National Bioethics Committee for review and at WashU, similarly a digital form with attached materials was submitted to the Institutional Review Board (IRB) Office of Human Subjects for a comprehensive review. Approval was gained on December 19, 2022.



Box 2. Focus Group Questions: Blended Foods

1. What kinds of blended foods (farines préparées) does your family consume? (probe with examples, Akamil, dried flours for porridge)? What kinds do your young children consume? Do you think they are healthy? Why or why not? Does your child like the foods? Why or why not?
2. Does your family purchase these blended foods or do you make them yourself? Why or why not? Where do you find them and cost? Do you ever receive these foods as aid, without cost?
3. How are they prepared for your child? Preparation techniques? Any added ingredients including water
4. In what ways could these blended foods be improved? What ingredients could be added to make them more nutritional? What do you think of these ingredients: fish powder; milk powder; sweet potato leaves; spinach; breadfruit; sweet potato; carrots; mangos?
5. What information about blended or processed foods for children have you received? Where did you receive this information?

Enumerator Recruitment and Training

Enumerators were recruited and hired locally and as well through the l'Université Publique du Nord au Cap Haitien (UPNCH) – a partner institution with Washington University in St. Louis. Student and graduates from UPNCH came from the undergraduate degree program in public health, social work, and tropical medicine. Enumerator training took place in December 2022 over 2.5 days, covering all four scopes of work: blended porridges; time-saving strategies; gender; and integrated care groups. Technical experts from WashU and CRS lead the training, also providing instruction on general ethical principles and formative research methods. During the training, enumerators conducted practice focus groups first with each other and then with a group of volunteer mothers. The leaders of the training then provided feedback and processing.

Data transcription, coding, and analysis

Focus group discussions were audio-recorded, transcribed and de-identified, and translated into English for analysis. Three investigators individually reviewed all the transcripts for themes recorded in Excel and later discussed any discrepancies. One investigator then coded the full dataset using NVivo software to further identify themes related to the primary research questions. Mention frequencies of foods used as ingredients in blended porridges were counted and recorded for later analyses.

Due to the severity of the security situation and logistical constraints, we reduced the number of originally planned focus groups and stakeholder interviews. As well, we were not able to conduct the sensory panels due to delays in the production of the blended food prototypes, now also reduced to two recipes. The fuel crisis and border closures also impeded progress.

Findings


3.1 Literature review

The intensification of food insecurity around the world arising from armed conflict and political instability, climate change and environmental disasters (Dasgupta et al. 2022)(Myers et al. 2017), and economic hardships among other causes has increased need for food assistance. In Haiti, there is confluence of these factors pressing people into a dire situation of food insecurity and malnutrition. Ayiti pi Djamn receives commodities from the USAID Food for Peace Program [US Public Law 480 (PL480)], one of the largest contributors of food aid globally. Historically, fortified blended foods (FBF) within the set of PL480 commodities represents the main food aid used for nutritional purposes, explicitly for vulnerable groups such as young children.

Over the last two decades, efforts have been made to improve the quality of FBF. In 2004, SUSTAIN launched the Food Aid Quality Enhancement Project (FAQEP) focused on increasing energy and viscosity for young children, and protein, fat, fiber, and micronutrients for all. FAQR (described above) followed with a mandate to generate evidence for more nutritionally appropriate and cost-effective formulations (Ignowski et al. 2021). FAQR was housed at Tufts University Friedman School of Nutrition Science and Policy and ran from 2009-2021. Three studies examined the feasibility, cost-effectiveness, and nutrition and health impacts of modified products, with the following results: 1) Malawi – increased feasibility of adding oil using social behavior change (SBC); 2) Burkina Faso – non-significant differences in the effectiveness of preventing wasting and stunting across four new products; and 3) Sierra Leone – nonsignificant differences in products on the treatment of moderate acute malnutrition (MAM) and recovery. This research called for an expanded portfolio of outcomes measures related to body composition, gut health (environmental enteric dysfunction), and brain development.

From June 16-17, 2021, FAQR held a Dialogue on Research and Innovation for Future Food Assistance together with USAID Bureau for Humanitarian Assistance. Consolidated priorities identified some relevant actions for increasing evidence around food aid on: cost-effectiveness; field-feasible metrics for effects on cognition, immune function (beyond anthropometry); sustainable change through food assistance; and knowledge about delivery channels; products for child development; effectiveness at scale; animal source foods in 6-11m; among others (Ignowski et al. 2021).

Animal source foods provide nutrients in highly bioavailable forms that may be more efficiently absorbed by young children and pregnant and lactating women and thus considered a crucial ingredient in blended porridges for nutritional purposes (Iannotti et al. 2017)(Iannotti et al. 2018)(Shapiro et al. 2019). While adding components of ASF such as whey protein concentrate to flours does not necessarily merit the cost in terms of nutrition outcomes (Noriega et al. 2014), there may be greater impacts with the addition of whole ASF ingredients. Fish, egg, or milk



powders, for example, could greatly enhance nutritional quality as well as other nutritious plant-based foods such as sweet potatoes (Borg et al. 2020)(Bierut et al. 2021). Two recent UN reports strongly support the importance of ASF for vulnerable groups, including *WHO Guidelines for complementary feeding of infants and young children age 6-23 months* (WHO 2023)(FAO TASF 2023).

Narrative reviews of the literature have been conducted to examine fortified blended porridges impacts on nutrition, concluding that these products do not meet the nutritional needs for infants and young children ages 6-24 months (Fleige et al. 2010); and there is limited evidence showing products can prevent micronutrient deficiencies and stunted growth (Pérez-Expósito AB, Klein BP 2009). The trend towards garnering evidence around treating moderate and severe malnutrition has continued with more recent evidence from trials examining ready-to-use therapeutic foods (Das et al. 2020). Studies examining blended porridges for preventing chronic malnutrition, impaired development and nutrient deficiencies are lacking in the literature. Findings do suggest the potential for important health outcomes of these products if appropriate formulations are applied (Dewey et al. 2021).

This scoping review identified studies that have examined the impacts of different aspects of blended porridges, some using local ingredients and others examining just the Title II commodity. In India, a **milk-based supplements** improved neurodevelopment outcomes (Upadhyay et al. 2023). **Amylase** added to blended porridges increased nutrient and energy density in a study carried out in Burkina Faso (Kampstra et al. 2018). **Baobab fruit** increased iron and zinc bioavailability (Adetola et al. 2022). A product developed in Tanzania with blended **sorghum, cowpea, corn, and soy** reduced anemia and improved vitamin A status (Delimont et al. 2019). One older review recommended viscosity ²of blended porridges be 80 mm (Fleige 2010). Techniques to lower viscosity might be extrusion cooking (starch granules can absorb 10x weight in water; extrusion breaks down long starch chains to reduce viscosity), adding enzymes to predigest starch and prevent thickening, or use of malted flour.

There is increasing attention globally to a more holistic consideration of food systems for achieving food and nutrition security. The **food environment** level of food systems represents various elements with the potential to influence nutrition and health outcomes (**Figure 1**). **Sustainability** was more recently highlighted as a key element in the food environment (Downs et al. 2020). Use of foods from native plants can uphold this principle (University of Florida IFAS). As well, studies have shown certain agricultural practices (e.g., cover crops; reforestation with fruit trees; hillside erosion control) can protect Haitian soil and sustainably produce foods for blended food ingredients (Bargout et al. 2013).

3.2 Optimal recipe design

Results from the Matrix Scoring Exercise appear in **Supplemental Table 1**. Fish (2.95) and milk (2.9) powders received the highest average score followed by insect powder (2.8) and eggs (2.55). Among the carbohydrates, corn (2.4) and cornmeal (2.35) ranked high and secondarily breadfruit and sweet potatoes. Vegetables

² Viscosity or consistency is defined as distance gruel flows under standardized conditions of preparation, solids content, time, and temperature and measured by Bostwick consistometer, for blended foods should be 80-120 mm/30s (Fleige 2010).

scoring high were sweet potato leaves (2.3), spinach (2.1), and carrots (2.0). Fruits came in lower, with only mangos making the list at dried (1.95) and fresh (1.55). After several discussions with the blended food team, insect powder was removed from consideration due to cultural reasons. Eggs were deemed challenging to source locally. The group agreed that leaves of various plants (sweet potatoes, spinach, cassava) could be mixed or used interchangeably.

After several meetings and processing experimentation, a porridge (sweet) recipe was derived. This product (145g) contains: 50% corn; 30% sorghum ³ ; 10% sweet potato ⁴ ; and 10% milk powder.

Nutrient composition estimates derived from *USDA FoodData Central* are found in **Supplemental Table 2**.

For children, we calculated estimates for the percentage of RDA or AI met by the product based on the vulnerable group categories defined by DRI:7-12m and 1-3y. Portion size was approximated using 25% of daily energy needs (to ensure the child receives other foods important developmentally for both meeting nutrient requirements and taste/texture exposures). For the infant 7-12m, the product provided all nutrients at levels below the 25% RDA/AI. In the older child, only macronutrients and vitamin A were provided in higher proportions, between 25-35%, and remaining nutrients fell below 20%. When we increased the portion size to 50% for young children 7-12m, carbohydrate, protein, and vitamin B12 improved.

For pregnant and lactating women, we estimated the RDA met based on consumption of the entire product (146g). For pregnant women, only phosphorous needs were met above 25%; nonetheless some critical nutrients such as vitamins A and B12, calcium and iron showed higher levels achieved.

GAPL has produced a preliminary recipe for the savory blended food containing 50% corn; 30% fish powder (herring or cod)⁵; and 20% leaves (sweet potato, cassava, and spinach)⁶. Using the same portion size estimates, the savory product performed better in terms of the RDA percentages provided (**Supplemental Table 3**). For the infant, 7-12m, protein, vitamin 6, and phosphorous levels provided by the savory product exceeded 25% of RDAs for these nutrients. Selenium came in at 57.1% and vitamin B12 141%. In the older child, 1-3yr, several of the nutrients also showed high levels of RDA percent met: protein (131%), selenium (186%), vitamin B12 (256%). Those exceeding 50% were vitamin B6, magnesium, and phosphorous, and those above 25% included carbohydrates, niacin, folate, and choline.


Among pregnant and lactating women, some important RDA levels could be achieved with consumption of the entire savory product. Vitamin B12 and selenium

3 The use of sorghum is based on consistent local availability. GAPL is exploring the use of breadfruit and cassava flour with comparable nutritional advantages. See **Supplemental Table 4** for nutrient composition comparisons between sorghum, breadfruit, and cassava. Potential biologically important differences are highlighted.

4 We used the sweet potato ingredient (#168484), boiled without skin, to estimate the sun-dried sweet potato product used by GAPL.

5 Cod fish powder (#174190) was used.

6 A mix in equal proportion of spinach (#16842), sweet potato leaves (#169303), and collard greens (#17046) was used for leaves estimate.



levels exceeded 100%, while biologically important nutrients during this life course phase, niacin and choline, were also met at higher levels.

3.3 Focus group discussions

One focus group discussion was held in each of the six study communities. There were 10 mothers of young children and pregnant and lactating mothers included. Here we present the findings under each of the questions used, highlighting recurring themes and illustrative quotes.

What kinds of blended porridges does your family consume? Do you think they are healthy? Does your child like the foods?

Blended flours (*manje melanje* in Haitian Kreyol) are commonly consumed across the study communities. In both the South and North East, carbohydrate-rich staples are the basis for the flours including corn, plantain, cassava, potato, sweet potato, yams and other tubers and rice (**Figure 2**). There were cultural preferences for particular ingredients in types of blended porridges falling into the general categories of porridge (sweet) and soups (savory). Akamil showed high mention frequently both as product and as generic word for blended food. Bread soup and crackers are also given to young children.

Attitudes were generally positive towards blended porridges. Mothers considered them healthy and articulated several potential health advantages coming from these foods including growth, development, and immune protection. Across the communities, caregivers communicated MSPP messages for particular food groups associated with the Haitian food pyramid: konstwi kò (animal foods for body building); bay fòs (starch foods for energy); and pwoteje kò (fruits and vegetables for protection) (**Figure 2**).

“These foods would be good for nourishing the child’s body. You would find this food protects their bodies, sustains their bodies, builds their bodies.”

There was also the concept of balance communicated with a variety of ingredients or colors used in flours. Several mothers also mentioned vitamins in association with blended porridges.

“Blended food is food that is balanced food...Meaning it has the three kinds of things in it. Like, there are foods that give the body strength, that protect the body, that build the body.”

“When we make food make the three colors of food—legim, bean sauce, even if corn you are cooking you make three colors.”

“Because children when you give them food and they eat it, they gain weight. That means the food is fortified and has other vitamins.”

Some mothers made specific connections between nutrients or foods and particular conditions. In one community, mothers recognized the importance of foods for blood health and preventing anemia. Another mother astutely described the role of vitamin C in protecting gum health.

“They prevent them from being sick, they keep them from being sick with...what is it called...the ones that the children have, but if I look for foods with vitamins it keeps them from getting sick, like anemia.”

“Things that have vitamin C are things that are sour. It is good for the children’s gums...Vitamin C protects the gums of children when they are teething.”

Does your family purchase blended porridges or do you make them yourselves? Where do you find them and at what cost?

The most commonly mentioned price of blended porridges from the market was 100HTG (US\$ 0.68), though quoted prices varied in some communities - 50HTG (US\$ 0.34), 75HTG (US\$ 0.51), 200HTG (US\$ 1.36).⁷

There were some differences in market access between the North East and South communities. In the North East, purchased flours sometimes came from the Dominican Republic and to a lesser extent from local markets. In the South, purchased flours come from Les Cayes. Across all communities, mothers expressed a desire to purchase blended porridges, but price and lack of financial means were barriers.

“Sometimes you might want to manage the child well, but you don’t have the financial means. There are some things that you can give the child to eat, but there is no possibility to buy them to give them. So what you eat you, find a little something to give to the child that can help you feed the child.”


“Other flours in the market, we don’t find them, we can’t buy them, we can’t afford them. We can’t buy in the market.”

How are the blended porridges prepared? Preparation techniques? What are the added ingredients? How can they be improved?

Mothers reported preparing the flours themselves in labor- and time-intensive processes. The general sequence of preparation activities followed this pattern with some variation depending on the base food types: chopping, peeling, and or grating ▶ roasting ▶ drying (in the sun) ▶ grounding ▶ pounding ▶ straining. Mothers described the use of sun for drying and risks with rain for spoilage. Spoilage of ingredients was a challenge for mothers, in particular for adding milk. A dependency on environmental conditions was expressed by one mother.

“When there is rain they can not make the flours, it’s not that it’s not good for the body but it’s not easy to make without it spoiling, especially in periods of rain and you can’t dry the foods in the sun”

⁷ Current exchange rate in the month the survey was carried out, January 2023, is applied to give estimated dollar amounts (147.04 Haitian Gourde = US\$ 1.00). <https://www.oanda.com/currency-converter/en/?from=EUR&to=USD&amount=1>



Foods and spices added to blended porridges were for: 1) nutrition and health reasons; and 2) for palatability and acceptance reasons. Assorted leaves were the most frequently mentioned vegetable followed by carrots and spinach specifically. Beans, garlic, leeks, and moringa were mentioned once by caregivers. Fruits were not as common and only mangos and bananas were mentioned. Of the animal source foods, milk was most often reported followed by fish and herring. A preference was expressed thematically for fish powder when available and affordable. Butter, cheese and eggs were also mentioned.

A common theme across all study communities was use of sugar, salt, and cinnamon to increase palatability and consumption by young children. Sugar was mentioned more frequently than any other ingredient except the generic term, flour (**Figure 3**). Sugar was added to the porridge with milk, while salt was used in savory recipes. Both were deemed important for child consumption. Cinnamon was used for taste and color.

“if you don’t have sugar to make porridge, then you make soup and put it in the strainer and give to the child. You don’t give porridge without sugar.”

“you can add sugar, milk to make it better. You put salt, butter, yes that makes it better...it will give a good taste”

“add cinnamon and boil it, and to have milk and have a good color. That makes it tastier.”

What information about blended or processed foods for children have you received? Where did you receive this information?

This question was posed towards the end of the FGD. Responses were minimal possibly due to fatigue or lack of comprehension regarding the question. Most of the caregivers responding to this question reported receiving information at health centers and rally posts, delivered by nurses and community health workers, care groups, and radio.

“I find it in the health center, there are also nurses who pass by and when they return they come with health agents who come and speak about these things.”

“well, during the training in the care group, they showed us how to make the food for the babies. They showed us how to prepare some small meals which should have three types of food in it.”

Conclusions & Recommendations


4.1 Conclusions

Haiti has a long history of food assistance, specifically under PL480, with socio-economic, political, and health implications. Blended porridges with local ingredients offer an opportunity to improve the feasibility and nutritional quality of these foods targeted to vulnerable populations while supporting local economic and natural resource development. Our scoping review yielded findings from the FAQR and evidence base that suggest the potential for increasing the effectiveness of food aid commodities. Most relevant to Haitian context were studies highlighting the importance of nutrient-dense and bioavailable ingredients such as animal source foods for young children and pregnant and lactating women. Reducing viscosity and enhancing bioavailability of flours through phytate reduction were other important lessons. The scoping review, underscored by FAQR conclusions, point to the need for assessing outcomes beyond anthropometry such as neurodevelopment, anemia, and gastro-intestinal health. Finally, our systematic review highlighted the need to ensure environmental sustainability is integral to the sourcing of ingredients and FBF production.

Findings from the FGD confirmed the need for both sweet and savory recipes with careful messaging and labels on the packaging. Our analyses indicate reducing the percent of corn flour in both recipes will improve nutritional quality. Analyses of recipes relative to RDA shows few nutrient requirements are met based on the prototype recipes and existing products. The savory recipe performed better in terms of meeting gaps in limiting nutrients based on RDA analyses. Higher percentages of RDAs were met in young children for: protein, vitamin B6, vitamin B12, and phosphorous. And among pregnant and lactating women, higher percentages of RDAs were met for: vitamin B12, niacin, choline, and selenium. In the sweet recipe, for young children 7-12m, all RDAs were met below the 25% level, and only vitamin A exceeded 25% RDA for children 1-3yr. For pregnant and lactating women, similarly there were few nutrient RDA intake levels achieved, with only phosphorous intakes exceeding 25%. Some opportunity, however, was apparent for vitamin A, B12, calcium, and iron.

Fruit and vegetable powders should be further explored particularly those rich in vitamins A and C (mango, moringa, citron, other leafy greens). Results from the FGD also underscore the need for detailed information on the packages about ingredients, nutrient content, and preparation instructions (to ensure low viscosity and clean water is used).

Several insights were gained from the FGD across the six communities. There was generally positive attitudes towards use of blended porridges particularly for young children. With certain ingredients such as fish, carrots, and leafy greens, mothers considered them healthy and achieving the goals of the food pyramid to build strength, energize, and protect. A variety of ingredients conferred balance. Common across all communities was the finding for added sugar and salt to FBF as a food preference. We found clear barriers to use including cost if purchasing from the



market and the time- and labor-intensive processes for home preparation. These findings validated those from the gender and time-saving analyses and highlighted the synergistic opportunity of FBF for improving vulnerable group nutrition while saving women time and energy. Messages were reported received from different information channels and could be further leveraged in the ApD programming to promote diet diversity, reduce sugar and salt consumption, and reinforce the MSPP food pyramid messages. Messages promoting healthy dietary patterns with affordable and available foods can also buffer any market shortages of the FBF that can occur.

Some limitations were present for this project. Importantly, the political and economic instability of the country impeded study team logistics. The cost of fuel also imposed some burden on the research budgets. To accommodate these barriers, we reduced the number of planned FGD and eliminated the in-depth interviews at the community level. Another related limitation was the slow development of the recipes arising in part from access to ingredients and problems with contamination and hijacked commodities. Nonetheless, progress was made the findings showed important opportunities with use of these FBF for improving nutrition, saving women time and energy, and achieving sustainable production.

4.2 Recommendations

Optimal Recipe

- Increase the percentage of animal source food content.
 - In the savory recipe, increase content of fish powder from 20% to 30% (as a widely acceptable ingredient), to the extent allowable by price point.
 - In the sweet recipe, increase the milk powder from 10% to 20%.
- Increase the percentage of fruit and vegetable content.
 - In the savory recipe, increase content of vegetable powder from 20% to 30% (as a widely acceptable ingredient). Use a mixture of different leafy greens (sweet potato, cassava, spinach, and moringa leaves).
 - In the sweet recipe, increase the fruit powder from 0% to 20%. Use mango an/ or carrots for vitamin A and citrus for vitamin C and increase absorption of iron
- Reduce the percentage of corn ingredient and replace with breadfruit or tuber powders to reduce starch and phytate content.
 - Use other starchy fruits (banana or plantain) or tubers (potatoes, sweet potatoes, cassava) to replace some portion of corn content.
 - Explore use of amylase and other fermentation products to increase bioavailability.
- Packaging should clearly communicate ingredients, preparation (limit added water as per viscosity guidelines), and shelf life.
 - Preparation guidelines should specify exact quantity of clean water and reducing or eliminating added salt, sugar, and cinnamon.
 - Careful messaging (without making unsubstantiated claims) could be used in promotional materials - building from the MSPP messages - such as: good nutrition boosts child growth and development; good nutrition gives your child energy and strength for healthy growth and development; good nutrition protects your child from infection and keeps them healthy; etc.

Messaging in Integrated Care Groups

- Promote use of FBF for pregnant and lactating women as well as for children
- Encourage reducing or eliminating added ingredients of sugar and salt.
 - Replace with sweet fruits or honey.
 - Make linkages to later risk of diabetes
- Reinforce MSPP messages:
 - 1) food pyramid roles of building, energy, and protection;
 - 2) balance and variety of healthy foods for health
- Leverage foundation understanding of links to health
 - Promote healthy foods for child growth and brain development

Gender & Time-Saving Linkages

- Blended porridges have the potential to save mothers time and labor if accessible (low cost) and received with assurance of high quality ingredients and food safety.
- Direct FBF vouchers to pregnant/lactating women and women with young children to ensure access
- Identify low-cost technologies to increase the feasibility of preparation; consider as a possible business idea for youth entrepreneurs and use of borrowed funds for SILC groups.

MEL & Sustainability

- Evaluate blended porridges with strong MEL to examine:
 - Health impacts – growth, anemia, and neurodevelopment
 - Cost-effectiveness
- Collaborate with universities such as UPNCH in Haiti to foster a culture of evidence-based decision making and programming.
- Source ingredients from farmers using sustainable food production practices (e.g., native plants, cover crops, terracing and mounds)
- Minimize food waste and spoilage to lower greenhouse gas emissions



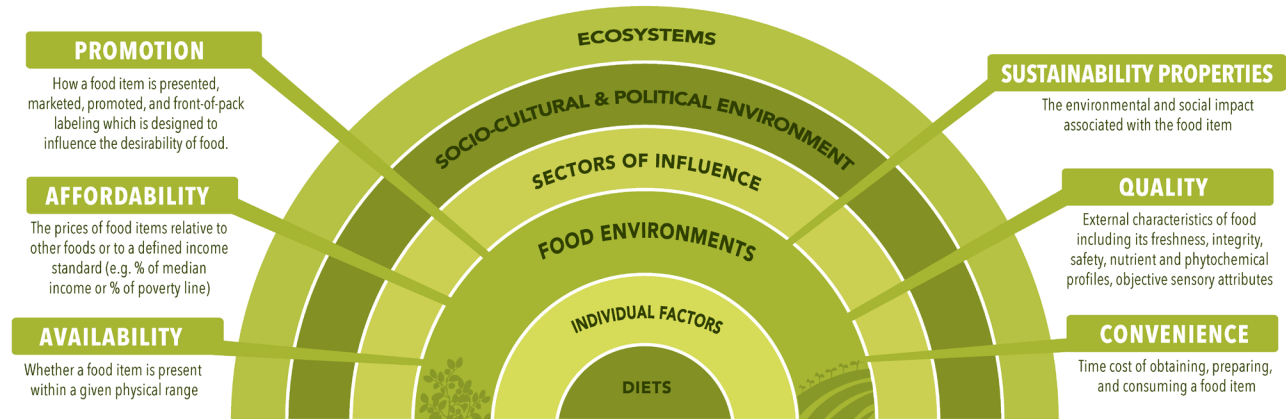
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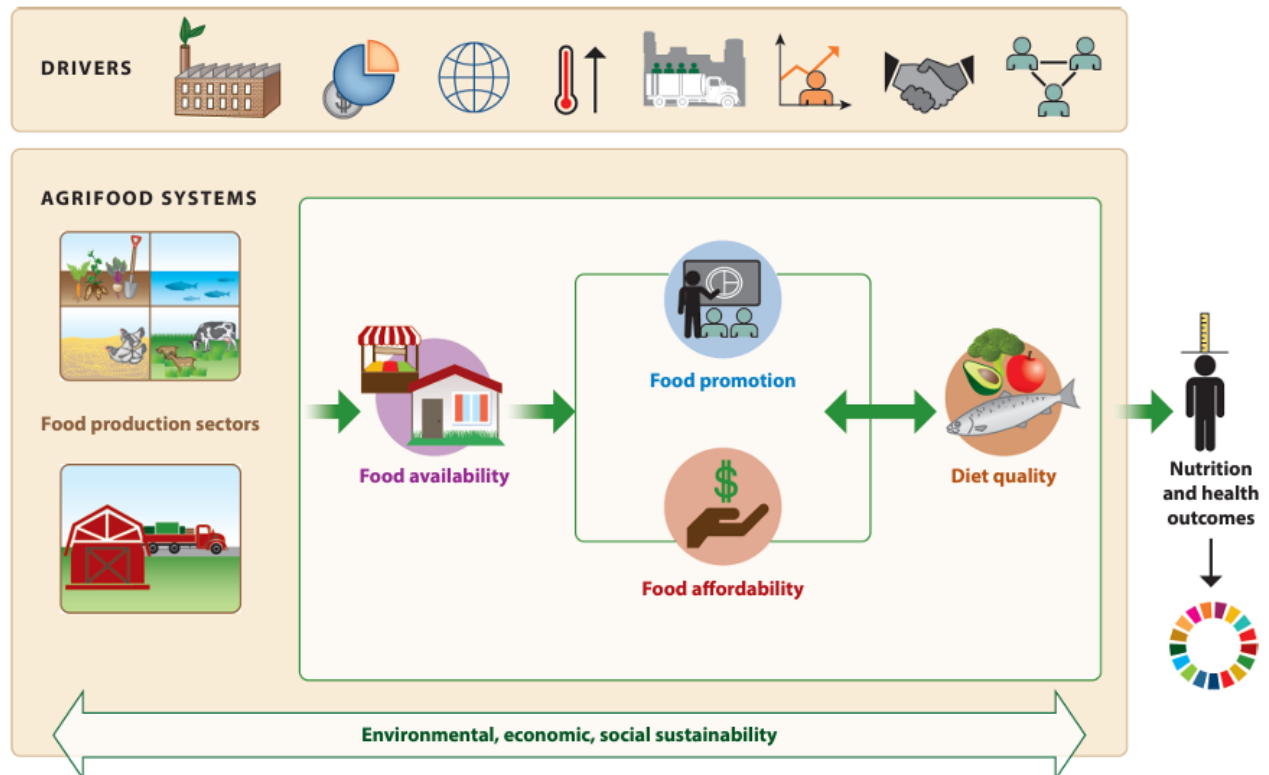
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Tables And Figures

Figure 1. Food Environment Frameworks



(Downs et al. Foods 2020)



(Iannotti et al. ARPH in press)

Figure 2. Haitian Food Pyramid

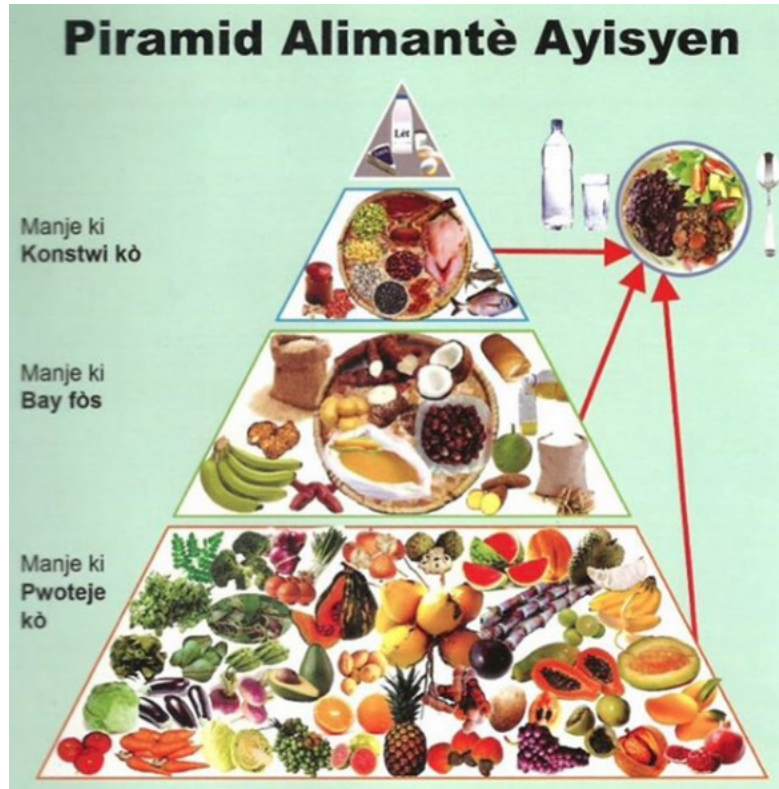


Figure 3. Mention Frequency of Blended Food Ingredients

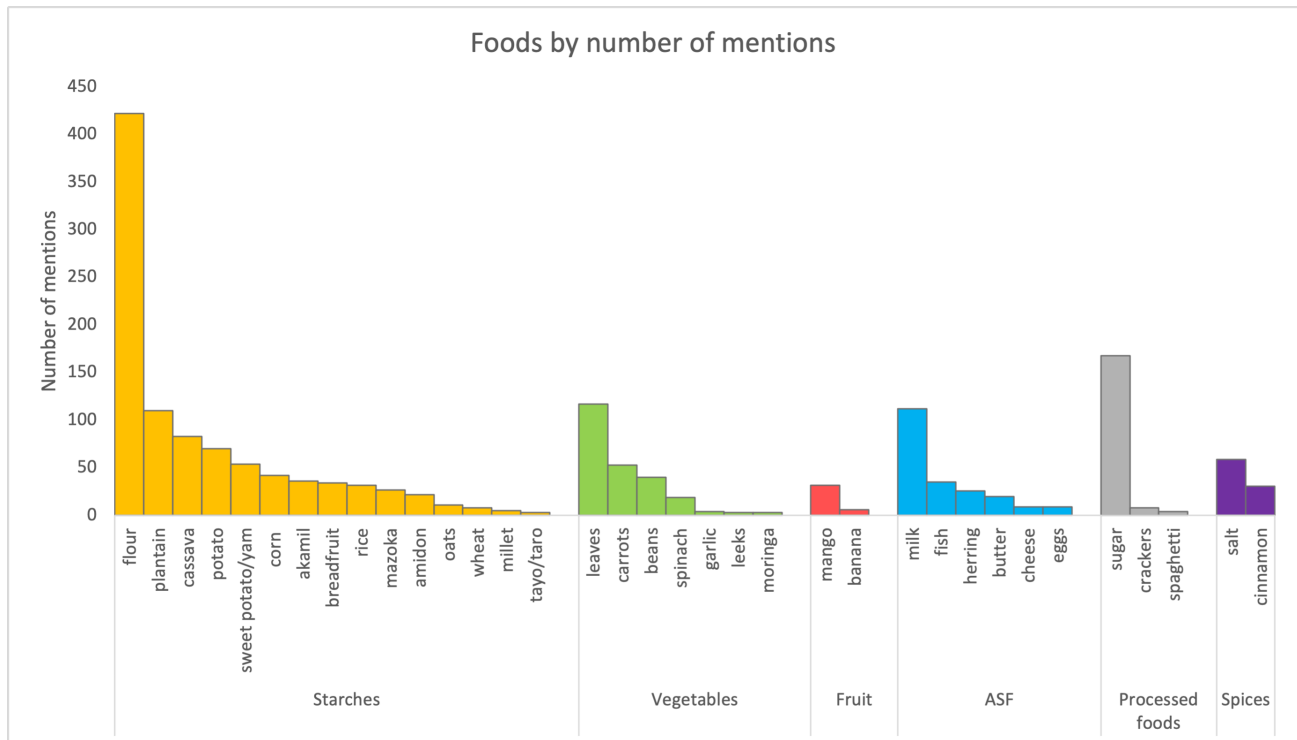


TABLE 1. Dietary Reference Intakes for Nutritionally Vulnerable Populations

					Pregnancy			Lactation		
NUTRIENTS	UNIT	0-6 MONTHS	7-12 MONTHS	1-3 YEARS	14-18 YEARS	19-30 YEARS	31-50 YEARS	14-18 YEARS	19-30 YEARS	31-50 YEARS
Energy	<i>kcal</i>									
Protein	<i>g</i>	9.1	11	13	71	71	71	71	71	71
Lipids (total)	<i>g</i>	31	30	-	-	-	-	-	-	-
Linoleic Acid (18:2n-6)	<i>g</i>	4.4	4.6	7	13	13	13	13	13	13
a-Linolenic Acid (18:3n-3)	<i>g</i>	0.5	0.5	0.7	1.4	1.4	1.4	1.3	1.3	1.3
DHA (22: 6n-3)	<i>g</i>	-	-	-	-	-	-	-	-	-
Carbohydrates	<i>g</i>	60	95	130	175	175	175	210	210	210
Fiber (total dietary)	<i>g</i>	-	-	19	28	28	28	29	29	29
Minerals										
Calcium	<i>mg</i>	200	260	700	1300	1000	1000	1300	1000	1000
Iron	<i>mg</i>	0.27	11	7	27	27	27	10	9	9
Magnesium	<i>mg</i>	30	75	80	400	350	360	360	310	320
Phosphorus	<i>mg</i>	100	275	460	1250	700	700	1250	700	700
Potassium	<i>mg</i>	400	860	2000	2600	2900	2900	2500	2800	2800
Sodium	<i>mg</i>	110	370	800	1500	1500	1500	1500	1500	1500
Zinc	<i>mg</i>	2	3	3	12	11	11	13	12	12
Copper	<i>mg</i>	200	220	340	1000	1000	1000	1300	1300	1300
Manganese	<i>mg</i>	0.003	0.6	1.2	2	2	2	2.6	2.6	2.6
Iodine	<i>μg</i>	110	130	90	220	220	220	290	290	290
Selenium	<i>μg</i>	15	20	20	60	60	60	70	70	70

					Pregnancy			Lactation		
NUTRIENTS	UNIT	0-6 MONTHS	7-12 MONTHS	1-3 YEARS	14-18 YEARS	19-30 YEARS	31-50 YEARS	14-18 YEARS	19-30 YEARS	31-50 YEARS
Vitamins										
Vitamin C (ascorbic acid)	mg	40	50	15	80	85	85	115	120	120
Thiamin (B1)	mg	0.2	0.3	0.5	1.4	1.4	1.4	1.4	1.4	1.4
Riboflavin (B2)	mg	0.3	0.4	0.5	1.4	1.4	1.4	1.6	1.6	1.6
Niacin (B3)	mg	2	4	6	18	18	18	17	17	17
Pantothenic acid (B5)	mg	1.7	1.8	2	6	6	6	7	7	7
Vitamin B6	mg	0.1	0.3	0.5	1.9	1.9	1.9	2	2	2
Folate, DFE	μg	65	80	150	600	600	600	500	500	500
Choline	mg	125	150	200	450	450	450	550	550	550
Vitamin B12	μg	0.4	0.5	0.9	2.6	2.6	2.6	2.8	2.8	2.8
Vitamin A, RAE	μg	400	500	300	750	770	770	1200	1300	1300
Vitamin E (alpha-tocopherol)	mg	4	5	6	15	15	15	19	19	19
Vitamin D (D2+D3)	μg	10	10	15	15	15	15	15	15	15
Vitamin K	μg	2	2.5	30	75	90	90	75	90	90



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