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DEVELOPMENT AND EVALUATION OF LOCALLY FORMULATED READY-TO-USE THERAPEUTIC FOODS (RUTFS) FOR TREATING ACUTE MALNUTRITION IN CHILDREN AGED 6–59 MONTHS IN NASARAWA STATE, NIGERIA

***[1,2]Sa'eedu, Auwal Magaji, [1]Saidu, Godiya Moses and [1]Haruna, Hauwa**

[1]Department of Nutrition and Dietetics, School of Home Economics and Hospitality Management, College of Agriculture, Science and Technology Lafia, Nasarawa State.
[2]Department of Nutrition and Dietetics, Faculty of Basic Medical Sciences, University of Maiduguri, Nigeria.

Corresponding Author's E-mail: samagaji.ntd@unimaid.edu.ng Phone: +2347038834050

ABSTRACT

Malnutrition occurs when individuals do not consume or absorb sufficient nutrients, contributing to nearly half of global child deaths, especially in low- and middle-income countries. It impairs growth, cognitive development, and productivity, creating significant economic burdens. Ready-to-Use Therapeutic Foods (RUTFs) are essential for treating severe acute malnutrition, however, inconsistent and insufficient supply, and costs of imported RUTFs undermining treatment coverage and outcomes in Nigeria. The study aims to develop and evaluate maize- and sorghum-based ready-to-use therapeutic foods for treating acute malnutrition in children (6-59 months) in Nasarawa State. Diverse ingredients including maize/sorghum, groundnuts, soybeans, sesame seeds, dates, cashew nut, crayfish, moringa leaves, vegetable oil, and sugar were sourced and processed, and mixed in defined ratios. Nutrients analysis was conducted using standard methods. Sensory evaluation was conducted with 35 panelists using a 9-point hedonic scale. Results showed energy values of 521.09 kcal/100g (MB-RUTF) and 527.44 kcal/100g (SB-RUTF). Protein contents were 15.70 g/100g (MB-RUTF) and 17.08 g/100g (SB-RUTF), while fat contents were 35.25 g/100g and 34.76 g/100g, respectively. Vitamin analysis indicated levels, respectively of vitamin A (526.40 and 622.00 mg/100g) and vitamin C (8.72 and 9.82 mg/100g). Vitamin D, E, K, B-complex, and mineral contents also demonstrating substantial contribution to micronutrient requirements. Sensory evaluation shows high acceptability, with SB-RUTF slightly preferred across all attributes. Findings demonstrate that locally produced, plant-based RUTF can meet nutritional requirements, reduce dependence on imported products, and enhance accessibility and affordability of SAM treatment in Nigeria. Incorporation of premixed micronutrients is recommended to ensure full nutritional adequacy.

Keywords: Severe Acute Malnutrition, Ready-to-Use Therapeutic Food, Maize, Sorghum, Premixed micronutrients

INTRODUCTION

Malnutrition results when people consistently do not consume or absorb the right amounts and types of nutrients. Globally, it contributes to nearly half of all child deaths (45%), accounting for more than three million deaths annually (UNICEF, 2020). Its consequences extend beyond immediate health impacts, undermining children's long-term growth, cognitive development and productivity, and ultimately imposing a substantial economic burden on affected nations.
Malnutrition (under-nutrition) remains a major global public health concern, particularly in southern Asia and sub-Saharan Africa (Obasohan et al., 2024). An estimated 144 million children under five years (21.3%) are stunted, 47 million (6.9%) are wasted, and 14.3 million (2.1%) are severely wasted (World Bank, 2020). In Africa, 12.7 million children under five (6.4%) are wasted, including 3.5 million who are severely wasted, with West Africa recording the highest burden at 4.8 million (7.5%) wasted and 1.1 million severely wasted (World Bank, 2020). In Nigeria, childhood malnutrition persists at alarming levels, according to Federal Ministry of Health and Social Welfare et al. (2024), 40% of children under five are stunted, 8% are wasted, 1% are overweight, and 27% are underweight. This calls for concerted efforts in order to reduce the devastating impact of malnutrition on the population.
Globally and in Nigeria, the management of acute malnutrition is structured around four components: inpatient therapeutic care, outpatient treatment, supplementary feeding and community-based programes (WHO, 2013). Outpatient treatment of uncomplicated severe acute malnutrition is provided, using Ready-to-Use Therapeutic Food (RUTF). Ready-to-Use Therapeutic Food is a high-energy, fortified, ready-to-eat foods that have a nutrient content of 100 kcal per 100 grams, similar to that of F-100, use to treat children with severe acute malnutrition in hospital settings. However, unlike F-100, ready-to-use therapeutic foods are not water based thus bacteria are less likely to grow in them. These foods can therefore be used safely at home or in hospital without refrigeration and even in areas where hygiene conditions are not optimal (WHO, 2013). RUTF is central to SAM treatment and is associated with significant reductions in childhood mortality (Schoonees et al., 2019). RUTF provides all nutrients required for rapid catch-up growth and is particularly suitable for children aged 6 months and above with SAM and no medical complications (Schoonees et al., 2019). Over the past two decades, the advent of RUTF has enabled a shift from inpatient to out-patient treatment of uncomplicated SAM, which has greatly helped in increasing the coverage of SAM treatment programs (Sebinwa, 2016).
Despite its proven effectiveness, global RUTF supply remains inconsistent and insufficient, undermining programme coverage and treatment outcomes. High production costs and inadequate funding are major constraints limiting availability (UNICEF, 2021). Efforts to reduce costs and expand access include increasing the supplier base and developing alternative plant-based formulations that exclude expensive animal-based ingredients such as milk (UNICEF, 2021; Osendarp et al., 2015; Choudhury et al., 2018). To tackle the

issue of funding, RUTF has been included on the list of essential drugs in many countries, which action was meant to increase government and stakeholders commitments and response to its funding (Aitken, 2015). Although these initiatives have showed some improvements, they have not fully addressed the persistent supply gaps. As of 2020, procured RUTF by all stakeholders, could treat only 30 to 35% of SAM cases, leaving 65 to 70% of affected children without access to treatment, particularly those outside emergency settings (UNICEF, 2021).

Inadequate RUTF also disrupts the community management of acute malnutrition (CMAM) programmes, where by the children discharged from inpatient therapeutic care fail to appropriately transit through outpatient care to community component, which may result into many relapses. While imported RUTF remains costly and often insufficient, the world is having limited options on how to take care of the affected children in the absence of the product. RUTF can be formulated from diverse local ingredients, including low- or no-milk options, which may lower costs and improving acceptability (Schoonees et al., 2019). Although development partners such as UNICEF and WHO have supported countries in establishing local production facilities (Banda et al., 2021), many existing local products still require substantial investment in processing and raw materials, making them even more expensive than imported RUTF (UNICEF, 2021; WHO, 2019). This has led to continued shortage of RUTF resulting into many affected clients failing to receive the right treatment. Thus, this study aim to formulate and evaluate maize- and sorghum-based ready-to-use therapeutic food for treatment of acute malnutrition in children 6-59 months in Nasarawa state. This will contribute to the ongoing efforts to reduce child mortality and the cost burden of purchasing and importing RUTF for management of SAM.

MATERIALS AND METHODS

Sources of Materials

Food materials (maize, sorghum, groundnuts, soybeans, sesame seeds, crayfish, cashew nuts, table sugar (Dangote brand), vegetable oil (kings brand) and dates fruits) were purchased from markets (modern market, neighborhood market, kasuwan koro and grain market Kwandare), while fresh moringa leaves were sourced from local farmers, in Lafia, Nasarawa state.

Processing of the Ingredients for the Formulation

All ingredients that constituted for the formulations of the RUTF were prepared separately before mixing as stated below:

Maize and sorghum were processed using a modified method of processing of grains for "Tom Brown", a complementary food commonly prepared from a mixture of cereals and legumes, while date palm fruits, sesame seeds and groundnuts were processed following the methods described by Sosanya et al. (2018) with modification. The cereals were cleaned and manually sorted to remove dirt and stones, then sun-dried and roasted. Soybeans were also manually sorted to remove dirt, stones, and spoiled seeds, and then soaked in clean water at a 1:3 (w/v) ratio in a covered plastic container for 24 hours. After soaking, they were drained, dehulled, washed, sun-dried, and subsequently roasted (Hui et al., 2015; Edema et al., 2005; Malomo et al., 2011). Fresh moringa leaves were plucked, washed under running tap water, and shade-dried. Date palm fruits were sliced to remove the seeds, washed, and oven-dried at 60 °C for about 2 hours (Reddy et al., 2020). Cashew nuts were purchased already roasted. All roasting was carried out using the dry roasting method in a pan over medium heat, with continuous stirring to ensure even roasting and to prevent scorching. Each roasted ingredient was ground separately into fine flour or powder using an electric blender manufactured by Yongkang Jinweilei Electrical Appliance Co., Ltd (Model JJ-668, rating: AC 220–240 V, 50/60 Hz, 300 W), and then sieved with a 200-micron kitchen sieve before being stored in airtight, labeled containers.

Sesame seeds were cleaned and manually sorted to remove dirt and stones, washed using tap water, sun-dried, and roasted. Groundnuts were manually sorted to remove debris, broken seeds, moldy nuts, and foreign materials. The selected groundnuts were washed thoroughly in clean potable water to remove surface dust and impurities, drained, allowed to dry, and roasted. The dried sesame seeds and groundnuts were roasted using the same dry roasting method in a pan over medium heat, with continuous stirring to prevent scorching. After roasting, the groundnuts were spread on clean trays and left to cool to room temperature for about 10 minutes. Once cooled, the seed coats were removed by gently rubbing the nuts between the palms, and the hulls were separated through manual winnowing. The dehulled groundnuts and roasted sesame seeds were ground separately into a fine paste using a mechanical grinder. Grinding was done in two passes to ensure a smooth and uniform consistency. No water was added during grinding to maintain low moisture content and reduce the risk of microbial growth. The resulting pastes were then packaged in airtight containers.

Mixing of the Ingredients for the Formulation

All the processed ingredients were mixed purposefully in different ratios (table 1) to formulate two (2) RUTFs samples. To achieve homogeneity of the formulated RUTFs, an electric blender was used for mixing the products. All the ingredients were measured and added to the blender then blended in medium speed for about 5 minutes and cooled. Each sample was then transferred into plastic containers and stored at ambient temperature until when required for proximate analyses and consumer evaluation. The locally products were in a paste form.

Table 1: Ingredients Ratio for the Formulation of local RUTF Samples

Ingredients	MB-RUTF (%)	SB-RUTF (%)
Maize flour	18	0
Sorghum flour	0	18
Peanut paste	23	23
Soybeans flour	15	15
Date fruits powder	9	9
Cashew nut powder	4	4
Sesame seeds paste	3	3
Table sugar	7	7
Vegetable oil	20	20
Cray fish powder	0.5	0.5
Moringa leaves powder	0.5	0.5

MB-RUTF: Maize-Based Ready-to-Use Therapeutic Food; SB-RUTF: Sorghum-Based Ready-to-Use Therapeutic Food.

Nutritional Compositional Analysis of the formulated RUTF

Moisture content (gravimetric method), crude fat (Soxhlet extraction method), total ash (gravimetric method), crude fibre (enzymatic-gravimetric method), crude protein (Kjeldahl method) (AOAC, 2019), and total carbohydrate was calculated by difference (FAO, 2003) while energy was calculated using the Atwater conversion factors in Kcal. Vitamins A, D, E and K were analyzed with high-performance liquid chromatography (HPLC), chosen for its fine-grained sensitivity. Vitamins B and C were assessed through spectrophotometric techniques, which capture their characteristic light signatures with reliable precision. Mineral profile was analyzed through atomic absorption spectrometry (AAS) with a Hitachi-Z8200 spectrometer connected to a Hitachi graphite furnace. Sample preparation and analysis followed AOAC (2010) methods.

Sensory Evaluation of RUTF Samples

Thirty-five panelists (mothers of children 6 months and above and have no allergies to the constituents of the products) were selected from Federal University of Lafia Teaching Hospital, Nasarawa state to assess the two formulated samples (coded) presented in transparent plastic sample containers, following the method described by Sosanya et al. (2018) with modification, using a 9-point hedonic scale questionnaire, with 9 as like extremely, 8 as like very much, 7 as like moderately, 6 as like slightly, 5 as neither like nor dislike, 4 as dislike slightly, 3 as dislike moderately, 2 as dislike very much and 1 as dislike extremely. The choice of caregivers was made based on the fact that they are familiar with children feeding preference and cues and they also have knowledge of what to look out for when examining the sensory attributes of their children's foods. The panelists examined the samples in terms of appearance/colour, texture/consistency, taste, sweetness, aroma and overall acceptability. Clean drinking water was served to the panelists to rinse their pallets before and after examining each sample.

Statistical Analysis

The data was summarized using mean ± SD, frequency, and percentages, as appropriate. SPSS version 25 was used for all analyses. $P < 0.05$ was set as a level of significance.

RESULTS AND DISCUSSION

Table 1: Proximate Composition of Formulated RUTFs

	MB-RUTF (G/100g)	SB-RUTF (G/100g)
Crude protein	15.70 ± 0.10^b	17.08 ± 0.08^a
Crude Fiber	4.85 ± 0.07^a	3.93 ± 0.02^b
Crude Fat	35.25 ± 0.05^a	34.76 ± 0.03^b
Ash Content	5.51 ± 0.01^a	4.12 ± 0.10^b
Moisture	3.43 ± 0.02^a	3.54 ± 0.09^a
Carbohydrate	35.26 ± 0.07^b	36.57 ± 0.06^a
Energy (kcal)	521.09 ± 0.04^b	527.44 ± 0.03^a

The Values in the table are means of triplicate determinations ± standard deviations. Means in the same row with different superscripts are significantly different (P < 0.05)

Table 2: Vitamins Content of Locally Formulated RUTFs

Vitamins	MB-RUTF (Mg/100g)	SB-RUTF (Mg/100g)
Vitamin A	526.40 ± 1.02^b	622.00 ± 1.80^a
Vitamin C	9.82±0.12^a	8.72±0.04^b
Vitamin D	0.24 ± 0.001^a	0.25 ± 0.002^a
Vitamin E	5.72 ± 0.12^a	1.36 ± 0.16^b
Vitamin K	4.00 ± 0.011^a	2.62 ± 0.002^b
Vitamin B_1	3.81 ± 0.03^a	2.55 ± 0.007^b
Vitamin B_2	1.55 ± 0.010^a	0.87 ± 0.004^b
Vitamin B_3	1.21 ± 0.011^a	1.24 ± 0.01^a
Vitamin B_5	5.77 ± 0.057^a	5.00 ± 0.391^a
Vitamin B_6	0.037 ± 0.001^a	0.016 ± 0.00^b
Vitamin B_7	3.23 ± 0.07^b	3.61 ± 0.01^a
Vitamin B_9	0.82 ± 0.003^a	0.81± 0.001^a
Vitamin B_{12}	0.03 ± 0.00^a	0.02 ± 0.001^b

The Values in the table are means of triplicate determinations ± standard deviations. Means in the same row with different superscripts are significantly different (P < 0.05)

Table 3: Minerals Content of Locally Formulated RUTFs

Minerals	MB-RUTF (Mg/100g)	SB-RUTF (Mg/100g)
Calcium	2.839 ± 0.018^a	2.577 ± 0.004^b
Cupper	0.064 ± 0.003^a	0.058 ± 0.0007^b
Iron	0.244 ± 0.003^a	0.239 ± 0.003^a
Potassium	699.00 ± 1.514^b	721.40 ± 4.782^a
Magnesium	0.576 ± 0.003^a	0.574 ± 0.006^a
Sodium	6.037 ± 0.016^a	5.569 ± 0.063^b
Zinc	0.157 ± 0.0004^a	0.150 ± 0.0008^b
Phosphorus	3.85 ± 0.02^b	6.49 ± 0.06^a
Chloride	523.17 ± 0.05^a	443.23 ± 0.04^b
Iodine	2327 ± 0.03^a	1563 ± 0.04^b

The Values in the table are means of triplicate determinations ± standard deviations. Means in the same row with different superscripts are significantly different (P < 0.05)

Ready-to-Use Therapeutic Food (RUTF) forms a central pillar in managing Severe Acute Malnutrition, a condition that sharply heightens the risk of childhood mortality. The Institute of Medicine (IOM) and WHO recommended that the ingredients for formulation of RUTF had to contain the essential nutrients (Schoonees et al., 2019). The IOM recommends that 450 grams of RUTF per day is required to release the energy level of 2,100-2,200 kcal/day (Sheibani et al., 2018; Schoonees et al., 2019).

The findings presented in table 2 shows there is significant difference ($p<0.05$) in crude proteins, crude fats, total ash, fiber, carbohydrates and energy values of the locally formulated grain-based RUTF samples. Energy values shows that SB-RUTF had 527.44kcal/100g, slightly higher than 521.09 kcal/100g in MB-RUTF, which are both within 520 – 550 kcal/100g recommended for RUTF formulation (UNICEF, 2023) and are also found to be comparable to energy value of imported RUTF (plumpy Nut) (Sosanya et al., 2018). The observed values are higher than the highest energy value (478.00kcal/100g) recorded by (Edafioghor et al., 2025), and 433.70, 464.70 and 404.95 kcal/100g documented by (Ishaq et al., 2025) from some locally produced RUTF in Nigeria. Sosanya et al. (2018), reported energy values between 517.3 – 573.0 kcal/100g in eight samples of locally formulated RUTFs in Bauchi state, Nigeria. The higher energy values observed in this study might be attributed to high calorie content of the most of the local food materials used in the formulation and percentage of vegetable oil added during formulation. This suggest that this formulations is capable of providing adequate energy needed by malnourished children during rehabilitation stage for weight gain.

UNICEF recommended protein content of RUTF should contribute 10%-12% of total energy. The protein contents (15.70 and 17.08 g/100g, respectively in MB-RUTF and SB-RUTF), conforms to this guideline, with protein content in SB-RUTF contributing slightly higher. The protein values were slightly above 14.0g in imported RUTF (Plumpy Nut) (Bharaniidharan and Reshmi, 2019), and also higher than values obtained (6.85, 9.41 and 9.75%) in a study conducted by Edafioghor et al. (2025), 9.5% protein reported by Sandeep and Mona, (2014) in a locally made RUTF Agra. Higher protein contents of crayfish, soybeans, peanut, sesame, moringa and other ingredients used in the combination may have contribute to the values observed. Protein is crucial for treating malnutrition as it provides the building blocks for tissue repair and growth, immune system function, and the production of enzymes and antibodies.

The fat contents of 35.25 and 34.76 g/100g, (MB-RUTF and SB-RUTF, respectively) also conforms to WHO recommended standards of protein should provide 40%-65% to the energy value in RUTF (Sosanya et al., 2018). Lipid contents were higher than 27.7% and 26.3% documented by Ashish et al. (2022) and Sandeep and Mona, (2014), respectively. However, the lipid values in this formulated RUTFs are lower than the 55.4% - 70.55% reported by Sosanya et al. (2018), and 56.6% in Plumpy Nut. Fat together with other macronutrients especially protein, are essential during management of severe acute malnutrition which causes severe wasting and loss of subcutaneous fat (Saaka et al., 2015). Fat in addition to protein helps in tissue regeneration, protection, and normal functioning of the immune cells which prevent children from suffering from childhood diseases (Sosanya et al., 2018).

Fibre contents (4.85 and 3.93 g/100g) of the formulated RUTF samples (MB-RUTF and SB-RUTF, respectively) were in-line with the recommended standard (<5%) for fibre. The observed lower values could be attributed to different processing methods (dehulling, milling, and sieving) involved in the production of these locally formulated RUTFs. Edafioghor et al. (2025) and Amegovu et al. (2018) recorded lower values, respectively (2.39% and 1.2%) in their findings. Studies on the nutrition significance of dietary fibers contents show varying levels of their importance and detriments. While as dietary fibers play a big role in maintaining bowel health and microflora, and in the prevention of constipation, as well as improving sensory attributes of foods, too much of the fibers may be detrimental (Yangilar, 2013).

The moisture contents (3.43 and 3.54 g/100g) reported in this study, revealed no significant different between MB-RUTF and SB-RUTF. The moisture contents was found to be higher than 0.0 - 2.5% recommended by UNICEF. Observed values are lower than 9.26, 9.89 and 11.11% reported in different locally formulated RUTF (Edafioghor et al., (2025) and 9.89% in METU-2 (Amegovu et al., 2018), however, Sosanya et al. (2018) documented 0.59 - 2.73%. Lowering moisture contents will allow the products to be safely stored at ambient tropical conditions for longer period of time, as low moisture content can limit microbial activity in a wide range of environments.

Other nutrients of concerns in formulation of local therapeutic foods for treatment of malnutrition is the vitamins and mineral contents, this is because malnutrition entailing not just energy and protein deficiency, but also inadequacies in essential vitamins and minerals (micronutrients). Rapid growth, high metabolic demands, frequent infections, and poor dietary diversity put children at increased risk for micronutrient deficiencies, which in turn impede recovery, impair immune function, and adversely affect cognitive and physical development.

Table 2 presents vitamin profile of MB-RUTF and SB-RUTF samples. It shows there is significant differences ($p<0.05$) in concentrations of all the vitamins analyzed, except for vitamin D, B_3, B_5, and B_9, signaling varying nutritional strengths between the two samples, with lipid soluble vitamins (ADEK) shows the widest variations. Worth knowing is, both samples had appreciable vitamins. Vitamin A contents was lower (526.40 mg/100g) in MB-RUTF compared with SB-RUTF (622.00 mg/100g), above 0.8 to 1.1 mg/100g in typical RUTF. Vitamin D also follows same trend. Concentration was lower in MB-RUTF (0.24 mg/100g) than SB-RUTF (0.25 mg/100g). Interestingly, similar pattern appears in vitamin C, E, and K, though in reverse. SB-RUTF retains a markedly higher level (5.72 mg/100g) compared to 1.36 mg/100g observed in SB-RUTF, possibly reflecting differences in the composition or antioxidant retention during preparation/processing, suggesting good antioxidant activities in both samples. MB-RUTF presents a higher level (9.82 mg/100g) than SB-RUTF (8.72 mg/100g). Vitamin K concentrations revealed that MB-RUTF having higher (4.00 mg/100g) than SB-RUTF which had (2.62 mg/100g). The presence of these vitamins indicating a substantial contribution to antioxidant defense and key cellular processes, potentially enhancing the formulation's ability to support recovery in severe acute malnutrition (Rimbawan et al., 2024).

B-complex vitamins create a more intricate pattern, with MB-RUTF exhibiting consistently better concentration for thiamin (B_1), riboflavin (B_2), pantothenic acid, (B_1), vitamin B_6, folate (B_9) and vitamin B_{12}. These nutrients underpin essential metabolic functions, from energy generation to the synthesis and maintenance of nucleic acids. These elevated values imply that MB-RUTF, may better support biochemical pathways dependent on these cofactors. In contrast, vitamin

B_3 and Biotin contents are slightly higher (1.24 and 3.61 mg/100g, respectively) in SB-RUTF than MB-RUTF (1.21 and 3.23 mg/100g, respectively).

Table 3 reveals statistical difference ($p<0.05$) between the mineral contents of the Maize-based formulated RUTF (MB-RUTF) and Sorghum-Based formulated RUTF (SB-RUTF). The findings shows that calcium, copper, zinc and sodium showed significantly higher levels in MB-RUTF (2.839, 0.064, 0.157, and 6.037 mg/100g, respectively) than SB-RUTF (2.577, 0.058, 0.150 and 5.569 mg/100g, respectively). The contents in both samples indicated that the products can supply good amount of these essential minerals, which are crucial to skeletal development, enzyme function and electrolyte balance. Iron composition (0.244 and 0.239 mg/100g) did not differ significantly between the two formulations, indicating comparable potential for supporting red blood cells formation in malnourished children. In reverse pattern, SB-RUTF demonstrated higher levels of potassium (K) and phosphorus (P), suggesting that the formulated product can support intracellular electrolyte balance and phosphate-driven energy functions. Magnesium (Mg) contents (0.576 and 0.574 mg/100g, respectively in MB-RUTF and SB-RUTF) like iron, shows no significant difference between the products, indicating a consistent contribution to neuromuscular and metabolic activities. Iodine, essential micronutrient required for the synthesis of thyroid hormones, which play a critical role in growth and development and critical for supporting thyroid-related functions (Novina et al., 2025), was observed to be significantly higher in MB-RUTF (2327 mg/100g). Chloride values (523.17 and 443.23 mg/100g in MB-RUTF and SB-RUTF, respectively), remained within ranges consistent with safe electrolyte balance. The mineral contents of the formulated RUTFs in this study were lower than the recommended standards for RUTF. This likely reflects the mineral content of the ingredients and the absence of the mineral/vitamin premix recommended for RUTF formulations. However, the current findings were similar to the results obtained by (30) and (21).

Therapeutic foods need to be highly acceptable and palatable for the target children. The results of this study showed both samples were accepted by the panelists in term of all sensory attributes studied. The figure reveals that SB-RUTF was rated slightly higher in all the attributes, indicating better acceptability. While similar research conducted acceptability study using children (Nga *et al*, 2013), this study conducted acceptability using normal adults because they can objectively assess the attributes of interest. Acceptability of therapeutic foods is vital for the success of the feeding program. The high acceptability of the developed therapeutic foods was expected given that the food ingredients used were commonly consumed foods in Nasarawa state and the processing methods followed process that improve such characteristics.

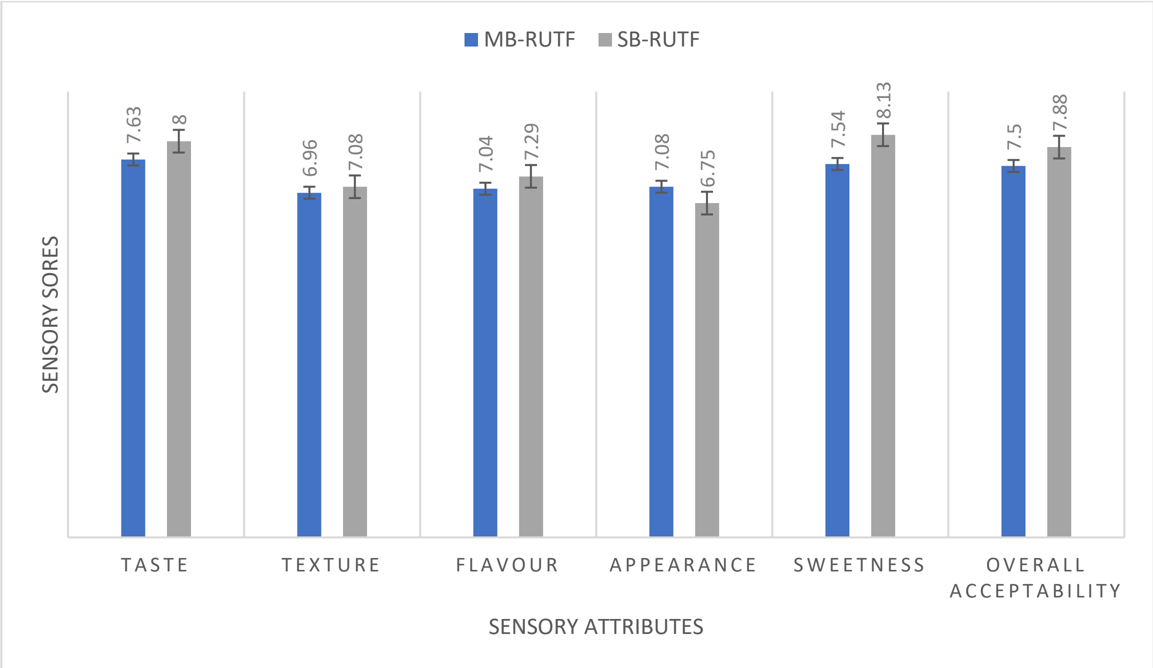

Figure 1: Sensory Evaluation of Formulated RUTFs
Values are mean ±SD of the scores (n=35) based on a 9-point hedonic scale where 1 is dislike extremely and 9 is like extremely.

CONCLUSION

The result from this study shows that RUTFs formulated from local ingredients in this study satisfied the UNICEF/WHO minimal macronutrients requirements for RUTF and the protein, carbohydrate, energy and several vitamin requirements of malnourished children can be met through consumption of these locally formulated products. The use of plant-based local ingredients also has the potential to reduce the cost of treating malnutrition and to improve the availability of RUTF in Nasarawa State and Nigeria, where the burden of severe acute malnutrition (SAM) continues to rise.

RECOMMENDATIONS

The locally formulated RUTFs in this study were highly acceptable to the panelists, indicating strong potential for adoption in the management of SAM and for use within community-based management of acute malnutrition (CMAM). Findings showed that RUTFs can be successfully produced from locally sourced ingredients and can comply with WHO/UNICEF nutrient compositional specifications.

However, observed gaps in micronutrients content underscore the need to incorporate premixed micronutrients to achieve full nutritional adequacy.

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