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Research Article

Formulation of Organoleptically Acceptable Maize-Based Complementary Food Enriched with Beetroot (*Beta Vulgaris*) and Faba Bean (*Viciafaba*) at Debube Ari Woreda, Southern Ethiopia

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Abstract

One of the main causes of malnutrition in infants and young children in developing nations is the consumption of complementary foods with inadequate nutrition. Thus, the goal of this study was to evaluate the nutrient composition, anti-nutritional factors and sensory properties of complementary food prepared from Maize, Faba bean and Beet root flour blends. Four formulations of the composite flours were produced and evaluated. Results showed that moisture were less than 10%. Ash content had ranged from 1.18% to 2.92%. Crude fibers varied from 1.18 % to 8.57%. Protein content had ranged from 7.46% to 13.18%. Phytate content was between 91.84 mg/100 g and 129.54 mg/100 g. Tannin content was between 235.44 mg/100 g and 899.42 mg/100 g. Vitamin A contents were detected except BF2 (MF 63%, BRF 10%, and FBF 27%). β-carotene contents were varied from 31 μg/100 g-246 μg/100 g. Iron content of the samples varied from 2.478 mg/100 g to 4.623 mg/100 g. Zinc content varied from 1.560 mg/100 g to 2.538 mg/100 g. The phytate to zinc molar ratio ranged from 0.425 to 0.579. Similarly, the phytate to iron molar ratio varied from 0.195 to 0.314. Results of sensory evaluation revealed that the mean score varied from 4.76 to 4.41 in terms of taste and overall acceptability. Sensory scores of porridges made from formulated flour blends of BF4 (50% MF: 30% BRF: 20% FBF) were highly acceptable by mother-child pairs in terms of different sensory attributes (flavor, taste, color, appearance, mouth feel) and scored significantly ($P<0.05$) higher than the other formulated complementary porridges. The blends formulated in this study could be used by rural and urban mothers to feed their infant and children during the complementary feeding period.

Keywords: Beet root; Complementary food; Fababean; Maize; Nutritional quality; Sensory acceptability

Introduction

According to a recent WHO report, there are 144 million stunted children under the age of five, 47 million wasting children, and 38.3 million overweight children worldwide [1]. This report also highlighted 57.5 million children less than five years of age are stunted in Africa, 12.7 million are wasted, and 9.3 million are overweight. The prevalence of stunted, underweight, wasted, and overweight children under five in Ethiopia in 2019 is 37%, 21%, 7%, and 2.9%, respectively [2]. One major contributor to children's growth stalling is the lack of high-quality, reasonably priced supplementary foods. In adequate nutrition during the first 1,000 days of life may result in child's growth being permanently impeded, their cognitive function being impaired, their school and work performance being affected, and their morbidity and death rates increased [3]. The high rates of child stunted growth problems in Ethiopia were mainly associated with in adequate dietary diversity [4]. Low dietary diversity and reliance on frequently consumed starchy staples, which do not provide enough calories or essential micronutrients, add to the burden of malnutrition and micronutrient deficiencies [5]. The majority of Ethiopians lack the financial means to purchase commercially produced complementary foods with improved nutrient profiles. According to CSA and ICF (International Classification of Functioning, Disability, and Health) report [6], only 1.6% of infants aged 6 to 23 months allegedly consumed infant's formula that had been factory processed. This consumption is primarily true form metropolitan families with disposable income. The situation is different in rural areas, particularly in border regions, where a lack of marketing connections, in adequate infrastructure, low money, disuses with utilizing enhanced factory-processed complimentary meals are prevalent. Because they consume a less diverse diet from the family dish, which is a primarily cereal-based, youngster is more likely to experience micronutrient deficiencies, such as those in vitamin A, iron, and zinc [7]. The nutritional value of beetroot is high as they are full of calcium, iron, and vitamins A and C. In addition to being a great source of fiber, manganese, and potassium, beetroots are also a great source of folic acid. The greens should not be disregarded because they can be prepared and eaten similarly to spinach. Beetroot is high in fiber, which improves digestive function and may help avoid constipation as well as lower cholesterol levels. The fababean is the most popular source of protein and is utilized in many traditional dishes.

The National Nutrition Program II (2016-2020) proposes the creation and implementation of low cost-cost nutritious

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complementary foods using locally available food resources as an approach to combat protein-energy malnutrition and micronutrient deficiencies among infants and young children in Ethiopia. However, there is a scarcity of evidence on the knowledge of processing and utilization of nutritionally enriched CF in the study areas in Ethiopia, particularly Debube Ari woreda. Hence, the objective of current investigation was to develop nutritionally and organolepticaly acceptable maize based complementary food blended with beetroot and fababean in Debube Ari Woreda, Southern Ethiopia.

Materials and Methods

Description of study areas

The study was conducted in Debube Ari Woreda, South Omo Zone, and Southern Ethiopia. The Woreda is located between latitudes 6.08 to 6.27' N and longitudes 36.54 to 36.75' E. The elevation of the areas ranges from 501 to 3500 meter above sea level. The district minimum and maximum annual average rainfall of the ranges between 1401 mm- 1600 mm with minimum and maximum annual temperature of 10.1°C and 25°C. According to information gathered from key informants and secondary source almost half of the study population faces poor consumption. The study districts are among the most maize, faba bean and beet root growing areas in Ethiopia.

Raw material collection

Maize, faba bean and beetroot samples were directly collected from farming plots of volunteer farmers and Jinka Agricultural Research Center (JARC). All the raw materials were carefully selected based on the availability in local region and for their best quality and productivity.

Raw material processing

Maize grain flour production: The maize grain was hand sorted and cleaned. According to Mehra and Eckhoff [8], the grains were washed with tap water, rinsed in deionized water, soaked for 10 minutes, and then the hulls were removed using a traditional Ethiopian wooden pestle and mortar. After that, the bran and grits were sun dried to make them easier to separate and to dry out the grits. The grits were then milled in a grain mill and passed through a 0.5 mm sieve. The milled samples were placed in airtight polythene bags and kept in a refrigerator (about 5°C) for later use.

Preparation of beet root flour: The collected beet roots were sorted, washed, peeled and sliced to remove adhering soil and dirt. The slices were dried using sunlight. The slices were ground using a local milling device, sieved into fine flour (250 μm) and stored in LDPE bag for later use.

Production of Faba bean flour: Defective grains (with holes), stones, dried pods and other debris were removed from the beans. After being thoroughly washed, the beans were soaked in tap water for 24 hours at room temperature. This was done to get rid of some the anti-nutritive components in the beans, like phytate and tannin. After that, a nylon sieve was used to drain the soaked beans. The beans were then sun-dried before being roasted for 15 minutes to further reduce the anti-nutritive components in beans, enhance flavor, boost digestibility, and reduce the cooking time for the final product. The roasted beans were de-hulled using a commercial de-huller and winnowed to remove the bran from the beans. The bean sample was then ground in to flour and sieved using a laboratory sieve with an opening size of 1.00 mm to produce uniform and smooth particle sizes. The bean flour sample was manually packed according to the required weight of flour in plastic polythene bags. Until they were used for analysis, the bags were kept at room temperature after being sealed with a heat sealer.

Formulation of composite flour: The formulation was estimated using the nutrient composition of the raw materials to produce a product that could have an energy level of 400 Kcal/100 and a protein content fat least 15 g/100 g on a dry matter basis, in accordance with the specified guidelines for complementary flour for older infants and young children [9]. Additionally, 250 mg of calcium, 5.8 mg of iron, and 4.15 mg of zinc were taken in to consideration as the necessary micronutrient composition at 50% supply of fortified supplemental food per 100 g (WHO/FAO, 2010). Breast milk was anticipated to provide the remaining 50%. The flours were thoroughly mixed to obtain a homogenous blend.

Experimental design

Total of five treatment combinations were generated which includes 100% MF (control), 63:10:27 (MF:BRF:FBF), 56:20:24 (MF:BRF:FBF), 50:30:20 (MF:BRF:FBF) and 50:35:15 (MF:BRF:FBF). These ranges were established based on previously published research on complementary foods made from grains, legumes, and vitamin rich plant foods, as well as WHO recommendations for in fants feeding [10,11].

Nutrient composition of flour blends

Proximate composition and energy estimation: The official AOAC [12] method was used to determine the proximate composition analysis, which included moisture content, crude protein, crude fat, crude ash, and crude fiber. The amount of utilizable carbohydrates was determined using the formula 100- (%crude protein+% crude fiber+% total ash+% crude fat). The gross energy content was calculated using the following conversion factors 4 kcal/g for protein 9 kcal/g for fat and 4 kcal/g for carbohydrates [13].

Determination of mineral content and β-carotene: The minerals (Fe and Zn) were analyzed using Atomic Absorption Spectrophotometer (AAS) .in accordance with the standard procedure of the AOAC. The AOAC was used to determine the products β-carotene carotene content.

Determination of phytate and tannin content: The Vaintraub and Lapteva [14] method was used to calculate Phytate. Tannin content was measured using the procedure Maxson and Rooney [15] developed.

Sensory evaluation

Five formulated complementary porridge samples were prepared and subjected to sensory evaluation. The evaluation was carried out based on appearance, aroma, taste, mouth feel, and overall acceptability using a 5-point hedonic scale, where "1" corresponding to "Dislike very much" and "5" corresponding to "Like very much". Total of 40 untrained panelists (mothers who have babies age between 6 and 24 months) were randomly selected from We set and Gedir Kebles of Debube Ari Woreda. The consumer panelists were informed about the Five points the donic scale and its use prior to assessment. Freshly prepared poor ridge was served on white plate, arranged, and coded randomly. During the evaluation, pane lists were instructed to palate clean with water between each sample testing.

Data analysis

The data was entered and analyzed using spssver 20. Mean and standard deviations were computed.

Ethical clearance

Permission was obtained from South Omo Zone and Woreda health offices. Informed consent was obtained from the mother and father of study participating child. Data obtained from each study participant was kept confidential. Nutritional advice was also given for those mothers/care gives on child feeding.

Results and Discussion

Proximate composition of maize-based CF enriched with fababean & beetroot

Moisture is a crucial factor in the quality and acceptability of flour and flour products since it has an impact on their shelf life and micro biological development while being stored [16]. The moisture content of the complementary flour blends in the current study varied from 10.24% to 10.74%, whereas maize flours moisture content was 10.66%. The values were greater than the Codex Alimentarius commission's recommended value in all blending ratios, but it was still within the 15% moisture content limit for maize meal flour, as recommended by the World Food Program [17].

Ash content represent total mineral level present in a given food staff. The ash value for maize flour is 1.18%; whereas, that of blended samples were found in the range of 2.02% to 2.92% (Table 1). Product 50:35:15 (MF:BRF:FBF) had the largest ash content (2.92%), where as 100% MF (control) had the lowest ash content. WHO/FAO [18] recommendation for complementary food ash content (<5 g/100 g) is met by all the Complementary foods processed for this study.

Because it contains vital fatty acids, aids in the absorption of fat-soluble vitamins, and improves dietary energy, density and sensory quality, fat is crucial in the meals of older infants and young children. The crude fat of the blended samples ranged from 3.71% where as 4.46% for maize flour (control sample) (Table 1). The result of the current study demonstrated that blended samples' fat content was lower than the daily recommended range of 10% to 25% for complementary foods [19]. This could be a result of the different crop types and processing techniques utilized while formulating the flour. For instance, there moval of the maize's outer layer and germ during processing has a considerable impact on the amount of fat in the final product [20]. According to our investigation, boosting the maize content can enhance the formulated complementary foods fat content. The crude fibers of the blended samples varied from 2.95% to 8.57%. The formulated samples' crude fiber content increased as the amount of Beet Root Flour (BRF) supplementation was increased. The blended sample BF4 sample BF4 (MF 50%, BRF 30%, and FBF 20%) had the highest crude fiber content (8.57%), whereas control samples BF1 (MF 100%) had the lowest. The fiber contents in all samples were within the recommended range of not more than 5 g dietary fiber per 100 g dry matter for complementary foods [21]. The carbohydrate of formulated samples ranged from 63.93% to 75.06%. The highest amount of carbohydrate content (75.06%) determined in BF1 (100% maize flour) and the lowest determined from the BF4 (MF 50%, BRF 30%, and FBF 20%) Table 1. With the increasing of maize content in the blend, the carbohydrate content was found to be increased. The control (100% CF) had the least protein and fiber contents, but had the highest carbohydrate content. The total carbohydrate result obtained in this study is consistent with range of recommended carbohydrate content ≥ 65 g/100 g of complementary food products for older infants and young children [22]. The gross energy of the formulated complementary flours ranged from 324.38 kcal/100 g to 370.22 kcal/100 g (Table 1). Sample BF1 had the highest gross energy reading (MF 100%), whereas BF4 had the lowest (MF 50%, BRF 30%, and FBF 20%). Unfortunately, the outcome falls short of the 400 kcal/100 g-425 kcal/100 g energy content for complementary foods recommended by WHO/FAO. This might be as a result of the lower fat content of the ingredients used in the formulation of the food. The energy value of the formulated complementary foods (310.07 kcal/100 g-356.66 kcal/100 g) exceeds the FAO/WHO/UN recommendation (200 kcal/day-300 kcal/day) for infant complementary food (under 1 year) in developing countries. The energy requirements for in fants who consume "average" amounts of breast milk in developing countries, according to Brown et al. [23], are approximately 200 kcal per day at 6 to 8 months of age, 300 kcal per day at 9-11 months of age, and 550 kcal per day at 12 to 23 months of age from complementary foods.

Crude protein content

The result shows that the protein content of the maize-based complementary samples ranged from 7.46% to 13.18 % (Table 1). The sample with the highest protein content was BF2 63:10:27 (MF:BRF:FBF), while the sample with the least protein content was the control sample BF1 (MF 100%). The protein content increased as the proportion of faba bean flour was increased, and decreased as the proportion of maize flour was increased. The variation in the blend ingration and crop types used during formulation could be there as on for the difference in the results. Gibson and Hotz [24] suggest that blending cereal-based foods and using specific processing methods can enhance the protein content of the flour. According to WHO/FAO, complementary foods should contain at least 15% of the required daily allowance for protein. However, in our finding, this result can be satisfied when the proportion of faba bean in the blend is greater than 25%. This suggests that increasing the proportion of fababean flour in maize-based complementary foods can improve their protein content.

Anti-nutritional content of maize based CF enriched with fababean and beetroot

Phytate is the primary storage compound of phosphorus in cereals, legumes, nuts, and oil seeds. The intake of phytate has a direct correlation with the poor iron and zinc status commonly seen in complementary food of preschool children after 6 months of age in low-income countries. Plant-based complementary diets often have poor mineral content due to poor bioavailability, particularly when based on unrefined cereals and legumes that contain high levels of phytate. Phytate is a potent inhibitor of mineral absorption, as noted by Gibsonetal [25]. Table 2 shows that the phytate content of the products ranged from 91.84 mg/100 g to 129.54 mg/100 g. The highest value of phytate was contained in BF4 50:30:20 (MF:BRF:FBF) but the least was detected in BF1 (MF 100% control). The foods with low phytate content are recommended for infants and all consumers. The phytate content of the current products is significantly lower than the recommended daily intake of phytate from complementary foods, which ranges from 300 mg/day-500 mg/day according to ADA [26-27]. According to Table 2, the tannin content of the products ranged from 235.44 mg/100 g to 899.42 mg/100 g. The highest value of tannin was contained in BF2 63:10:27 (MF:BRF:FBF) but the least was detected in BF3 56:20:24 (MF:BRF: FBF). According to WHO [28], the total acceptable daily intake of tannin is 560 mg. Based on the results of this study, all samples contained low levels of tannin except for BF2 63:10:27 (MF:BRF:FBF). The Complementary flour formulated in this study has low tannin content and is unlikely to significantly impair

Table 1: Proximate composition of maize-based CF enriched with Fababean &Beetroot.

Parameters	BF1(control)	BF2	BF3	BF4	BF5
Moisture (%) w/w	10.66	10.24	10.59	10.74	10.31
Fat (%) w/w	4.46	3.71	3.27	2.58	2.61
Protein (%)	7.46	13.18	12.23	11.36	10.06
Ash (%) w/w	1.18	2.02	2.4	2.82	2.92
CHO (%)	75.06	67.9	68.32	63.93	66.2
Crude fiber (%) w/w	1.18	2.95	3.19	8.57	7.9
Energy (kcal/100 g)	370.22	357.71	351.63	324.38	328.53

Values are expressed as means of duplicate sample. BF1=100% Maize flour (control), BF2= 63 Maize flour+10Beetroot flour+27 Fababean flour, BF3=56 Maize flour+20 Beetroot flour+10 Fababean flour, BF4=50 Maize flour+30 Beetroot flour+20 Fababean pea flour, BF5=50 Maizeflour+35 Beetroot flour+15Fababean flour.

Table 2: Anti-nutritional content of Maize based CF enriched with Fababean & Beetroot.

Parameters	BF1(control)	BF2	BF3	BF4	BF5
Phytate (mg/100 g)	91.84	111.62	108.46	129.54	106.05
Tannin (mg/100 g)	532.73	899.42	235.44	443.6	501.03

Values are expressed as means of duplicate sample. BF1=100% Maize flour (control), BF2=63 Maize flour+10 Beetroot flour+27 Fababean flour, BF3=56 Maize flour+20 Beetroot flour+10 Fababean flour, BF4=50 Maize flour+30 Beet rootflour+20 Fababean pea flour, BF5=50 Maize flour+35 Beetroot flour+15 Fababean flour.

protein digestibility through complex formulation, as suggested by Uzoechina [29].

Vitamin A, β-carotene and mineral content of maize based CF

β-carotene content: The result shows that the amount of Beta-carotene in all treatments was found in the range of 31 µg/100 g-246 µg/100 g (Table 3). The highest β-carotene content observed in porridge prepared with BF5 (MF 50%, BRF 35%, and FBF 15%) while lowest in BF1 (MF 100%). It was observed that the β-carotene in the treatments increased as the proportion of Beet Root increased in the formulations.

Mineral contents (iron and zinc): The sinachi and Eresiya [30] reported that iron is an essential micronutrient that plays a crucial role in haemoglobin formation, oxygen, and electron transport in the human body. Therefore, it is an essential micronutrient for complementary feeding. Supplementation of iron (Fe) in infants' diets is vital for mental health and the reducing anemia prevalence [31]. The iron content of the samples varied from 2.478 mg/100 g to 4.623 mg/100 g. The highest Fe content (4.623 mg/100 g) found in BF4 (MF 50%, BRF 30%, and FBF 20%) whereas lowest Fe content (2.478 mg/100g) found in BF1 (MF 100%). The World Health Organization [32] recommends a daily intake of 0.27 mg of Fe for infants aged 6-8 months, 11 mg for 9-11 months, and 7 mg for 12-23 months. While the Fe content in all formulated complementary flour blends meets the recommended daily intake of infants aged 6-8 months, it falls short of meeting the needs of the other two age groups. The FAO/WHO guidelines state that the overall recommended amount of minerals in formulated complementary foods should be at least 50% of Reference Nutrient Intake (RNI) [33]. In this study, all of the designed complementary foods offer roughly 50% of the RNI for each mineral at a medium bioavailability. Zinc is essential in promoting satisfactory growth and overall maintenance of the human body. Growth retardation, poor appetite, and an impaired sense of taste have all been linked to low Zinc status in young children [34]. The Zinc content of prepared complementary food products ranged from 2.382 mg/100 g to 2.538 mg/100 g. The formulated food product made from BF2 63:10:27 (MF:BRF:FBF) had the highest Zn content, whereas the control sample had the lowest Zn content. The results of this study indicate that the complementary foods meet the daily zinc requirements for infants aged between 6 to 12 months (2.5 mg/day), except for the BF5 food sample. Infants aged at 6-8 months, 9-11 months, and 12-23 months should take 2 mg/day and 3 mg/day, respectively. This research found that the complementary foods created in the study contain around 50% of the recommended dietary intake of zinc with moderate bioavailability. Bekele and Shiferaw [35] also discovered comparable outcome sin their study on the nutritional evaluation and development of instant complementary food made from crops high in vitamin A iron and zinc. According to Umeta [36] the complementary flour that was formulated has the potential to alleviate zinc deficiency, which could lead to improvements in the immune system and are duction in stunting among children.

Phytate and bio availability of iron and zinc

Table 4 shows that the molar ratio of phytate to zinc ranged from 0.425 to 0.579. BF1 had the highest molar ratio of phytate to zinc. Norhaizan and Nor Faizadatul suggested that the critical molar ratio of phytate to zinc should be higher than 15. The available data suggests that the molar ratio of phytate to zinc in the entire product exceeds the critical value proposed by Norhaizan and Nor Faizadatul. Due to the molar ratio of phytate to zinc in the entire product being greater than the critical value, it can be concluded that the amount of phytate present in these products is not significant enough to hinder the bioavailability of zinc. Corresponding to this, the range of the phytate to iron molar ratio was 0.195 to 0.314 (Table 4). BF1 had the greatest phytate to iron molar ratio, while BF5 had a lower amount of phytate. Norhaizan and Nor Faizadatul recommended that the phytate to iron ratio should be higher than 1 (phytate/iron>1). Unfortunately, the phytate to iron molar ratio of all the products is too low compared to the critical value. As a result, the amount of available phytate is not sufficient to significantly impede the absorption of iron.

Sensory acceptability of complementary food

The mean score of sensory acceptability of porridge samples was presented in Table 5. The values ranged from 2.80-4.80, 2.68-4.80, 2.28-4.84, 2.64-4.64 and 2.55-4.78 for appearance, color, taste, mouth feel and over all acceptability, respectively. The sensory acceptability scores of all products were remained above 3 in the scale of 5-point which indicated acceptability levels near and above the moderate degree of liking. From all prepared samples BF3 and BF4 formulated samples scores the highest value for most sensory attributes.

Conclusion

The aim of this study was to create complementary food products suitable for infants aged 6-23 months by blending maize, beetroot, and fababean flour to meet their nutritional requirements. From the formulated food products BF4 (50% MF:30% BRF:20% FBF) sample contained the most desirable nutritional value among the four formulated complementary flour treatment. Moreover, sensory properties of composition BF4 (50% MF:30% BRF:20% FBF) gruel highly acceptable by mother-child pairs in terms of different sensory attributes (flavor, taste, color, appearance, mouth feel) and scored significantly (P<0.05) higher than the other formulated complementary foods. Therefore, formulated complementary foods were found with improved nutrient profiles, reduced anti-nutrients and acceptable than the control with the potential to minimize burdens of protein-energy malnutrition and micronutrient deficiency

Table 3: Vitamin A, β-carotene and mineral content of Maize based CF.

Parameters	BF1 (control)	BF2	BF3	BF4	BF5
Iron(mg/100g)	2.478	3.33	3.61	4.62	4.58
Zinc(mg/100g)	1.56	2.54	2.51	2.53	2.38
VitaminA(µg/100 g)	2	ND	1	2	1
β-carotene(µg/100 g)	31	138	210	231	246

Values are expressed as means of duplicate sample. BF1=100% Maize flour (control), BF2=63 Maize flour+10 Beetroot flour+27 Fababean flour, BF3=56 Maize-flour+20 Beetroot flour+10 Faba bean flour, BF4=50 Maize flour+30 Beetroot flour+20 Faba bean pea flour, BF5=50 Maize-flour+35 Beetroot flour+15 Fababean flour.

Table 4: Phytate and bio availability of Iron and Zinc.

Parameters	BF1(control)	BF2	BF3	BF4	BF5
Iron(g/mol)	0.442	0.6	0.64	0.83	0.82
Zinc(g/mol)	0.24	0.39	0.39	0.39	0.37
Phytate(g/mol)	0.139	0.17	0.16	0.2	0.16
Molar ratio phytate/Fe	0.314	0.28	0.25	0.24	0.2
Molar ratio phytate/Zn	0.579	0.43	0.43	0.51	0.44

Values are expressed as means of duplicate sample. BF1=100% Maize flour (control), BF2= 63 Maize flour+ 10 Beetroot flour+27 Fababean flour, BF3 = 56 Maize flour+20 Beetroot flour+10 Fababean flour, BF4=50 Maize flour+30 Beetroot flour+20 Fababean pea flour, BF5=50 Maize flour+35 Beetroot flour+15Fababean flour.

manifested in the region or beyond. However, for better quality products, further nutritional enrichments can be done through fortification for additional fats, minerals and vitamins.

Recommendation

Generally, we recommend that locally available and low cost food ingredients used in the present study have good potential to develop complementary foods with enhanced nutritional value and sensorial acceptability for resource-poor households if some enhancement made by including studied amount of milk and milk products and other micronutrient dense food stuffs. The authors recommend continuous nutrition education in consumption of diversified foods that include pulse and other legumes in order to enhance daily protein supplies.

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Table 5: Sensory acceptability of complementary food blended from maize, beet rootandfababean.

Parameters (Sensory attributes)	BF1 (control)	BF2	BF3	BF4	BF5	CV	LSD
Flavor	4.84±0.80[a]	2.36±1.44[b]	4.56±0.58[a]	4.80±0.41[a]	4.44±1.04[a]	22.11	0.5199
Taste	4.84±0.80[a]	2.28±1.37[b]	4.44±0.71[a]	4.76±0.43[a]	4.44±1.04[a]	22.34	0.5195
Color	4.80±0.82[a]	2.68±1.52[b]	4.48±0.71[a]	4.12±1.48[a]	4.04±1.62[a]	32.02	0.7217
Appearance	4.80±0.82[a]	2.80±1.53[b]	4.44±0.71[a]	4.08±1.47[a]	4.00±1.61[a]	31.92	0.7193
Mouthfeel	4.64±1.11[a]	2.64±1.50[b]	4.36±0.99[a]	4.44±0.04[a]	4.48±1.16[a]	28.58	0.658
Overall acceptability	4.78±0.81[a]	2.55±1.32[b]	4.46±0.60[a]	4.41±0.84[a]	4.28±1.13[a]	23.82	0.5464

CV: Coefficient of Variation; values are mean ± SD and mean values followed by the same letter in a column are not significantly different at 5% level of significance; LSD: Least Significance Difference. BF1=100% Maize flour (control), BF2= 63 Maize flour+10 Beetrootflour+27 Faba bean flour, BF3=56 Maize flour+20 Beetroot flour+10 Fababean flour, BF4=50 Maize flour+30 Beetroot flour+20 Fababean flour, BF5=50, Maizeflour+35 Beetroot flour+15 Fababean flour.

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