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Proximate and Phytochemical Properties of Weaning Food from Flour Blends of Millet (Pennisetum Glaucum) and Lyon Bean (Mucuna Cochinchinensis)

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ABSTRACT

Proximate and Phytochemical Properties of Weaning Food from Flour Blends of Millet (Pennisetum glaucum) and Lyon Bean (Mucuna cochinchinensis). The formulated samples were analyzed for proximate and phytochemical properties. Moisture content ranged from 4.00% (Nutrend) to 10.41% (Diet 1), with significant differences ($p < 0.05$) among samples. Crude protein was highest in Diet 2 (24.75%) and lowest in Diet 3 (10.51%). Nutrend exhibited the highest energy value (400.07 Kcal/100g), crude fibre (4.93%), and carbohydrate (63.79%), but lowest tannins (0.03 mg/100g), oxalates (0.0 mg/100g), and phenols (0.00%). Anti-nutrients (trypsin inhibitor, phytate) were generally low, with significant differences ($p < 0.05$) among samples. Overall, Nutrend exhibited superior nutritional and safety profiles, while formulated diets showed potential for optimization.

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Introduction

Chronic malnutrition remains a persistent problem for young children in sub-Saharan Africa [1]. Children in developing countries are the most vulnerable and most affected by malnutrition. The World Health Organization (WHO) recommends exclusive breastfeeding for the first six months of life. Then, from 6 months to 2 years of age, the addition of complementary foods (known as complementary weaning foods) is coupled with continuous breastfeeding [2]. During this period, it is necessary to feed the child with liquid or semi-liquid food to complement the mother's milk [3]. These complement foods should bring, in balanced proportion, major nutrients such as proteins, lipids and carbohydrates.

In most parts of Africa, the traditional weaning food which supplements breast-feeding are gruels, watery suspension cereals such as millet, maize, rice, sorghum and other available. Previous studies showed that millet has several potential health benefits, partly attributed to its polyphenol and dietary fiber contents [4]. Millet could be used as a cheaper source of flour as compared to other cereals for developing functional foods [5]. In addition to its nutritional quality and being gluten free, millet has been reported to have several health benefits such as prevention of cancer, cardiovascular diseases, reducing tumor incidence, lowering blood pressure, delaying gastric emptying and supplying gastro intestinal bulk [6]. However, cereals have low quality proteins because of their poverty in some essential amino acids such as lysine and tryptophan [3], which are indispensable for the child growth and contribute to 45% of dietary proteins [1]. In this context, supplementation with grain legumes is a promising strategy to address essential nutrients deficiency among the children [7].

Lyon beans (Mucuna cochinchinensis), one of the many species of Mucuna in the family Leguminosae, is an underutilized tropical legume grown in many parts of the world. It is nutritionally comparable to other legumes such as soybeans because of their similar contents of protein, fat and other nutrients [8]. It contains approximately 28.7% protein, 6.12% ether extract, 3.82% crude fibre, 3.97% ash, 50.3% nitrogen free extract and 4.42kcal/g energy. It is used as a minor food crop in parts of Nigeria as well as Asia. The need for cheap sources of protein for developing countries has led many individuals to research potentials of underutilized legumes to supply valuable nutrients of which Lyon beans are one but its utilization in food forms may be hindered as a result of the anti-nutritional factors present in the plant. These anti-nutritional factors have been reported to interfere with nutrient absorption and also cause a reduction in nutrient intake, digestion and utilization [8]. Consumption of food containing anti-nutritional factors may cause some specific symptoms in the human body such as nausea, rashes, bloating, and nutritional deficiencies among others [9]. In order to improve the nutritional content and reduce the anti-nutrient contents of Mucuna species, some common processing methods have been used such as soaking in portable water, heating in water, alkaline or acid solutions at elevated temperatures, germination, roasting, dehulling and fermentation [10]. Therefore, this study was aimed at formulating weaning foods from flour blends of millet and lyon bean as an alternative to traditional complementary foods. The proximate and phytochemical compositions of the flour blends were evaluated to ascertain their nutritional quality as weaning foods.

Materials and Methods

Sources of Raw Materials

Pearl millet (*Pennisetum glaucum*) and lyon bean (*Mucuna cochinchinensis*) and other ingredients such as sucrose, crayfish and bone meal were purchased from Umuahia main market.

Sample Preparation

Lyon bean was sorted to separate the healthy ones from the bad ones weighed and washed with clean running water to remove debris. The sample was boiled at 100°C for 90 min, dehulled, dried at 65°C before milling and sieved into flour while the pearl millet were weighed, winnowed, washed, air dried, roasted at 80°C for 10 min, milled and sieved into flour.

Formulation of the Composite Flour

Four different experimental diet samples were formulated with a total of 100 g per diet.

- D_0 = Control diet nutrend
- D_1 = Equal proportion of millet and lyon bean flours
- D_2 = Higher proportion of lyon bean flour and lower proportion of millet flour
- D_3 = Lower proportion of lyon bean flour and higher proportion of millet flour

Table 1: Formulation of Different Experimental Diet Samples

Sample	Millet	Lyon bean	Crayfish	Sucrose	Bone meal
D1	45	45	3.25	3.75	3
D2	30	60	3.25	3.75	3
D3	60	30	3.25	3.75	3

Determination of Proximate Composition

Moisture, crude protein, fat, ash, Crude fiber, carbohydrate and energy value contents of the grounded rice varieties were all determined using the method described by AOAC [11,12].

$$\%Moisture = \frac{W2-W3}{W2-W1} \times \frac{100}{1} \quad (1)$$

Where: W_1 = weight of empty dish, W_2 = weight of dish and sample before drying, W_3 = weight of dish and sample after drying

$$\%Ash = \frac{W3-W1}{W2-W1} \times \frac{100}{1} \quad (2)$$

Where: W_1 = weight of empty crucible, W_2 = weight of crucible+sample before ashing, W_3 = weight of crucible + sample after ashing

$$\%Fat = \frac{W2-W1}{W} \times \frac{100}{1} \quad (3)$$

Where: W = weight of sample, W_1 = weight of flask, W_2 = weight of flask and oil extracted

$$\%Crude\ fibre = \frac{W1-W2}{W} \times \frac{100}{1} \quad (4)$$

Where: W = weight of sample, W_1 = weight of crucible + residue after drying, W_2 = weight of crucible + sample after ashing

% Total Nitrogen = Titre Value x Atomic mass of nitrogen x Normality of HCl used x 4….(5). Therefore, the crude protein content w determined by multiplying percentage Nitrogen by a conversion factor of 6.25 i.e. % crude protein = % N x 6.25.

The Percentage of Carbohydrate Content was Obtained by Differential Method as follows:

Carbohydrate (%) = 100 - [%Moisture + % Ash + %Protein + %Crude fiber + %Fat]……(6)

The energy value was calculated by multiplying the proportion of protein, fat and carbohydrate by their respective conversion factors of 4, 9, and 4 kcal/g respectively and taking the sum of their products.

The Energy Value was Calculated Thus:

Ev = (% CP x 4) + (% CF x 9) + (% CHO x 4)

Where: Ev = Food energy, CP = Crude protein, CF = Crude fat, CHO = Carbohydrate

Determination of Phytochemical Properties

Tannins were determined and calculated using the method of Pearson [13]. Five {5 g} weight of each sample was dispersed in 50 mL of distilled water, shaken and allowed to stand for 30 minutes at 28 °C before it was filtered through whatman No.42 grade filter paper. Two {2 mL} volume of each sample extract was dispensed into a 50 mL volumetric flask and mixed with 2 mL standard reagent and 2.5 mL of saturated Na2CO3 solution. After mixing, the content of each flask was made up to 50 mL with distilled water and allowed to incubate at 28 °C for 90 minutes. The respective absorbance was measured in a spectrophotometer at wave length of 260 nm. The reagent blank was used to calibrate the instrument while the absorbance values of the samples was plotted to determine tannin content against the weight of the sample. Tannin content was calculated as:

$$\%\ Tannin = \frac{100}{w} \times AU \times \frac{C}{AS} \times C \times \frac{Vf}{1000} \times D/Va$$

W = weight of sample analyzed, AU = Absorbance of the test sample, AS = Absorbance of the standard solution in mg/ml, C = Concentration of standard solution in mg/ml, Vf = Total volume of extract, Va= Volume of extract analyzed, D = Dilution factor.

Phenol was determined using the method of [14]. A known weight {0.2 g} of the various samples was treated with 10 ml of concentrated methanol in other to extract the phenol and the filtrate. The resultant was thoroughly mixed for 30 minutes at room temperature (28°C). The mixture was then centrifuged at 500rpm for 15 minutes and the supernatant was recovered and used for the analysis. One {1 mL} of the extant obtained from each sample was treated with equal volume of folin- ciocalteu's reagent. This is followed by the addition of 2 mL of 2 % Na_2CO_3 solution. The phenol solution was prepared to standard and diluted to a desired concentration. One {1 mL} of the standard solution was also treated with Folin-Denis reagent and Na_2CO_3 solution.

Two modifications of the trypsin inhibitor assay method of were used [15]. The defatted samples were suspending in 0.01 M NaOH (0.50 g in 50 ml) with pH adjustment (94-9.6) and stirring for 3 h using a multiplace stirring table. After extraction, sample volumes were made up to 100 ml with distilled water, and further diluted to give 40-60% inhibition of the trypsin standard when measured in the assay. Freshly prepared N-a-ben- zoyl-DL-arginine-p-nitroanilide (BAPNA) hydro- chloride solution (Sigma Chemical Co., St Louis, MO); (0.040 g dissolved in 1 ml of dimethyl sul- foxide) diluted to 100 ml with prewarmed Tris (50 mM, pH 8.2 containing 20 mM calcium chloride) was kept at 37°C. Sigma Type IV bovine trypsin (0.040 g in 2 litres of 1 mM HCl) and 30% acetic acid solutions were prepared weekly. Triplicate tubes of reagent blank (a), standard (b), samples (c) and sample blank (d) were prepared using reagent additions and reaction times as described by Smith et al. (1980) and absorbance measure- ments were made at 410 nm. Trypsin inhibitor levels were determined according to the formula: TI (mg pure trypsin inhibited per g) = (A1 X D)/ (0.019 X 1000 X S or P) where: D = dilution factor including original 50 ml dilution, A1 = (Absorbanceb-Absorbancea)-(Absorbancec -Absorbanceb), S = weight of original sample, P = weight of protein in sample, where a, b, c and d refer to reagent blank, standard, sample and sample blank respectively and 1µg of pure trypsin = 0.019 absorbance units at 410 nm.

Phytate (phytic acid) content was measured by the colorimetric method using Wade's reagent [16]. The absorbance at 490 nm was measured using sodium phytate as standard. While oxalate was determined using the titrimetric method of [17].

Statistical Analysis
All experiments were conducted in triplicate, with results reported as mean values ± standard deviation (SD). Statistical significance between groups was evaluated using a one way analysis of variance (ANOVA), followed by Duncan's Multiple range test. Differences were considered statistically significant at p-values ≤ 0.05. These analyses were performed using statistical software (SPSS version 22).

Results and Discussion
The proximate compositions of roasted millet and lyon bean flour blends are shown in Tables 2. The moisture contents of the formulated weaning diet and nutrend ranged from 4.00 to 10.41%. Nutrend had the least value (4.00%) while diet 1 had the highest value (10.41%). There were significant ($p<0.05$) differences among the samples. The moisture content of the samples vary from the values 3.54 – 6.46% reported by for millet (*Pennisetum glaucum*) flours fortified with sesame (*Sesamum indicum*) and Moringa (*Moringa oleifera*) as a weaning food and 1.55 – 11.08% reported by for smart baby-led weaning foods from millet, soybean and ripe banana flour blends [18,19]. Moisture content is very essential for life maintenance and analysis of it is one of the most widely used instruments which determine the way the food was processed and its shelf life. It has also been used as a measure of stability and susceptibility to microbial contamination. The lower moisture content recorded in flours showed that the flour would have good shelf stability. According to, flour with lower moisture have greater shelf stability since spoilage is often caused by microbial activities and related chemical reactions that require higher moisture levels [20].

The crude protein contents of the formulated weaning diet and nutrend ranged from 10.51 to 24.75%. Diet 3 had the least value (10.51%) while diet 2 had the highest value (24.75%). There were significant ($p<0.05$) differences among the samples [21]. The protein content of the samples vary from the values 19.97 – 36.41% reported by for dehulled and undehulled fermented Lyon bean (*Mucuna cochinchinensis*) but within the range 4.28 – 25.33 reported by for smart baby-led weaning foods from millet, soybean and ripe banana flour blends [19]. The high protein content recorded in diet 2 could be as a result of high protein content of lyon beans. This similar observation was made in a research study by [22]. Proteins are essential component of the diet needed for survival of animals and humans and of which basic function in nutrition is to supply adequate amounts of required amino acids [23].

The crude fibre contents of the formulated weaning diet and nutrend ranged from 2.01 to 4.93%. Diet 3 had the least value (2.01%) while nutrend had the highest value (4.93%). Nutrend differ significantly ($p<0.05$) from other samples [21]. The crude fibre of the samples vary from the values 0.29 – 4.83% reported by for dehulled and undehulled fermented Lyon bean (*Mucuna cochinchinensis*) and 3.83 – 7.94% reported by for millet (Pennisetum glaucum) flours fortified with sesame (*Sesamum indicum*) and Moringa (*Moringa oleifera*) as a weaning food [18]. According to Eromosele and Eromosele, presence of high crude fibre improves glucose tolerance and is beneficial in treating maturity on set diabetics [24]. Fibre helps in the maintenance of human health and has been known to reduce cholesterol level in the body. Fibre diets promote the wave-like contraction that moves food through the intestine. High fibre food expands the inside walls of the colon, easing the passage of waste, thus making it an effective anti-constipation [24].

The ash contents of the formulated weaning diet and nutrend ranged from 2.37 to 4.04%. Diet 2 had the least value (2.37%) while diet 1 had the highest value (4.04%). There were no significant ($p>0.05$) differences between nutrend and diet 3. The moisture content of the samples vary from the values 0.58 – 3.14% reported by for millet (*Pennisetum glaucum*) flours fortified with sesame (*Sesamum indicum*) and Moringa (*Moringa oleifera*) as a weaning food and 1.16 – 2.83% reported by for smart baby-led weaning foods from millet, soybean and ripe banana flour blends [18,19]. This could be as a result of the processing method. Ash is a non organic compound containing mineral content of food and nutritionally it aids in the metabolism of other compounds. The ash content recorded in the composite samples could be a source of minerals which apart from its nutritional value are good for good skin and strong bones [25]. The ash content represents the total mineral content in foods and serves as available tool for nutritional evaluation [26].

The fat contents of the formulated weaning diet and nutrend ranged from 8.99 to 10.85%. Nutrend had the least value (8.99%) while diet 1 had the highest value (10.85%). There were no significant ($p>0.05$) differences between nutrend and diet 3. The fat content of the composite flour samples were higher than the values 1.20 – 4.56% reported by for rice flour blended with bambara groundnut flour and 2.04 – 3.50% reported by for flour blends produced from wheat, unripe plantain and pigeon pea [27,28]. The high fat content recorded in the samples show that the composite flour will have high energy products because of the fat content. Fats and oils provide more than twice as much energy as the carbohydrate on a weight-weight basis [29]. One gram of fat or oil will yield about 368 k/cal of energy when oxidized in the body. High fat content of the product may not provide a conducive environment for microbial growth and activities hence improving the shelf life of the product [30].

The carbohydrate contents of the formulated weaning diet and nutrend ranged from 49.26 to 63.79%. Diet 1 had the least value (49.26%) while nutrend had the highest value (63.79%). There were no significant (p>0.05) differences between diets 1 and 2. The carbohydrate content of the samples vary from the values 40.85 – 57.82% reported by for dehulled and undehulled fermented Lyon bean (*Mucuna cochinchinensis*) and 42.99 – 88.92% reported by for smart baby-led weaning foods from millet, soybean and ripe banana flour blends [21,19]. The high carbohydrate content of these samples suggests that the flours would be a very good source of energy for the body [31]. The high carbohydrate content of the samples is attributed to the high carbohydrate content in millet. The total carbohydrate content indicated that these types of flour are classified as food energy supplier of nutritive and economical value which could represent good sources for industrial flour and starch.

The energy value contents of the formulated weaning diet and nutrend ranged from 385.39 to 400.07 Kcal/100g. Diet 3 had the least value (385.39 Kcal/100g) while nutrend had the highest value (400.07 Kcal/100g). Nutrend differ significantly (p<0.05) from other samples. Nutrend vary (p<0.05) significantly from other samples in the energy values. This result could be attributed to the values of protein, carbohydrate, and fat content of the samples. This is highly desired especially in famine and war locations where the next meal is not easy to come by. High energy foods have shown to have protective effect in the optimal utilization of other nutrients [32]. Energy was observed to be high for all the samples, so energy content is a parameter used to determine the quality of food especially for formulation designed for adults with high energy requirements.

Table 2: Proximate Composition of Formulated Weaning Diet and Nutrend

Parameters	Nutrend	Diet 1	Diet 2	Diet 3
Moisture (%)	4.00^{d}±0.01	9.80^{b}±0.00	9.61^{c}±0.09	10.41^{a}±0.03
Crude protein (%)	16.00^{c}±0.01	23.52^{b}±0.08	24.75^{a}±0.03	10.51^{d}±0.12
Crude fibre (%)	4.93^{a}±0.05	2.51^{b}±0.01	2.37^{b}±0.05	2.01^{b}±0.03
Ash (%)	2.50^{b}±0.05	4.04^{a}±0.13	2.37^{c}±0.04	2.66^{b}±0.05
Fat (%)	8.99^{c}±0.01	10.85^{a}±0.09	10.38^{b}±0.04	9.15^{c}±0.21
Carbohydrate (%)	63.79^{a}±0.04	49.26^{c}±0.16	49.93^{c}±0.16	55.25^{b}±0.12
Energy value (Kcal/100g)	400.07^{a}±0.01	388.77^{b}±0.02	392.14^{b}±0.01	385.39^{b}±0.03

Values shows the mean of triplicate analysis and ± standard deviation. Figures with different superscript down the row are significantly different (p<0.05). Nutrend = commercial weaning food, D1 = 45MF:45LBF:3.35C:3.75S:3BM, D2 = 30MF:60LBF:3.35C:3.75S:3BM, D3 = 60MF:30LBF:3.35C:3.75S:3BM, MF = millet flour, LBF = lyon bean flour, C = crayfish, S = sucrose, BM = bone meal

The Phytochemical properties of roasted millet and lyon bean flour blends are shown in Tables 3. The tannin contents of the formulated weaning diet and nutrend ranged from 0.03 to 0.24 mg/100g. Nutrend had the least value (0.03 mg/100g) while diet 2 had the highest value (0.24 mg/100g). Nutrend differ significantly (p<0.05) from other samples. The tannin content of the samples vary from the values 0.13 – 1.49 mg/100g reported by for weaning food produced from blends of millet, soya beans and Moringa Oleifera leaf flour but much lower than the values 19.62 – 75.63 mg/100g reported by for millet (*Pennisetum glaucum*) flours fortified with sesame (*Sesamum indicum*) and Moringa (*Moringa oleifera*) as a weaning food [33,18]. There was an increase in the tannin contents of the samples with increase in lyon bean. This may be that lyon beam contain higher tannin. The tannin content of flours may have a significant role in antioxidant activity. They have vasculoprotective, healing and anti-diarrheal properties. Also, tannins have been considered to be anti inflammatory, anti-carcinogenic and anti mutagenic agents [34]. This property attributes to tannins an important and beneficial nutritional interest in the children nutrition and the health of people at risk.

The oxalate contents of the formulated weaning diet and nutrend ranged from 0.07 to 0.22 mg/100g. Nutrend had the least value (0.07 mg/100g) while diet 1 had the highest value (0.22 mg/100g). Nutrend differ significantly (p<0.05) from other samples. The oxalate content of the samples vary from the values 0.33 – 0.95 mg/100g reported by for weaning food produced from blends of millet, soya beans and Moringa Oleifera leaf flour and 0.32 – 1.71 mg/100g reported by for dehulled and undehulled fermented Lyon bean (*Mucuna cochinchinensis*) [33,21]. The oxalate content in this study is considered to be safe as they are below the safe normal range of 4-9 mg/ 100 g for oxalates as reported by [35].

Phenol contents of the formulated weaning diet and nutrend ranged from 0.00 to 0.41%. Nutrend had the least value (0.00%) while diet 2 had the highest value (0.41%). There were no significant (p>0.05) differences between diet 1 and diet 3. The phenolic content of the samples were much lower than the values 198.55 – 661.21 mg/100g reported by for millet (*Pennisetum glaucum*) flours fortified with sesame (*Sesamum indicum*) and Moringa (*Moringa oleifera*) as a weaning food [18]. There was an increase in the phenolic content of the samples with increase in lyon bean. This may be that lyon beam contain higher phenol. The health properties of phenolic compounds have been extensively studied from an epidemiological point of view by studying directly their effect on enzymatic systems and/or on physiological functions. Phenol and other phytochemicals found in fruits, vegetables and legumes are bioactive compounds which are able to neutralize free radicals and that play a role in several diseases prevention [36].

The trypsin inhibitor of the formulated weaning diet and nutrend ranged from 0.00 to 0.17 mg/100g. Nutrend had the least value (0.00 mg/100g) while diet 2 had the highest value (0.17 mg/100g). There were significant (p<0.05) differences among the samples. The trypsin inhibitor content of the samples were slightly higher than the values 0.03 – 0.07 mg/100g reported by for weaning food produced from blends of millet, soya beans and *Moringa Oleifera* leaf flour [33]. There was an increase in the trypsin inhibitor of the samples with increase in lyon bean. This may be that lyon beam contain higher trypsin inhibitor. The low levels of trypsin inhibitor found in this study may be as a result of the processing methods used such as dehulling and degradation caused by heat treatment such as boiling and roasting applied in the processing of the samples [37].

The Phytate contents of the formulated weaning diet and nutrend ranged from 0.00 to 0.29 mg/100g. Nutrend had the least value (0.00 mg/100g) while diet 3 had the highest value (0.29 mg/100g). There were no significant (p>0.05) differences between diet 1 and diet 3. The phytate content of the samples vary from the values 0.09 – 0.43 mg/100g reported by for weaning food produced from blends of millet, soya beans and Moringa Oleifera leaf flour but lower than the values 1.35 – 1.97 mg/100g reported by for dehulled and undehulled fermented Lyon bean (Mucuna cochinchinensis) and 17.96 – 23.22 mg/100g reported by for millet (*Pennisetum glaucum*) flours fortified with sesame (Sesamum indicum) and Moringa (*Moringa oleifera*) as a weaning food [33,21,18]. There was an increase in the phytate content of the samples with increase in millet. This may be that millet contains higher phytate content. The phytate content observed to have decreased in this study is expected to enhance the bioavailability of proteins and dietary minerals such as iron, zinc, calcium and magnesium of the weaning food formulations [37]. Dietary phytate at low levels are said to have beneficial role as an antioxidant, anticarcinogens and are likely to play an important role in controlling hypercholesterolemia and atherosclerosis [38].

Table 3: Phytochemical Properties of Formulated Weaning Diet and Nutrend

Parameters	Nutrend	Diet 1	Diet 2	Diet 3
Tannin (mg/100g)	0.03b±0.01	0.19a±0.01	0.24a±0.02	0.23a±0.08
Oxalate (mg/100g)	0.07b±0.01	0.22a±0.01	0.14a±0.00	0.16a±0.01
Phenol (mg/100g)	0.00c±0.00	0.32b±0.08	0.41a±0.01	0.30b±0.08
Trypsin inhibitor (mg/100g)	0.00d±0.00	0.13b±0.01	0.17a±0.02	0.08c±0.01
Phytate (mg/100g)	0.00c±0.00	0.25a±0.00	0.13b±0.01	0.29a±0.08

Values shows the mean of triplicate analysis and ± standard deviation. Figures with different superscript down the row are significantly different (p<0.05). Nutrend = commercial weaning food, D1 = 45MF:45LBF:3.35C:3.75S:3BM, D2 = 30MF:60LBF:3.35C:3.75S:3BM, D3 = 60MF:30LBF:3.35C:3.75S:3BM, MF = millet flour, LBF = lyon bean flour, C = crayfish, S = sucrose, BM = bone meal

Conclusion

The formulated weaning diets (Diet 1, Diet 2, Diet 3) demonstrated competitive nutritional profiles compared to Nutrend, with Diet 2 standing out for its high protein content (24.75%). However, Nutrend excelled in energy value, fibre, and carbohydrate content, coupled with lower anti-nutrients, suggesting better safety and digestibility. The significant variations in proximate and anti-nutrient levels highlight the need for optimization of ingredient ratios and processing methods to enhance the nutritional quality of the formulated diets. Further studies on shelf stability are recommended to inform large-scale production and commercialization.

References

1. (2008) Soaring food prices: Facts, Perspectives, and Actions required. High-level conference on world food security: The challenges of climate change and HLC/08/INF/1. FAO https://www.fao.org/fileadmin/user_upload/foodclimate/HLCdocs/HLC08-inf-1-E.pdf.
2. Achidi AU, Tiencheu B, Tenyang N, Womeni HM, Moyeh MN, et al. (2016) Quality evaluation of nine instant weaning foods formulated from cereal, legume, tuber, vegetable and crayfish. Int J Food Sci Nutr Eng 6: 21-31.
3. Kouakou B, N'Da-Kouassi AM, Halbin KJ, Tagro G, N'Guessan KF, et al. (2013) Biochemical characterization functional properties of weaning food made from cereals (millet, maize) and legumes (beans, soybeans). J Food Chem Nutr 1: 22-32.
4. Adebiyi JA, Obadina AO, Mulaba Bafubiandi AF, Adebo OA, Kayitesi E, et al. (2016) Effect of fermentation and malting on the microstructure and physicochemical properties of pearl millet (Pennisetum glaucum) flour and biscuit. J Cereal Sci 70: 132-39.
5. Punia S, Kumar M, Siroha AK, Kennedy JF, Dhull SB, et al. (2021) Pearl millet grain as an emerging source of starch: A review on its structure, physicochemical properties, functionalization, and industrial applications. Carbohydr Polym 260: 117776.
6. Mishra A, Pattnaik B, Dutta T, Baitharu I (2022) Nutritional values and potential health benefits of millets- A review. J Nutr 8: 9-26.
7. Shiriki D, Igyor MA, Gernah DI (2015) Nutritional evaluation of complementary formulations from maize, soybean and peanut fortified with Moringa oleifera leaf powder. Food Nutr Sci 6: 494-500.
8. Adebowale AY, Adeyemi AI, Oshodi AA (2005) Functional and physicochemical properties of flours of six Mucuna species. African Journal of Biotechnology 4: 1461-1468.
9. Essack H, Odhav B, Mellem JJ (2017) Screening of traditional South African leafy vegetables for specific anti-nutritional factors before and after processing. Food Science and Technology 37: 462-471.
10. Esenwah CN, Ikenebomeh MJ (2010) Nutritional compositions and oligosaccharide contents of preprocessed and fermented African locust beans (Parkia Biglobosa Benth) seed during processing. Nigerian Food Journal 28: 57404.
11. AOAC (2000) Official Methods of Analysis. 17th Edition, The Association of Official Analytical Chemists, Gaithersburg, MD, USA. Methods 925.10, 65.17, 974.24, 992.16.
12. AOAC (2016) Official Methods of Analysis of the Association of Official Analytical Chemists. 20th Edition, AOAC Inc., Washington DC.
13. Pearson D (2000) The chemical analysis of foods.11th edition Churchill living stone, London.

14. Singleton VL, Orthofer R, Lamuela-Raventos RM (1999) Analysis of total plant phenols and other oxidation substrates and antioxidants by means of Folin- Ciocalteu reagent. Methods in Enzymology 299: 152-178.
15. Kakade ML, Rackis JJ, McGhee JE, Puski G (1974) Determination of trypsin inhibitor activity of soy products: a collaborative analysis of an improved procedure. Cereal Chem 51: 376.
16. Latta M, Eskin M (1980) A simple and rapid colorimetric method for phytate determination. J Agric Food Chem 28: 1313-1315.
17. Day RA, Underwood AL (1986) Quantitiv analysis. 5th ed. Prentice Hall 701.
18. Disseka WK, Faulet MB, Koné FMT, Gnanwa MJ, Kouamé LP, et al. (2018) Phytochemical Composition and Functional Properties of Millet (Pennisetum glaucum) Flours Fortified with Sesame (Sesamum indicum) and Moringa (Moringa oleifera) as a Weaning Food. Advances in Research 15: 1-11.
19. Oladebeye AA, Oladebeye AO, Suleiman M, Jeff-Agboola YA (2023) Sensory, Proximate and Mineral Properties of Smart Baby-Led Weaning Foods from Millet, Soybean and Ripe Banana Flour Blends. Asian Food Sci. J 22: 15-24.
20. Akinsanmi AO, Oboh G, Akinyemi J, Ayodele J, Adefegha AS, et al. (2015) Assessment of the nutritional and antioxidant capacity of unripe, ripe and over ripe plantain (Musa paradisiaca) peels. International Journal of Advanced Research 3: 63-72.
21. Olaleye HT, Oresanya TO, Ogundipe OO (2020) Comparative study on proximate and antinutritional factors of dehulled and undehulled fermented Lyon bean (Mucuna cochinchinensis). Food Research 4: 1611-1615.
22. Olaoye OA, Onilude AA, Idowu OA (2006) Quality characteristics of bread produced from composite flours of wheat, plantain and soybeans. African Journal of Biotechnology 5: 1102-1106.
23. Pugalenthi M, Vadivel V, Gurumoorthi P, Janardhanan C (2004) Comparative nutritional evaluation of little known legumes, Tamarindus indica, Erythrina indica and Sesbania bispinosa. Trop. Subtrop. Agroecosyst 4: 107-123.
24. Eromosele IC, Eromosele CO (2003) Studies on the chemical composition and physio-chemical properties of seeds of some wild plants: (Netherland) Plant Food Hum. Nutr 43: 251-258.
25. Ayo JA, Ayo VA, Popoola C, Omosebi M, Joseph L (2014) Production and evaluation of malted soybean-acha composite flour bread and biscuit. African Journal of Food Science and Technology 25: 21-28.
26. Lienel HH (2002) Ash analysis. In: introduction in chemical analysis of food. Nielson SS. (Ed). CBS Publishers, New Delhi 972.
27. Ivo N, Ekwu FC, Efuribe NE, Irem OJ (2024) Quality Evaluation of Swallow Meal Produced from Blends of Broken Rice and Bambara Groundnut Flour. Research Journal of Food Science and Quality Control (RJFSQC) 10: 1-17.
28. Obasi BC, Askepnde P (2023) Phytochemical, physical and functional properties of flour blends produced from wheat, unripe plantain and pigeon pea. International Journal of Science and Research Archive 10: 516-526.
29. Iwe MO (2003) The science and Technology of soy bean, Chemistry, Nutrition, Processing, Utilization. Rejoin communication service LTD. Enugu, Nigeria 159-262.
30. Okaka JC (2005) Handling, storage and processing food plant. OCJ Academic Publishers Enugu 250-270.
31. Omeire GC, Kabuo NO, Nwosu JN, Peter IA, Nwosu MO, et al. (2015) Enrichment of wheat/cassava noodles with partially defatted protein-rich flours. Journal of Environmental Science, Toxicology and Food Technology 9: 121-125.
32. Wardlaw GM (2004) Perspectives in nutrition. (6th ed.). McGram Hill Companies, New York, USA.
33. Gwer JH, Igbabul BD, Ubwa ST (2020) Micronutrient and Antinutritional Content of Weaning Food Produced from Blends of Millet, Soya Beans and Moringa Oleifera Leaf Flour. European Journal of Agriculture and Food Sciences 2: 1-7.
34. Kumari M, Jain S (2015) Screening of potential sources of tannin and its therapeutic application. Int J Nutr Food Sci 4: 26-29.
35. Siddhuraju P, Becker K (2001) Effect of Various Domestic Processing Methods on Antinutrients and In Vitro Protein and Starch Digestibility of Two Indigenous Varieties of Indian Tribal Pulse, Mucuna Pruriens Var. Utilis. Journal of Agriculture and Food Chemistry 49: 58-67.
36. Doss A, Pugalenthi M, Rajendrakumaran D, Vadivel V (2010) Phenols, flavonoids and antioxidant activity of underutilized legume seeds. Asian J Exp Biol Sci 1: 700-705.
37. xOsunbitan K, Taiwo KA, Gbadamosi SO (2015) Effects of Different Processing Methods on the Antinutrient Contents in Two Improved Varieties of Cowpea. American Journal of Research Communication 3: 74-87.
38. Omueti O, Otegbayo B, Jaiyeoba O, Afolabi O (2016) Functional Properties of Complementary Diets Developed from Soybean. (Glycine Max), Groundnut (Macrobrachium SPP). Electronic Journal of Environmental, Agricultural and Food Chemistry 8: 563-573.