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Full Length Research

Wheat-plantain flour blends enriched with velvet beans flours: Vitamins and mineral composition

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ABSTRACT: Wheat (*Triticum aestivum*) has been the major ingredient in the production of different kind of foods but relatively low in total protein especially in lysine and other amino acids, which could be supplemented by other nutrient dense flours to produce composite flours. This would reduce the over dependence on the importation of wheat. Hence, the need for strategic development in the use of inexpensive local and underutilized fruits and legumes in the production of functional foods. The vitamins and mineral composition of the flour blends processed from wheat, plantain and velvet bean were investigated for their end uses. Wheat, plantain and velvet composite flours were prepared in the ratio 240:37.5:22.5, 210:60:30 and 150:105:45 respectively and 100% wheat flour was used as the control. Vitamins and mineral composition of the flour blends were investigated using standard methods. Vitamins and mineral revealed that vitamin A, B1, B2, B6, B12 and C ranged from 0.46 – 0.56 µg/100 g, 0.59 – 0.68 mg/g, 0.67 – 0.79 mg/g, 0.71 – 0.89 mg/g, 0.09 – 0.39 µg/100 g and 30.86 – 38.48 mg/g ; calcium, iron and zinc ranged from 48.97 – 105.97, 3.62 to 4.03 and 1.65 – 2.27 mg/100 g respectively. This study, therefore, shows that fortification of wheat-plantain flour blends with velvet beans flour significantly ($p < 0.05$) enhanced the vitamins and mineral composition of the flour blends. Hence, the fortification of wheat-plantain flour with velvet beans flour should be encouraged to be used as nutritional ingredient in the production of functional foods. Hence, their food applications are highly recommended.

Keywords: Flour blends, minerals, plantain, protein, velvet beans, vitamins, wheat.

INTRODUCTION

Wheat (*Triticum aestivum*) is one of the most useful and valuable crops grown around the world and it is considered as almost first among cereal largely because of the fact that it contains protein with unique chemical and physical properties, and other vital nutrients (Adeyanju *et al.,* 2021). Wheat is a popular cereal in the world. It plays significant part as global commodity due to its gluten forming proteins, which are capable of having extensibility and elasticity required for bakery products and pasta (FAO, 2013; Inyang *et al*., 2018).

Plantain (*Musa paradisiaca*) is an important staple food in Central and West Africa (Makanjuola *et al.,* 2013). Plantains are abundant in Nigeria and other developing countries. Plantain fruit is composed of 75% different elements and 32% of carbohydrates and it also contains several vitamins including A, B, C and is very low in protein and fat but rich in minerals particularly iron. Also, it is free from cholesterol, high in fibre and low in sodium (Adewole and Duruji, 2010). Because plantains have poor amino acid profile, it should be supplemented with protein rich food crops like legumes. The resulting products would be rich in both protein and carbohydrates.

Velvet bean (*Mucuna pruriens*), belongs to the *Fabaceae* family, it is part of various legumes which is not commonly used by people as a result of antinutrients. Velvet bean is commonly grown in the tropical and subtropical part of the world. It has been reported to be a great source of dietary protein because it has a higher percentage of protein (about 26%), and it is easily digestible compared to other annual leguminous crops (Janardhanan *et al*., 2003). Velvet bean can also help in stress management and improvement of semen quality (Shukla, 2007). One of the possible ways to promote the use of velvet bean could be its utilization in formulations for mass consumer goods, such as bread, etc. Therefore, the purpose of this study was to evaluate the vitamins and mineral composition of wheat-plantain flour blends enriched with velvet beans flours.

MATERIALS AND METHODS

Plantain, velvet bean and wheat flour were purchased from Owode market, Offa, Kwara State, Nigeria. The equipment used was made available from the Department of Food Technology, Federal Polytechnic Offa, Nigeria. All chemicals that were used are of food standard and analytical grade.

Sample preparation

Preparation of plantain flour

Plantain (*Musa paradisiaca*) flour was prepared following the processing steps described by Kure *et al.* (2012). Plantain fingers were separated from the bunches, washed, peeled manually and sliced to (2 mm thickness) using a stainless-steel kitchen slicer. The sliced chips were blanched at 70°C for 5 minutes, and dried in a cabinet drier at 50°C for 48 hours. The dried slices were milled, sieved and packaged in a low density polyethylene bag; and stored at ambient conditions for subsequent use. See Figure 1.

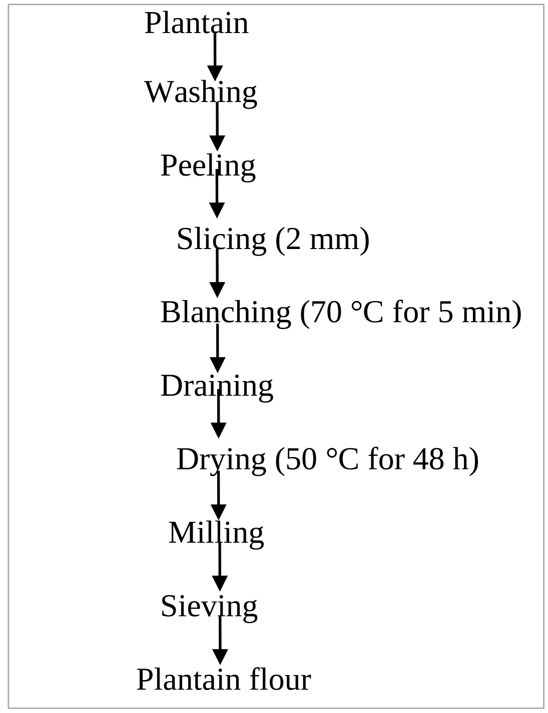

Figure 1. Flow chart for the production of plantain flour (Source: Kule *et al*., 2021).

Preparation of boiled-velvet beans into flour

Velvet beans (*Mucuna pruriens*), were processed into flour as described by Balogun and Olatidoye (2010). About 1000 g of matured velvet beans seed were sorted cleaned to remove extraneous materials like stones and defective seeds. The seeds were introduced into already boiling distilled water (1000:4000 g/ml) and boiled for 30 minutes. The seeds were dehulled manually and washed thoroughly under running water and drained. The seed was oven-dried at 50°C for 24 hours and milled into flour (300 µm). See Figure 2.

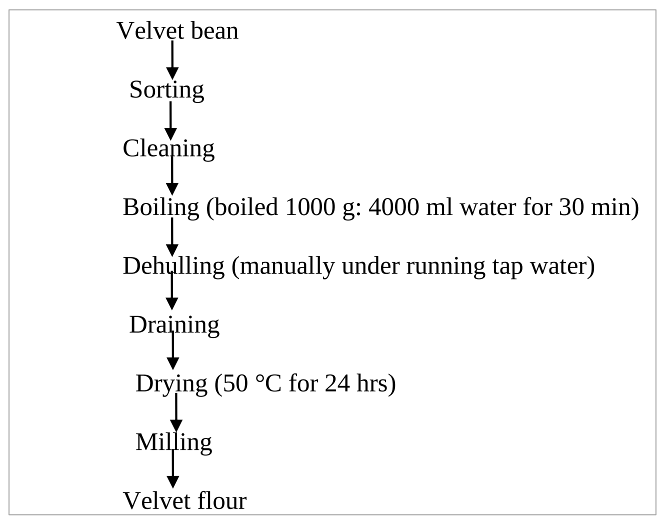

Figure 2. Flow chart for the production of Soaked-velvet bean flour (Source: Balogun and Olatidoye, 2010).

Composite flour preparation

Boiled-velvet bean flour and plantain flour composite flours were prepared by blending them with wheat flour. The composite flour of wheat-plantain-velvet beans (240:37.5:22.5, 210:60:30 and 150:105:45 respectively and 100% wheat flour was used as the control.

Vitamins determination

Pro-vitamin A (β-carotene), Vitamin B1 (Thiamine), Vitamin B2 (Riboflavin), B6 (Pyridoxine), Vitamin B12 (Cobalamin) and Vitamin C (Ascorbic acid) were all determined by adopting the method of Jenfa (2024).

Mineral analyses

Mineral analyses were determined using the standard illustrated by Coțovanu *et al*. (2022). The analysis of the sample involved two stages: the mineralization of the sample and the metal dosage by spectrophotometry. During mineralization, the organic matter in the sample (5.00 ± 0.001 g) was destroyed by carbonization and combustion in the calciner, with the temperature gradually increasing from 250 to 450°C, up to 900°C, for 8 hours. A total of 5 mL HCl 6 mol/L (STAS 13013/1-91) was added to the ash obtained, and then the acid was evaporated using a sand bath. The residue was dissolved with 730 µL HNO_3 69% and brought to the mark (50 mL) with deionized water. As a control sample, deionized water was used following the same procedure as for the analyzed sample. The spectrophotometric determination involved the following steps: activating the cathode lamp corresponding to the elements (Ca, Fe and Zn), adjusting the operational parameters, activating and adjusting the flame, and establishing the curve standard by absorbing four working standard solutions of different concentrations. In the flame system used, the nebulizer and the atomizer play a decisive role: the nebulizer aspirates a liquid sample with a controlled flow and the atomizer creates a fine aerosol and mixes the aerosol with the oxidizing gas. The mineral elements are expressed as mg/100 g of flour and were calculated with Equation below:

$$E=C \cdot F \cdot VM$$

Where: E = mineral element concentration, mg/100 g; C = the concentration measured on the calibration curve, mg/L; F = dilution factor; V = sample volume, mL; M = sample mass taken in the analysis, g.

Statistical analysis

Data generated from this study were analyzed using Analysis of Variance (ANOVA). Values were expressed as mean ± standard error of mean (SEM) from three determinations. Differences in mean were compared using Duncan multiple test range. P<0.05 was considered significant (Iwe, 2002).

RESULTS AND DISCUSSION

Table 1 showed the result of the selected vitamins from wheat, plantain and velvet bean composite flour blends. Pro-vitamin A is essential in the health of the cornea, gastrointestinal tract, skin, urinary tract, and lungs. This vitamin is essentially important in the prevention of night blindness and certain atherosclerosis conditions (Oduro-obeng and Plahar, 2017). The pro-vitamin A contents of the composite flours ranged from 0.46 – 0.56 µg/100g with CSD (150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour) significantly ($p < 0.05$) having the highest level of vitamin A (0.56 µg/100g) while the least value (0.46 µg/100g) was observed in CSA (300 g wheat flour). There were significant differences ($p < 0.05$) among the vitamin A contents of plantain-velvet beans flour samples. The result showed an increase in vitamin A contents of the composite flours as the level of plantain and velvet beans flours substitution increased. This is in line with the claim of Ayanwale *et al.* (2016) that plantains contain about 1127 IU of vitamin A which is sufficient for increment of vitamin A in plantain-supplemented diets. The findings in this study are below the recommended dietary allowance (RDA) and adequate intakes (AI) for vitamin A in infants and adults (300 µg/day). The vitamin A contents of the composite flours are lower than the report of Kambabazi *et al.* (2022) for vitamin A content (210 µg/100g) of bean based composite soup flour and (450 – 5670 µg/100 g) reported by Adebowale (2005) in wheat-cocoyam flour blends biscuits.

The vitamin B1 (thiamin) contents of the composite flours differed significantly ($p < 0.05$) with values ranging from 0.59 to 0.68 mg/g. Sample CSA (300 g wheat flour) had the lowest thiamin (0.59 mg/g) while the highest value (0.68 mg/g) was observed in CSD (150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour). Thiamine values obtained in this study corroborate the RDI value (0.5 mg/100 g) for feeding infants below three years (Nestle, 2000). The result showed increasing trend with an increase in level of plantain-velvet beans flour substitution. Findings here, are not in agreement with the work of Eze *et al.* (2020) for vitamin B1 contents of extruded snacks from sorghum-charamnya flour blends (0.77 – 1.05 mg/100g) but lower than (14.15 - 36.95 mg/kg) for some Nigerian breads by Ebuehi *et al.* (2007).

Vitamin B2 (riboflavin) functions in oxidation-reduction reactions in energy production, in the respiratory chain, and in many other metabolic pathways (Adesina and Adeyeye, 2015). The vitamin B2 (riboflavin) contents of the composite fours ranged between (0.67 – 0.79 mg/g) with CSA (300 g wheat flour) having the lowest value (0.67 mg/g) while the highest riboflavin content was observed in CSD (150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour). There were significant differences ($p < 0.05$) among the vitamin B2 contents of the composite flours. Results showed an increased in vitamin B2 contents of the composites as the level of plantain-velvet beans flour supplementation increased. The findings are not in consonance with other literatures; (0.13 – 0.65 mg/g)

Table 1. Results for selected vitamin composition of composite flour blends.

Parameters	CSA	CSB	CSC	CSD
Pro-vitamin A (µg/100g)	0.46±0.06^a	0.49±0.01^b	0.51±0.00^c	0.56±0.00^d
Vitamin B1 (mg/g)	0.59±0.00^a	0.59±0.01^a	0.61±0.00^b	0.68±0.00^c
Vitamin B2 (mg/g)	0.67±0.00^a	0.68±0.00^a	0.70±0.00^b	0.79±0.00^c
Vitamin B6 (mg/g)	0.71±0.00^a	0.72±0.00^a	0.76±0.00^b	0.89±0.00^c
Vitamin B12 (µg/100g)	0.09±0.00^a	0.09±0.00^a	0.35±0.41^b	0.39±0.01^c
Vitamin C (mg/g)	30.86±0.01^a	32.44±0.04^b	34.10±0.10^c	38.48±0.15^d

Values are mean ± standard deviation. Data with different superscripts in the same column are significantly different at $p < 0.05$.
Key: CSA = 300 g wheat flour; CSB = 240 g wheat flour, 37.5 g plantain flour and 22.5 g velvet bean flour; CSC = 210 g wheat flour, 60 g plantain flour and 30 g velvet bean flour; CSD = 150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour.

for vitamin B_2 (riboflavin) of raw, roasted and cooked African bread fruit seed flours by Adesina and Adeyeye (2015) and (0.075 – 0.28 mg/g) for vitamin B_2 contents of bread from wheat, cowpea, pigeon pea, African yam bean, water yam, cocoyam and maize researched by Onoja *et al.* (2011). The report of Abiodun *et al.* (2014) for vitamin B_2 in African bread fruit seeds cooked with alum and trona as tenderizers (2.99 – 12.73 mg/g) are contradictory to the claim of the current work.

The vitamin B6 (pyridoxine) contents of the composite flours differed significantly ($p < 0.05$) with values ranging between (0.71 – 0.89 mg/g). The highest level of vitamin B6 (0.89 mg/g) was observed in CSD (150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour) while the least value (0.71 mg/g) was observed in CSA (300 g wheat flour). The results indicated an increase in vitamin B_6 contents of the composites with increased level of plantain-velvet beans flour supplementation. Results here, are not in agreement with the findings of Doaa *et al.* (2018) for pyridoxine contents of bread fortified with active *Saccharomyces cerevisiae* (0.11 – 0.25 mg/100g) and (0.27 mg/g) reported for bean based composite soup flour by Kambabazi *et al.* (2022). Contrarily, the report of Sami *et al.* (2014) for vitamin B_6 content of okra pods (11.50 – 49.81 μg/100 g DW) are higher than the values obtained for vitamin B_6 contents of composites in this study. The vitamin B_6 contents of the composite flours in this study are higher to the recommended dietary allowance (RDA) and adequate intakes (AI) for infants and adults (0.5 mg/day).

The vitamin B_{12} (cobalamin) contents of the composite flours ranged between (0.09 – 0.39 µg/100g). CSD (210 g wheat flour, 60 g plantain flour and 30 g velvet bean flour) had the best vitamin B_{12} while the least value (0.04 µg/100g) was observed in CSD (150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour). There were significant differences ($p < 0.05$) between the vitamin B_{12} contents of the composite flours except at CSB (240 g wheat flour, 37.5 g plantain flour and 22.5 g velvet bean flour) where there was no significant different. The reports of this study are slightly in agreement with the findings of Doaa *et al.* (2018) for cobalamin contents (0.06 – 1.55 mg/100g) of bread fortified with active *Saccharomyces cerevisiae* but lower than the findings of Sami *et al.* (2014) for okra pods powder (34.54 – 91.20 μg/100 g/ DW).

The vitamin C (ascorbic acid) contents of the composite flours varied between (30.48 – 38.48 mg/g) with CSA (300 g wheat flour) having the least value (30.48 mg/g) while the highest vitamin C (38.48 mg/g) was observed in CSD (150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour). Significantly ($p < 0.05$), there were increased in vitamin C contents of the blends with an increase in the levels of plantain and velvet beans flour supplementation. The results in this study are in agreement with the work of Olapade and Umeonuorah (2013) for ascorbic acid conn-tents of raw, roasted and cooked African bread fruit seed flours (2.29 mg/100g). Discrepancy in vitamin C contents of samples in this current study and that of the cited literature could be due to the alum and trona employed in their study as tenderizers for cooking African bread fruit.

Table 2 presents the results for the selected mineral composition of composite flours from wheat, plantain and velvet bean. The calcium contents of the composite flours differed significantly ($p < 0.05$) with values ranging between (48.97 – 105.97 mg/100 g). The highest calcium content (105.95 mg/100 g) was observed in CSD (150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour) while CSA (300 g wheat flour) had the least value (48.97 mg/100 g). The results showed significant ($p < 0.05$) increase in calcium contents of the composites with increased level of plantain-velvet beans flour inclusion. Similar findings have been reported by Ezeocha *et al.* (2022) whose study reported increase in calcium contents of wheat-bambara groundnut-velvet tamarind composite flours with increase in proportion of bambara groundnut-velvet tamarind flours. Contrarily, the report of Igbabul *et al.* (2014) for calcium contents (0.73-1.11 mg/100 g) of wheat-maize-orange fleshed sweet potato flours are lower than the values obtained in this current work. Calcium is essential for proper bone and teeth formation (Li *et al*., 2016); hence, the composite flours in this study, due to

Table 2. Results for selected mineral composition of composite flours

Samples	Calcium (mg/100g)	Iron (mg/100g)	Zinc (mg/100g)
CSA	48.97±0.41^{a}	3.62±0.06^{a}	1.65±0.05^{a}
CSB	76.02±1.31^{b}	3.69±0.01^{ab}	1.91±0.03^{b}
CSC	90.02±0.88^{c}	3.82±0.04^{b}	1.99±0.04^{b}
CSD	105.97±0.30^{d}	4.03±0.11^{c}	2.27±0.08^{c}

Values are mean ± standard deviation. Data with different superscripts in the same column are significantly different at $p < 0.05$. **Key:** CSA = 300 g wheat flour; CSB = 240 g wheat flour, 37.5 g plantain flour and 22.5 g velvet bean flour; CSC = 210 g wheat flour, 60 g plantain flour and 30 g velvet bean flour; CSD = 150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour.

high calcium contents, could be beneficial for supporting bone formation and growth.

The mean score values for the iron contents of the composite flours ranged from 3.62 to 4.03 mg/100 g with CSD (150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour) significantly ($p < 0.05$) having the highest value (4.03 mg/100 g) while the least iron content (3.62 mg/g) was observed in CSA (300 g wheat flour). Values of the current study are higher than reports (1.06 – 1.36 mg/g) of Onoja *et al.* (2011) for iron contents of bread supplemented with wheat, African yam bean, cowpea, pigeon pea, water yam, cocoyam and plantain flour blends and those reported by Oyet and Chibor (2020) for composite blends of wheat, coconut and defatted fluted pumpkin seeds flour (1.67 – 2.82 mg/100 g). Inadequate intakes of micronutrients (Zinc and Iron) have been associated with severe malnutrition, increased disease conditions and mental impairment (Mannay and Shadaksharaswany, 2005).

The mean results for the zinc contents of the composite flours ranged from 1.65 – 2.27 mg/100 g. Significantly (p < .05), CSD (150 g wheat flour, 105 g plantain flour and 45 g velvet bean flour) had the best zinc content (2.27 mg/100 g) while the lowest value (1.65 mg/100 g) was observed in CSA (300 g wheat flour). There were indications of increased zinc contents with increase in plantain-velvet beans flour supplementation. The findings of this study are lower than the reports (9.59 – 17.92 mg/100 g) obtained for zinc contents of biscuits from composite blends of wheat, coconut and defatted fluted pumpkin seeds flour by Oyet and Chibor (2020). On the flip side, Akujobi (2018) documented (0.64 – 0.81 mg/100 g) for zinc contents of cookies from cocoyam and tiger-nut flour blends are lower than the values obtained in this work. Zinc boosts the health of hairs, plays a role in the proper functioning of some sense organs such as ability to taste and smell, helps in carbohydrate and protein metabolism and also assists in metabolism of vitamin A from its storage site in the livers and facilitates the synthesis of DNA and RNA necessary for cell production (Jacob *et al.*, 2015).

Conclusion

The study investigated the Vitamins and mineral composition of the wheat-plantain flour blends enriched with velvet beans flours. It shows that addition of velvet beans flour to the wheat-plantain flour blends significantly improved the mineral composition of the composite flour and contributed to the vitamin profiles of the blends, as the addition of velvet beans flours increased. Lastly, further research should focus on the utilization of velvet flour as a supplement especially where mineral and vitamins supplement are recommended. These findings may have implications for developing functional foods that can help to improve health challenges.

CONFLICTS OF INTEREST

The authors declare that they have no conflict of interest.

REFERENCES

Abiodun, O. A., Akinoso, R., Olosunde, O. O., Adegbite, J. A., & Omololа, O. A. (2014). Nutritional quality and essential oil compositions of *Thaumatococcus danielli* (Benn.) tissue and seed. *Food Chemistry*, *160*, 286-291.

Adebowale, A. A., Sanni, S. A., & Oladapo, F. O. (2008). Chemical, functional and sensory properties of instant yam-breadfruit flour. *Nigerian Food Journal*, *26*(1), 2-12.

Adesina, A. J., & Adeyeye, E. I., (2015). Effects of traditional processing methods on the vitamin profiles of African breadfruit (*Treculia africana*) seed flours. *African Journal of Pharmacy Biology and Medical Sciences*, 2(3), 100-119.

Adeyanju, J. A., Babarinde, G. O., Olanipekun, B. F., & Bolarinwa, I. F. (2021). Quality assessment of flour and cookies from wheat, African yam bean and acha flours. *Food Research, 5*(1), 371-379.

Akujobi, I. C. (2018). Nutrient composition and sensory evaluation of cookies produced from cocoyam (*Xanthosoma sagittifolium*) and tiger nut (*Cyperus esculentus*) flour blends. *International Journal of Innovative Food, Nutrition and Sustainable Agriculture*, *6*(3), 33-39.

AOAC (2015). Official methods of analysis. Association of official analytical chemists. In AOAC (18th edition).

Ayanwale, A. B., Fatunbi, A. O., & Ojo, M. (2016). Innovation opportunities in plantain production in Nigeria. In *Guide Book 1. Forum for Agricultural Research in Africa (FARA), Accra, Ghana*.

Coțovanu, I., Stroe, S. G., Ursachi, F., & Mironeasa, S. (2022).

Addition of amaranth flour of different particle sizes at established doses in wheat flour to achieve a nutritional improved wheat bread. *Foods*, *12*(1), 133.

Ebuehi, O. A. T., Owolabi, O. O., Ikanone, C. E., Amabibi, I. T., & Ajekwu, A. P. (2007). Organoleptic, minerals and vitamins' evaluation of some Nigerian breads. *Nigerian Food Journal*, 25(2), 95-100.

Eze, C. R., Okafor, G. I., Omah, E. C., & Azuka, C. E. (2020). Micronutrients, antinutrients composition and sensory properties of extruded snacks made from sorghum and charamenya flour blends. *African Journal of Food Science*, *14*(1), 25-31.

Ezeocha, V. C., Arukwe, D. C., & Nnamani, M. U. (2022). Quality evaluation of cake from wheat, bambara groundnut (Vigna subterranean) and velvet tamarind (*Dalium guineense*) flour blends. *FUDMA Journal of Sciences*, *6*(4), 88-94.

Igbabul, B., Grace, N., and Julius, A., (2014). Quality evaluation of composite bread produced from wheat, maize and orange fleshed sweet potato flours. *American Journal of Food Science and Technology*, *2*(4), 109-115.

Jacob, A. G., Etong, D. I., & Tijjani, A. (2015). Proximate, mineral and anti-nutritional compositions of melon (*Citrullus lanatus*) seeds. *British Journal of Research*, *2*(5), 142-151.

Jenfa, M. D., Adelusi, O. A., Aderinoye, A., Coker, O. J., Martins, I. E., & Obadina, O. A. (2024). Physicochemical compositions, nutritional and functional properties, and color qualities of sorghum–orange-fleshed sweet potato composite flour. *Food Science & Nutrition*, *12*(4), 2364-2378.

Kambabazi, M. R., Okoth, M. W., Ngala, S., Njue, L., & Vasanthakaalam, H. (2022). Physicochemical properties and sensory evaluation of a bean-based composite soup flour. *Legume Science*, *4*(4), e139.

Mannay S., & Shadaksharaswany, C. M. (2005). Foods: Facts and Principles. (2nd ed.). New Age International Ltd. Publishers. New Delhi, India.

Oduro-obeng, H., & Plahar, W. A. (2017). Development, quality evaluation and estimated contribution of composite flour snack foods to nutrient requirements of young children aged 2 to 6 years. *African Journal of Food Science*, *11*(9), 318-329.

Olapade, A. A., & Umeonuorah, U. C. (2013). Mineral, vitamin and antinutritional content of African breadfruit (*Treculia africana*) seeds processed with alum and trona. *Journal of Environmental Science, Toxicology and Food Technology*, *5*(5), 71-78.

Onoja, U. S., Akubor, P. I., Gernar, D. I., & Chinmma, C. E. (2014). Evaluation of complementary food formulated from local staples and fortified with calcium, iron and zinc. *Journal of Nutrition and Food Science*, *4*(6), 326.

Oyet, G. I., & Chibor, B. S. (2020). Amino acid profile, mineral bioavailability, and sensory properties of biscuits produced from composite blends of wheat, coconut and defatted fluted pumpkin seed flour. *European Journal of Agriculture and Food Sciences*, *2*(6), 1-7.

Doaa, A. S., El Omyma, S. S., Nader, R. A., Mona, M. S., & El Amro, A. F. A. (2018). The development fortified pan bread by increasing its protein content with high levels of live yeast cells *Saccharomyces cerevisiae*. *Concepts of Dairy & Veterinary Sciences, 1*(2), 43–50.

Sami, R., Li, Y., Qi, B., Wang, S., Zhang, Q., Han, F., Ma, Y., & Jiang, L. (2014). HPLC analysis of water-soluble vitamins (B2, B3, B6, B12, and C) and fat-soluble vitamins (E, K, D, A, and β-carotene) of okra (Abelmoschus esculentus). *Journal of Chemistry*, *Volume 2014,* Article ID 831357, 6 pages.

Topping, D. (2007). Cereal complex carbohydrates and their contribution to human health. *Journal of Cereal Science*, *46*(3), 220-229.

Li, X., Wang, L., Li, Y., Zhao, N., Zhen, L., Fu, J., & Yang, Q. (2016). Calcium regulates motility and protein phosphorylation by changing cAMP and ATP concentrations in boar sperm in vitro. *Animal Reproduction Science*, *172*, 39-51.