International Journal of Multidisciplinary Research and Development
www.allsubjectjournal.com
ISSN Online: 2349-4182 ISSN Print: 2349-5979
Received: 29-08-2025, Accepted: 28-09-2025, Published: 11-10-2025
Volume 12, Issue 10, 2025, Page No. 71-76

Minerals and Vitamin composition of bread from bambara groundnut and sorghum flour

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Abstract
Determining the mineral and vitamin composition of bread prepared with sorghum and Bambara groundnut flour was the aim of the study. Various Bambara grundnut and sorghum flour samples were prepared using standard processes, mixed with wheat flour to make bread, and then examined for micronutrients (vitamins and minerals). Sorghum and Bambara groundnut flours were utilized to replace 25% and 50% of the wheat flour, respectively, while 100% wheat flour served as a control in the bread-making process. Between 41.63 and 88.37 mg of phosphorus, 413.24 and 453.21 mg of calcium, 1.82 and 2.88 mg of iron, 0.25 and 0.31 mg of zinc, 123.43 and 182.34 mg of magnesium, and 18.22 and 21.36 mg of sodium were among the minerals found in the bread. The bread samples' vitamin composition exhibited 15.44 IU to 16.14 IU of vitamin A, 0.99 mg/100g to 1.04 mg/100g of vitamin B2, 0.07 mg/100g to 0.14 mg/100g of vitamin B1, 0.33 mg/100g to 0.37 mg/100g of vitamin K, 4.33 mg/100g to 4.74 mg/100g of vitamin E, and 6.62 mg/100g to 6.87 mg/100g of vitamin D. In place of wheat flour, Bambara groundnut and sorghum flour can be used to boost the biscuits' mineral and vitamin content. When compared to biscuits manufactured with wheat flour, the blend of Bambara groundnut and sorghum flours improved the micronutrient quality of the biscuits.

Keywords: Bambara groundnut; sorghum flour; bread; composite flour, minerals: v

Introduction

Micronutrient deficits and protein-energy malnutrition are two hallmarks of malnutrition, a prevalent nutritional problem in many impoverished countries, including Nigeria (WHO, 2006). In recent years, efforts have been made worldwide to mitigate or eliminate the problem. It has been suggested that the most effective strategy to fight malnutrition is to diversify one's diet. Dietary diversification is using widely available or consumed nutrient-dense crops, such as grains and legumes, to suit the population's nutritional and dietary demands. In order to identify and leverage the potential of locally available but underutilized agricultural crops, including sorghum and Bambara groundnut, in the creation of nutrient-dense products, baseline research is necessary.

Sorghum and bambara groundnut are two locally accessible underutilized agricultural products in Nigeria, that are only used in households, despite their potential for industrial usage. Underappreciated native legumes like bambara groundnuts are among Africa's most important crops. It is a low-cost, high-quality protein source and the third most important legume in Africa, after cowpea and groundnut. However, its usage is limited to residential use in most of Nigeria. In the eastern states, the seed is used to manufacture a steam gel called "Okpa," whereas in the northern states, it is consumed as a meal or roasted snack. Apart from being rich in minerals and vitamins, bambara groundnuts have 50% carbs, 6-8% lysine, 1.3 methionine, and 24% protein.

They consist of 60–63% carbohydrates, 6.0–6.5% fat, 18–24% protein, and 7.3% moisture (Yusuf *et al.*, 2008) [33]. Around 60.06 million metric tons of sorghum grain (Sorghum bicolor L. Moench), a grass family member, are expected to be produced worldwide in 2023, according to USDA projections (Devi *et al.*, 2011) [14]. After barley, rice, corn, and wheat, sorghum is the fifth most prevalent crop worldwide (CCCF, 2011). Sorghum grains and sorghum flour (SF) are rich in proteins, minerals, vitamins, phenolic compounds, micronutrients, macronutrients, and bioactive substances (Awika *et al.*, 2004) [9, 10]. One of SF's functional characteristics is its high capacity for water absorption, which is necessary for food ingredients to hydrate and bind.

According to Dicko *et al.* (2005) [15], it has the ability to absorb and hold onto water, which improves the texture and moistness of baked products and other food formulations. SF has binding qualities because of its distinct protein makeup, which helps food structures form and stabilize (Mal *et al*, 2005). Oils, lipids, and emulsifiers can all be absorbed and retained by SF. This characteristic is useful for bakery goods since it can improve bread, cakes, and pastries' volume, tenderness, and shelf life (Dicko *et al.*, 2005) [15]. The grain has between 8 and 12 percent protein, 65 and 76 percent starch, and about 2 percent fiber. The germ has a high percentage of protein (19%) and ash (10%) in addition to being a significant source of oil (28% of the germ) (Gyan-Chand *et al.*, 2017) [23].

Combinations of these nutrient-dense agricultural products might be used to create wholesome bread, which could aid in reducing the nation's problems with micronutrient deficiencies and protein-energy malnutrition. However, these crops must be processed to minimize or eliminate natural anti-nutrients that could impede the nutrients' biological availability if you want to extract the most nutrients out of them.

Due to its affordability, high nutritional value, and availability in "ready to eat" form, bread is a staple item that is consumed in huge numbers. Wheat is one of the most significant crops farmed worldwide and is used as a key ingredient in bread production. However, not all bread-consuming regions can grow it, so it may need to be imported, which raises the cost. Nigerian bread production has up to now relied solely on imported wheat flour. However, reports of effective composite bread technologies using native crops including kidney beans, soybeans, plantains, cocoyam's, sweet potatoes, breadfruits, etc. have been reported throughout time in reaction to the rise in wheat prices. By using these composite flours, the demand for imported wheat would decline, foreign reserves would be preserved, and the use of native crops in food formulation would increase, improving the goods' nutritious value. Since the body cannot produce micronutrients (vitamins and minerals), they are necessary for proper bodily function. Micronutrients must be supplied from diet because they are needed in trace amounts (Aniemena *et al*., 2024) [7]. Plantains, cassava, soybeans, and other locally grown crops can be used to make composite flour (Aniemena *et al*., 2024) [7]. There have been efforts to promote the use of composite flour, which uses flours manufactured from locally cultivated crops with high nutritional value to either completely or partially substitute wheat flour in baked items (Aniemena *et al*., 2024) [7]. By using composite flour, we may save foreign exchange, get our young people involved in economic activities, and lessen our dependency on imported wheat for the creation of baked goods (Anene *et al*., 2023; Aphiar *et al*., 2024) [5, 6, 8].
Most developing countries suffer from severe micronutrient deficiencies and a high prevalence of protein-energy malnutrition, which has prompted several initiatives by important stakeholders to address the problems. Dietary diversity has often been encouraged to suit the nutritional needs of the community. This involves making use of easily accessible or ingested nutrient-dense foods, such as grains and legumes. The high cost of importing wheat has a negative effect on our economy, so we must use local agricultural products to replace wheat flour in order to protect our foreign exchange (Emojorho *et al*., 2024) [20].
The current study set out to investigate the mineral and vitamin makeup of bread made using sorghum flour and Bambara groundnuts (V. subterranean). This study may offer some fundamental data that would aid in deciding how to use sorghum and Bambara groundnut flour in culinary products. The combined problems of micronutrient deficiencies, which make it challenging to meet the nutrition-related Millennium Development Goals (MGDs), may be resolved by this study. In order to help vulnerable households and groups maintain food security, it will promote the development of facilities for the production of nutrient-dense bread, which could be utilized right away in nutrition intervention programs like school feeding programs, community nutrition initiatives, and emergency nutrition support.

Material and Methods

Source of raw materials

We bought Bambara groundnuts, sorghum, wheat flour, and other components from Ozoro market in Delta State.

Bambara groundnut flour

After sorting the Bambara groundnut seeds (Bukina), the beans were steeped in distilled water for 24 hours and then manually dehulled. The seeds were cooked for an additional 10 minutes (1:4 beans to water ratio); they were then drained and dried for 9 hours at 50°C in an air-circulating oven in a stainless steel pot. Using 0.25 mm sieves, the dry samples were ground and turned into flour (Olaoye, 2006) [29].

Production of Sorghum Flour

The method outlined by Bolarinwa (2015) [13] was used to create malted sorghum flour. To get rid of dirt and stones, the 2 kg of sorghum grains will be sifted. To get a moisture content of 42-46%, the cleansed grains will be completely cleaned and steeped in water for 12 hours. After being boiled for 30 minutes to sterilize it, the hydrated grains were spread out over a moist jute bag and left to germinate for four days. The germinated seeds were dried in a cabinet dryer at 60°C until they had a moisture content of 10–12%, while the non-germinated grains were thrown away. After carefully brushing off the withered rootless grains, the malted grains were sieved, dry milled, and sealed in a cellophane bag until they were ready to use.

Formulation of composite flour blends: The wheat blends. Sorghum and Bambara groundnut flour were made with increasing amounts of sorghum and Bambara groundnut (25 and 50%, respectively). To create a uniform mixture, the flours were well combined. Before being used to make bread, the samples were tagged and kept in an airtight container at room temperature (30 ± 2°C).

Preparation of bread

The bread samples were made in accordance with Akubor and Obiegbuna's (2014) [3] instructions. 50g of flour, 4g of sugar, 2g of salt, 8g of margarine, 25ml of water, 1g of yeast, and 10g of powdered milk made up the formula used to make the breads. For the dry materials, the rubbing process was employed. After weighing the materials, the milk-water combination was combined with yeast in a basin. After creating a hole in the middle of the flour mixture, the dissolved yeast was added. This was fermented at 35°C while covered with cheesecloth. After adding the remaining milk-water combination, butter, sugar, and salt, the dough was hand kneaded until it was smooth and free of stickiness. The leftover dough was put back in the bowl, covered with cheesecloth, and allowed to prove at 35 degrees Celsius. The proofed doughs were then gently smeared with egg, placed in pans that had been oiled with fat, and baked in a baking oven set to 220°C for 10 minutes.

Determination of mineral composition

Determination of zinc content

Wet ashing was used to accomplish this (AOAC, 2023) [1]. To find the potassium and sodium content, atomic absorption spectrophotometry, as described by James (1996) [25], was employed.
Calculating the calcium content was done using Kirk and Sawyers' (1991) [26] approach. The method outlined by "AOAC (2023) [1]" was used to ascertain the samples' mineral contents of iron (Fe) and magnesium (Mg). The APHA (1995) method was used to determine phosphorus.

The AOAC (2010) methodologies were used to determine the vitamin B1 and D content. Vitamin B2 was determined using Kirk and Sawyer's (1991) [26] technique. To determine vitamin A, the method developed by Jakutowicz *et al.* (1997) [24] was applied. Vitamin E and vitamin K were determined using the AOVC (1966) [2] method.

Data and experimental design: A split-plot design with complete randomization will be used to carry out the experiment. Analysis of variance was used to examine the collected data (ANOVA). Significantly different means were distinguished using the least significant difference (LSD) test. At p < 0.05, significance was acknowledged.

Result And Discussion

Minerals Composition of bread produced from wheat flour, Bambara groundnut, and sorghum flour

Table 1: Minerals Composition of bread produced from wheat flour, Bambara groundnut, and sorghum flour (mg/100g)

SAMPLE	POTASSIUM	SODIUM	MAGNESSIUM	ZINC	IRON	CALCIUM	PHOSPHOROS
W	150.34^{e}±0.02	18.22^{d}±0.01	123.43^{e}±0.02	0.25^{c}±0	1.82^{e}±0.01	415.23^{c}±0.01	41.63^{e}±0.01
WB1	301.62^{b}±0.01	19.84^{b}±0.02	159.45^{c}±0.02	0.31^{b}±0.01	1.91^{c}±0.01	425.54^{b}±0.02	72.83^{c}±0.02
WB2	368.67^{a}±0.04	21.36^{a}±0.01	182.34^{a}±0.02	0.42^{a}±0.01	2.93^{a}±0.01	453.21^{a}±0	88.37^{a}±0.03
WS1	280.34^{d}±0.02	18.96^{c}±0.01	142.24^{d}±0.02	0.29^{b}±0.01	1.87^{d}±0.01	414.84^{d}±0.01	68.24^{d}±0.01
WS2	295.62^{c}±0.02	19.86^{b}±0.01	168.97^{b}±0.03	0.31^{b}±0.01	2.88^{b}±0.01	413.24^{e}±0.02	79.44^{b}±0.03

Values are expressed as means ± standard deviation of the duplicate determinations. Values with different superscript letter within the same column are significantly (p<0.05) different. Values with same superscript letter in a column are not significantly (p>0.05) different. Keys: w=wheat, WB1=wheat 75, Bambara 25, WB2= wheat 50, Bambara 50, WS1= wheat 75, Sorghum 25, WS2= wheat 50, Sorghum 50

Mineral composition of Bread Sample: The mineral composition of bread produced from wheat flour, Bambara groundnut, and sorghum flour is shown in Table 1.

According to Table 1, the bread's phosphorus concentration varied from 41.63 mg/100g to 88.37 mg/100g. The results were comparable to phosphorus levels for biscuits made with wheat and orange seed composite flour reported by Emojorho *et al.* (2023) [17, 19] that ranged from 40.65 to 91.57 mg/100g). "As the amount of sorghum flour and bambara groundnut flour in the bread increased, the phosphorus content values gradually rose as well." At 41.63 mg/100g, the bread made entirely of wheat flour had the lowest phosphorus concentration. The bread made with 50% bambara groundnut flour had the highest phosphorus concentration (88.37 mg/100g), while the bread made with sorghum flour had lower levels (68.24 mg/100g to 79.44 mg/100g) than the bread made with bambara groundnut flour (72.83 mg/100g to 88.37 mg/100g).

Because sorghum and bambara groundnut flour had greater phosphorus contents than wheat flour, "the phosphorus contents increased significantly (p<0.05) with the increase in the level of sorghum and bambara groundnut flour in the bread, due to the addition effect." There was a significant difference (P < 0.05) in the phosphorus concentration between the bread samples.

According to Table 1, the bread's calcium contents varied from 413.24 mg/100g to 453.21 mg/100g. When compared with results of tortillas made from composite flours, the findngs were significantly higher than the 1.40 to 2.10 mg/100g reported by Emojorho *et al.* (2025) [16]. The bread enriched with bambara groundnut had a higher calcium content than the bread treated with sorghum.

Gradually, when the amount of bambara groundnut flour in the bread increased, so did the values. At 413.24 mg/100g, the bread made with 50% sorghum flour had the lowest calcium concentration. The biscuits with 50% bambara groundnut flour had the highest calcium level (453.21 mg/100g), whereas the bread made with sorghum flour had lower calcium contents (413.24 mg/100g – 414.84 mg/100g) than the bread made with bambara groundnut flour (425.54 mg/100g – 453.21 mg/100g). There were notable (p<0.05) variations in the bread's calcium content. Because of the addition effect, the calcium levels rose noticeably (p<0.05) when the amount of sorghum flour and bambara groundnut flour in the bread increased.

According to Table 1, the bread's iron level varied from 1.82 mg/100g to 2.88 mg/100g. For tortillas made from composite flour, the values were less than the 2.92 to 3.05 mg/100g of iron reported by Okoh *et al.* (2025) [28]. The breads that were supplemented had a higher iron level. As the amount of wheat flour in the loaf rose, the values of iron eventually dropped. Iron concentration ranged from 1.82 mg/100g for the 100% wheat flour cookie to 2.93 mg/100g for the 50% bambara groundnut flour bread. Compared to the bambara groundnut samples, the iron content of the sorghum-based bread is lower. "The bread's iron contents varied significantly (p<0.05) from one another."Because wheat flour had a lower iron concentration than bambara groundnut and sorghum flour, the dilution effect caused the iron content of all supplemented biscuits to steadily decline as the amount of wheat flour decreased.

The bread's zinc levels varied between 0.25 and 0.31 milligrams per 100 grams (Table 1). The zinc levels were less than the 0.20–1.02 mg/100g found in bread made with wheat-orange seed composite flour by Emojorho *et al.* (2024) [20]. The zinc level of the 50% bambara groundnut flour bread was the greatest at 0.42 mg/100g, while the 100% wheat bread had the lowest at 0.25 mg/100g. The bread made with sorghum flour contained less zinc (0.29–0.31 mg/100g) than the biscuits made with bambara flour (0.31–1.42 mg/100g). As the amount of bambara groundnut and sorghum flour in the bread rose, the zinc levels increased significantly (p<0.05), most likely as a result of the additive effect because these flours had greater zinc contents than wheat flour. "As the amount of wheat flour in all supplemented bread decreased, the zinc content progressively rose."

According to Table 1, the bread' magnesium contents varied from 123.43 mg/100g to 182.34 mg/100g. For tortilla composite flour, the readings exceeded the magnesium levels of 0.03 to 0.58 mg/100g reported by Emojorho *et al.* (2025) [16]. With a magnesium concentration of 123.43 mg/100g, 100% wheat bread had the lowest value, while 50% bambara groundnut flour had the highest (182.34 mg/100g).

Compared to bambara groundnut flour breads (159.45 mg/100g – 182.34 mg/100g), the bread made from sorghum flour showed lower magnesium concentrations (142.24 mg/100g – 168.97 mg/100g). Significant (p<0.05) variations existed in the bread's magnesium content. Because bambara groundnut and sorghum flour had greater magnesium contents than wheat flour, there was an extra effect that caused the magnesium levels to rise significantly (p<0.05) as the amount of these flours in the bread rose. According to Table 1, the bread's sodium levels varied from 18.22 mg/100g to 21.36 mg/100g. For composite flour, the values were less than the 0.51 to 0.80 mg/100g of sodium found by Emojorho *et al*. (2024b) [18].

The bread made with 100% wheat had the lowest sodium level (18.22 mg/100g), whereas the bread made with 50% bambara groundnut flour had the highest value (21.36 mg/100g). Compared to bambara groundnut flour breads (19.84 mg/100g – 21.36 mg/100g), the sorghum flour breads had reduced sodium contents (18.96 mg/100g – 19.86 mg/100g). "The bread's sodium contents varied significantly (p<0.05) from one another." Because sorghum and bambara groundnut flours had greater salt contents than wheat flour, the adding effect caused the sodium content of all supplemented bread to steadily rise as the amount of sorghum and bambara groundnut flour rose.

According to Table 1, the bread's potassium level varied from 150.34 mg/100g to 301.27 mg/100g. For composite flour, the findings exceeded the 5.03 to 6.02 mg/100g of magnesium reported by Emojorho *et al*. (2024) [20]. Compared to 100% wheat bread, the enhanced bread had increased potassium concentrations. "As the amount of bambara groundnut and sorghum flour in the bread increased, the values gradually increased as well." At 150.34 mg/100g, the bread made entirely of wheat flour had the lowest potassium concentration. Higher potassium contents (150.34 mg/100g to 301.62 mg/100g) were found in the bread supplemented with bambara groundnut flour than in the bread supplemented with sorghum (280.34 mg/100g to 295.62 mg/100g). The bread containing 50% bambara groundnut flour had the highest potassium content (368.67 mg/100g)."Because sorghum and bambara groundnut flour had higher potassium contents than wheat flour, the potassium contents increased significantly (p<0.05) with an increase in the amount of these flours in the bread, due to the addition effect." The samples' potassium contents differed considerably (P < 0.05).

Vitamin Composition of Bread Samples produced from wheat flour, Bambara groundnut, and sorghum flour

Table 2: VITAMINS composition of bread produced from wheat flour, Bambara groundnut, and sorghum flour (mg/100g)

SAMPLE	VIT_A (IU)	VIT_D	VIT_E	VIT_K	VIT_BI	VIT_B2
W	15.61^{c}±0.01	6.87^{a}±0.03	4.74^{a}±0.35	0.33^{c}±0.01	0.09^{b}±0.01	0.99^{c}±0.01
WB1	15.54^{d}±0.01	6.82^{b}±0	4.61^{a}±0.01	0.34^{b}±0	0.09^{b}±0	0.99^{c}±0
WB2	15.44^{e}±0.01	6.73^{c}±0	4.54^{a}±0.01	0.36^{a}±0.01	0.14^{a}±0.01	1.04^{a}±0.01
WS1	15.95^{b}±0.01	6.72^{c}±0.01	4.43^{a}±0.01	0.36^{a}±0.01	0.08^{bc}±0	1.01^{b}±0
WS2	16.14^{a}±0.02	6.62^{d}±0.02	4.33^{a}±0.01	0.32^{c}±0	0.07^{c}±0	1.03^{a}±0.01

Values are expressed as means ± standard deviation of the duplicate determinations. Values with different superscript letter within the same column are significantly (p<0.05) different. Values with same superscript letter in a column are not significantly (p>0.05) different.

The bread's vitamin B2 concentration varied between 0.99 and 1.04 milligrams per 100 grams. The findings were less than the 1.16 to 2.26 mg/100g that Anene *et al*. (2025) reported for composite flour made from idli. The enhanced bread had higher levels of vitamin B2. "The values gradually rose as the bread's bambara nut and sorghum flour content increased." The bread made entirely of wheat flour had the lowest vitamin B2 concentration (0.99 mg/100g). Vitamin B2 levels in the bread made with sorghum flour were lower (1.01 mg/100g – 1.03 mg/100g) than those made with bambara groundnut flour (0.99 mg/100g – 1.04 mg/100g), while the bread made with 100% wheat flour flour had the lowest value (0.99 mg/100g).

Because bambara nut and sorghum flour had greater vitamin B2 contents than wheat flour, the additive effect caused the vitamin B2 contents to rise significantly (p<0.05) as the amount of these ingredients increased in the bread samples. The bread samples had vitamin B1 concentrations ranging from 0.07 to 0.14 mg/100g. The results exceeded the 0.03 to 0.14 mg/100g of tortillas with composite flour reported by Emojorho *et al*. (2025) [16]. Compared to bread supplemented with bambara groundnut, the bread added with sorghum had lower vitamin B1 concentrations. Gradually, as the amount of sorghum flour in the loaf rose, the values declined. The vitamin B1 level of the 100% wheat flour bread was 0.09 mg/100g.itamin B1 levels in the bambara nut bread were greater (0.09 mg/100g – 0.14 mg/100g) than in the bread made with sorghum flour (0.07 mg/100g – 0.08 mg/100g). As the amount of sorghum flour in all supplemented bread increased, the vitamin B1 content progressively dropped. There was a significant difference (P < 0.05) in the bread samples' vitamin B1 concentration. The bread's vitamin K level varied between 0.33 and 0.37 milligrams per 100 grams (Table 2). As the amount of sorghum flour and bambara groundnut flour in the bread increased, the values gradually rose as well. At 0.33 mg/100g, the bread made entirely of wheat flour had the lowest vitamin K concentration.

Vitamin K levels in bambara groundnut flour bread were lower (0.33 mg/100g – 0.36 mg/100g) than in sorghum flour bread (0.36 mg/100g – 3.37 mg/100g), whereas the bread with 50% sorghum flour had the greatest value (0.37 mg/100g). Since bambara groundnut and sorghum flour had greater vitamin K contents than wheat flour, "the vitamin K contents increased significantly (p<0.05) with the increase in the level of bambara groundnut and sorghum flour in the bread, probably due to the addition effect." There was a significant difference (P < 0.05) in the vitamin K content of the bread samples.

The bread's vitamin E level varied between 4.33 and 4.74 milligrams per 100 grams. The results were marginally less than the vitamin E content of biscuits made with orange seed and wheat composite flour, which was 4.56 to 11.70 mg/100g, as reported by Emojorho *et al*. (2023) [17, 19]. At 4.74 mg/100g, the bread made entirely of wheat flour had the highest vitamin E concentration. The bread made with sorghum flour had lower vitamin E levels (4.33–4.43 mg/100g) than the bread made with bambara groundut flour (4.33–4.64 mg/100g), while the bread made with 100% wheat flour had the greatest value (4.74 mg/100g). As the amount of sorghum and bambara groundnut flour in the bread increased, the vitamin E contents dropped significantly ($p<0.05$), most likely as a result of an extra effect because the wheat flour had a higher vitamin E content. There was a significant difference ($P < 0.05$) in the vitamin E content of the bread samples. The bread's vitamin D level varied between 6.62 and 6.87 milligrams per 100 grams. The results were marginally less than the vitamin E content of biscuits made using orange seed and wheat composite flour, which was 7.04 to 10.20 mg/100g, as reported by Emojorho *et al*. (2023) [17, 19]. At 6.87 mg/100g, the biscuit made entirely of wheat flour had the highest vitamin D concentration. Compared to bread made with sorghum flour (6.72 mg/100g – 6.73 mg/100g), the bambara groundnut flour bread exhibited lower vitamin D concentrations (6.73 mg/100g – 6.82 mg/100g). Since sorghum and bambara groundnut flour had lower vitamin D contents than wheat flour, the vitamin D contents in the bread declined significantly ($p<0.05$) as the amount of these flours increased. This could be the result of an additive effect. There was a significant difference ($P < 0.05$) in the vitamin D content between bread samples. The vitamin content of bread samples is displayed in Table 2. According to Table 2, the bread's vitamin A concentration varied from 15.44 IU to 16.14 IU. The results exceeded the vitamin A content of biscuits made with orange seed and wheat composite flour, which was reported by Emojorho *et al*. (2023) [17, 19] to be between 0.995 and 7.795 IU. The values gradually rose as the bread's sorghum flour content rose, while they decreased when the bread samples' Bambara groundnut flour content rose. The vitamin A level of the 100% wheat flour bread was higher than that of the bread samples added with bambara groundnut flour, but it was lower than that of the bread samples supplemented with sorghum flours (15.61- 16.14 IU). The bread made with 50% sorghum flour had the highest value (16.14 IU). Since sorghum flour had a greater vitamin A content than wheat flour, the vitamin A levels rose significantly ($p<0.05$) as the amount of sorghum flour in the bread increased. This could be the result of an additive effect.

Conclusion
To boost the bread's mineral and vitamin qualities, up to 50% of the wheat flour could be replaced with sorghum and Bambara groundnut flour. Justification: Compared to bread made with wheat flour, bread made with sorghum and bambara flour had higher mineral and vitamin levels. There should be research done on how well sorghum and bambara flour work in baked goods like cakes and biscuits. Customers should also be informed of the nutritional and health advantages of bambara flour and sorghum. To determine the ideal packaging suggested for the prepared samples, more investigation should be done.

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