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## Proximate, vitamin and mineral composition of bread produced from wheat, banana and mango flour blends

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### Abstract

**Purpose:** This study was intended to evaluate the proximate, vitamin and mineral composition of bread produced from wheat, banana and mango flour blends.

**Methodology:** Bread samples were produced using different proportions of composite flour formulated from wheat, banana and mango. The flour blends were used to bake 7 bread samples which includes; Sample A (100% wheat flour), Sample B (90% wheat and 10% banana flour blend) Sample C (90% wheat and 10% mango flour blend) Sample D (80% wheat, 15% banana and 5% mango flour blend) Sample E (80% wheat, 15% mango and 5% banana flour blend) Sample F (70% wheat, 20% banana and 10% mango flour blend) Sample G (70% wheat, 20% mango and 10% banana flour blend). The bread samples subjected to proximate, vitamin and mineral composition analysis using standard methods.

**Results:** The proximate composition were obtained as follows; moisture (38.05-39.83%), ash (0.50-1.02%), fibre (0.30-1.05%), fat (1.01-2.50%), protein (10.53-13.01%), and carbohydrate (43.12-48.86 %). Vitamin analysis obtained the following rang of values; Vitamin A (0.22-0.52mg/100g), Vitamin B<sub>1</sub> (0.32-0.37mg/100g.), Vitamin B<sub>2</sub> (5.11-11.97mg/100g), Vitamin B<sub>3</sub>(4.67-5.65mg/100g), Vitamin B<sub>6</sub>(0.23-0.48mg/100g), Vitamin C (0.06- 3.20mg/100g). Mineral composition was as follows; Potassium (44.75-98.06mg/100g), Calcium (18.84-37.13mg/100g), Sodium (4.91- 9.40 mg/100 g), Magnesium (6.11- 9.12mg/100g), Phosphorus (9.18-17.93mg/100g) and Iron (0.55- 1.25mg/100).

**Keywords:** wheat flour, banana flour, mango flour

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### Introduction

Bread is a leavened food produced via fermentation of wheat flour. It is described as a fermented confectionary product produced mainly from wheat flour, water, yeast and salt by a series of operations including mixing, kneading, proofing, shaping and baking (Dewettinck, *et al.*, 2008) [8]. The wheat flour is mixed in either batter or dough before being placed in an oven where it is baked to bread. Bread is famous for being one of the staple foods of the early civilization and it is still consumed by millions of people on a daily basis. All of the processes which have evolved for the production of bread have a single, common aim, namely to convert wheat flour into an aerated and palatable food (Muhammad *et al.*, 2013) [18].

Wheat (*Triticum aestivum*) is one of the most important staple foods for Man. The kernel consists of a wheat germ and an endosperm, which is full of starch and protein (Honda *et al.*, 2005) [11]. Wheat is not readily cultivated in the tropics hence most of the wheat flour used in baking in the developing countries is imported. Bread produced from whole grain wheat is more nutritious than bread from refined wheat flour. The bran contains fibre, minerals such as iron, zinc, copper and magnesium and vitamins E, B, as well as multitude of other bioactive compounds. The germ contains essential unsaturated fats, vitamins, selenium, antioxidants, plant sterols, and other bioactive compounds. The endosperm contains largely starchy carbohydrates, some proteins, and small amounts of fibres, vitamins and minerals. Generally, cereal grains contain fibres and other health promoting compounds, making them ideal ingredients for functional foods that target outcomes such as cholesterol reduction and glycaemic control. Processing can also play an important role in the potential health benefits of cereal grain ingredients (Slavin *et al.*, 2013) [23]. Health campaigns are encouraging consumers to eat more whole grains. With increased availability of appealing whole grain products and improved labelling and sign posting of whole grain foods, consumers may find it easier to increase their intake. Consumer research conducted by the International Food Information Council (IFIC) show that consumers that are aware of whole grain, are increasingly interested in consuming more whole-grain foods (Mona *et al.*, 2016) [16]. The substitution of this wheat with readily available and nutritive flour will reduce the cost of production and also increase productivity.

The bread industry has changed and developed over the years in order to satisfy customer needs and consumer behaviour. This industry is characterized by a complex system of activities concerning the production, supply, delivery and consumption of bread across the world. Bread is one of the most important products of the wheat flour. One of the main problems encountered by bread producers is its short shelf life. Baked products are perishable foods and undergo severe physical, chemical, sensory and microbial changes during storage (Tang *et al.*, 2015) [26].

Banana (*Musa acuminata*), is the largest herbaceous plant and one of the most cultivated fruit crops in the tropical and subtropical countries, being the fourth most important agricultural commodity in the world, after maize, rice and wheat (Sarawong *et al.*, 2014) [22]. However, of the total banana production, approximately 40% is lost in the post-harvest period (Subbaiah *et al.*, 2013) [25]. Converting the readily available banana to its flour and incorporating it into baking will not only reduce the cost of bread production but will also go a long way to manage the postharvest loss of banana. Banana flour is rich in starch, high in fibres and potassium.

Also, mangoes are among one of the most widely grown fruits in the world. Mango (*Mangifera indica*) is one of the most economically important fruit in the Anacardiaceae (Cashew family). Other important members of this family include cashew and pistachio. Mango is an important fruit-foodstuff for inhabitants of the tropics after banana. Mango fruits are an important source of micronutrients; minerals, vitamins and other phytochemicals. Moreover, mango fruits are nutritionally rich in dietary fibres, carbohydrates, proteins, fats, poly-phenolic flavonoids, antioxidants compounds and have a unique flavour, fragrance, taste and health promoting benefits (Guiamba *et al.*, 2016) [10], which are vital to normal human growth, development and health. The largest share of mango production is traded and consumed fresh; a very small quantity is processed into juice or pulp whereas the remainder end up as postharvest loss. Over 90 percent of mango production is by smallholder farmers with low investment capacity (Vayssieres, *et al.*, 2008) [28].

In Nigeria like elsewhere in Africa, bananas and mangoes are the most important food crops for direct human consumption. These crops are grown in varied agro-ecologies and production systems. There are many compelling reasons for encouraging bananas and mango production. They are a cheap but nutritionally rich staple food, versatile staple to address food and nutrition security and produce more food per unit area of land. Despite the great nutritional importance of these crops, their production faces many challenges. The common and unique challenges are related with storage of harvested products and tolerance to stress associated with heat and drought. Owing to these challenges, these crops warrant more research to permit the development of a competitive agricultural sector in Nigeria. This leads us to question the nature and magnitude of post-harvest losses in bananas and mangoes in our Nigerian society. To this end, this study exploits avenues for the management of post-harvest losses in bananas and mangoes as well as reducing the cost of bread production in some communities of Benue State, Nigeria.

## Materials and Method

Wheat, bananas, mangoes, margarine, yeast, sugar, salts, potable water and Calcium propionate preservative were purchased from the Wurukum Market, Makurdi. Procured materials were taken to the chemistry department, Benue state university laboratory for processing. The equipment that were used for the study included baking pans, mixer, blender, oven (Hipman 60), kneader, sieve (0.5 mm - 0.7), measuring cylinder and weighing scale.

### 1. Preparation of Banana Flour

Mature unripe banana fruits (*Musa sapientum*), obtained from the bunch, as recommended by (Baiyeri *et al.*, 2000) were washed using potable water. The washed fruits were peeled with the aid of stainless steel kitchen knives and the pulp sliced using a manual food slicer in to smaller sizes of approximately 10mm thickness to facilitate the drying process. The sliced banana pulp were blanched for 5mins at 70°C and dried in air circulating oven (Gallenkamp S/No 90/02/190, UK) at 60°C for 24 h according to the method of Adeniji *et al.*, 2007. The dried samples were milled to pass a 0.25 mm sieve as earlier reported Kiin-Kabari *et al.*, 2015 for non-wheat or flour blends bread. The flow chart for the process is shown in figure 1.

### 2. Preparation of Mango Flour

Ripe Alphonso mangoes (*Mangifera indica* 'Alphonso') popularly known as Brockley were washed manually using potable water. The mangoes were peeled using a stainless steel knife and the pulp sliced using a manual food slicer in to smaller sizes of approximately 1cm thickness to create large surface area to facilitate the drying process. The sliced mango pulps were dried using a control sample drying oven at 60°C for 72 hours to obtain mango flakes. The mango flakes were ground using laboratory blender (M/S Sujata: New Delhi India) to obtain the flour. The mango flour was sieved through a 0.5 mm size mesh (Mohamed *et al.*, 2017; Caparino *et al.*, 2012).

### 3. Bread samples production

Bread samples were prepared from the different blends of refined wheat flour, banana flour and mango flour as follows. Sample A (100% wheat flour), Sample B (90% wheat and 10% banana flour blend) Sample C (90% wheat and 10% mango flour blend) Sample D (80% wheat, 15% banana and 5% mango flour blend) Sample E

(80% wheat, 15% mango and 5% banana flour blend) Sample F (70% wheat, 20% banana and 10% mango flour blend) Sample G (70% wheat, 20% mango and 10% banana flour blend).

#### 4. Recipe for formulation of bread from wheat flour, banana and mango flour blends

The method used for the preparation of dough was the creaming method where fat and sugar were creamed together using the Kenwood mixer (United Kingdom) at medium speed for two (2) min. After creaming, ingredients such as flour, yeast and salt were added and properly mixed to form dough (details on table 1). The dough was manually kneaded to ensure uniformity. The dough was then transferred to a clean tray and cut into specific sizes of 250gram per loaf using a cutter. The 250g pieces of dough were gently rolled into round shapes using the hands. Shaped dough pieces were placed into a greased pan and allowed to proof for 1hour. The risen dough was transferred to the oven and baked at (180-210) °C for (30-45) min. The baked bread was placed on a cooling rack for 30 min to cool before packaging (Cauvain, 2015).

**Table 1:** Recipe for the formulation and development of bread samples

ingredients	A (g)	B (g)	C (g)	D (g)	E (g)	F (g)	G (g)
Wheat	500	450	450	400	400	350	350
Banana	0	50	0	75	25	100	50
Mango	0	0	50	25	75	50	100
Sugar	80	80	80	80	80	80	80
Yeast	10	10	10	10	10	10	10
Fat	50	50	50	50	50	50	50
Salt	5	5	5	5	5	5	5
C <sub>6</sub> H <sub>10</sub> CaCO <sub>4</sub>	1	1	1	1	1	1	1
Water(ml)	300-350	300-350	300-350	300-350	300-350	300-350	300-350

**Source:** (Cauvain, 2015).

#### 5. Analysis

##### 1. Proximate composition of bread samples

The moisture, protein, fat, ash, and crude fibre contents of bread samples were determined by oven method described in AOAC 2010. Total carbohydrate was determined by differences between 100 and total sum of the percentage of fat, moisture, ash, crude fibre and protein content.

##### 2. Determination of Vitamin of the bread samples

Vitamin A was determined by the calorimetric method described by AOAC 2010. Vitamins B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub> and B<sub>6</sub> were determined through the spectrophotometric method, described by Okwu *et al.*, 2004. Vitamin C was determined through the method described by Okwu, D.E. (2004). Exactly 10 g of the sample was extracted with 50 ml EDTA/TCA (50 g in 50 ml of water) extracting Solution for 1 hour and filtered through a What man filter paper into a 50ml volumetric flask and made up to the mark with the extracting solution. Twenty (20 ml) of the extract was pipetted into a 250 ml conical flask and 10 ml of 30% KI was added and also 50ml of distilled water added. This was followed by 2 mL of 1% starch indicator. This was titrated against 0.01 mL CuSO<sub>4</sub> solution to a dark end point.

##### 3. Determination of Mineral elements of bread samples

Sodium and Potassium were determined by Flame Photometry method. Calcium and Magnesium were determined by Versenate Titration Method. Phosphorous concentration in the sample was measured colourimetrically using the molybdovanadate method recommended by Iron concentration in sample digest was determined using Orthophenathroline colometric Method (Anna *et al.*, 2011).

#### 6. Statistical Analysis

Experiments were conducted in triplicates and analysis of variance (one-way ANOVA) were performed and results were separated using the Multiple Ranges Duncan's test ( $p < 0.05$ ) on a statistical software of Statistical Package for the Social Sciences (SPSS), Version 28. The mean values and standard deviations were calculated where appropriate, reported with differences considered at 95% significant level.

#### Results and Discussion

##### 1. Proximate composition of bread samples from wheat, banana and mango flour blends.

In this study, the following proximate composition of bread samples were analysed as shown in Table 2. The proximate parameters that were determined were moisture content, ash content, fibre content, fat content, protein content and carbohydrate content.

##### 1. Moisture content of bread samples

It could be seen that the moisture content of the samples ranged from 38.25% to 39.83%. The proximate composition showed that all the samples were within the normal moisture content of white bread which should

not be more than 40% (Mudau *et al.*, 2012; SON, NIS75:2004). According to these results, there were significant differences ( $p < 0.05$ ) in the moisture content between some of the seven samples. Sample A and D as well as sample B, F and G were not significantly different, respectively. The high moisture observed for the seven formulations was a good indicator that the samples could not be kept naturally for long. For this reason, preservative needed to be applied to bread that was destined for a longer shelf life. The sample D (39.83%) had the highest moisture content and significantly ( $p < 0.05$ ) differed from others samples except sample A. Different food materials have different capacity for absorbing/retaining moisture which may exist as occluded or absorbed water (Mudau *et al.*, 2012; SON, NIS75:2004). As the banana and mango flours were added to the wheat flour, it tended to release moisture, thereby increasing the moisture content of the bread samples as seen in Table 2. Moisture contents of wheat composite bread agreed with the results of (Badifu *et al.*, 2005) who supplemented wheat flour with mango mesocarp flour in production of bread.

## 2. Ash content of bread samples

The ash content of the bread samples ranged from 0.50% to 1.02%. The ash content of the bread samples increased as the ratio of banana and mango flours in the bread was increased. Sample F was significantly different from other samples at ( $p < 0.05$ ) because it had the highest ash content (1.02%). Sample G (0.85%) was not significantly different ( $p > 0.05$ ) from samples C (0.66%), D (0.71%), E (0.67%) but it was significantly different from sample A (0.50%) and B (0.51%). Sample A and B were not significantly different from sample C, D, E at ( $p < 0.05$ ). The ash content of bread is simply a measure of its mineral content (Mudau *et al.*, 2012; SON, NIS75:2004). The high ash content as a result of banana and mango flours addition to the wheat flour could imply an increase in the quantity of minerals in the bread.

## 3. Crude fibre content of bread samples

The crude fibre content of the bread samples ranged from 0.30% to 1.05 % and they were significantly different from each other at 0.05% level significance. The crude fibre content of the bread from pure wheat flour was 0.30% and it could be seen that wheat flour had the lowest percentage of fibre compared to other samples, but at 10% substitution of banana and mango flours to the wheat flour, it tended to increase to 0.35% and 0.40 % respectively. Then at 20%, and 30% substitution of banana and mango flours to the wheat flour, the percentage of crude fibre continued to increase up to 1.05% at sample F and G. These values were within the range stipulated by Standard Organisation of Nigeria (SON, NIS75:2004). This indicated that banana and mango flours supplementation to wheat flour improved the crude fire content and this result agrees with Mudau *et al.*, 2012.

## 4. Fat content of bread samples

The fat content ranged from 1.01% to 2.50 %. The fat content for some of the samples were significantly different ( $p < 0.05$ ) from each other. Sample F (70% wheat flour, 20% banana flour and 10% mango flour) had the highest fat content of 2.50% followed by sample E (80% wheat flour, 15% mango flour and 5% banana flour) which had a fat content of 2.40 % and sample C (90% wheat flour and 10% mango) had the least fat content (1.01%). On a general point of observation of the result, it shows that bread produced from wheat flour supplemented with banana and mango flours will have a high amount of polysaturated fat which is very healthy. This implied that a major feedback of this study was the fact that the high fat content of the composite flour samples made the bread more nutritionally balance compared to bread from pure wheat flour.

## 5. Protein content of bread samples

The protein content of the bread samples ranged from 9.53% to 13.01 %. The crude protein content of some of the seven bread formulations was significantly different ( $p < 0.05$ ) from each other. Sample F and G with 70% wheat flour had the highest crude protein content (12.76 % and 13.01% respectively) and they were significantly different from sample A, B, and D. Sample A (100% wheat flour) had the least crude protein content (10.53%). This could be attributed to the fact that the high percentage of protein content was provided by the banana and mango flours. This result indicated that the supplementation of the bread with banana and mango flours increased the protein content.

## 6. Carbohydrate content of bread samples

The carbohydrate content ranged from 43.12% to 48.86 %. The carbohydrate content for some of the samples was significantly different ( $p < 0.05$ ) from each other. Sample A (100% wheat flour) showed a very high percentage of carbohydrate content of 48.86 %. As the quantity of the banana and mango flour was added to the wheat flour, a corresponding decrease in carbohydrate content was observed in the bread samples from composite flour. This was in agreement with the findings of Offia-Olua, (2014) <sup>[19]</sup> who reported a decrease in carbohydrate content of wheat flour with increase in soybean flour fortification

## 2. Vitamin Composition of Bread Samples from wheat, banana and mango flour blends.

The research study also evaluated the vitamin composition of the bread samples as shown in Table 3. The vitamins that were determined were vitamin A, vitamin B<sub>1</sub>, vitamin B<sub>2</sub>, vitamin B<sub>3</sub> vitamin B<sub>6</sub>, vitamin C.

### 1. Vitamin A content of bread samples

Table 4 showed that Vitamin A varied from 0.22mg/100g to 0.52mg/100 g. G had the highest value (0.52mg/100g) which was significantly different from the other breads at ( $p < 0.05$ ). This was followed by sample F (0.50mg/100g), then E (0.49mg/100g), right down to the sample with 100% pure wheat flour. Sample A and B, had the lowest values (0.22mg/100g) hence there was no significant difference between the two samples at ( $p < 0.05$ ). Apart from A and B, all the other samples were significantly different from each other at ( $p < 0.05$ ). This result shows that pro-vitamins A was found more in bread samples produced from mango flours. This might be as a result of high level of  $\beta$ -carotene in mango. This result agrees with the findings reported by (Lebaka *et al.*, 2021) <sup>[13]</sup> which explained that mango pulp was very rich in vitamin A.

### 2. Vitamin B<sub>1</sub> content of bread samples

The results also showed that thiamine or Vitamin B<sub>1</sub> content ranged from 0.32 mg/100g to 0.37mg/100 g. Sample C had the highest value (0.37mg/100g) which was significantly different from the other breads at ( $p < 0.05$ ). This was followed by sample A, B, and E with the value of 0.33mg/100g. Sample D, F and G, had the lowest values (0.32 mg/100g). Samples A, B and E were not significantly different from each other but were significantly different from samples D, F and G at ( $p < 0.05$ ). The quantities of Vitamin B<sub>1</sub> in the bread samples were considerably higher than that of pure white wheat flour as explained by (Madiha *et al.*, 2013) <sup>[14]</sup>. This implies that the supplementation of the pure wheat with the banana and mango flours increased the Vitamin B<sub>1</sub> content of the bread samples.

### 3. Vitamin B<sub>2</sub> content of bread samples

The riboflavin or Vitamin B<sub>2</sub> content varied from 5.11mg/100g to 11.97 mg/100g. Sample A composed of 100% pure wheat flour had the least value (5.11 mg/100 g) and the value increased proportionately as the quantity of banana and mango flour was increased in the flour blends of the bread samples. Sample F had the highest value (11.97mg/100g). The result agrees with those of (Madiha *et al.*, 2013) <sup>[14]</sup>. This is because the quantities of Vitamin B<sub>2</sub> in the bread samples were considerably higher than that of pure white wheat flour as explained. This implies that the supplementation of the pure wheat with the banana and mango flours increased the Vitamin B<sub>2</sub> content of the bread samples. There was a significant difference between all the samples of the bread and the result revealed that the samples with more banana flour were very rich in riboflavin as compared to mango flour blends and pure wheat flour.

### 4. Vitamin B<sub>3</sub> content of bread samples

The niacin or Vitamin B<sub>3</sub> content of the bread samples ranged from 4.67mg/100g to 5.65mg/100g. Sample F and G with 70% wheat flour had the highest Vitamin B<sub>3</sub> content (5.58mg/100g and 5.65mg/100g respectively) and they were significantly different from sample A, B, C, D and E at ( $p < 0.05$ ). Samples A and B had the least Vitamin B<sub>3</sub> content (4.67mg/100g and 4.68mg/100g respectively) and were not significantly different at ( $p < 0.05$ ). We noticed a progressive increase in the quantity of Vitamin B<sub>3</sub> from samples A to sample G and this could be attributed to the fact that the high percentage of banana and mango flours in their corresponding flour blends. The result agrees with those of (Madiha *et al.*, 2013) <sup>[14]</sup>. This result indicated that the supplementation of the bread with banana and mango flours increased the niacin.

### 5. Vitamin B<sub>6</sub> content of bread samples

The results also showed that pyridoxine or Vitamin B<sub>6</sub> content ranged from 0.23mg/100g to 0.48mg/100g. All samples were significantly different from each other at ( $p < 0.05$ ). Sample E had the highest value (0.48mg/100g) and sample A composed of 100% pure wheat flour had the least value (0.23mg/100 g). The values of vitamin B<sub>6</sub> increased proportionately as the quantity of banana and mango flour was increased in the flour blends of the bread samples. This result agrees with the findings reported by (Madiha *et al.*, 2013) <sup>[14]</sup>. The result revealed that the samples with more mango flour were very rich in pyridoxine as compared to banana flour blends and pure wheat flour.

### 6. Vitamin C content of bread samples

The ascorbic acid or Vitamin C content varied from 0.06mg/100g to 3.20mg/100g. All samples were significantly different from each other at ( $p < 0.05$ ). Sample A composed of 100% pure wheat flour had the least value (0.06mg/100 g) and sample E had the highest value (3.20mg/100g). The value of Vitamin C in the samples increased as the quantity of mango and banana flour was increased in the flour blends of the bread samples. The result revealed that the samples with more mango flour were very rich in ascorbic acid as compared to mango flour blends and pure wheat flour. This result agrees with the findings reported by (Lebaka *et al.*, 2021) <sup>[13]</sup> which explained that mango pulp was very rich in vitamin C.

### 3. Mineral composition of Bread Samples from wheat, banana and mango flour blends.

The research study also evaluated the mineral composition of the bread samples as shown in Table 4. The minerals that were determined were potassium, calcium, sodium, magnesium, phosphorus, and Iron.

### 1. Potassium content of bread samples

The potassium content in the studied bread samples ranged from 44.75mg/100g to 98.06mg/100g. It was noted that 100% pure wheat bread contained the lowest amounts of this element than the other bread samples. The values of potassium increased proportionately as the quantity of banana and mango flour was increased in the flour blends of the bread samples. This result agrees with the findings reported by Gesare *et al.*, (2016) [9]. The highest share of potassium was found in sample G bread. All samples were significantly different from each other at ( $p < 0.05$ ).

### 2. Calcium content of bread samples

Calcium content in the studied bread samples varied from 18.84mg/100 to 37.13mg/100g. All samples were significantly different from each other at ( $p < 0.05$ ). Sample A composed of 100% pure wheat flour had the least value (18.84mg/100 g) and sample G had the highest value (37.13mg/100g). The value of Calcium in the samples increased as the quantity of mango and banana flour was increased in the flour blends of the bread samples. This result agrees with the findings reported by Gesare *et al.*, (2016) [9].

### 3. Sodium content of bread samples

In all of the studied bread samples, the content of sodium ranged between 4.91 mg/100g to 9.40 mg/100 g. The lowest amount was observed in 100% pure wheat bread (4.91mg/100g). The quantity of sodium in the samples increased and the ratio of the banana and mango was increased in the composite bread and this result agrees with the findings reported by Gesare *et al.*, (2016). The studies further revealed that the highest share of sodium was present in sample G bread (70% wheat/20% mango/10% banana flour blend) which was 9.40mg/100g. The basic source of sodium in bread is table salt. All the bread samples were significantly different from each other at ( $p < 0.05$ ).

### 4. Magnesium content of bread samples

The magnesium content of bread samples ranged from 6.11mg/100g to 9.12mg/100g. The highest amount of this element was recorded in sample G bread with 20% mango flour and 10% banana flour. The high value of magnesium in sample G bread resulted from the higher proportion of mango and banana in the composite flour. The lowest amount of Magnesium was noted in pure wheat bread. The quantity of magnesium in the samples increased and the ratio of the banana and mango was increased in the composite bread and this result agrees with the findings reported by Gesare *et al.*, (2016) [9]. All the bread samples were significantly different from each other at ( $p < 0.05$ ).

### 5. Phosphorus content of bread samples

The studied bread samples contained about 9.18 mg to 17.93 mg of phosphorus per 100g of product's fresh mass. The lowest amount of Magnesium was noted in sample A with 100% pure wheat four bread. The highest amount of this element was recorded in sample G bread with 20% mango flour and 10% banana flour. The high value of phosphorus in sample G bread resulted from the higher proportion of mango and banana in the composite flour. The quantity of phosphorus in the samples increased and the ratio of the banana and mango was increased in the composite bread and this result agrees with the findings reported by Gesare *et al.*, (2016) [9]. All the bread samples were significantly different from each other at ( $p < 0.05$ ).

### 6. Iron content of bread samples

The iron content of bread samples ranged from 0.55mg/100to 1.25mg/100. The highest content of iron was found in recorded in sample G bread with 20% mango flour and 10% banana flour bread (1.25 mg/100g of fresh mass), whereas its lowest value was noted in 100% pure wheat four bread (0.55 mg/100 g). The quantity of iron in the samples increased and the ratio of the banana and mango was increased in the composite bread and this result agrees with the findings reported by Gesare *et al.*, (2016) [9]. On the basis of the results obtained in this study, all the bread samples were significantly different from each other at ( $p < 0.05$ ). This result is in according to the work of (Wekhe *et al.*, 2021) [30], whose observations were that the iron content in sun dried bread fruit was higher than in white bread. All the samples were significantly different from each other at ( $p < 0.05$ ).

### Conclusion

The results of this study show that supplementing wheat flour with banana and mango flour resulted in considerable improvement in macro-nutrients such as protein, fat, fibre and micro-nutrients such as minerals (potassium, iron, calcium, magnesium, sodium and phosphorus) and vitamins (vitamin A, vitamin B<sub>1</sub>, vitamin B<sub>2</sub>, vitamin B<sub>3</sub> vitamin B<sub>6</sub> and vitamin C). However, the blending of the flours let to a proportionate decrease in carbohydrate. There was a significant difference between most of the bread samples at ( $p < 0.05$ ).

**Table 2:** Proximate composition of bread from wheat, banana and mango flour blends

Samples	Moisture (%)	Ash (%)	Fiber (%)	Fat (%)	Protein (%)	CHO (%)
A	39.67 <sup>ab</sup> ±0.23	0.50 <sup>c</sup> ±0.05	0.30 <sup>d</sup> ±0.00	1.14 <sup>d</sup> ±0.45	9.53 <sup>c</sup> ±0.28	48.86 <sup>a</sup> ±0.11
B	39.57 <sup>b</sup> ±0.10	0.51 <sup>c</sup> ±0.01	0.35 <sup>d</sup> ±0.07	1.40 <sup>d</sup> ±0.18	9.95 <sup>c</sup> ±0.45	48.21 <sup>a</sup> ±0.67

<b>C</b>	39.05 <sup>c</sup> ±0.01	0.66 <sup>bc</sup> ±0.13	0.40 <sup>cd</sup> ±0.14	1.01 <sup>d</sup> ±0.46	11.05 <sup>b</sup> ±0.63	47.84 <sup>a</sup> ±0.11
<b>D</b>	39.83 <sup>a</sup> ±0.21	0.71 <sup>bc</sup> ±0.07	0.60 <sup>bc</sup> ±0.00	1.08 <sup>d</sup> ±0.08	11.74 <sup>b</sup> ±0.29	46.05 <sup>b</sup> ±0.52
<b>E</b>	38.25 <sup>d</sup> ±0.29	0.67 <sup>bc</sup> ±0.03	0.80 <sup>b</sup> ±0.14	2.40 <sup>ab</sup> ±0.02	12.53 <sup>ab</sup> ±0.01	45.36 <sup>b</sup> ±0.39
<b>F</b>	39.35 <sup>b</sup> ±0.01	1.02 <sup>a</sup> ±0.21	1.05 <sup>a</sup> ±0.07	2.50 <sup>a</sup> ±0.03	12.96 <sup>a</sup> ±0.00	43.12 <sup>c</sup> ±0.32
<b>G</b>	39.31 <sup>b</sup> ±0.01	0.85 <sup>ab</sup> ±0.01	1.15 <sup>a</sup> ±0.08	1.81 <sup>bc</sup> ±0.01	13.01 <sup>a</sup> ±0.22	43.87 <sup>c</sup> ±0.30

Values are mean ± standard deviation of triplicate determinations

Mean scores in columns with same letters are not significantly different (p>0.05).

**Key:** A= (100% wheat flour), B= (90% wheat and 10% banana flour blend), C= (100% wheat and 10% mango flour blend), D= (80% wheat, 15% banana and 5% mango flour blend), E= (80% wheat, 15% mango and 5% banana flour blend), F= (70% wheat, 20% banana and 10% mango flour blend), G= (70% wheat, 20% mango and 10% banana flour blend).

**Table 3:** Vitamin Analysis of Bread Samples

<b>Samples</b>	<b>Vit A (mg/100 g)</b>	<b>Vit B1 (mg/100 g)</b>	<b>Vit B2 (mg/100 g)</b>	<b>Vit B3 (mg/100 g)</b>	<b>Vit B6 (mg/100 g)</b>	<b>Vit C (mg/100 g)</b>
A	0.22 <sup>f</sup> ±0.00	0.33 <sup>b</sup> ±0.00	5.11 <sup>g</sup> ±0.00	4.67 <sup>d</sup> ±0.00	0.23 <sup>f</sup> ±0.01	0.06 <sup>g</sup> ±0.00
B	0.22 <sup>f</sup> ±0.00	0.33 <sup>b</sup> ±0.00	8.68 <sup>e</sup> ±0.00	4.68 <sup>d</sup> ±0.11	0.26 <sup>e</sup> ±0.00	2.39 <sup>e</sup> ±0.00
C	0.48 <sup>e</sup> ±0.00	0.32 <sup>c</sup> ±0.00	8.49 <sup>f</sup> ±0.00	5.25 <sup>c</sup> ±0.00	0.32 <sup>d</sup> ±0.01	2.44 <sup>e</sup> ±0.00
D	0.45 <sup>d</sup> ±0.00	0.37 <sup>a</sup> ±0.00	10.99 <sup>d</sup> ±0.00	5.35 <sup>b</sup> ±0.00	0.35 <sup>c</sup> ±0.01	2.55 <sup>f</sup> ±0.00
E	0.49 <sup>c</sup> ±0.00	0.33 <sup>b</sup> ±0.00	11.92 <sup>b</sup> ±0.00	5.31 <sup>bc</sup> ±0.00	0.48 <sup>a</sup> ±0.01	3.20 <sup>e</sup> ±0.00
F	0.50 <sup>b</sup> ±0.00	0.32 <sup>c</sup> ±0.00	11.97 <sup>a</sup> ±0.00	5.58 <sup>a</sup> ±0.00	0.46 <sup>b</sup> ±0.01	2.36 <sup>f</sup> ±0.00
G	0.52 <sup>a</sup> ±0.00	0.32 <sup>c</sup> ±0.00	11.59 <sup>c</sup> ±0.00	5.65 <sup>a</sup> ±0.00	0.48 <sup>a</sup> ±0.00	2.42 <sup>d</sup> ±0.00

Values are mean ± standard deviation of triplicate determinations.

Mean scores in columns with same letters are not significantly different (p>0.05).

**Key;** Same as in Table 2

**Table 4:** Mineral Analysis of Bread Samples

<b>Samples</b>	<b>K (mg/100 g)</b>	<b>Ca (mg/100 g)</b>	<b>Na (mg/100 g)</b>	<b>Mg (mg/100 g)</b>	<b>P (mg/100 g)</b>	<b>Fe (mg/100 g)</b>
A	44.75 <sup>g</sup> ±0.14	18.84 <sup>g</sup> ±0.01	4.91 <sup>g</sup> ±0.14	6.11 <sup>g</sup> ±0.01	9.18 <sup>g</sup> ±0.01	0.55 <sup>g</sup> ±0.01
B	52.26 <sup>f</sup> ±0.14	21.14 <sup>f</sup> ±0.01	5.39 <sup>f</sup> ±0.01	6.56 <sup>f</sup> ±0.00	12.30 <sup>f</sup> ±1.41	0.63 <sup>f</sup> ±0.01
C	71.15 <sup>e</sup> ±0.14	25.91 <sup>e</sup> ±0.01	5.55 <sup>e</sup> ±0.01	7.13 <sup>e</sup> ±0.02	15.22 <sup>e</sup> ±0.01	0.66 <sup>e</sup> ±0.01
D	83.17 <sup>d</sup> ±0.01	27.73 <sup>d</sup> ±0.01	5.94 <sup>d</sup> ±0.01	7.36 <sup>d</sup> ±0.02	16.33 <sup>d</sup> ±0.10	0.76 <sup>d</sup> ±0.00
E	87.62 <sup>c</sup> ±0.14	28.56 <sup>c</sup> ±0.00	7.16 <sup>c</sup> ±0.14	7.46 <sup>c</sup> ±0.02	16.14 <sup>c</sup> ±0.01	0.83 <sup>c</sup> ±0.01
F	91.56 <sup>b</sup> ±0.14	29.12 <sup>b</sup> ±0.01	7.86 <sup>b</sup> ±0.14	7.55 <sup>b</sup> ±0.02	17.57 <sup>b</sup> ±0.01	1.23 <sup>b</sup> ±0.01
G	98.06 <sup>a</sup> ±0.14	37.13 <sup>a</sup> ±0.01	9.40 <sup>a</sup> ±0.00	9.12 <sup>a</sup> ±0.01	17.93 <sup>a</sup> ±0.01	1.25 <sup>a</sup> ±0.00

Values are mean ± standard deviation of triplicate determinations. Mean scores in columns with same letters are not significantly different (p>0.05).

**Key;** Same as in Table 2

## References

- Adeniji TA, Sanni LO, Barimalaa IS, Hart AD. Nutritional composition of five new Nigerian Musa hybrid cultivars, Implications for adoption in human nutrition. *Fruits*,2007:62:135-142.
- Anna Winiarska-Mieczan, Małgorzata Kwiecień. Evaluation of The Mineral Composition of Breadstuff And Frequency Of Its Consumption. University of Life Sciences in Lublin, Acta Sci. Pol., Technol. Aliment.,2011:10(4):487-495.
- AOAC Official methods of analysis. Association of Official Analytical Chemists.18th edition. Washington D. C. USA., 2010.
- Badifu SO, Chima CE, Ajayi YI, Ogori AF. Influence of mango mesocarp flour supplement to micronutrient; physical and organoleptic qualities of wheat-based bread. *Nigerian Food Journal*,2005:23:59-68.
- Baiyeri KP, Ortiz. Agronomic evaluation of plantain and other triploid musa, In: Creanen K; Ortiz R; Karamura E. B; Vuylsteke D. R (Eds), Proceedings of First International Conference on Banana Plantain Africa. Kampala Uganda, 12 – 18 Oct. 1996, Beta Horticulture,2000:540:125-135.
- Caparino OA, Tang J, Nindo CI, Sablani SS, Powers JR, Fellman JK. Effect of drying methods on the physical properties and microstructures of mango (Philippine 'Carabao' var.) powder, *J. Food Eng.*,2012:111:135-148.
- Cauvain SP. Technology of bread making. 3rd Ed. Switzerland: Springer International Publishing, 2015.
- Dewettinck K, Van Bockstaele F, Kuhne B, Van de Walle, Courtens T, Gellynck X. *Journal Cereal Science*,2008:48:243-257.
- Gesare Lilian Soibe, Ben N. Chikamai, Symon Mahungu. Evaluation of The Quality Characteristics Of Wheat - Plantain Composite Flour Bread Containing Gum Arabic From Acacia Senegal VarKerensis. *Food Science*, Egerton University., 2016.

10. Guiamba I. Nutritional value and quality of processed mango fruits. PhD Thesis, Food and Nutrition Science, Department of biology and biological engineering, Chalmers University of Technology, Göteborg, Sweden, 2016.
11. Honda S, Jood S. Organoleptic and nutritional evaluation of wheat biscuits supplemented with untreated and treated fenugreek flour. *Food Chemistry*, 2005;90:427-35.
12. Kiin-Kabari DB, Giarni SY. Physico-chemical properties and in-vitro protein digestibility of non-wheat cookies prepared from Plantain flour and Bambara Groundnut Protein concentrate. *Journal of food research*, 2015;4(20):78-86.
13. Lebaka VR, Wee Y-J, Ye W, Korivi M. Nutritional Composition and Bioactive Compounds in Three Different Parts of Mango Fruit. *Int. J. Environ. Res. Public Health*, 2021;18:741. <https://doi.org/10.3390/ijerph18020741>.
14. Madiha Rohi, Imran Pasha, MasoodSadiq Butt, Haq Nawaz. Variation in the Levels of B-Vitamins and Protein Content in Wheat Flours. *Pakistan Journal of Nutrition*, 2013 ISSN 1680-5194, 2013;12(5):441-447.
15. Mohamed GF, Nahed M Abdelmaguid, Wafaa Aboelsood Ibrahim, Helmy IMF, Nadir AS. Effect of Different Drying Methods and Pre-Treatments on Quality Characteristics of Mango Slices. *Food Science and Technology Department, National Research Centre, Cairo, Egypt.*, 2017, 519-531.
16. Mona Elena Popa, AmaliaMitelut, Georgiana-Aurora Stefanoiu, Elisabta Elena Popa. "Trends of Innovation In Bread And Bakery Production", 2016. <https://www.researchgate.net/publication/304215143>
17. Mudau M, Ramashia SE, Mashau ME, Silungwe H. Physicochemical characteristics of bread partially substituted with finger millet (*Eleusinecorocana*) flour. *Brazilian Journal of Food Technology*, 2021, 24, e2020123. <https://doi.org/10.1590/1981-6723.12320>
18. Muhammad RA, Aamir SSH, Muhammad AS, Moazzam RK, Muhammad SA. Comprehensive review on wheat flour dough rheology. *Pakistan Journal of Food Sciences*, 2013;23:105-123.
19. Offia-Olua BI. Chemical, Functional and Pasting Properties of Wheat (*Triticum*spp)-Walnut (*Juglansregia*) Flour. *Food and Nutrition Sciences*, 2014;5:1591-1604. <http://dx.doi.org/10.4236/fns.2014.516172>
20. Okwu DE. Phytochemicals and vitamin contents of indigenous spices of south eastern Nigeria. *Journal Sustainable Agriculture Environment*, 2004;6(1):30-37.
21. Oyetayo1 VO, RR Oyedeji1. Proximate And Mineral Composition Of Bread Fortified With Mushroom (*PlerotusOstreatus* And *CalocybeIndica*), 2017;19(4):1-9; Article no. MRJI.32133
22. Sarawong C, Schoenlechner R, Sekiguchi K, Berghofer E, Perry KWN. Effect of extrusion cooking on the physicochemical properties, resistant starch, phenolic content and antioxidant capacities of green banana flour. *Food Chemistry*, 2014;143:33-39.
23. SlavinJl, M Tucker, C Harrimanl. "Whole Grains: Definitions, Dietary Recommendations and Health Benefits". *Cereals Foods World*, 2013;58(4):191-198.
24. Standard Organisation of Nigeria (SON), NIS75:2004. Standard for White Bread. ICS 67.060 Plot 13/14 Victoria Arobieke Street, Off Admiralty Way, Lekki Peninsula Scheme1, Lekki Lagos Nigeria.
25. Subbaiah KV, Jagadeesh SL, Reddy S, Kanamadi VC. Effect of varieties and pre-treatments on physico-chemical and sensory quality of banana papads. *Karnataka Journal of Agricultural Science*, 2013;26:115-118.
26. Tang G, Wang D, Long J, Yang F, Si L. "Meta-Analysis of The Association Between Whole Grain Intake and Coronary Heart Disease Risk". *American Journal of Cardiology*, 2015;115(5):625-629.
27. US Food and Drug Administration. "Guidance For Industry: A Food Labelling Guide" (11.Appendix C: Health Claims), 2013.
28. Vaysieres J-F, Korie S, Coulibaly O, Temple L, Boueyi SP. The mango tree in central and northern Benin: Cultivar inventory, yield assessment, infested stages and loss due to fruit flies (*DipteraTephri-tidae*) *Fruits*, 2008;63(6):335-348.
29. Vernaza MG, Gularte MA, Chang YK. Addition of green banana flour to instant noodles: rheological and technological properties. *CiênciaAgrotecnologia, Lavras*, 2011;35(6):1157-1165.
30. Wekhe EO, Chuku EC, Barber LI. Determination of Mineral and Vitamin Composition of Sun Dried Bread Fruits Found In Rivers State, Nigeria. *International Journal of Agriculture and Earth Science E-ISSN 2489-0081 P-ISSN 2695-1894*, 2021, 7(1). [www.iiardpub.org](http://www.iiardpub.org).