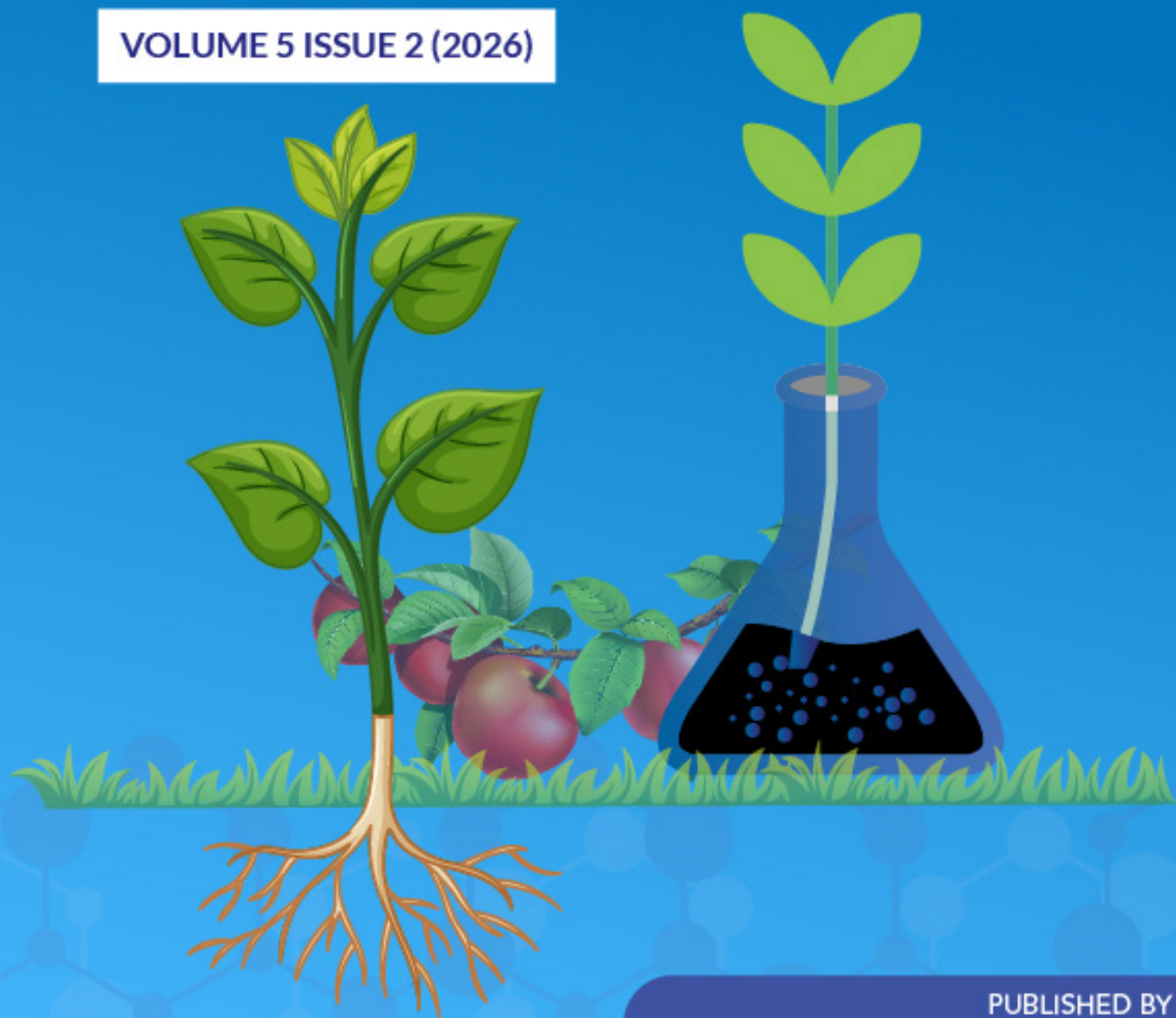




American Journal of Food Science and Technology (AJFST)

ISSN: 2834-0086 (ONLINE)

VOLUME 5 ISSUE 2 (2026)



PUBLISHED BY
E-PALLI PUBLISHERS, DELAWARE, USA

Functional, Nutritional and Antioxidant Properties of Wheat, Maize, Partially Defatted Peanut and Beetroot Composite Flours

I.A Akor^{1*}, J. K. Ikya², B. B. Kyenge³, M.S. Akpensuen²

Article Information

Received: January 02, 2026

Accepted: March 17, 2026

Published: September 07, 2026

Keywords

*Beetroot, Composite Flour,
Maize, Peanut, Wheat*

ABSTRACT

Composite flours are widely used in production of baked products; however, conventional wheat-based flours are becoming a concern for gluten intolerant people, also wheat is mainly imported in several countries of the world. Therefore, the use of maize incorporated with partially defatted peanut and beetroot presents a better option in terms of the nutritional and functional benefits. This study evaluates the qualities of composite flours made from wheat, maize-peanut-beetroot flour blends. Six samples were formulated with the designations A, B, C, D, E and F, Sample A was 100% wheat, Sample B was 100% maize, C, D, E, F were 0:80:10:10, 0:70:20:10, 0:60:30:10 and 0:50:40:10. Functional properties of the flour blends, they were analysed for chemical and antioxidant properties. There was no significant increase ($p < 0.05$) in the bulk density while water absorption capacity, forming capacity, swelling capacity and gelatinization temperature differed significantly with peanut inclusion. There was significant decrease ($p < 0.05$) among the samples with peanut inclusion in moisture content (9.99 – 6.29) %, while ash (0.29 – 2.49) %, fibre (7.65 – 20.85) %, fat (7.63 – 20.84) %, protein (8.75 – 13.56) %, carbohydrate (67.61 – 38.58) % and energy (333.07 – 396.1) % increased. Mineral (mg/100g) analyses of flour blends revealed that there was significant increase in the flour blend Iron (0.4 – 0.9), Potassium (9.04 – 19.84) and Sodium (5.06 – 6.63) while Zinc (0.4 – 0.2), Magnesium (0.09 – 0.06) and Calcium (3.19 – 2.84) showed significant decrease ($p < 0.05$) with peanut and beetroot inclusion. The antinutrient content (mg/g) of flours decreased with inclusion of peanut and beetroot, phytate (0.0824 – 0.0250), oxalate (0.1744 – 0.0912) and lectin (0.223 – 0.108). The results for vitamins showed increase in Vitamin A (0.43 – 68.37) µg, vitamin B1 (4.54 – 30.6) and vitamin B3 (1.76 – 57.08) mg/g while vitamin C (2.98 – 1.21) mg/g decreased with peanut and beetroot inclusion. The antioxidant properties of the flour blends showed differences among the sample, DPPH (20.51 – 46.59) %, SOD (14.29 – 47.62) % and FRAP (336.86 – 648.47) µmol. Maize, peanut and beetroot flours are suitable for making nutritious snacks and serves as a good alternative for wheat flours.

INTRODUCTION

The primary base material in bread, cakes, cookies, and other baked goods is flour. It is mostly made up of water, protein, and carbohydrates. The major flour used in baking is wheat flour primarily for its protein content (gluten). In contrast to protein, starch does not create a substantial gluten network in cookies dough, but serves as the primary dough filler. Low protein (8–11%) soft wheat flour is said to be the best flour for cookies because gluten produces a smaller network structure (Pareyt and Delcour, 2008). Products free of gluten are becoming more and more popular. Wheat containing gluten as causative agent for colon cancer, current research is now focused on product development using healthy available food crops which are underutilized for production of cookies (Bahmani S, Azarpira N and Moazamian E, 2019). Due to inadequate research on the nutritional advantages and dietary applications of many of cereals, legumes, and tubers/roots crops farmed in Nigeria, such as maize, acha, sorghum, peanut and beetroot, which are

grossly underutilized (Mepba *et al.*, 2021). Food security in poor countries such as Nigeria is compromised by two factors: post-harvest losses and underutilization of locally grown food crops (Ubbor, 2020).

Furthermore, the high carbohydrate content of flour can easily contribute to obesity among consumers.

As a result, several types of flour such as multigrain mixture (Kumar *et al.*, 2016), rice flour (Mancebo *et al.*, 2016), millet or adzuki bean flour (Eneche, 1999), oat flour (Duta and Culetu 2015), soybean and cassava flour (Ukwuru and Adama, 2013) and so forth—are used in place of wheat flour or to add different nutrients to cookies. Less reliance on wheat flour as the sole source has a positive impact on the economies of developing nations, reducing the need for imported wheat and increasing the use of underutilized native crops (Fadzelly, 2014). The problem of public health concerns due to gluten is also considered before shifting attention to promote use of locally available raw materials in product development. It also reduces dependence on wheat imports.

¹.Centre for Food Technology and Research, Moses Orshio Adasu University Makurdi, Nigeria

².Department of Human Nutrition and Dietetics, Joseph Sarwuan Tarka University Makurdi, Nigeria

³.Department of Chemistry, Benue State University, Makurdi, Nigeria

* Corresponding author's e-mail: isaacakor4@gmail.com

The objective of the study is to determine the functional, Chemical, Antioxidant properties of wheat, maize, peanut, and beetroot flour blends

LITERATURE REVIEW

Cereals have a low protein content compared to their high carbohydrate content in terms of nutritional value. For instance, 10% of wheat flour is protein, but approximately 87% of it is carbohydrates. Cereals have a high nutritional content in terms of carbs, vitamins, and fibre; however, they are lacking (limited) in the amino acid lysine. Legumes, on the other hand, are abundant in the amino acid lysine, therefore they can be added to cereal flours to help solve the limited amino acid issue (Samtiya *et al.*, 2020). Because of its composition, which includes macronutrients like proteins, carbs, and lipids as well as minerals like zinc, phosphorus, iron, calcium, and magnesium, wheat is mostly regarded as a cereal crop with a high nutritional value (Samtiya *et al.*, 2020). In addition to the high expense on wheat importation, excessive intake of wheat has been linked in various regions of the world to autoimmune reactions, allergies, asthma, diabetes, and gluten sensitivity (Adebayo *et al.*, 2021).

Maize is deficient in some essential amino acids such as lysine and tryptophan (Tortoe, 2017). Maize contains vitamin B-complex such as B1 (thiamine), B2 (niacin), B3 (riboflavin), B5 (pantothenic acid) and B6 that makes it good for hair, skin, digestion, heart and brain. Red beetroot is a rich source of minerals (manganese, sodium, potassium, magnesium, iron, copper). Beetroot contains a lot of antioxidants, vitamins (A, C, B) (Akonor, 2017), anti-inflammatory and anti-carcinogenic properties (Akor *et al.*, 2012). Red beetroot is also rich in phenol compounds, which have antioxidant properties with capabilities for protective effects against DNA damage and oxidative stress (Akor *et al.*, 2012), hypertension, atherosclerosis, type 2 diabetes, hypertension, atherosclerosis, type 2 diabetes and dementia (Akor *et al.*, 2012). The high monounsaturated fat peanut has been reported to lower body cholesterol by 11% (Akor *et al.*, 2012), reduction in the risk of coronary heart disease (Akor *et al.*, 2012). Peanuts contain all the 20 amino acids in variable proportions and is the biggest source of the protein called arginine (Akor *et al.*, 2012). Peanut meal amino acid profile shows that it can be an ingredient for protein fortification (Akor *et al.*, 2012). Therefore, the aim of this study was to investigate functional, nutritional and antioxidant qualities of maize-partially defatted peanut and beetroot composite flours.

MATERIALS AND METHODS

Source of Raw Materials

Maize grains and peanuts were purchased from Wadata market Makurdi, Benue State. Beetroots were purchased from local sellers in Jos, Plateau State.

Samples Preparation

Preparation of maize flour

Maize flour will be prepared following the description of Awofadeju and Olapade 2020 method as shown in figure 3.1. About 10 kg of maize grains were obtained and sorted. The maize grains were cleaned of any remaining dust and small particles by washing them with water, after which they will be conditioned and oven dried. The

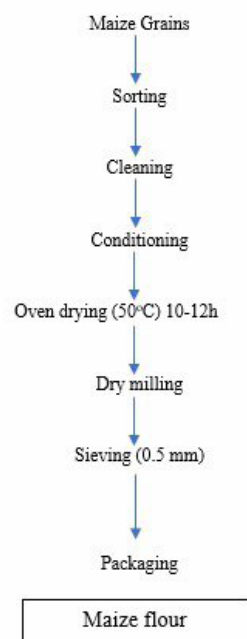


Figure 1: Flow chart for the production of maize flour

Source: Awofadeju and Olapade 2020

dried grains will be ground into flour using a commercial grinder (Heavy-duty electric Grinder, Model MG182/00, Chennai-India), the maize flour was be sieved using 0.5 mm sieved size. The sieved flour was packaged in Ziploc high-density polyethylene bags for further use.

Preparation of defatted peanut flour

Defatted ground nut flour will be made using a modified method of the Adjou *et al.* (2012), with the exception that the cake will be ground into flour. Whole peanuts will be dehulled, the hulls will be separated from the kernel, the kernels will be sorted to remove any foreign matter, and the kernels will be toasted at 150 oC for 15 minutes. Toasted seeds were then ground using clean GX160 attrition mill. Peanut cakes will be formed by shaping the paste and frying it in the extracted oil after it had been crushed in a mortar with the addition of boiling water to improve oil extraction. The oil will then be removed using a large spoon. In the end, a GX 160 attrition mill was used to produced peanut cake flour. The flour was oven dried at 50 oC for one hour and sieved for 0.5 mm screen sieve.

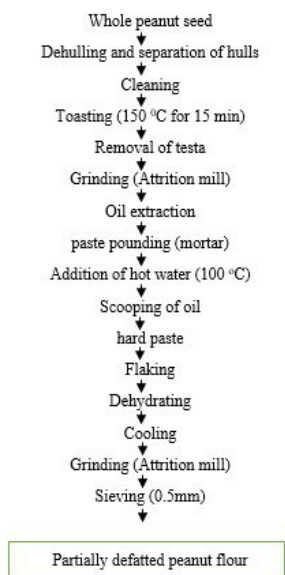


Figure 2: A Typical Processing Chart for Defatted Peanut Flour Production and oil extraction
 Source: As described by Adjon *et al.* (2012) with modification

Production of beetroot flour

Beet root was produced according to the method of Adegunwa (2012) as shown in Figure 3.3. After the beets was cleaned, trimmed, and sorted, the roots were blanched for 40 minutes at 100oC, then they were peeled, sliced, and dried in a hot air oven set at 60 oC for ten hours. Finally, the dried chips will be ground into flour using a BLG-595 MK2 blender and sieved through a 0.5 mm wire mesh. The flour will be store in Ziploc high-density polyethylene bags for further use.



Figure 3:Flow chart showing the production of beetroot flour
 Source: Adegunwa *et al.* (2012)

Blend formulation

Wheat, Maize, defatted peanut and beetroot flour samples were mixed into proportions of 100:0:0:0, 0:100:0:0, 0:80:10:10, 0:70:20:10, 0:60:30:10 and 0:50:40:10 respectively. Each combination represents samples A, B, C, D, E, F respectively .

Determination of functional properties maize, defatted peanut and beetroot flour blends

Determination of bulk density, Gelation Concentration AOAC (2012), Swelling capacity, foaming capacity was determined according to the method of Onwuka (2005). Water absorption capacity will be determined following the methodology of Robertson *et al.* (2000).

Proximate analysis of flour blends and cookies

Moisture content will be determined using the oven drying method as outlined by AOAC (2012) method. The amount of protein will be determined by total-Kjeldahl Nitrogen method according to AOAC (2012) method. Crude fat content was determined by the Soxhlet extraction method as outlined by AOAC (2012) method. Total ash content will be determined by dry ashing according to AOAC (2012) method. The total carbohydrate content will be estimated by the difference as described by Onwuka (2005). The total energy value was calculated using the Atwater general factor according to FAO (2001)

Determination of anti-nutrients Content of flour blends and cookies

Phytate, Tannin, Trypsin determination in the samples will follow the method of AOAC (2012).

Mineral Analysis

The method of AOAC (2012) with slight modification was used in to determine minerals contents. Mineral analysis of samples will be determined in two phases: sample digestion, and atomic absorption spectrophotometer (AAS) analysis.

Determination of Antioxidant activity

The SOD activity was determined by the method of Misra & Fridovich (1972). The DPPH assay was performed as described by Ravichandran *et al.* (Ravichandran et al 2012). The FRAP method was assayed according to Benzie and Strain (1996).

Determination of Vitamins Composition

The methods of AOAC (2012) were used in the determination of vitamins (A, B1, B3, and C)

RESULTS AND DISCUSSION

Functional Properties of Wheat, Maize, Peanut, and Beetroot Flour Blends

Functional properties are very critical to the quality of food. Starch is the main component responsible for the

Table 1: Functional Properties of Wheat, Maize, Peanut, and Beetroot Flour Blends.

Sample Code	Bulk density g/ml	Water absorption capacity g/ml	Forming Capacity %	Swelling Capacity%	Gelatinization Temperature oC
A-100:0:0:0	0.53a±0.50	8.2b±0.38	2a±0.71	86.17b±0.43	86.17e±0.56
B-0:100:0:0	0.51a±0.49	9.4c±0.34	2a±0.68	90.9d±0.50	62.5a±0.51
C-0:80:10:10	0.8a±0.54	8.4b±0.29	2a±0.65	85.1a±0.45	67.3c±0.57
D-0:70:20:10	0.73a±0.48	4.8a±0.30	2a±0.70	86.8b±0.53	67.5cd±0.53
E-0:60:30:10	0.62a±0.51	8.3b±0.32	3b±0.70	88.7c±0.39	65.2b±0.46
F-0:50:40:10	0.78a±0.53	8.3b±0.40	3b±0.67	88.8c±0.48	68.3d±0.38

Values are means ± standard deviations of triplicate determinations. Means in the same column with different superscripts are significantly different at ($p < 0.05$)

Table 2: Proximate Composition (%) of Wheat, Maize, Peanut, and Beetroot Flour Blends

Sample Code	Moisture content	Ash content	Crude fibre	Crude lipid	Crude protein	CHO	Energy (Kcal)
A-100:0:0:0	9.99d±0.63	0.29a±0.24	16.07b±0.75	7.63a±0.34	11.81b±0.45	54.28e±0.61	333.07a±0.35
B-0:100:0:0	6.29a±0.57	0.74a±0.32	7.65a±0.69	8.96b±0.28	8.75a±0.51	67.61f±0.58	386.07e±0.57
C-0:80:10:10	8.39c±0.65	2.36b±0.43	16.28bc±0.84	11.49c±0.42	11.38b±0.39	50.1d±0.47	349.28b±0.44
D-0:70:20:10	7.26b±0.47	2.12b±0.40	16.99cd±0.57	13.48d±0.38	12.75c±0.36	47.4c±0.68	361.91c±0.27
E-0:60:30:10	6.92ab±0.54	2.15b±0.39	20.85e±0.74	16.86e±0.43	13.13c±0.47	40.1b±0.32	364.61d±0.38
F-0:50:40:10	7.17ab±0.56	2.49b±0.28	17.36d±0.63	20.84f±0.38	13.56c±0.25	38.58a±0.56	396.1f±0.47

Values are means ± standard deviations of triplicate determinations. Means in the same column with different superscripts are significantly different at ($p < 0.05$).

Table 3: Mineral Content (mg/g) of Wheat, Maize, Peanut, and Beetroot Flour Blends

Sample Code	Fe	Zn	Mg	K	Ca	Na
A-100:0:0:0	0.7c±0.05	0.4c±0.02	0.09a±0.03	9.57c±0.04	3.19e±0.05	6.43c±0.07
B-0:100:0:0	0.4a±0.02	0.3b±0.06	0.08a±0.02	13.35e±0.02	2.46a±0.03	5.06a±0.04
C-0:80:10:10	0.8d±0.09	0.2a±0.01	0.08a±0.04	10.87d±0.05	2.6b±0.03	5.07a±0.06
D-0:70:20:10	0.9d±0.03	0.2a±0.06	0.07a±0.01	9.60c±0.04	2.67c±0.07	6.42c±0.02
E-0:60:30:10	0.9d±0.2	0.2b±0.03	0.06a±0.05	9.04b±0.08	2.65a±0.03	6.24b±0.01
F-0:50:40:10	0.9d±0.08	0.2a±0.05	0.06a±0.06	9.84a±0.02	2.84d±0.6	6.63d±0.03

Values are means ± standard deviations of triplicate determinations. Means in the same column with different superscripts are significantly different at ($p < 0.05$).

Table 4: Antinutrient Content (mg/g) of Wheat, Maize, Peanut, and Beetroot Flour Blends

Sample Code	Phytate%	Oxalate %	Lectine mg/100g
A 100:0:0: 0	0.0824d±0.0016	0.1744e±0.0079	0.223b±0.0057
B 0:100:0: 0	0.0383b±0.0033	0.0411a±0.0024	0.1336a±0.0027
C 0:80:10: 10	0.0250a±0.0008	0.1142c±0.0009	0.348c±0.0014
D 0:70:20:10	0.0406b±0.0017	0.1238d±0	0.237b±0.0057
E 0:60:30:10	0.0609c±0.0009	0.0912b±0.0016	0.281b±0.0651
F 0:50:40:10	0.0377b±0.0009	0.0962b±0.0024	0.108a±0.0014

Values are means ± standard deviations of triplicate determinations. Means in the same column with different superscripts are significantly different at ($p < 0.05$).

Table 5: Vitamin Content (mg/g) of Wheat, Maize, Peanut, and Beetroot Flour Blends

Sample Code	Vit A (µg)	Vit B1	Vit B3	Vit C
A 100:0:0:0	0.43a±0.5	4.54a±0.5	5.59a±0.5	0.32a±0.5
B 0:100:0:0	0.64a±0.5	8.08b±0.5	1.76a±0.5	2.98c±0.5
C 0:80:10:10	23.49a±39.59	10.69b±4.54	9.83a±13.99	2.38bc±1.14
D 0:70:20:10	68.37b±0.29	20.97c±0.29	36.51b±0.29	1.40ab±0.29
E 0:60:30:10	67.20b±0.5	25.70d±0.5	46.71c±0.5	1.21ab±0.5
F 0:50:40:10	66.20b±0.5	30.60e±0.5	57.08d±0.5	1.25ab±0.5

Values are means ± standard deviations of triplicate determinations. Means in the same column with different superscripts are significantly different at ($p < 0.05$).

Table 6: Antioxidant (µg/ml) Properties of Wheat, Maize, Peanut, and Beetroot Flour Blends.

Sample Code	DPPH Scavenging Activity (%)	SOD (%)	FRAP (µmol)
A-100:0:0:0	20.51a±1.41	14.29a±2.05	345.66a±187.5
B-0:100:0:0	46.59c±5.43	47.62d±3.12	635.62a±340.52
C-0:80:10:10	37.00b±3.61	27.21bc±5.13	648.47a±351.12
D-0:70:20:10	35.78b±2.28	21.77b±4.25	639.59a±371.92
E-0:60:30:10	46.01c±6.16	32.65c±4.08	336.86a±193.2
F-0:50:40:10	39.57bc±1.13	28.57c±2.04	610.23a±370.44

Values are means ± standard deviations of triplicate determinations. Means in the same column with different superscripts are significantly different at ($p < 0.05$).

gelatinization, browning, dextrinisation, gelation, (Sethi et al, 2022), protein on the other hand is responsible for the foaming, emulsification, coagulation. The bulk density values ranging from 0.51 to 0.8 g/ml are low, the values suggest that the flours have a relatively low density, which is often desirable in food products as it can influence texture and mouthfeel. Similar studies have reported bulk densities for various flour types, indicating that lower bulk density can enhance the lightness and aeration of baked products (Adebisi, et al, 2023). It is interesting to note the significant variation in water absorption capacity (0.62 – 8.4) among the samples. Research has shown that the water absorption capacity of flour can be influenced by the protein and fiber content, as well as the presence of soluble carbohydrates (Oluwafemi *et al.*, 2019). Increase in protein-rich ingredients in flours has been reported to increase water absorption (Seong et al 2022), the high fiber content in peanut might have contributed to the increase in the water absorption (Zemenu et al 2025, Oyeyinka & Bassey 2023), Water absorption of the flour is a very good indicator of the quality of the final baked product (Shongwe et al 2024). The foaming capacity observed (2.0 – 3.0) values are similar to Olosunde et al, 2025 (0.37 – 7.80), which indicates the ability of the flour blends to incorporate air, which is essential for products like cookies. The swelling capacity ranging from 85.1 to 90.9 suggests that the flour blends can absorb water and swell significantly. Studies have indicated that different starch sources can exhibit varying swelling behaviours, impacting the final product's texture (Joyner *et al.*, 2021). The gelation temperature range of 63.5 to 67.5°C indicates the temperature at which the starches in the flour begin to gelatinize. Gelation temperature can vary

significantly among different starch sources, influencing the cooking characteristics of the final product (Li, 2022; Chakraborty et al 2022).

Mineral Content of Wheat, Maize, Peanut, and Beetroot Flour Blends

The iron content in these blends (0.4-0.9 mg/g) is notably higher than values reported by Cheung *et al.* (2024), who found average iron content of 40 - 50 µg/g in conventional wheat flours. They recommended a minimum iron content of 0.5 mg/g in composite flours for meaningful nutritional impact, which all samples except B meet. Mustafa et al (2025) reported that peanut flour typically contributes 0.052 mg/g of zinc to composite flour blends, which may explain the zinc content in Samples. The variations observed in zinc content align with findings from Hassan (2025). Magnesium content shows less variation across all samples (0.03-0.086 mg/g) with no statistically significant differences, though Sample E has notably lower content. Potassium content shows significant variation, ranging from 8.84 - 13.35. Maria *et al.* (2019) report suggests that processing methods may have affected mineral retention. Calcium content ranges from 2.45 - 3.19, with all samples showing statistically significant differences. Martínez-Martín et al (2023) demonstrated that calcium-enhanced lentil and wheat flours composite flours could contain 0.06 – 0.229 g/100g. Sodium content varies from 4.63 - 6.43, with significant differences among samples. Kumar *et al.* (2024), the sodium contribution from flour typically represents a small proportion of total sodium in finished bakery products, with most sodium coming from added salt and leavening agents.

Antinutrient Content of Wheat, Maize, Peanut, and Beetroot Flour Blends

The antinutrient content in the flour blends, comprising wheat, maize, peanut, and beetroot, reveals notable variations that can influence nutrient bioavailability, digestibility, and overall nutritional quality (Longin et al, 2023). Phytate, a major antinutrient in cereals and legumes, chelates minerals and reduces their bioavailability (Zhang et al, 2022), 100% wheat shows the highest phytate at 0.08 mg/g, consistent with wheat's naturally elevated phytate content due to its concentration in the bran layer (Gupta et al, 2023). Maize flour (100% maize) has lower phytate at 0.038mg/g, aligning with reports that maize generally contains 0.067% phytate (Tura et al, 2024). Oxalates bind calcium to form insoluble complexes, potentially contributing to kidney stone risk (Siener, 2021), and are prevalent in root vegetables and some cereals. Wheat flour (A) has the highest oxalate at 0.1744 ± 0.0079 mg/g ($\sim 0.1744\%$), while maize (B) is lowest at 0.0411 ± 0.0024 mg/g ($\sim 0.0411\%$), reflecting maize's lower inherent oxalate (0.032% or 32.29 mg/100g). Blends show intermediate values (0.0912–0.1238 mg/g), with Sample D (70% maize, 20% peanut, 10% beetroot) highest at 0.1238 ± 0 mg/g and E/F lower (~ 0.091 – 0.096 mg/g). Jody Braverman (2024) highlighted that beetroot ranks among the highest oxalate-containing vegetables. Lectin content revealed the most striking variations among samples. Sample C demonstrated the highest lectin concentration at 0.348 (HU)/mg, substantially exceeding both pure wheat (0.223 (HU)/mg) and pure maize (0.1336 (HU)/mg) flours. This marked increase stems from peanut's naturally abundant lectin content.

Wheat flour 100% (Sample A) and 100% maize flour (Sample B) both showed minimal levels at 0.43 μ g/g and 0.64 μ g/g respectively of Vitamin A. The slight variation among Samples C to F (69.2 to 66.2 μ g/g) may reflect minor differences in beta-carotene retention influenced by the proportion of defatted peanut, which is not a significant source of Vitamin A. Wheat flour 100% (Sample A) has a low thiamine (B1) content which indicate that refining processes reduce B-vitamin content in wheat (Garg et al, 2021). Maize flour (Sample B, 8.079 mg/g) has a higher thiamine content, as maize retains more B-vitamins naturally (Szulc et al., 2022). The increasing trend from Sample C (15.9 μ g) to F (30.6 μ g) correlates with the rising proportion of defatted peanut (10% to 40%), supporting the role of peanut flour in enhancing thiamine content. The low niacin (B3) content in 100% wheat (Sample A) and 100% maize (Sample B) flours aligns with findings from Kumari et al. (2024), The trend of increasing niacin from Sample C (25.97 mg/g) to F (57.08 mg/g) corresponds to the increasing proportion of defatted peanut (10% to 40%). Wheat flour (Sample A) has negligible Vitamin C, which is consistent with Akhtar et al. (2021), as cereals are not significant sources of vitamin C. Maize flour (Sample B) contains a higher amount, possibly due to residual ascorbic acid, as reported by Ezekiel et al. (2022). However, the relatively

low Vitamin C content in Samples C to F, despite 10% beetroot inclusion, is unexpected, given beetroot's known Vitamin C content. This could be due to processing losses, as Vitamin C is heat- and oxygen-sensitive, and flour blending or storage may degrade it (Al-Sharif et al, 2025).

Antioxidant Properties

The antioxidant capacity of composite flours is increasingly recognized as an important functional property with potential health benefits. The DPPH (2,2-diphenyl-1-picrylhydrazyl) radical scavenging activity ranged from 20.51% to 46.59%. Consumption of plant products which has an antioxidant effect, reduces the risk of catching diseases and prevents the development of degenerative disorders (Gulcin & Alwaseel, 2023). The SOD activity shows even greater variation across samples, ranging from 14.29% (Sample A) to 47.62% (Sample E). The relatively low SOD activity in Sample E (32.65%) is not surprising given the expected the effect of UV radiation and oxygen degradation of the antioxidant reducing capacities. SOD regulates oxidative stress, lipid metabolism, inflammation, and oxidation in cells. It can prevent lipid peroxidation, the oxidation of low-density lipoprotein in macrophages, lipid droplets' formation, and the adhesion of inflammatory cells into endothelial monolayers. The Ferric Reducing Antioxidant Power (FRAP) content ranged from 336.86 to 648.47 μ mol, with no significant differences observed among the samples. The FRAP values range from 336.86 (Sample E) to 648.47 (Sample C), showing substantial variation, though the differences were not statistically significant due to the high standard deviations. The relatively high FRAP values in Samples B, C, D, and F (all exceeding 600) suggests substantial reducing power. The reducing power indicated by FRAP values may have cardiovascular implications.

CONCLUSION

Composite flours made from maize, partially defatted peanut, beetroot flours have improved functional and nutritional value which makes it suitable for baked products and a good substitute for those who are gluten intolerant.

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