

Quality Evaluation of Bread Produced from Blends of Wheat, Pro-Vitamin A Cassava and *Prosopis africana* Flour

Iornyor, M. S.¹; Igoli, J. O.²; and Magashi, L. N.³

¹Centre for Food Technology and Research (CEFTER), Moses Orshio Adasu University Makurdi, Benue State, Nigeria. ²Department of Chemistry, Joseph Sarwuan Tarka University, Makurdi, Benue State, Nigeria.

³Department of Science Laboratory Technology, Federal Polytechnic Wannune, Benue State, Nigeria.

Corresponding author: soniaiornyor@gmail.com

DOI: <https://doi.org/10.62154/ajasfr.2026.022.01021>

Abstract

This study assessed the quality of bread produced from a blend of wheat, pro-vitamin A cassava, and *Prosopis Africana* flours. Various formulations from wheat, *Prosopis Africana* and pro-vitamin A cassava (100:0:0, 80:10:10, 75:10:15 and 70:10:20) were prepared and assessed for their proximate composition, functional characteristics and sensory using standard methods. The inclusion of *prosopis africana* flour in wheat-cassava flour significantly influenced functional properties such as bulk density (0.46-0.74 g/ml), swelling index (0.23-0.71 %) water absorption capacity (1.15-1.56 mL/g) and oil absorption capacity (1.77-2.03 mL/g). Proximate composition showed improvements in protein (10.60-15.67%), fiber (2.59-4.01 %), and ash (2.23-3.04 %) content as substitution levels increased, while moisture 21.99–26.88% and fat (1.46-2.54 %) remained within recommended limits. The study highlights the potential of utilizing underexploited plant ingredients to develop functional, nutrient-dense traditional foods. The study recommends that the formulation with 15% *Prosopis africana* flour inclusion should be adopted for its sensory acceptability and improved nutritional quality.

Keywords: Bread, Pro-Vitamin A, *Prosopis Africana*, cassava, Wheat.

Introduction

Bread is a widely consumed staple in urban Nigeria, yet the country relies heavily on imported wheat to meet local demand, with more than 90% of its wheat supply sourced from abroad (Sobowale *et al.*, 2021). In response, the use of locally available alternatives such as cassava flour in composite bread formulations presents a cost-effective and nutritionally beneficial solution. This approach not only reduces dependence on imported wheat but also supports local agricultural and processing industries.

Wheat flour remains crucial in bread-making due to its gluten content, which provides the elasticity and strength necessary for gas retention, dough expansion, and loaf volume. Despite these advantages, wheat is nutritionally poor or low in amino acid and micronutrients. Wheat flour is the major flour utilized in the production of bread; however, in recent studies, bread have been produced from flours of other sources including root/tuber crops, flours from legume sources or their protein isolates, amongst other commodities (Abolaji *et al.*, 2019).

Pro-vitamin A cassava, particularly the yellow-fleshed varieties like UMUCASS 36, 37, and 38, has been developed through initiatives by organizations such as Harvest Plus, IITA, and the National Root Crops Research Institute (Afolami *et al.*, 2021). These cassava types are enriched with β -carotene, the precursor to vitamin A, reaching concentrations of up to approximately 9 $\mu\text{g/g}$ in fresh roots. Studies have shown that consuming foods made from these varieties can significantly improve vitamin A intake in at-risk populations, such as preschool-aged children, reducing deficiency rates from nearly 30% to below 10% in controlled trials (Afolami *et al.*, 2021). While blending wheat and cassava is relatively well-established, introducing *Prosopis africana* flour into the mix offers an innovative nutritional enhancement. This legume seed flour is rich in protein and is typically processed by dehulling and defatting (Gonzales-Barron *et al.*, 2020).

Although underutilized in bread applications, research involving similar legumes, such as *Prosopis pallida*, shows that adding even modest amounts (up to 10%) can improve bread volume and dough cohesiveness (Gonzales-Barron *et al.*, 2020). This is attributed to the flour's high water-binding capacity, globular proteins, and naturally occurring polysaccharides like galactomannans. These features suggest that *Prosopis africana* flour could help counteract the negative effects of reduced gluten in wheat cassava blends, improving both the nutritional profile and baking performance of composite breads. It is to this effect that the present study focuses on evaluating the quality of bread produced from wheat, pro-vitamin A cassava and *Prosopis Africana* flour.

Statement of the Problem

The use of composite flours from tubers like cassava and legumes for their nutritional benefits is in place. However, the major limitation of using pro-vitamin A cassava in bread-making is its lack of gluten-forming proteins, which are essential for dough elasticity and bread structure. High levels of cassava substitution often result in poor loaf quality, characterized by reduced volume and undesirable texture, unless functional ingredients are added to improve dough performance (Olatunde *et al.*, 2020). On the other hand, legumes such as *Prosopis africana* are rich in protein but highly underutilized in food system. In addition, there has been limited research on combining wheat, pro-vitamin A cassava, and *Prosopis africana* flours to examine how they collectively influence bread quality, nutrient retention (especially β -carotene), and sensory properties. Producing bread from Provitamin A cassava flour enriched with *Prosopis africana* will provide valuable insights into alternative gluten-free formulations, particularly those utilizing cassava and *Prosopis africana* flours. Furthermore, the inclusion of this concentrate is expected to enhance both the quantity and quality of bread proteins, thereby supporting the nutritional well-being of individuals with celiac disease—an autoimmune digestive disorder triggered by the consumption of gluten.

Objectives of the Study

The objectives of the study include:

- i. to produce bread from provitamin A cassava supplemented with *Prosopis africana* flour.
- ii. to determine the functional properties of flour from wheat-cassava and *prosopis africana* blends
- iii. to determine the proximate properties of flour from wheat-cassava and *prosopis africana* blends
- iv. determine the Sensory quality attributes of wheat-cassava and *Prosopis africana* flour blend bread

Materials and Methods

Sources of Raw Materials

Pro-vitamin A cassava, newly bred β -carotene NR07/0427 was obtained from cassava program, National Root Crops Research Institute (NRCRI), Umudike while *Prosopis africana* was obtained from Katsina-Ala Local Government Area of Benue State. Other ingredients: yeast, salt, sugar, fat, ascorbic acid and Xanthan gum were procured from Wurukum market, Makurdi, Benue State, Nigeria.

Production of Pro-Vitamin A Cassava Flour

Pro-vitamin A cassava flour was produced using the method as described by Aniedu and Omodamiro, (2012). Harvested tubers were sorted, peeled and washed in clean running tap water. The washed tubers were grated and screw using hydraulic presser to dewater the mash. The mashed was pulverized and oven-dried, milled and sieved to obtain cassava flour (Figure 1).

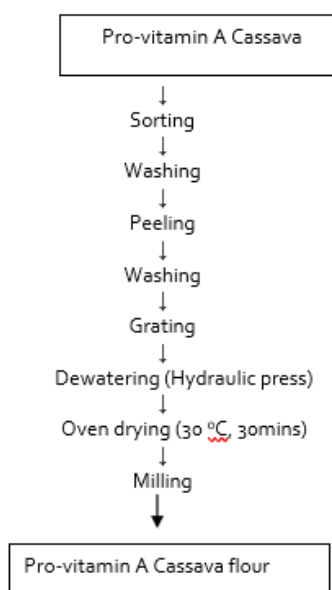


Figure 1: Production of Pro-vitamin Cassava Flour (Aniedu and Omodamiro, 2012)

Preparation of *Prosopis africana* Beans into Flour

Prosopis africana beans was processed into flour as described by Balogun and Olatidoye (2010). Exactly 1000 g of matured *Prosopis africana* beans was sorted, cleaned to remove extraneous materials like stones and defective seeds, soaked in distilled water (1:4 w/v) for 48 hours at ambient temperature (27 ± 2 °C) to reduce the anti-nutrients present in beans. It was dehulled manually, oven-dried at 30 °C for 24 and subsequently milled into flour (300 μ m).

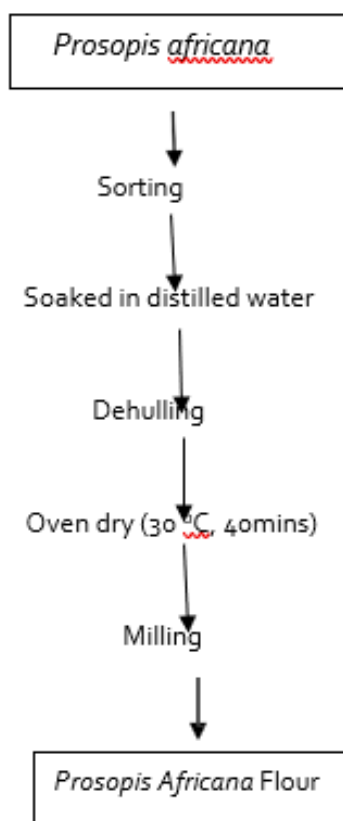


Figure 2: Flow chart for *Prosopis africana* flour production (Balogun and Olatidoye, 2010)

Preparation of Bread

The bread was produced according to the method described by Edema *et al.* (2005) with slight modification. Wheat, Pro-vitamin A Cassava flour (PVACF) and *Prosopis africana* were mixed in the ratio of 100:0:0, 80:10:10, 75:10:15, 70:20:10 w/w. The bread recipe consisted of 100 g of each flour blend, 15 g sugar, 18 g xanthan gum, 2.0 g salt, 10.0 g margarine, 15 g yeast, 2.0 g nutmeg, 7.0mL EDC oil and 150mL of water. The dough was kneaded with kneading machine, molded and transferred into baking pans greased with fats. The dough was allowed to rise at room temperature (27 ± 2 °C) in the baking pan, proofed and baked (210 °C, 33 min.) as shown in the Figure below. It was allowed to cool then packaged for further analyzes.

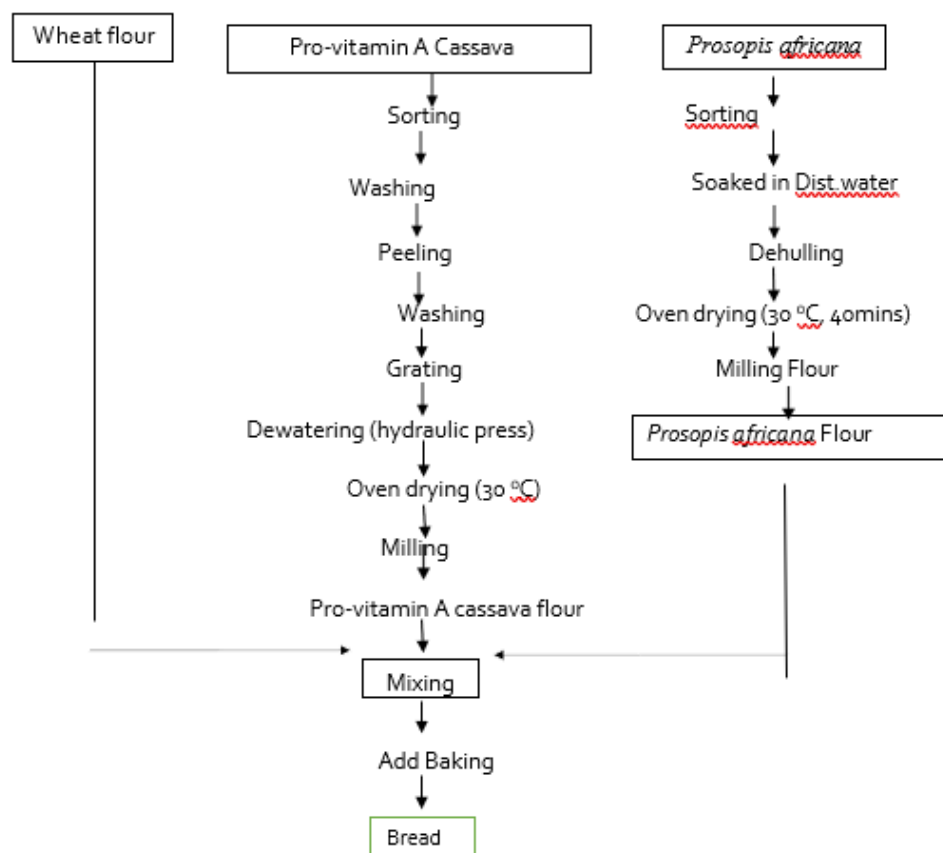


Figure 3: flow chart for bread production (Edema, et al.,2005)

Sample Formulation

Composite flours with different proportions of pro-vitamin A cassava and *Prosopis africana* was made as shown in Table 1 below with 100 % cassava flour as control. A digital weighing balance and blender (Philips, HR 1702) respectively were used in weighing and mixing the flour.

Table 1: Wheat, Cassava and *Prosopis africana* flour blends formulation

Sample code	Wheat	<i>Prosopis Africana</i>	Cassava
A	100	0	0
B	80	10	10
C	75	10	15
D	70	10	20

Analysis

Proximate Analysis

The total moisture content, total ash, fat, crude protein, total dietary fiber and total carbohydrates were determined as described by AOAC, 2019. Carbohydrate was determined by a difference as described by Nwafor *et al.*, (2020) using the equation:

$$\text{Carbohydrate (\%)} = 100 - (\text{moisture} + \text{ash} + \text{fat} + \text{fiber} + \text{protein}) \dots\dots\dots(1)$$

Functional Analysis

Bulk Density

The bulk density of the flour was determined according to the method described by Nwosu et al. (2014). A calibrated centrifuge tube was weighed using an analytical balance in each case and the samples was filled up to the 10 mL mark. The sample was then tapped until there was be no further changes in volume. The contents were each weighed with the aid of an analytical balance and from the difference in weights, the bulk density of each sample was calculated thus;

$$\text{Bulk density} = \frac{\text{weight (g)}}{\text{volume (ml)}} \dots\dots\dots(2)$$

Water Absorption Capacity

WAC was determined following the methodology of Nwosu *et al.* (2014). Exactly 0.5g of sample was weighed in a test tube and an excess of water (10 mL) was added. The mixture was agitated and left to hydrate for 30 min. After centrifugation at 1650 r/min for 10 minutes the mixture was left to settle and to separate the supernatant. Finally, the sediment was weighed. The WAC was calculated as follows:

$$\text{WAC} = \frac{\text{sediment weight (g)} - \text{weight (g)}}{\text{sample weight}} \dots\dots\dots(3)$$

Swelling Index

The swelling index was determined according to the method described by Eke, et al., (2014). Two (2) grams of the bread sample was weighed into a 50 ml measuring cylinder and the volume occupied was recorded. Distilled water was then added to 50 ml mark and the mixture was allowed to stand for 45mins after which the new volume was recorded. The ratio of the initial volume to the final volume was taken as the swelling index.

$$\text{Swelling index} = \frac{v_2 - v_1}{v_2} \dots\dots\dots(4)$$

Where V_1 = Initial volume occupied by sample and V_2 = Final volume occupied by the sample after swelling.

Water and Oil Absorption Capacity (WAC and OAC)

Water and oil absorption capacities of the bread samples were determined by the method described by Oladele and Anna (2007). One (1) gram of the bread was mixed with 10 ml of water or oil in a centrifuge tube and was allowed to stand at room temperature (30 °C) for 1h. the mixture was centrifuged at 2000 g/min for 30 min. The volume of water or oil on the sediment (supernatant) was then measured. Water and oil absorption capacities were calculated as volume (milliliters) of water or oil absorbed per gram of flour.

$$\text{WAC/OAC} = \frac{V_1 - V_2}{W} \dots\dots\dots(5)$$

where,

WAC = Water absorption capacity

OAC = Oil absorption capacity

V₁ = Initial volume of water or oil

V₂ = Final volume after centrifuging

W = Weight of the sample

Sensory Evaluation

The sensory evaluation was done using method described by Ihekoronye and Ngoddy, (1985). A twenty-member panel of judges comprising a broad cross section of adult population (students and staff) of Benue State University Makurdi. The sensory qualities evaluated were appearance (colour), flavour (aroma and taste), texture and overall acceptability. The coded samples were presented to the panelists with portable water to rinse their mouths before and during the evaluation. The 9-point hedonic scale was used. The rating scale was as follows: 1 - Dislike extremely, 2 - Dislike very much, 3 - Dislike moderately, 4 - Dislike slightly, 5- Neither like nor dislike, 6- Like slightly, 7- Like moderately, 8- Like very much, 9- Like extremely.

Statistical Analysis

The results generated were subjected to statistical analysis using SPSS version 26 (SPSS Inc., Chicago, IL) and MS-Excel (Microsoft Inc., USA) at 95% confidence level. The analysis of variance (ANOVA) was used for replicate determinations to detect the existence (or otherwise) of significant differences amongst the results. For replicate determinations, the mean and standard deviation were calculated. Duncan's new multiple range test was used to separate the means at 5% level of significance.

Results and Discussion

Proximate Properties

The result of the proximate analysis carried out on the bread produced from wheat, pro-vitamin A cassava and *Prosopis africana* flour are presented in table 2 below. The inclusion of *Prosopis africana* and cassava flour in wheat flour had significant ($p < 0.05$) effect on proximate composition wheat-based bread. The protein, ash, fat, fibre and moisture content significantly ($p < 0.05$) increased with inclusion of *Prosopis africana* and cassava flour in wheat flour. The carbohydrate content significantly ($p < 0.05$) decreased with inclusion of *Prosopis africana* and cassava flour in wheat flour-based bread.

The crude protein ranged from 8.96 % to 13.31 %. Sample A had the lowest protein content (8.96%) while sample D had the highest value (13.31 %). There was a significant increase ($p < 0.05$) with an increase in the level of *Prosopis africana* and cassava flours. The increase was anticipated because *Prosopis africana* is a legume while wheat is a cereal crop. Legumes naturally, have more protein than cereals although the prevalent protein in wheat occurs as gluten which is needed in baking. The high crude protein content of food legumes generally

constitutes the natural protein supplements to the staple diet. Similar results were also obtained by Okoye and Ezeugwu who worked on the quality of bread from wheat, bambara nut and cassava flour blends. The fat content of the sample ranged from 1.61 to 2.92 % with sample A and D having the lowest and the highest values respectively (table 2). The fat content of the samples increased with increased percentage level of pro-vitamin A cassava and the *Prosopis African* flours. The control (100% wheat) had the lowest fat, and the increase with substitution is primarily attributed to *Prosopis africana*, which has been reported to contain appreciable lipid levels (6–10%) by Girgih et al. (2011). Cassava flour itself is low in fat, so *Prosopis africana* is the dominant driver of this trend. Higher fat content may positively influence mouthfeel and energy density of products, though it could also reduce shelf life if not properly managed. The crude fibre content increased significantly from 1.19% (A) to 1.67% (D), which is nutritionally beneficial. Both cassava and *Prosopis africana* are good sources of dietary fibre. Ogori, et al., (2024) reported that substituting wheat with cassava flour increased dietary fibre in composite flours, which is associated with improved gastrointestinal health, reduced glycaemic response, and better satiety. The increasing fibre trend here supports the functional nutritional advantage of the composite blends over the 100% wheat control. Ash content increased from 2.71% (A) to 2.95% (D), reflecting a progressive increase in mineral matter with increasing substitution. This is a desirable nutritional outcome. *Prosopis africana* is known to be rich in minerals including calcium, iron, and zinc (Obasi et al., 2012), and cassava flour also contributes some mineral content. The significantly higher ash in composite blends compared to the control suggests improved mineral bioavailability potential, consistent with findings by Eke-Ejiofor and Owuno (2012) in cassava-wheat composite flour studies. As in Table 2, Moisture values ranged from 21.99–26.88%, increasing significantly ($p < 0.05$) with higher cassava substitution. All values fall within the acceptable moisture limit of $\leq 14\%$ recommended by the Codex Alimentarius for flour safety and shelf stability. The increase in moisture with cassava inclusion aligns with findings by Eleazu et al., (2011), who reported higher moisture in cassava-wheat composite flours compared to 100% wheat, attributable to cassava's hygroscopic nature. Sample D's slightly elevated moisture warrants attention regarding shelf life. Carbohydrate content decreased from 75.58% (A) to 74.07% (D) as substitution increased. This inverse trend is a consequence of the increase in other proximate fractions (fat, ash, fibre, and moisture), since carbohydrate is calculated by difference. Despite the decrease, CHO remained the dominant macronutrient across all samples, consistent with the starchy nature of all three flour components. Asadu and Chukwu, (2024) reported similar declining CHO trends in multi-component composite flour systems, noting that this does not necessarily diminish the energy value of the product given the compensatory rise in fat.

Table 2: Proximate composition (%) of wheat, *Prosopis africana* and cassava flour blends

Wheat: <i>prosopis</i> : cassava	Protein	Fat	Fibre	Ash	Moisture	Carbohydrate
A (100:0:0)	8.96 ^a ±0.02	1.61 ^a ±0.01	1.21 ^a ±0.02	5.65 ^a ±0	21.99 ^a ±0.03	60.58 ^d ±0.06
B (80:10:10)	9.22 ^a ±0.03	2.31 ^b ±0.02	1.62 ^b ±0.03	5.71 ^b ±0.02	22.48 ^d ±0.02	58.66 ^c ±0.12
C (75:10:15)	10.41 ^b ±0.02	2.61 ^c ±0.02	1.71 ^c ±0.01	5.81 ^c ±0.01	24.88 ^b ±0.01	54.58 ^b ±0.08
D (70:10:20)	13.31 ^c ±0.74 ^c	2.92 ^d ±0.01	2.01 ^d ±0.02	6.14 ^d ±0.02	26.88 ^c ±0.01	48.74 ^a ±0.10

Values are means ± standard deviation of triplicates determinations. Values in the same column followed by different superscripts are significantly (p<0.05) different.

Table 3: Functional properties of wheat, *Prosopis africana* and cassava flour blends

Wheat: <i>prosopis</i> : cassava	Swelling index (%)	Water absorption capacity(mL/g)	Bulk density g/mL	Oil absorption capacity(mL/g)
A (100:0:0)	0.71 ^c ±0.01	1.15 ^a ±0.02	0.74 ^d ±0.04	1.77 ^a ±0.02
B (80:10:10)	0.56 ^b ±0.01	1.34 ^b ±0.01	0.65 ^c ±0.01	1.84 ^a ±0.06
C (75:10:15)	0.35 ^a ±0.03	1.45 ^c ±0.02	0.57 ^b ±0.01	1.96 ^b ±0.05
D (70:10:20)	1.23 ^d ±0.01	1.56 ^d ±0.01	0.46 ^a ±0.04	2.03 ^b ±0.01

Values are means ± standard deviation of triplicates determinations. Values in the same column followed by different superscripts are significantly (p<0.05) different.

Table 4: Sensory quality attributes of wheat, *Prosopis africana* and cassava flour blends bread

Wheat: <i>prosopis</i> : cassava	Appearance	Aroma	Taste	General Acceptability
A (100:0:0)	7.67 ^a ±2.19	7.00 ^a ±2.17	7.92 ^a ±0.67	8.08 ^a ±1.00a
B (80:10:10)	5.92 ^{ab} ±2.54	5.58 ^{ab} ±2.43	5.50 ^b ±2.32	5.17 ^b ±2.17
C (75:15:10)	6.00 ^{ab} ±2.37	5.58 ^{ab} ±2.31	5.25 ^b ±2.49	5.58 ^b ±2.23
D (70:20:10)	4.58 ^b ±3.06	4.17 ^b ±2.30	3.92 ^b ±2.68	4.00 ^b ±2.17

Functional Properties

The result of the functional analysis carried out on the bread produced from wheat, pro-vitamin A and *Prosopis africana* flour is shown in Table 3 above. The inclusion of *Prosopis africana* and cassava flour in wheat flour resulted to significant (p<0.05) decrease in swelling index of flour blends with sample A, B, C and D recording 0.71 %, 0.56 %, 0.35 % and 1.23 % respectively. Zhu *et al.* (2017) reported that the swelling index of is influenced by particle size, composition (such as starch content) and processing methods or unit operations involved in flour production. The particle size and composition of *Prosopis africana* and cassava flour could be responsible for the decrease in swelling index of the flour blends. The

swelling index reported by this study shows similar trend with the report of Taiwo and Dorcas (2023) and Ezeocha *et al.* (2023) who reported higher values of 1.36-1.66 mL/g and 1.31-2.41 g/mL in maize and soybeans bean composite flour and rice and pigeon pea composite flour respectively. The swelling index of flour represents the volume of in milliliters occupied by the swelling of 1 g of flour under specific conditions, is influenced by particle size, composition (such as starch content) and processing methods or unit operations involved in flour production (Zhu *et al.*, 2017). The water absorption capacity of the blends ranged between 1.15 mL/g to 1.56 mL/g. The inclusion of *Prosopis africana* and cassava flour resulted to significant ($p < 0.05$) increase in water absorption capacity of the flour blends. Water absorption capacity is influenced by the polysaccharides as well as protein hydrophilic and hydrophobic constituents. The increase in WAC of flour blends could be due to the nature of protein, their hydrophilic and hydrophobic properties. Among the flour blends, the sample with 20 % *Prosopis africana* and 10 % cassava flour inclusion was highest in WAC while the 100 % wheat flour was least in water in WAC.

The result of this study agrees with the findings of Ape *et al.* (2016), who reported water absorption capacities ranging from 1.13 to 1.27 g/g in maize-based flour supplemented with African locust bean flour. Similarly, the result aligns with the report of Abolaji *et al.* (2019), who obtained values between 1.3 and 2.4 g/g for flour blends from sorghum, African yam bean, and soybean used for complementary feeding. The result showed that the bulk density of samples A, B, C and D are 0.74 g/mL, 0.56 g/mL, 0.57 g/mL and 0.46 g/mL respectively. The bulk density decreased with the inclusion of *Prosopis africana* and cassava flour in the blends implying that *Prosopis africana* and cassava flour had effect on the bulk density of flour blends. Awulachew, M. T. 2021, stated that the difference or variation in starch content of flours can affect the bulk density, and this could be responsible for the variation in bulk density. The higher the starch content the more likely the increase in bulk density. Among the formulated samples, the blend containing 20% *Prosopis africana* and 10% cassava flour recorded the lowest bulk density. This could be attributed to its lower carbohydrate content and the structural and compositional changes in the flour resulting from the influence of sprouting. The result agreed with the report of Bolarinwa *et al.* (2015) whose bulk density ranged from (0.60-0.67 g/mL) and decreased with the inclusion of soybeans flour in sorghum-based complementary food. High bulk density of flours indicates that they are suitable for use in food preparation. A decrease in bulk density of cereal and legume composite flours provides multiple advantages, particularly in terms of functionality, processing, and application in food formulations, a lower bulk density enhances the nutrient concentration within a given volume of the composite flour, which improves suitability for producing nutrient-dense foods, especially in weaning diets and therapeutic solutions for malnourished individuals. Decreased bulk density enhances digestibility by creating lighter, aerated products that facilitate enzyme penetration during digestion. Foods with a reduced bulk density are easier to compress, using less packaging material and decreasing transportation costs. A decreased bulk density enhances mixing

with other components, thus improving homogeneity in food formulations. Oil absorption capacity of samples A, B, C recorded in the present study are 1.77 mL/g, 1.84 mL/g, 1.96 mL/g and 2.03 mL/g respectively and the results showed significant difference ($p < 0.05$) between the samples. The oil absorption capacity (OAC) is an essential functional property that contributes to enhancing the mouth feel while retaining the food products flavor (Iwe *et al.*, 2016). The oil absorption capacity increased in the flour blends as the substitution with *Prosopis africana* flour increased. Just like the water absorption capacity, the oil absorption capacity increased due to the high protein content in the soybean flour (Kakar *et al.*, 2021).

Sensory Evaluation

Sensory properties are important measures for assessing quality in the development of new products and for meeting consumer requirements. The sample bread from 100% wheat (A) was better rated in all sensory attributes assessed. The scores for all attributes decreased with increase in *Prosopis africana* inclusion in wheat flour. The inclusion of *Prosopis africana* flour in wheat flour at up to 15% level showed no significant ($p > 0.05$) in appearance and aroma, however the appearance and aroma of the sample with 20% *Prosopis africana* flour inclusion had significantly ($p > 0.05$) lower appearance and this could be due to the high level of *Prosopis africana* flour inclusion which affected these bread parameters. There was no significant difference ($P < 0.05$) in the taste of the composite sourdough bread samples. The samples with *Prosopis africana* and cassava flour inclusion were not significantly ($p > 0.05$) different in taste and general acceptability, however, the taste and general acceptability of the blended samples were significantly lower than the sample with 100% wheat flour (A). The sensory quality result of this study agreed with the report of Christiana and Henry (2019) who observed the same trend of result in wheat, Bambara nut and yellow root cassava flour blends. The sensory quality result of this study showed that the inclusion of *Prosopis africana* flour at up 15% gave sensory scores within the acceptable limit.

Conclusion

The results of the study showed that *Prosopis Africana*, cassava flour wheat flour had significant effect on the functional properties of the flour blends. The Bulk density and while water absorption capacity, and oil absorption capacity all increased with level of *Prosopis africana* flour inclusion in the blends. Swelling index on the other hand showed a non-linear trend. The study established that the inclusion *Prosopis africana* flour to wheat flour bread resulted to increase in nutritional parameters of protein, ash and fat with shelf stable moisture content of less 14 % for flour.

The study established that the inclusion of *Prosopis africana* and cassava flour in wheat flour resulted to improvement in the micronutrients content of bread samples. However, the formulated food could not meet the RDA of minerals and vitamins analyzed.

Recommendation

The study recommends that the formulation with 15% *Prosopis africana* flour inclusion should be adopted for its sensory acceptability and improved nutritional quality. Microbiological studies should be carried out on the formulation with 15% *Prosopis africana* flour inclusion. Studies on storage stability of the flour blends bread should be carried out.

Declaration of Conflict Interest

The authors declare that there's no known competing interest whatsoever or personal conflicts that could have appeared to influence the work reported in this present research work.

Acknowledgements

The authors acknowledge the support by the Head of Department of Chemistry, Rev. Moses Orshio Adasu University Makurdi, staff of the Centre for Food Technology and Research, Rev. Moses Orshio Adasu University Makurdi.

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<https://doi.org/10.1007/s11947-016-1818-7A>