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INFLUENCE OF PRO-VITAMIN -A- CASSAVA FLOUR AND CASHEW NUT FLOUR SUPPLEMENTATIONS ON PHYSICO-CHEMICAL PROPERTIES OF WHEAT BASED BREAD

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ABSTRACT

The quality of bread produced from wheat, cashew nut flour and pro-vitamin –A- cassava flour blends were evaluated. Pro-vitamin -A - cassava flour and Cashew nut flour were prepared. Wheat, pro-vitamin A cassava flour and cashew nut flour were made into blends ration of 100%:0%:0% sample A, 90%:5%:5% sample B, 80%:15%:5% sample C, 85%:10%:5% Sample D and sample E, 75% 20%:5% respectively. Result analysis revealed increase in physiochemical properties as blending increased. The moisture content, Protein content, Fat content, Carbohydrate and Pro-vitamin A contents increased constantly with increase in blending. The oil absorption capacity decreased with blending. Other functional properties such as Water absorption capacity, Bulk density, swelling index, loaf height, and loaf volume increased as blends ration increases. Sensory characteristic reflected a down turn progression as blending was increased. Increase in cashew nut flour led to increase in chemical and functional quality values of the bread samples hence cheap bio functional ingredient which could also alleviate hidden hunger in rural populations with supplies of macro and micro nutrients.

Keywords: Soymilk, Substitution, malted maize, Beverage, Drink, Quality

INTRODUCTION

Bread is a broad staple food eaten by many and accepted in many cultures **(Kulushtayeva *et al.*, 2019)**. It is usually prepared from a dough of water and flour by baking. The proportions of flour ingredients and the dilution of substrates vary greatly with the method of bread making. As a result, the type, shape, size, and texture of bread vary around the world. Bread can be leavened by processes such as reliance on naturally occurring sourdough microbes, chemical, industrially produced yeast, or high-pressure aeration. Some breads are cooked before leavening for religious or traditional reasons and do not contain nuts, fruits, or vegetables as additives. **Serrem et al. (2011)** noted that commercial bread commonly contains additives to improve flavor, texture, color, shelf life, and ease of production. Bread is served in various forms at every meal of the day. It can be eaten as a snack, used as an ingredient in other culinary applications, such as sandy deserts and French fries coated with bread crumbs to prevent sticking. Triticum aestivum is the most commonly grown type of wheat, contributing 90-95% of total production. This wheat is preferred for its protein and yellow pigment and ease of pasta production (**Sobota *et al.*, 2015**), but differs in glutein properties (**Jankovi *et al.*, 2015**).
Cassava Manihot Esculentus with improve nutritional value as pro-vitamin A. Cassava is currently used as an aid in curbing dietary vitamin, a deficiency due to its high content of β-carotene (**Omodamiro et al., 2012).** It has been reported that cassava has the potential of providing about 25% of the daily vitamin. A requirement of children and women. (**Aniedu & Omodamiro 2012**). The preparation of bread, chin - chin, cake, strips and salad has been used by pro-vitamin A cassava species (**Aniedu & Omodamiro 2012**). Cashew nut is widely used as a recipe, for cheese or butter making. The use of cashew shells has been reported for the production of lubricants, waterproofing, paints and for weapons production (**Justock, 2012**).
This work focused on macro- and micronutrient deficiencies such as vitamin A, a major challenge for developing countries. Fortification of biologically tested or synthesized vitamins **(Suychinov *et al.*, 2019**), especially vitamin A in wheat during milling, has not been shown to be effective in bread during flour storage and after bread baking (**Ogori *et al.*, 2016).** Vitamin A deficiency could lead to night blindness and other acute diseases triggering conditions. Bread is one of the most common staple foods in Nigeria and Russian Federation that contains little or no bio-nutrients, even proteins, after processing except starch. This work aims to incorporate vitamin A cassava flour and cashew nut flour into wheat flour for bread making to determine its bio nutrient component such as vitamins and protein adequacy.

MATERIAL AND METHODS

Materials

The wheat and cashew nuts were purchased from Wadata market in Makurdi town, Benue State. The pro-vitamin A tubers were obtained from farmers in Makurdi local government farms. Other ingredients such as sugar, salt, and milk were purchased from North Bank Market in Benue State.

Sample preparations

Pro – vitamin A cassava flour was produced using the method as described by (**Aniedu & Omodamiro, 2012**). Harvested tubers were harvested 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 were pulverised and sun dried, milled and sieved to obtain cassava flour (Figure 1).

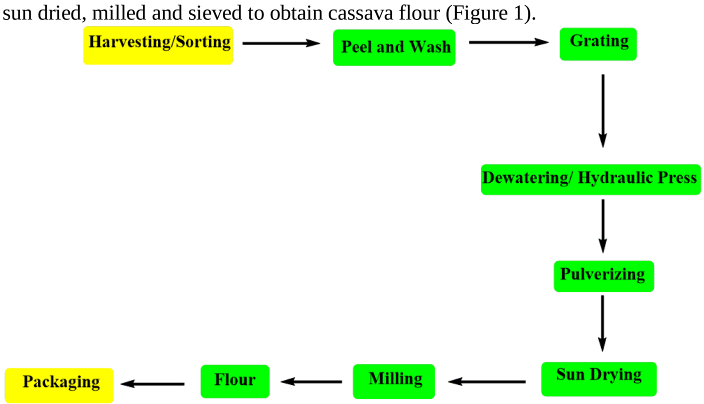

Figure 1 Production of pro – vitamin A cassava flour (Omodamiro et al., 2012)

Production of cashew nut flour

Cashew nut was sorted and cleaned**.** The nuts were soaked in water to avoid scorching during roasting operations. After roasting which exfoliated the shell from the kernels after hammer hit to separate the shell from the kernel completely, the nuts are then placed upon flat surfaces and re-hammered again to obtain final clean kernels from the nuts of cashew with less cracking of the kernels. After this the kernels were graded and milled into flour (Figure 2).

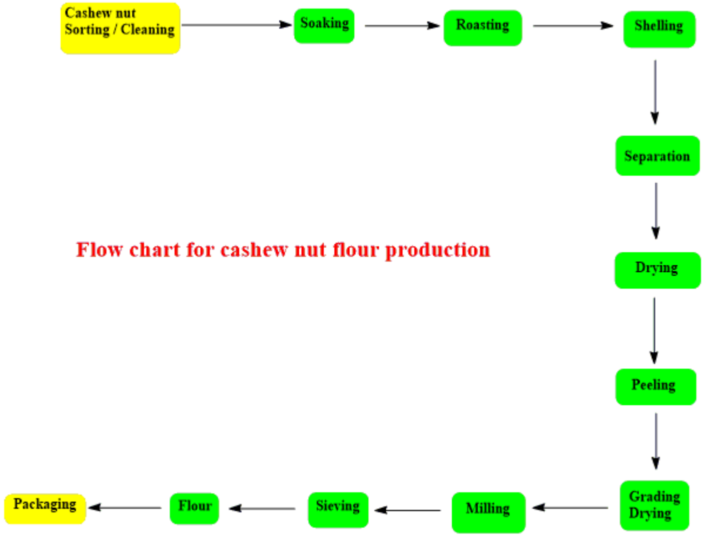

Figure 2 Flow chart for cashew nut flour production **(Justock , 2012)**

Blend formulation

Blends for the formulation and production are shown in Table 1. Sample A represent 100% wheat bread without any supplement. Sample B to E represent samples with 8, 15 ,23 and 30 % cashew nut flour and 2,5 ,7 and 10 % vitamin A cassava flour respectively.

Table 1 Flour blend formulations

Samples	Wheat %	Cashew nut flour %	Vitamin A cassava flour %
A	100	0	0
B	90	5	5
C	85	10	5
D	80	15	5
E	75	20	5

Keys:
A.100% Wheat, 0%cashew nut flour ,0% pro-vitamin A cassava flour
B. 90% Wheat, 5%cashew nut flour, % pro-vitamin A cassava flour
C. 80% Wheat ,15%cashew nut flour, 5% pro-vitamin A cassava flour
D. 85%Wheat ,10%cashew nut flour, 5% pro-vitamin A cassava flour
E. 75% Wheat, 20% cashew nut flour, 5% pro-vitamin A cassava flour

Production of Bread

The production of bread from each mixture follows the direct dough method. Dry ingredients such as sugar, flour and yeast were measured in the proper amount and then mixed with water to make a dough. The dough was kneaded until it was smooth and the air space was checked by a manual elasticity test. The respective dough was left to proof in a room temperature chamber for 45 minutes and then baked in a hot oven at 230°C until a golden brown colour appeared (Figure 3).

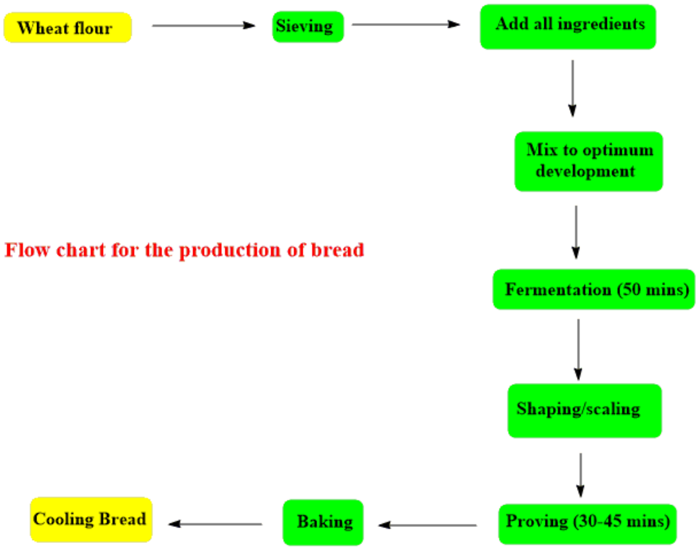

Figure 3 Flow chart for the production of bread (Shittu, & Raji 2007)

Methods

Crude protein determination

Two grams of the sample was weighed into a digestion tube and 15 ml of concentrated tetraoxosulphate (IV) acid (H_2SO_4) was added to dissolve the sample. Kjedhal tablet was added to speed up the digestion process in a fume cupboard until it gave a clear solution. Distilled water (75 ml) was added to prevent it from solidifying after digestion. The tube was placed in a distilling unit and 50 ml of 40 % NaOH dispensed into the diluted solution, and the digested distilled into 25 ml of 40 % boric acid. The distillate was titrated against 0.47 M HCl until the first grey colour was seen. A blank was first titrated and the titer value was recorded (AOAC, 2012).

$$\%\, Total\ Nitrogen\ = \frac{Titre\ value\ \times 14.01\ \times 0.47}{Weight\ of\ sample\ \times 100}$$

$\%\, Protein\ = Total\ nitrogen\ \times conversion\ factor$
$Molecular\ weight\ of\ Nitrogen\ = 14.01$
$Molarity\ of\ HCl\ = 0.47$
$Conversion\ factor\ = 6.25$

Ash content determination

Two gram (2 g) of the sample was weighed into an empty porcelain crucible that was previously ignited, cooled and weighed. The sample was ignited over a hot plate in a fume cupboard to char organic matter. The crucible was thereafter placed in the muffle furnace maintained at a temperature of 600°C for 6 h. After ashing, it was then transferred directly to a desiccator to cool and weighed immediately (**AOAC, 2012**).

$$\%\, Ash = \frac{(Weight\ of\ the\ crucible\ + Ash) - (Weight\ of\ empty\ crucible) \times 100}{Weight\ of\ sample}$$

Crude fat determination

The crude fat determination was carried out using the method of AOAC. (2012). The thimble was cleaned and empty weight recorded as W_1. Five (5) grams of oven-dried sample was added and re-weighed as (W_2). The round bottom flask was cleaned and weighed empty (W_3) and then filled up with petroleum ether up to three-quarter of the flask. Soxhlet extractor was fixed with a reflux condenser to adjust the heat sources so that the solvent boils gently. The thimble containing the sample was then put inside the thimble and inserted into the Soxhlet apparatus and extraction under reflux was carried out with petroleum ether for 6 hours. At the end of extraction, the solvent was siphoned out and the flask containing the oil was dried in the hot -air oven at 100°C for an hour to remove traces of water and solvent. Thereafter it was cooled and weighed (W_4).

$$\% Fat = \frac{W4 - W3}{W2 - W1} \times 100$$

W_1 = weight of empty thimble
W_2 = weight of thimble and sample before extraction
W_3 = weight of the empty round bottom flask
W_4 = weight of flask and extracted oil

Crude fiber determination

The crude fiber content of the sample was determined using the method described in AOAC. (2012). Two (2) grams of sample was weighed and transferred into 250 ml beaker. It was then boiled for 30 minutes with 100 mL of 0.12M H_2SO_4 and filtered through a funnel. The filtrate was washed with boiling water until the washing was no longer acidic. The solution was boiled for another 30 minutes with 100 ml of 0.012 M NaOH solution; filtered with hot water and methylated spirit three times. The residue was transferred into a crucible and dried in the oven at 103^0C for 1 hr. The crucible with its content was cooled in a desiccator and then weighed (W_1). The residue was then taken into a furnace for ashing at 600°C for 1 h. The ashed sample was removed from the furnace and put into the desiccator to cool and later weighed (W2). The percentage crude fiber was calculated thus:

$$\% \, Crude\ fibre = \frac{W1\text{-}\ W2}{Weight\ of\ sample2a}$$

Where:
W_1 = Weight of crucible and residue, W_2 = Weight of final ash sample

Carbohydrate content determination

Carbohydrate content determination was determined by difference (Ihekoronye & Ngoddy,1985).

$$\% \text{ Carbohydrate} = 100 - (\%\text{moisture} + \%\text{Protein} + \%\text{Fat} + \%\text{Ash} + \%\text{Fibre})$$

Functional Properties of the bread samples

Bulk density

Five (5) gram of bread sample was allowed into a 100 ml measuring cylinder. The cylinder was tapped continuously until a constant volume was obtained. The bulk density (g /cm^3) was calculated as the weight of sample (g) divided by volume of flour (cm3). (Oladele & Anna, 2007).

$$\text{Bulk density} = \frac{Weight\ of\ sample\ (g)}{\text{Volume of the sample(ml)}}$$

Water and oil absorption capacities

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

$$WAC/OAC = \frac{V1 - V2}{W}$$

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

Swelling index

The swelling index was determined according to the method by Olaitan, Eke. &Uja. (2014). Two (2) grams of the bread sample was poured into a 50 ml measuring cylinder and the volume it occupied was recorded. Already boiled water was added up to 50ml mark and the measuring cylinder was allowed to stand for 45mins after which the new volume of flour was recorded. The ratio of the initial volume to the final volume was taken as the swelling index.

$$\text{Swelling index} = \frac{change\ in\ volume\ of\ sample\ (ml)}{Original\ volume\ of\ sample(ml)}$$

Physical properties of the bread

Diameter of the bread.

The method of Gelina & Makinnon (2016) was used. Five grams loaves of bread were placed edge by edge with each other. Then the initial diameter measured using meter rule and reading made in centimers (cm). The reading was done twice to arrive at a mean values

Bread thickness

The method of Gelina & Makinnon.(2016) was used. Five grams loaves of bread were placed on top each other. Then the total height measured using meter rule and reading made in centimers (cm). The reading was done twice to arrive at a mean values

Bread weight

The method of Gelina &Makinnon. (2016) was used. Five grams loaves of bread were weighted using digital weighing balance and reading made in grams (g). The reading was done twice to arrive at a mean values

Bread Spread factor

The method of Gelina & Makinnon (2016) was used. The spread factor was determined from the measured diameter D and thickness using the formula. Thus

$$SF = \frac{\text{D} \times \text{CF}}{\text{T}} \times 10$$

Where CF is the correctional factor at constant atmospheric pressure and given as 1

Determination of pro-vitamin -A- in bread samples

Determination of pro-vitamin A content was performed according to AOAC (2012) procedures. Vitamin A in the bread sample was determined by HPLC. Three grams of ground sample was mixed with 5ml of n-hexane and 200ml of HPLC grade water. The mixture was homogenized using an ultra turra macerator at 12.00rpm and then centrifuged at 3500g for 30 minutes. The aqueous phases were filtered through a whattman filter paper and a 0.45m membrane filter sequentially. Then 15 um of supernatants were injected into the HPLC system equipped with a UV detector set at 254 nm in absorbance mode. The vitamin standards were prepared in the mobile phase. The vitamin peaks of selected samples and the area of each peak were calculated relative to the standard vitamin peak.

Sensory evaluation

The sensory analysis was performed by fifteen panellists consisting of students and staff members of the Department of Food Science and Technology of the Federal Agricultural University of Makurdi. The sensory qualities evaluated were: taste, appearance, aroma, mouthfeel and overall acceptability. Portable water was provided for panelists to rinse their mouths before and during the evaluation. Each sensory attribute was rated on a 9-point hedonic scale, with the smallest being the one that was not liked (1) and the largest being the one that was liked (9).

Statistical analysis
Results were expressed as mean values and standard deviation of 2 determinations. Mean values were separated by Fisher's least significant difference (LSD) method. Data were analysed by one-way analysis of variance (ANOVA). Significant differences were accepted at the 5% $p>0.05$ probability level using the genstat (17th edition) statistical package.

RESULTS AND DISCUSSION

Chemical composition of bread produced from wheat cashew nut pro-vitamin –A- cassava flour
The chemical composition of bread produced from wheat, cashew nut and cassava flour pro -vitamin A is presented in Table 2 below. The water content decreased with the level of substitution during mixing (34.97 -27.01). The highest water content was found in the control A sample and the lowest value at 20% cashew nut incorporation and pro-vitamin A cassava flour. This decrease in water content with increasing blend incorporation is higher than that reported by Sanful, Hadiza, and Darko (2010) for bread made from a wheat-soy composite flour. Lower values were also reported by Rahut et al. 2012 for a bread made from a composite wheat-rice-chickpea flour enriched with Palmyra palm. The low moisture value observed in the bread sample outside of the control sample may stem from the fiber content of the cashew flour, binding free moisture that

may become unavailable for microbial growth. Protein content increases with incorporation of the mixture. (7.66-13.13) % Control sample A of whole wheat flour had the lowest protein value, this increasing with the incorporation of cashew nut flour and pro-vitamin A cassava flour, leaving sample E at 20% and 5% with the highest protein content value. This slight increase in the protein value of the baked bread sample could be from the incorporation of cashew flour and its percentage, as well as from protein molecules that bind to starch micelles to protect them from thermal denaturation during baking. The fat content increased with increasing blend (2.97-5.55) %. The control whole wheat sample had the lowest fat content and the E sample had the highest. The increase in fat content with the incorporation of cashew flour and pro -vitamin A flour is in agreement with the report of (USDA, 2015) that cashew is generally oily.

Crude fiber and ash content were observed to increase similarly with the incorporation of cashew and pro -vitamin A flour - cassava flour when the mixture increased proportionally. This confers intestinal probiotic substration and mineralization of the bread samples during enzymatic digestion.

The carbohydrate values decreased with the incorporation of the samples. The carbohydrate content varies from (50.39-55.55) %, leaving sample E at the lowest carbohydrate value while sample B had the highest value of 55.55%, this value is tangible as it can potentially meet daily energy requirements.

Table 2 Proximate composition of bread produced from wheat , cashew nut and pro – vitamin A cassava flour

Samples	A	B	C	D	E	LSD
Moisture%	34.97^{a}+_0.02	29.94^{b}+_0.01	29.72^{c}+_0.03	27.32d+_0.01	27.01+_0.01	0.04
Protein %	7.66^{e}+_0.02	8.74^{d}+_0.03	10.97+_0.03	12..03b+_0.04	13.13+_0.01	0.06
Fat%	2.97^{e}+_0.02	3.55^{d}+_0.02	3.77+_0.02	4.55+_0.03	5.55+_0.05	0.06
Crudefibre%	0.77^{c}+_0.01	0.77^{c}+_0.02	0.84b+_0.04	0.86b+_0.03	0.96b+_0.01	0.04
Ash%	1.40^{c}+_0.01	1.47^{c}+_0.02	2.01c+_0.02	2..46+_0.03	2.96+_0.01	0.03
Ccarbohydrate%	52.23^{d}+_0.03	55.55^{a}+_0.02	53.63^{c}+_0.02	34.97+_0.02	50.39+_0.01	0.14

Values are Means ± standard deviation of triplicate determinations. Means values along rows followed with the same superscripts are not significantly (p<0.05) different.

Keys:

A.100% Wheat , 0%cashew nut flour ,0% pro-vitamin A cassava flour, B. 90% Wheat , 5%cashew nut flour , %pro-vitamin A cassava flour, C. 80% Wheat, 15%cashew nut flour , 5%pro-vitamin A cassava flour, D. 85%Wheat ,10%cashew nut flour , 5%pro-vitamin A cassava flour, E . 75% Wheat , 20% cashew nut flour, 5%pro-vitamin A cassava flour

Pro-vitamin -A- composition of bread samples produced from wheat, cashew nut and pro – vitamin –A- cassava flour

The pro-vitamin -A- composition of bread samples produced from wheat flour, cashew nut flour and pro-vitamin -A- cassava flour is presented in Table 3 below. The incorporation of cashew nut flour and cassava pro-vitamin -A- flour significantly increased the pro-vitamin -A- content in the bread mixtures formula (0.55-2.238) mg/100g. This observed increase is in agreement with Badifu et al. (2005) on the influence of mango flour supplementation on the micro-nutrient quality of wheat-based bread. This increase and stability may be due to the natural state of the pro-vitamin used from the cassava variety which may have caused resistance to the effect of heat during bread baking.

Table 3 Pro-vitamin -A- composition of bread samples produced from wheat , cashew nut and pro – vitamin –A- cassava flour

Samples	Pro- vitamin A Values (mg/100g)
A	0.553^{c}+_ 0.03
B	2.317^{a}+_ 0.01
C	2.233^{b}+_ 0.03
D	2.237^{b}+_ 0.01
E	2.238^{b}+_ 0.01
LSD	0.0501

Values are Means ± standard deviation of triplicate determinations. Means values along rows followed with the same superscripts are not significantly (p<0.05) different.

Keys:

A.100% Wheat , 0%cashew nut flour ,0% pro-vitamin A cassava flour, B. 90% Wheat , 5%cashew nut flour , %pro-vitamin A cassava flour, C. 80% Wheat ,15%cashew nut flour , 5%pro-vitamin A cassava flour, D. 85%Wheat ,10%cashew nut flour , 5%pro-vitamin A cassava flour, E . 75% Wheat , 20% cashew nut flour , 5%pro-vitamin A cassava flour

Functional properties of Bread Produced from Wheat , Cashew nut and Pro – vitamin –A- cassava flour

The functional properties of bread produced from wheat, cashew nut and pro-vitamin A flour is shown in Table 4 below. The oil absorption capacity ranged from 0.96 (Sample A) to 1.22g/ml (Sample E). The highest value was found in the sample with 5% cashew nut and 5% vitamin A flour. The increase in the oil absorption capacity could be as a result of the protein-protein interaction between the flours used. Bulk density is an important factor in food products handling, packaging, storage, processing and distribution. It is particularly useful in the specification of products derived from size reduction or drying processes. Bulk density of the samples was similar to that reported by Adeyemi & Becky (1986). The bulk density of bread ranged from 0.713 (Sample A) to 0.793g/ml (Sample E). Increase in the level of cashew nut flour led to increase in the bulk density. Plaami (1997) reported that higher bulk density is desirable, since it helps to reduce the paste thickness.

The swelling index of the bread samples ranged from 2.74 (Sample A) to 2.88% (Sample E). Swelling index of all formulated bread samples were higher than that of the control (100 % wheat flour). The glutinous properties of the pro vitamin A cassava flour used could be a reason for the high swelling properties.The water absorption capacity ranged from 1.203 (Sample A) to 1.447g/ml (Sample D). The control (100% wheat flour) had the lowest water absorption.

Physical Properties of Bread produces from wheat, cashew nut and pro vitamin A cassava flour

The physical properties of bread produced from wheat, cashew nut and provitamin A cassava flouris shown in Table 5. The loaf height ranged from 4.25 (Sample E) to 7.81cm (Sample A) with the highest height found in the control (100% wheat flour) while the smallest height was found in the sample incorporated with 20% cashew nut and 5% provitamin A cassava flour. Continuous increase in the level of cashew nut and constant addition of Vitamin A cassava had led to a decrease in the height of the bread samples. This decrease could be as a result of the decrease in wheat flour which is high in glutinous property.The loaf volume ranged from 182 (Sample E) to 340cm^{3} (Sample A). Increased addition of cashew nut flour led to a significant decrease in the loaf volume. However, a significant increase was observed in the weight of the bread with increased addition of cashew nut flour.

Table 4 Functional properties of Bread Produced from Wheat , Cashew nut and Pro – vitamin –A- cassava flour

Samples	Oil absorption capacity	Bulk density	Swelling index	Water Absorption capacity
A	0.96^{a}+_0.02	0.71^{c}+_0.01	2.74^{c}+_0.03	1.203d+_0.01
B	7.66^{e}+_0.02	0.76^{a}+_0.03	2.82b+_0.02	1.26b+_0.04
C	1.25^{a}+_0.02	0.74^{b}+_0.02	2.86a+_0.01	1.34+_0.03
D	1.23^{a}+_0.01	0.77^{a}+_0.02	2.85a+_0.01	1.44b+_0.03
E	1.22^{a}+_0.01	1.79^{a}+_0.02	2.88a+_0.01	1..33+_0.03
LSD	0.0575	0.038	0.0293	0.0535

Values are Means ± standard deviation of triplicate determinations. Means values along column followed with the same superscripts are not significantly (p<0.05) different.

Keys:

A.100% Wheat , 0%cashew nut flour ,0% pro-vitamin A cassava flour
B. 90% Wheat , 5%cashew nut flour , % pro-vitamin A cassava flour
C. 80% Wheat ,15%cashew nut flour , 5% pro-vitamin A cassava flour
D. 85%Wheat ,10%cashew nut flour , 5% pro-vitamin A cassava flour
E . 75% Wheat , 20% cashew nut flour , 5% pro-vitamin A cassava flour

Table 5 Physical Properties of Bread produces from wheat, cashew nut and pro vitamin A cassava flour

Samples	Loaf Height (cm)	Loaf volume (cm)	Loaf weight (g)
A	7.81^{a}+_0.01	340.01^{a}+_0.01	186.33^{c}+_0.03
B	6.55^{b}+_0.00	256.01^{b}+_0.01	200.02^{d}+_0.02
C	5.24^{c}+_0.02	220.02^{c}+_0.02	217.83^{c}+_0.01
D	5.10^{d}+_0.01	200.03^{d}+_0.02	249.97^{b}+_0.01
E	4.25^{c}+_0.01	182.02^{a}+_0.06	251.85^{a}+_0.01
LSD	0.0155	0.0303	0.0265

Values are Means ± standard deviation of triplicate determinations. Means values along column followed with the same superscripts are not significantly (p<0.05) different.

Keys:

A.100% Wheat , 0%cashew nut flour ,0% pro-vitamin A cassava flour
B. 90% Wheat , 5%cashew nut flour , % pro-vitamin A cassava flour
C. 80% Wheat ,15%cashew nut flour , 5% pro-vitamin A cassava flour
D. 85%Wheat ,10%cashew nut flour , 5% pro-vitamin A cassava flour
E . 75% Wheat , 20% cashew nut flour , 5% pro-vitamin A cassava flour

Sensory Attributes of Bread produced from wheat, Cashew nut and Vitamin A cassava Flour.

The sensory attributes of bread produced from blends of wheat, cashew nut and pro-vitamin A cassava flour is shown in Table 6. The result showed that the sample with 5% cashew nut and 5% vitamin A cassava flour were the best in terms of taste, appearance, aroma and mouth feel, while the sample with 20% cashew nut inclusion and 5% vitamin A cassava flour had the least scores according to panellists. Generally, the sample incorporated with 5% cashew nut and 5% vitamin A flour was rated the best while the sample with 20% cashew nut and 5% vitamin A cassava flour were most disliked by panelists. This judgement could be as a result of enhanced taste, appearance, aroma and mouth feel observed in the most preferred sample.

Table 6 Sensory Attributes of Bread produced from wheat, Cashew nut and Vitamin A cassava Flour.

Samples	Taste	Appearance	Aroma	Mouthful	General acceptability
A	7.03^{a}+_0.88	6.40^{b}+_0.083	6.90^{b}+_0.99	6.80^{a}+_0.86	6.50 ^{b}+_0.85
B	7.40^{e}+_0.74	7. 60^{a}+_0.74	7.33^{a}+_0.72	7.07^{a}+_0.70	7.00^{a}+_0.66
C	5.13^{a}+_0.83	5.47^{c}+_0.64	7.33^{a}+_0.72	6.00^{b}+_0.65	4.93^{c}+_0.88
D	4.00^{a}+_0.93	4.80^{d}+_0.68	6.00^{c}+_0.76	4.87^{c}+_0.99	4.47^{cd}+-1.25
E	3.60^{a}+_0.83	4.13^{e}+_0.83	6.00^{c}+_0.85	5..33^{c}+_1.23	3.80^{d}+_1.32
LSD	0.3732	0.5455	0.5937	0.67	0.7462

Values are Means ± standard deviation of triplicate determinations. Means values along rows followed with the same superscripts are not significantly (p<0.05) different.

Keys:

A.100% Wheat , 0%cashew nut flour ,0% pro-vitamin A cassava flour
B. 90% Wheat , 5%cashew nut flour , % pro-vitamin A cassava flour
C. 80% Wheat ,15%cashew nut flour , 5% pro-vitamin A cassava flour
D. 85%Wheat ,10%cashew nut flour , 5% pro-vitamin A cassava flour
E . 75% Wheat , 20% cashew nut flour , 5% pro-vitamin A cassava flour

CONCLUSION

The study on the evaluation of bread quality from blends of wheat flour, cashew nut and provitamin A - cassava showed that cashew and cassava vitamin A flour can be successfully incorporated with wheat flour to obtain a nutritious bread. The incorporation of cashew and cassava resulted in a significant increase in the protein, fat, crude fiber and ash content of the bread. The pro-vitamin A content of the formulated bread was also increased with the addition of the vitamin A from the cassava flour. The physical properties of the formulated bread samples were improved by the inclusion of cashew nuts and vitamin A in the cassava flour. Thus, the incorporation of 5% cashew nuts and 5% cassava vitamin A exhibited the best sensory attributes. Cassava flour with vitamin A and cashew nut could be incorporated into bread formulation by bakers to improve the nutritional composition of bread.

Declaration of Competing Interest: The authors declare that they have no known competing interest whatsoever or personal conflicts that could have appeared to influence the work reported in this paper.

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