Vitamin, and Sensory Properties of Bread Produced from Wheat, malted Mung Bean, and Watermelon rind Flour Composites.

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KEYWORDS

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ABSTRACT

This study was carried out to evaluate the vitamin, and sensory properties of breads produced from composite flours of wheat, malted mung bean and watermelon rind. Mung bean seeds were soaked for 24 h, washed, drained, germinated for 72 h, oven-dried at $60^{o}C$ for 18 h and milled into flour. Watermelon rind was sliced, washed, oven-dried, milled and sieved. All flours were blended with wheat flour, in varying proportions (100:0, 90:5: 5, 80:10:10, 70:15:15, 60:20:20, and 50:25:25) to produce composite flour used to make bread. The vitamin, and sensory properties of the bread samples were determined using standard methods. The thiamine, niacin, riboflavin, vitamin A, ascorbic acids and folic acid content of the bread samples were 3.36 to 4.57mg/100g, 2.45 to 3.36mg/100g, 3.51 to 4.60mg/100g, 2.23 to 4.27mg/ 100g, 1.55 to 3.22mg/100g and 1.02 to 1.81mg/100g, respectively. The content of the analyzed vitamins increased with increase in substitution with mung bean and watermelon rind flours. The sensory properties of bread produced from 100% wheat flour, were most acceptable to the panelists and also differed significantly ($p<0.05$) in colour, taste, texture and aroma from composite flour bread samples. However, the composite bread loaves were also acceptable to the judges because they were relatively rated high in all the sensory attributes evaluated. The findings suggest that the inclusion of malted mung bean and watermelon rind flours to wheat flour in bread production enhances nutritional quality while maintaining good sensory attributes, making it a viable ingredient for fortification.

INTRODUCTION

Bread, a staple food worldwide, is commonly produced using wheat flour as its primary ingredient due to its unique gluten-forming ability, which provides the necessary structure and texture (Umego, *et al.,* 2010). However, there is growing interest in composite flours, which blend wheat flour with other plant-based flours to enhance the nutritional profile and diversify bread products (Akoja *et al.,* 2010). The incorporation of non-wheat flours, such as those from legumes, fruits, and vegetables, can improve the vitamin content, dietary fiber, and overall health benefits of bread (Egbujie *et al.,* 2021).

Mung beans (*Vigna radiata*) are recognized for their high nutritive value, containing substantial amounts of protein (20-25%), vitamins, and minerals (Umego *et al.,* 2010). Mung beans are rich in fiber can help to slow down the digestion of carbohydrates, reducing the glycemic index of bread and making it more suitable for people with diabetes or those who want to manage their blood sugar levels. Mung bean was malted by soaking in water for 24 and germinated for 72 h followed by drying in the oven. Umego *et al.* (2010) reported that malting mung beans can further enhance their nutritional properties and digestibility, making them a valuable addition to composite flours.

Watermelon rind flour, derived from the often-discarded rind of watermelons, presents a sustainable and nutritious option. It is rich in protein, vitamins, minerals, and dietary fiber, offering a means to reduce food waste while improving the nutritional content of bread (Fahmy *et al.,* 2022).

This study aims to evaluate the vitamin and sensory properties of bread produced from wheat flour, malted mung bean flour, and watermelon flour composite. By combining these ingredients, the resulting bread is expected to exhibit improved nutritional value and acceptable sensory characteristics, contributing to the development of healthier and more sustainable bread-making practices (Abu *et al*., 2021), thus waste is converted to food.

MATERIALS AND METHODS

Source of Materials:

The major raw materials used for the study (Mung bean seeds, watermelon fruit, wheat flour, bakery fat, sugar, yeast, salt and flavour) were all purchased from New Market Enugu, Enugu State, Nigeria.

Table 1: The Design Table for Composite Blends

Flour Samples	Unit	Minimum	Maximum
Wheat flour	g	50	100
Mung bean flour	g	0	25
Watermelon rind flour	g	0	25

Experimental Design

A Partial Substitution Design was used.

Table 2: Flour blends used for bread production

Samples	Wheat flour	Mung bean flour	Watermelon rind flour
A	100	0	0
B	90	5	5
C	80	10	10
D	70	15	15
E	60	20	20
F	50	25	25

Mung Bean Flour Preparation

The malted mung bean flour was prepared according to the method described by Onwurafor *et al.,* (2019). One kilogramme (1 kg) of mung bean seeds were cleaned to remove dirt and other extraneous materials. The cleaned seeds were soaked in 4 litres of potable water in a plastic bowl at room temperature (30 ± 2 ºC) for 20 h with a change of water at every 5 h to prevent fermentation. After soaking, the grains were drained, rinsed and immersed in 2% Sodium hypochlorite solution for 10 min to disinfect the grains. The seeds were rinsed five consecutive times with excess water and cast on a moistened jute bag, covered with polyethylene bag and left for 48 h to fasten sprouting. The grains were then spread carefully on the jute bag and allowed to germinate for 72 h and dried in a tray dryer (Model EU850D, UK) at 60ºC for 18 h. The dried malted mung bean seeds were milled in the attrition mill and sieved through a 500-micron mesh sieve. The flour produced was packaged in an air tight plastic container, labelled and stored in a refrigerator until needed for further use.

Watermelon Rind Flour Preparation

The watermelon rind flour was prepared according to the method described by Onwurafor *et al*. (2019). The cleaned watermelon rinds were sliced into smaller slices of 5mm in diameter with a stainless – steel knife.

The slices were dried in a tray dryer (Model EU850D, UK) at 50ºC for 18 h to obtain dried chips. The chips were milled in the attrition mill and sieved through a 500-micron mesh sieve to obtain the fine flour. The flour produced was packaged in an air tight plastic container, labelled and stored in the refrigerator until needed for further use.

Formulation of Composite Flour

The wheat, mung bean and watermelon rind flours were blended in the ratios of 100:0:0, 90:5:5, 80:10:10, 70:15:15, 60:20:20 and 50:25:25 in a Ken wood mixer (Model Philips, type HR, 1500/ A, Holland) to obtain homogenous samples of composite flour. Thereafter, the flour blends were individually packaged in air tight plastic containers, labelled and kept in a refrigerator until needed for further use. The flour blends were used for the production of bread loaves

Bread Production

The bread loaves were prepared according to the method described by Onwurafor *et al.,* (2019). The recipe used for the preparation of breads contained 100% flour, 60% sugar, 20% fat, 2% yeast, 2.5mL vanilla flavour, 5% milk, 0.25% salt. All the raw materials were thoroughly mixed together manually to obtain homogeneous mixtures and kneaded properly on a dusty table (to avoid sticky) to incorporate air into the dough. The milled dough was weighed to obtain accurate and uniform measurement, thereafter, the weighed dough was molded into shape, placed in a greased pan and then, kept in a heating room to ferment and increase in size. The fermented dough was baked in a conventional oven (Mac Adams Rotary Oven, South Africa) at 200ºC for 20 min. After baking the baked bread loaves were removed from oven and allowed to cool to ambient room temperature. The cooled breads were de panned, packaged, labelled and kept in a refrigerator until needed for analysis.

Vitamin Composition of the Samples

Vitamin composition of the samples was evaluated as described by AOAC (2010).

Sensory Evaluation:

The method described by Iwe *et al*, (2014) was adopted for the sensory evaluation. A sensory panel of 20 semi – trained panelists evaluated the quality features of bread. They rated the samples on a 9 – point Hedonic scale for taste, colour, texture, aroma, and overall acceptability, with 9 representing strongly like and 1 representing extremely dislike.

Statistical Analysis:

The data generated was subjected to one – way analysis of variance (ANOVA) using Statistical Package for the Social Sciences (SPSS, Version 20) software. Means were separated using Turkey's least significant difference (LSD) test at $p<0.05$.

RESULTS AND DISCUSSION

Vitamin Composition of Bread Samples.

The vitamin composition of the bread samples is presented in Table 1. The thiamine content of the samples ranged from 3.36 to 4.57 mg/100g. The sample substituted with 25% malted mung bean and 25% watermelon rind flours had the highest value (4.57mg/100g), while the control (100% wheat flour bread) had the least value (3.361mg/100g). The observed increase in thiamine contents of all the samples of composite bread samples could be attributed to increase in the addition of malted mung bean and watermelon rind flours to the samples. There were significant ($p<0.05$) differences in the thiamine content among the samples. The values (3.36 – 4.57mg/100g) obtained in this study were lower than the thiamine content (4.86 – 6.67mg/100g) reported by Chinwendu *et al*. (2015) for bread produced from composite flours of wheat and beans. Okaka *et al.* (2006) reported that thiamin promotes proper functioning of peripherial nerves and in the treatment of beriberi.

The niacin content of the bread samples ranged from 2.45 to 3.36mg/100g. The sample fortified with 25% malted mung bean and 25% watermelon rind flours had the highest value (3.36mg/100g), while the control (100% wheat flour bread) had the least value (2.45mg/100g). The increase in the niacin content of the sample could be attributed to substitution effect which is an indication that mung bean and watermelon rind are good sources of niacin Chinwendu *et al*. (2015). The niacin content (2.45 – 3.36mg/100g) obtained in the study was higher than the values (2.14 – 3.10 mg/100g). Thus consuming this product could reducing the level of cholesterol in the blood due to its high Niacin content (Okaka *et al*., 2006).

Table 2: Vitamin Composition (mg/ 100g) of Bread Samples.

Samples	% Substitution WF: MMBF:WRF	Thiamin	Niacin	Riboflavin	Vitamin A	Ascorbic acid	Folic Acid
A	100:0:0	$3.36^{c}\pm0.03$	$2.45^{d}\pm0.01$	$3.51^{f}\pm0.16$	$2.23^{f}\pm0.01$	$1.55^{f}\pm0.01$	$1.02^{f}\pm0.01$
B	90:5:5	$3.54^{d}\pm0.01$	$2.60^{c}\pm0.01$	$3.59^{e}\pm0.01$	$2.54^{e}\pm0.01$	$1.88^{e}\pm0.08$	$1.13^{e}\pm0.01$
C	80:10:10	$3.79^{c}\pm0.01$	$2.65^{c}\pm0.01$	$3.65^{d}\pm0.01$	$2.85^{d}\pm0.01$	$2.15^{d}\pm0.06$	$1.24^{d}\pm0.01$
D	70:15:15	$3.97^{b}\pm0.01$	$2.67^{c}\pm0.01$	$3.82^{c}\pm0.01$	$3.43^{c}\pm0.01$	$2.79^{c}\pm0.01$	$1.36^{c}\pm0.01$
E	60:20:20	$3.97^{b}\pm0.01$	$3.17^{b}\pm0.01$	$3.96^{b}\pm0.01$	$3.87^{b}\pm0.01$	$3.01^{b}\pm0.01$	$1.67^{b}\pm0.01$
F	50:25:25	$4.27^{a}\pm0.02$	$3.36^{a}\pm0.01$	$4.60^{a}\pm0.01$	$4.27^{a}\pm0.01$	$3.22^{a}\pm0.01$	$1.81^{a}\pm0.01$

Data are mean ± standard deviation of duplicate determinations. Means in the same column bearing different superscripts differed significantly ($p<0.05$) from each other. A: Bread made from 100% wheat flour, B: Bread made from 90% wheat flour, 5% malted mung bean flour and 5% watermelon rind flour, C: Bread made from 80% wheat flour, 10% malted mung Bean flour and 10% watermelon rind flour, D: Bread made from 70% wheat flour, 15% malted mung bean flour and 15% watermelon rind flour, E: Bread made from 60% wheat flour, 20% malted mung bean flour and 20% watermelon rind flour, F: Bread made from 50% wheat flour, 25% malted mung bean flour and 25% watermelon rind flour.
WF — Wheat flour, MPPF — Malted mung bean flour, WRF — Watermelon rind flour.

The riboflavin content of the samples ranged from 3.51mg/100g to 4.60mg/100g. There were significant ($p<0.05$) differences in riboflavin content among the samples. The variation could be due to differences in the proportions of the raw materials used for bread production. The increase in the incorporation of malted mung bean and watermelon rind flours in the bread samples resulted to a remarkable increase in riboflavin contents of the samples when compared with the control sample with a riboflavin content of 2.23mg/100g. This value is lower that the value (5.11 mg/100g to 11.97 mg/100g) reported for wheat flour with banana and mango flours (Abuengmoh *et al*., 2022).

The vitamin A content of the samples ranged from 2.23 to 4.27mg/100g. There were significant ($p<0.05$) differences in the vitamin A content among the samples. The differences could be due to the variations in the proportions of the raw materials used for the bread production. The sample substituted with 25% mung bean and 25% watermelon rind flours had the highest vitamin A content (4.27mg/100g) compared to control sample (100% wheat flour bread) which had the least value (2.23mg/100g). The values (2.23mg/100g to 4.27mg/100g) obtained in this study were higher to the vitamin content (2.26mg/100g to 4.30mg/100g) reported by Onwurafor *et al*. (2019) for cookies made from wheat, malted mung bean and unripe plantain composite flours. Vitamin A helps in the maintenance of good eye sight.

The ascorbic content of the bread samples ranged from 1.55mg/100g to 3.22mg/100g. There were significant ($p<0.05$) differences in the vitamin C content among the samples. The sample substituted with 25% mung bean and 25% watermelon rind flours had the highest value (3.22mg/100g) while the control sample had the least value (1.55mg/100g). The result acid content of the samples was found to increase with the increase in the addition of mung bean and watermelon rind flours in the products. The observation is an indication that mung bean and watermelon rind are good sources of ascorbic acid reported by Onwurafor *et al*. (2019). The values (1.55 – 3.22mg/100g) obtained in the study were lower than ascorbic acid content (12.15 – 12.74mg/100g) reported by Onwurafor *et al*. (2019) for bread produced from wheat and sweet potatoes flour blends. Ascorbic acid plays an important role in the prevention of scurvy (Okaka *et al.*, 2006).

The folic acid content of the bread samples ranged from 1.02mg/100g to 1.81mg/100g. The results showed ($p<0.05$) significant differences in the folic acids content among the samples. The samples substituted with higher proportions of mung bean and watermelon rind flours had the higher folic acid contents than the control sample. This might be as a result of substitution effect. Which showed that mung bean and watermelon rind are relatively high in folic acid contents (Jacob *et al.*, 2015, Onwurafor *et al.*, 2019). The folic acid content (1.02 – 1.81mg/100g) obtained in this study was lower than the values (2.22 – 4.22mg/100g) for the bread produced from whole wheat and soy bean flour blends. Folic acids is essential in the maintenance of mental and emotional health in human body (Okaka *et al.*, 2006).

Sensory Properties of the Bread Samples

The sensory properties of the bread samples are presented in Table 3. The colour of the bread samples ranged from 5.25 to 8.25. The control sample (100% wheat flour bread) had the highest value (8.25) while the sample substituted with 25% malted mung bean flour and 25% watermelon rind flour had the least value (5.25). The colour of the bread sample produced from 100% wheat flour (control) was more acceptable and also differed significantly (p<0.05) from the composite bread samples. The change in the colour of breads during baking could be attributed to calamelization and Maillard reactions which tends to enhance the colour and aroma of the baked bread loaves (Olaoye and Ade-Omowaye, 2011).

Table 3: Sensory properties of bread samples.

Samples	% Substitution WF: MMBF:WRF	Colour	Taste	Texture	Aroma	Overall acceptability
A	100:0:0	$8.25^{a}\pm1.07$	$7.95^{a}\pm1.23$	$8.80^{a}\pm1.01$	$7.65^{a}\pm1.04$	$8.25^{a}\pm11.07$
B	90:5:5	$7.60^{b}\pm0.94$	$7.60^{b}\pm0.94$	$7.25^{b}\pm0.10$	$6.75^{b}\pm2.15$	$7.75^{b}\pm0.85$
C	80:10:10	$7.15^{c}\pm0.88$	$7.20^{c}\pm0.89$	$6.65^{c}\pm0.88$	$5.80^{c}\pm1.61$	$7.10^{c}\pm0.64$
D	70:15:15	$6.25^{d}\pm1.71$	$6.10^{d}\pm1.74$	$5.15^{d}\pm1.46$	$5.35^{d}\pm0.93$	$5.85^{d}\pm1.84$
E	60:20:20	$5.50^{e}\pm0.95$	$5.85^{e}\pm1.05$	$5.45^{e}\pm1.15$	$5.25^{e}\pm1.55$	$5.35^{e}\pm0.92$
F	50:25:25	$5.25^{f}\pm1.33$	$5.50^{f}\pm1.14$	$5.05^{f}\pm0.76$	$5.20^{e}\pm1.52$	$5.25^{f}\pm0.49$

Data are mean ± standard deviation of twenty (20) semi – trained judges. Means in the same column bearing different superscripts differed significantly (p<0.05) from each other. A: Bread made from 100% wheat flour, B: Bread made from 90% wheat flour, 5% malted mung bean flour and 5% watermelon rind flour, C: Bread made from 80% wheat flour, 10% malted mung bean flour and 10% watermelon rind flour, D: Bread made from 70% wheat flour, 15% malted mung bean flour and 15% watermelon rind flour, E: Bread made from 60% wheat flour, 20% malted mung bean flour and 20% watermelon rind flour, F: Bread made from 50% wheat flour, 25% malted mung bean flour and 25% watermelon rind flour.

WF — Wheat flour, MPPF — Malted mung bean flour, WRF — Watermelon rind flour.

The taste of the bread samples ranged from 5.50 to 7.95. The result showed that the control sample (100% wheat flour bread) had the highest value (7.95), while the samples substituted with 25% malted mung bean flours and 25% watermelon rind flour had the least value (4.85). The taste of the bread samples decreased significantly (p<0.05) with increase in substitution with malted mung bean and watermelon rind flours. The taste of the bread sample produced from 100% wheat flour (control) was rated higher by the judges than the other test samples. The difference could be due to the unique quality of wheat flour in the preparation of bread and other baked products (Uckiah *et al.,* 2016).

The texture of the bread samples ranged from 5.05 to 8.80. The bread sample produced from 100% wheat flour was rated higher by the panalists in terms of texture compare to the composite flour breads. The texture of the bread samples decreased significantly (p<0.05) with increase in addition of mung bean and watermelon rind flours. This observation is in close agreement with the report of Pico *et al.* (2017) for bread produced from cassava – wheat composite flours.

The aroma of the bread sample ranged from 5.20 to 7.65. The bread sample produced from 100% wheat flour (control) was rated higher in terms of aroma compared to the other test samples attributed to caramelization and Maillard reactions which enhance the taste and aroma of the bread Loaves and other baked products (Olaoye and Ade-Omowaye, 2011). The observation is in agreement with the findings of Arisa *et al.* (2023) who reported a significant difference in aroma of wheat flour bread compared with samples substituted with young corn powder.

The overall acceptability of the bread samples ranged from 5.25 to 8.25. Sample A (100% wheat flour bread) had the highest value (8.25), while the sample substituted with 25% malted mung bean flour and 25% watermelon rind flours had the least value (5.25). The bread sample produced from 100% wheat flour (control) was most acceptable to the panalists compare to the composite bread samples. Therefore, was rated higher in colour, taste, texture and aroma compared to the substituted samples. The observation is in consonance with, the findings of Arisa *et al*. (2023) who reported a significant difference in acceptability of bread produced from 100% wheat flour compared to the samples produced from cassava and wheat composite flours.

Generally, the result showed that the bread produced from 100% wheat flour was more acceptable organoleptically than the composite bread samples substituted with mung bean and watermelon rind flours at different graded proportions.

CONCLUSION

The study showed that the substitution of wheat flour with mung bean and watermelon rind flours in the production of bread improved the vitamin content of the product. The vitamin contents niacin, thiamine, folic acid, riboflavin, vitamin A, Ascorbic acid contents of the samples increased gradually with increase in the addition of mung bean and watermelon rind flours to the products. The sensory properties of the bread samples also revealed that the control sample (100% wheat flour bread) was most acceptable to the panelist and also differed significantly ($p<0.05$) from the composite bread samples in colour, taste, texture and aroma. Although the control sample was most acceptable organoleptically, the composite bread Loaves were equally acceptable because they were also rated relatively high in all the sensory parameters evaluated by judges.

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