Production of Bread from Composites of Wheat, Maize, and Soybeans Flours

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Abstract:

Bread consumption prepared from solely wheat flour have remained popular in Nigeria. The low protein and fiber content of wheat flour and its associated high cost are the major concerns in its utilization as ingredient in bakery industries.

The use of wheat flour, maize flour and soybeans flour blends in varying proportions for the production of bread was studied. Wheat flour was substituted with maize and soybeans flour in ratios 9:5:5, 8:15:5, 8:10:10, 8:5:15, 7:25:5, 7:20:10, 7:15:15, 7:10:20 while wheat flour bread served as control. The different bread samples were produced and subsequently were analyzed for functional properties, proximate compositions, physical parameters, sensory evaluation, pasting properties and shelf-life studies. The crude protein of the composite bread samples ranged from 8.75% to 29.17%. Sensory properties of the composite bread were significantly ($p < 0.05$) affected by blending ratio.

(T6) had the highest value compared to other treatments, while (T5 and T8) had the least value and are not significantly different from each other. However, there was significance difference ($P \leq 0.05$) among the entire treatments. The bread with blend 70% wheat flour, 20% maize flour and 10% soybean flour was organoleptically preferred as much as that of whole wheat flour and it also has the highest protein value of 29.17% when compared with bread from other treatment. The shelf life study also indicated that all the bread samples can be stored for 5 days before the onset of mould growth.

Key words: bread; composite flour; wheat; maize; soybeans

1.Introduction

Bread is an important staple food and the most widely consumed bakery product (Aini and Maimon, 1996). It constitutes one of the most important sources of nutrients such as carbohydrates, protein, fiber, vitamins and minerals in the diets of many people worldwide.

Bread is a fermented confectionary product produced mainly from white wheat flour, water, yeast and salt by a series of processes involving mixing, kneading, proofing, shaping and baking (Dewettinck et al., 2008).

Wheat flour for bread has starches and functional protein glutens that favor the processing of leavened aerated bread, but is limited in fat and balanced amino acids (Goesaert et al., 2005).

Maize nutritionally is superior to others cereals in many ways, except in protein value. Maize has high nutrients profile. It is rich in carbohydrates which are a good source of energy, fats, fibers, phosphorous, sodium, sulfur, riboflavin, amino acids, minerals, calcium, iron, potassium, thiamine, vitamin-C, magnesium and copper as well as ashes are present in the maize kernels (Breadley, 1992). These nutrients make the maize high profile nutrients.

Soybeans are high in protein and a decent source of both carbohydrates and fat. They are a rich source of various vitamins, minerals, and beneficial plant compounds, such as isoflavones. Soybean is rich in high quality proteins with balanced amino acids, lipids, minerals and bioactive compounds but is limited in starches (Garg, Lule, Malik, &Tomar, 2016). The protein content of soybean is about 2 times of other pulses, 4 times of wheat, 6 times of rice grain, 4 times of egg and 12 times of milk. It is also rich in calcium, phosphorous, isoflavones and Vitamins A, B, C and D, and it has been referred to as "the protein hope of the future" (Islam et al. 2007). Soybean protein is rich in valuable amino acid lysine (5%), which is deficient in most of the cereals. Hence, soybean is the richest in food value of all plant foods consumed in the world (Bolarinwa, 2016).

The use of composite flour has been identified by researchers as a possible avenue of producing high-quality nutritious food products, reduced celiac diseases and a means of reducing the huge amount of foreign exchange spent by Nigeria in the importation of wheat flour (Vaugha et al., 2014). One method to alleviate the shortage of wheat flour, increase the nutritional quality and bioactive contents of the bread is to use composite flours prepared from different crops like protein rich legumes, tubers rich in starches and/or other cereal grain flours (Nwanekezi, 2013).

Since bread comprised of a significant proportion of wheat flour products, fortification of flour used for their production presents an opportunity to improve nutrient intake among bread consumers, particularly given the increasing demand

for bread, hence this study will utilize incorporation of maize and soybeans into wheat flour for the fortification of a nutrient dense, palatable, affordable and shelf stable bread from locally available raw materials. The fortified bread will be of a balanced diet for all categories of consumers.

Materials and methods

The raw materials used were wheat flour, maize, soybeans, butter, yeast, sugar and salt.

Golden penny' brand of wheat flour produced by Flour Mill of Nigeria Plc. was purchased from a licensed marketer in Iwo, Osun State Iwo,

Maize grain, soybeans, and other ingredients were obtained from a supermarket in Iwo Osun State

Flour Preparation

Wheat flour

This was bought in an open market

Wheat flour (Plate 1) is a key ingredient in baking products. Wheat flour is unique among cereals because when mixed with water, it forms a visco-elastic dough.

Maize flour (Plate 2) is gluten-free and cannot be used to make rising breads on its own

Soy flour (Plate 3) is made by milling processed soybeans

Production of maize flour

The production of maize flour as described by Houssou and Ayemor (2002).

Water was sprinkled on cleaned maize seeds so as to allow absorption of water by the grains, toughening the pericarp and germ so they do not splinter during milling. The grains were left for about 10 min before dehulling and milling. The flour was sieved using 250 μm mesh size

Production of soybeans flour

The seeds were cleaned by removing dirt and other foreign materials before being soaked in water for about 8 hours. The soaked beans were dehulled and dried in an oven at 80oC for 8 hr. The dried soybeans were allowed to cool, milled and sieved with a 250 μm mesh

Formulation of recipe

The recipe formulation for the wheat, maize and soybeans flour incorporated bread

	T1	T2	T3	T4	T5	T6	T7	T8
Wheat flour	90.0g	80.0g	80.0g	80.0g	70.0g	70.0g	70.0g	70.0g
Maize flour	5.0g	15.0g	10.0g	5.0g	25.0g	20.0g	15.0g	10.0g
Soybeans flour	5.0g	5.0g	10.0g	15.0g	5.0g	10.0g	15.0g	20.0g
Fat	4.0g	4.0g	4.0g	4.0g	4.0g	4.0g	4.0g	4.0g
Sugar	5.0g	5.0g	5.0g	5.0g	5.0g	5.0g	5.0g	5.0g
Yeast	2.0g	2.0g	2.0g	2.0g	2.0g	2.0g	2.0g	2.0g
Salt	2.0g	2.0g	2.0g	2.0g	2.0g	2.0g	2.0g	2.0g
Water	62.0ml	62.0ml	62.0ml	62.0ml	62.0ml	62.0ml	62.0ml	62.0ml

Table 1. Recipe formulation for bread

Production of composite bread

The straight dough method was used to produce the bread. This method involves the addition of all the ingredients (flour, salt, water, sugar, yeast etc.) at mixing stage and kneading same to obtain the dough. The different dough samples were placed in baking pans smeared with vegetable oil and was covered for the dough to ferment resulting in gas production and gluten development for about 3 hour. The dough was then baked in the oven at 2200C for 30 minutes. The baked loaves were carefully removed from the pans and allowed to cool and packaged in polyethylene bags for analysis.

Plate 4: Composition of different bread blends

Determination of physical properties of bread loaves

The physical characteristics of the breads investigated included height, breadth, weight, length, and specific volume were determined according to the method described by Ceserani et al. (1995). The height, breadth and length were measured by a metal rule. The weight was determined using a weighing balance. Specific volume was determined using the formula below.

Thus, Specific volume (cm3 /g) = HxBxL W Where L = Bread length

B = bread breadth H = bread height W = bread weight.

Determination of functional properties

The bulk density of flour was determined as described by (Ojinnaka et al., 2013). Ten grams of each flour sample was measured into a clean 100 ml graduated measuring cylinder. It was taped repeatedly on a padded table until constant volume of flour was obtained. This was express as weight of flour per its constant volume.

Bulk density=weight of samp(g)weight of constant volume of sample(cm3)

Water absorption capacity

This was determined as the weight of the water absorbed by one gram of the sample as described by (Ojinnaka et al., 2013). One gram of the sample was weighed and placed into a weighed test tube. Ten ml of distilled water was added to the tube and mixed thoroughly. The mixture was then allowed to stand for 30 minutes at room temperature it was centrifuged as 3500 rpm for 30 minutes. The supernatant was decanted and the residue in the test tube was inverted over an absorbent paper (tissue pad). It was allowed to drain

completely before the tube and its content held by the flour was measured. This was expressed as volume of water held by flour per gram of flour.

water absorption=weight of water absorpedweight of sample

Proximate analysis

The proximate composition of the bread samples was estimated using AOAC 2012. Moisture, pH, Protein, Fat, Ash, Crude fibre were determined using (A.O.A.C 2012)

Sensory evaluation

Bread loaves were cut into slices of uniform thickness and transferred onto white coloured plates coded with random 3-digit codes. A sensory panel consisting of 25 semi-trained students at Bowen University and familiar with sensory attributes of local bread was employed to evaluate the products. A 5-point Hedonic scale was used to rate the breads for crumb appearance, colour, taste, texture, flavour and overall acceptability. A score of 1 represented "dislike extremely" and a score of 5 represented "like extremely". An atmosphere of complete quietness and privacy was provided for each panelist.

Statistical analysis

Statistical Package for Social Sciences (SPSS) version 26.0 computer was used to analyze the data. Means was used to analyze the continuous variables and standard deviations were calculated to show the statistical variability. Descriptive statistics was performed and the generated means were compared using the least significant ($P<0.05$) difference (LSD).

Result and discussion

Treatment	Bulk density (g/ ml)	Dispersibility (%)	Water absorption capacity (%)
T1	0.53±0.00d	73.33±0.57bc	2.52±0.23bc
T2	0.56±0.03c	75.00±0.00a	2.80±0.00a
T3	0.57±0.01c	72.00±1.00d	2.61±0.12ab
T4	0.50±0.00e	72.00±0.00d	2.13±0.24de
T5	0.61±0.02b	73.33±0.57bc	2.33±0.02cd
T6	0.57±0.01c	74.33±0.57ab	2.29±0.03cd
T7	0.63±0.00b	72.33±0.57cd	2.47±0.14bc
T8	0.53±0.00d	73.33±0.57bc	2.03±0.11e

Values with different superscripts within the same column are significantly different (p≤0.05) using Duncans mean separation method.
T1: 90% Wheat flour + 5% Maize flour + 5%Soybeans flour
T2: 80% Wheat flour + 15% Maize flour + 5%Soybeans flour
T3: 80% Wheat flour + 10% Maize flour + 10%Soybeans flour
T4: 80%Wheat flour + 5% Maize flour + 15%Soybeans flour
T5: 70% Wheat flour + 25% Maize flour + 5%Soybeans flour
T6: 70% Wheat flour + 20% Maize flour + 10%Soybeans flour
T7: 70% Wheat flour + 15% Maize flour + 15% Soybeans flour
T8: 70% Wheat flour + 10% Maize flour + 20%Soybeans flour

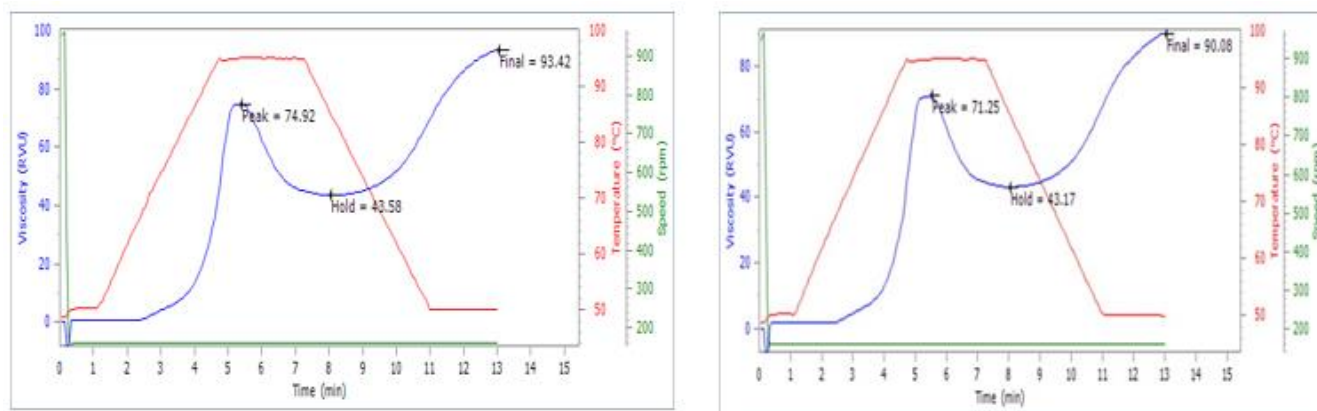**Table 2:** Functional properties of flour blends

Figure 2: Influence of heating time on the viscosity of sample T2 (80% Wheat flour + 15% Maize flour + 5%Soybeans flour).
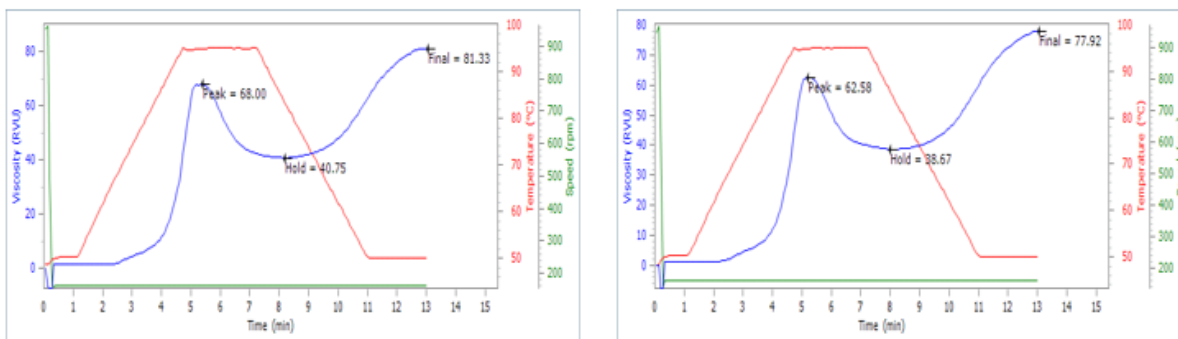
Figure 3: Influence of heating time on the viscosity of sample T3 (80% Wheat flour + 10% Maize flour + 10% Soybeans flour).

Figure 4: Influence of heating time on the viscosity of sample T4 (80% Wheat flour + 5% Maize flour+ 15% Soybeans flour).

Figure 5: Influence of heating time on the viscosity of sample T5 (70% Wheat flour + 25% Maize flour + 5% Soybeans flour).

Figure 6: Influence of heating time on the viscosity of sample T6 (70% Wheat flour + 20% Maize flour + 10% Soybeans flour).
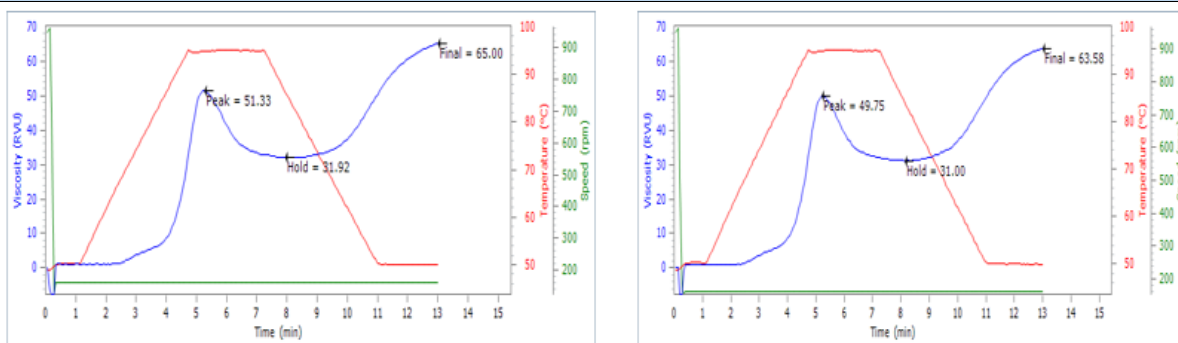
Figure 7: Influence of heating time on the viscosity of sample T7 (70% Wheat flour + 15% Maize flour + 15% Soybeans flour).
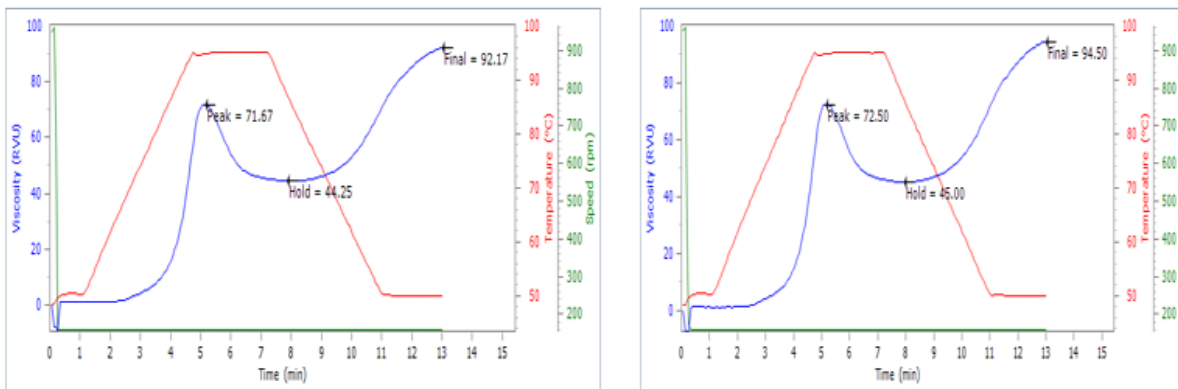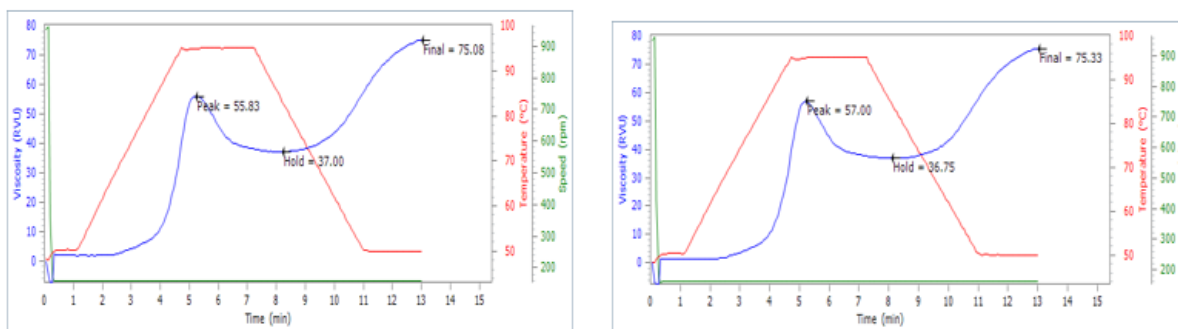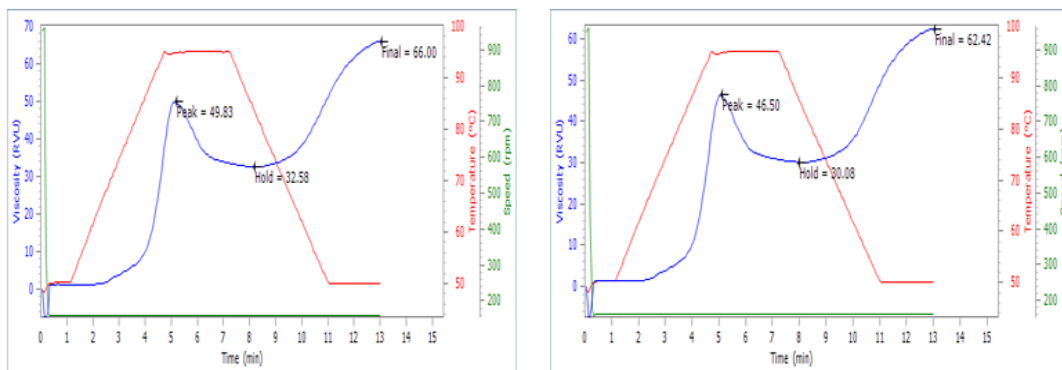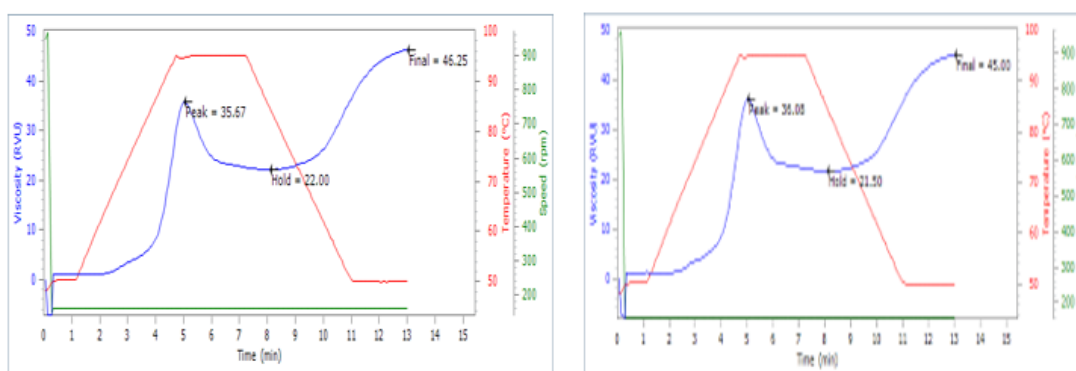

Figure 8: Influence of heating time on the viscosity of sample T8 (70% Wheat flour + 10% Maize flour + 20% Soybeans flour).

Treatment	Length(cm)	Breadth(cm)	Height(cm)	Weight (g)	Specific volume (cm3/g)
T1	14.36±0.15bc	9.66±0.57ab	4.26±0.25b	258.33±2.08c	2.29±0.19ab
T2	14.00±0.20c	9.73±0.11ab	4.23±0.20b	233.33±1.52e	2.47±0.17a
T3	13.23±0.251d	9.43±0.20b	5.00±0.26a	247.33±1.15d	2.52±0.21a
T4	14.16±0.76bc	10.06±0.25a	5.03±0.15a	273.66±2.51b	2.62±0.24a
T5	14.63±0.11b	9.56±0.30ab	3.46±0.25c	291.33±1.52a	1.67±0.11c
T6	15.46±0.25a	9.60±0.30ab	3.43±0.15c	292.66±2.51a	1.74±0.12c
T7	15.53±0.15a	9.60±0.34ab	4.23±0.25b	293.00±5.29a	2.15±0.15b
T8	14.70±0.10b	9.53±0.15ab	4.20±0.17b	234.66±4.16e	2.50±0.11a

Values with different superscripts within the same column are significantly different (p≤0.05) using Duncans mean separation method.

T1: 90% Wheat flour + 5% Maize flour + 5% Soybeans flour
T2: 80% Wheat flour + 15% Maize flour + 5% Soybeans flour
T3: 80% Wheat flour + 10% Maize flour + 10% Soybeans flour
T4: 80% Wheat flour + 5% Maize flour + 15% Soybeans flour
T5: 70% Wheat flour + 25% Maize flour + 5% Soybeans flour
T6: 70% Wheat flour + 20% Maize flour + 10% Soybeans flour
T7: 70% Wheat flour + 15% Maize flour + 15% Soybeans flour
T8: 70% Wheat flour + 10% Maize flour + 20% Soybeans flour 110

(T4) has the highest level of Specific volume which was not significant different from sample (T4, T3 and T8). (T5) shows the lowest level of specific volume of 1.67cm3/g.

Table 3: Results of physical parameters of composite bread

Proximate analysis and pH value of composite bread

Table 4 below shows the moisture, crude protein, fat, ash, total dietary fiber, carbohydrate content and pH of the various bread treatments. There was a significant difference in the proximate composition and pH value of the tested samples.

The moisture content of the composite bread ranged from 32.05% to 39.53 with (T2) having the least and (T1) had the highest as shown in table 4.10 below. There was significant difference (P≤0.05) in the moisture content of the various treatments. However, (T1 and T5, T3, T4 and T8, T6 and T7) are not significantly different from each other but are significantly different from other treatments.

The crude protein of the composite bread samples ranged from 8.75% to 29.17%. (T6) had the highest value compared to other treatments, while (T5 and T8) had the least value and are not significantly different from each other. However, there was significance difference (P≤0.05) among the entire treatments.

The crude fat of the composite bread samples ranged from 1.85% to 2.30%. (T5) has the highest fat followed by (T6) while (T4) has the lowest fat. There was significant differences (P≤0.05) among the entire samples but, (T1 and T7, T2, T3, and T8) are also not significantly different from each other but significantly different from other treatments.

Treatment	Moisture (%)	Crude protein (%)	Crude fat (%)	Crude fiber (%)	Total ash (%)	Carbohydrat e (%)	pH
1	39.53±1.94a	21.87±4.37 bc	2.08±0.07d	6.06±0.05a	1.06±0.06b	29.41±2.37c	6.00±0.00e
2	32.05±0.01c	13.13±0.00 cd	1.95±0.05e	4.95±0.05b	0.90±0.09b	47.04±0.13b	6.06±0.01d
3	34.52±2.04bc	26.25±4.37b	2.00±0.00e	4.40±0.00e	1.08±0.00b	31.73±6.41c	6.17±0.01b
4	34.32±0.07bc	14.58±6.68 cd	1.85±0.05f	4.63±0.02c	1.28±0.04b	46.95±2.25b	6.24±0.02a
5	38.64±1.47a	8.75±0.05d	2.40±0.00b	5.00±0.00b	0.90±0.08b	44.30±1.39b	6.06±0.00d
6	34.75±1.73b	29.17±6.68 b	2.30±0.00c	4.50±0.00d	1.12±0.08b	28.89±8.21c	6.15±0.02b c
7	35.49±1.23b	17.50±7.58 cd	2.10±0.00d	4.95±0.05b	1.03±0.04b	41.14±5.32b	6.14±0.01c
8	33.23±0.85bc	8.75±0.00d	2.00±0.00e	4.60±0.00c	2.13±0.78a	49.22±1.63b	6.22±0.01a

Values with different superscripts within the same column are significantly different (p≤0.05) using Duncans mean separation method

T1: 90% Wheat flour + 5% Maize flour + 5% Soybeans flour
T2: 80% Wheat flour + 15% Maize flour + 5% Soybeans flour
T3: 80% Wheat flour + 10% Maize flour + 10% Soybeans flour
T4: 80% Wheat flour + 5% Maize flour + 15% Soybeans flour
T5: 70% Wheat flour + 25% Maize flour + 5% Soybeans flour
T6: 70% Wheat flour + 20% Maize flour + 10% Soybeans flour
T7: 70% Wheat flour + 15% Maize flour + 15% Soybeans flour
 T8: 70% Wheat flour + 10% Maize flour + 20% Soybeans flour

Table 4: Results of proximate analysis and pH value of composite bread

The crude fiber of the composite bread samples ranged from 4.40% to 6.06%. (T1) has the highest value compared to other treatments. There was significant difference (P≤0.05) in the crude fiber of (T1) when compared to other treatments while (T3) has the lowest fiber content and also significantly differ when compared with other treatments.

The total ash of the composite bread samples ranged from 0.90% to 2.13. (T8) has the highest value and there was a significant difference (P≤0.05) compared to other treatments while (T2 and T5) had the lowest value and are not significantly different from each other but are significantly different from other treatments.

The carbohydrate content of the composite bread samples ranged from 49.22% to 28.89%. (T8) had the highest carbohydrate value followed by

(T2) while (T6) had the lowest carbohydrate value. There was significant difference (P≤0.05) among the entire treatments but, (T1, T3 and T6, T2, T4, T5, T7 and T8) are not significantly different from each other but are significantly different from other treatments.

The pH value of the composite bread samples ranged from 6.00 to 6.24. (T4) had the highest pH value followed by (T8), while (T1) had the lowest pH value. There was significant difference (P≤0.05) among the entire treatments. However, It was observed that (T2 and T5) had similar values and there was no significant difference between the two treatments. Composite bread was produced with varying proportion of wheat flour, maize flour and soybeans flour i.e. 8 formulations incorporating different proportion of wheat flour with respect to maize flour along soybeans flour in every samples

Plate 5: Showing bread from replacement blends

T1: 90% Wheat flour + 5% Maize flour + 5%Soybeans flour,

T2: 80% Wheat flour + 15% Maize flour + 5%Soybeans flour,

T3: 80% Wheat flour + 10% Maize flour + 10%Soybeans flour,

T4: 80%Wheat flour + 5% Maize flour + 15%Soybeans flour,

T5: 70% Wheat flour + 25% Maize flour + 5%Soybeans flour,

T6: 70% Wheat flour + 20% Maize flour + 10%Soybeans flour

T7: 70% Wheat flour + 15% Maize flour + 15% Soybeans flour,

T8: 70% Wheat flour + 10% Maize flour + 20%Soybeans flour.

4.11 Colour parameters of composite bread

The results of colour parameter is shown in Table 4.11 below

The $L*$ values of crumb colour ranged from 63.83 to 66.98 with (T5) having the highest value and (T8) having the lowest value. There was no consistence variation in the value of the various treatments of the crust colour.

The $a*$ values of the crumb colour ranged between 0.89 and 2.34 with (T8) having the highest value and (T1) having the lowest value. It was observed that there was no consistence variation in the value of the various treatments of the crust colour.

The $b*$ values of the crumb colour ranged from 17.53 to 19.58 with (T1) having the highest value and (T8) having the lowest value. There was also no consistence variation in the value of the various treatments of the crust colour.

However, $a*$ and $b*$ values are always higher in the crust compared to the crumb and this is due to caramelization and Maillard reaction during crust formation. During baking, the two processes are important since they transform reducing sugars to other components and change the color of bread samples (Jusoh et al., 2008). Martins et al. (2000) indicated that caramelization and Maillard browning are governed by baking temperature and time.

Treatment	L*	a*	b*
1	58.80±0.20ef	2.90±0.10f	18.70±0.18d
2	58.29±0.17f	8.60±0.11b	23.83±0.11a
3	65.40±0.12a	5.07±0.02d	23.04±0.06b
4	59.01±0.19e	6.29±0.28c	22.16±0.23c
5	64.22±0.63b	3.45±0.28ef	18.97±0.83d
6	60.69±0.34d	3.62±0.01e	18.92±0.24d
7	61.63±0.29c	5.36±0.82d	22.32±0.74bc
8	50.86±0.63g	10.20±0.05a	22.54±0.34bc

Crumb colour

Treatment	L*	a*	b*
1	65.39±0.44b	0.89±0.01f	17.53±0.00f
2	65.28±0.22bc	0.95±0.02ef	17.91±0.08e
3	64.29±0.21d	1.53±0.05d	18.12±0.08e
4	65.16±0.20bc	2.01±0.02b	19.13±0.14c
5	66.98±0.58a	1.04±0.15e	17.78±0.07ef
6	66.89±0.55a	1.69±0.03c	18.84±0.26cd
7	64.51±0.28cd	1.51±0.03d	18.53±0.23d
8	63.83±0.79d	2.34±0.09a	19.58±0.38b

T1: 90% Wheat flour + 5% Maize flour + 5%Soybeans flour,
T2: 80% Wheat flour + 15% Maize flour+ 5%Soybeans flour,
T3: 80% Wheat flour + 10% Maize flour + 10%Soybeans flour,
T4: 80%Wheat flour + 5% Maize flour + 15%Soybeans flour,
T5: 70% Wheat flour + 25% Maize flour + 5%Soybeans flour,
T6: 70% Wheat flour + 20% Maize flour + 10%Soybeans flour,
T7: 70% Wheat flour + 15% Maize flour + 15% Soybeans flour,
T8: 70% Wheat flour + 10% Maize flour + 20%Soybeans flour

Table 5: Results of colour parameters of composite bread Crust colour

Shelf life study of composite bread

After baking, bread quality deteriorates, resulting in large monetary losses for the bakery sector and the consumer. (Axel, C. et.al, 2017). Bread spoilage is a complex process that involves chemical (nutritional value changes, rancidity), physical (moisture redistribution, staling), and microbiological (yeast, bacterial spoilage, and mold) changes and contributes to the "staling process" of bread. (Melini, V. et. al, 2018). Staling reduces bread's shelf life, which is defined as the amount of time that food remains "acceptable" for consumption under specific storage conditions. Acceptable indicates that it retains the required sensory, chemical, physical, and biological properties while also being safe. (Nicoli, M.C et al. 2012). Microbial deterioration, which eventually results in detectable mold growth and the development of mycotoxins that are not recognized, is another key factor for the lowering of the shelf life of bakery items through post- baking storage. High moisture levels (aw = 0.94-0.99) promote the growth of nearly all bacteria, yeasts, and molds. (Sun, L. et al., 2020).

The shelf life study of the composite bread was observed as shown in Table 6 below

At day 1 to 4, there was no visible growth among the various treatments of the composite bread, but at day 5, it was observed that (T1, T2, T5, T6, T7, and T8) had superficial growth of mold, while (T3 and T4) had no superficial growth of mold. However, at day 6, it was observed that (T3 and T4) had superficial growth of mold as shown in Table 6 below.

Treatments 1	Days 2	3	4	5	6	7
1	−	−	−	−	+	+	+
2	−	−	−	−	+	+	+
3	−	−	−	−	−	+	+
4	−	−	−	−	−	+	+
5	−	−	−	−	+	+	+
6	−	−	−	−	+	+	+
7	−	−	−	−	+	+	+
8	−	−	−	−	+	+	+

Results are expressed as follows: (−) means no superficial growth detected; (+) means superficial growth detected.

Table 6: Shelf life study of composite bread

Plate 6: Bread baked from blends affected by microbial spoilage

T1: 90% Wheat flour + 5% Maize flour + 5%Soybeans flour,
T2: 80% Wheat flour + 15% Maize flour + 5%Soybeans flour,
T3: 80% Wheat flour + 10% Maize flour + 10%Soybeans flour,
T4: 80%Wheat flour + 5% Maize flour + 15%Soybeans flour,
T5: 70% Wheat flour + 25% Maize flour + 5%Soybeans flour,
T6: 70% Wheat flour + 20% Maize flour + 10%Soybeans flour
T7: 70% Wheat flour + 15% Maize flour + 15% Soybeans flour,
T8: 70% Wheat flour + 10% Maize flour + 20%Soybeans flour.

Conclusion

This study was carried out to evaluate the effect of adding maize flour and soybeans flour on the quality of wheat bread. Maize and soybeans were processed into flour and added in different percentages to wheat flour for bread production. Bread with high nutrients and soybean bioactive compounds can be processed. Utilization of the maize and soybean flours in bread formulation has a significant implication in improving nutrition and reducing the rising price of bread processed from 100% wheat flours. The information could be useful for job creation for cooperatives such as women associations who can provide breads for different sectors in countries that could not afford 100% wheat bread. Composite bread from wheat, maize and soy beans flour can be prepared successfully. The statistical analysis showed that treatment with 70% wheat, 20% maize and 10% soya bean flour was significantly acceptable in terms of crumb appearance, taste, flavor, and overall acceptability among other treatments and thus can compete favorably with 100% wheat bread. However, sensory evaluation results also indicated a decrease in acceptance of bread with higher soybeans flour substitution

Recommendations

The findings of this project indicated that bread production from composite flours of wheat, maize and soybeans is possible. Therefore, this recipe should be made available for bakers so as to reduce high cost of bread produced mainly from wheat.
Further research activities are necessary to utilize other classes of cereal and legumes to produce protein dense and high fiber bread that is nutritious and health

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