Journal of
Food Chemistry & Nanotechnology

https://doi.org/10.17756/jfcn.2023-145

Research Article

Open Access

Physiochemical Properties and Sensory Acceptability of Bread Developed from Wheat-Pumpkin and Common Bean Flour

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Received: September 16, 2022
Accepted: February 20, 2023
Published: February 22, 2023

Citation: Melese AD, Keyata EO. Physiochemical Properties and Sensory Acceptability of Bread Developed from Wheat-Pumpkin and Common Bean Flour. *J Food Chem Nanotechnol* 9(1): 13-20.

Published by United Scientific Group

Abstract

This study aimed to evaluate the bread quality by substituting pumpkin flour and common bean flour in wheat-based composite bread. The four blending ratios of pumpkin, common bean and wheat flour composite bead (2.5:5:92.5, 5:10:85, 10:15:75, and 15:20:65) were prepared and evaluated whole wheat flour (100%) was taken as control. The bread's proximate composition, functional, and sensory properties were evaluated using standard procedure. Moisture (26.42 - 29.13%), crude protein (9.40 - 12.85%), ash (1.42 - 2.06%), fat (3.60 - 5.22%), and fibre (1.36 - 1.96%) content would increase significantly ($p < 0.05$) as pumpkin, and common bean flour supplementation increased in the blend. However, composite bread values were lower in carbohydrate (59.15 - 50.73%) and energy contents (306.64 - 301.36%) than in control bread. The physical properties of the bread such as specific volume, loaf volume, and hardness were significantly ($p < 0.05$) influenced by blending ratios. The sensory score of the bread samples showed that the control sample had a significantly ($p < 0.05$) higher likeness in all the analyzed attributes compared to the composite bread. The overall sensory acceptability evaluated by panelists depicted that the composite flour bread was within an acceptable score rated above five. Substituting up to 10% pumpkin and 15% common bean could not have a significant ($p < 0.05$) difference from control sample in case of organoleptic attributes.

Keywords

Common bean, Functional properties, Pumpkin, Sensory attributes

Introduction

Pumpkin (*Cucurbita* sp.) is one of the most important vegetables, having vital nutrients and health benefits [1]. Traditionally, pumpkin pulp was processed and eaten in the form of boiled sauces, soups, and in the baking industry as the main ingredient [2]. Pumpkin pulp has been replaced with different flour in many countries to produce various baked goods with wheat flour and others. The Pumpkin flour's flavor, sweetness, and deep yellow orange colour properties make it appealing for bakery products [3]. Numerous studies on pumpkin flour incorporation reported that it could improve bakery products' quality and nutritional benefits [4].

However, wheat flour is widely used in the bakery industry. This might be due to its appropriate and unique gluten content, which imparted the dough the desired degree of plasticity, elasticity, and viscosity, as well as being a good source of calories and other nutrients. Still, its protein and mineral content were lower than legumes [5]. The replacement of wheat flour with legumes was essential to improve the protein quality of the bread. Common bean (*Phaseolus vulgaris* L.)

was a food legume ranked the second most important source of human dietary proteins [6]. Ketema et al. [7] declared common beans contain 22.73% protein, 6.22% crude fibre, 1.42% fat, 61.75% carbohydrates, and 4.09% ash. Production of food products from legumes have an advantage for improving the overall nutrition contents of foodstuff [8, 9].

Bread is a type of bakery food product consumed worldwide that provides essential nutrients to human body [10]. In developing countries, particularly Ethiopia, progress in development and urbanization coupled with the population's fast rise has led to a highly interested in consuming wheat-based food products such as bread and biscuits [11]. However, the country's production capacity and demand for wheat were imbalanced, resulting in importing wheat from other countries [12]. Abdulwahab et al. [13] and Goranova et al. [14] attempted to replace whole wheat with desirable composite flour made from locally grown and abundant cereals, tubers, and fruits and vegetables.

In developing countries, malnutrition is estimated to be responsible for 60% of all deaths of children below the age of 5 years [15]. Diversifying and utilizing locally grown vegetables and low-cost protein-rich legumes reduced malnutrition. Although, applications of composite flour have benefits in developing countries in terms of the retention of hard currency for the importation of wheat from other countries, for promotion of indigenous and under-utilized crops, and for improving the nutritional profile of products [16]. This research aimed to characterize the proximate composition, functional, physical properties, and sensory acceptability of bread produced from the composite flour of wheat, pumpkin, and common bean.

Materials and Methods

Experimental materials

The wheat Liban variety and common bean of the Wajo variety were collected from the Gitilo and Bako Agricultural Research Centers, Ethiopia, respectively. Fresh pumpkin was collected from Shambu local market.

Experimental design

The treatments were being performed in three replicates. The total experiment used in this study was 5 (table 1). The experiment consisted of four blending ratios recommend by different authors for bread formulations [2, 4]. While the 100% of wheat flour sample was used as a control sample.

Sample preparation

Preparation of wheat flour

The wheat grains were cleaned to remove dirt, stones, and extraneous matter. The cleaned grain was dried under a cabinet oven (Memmert, model 765, Germany) at 60 ˚C for 6 hours. The dried samples were milled using a miller (RRH-200, Zhejiang, China). The powder was sieved through a 500 µm sieve to obtain fine homogenized flour. The flour was sealed in a polythene bag and stored at room temperature [17].

Preparation of common bean flour

Common beans were manually cleaned by handpicking the chaff and stones. The selected beans were washed and soaked in water for 10 min and pounded gently in a mortar to dehull, then dried under a cabinet oven (Memmert, model 765, Germany) at 60 ˚C for 6 hours and milled (RRH-200, Zhejiang, China) to the flour aperture size of a 500 µm [7].

Preparing of pumpkin flour

The pumpkin flour was prepared following the method outlined by Cerniauskiene et al. [3]. Ripe pumpkin fruits were washed with tap water, distilled water, and dried carefully. The pumpkin fruits were peeled and cut with sharp knives. Fibres and seeds were removed, and the pulp was cut into 2 - 3 mm thick pieces. Finally, each sample was dried at 60 ˚C in the laboratory cabinet drying oven (Memmert, model 765, Germany). The samples were ground, sieved, packed, and kept at room temperature in containers until the required tests were performed.

Preparation of bread

The bread was baked using straight-dough methods described in the AACC [18]. It was prepared with the ingredients (flour (200 g), water (430 g), salt (20 g), sugar (18 g), fat (20 g), yeast (10 g), and hardened vegetable oil).

Determination of proximate analysis of bread

The moisture content was estimated using the convective oven drying method (130 °C for 1 hour) by taking about 3 g sample (dried sample powder) as described in the AOAC [19] method 925.10. Protein content was estimated by the micro-Kjeldahl method by taking about 1.0 g of the sample as described in AOAC [19] official method, 920.87. The fat content was determined by taking about 1.5 g of sample and extracting petroleum ether using the Soxhlet extractor [19], 920.39. The crude fibre content was determined following AOAC [19] method 962.09 after sequential digestion with 1.25% H_2SO_4 and 28% KOH. The total ash content was determined gravimetrically. After carbonization of about 2.0 g sample on a blue flame of Bunsen burner followed ignition of the sample at 550 ˚C until ashing complete [19] method 923.03. The difference determined total carbohydrate content (TCC) [20]. The energy value (kcal) of each sample was determined according to the already established Atwater factor method, as described by Lewu et al. [21].

Energy value = (9 x crude fat \ %) + (4 x crude protein \ %) + (4 x total carbohydrate %)

Determination of functional properties of composite flours

Bulk density

Bulk density (BD) was determined according to the method stated by Gupta et al. [22]. About one gram of the powder sample was placed in a 10 ml test tube, constantly tapping until there was no further change in volume. The final bulk volume was recorded. Bulk density was then calculated as the weight of sample powder (g) divided by its final volume (ml).

$$Bulk\ density\ (g/ml) = \frac{Weight\ of\ flour\ used}{Volume\ of\ the\ flour\ after\ tapping}$$

Water absorption capacity

Water absorption capacity (WAC) was determined according to Adebowale et al. [23]. The sample (1 g) was weighed and mixed for 30 seconds at room temperature with 10 ml of water. The flour suspension was left to rest for 30 min before centrifugation (2000 rpm, 10 min and ambient temperature). The clean water was drained by keeping the micro-centrifuge pipe at an angle. The tube was weighed again, and the difference in weights obtained the weight of the supernatant before and after draining. Water-holding capacity was expressed as a gram of water held per gram of flour sample.

$$Water\ Absorption\ Capacity\ (g/g) = \frac{W_3 - W_2}{W_1}$$

Where, W3 is weight of empty tube + sample after centrifuged and decanted, W2 is weigh of empty tube + sample before centrifuging, and W1 is weight of sample.

Oil absorption capacity

Oil absorption capacity (OAC) was determined using the method of AACC [18]. About 1 g of the sample (W0) was weighed into pre-weighed 15 ml centrifuge tubes and thoroughly mixed of 10 ml (V1) with refined pure groundnut oil using a vortex mixer. Samples are allowed to stand for 30 min. The sample-oil mixture was centrifuged (Centurion Scientific Model: 1020D) at 3000 rpm for 20 min. Immediately after centrifugation, the supernatant was carefully poured into a 10 ml graduated cylinder, and the volume was recorded (V2). Oil absorption capacity (millilitre of oil per gram of sample) was calculated.

$$Oil\ Absorption\ Capacity\ (ml/g) = \frac{V_1 - V_2}{W_0}$$

Swelling power

Swelling power (SP) determinations were carried out in the temperature range of 60 - 90 °C using the method of Leach et al. [24]. About one gram of flour sample was accurately weighed and transferred into a clear dried test tube. About 15 ml of distilled water was added and mixed gently at low speed for 5 min. The slurry was heated in a thermostated water bath (S/No.108400557 -USA) at 75 °C for 30 min by mixing the suspension intermittently. The slurry was stirred gently during heating to prevent lumps from forming in the flour. The test tube was cooled with its content rapidly to 20 °C. Then the cool paste was centrifuged at 2200 rpm for 15 min. The supernatant was decanted into a pre-weighed evaporating can and dried at 100 °C to constant weight approximately for 4 hours. The weight of the sediment was taken and recorded as or swollen mass.

$$Swelling\ Power\ (\%) \frac{Wt\ of\ sediment}{Wt\ of\ sample\text{-}Wt\ of\ soluble}$$

Dispersibility

Dispersibility was determined using the method described by AACC [18]. Ten grams of the flour sample were weighed into a 100 ml measuring cylinder; water was added to reach a volume of 100 ml. The set-up was stirred vigorously and allowed to stand for three hours. The volume of settled particles was recorded and subtracted from 100. The differences are reported as percentage dispersibility.

$$\%Dispersibility = 100 - Volume\ of\ settled\ particle$$

Physical analysis of bread

Loaf volume and specific volume of bread

The rape seed displacement method was used to determine bread samples' specific volume (cm^3/g); the loaf volume per bread weight was calculated according to the AACC [18].

Textural profile analysis

The braking force required of the bread was determined by a three-point bending test performed on a texture analyzer as designated by Pareyt et al. [25]. In this test, Crust hardness was measured on five preselected points using a puncture test using a 3-mm diameter stainless steel probe and a test speed of 2 mm/s. With a blade (70 mm wide and 3 mm thick), a downward movement of the top beam was then exerted until the product broke. A texture analyzer with the 50 N load cells measured force as crust hardness. The textural parameters considered were hardness (maximum peak force of the first compression cycle, N).

Sensory quality evaluation

Thirty (30) semi-trained panelists were randomly selected from Food Science and Nutrition department students, Wollega University, Ethiopia. They were requested to express their perceptions about the products by scoring the sensory attributes; visual colour, taste, aroma, textures, and overall acceptability were evaluated using a seven-point hedonic scale rated from 1 (extremely dislike) to 7 (extremely like) [26]. The results for each quality characteristic were expressed as an average of the quality scores from all the panelists.

Statistical analysis

A one-way ANOVA analyzed variance within three replications. All the data were analyzed using SAS 9.1 software package (SAS Institute Inc., Cary, NC). This means that the comparison was made using Fisher's protected least significant difference (LSD) at a probability level of 5%.

Results and Discussion

Functional properties of flours

The BD is an essential in determining and deciding the storage, transportation, marketing, and design of packaging materials [27]. The BD in this study decreased from 0.88 to 0.67 g/ml with decrease the proportion of wheat flour and increase ratios of pumpkin and common bean in the blend (table 2). The highest value of BD was observed in the control sample while the lowest was recorded in the blending ratios of 15% pumpkin flour, 20% common bean, and 65% wheat flour. The composite flours with a high percentage of pumpkin flour rated a low bulk density value, which was essential for producing infant food products. Conversely, low bulk density flour contains many particles that can stay together and require low packaging material. For this reason, it is crucial to saving packaging material [27, 28].

Table 1: Experimental layout of breads made with the wheat, pumpkin, and common bean composite flour.

Treatments	WF	CBF	PF
W	100	-	-
A	92.5	5	2.5
B	85	10	5
C	75	15	10
D	65	20	15

WF- Wheat flour, CBF- Common bean flour and PF- Pumpkin flour.
Note: W = control 100% wheat flour; A = 2.5% pumpkin flour, 5% common bean and 92.5% wheat flour; B = 5% pumpkin flour, 10% common bean and 85% wheat flour; C = 10% pumpkin flour, 15% common bean and 75% wheat flour; and D = 15% pumpkin flour, 20% common bean and 65% wheat flour.

The WAC indicates the ability of a product to associate with water under conditions where the water is limited [29]. The WAC of composite flours increased from 1.72 to 2.19 g/g with an increased proportion of common bean and pumpkin flours (table 2). The WAC of control wheat flour was significantly ($p < 0.05$) higher than composite flour. The incorporation of pumpkin and common beans reduces the water absorption capacity. The decrease in water absorption capacity may be due to the rise in protein and reduction of carbohydrate contents in the composite flour. Similar result was reported by Ohizua et al. [30]. The high WAC may be used to produce some bakery products. It could be used as a thickener in liquid and semi-liquid foods [27, 31]. Osundahunsi et al. [32] also showed that higher WAC could improve the yield and consistency of food.

The OAC is a vital flour quality characteristic to maintain flavour and improve the mouth feel of food products [33]. The OAC of composite flour ranged from 1.15 to 2.12 g/ml (table 2). The results showed that the OAC was increased with an increase in the proportion of pumpkin and common bean flour in the blend. The OAC of the composite flours tended to increase with an increase in protein content since the protein in foods influences fat absorption. Flours with a high OAC enhance flavor and tongue feels [34].

The SP of the composite flour values decreased from 10 to 9.32% (table 2). Increasing supplementation of pumpkin and common bean flour reduces the SP of the flour. This could be due to the reduction of amylose content in composite flours. In addition, the high-fat content of flour resulted in lower SP and water-binding capacities [31].

The foaming capacity of the composite flour significantly ($p < 0.05$) influenced by the blending of wheat, pumpkin, and common bean flour (table 2). The composite flour had a significantly higher foaming capacity (6.22 to 10.10%) than the control sample (5.99%). As the amount of common bean increased in composite flours, the foaming capacity also increased. This may be attributed to the highest protein content of the common bean [7].

Dispersibility is a determination of the reconstitution of flour blends in water. The higher the dispersibility, the better the flour reconstitutes in water [35]. Dispersibility can indicate particle suspensibility in water, a useful functional parameter in various food product formulations. The dispersibility values of whole wheat flour (75.78%) were rated significantly ($p < 0.05$) higher than composite flour (71.46 to 73.70) (table 2). This study indicates that replacing pumpkin and common beans reduces the dispersibility values of flour.

Proximate composition of breads

The moisture content of the control sample (26.42%) was lower than the composite bread (26.44 to 29.13) (table 3). The highest moisture values (29.13%) were recorded for the D sample (15% pumpkin flour, 20% common bean, and 65% wheat flour), which was significantly ($p > 0.05$) different from the others. The study indicates that replacing pumpkin and common bean increased the moisture values of the formulated bread. The moisture contents found in this study was lower than the results of Olaoye et al. [36], who reported that moisture values for wheat, plantain, and soybean composite flour bread ranging from 30.98 to 35.59%. The variations in moisture content could be due to drying techniques applied in this study. The high moisture value of a product can quickly deteriorate within a short period.

The protein content of bread samples increased from 9.92 to 12.85 with a reduction in the proportion of wheat and increase in common bean flour in the blend. The findings suggested that adding common beans in the formulations could significantly improve protein content in the developed product and overcome the problem of protein energy malnutrition. Similar results were observed by Bojňanská et al. [37].

Table 2: Functional properties of wheat, pumpkin, and common bean composite flour.

Treatments	Bulk Density (g/ml)	Water Absorption Capacity (g/g)	Oil Absorption Capacity (ml/g)	Swelling Capacity (%)	Foaming Capacity (%)	Dispersibility (%)
W	0.88 ± 0.01^{A}	2.36 ± 0.04^{A}	1.09 ± 0.11^{C}	10.42 ± 0.38^{A}	5.99 ± 0.30^{D}	75.78 ± 0.55^{A}
A	0.81 ± 0.01^{B}	2.19 ± 0.08^{B}	1.15 ± 0.21^{C}	10.00 ± 0.32^{AB}	6.22 ± 0.01^{CD}	73.70 ± 0.36^{B}
B	0.80 ± 0.02^{B}	2.16 ± 0.01^{B}	1.59 ± 0.32^{B}	9.61 ± 0.49^{BC}	6.98 ± 0.21^{BC}	72.54 ± 1.10^{BC}
C	0.71 ± 0.01^{C}	1.96 ± 0.05^{C}	1.77 ± 0.04^{B}	9.48 ± 0.36^{BC}	7.63 ± 0.73^{B}	72.17 ± 0.49^{C}
D	0.67 ± 0.07^{C}	1.72 ± 0.08^{D}	2.12 ± 0.04^{A}	9.32 ± 0.11^{C}	10.10 ± 0.54^{A}	71.46 ± 0.71^{C}
LCD	0.04	0.11	0.33	0.65	0.80	1.27
Cv	3.33	2.96	4.31	3.63	5.96	0.95

Means with different letters across a column are significantly different ($p < 0.05$).
Note: W = control 100% wheat flour; A = 2.5% pumpkin flour, 5% common bean and 92.5% wheat flour; B = 5% pumpkin flour, 10% common bean and 85% wheat flour; C = 10% pumpkin flour, 15% common bean and 75% wheat flour; and D = 15% pumpkin flour, 20% common bean and 65% wheat flour.

Ash is an indication of the total mineral content of food material. The ash content of the bread samples ranged from 1.42% to 2.06%, as indicated in table 3. The value was similar to the ash content of wheat, pumpkin, and soybean composite bread reported by Mitiku and Bereka [4] (1.51 to 2.15%). The ash content of composite bread flour was significantly higher than the control samples. Increasing the incorporation of pumpkin and common bean could increase the mineral content of the bread samples. The result found in this study was in line with the findings of Bassey et al. [38]. Imran et al. [1] also found that increasing the amount of pumpkin flour in composite bread increases the ash content of the product.

Blending common bean and pumpkin flour into wheat bread (4.48 to 5.22%) significantly ($p > 0.05$) increased fat content compared to the control sample (3.60%) (table 3). Mitiku and Bereka [4], reported the same trend, incorporating pumpkin and soybean increases the fat content of wheat-based composite bread. The high-fat content of the sample indicates a fast chance of deteriorating due to lipid oxidation problems to affect the flour flavour. The relatively low-fat content of raw food materials was recommended in formulating various food products [39].

Food fibres are the sum of non-starchy polysaccharides and lignin, which are the main components of plant cell walls. The fibre content of bread samples ranged from 1.36 - 1.96, as shown in table 3. The control samples had the lowest fibre content (1.36%), followed by sample A (2.5% pumpkin, 5% common bean, and 92.5% wheat flour) (1.38) bread sample with no significance ($p > 0.05$) between them. At the same time, the highest value (1.96%) was for the sample D (15% pumpkin, 20% common bean, and 65% wheat flour) bread samples with a significant ($p > 0.05$) difference. The replacement of pumpkin flour increases the fibre content of samples. The high fibre content found in this study may positively impact the products' dietary fibre content. Consumption of ample dietary fibre decreases the risk of obesity, constipation, gallstones, diabetes, and coronary heart diseases [40]. This indicates that the landraces and processing conditions are suitable for producing anchote flour, advantageous to consumers' health.

The total carbohydrate content of bread samples in this study was ranged from 50.73 to 59.15% (table 3). The control bread sample rated the highest (59.15%) carbohydrate content while the lowest values (50.73%) were recorded for the D sample (15% pumpkin, 20% common bean, and 65% wheat flour) bread sample. This study indicates that increasing supplementation of pumpkin and common bean flour reduces the total carbohydrate values of the bread sample. Correspondently, several authors report that pumpkin replacement in composite flour reduces the carbohydrate content [2, 41]. Similarly, legume incorporation can also reduce the carbohydrate content of the composite products [42].

The energy values, which are functions of fat, carbohydrate, and protein, obtained for the flours ranged from 306.64 to 310.16, as indicated in table 3. The composite four had higher energy values than the control sample. This indicates that supplementation of pumpkin and common bean flour increases the energy values of the formulated bread.

Physical properties of breads

The blending ratios significantly ($p < 0.05$) affected the loaf volume. The value ranged from 271.29 to 242.93, as indicated in table 4. The highest loaf volume was noticed for control bread, and the value was decreased with an increase in the replacement of pumpkin and common bean flour. Lowering the ratio of wheat flour induces the minimum amount of gluten content in composite samples. However, the lack of the gluten protein content of composite flour reduces the loaf volume of leavened composite bread [43].

The specific volume of wheat, pumpkin, and common bean bread is presented in table 4, and the value ranged from 1.41 to 1.63 cm^3/g. The specific volume of composite bread samples was significantly decreased ($p > 0.05$) by substitutions of pumpkin and common bean flour compared to control bread. This can be due to the high fibre content of pumpkin flour that resulted in lower levels of gluten network in the dough and consequently less ability of the dough to rise; due to the weaker cell wall structure [44]. This finding is in agreement with the studies of Taghdir et al. [45] and Udomkun et al. [46], which decreased the specific volume perceived as substitutions of non-gluten flour increased in wheat-based composite bread.

Hardness is the force needed to compress the material by

Table 3: Proximate composition of wheat, pumpkin, and common bean composite flour.

Treaments	Moisture (%)	Protein (%)	Ash (%)	Fat (%)	Fiber (%)	Carbohydrate (%)	Energy Value (kcal)
W	26.42 ± 0.20^{D}	9.40 ± 0.17^{D}	1.42 ± 0.19^{D}	3.60 ± 0.16^{C}	1.36 ± 0.01^{D}	59.15 ± 0.66^{A}	306.64 ± 0.65^{B}
A	26.44 ± 0.46^{D}	9.92 ± 0.11^{CD}	1.54 ± 0.08^{CD}	4.48 ± 0.32^{B}	1.38 ± 0.05^{D}	57.52 ± 0.62^{B}	310.16 ± 0.98^{A}
B	27.18 ± 0.54^{C}	10.78 ± 0.65^{BC}	1.67 ± 0.05^{BC}	4.75 ± 0.49^{AB}	1.62 ± 0.03^{C}	55.61 ± 0.78^{C}	308.32 ± 4.33^{A}
C	28.04 ± 0.23^{B}	11.58 ± 1.22^{B}	1.85 ± 0.05^{AB}	5.13 ± 0.23^{A}	1.79 ± 0.17^{B}	53.38 ± 1.18^{D}	306.06 ± 2.29^{A}
D	29.13 ± 0.44^{A}	12.85 ± 0.35^{A}	2.06 ± 0.21^{A}	5.22 ± 0.10^{A}	1.96 ± 0.01^{A}	50.73 ± 0.40^{E}	301.38 ± 1.88^{C}
LCD	0.73	1.17	0.24	0.54	0.14	1.40	4.71
Cv	1.46	5.91	8.01	4.62	5.03	1.41	0.84

Means with different letters across a column are significantly different ($p < 0.05$).

Note: W = control 100% wheat flour; A = 2.5% pumpkin flour, 5% common bean and 92.5% wheat flour; B = 5% pumpkin flour, 10% common bean and 85% wheat flour; C = 10% pumpkin flour, 15% common bean and 75% wheat flour; and D = 15% pumpkin flour, 20% common bean and 65% wheat flour.

a given amount of force. It is defined as the peak force during the first compression cycle. The blending ratio induces a significant ($p < 0.05$) difference in the hardness of the bread. The hardness value ranged from 2.32 to 3.95 N, as shown in table 4. This study shows that bread prepared from the composite samples requires more force than the control sample. The study was identical to the report of Udomkun et al. [46]. The bread crust breaking strength increased as the supplementations of plantain flour and soybean flour increased in wheat-based composite flour.

Sensory properties of breads

The sensory properties of the bread, such as colour, taste, aroma, texture and overall acceptability indicated in table 5. The colour score of the bread formulated from wheat, pumpkin and common bean flour ranged from 4.86 to 6.33. The control bread showed a significantly ($p < 0.05$) higher in the colour score than the composite samples. However, replacing up to 5% pumpkin and 10% common bean did not have a significant ($p < 0.05$) effect. This study showed that the bread's colour score decreased as the pumpkin and common bean supplementation increased. This may be due to the pigment content of the pumpkin that provides yellow colour to flour [2] and the formation of the Millard reaction [47]. The study was in line with the report of Mitiku and Bareke [4] and Mala et al. [2].

The control bread values (6.13) had a significantly ($p < 0.05$) higher mean scores in taste than the composite samples (5.20 - 6.00) with exception of bread formulated from 2.5% pumpkin flour, 5% common bean, and 92.5% wheat flour (table 5). The panelists indicated that a low score taste was recorded for the sample which contains a high ratio of pumpkin and common bean. This might be due to pumpkin contain more pungent odour [48] and common bean associated with beany flavor enhancement [49].

There was a significant ($p < 0.05$) difference in the aroma between control (6.23) and formulated samples (5.06 to 5.83) (table 5). The highest aroma value was observed in the control wheat sample practiced in the local communities while the lowest was recorded in the blending ratios of 15% pumpkin flour, 20% common bean, and 65% wheat flour. The same trend was reported by Mitiku and Bareke [4]; the aroma score of bread was decreased as the incorporation of pumpkin, and common bean was increased.

The mean score texture of the formulated bread increased from (5.40) in the blending ratio of 15% pumpkin flour, 20% common bean, and 65% wheat flour to 6.30 (2.5% pumpkin flour, 5% common bean, and 92.5% wheat flour) (table 5). The results showed that there were no significant ($p > 0.05$) variations in texture among control sample, formulation A and B. Findings depicted that increasing the replacement of pumpkin and common bean flour in wheat-based composite flour could reduce the textural acceptability of bread samples. This study was in line with Kulkarni and Joshi [48], who reported that increasing pumpkin replacement decreased the textural acceptability of products.

The overall acceptability score of the bread ranged from moderately liked to liked, as shown in table 5. The control sample had the highest overall acceptability score than the composite bread sample. The results revealed that supplementing flour to produce bread with up to 10% pumpkin and 15% common bean flour does not have a significant ($p < 0.05$) effects compared to the control sample. However, substitution beyond 10% pumpkin and 15% common bean flour could significantly ($p < 0.05$) reduce the overall acceptability score of the product. The means values recorded in this study within the results reported by Meilgaard et al. [50]. The findings highlighted that overall acceptability of developed bread increased with an increase in the proportion of wheat flour and decreased pumpkin and common bean flour in the blend.

Conclusion

This study examines physicochemical properties and sensory acceptance of composite bread with partial wheat flour substitutions by pumpkin and common bean flour. The findings showed that the bread sample with a high amount of pumpkin and common bean flours had high protein, ash, fat, and fibre content. However, the carbohydrate content would have decreased in the composite bread sample. Although, the composite sample had good sensory attributes that were im-

Table 4: Physical properties of wheat, pumpkin, and common bean composite flour bread.

Treatments	Loaf Volume (cm^3)	Weight (g)	Specific volume (cm^3/g)	Hardness (N)
W	242.93 ± 3.68^{B}	148.63 ± 3.67^{D}	1.63 ± 0.01^{A}	2.32 ± 0.14^{C}
A	245.28 ± 2.58^{B}	161.86 ± 7.18^{C}	1.52 ± 0.05^{B}	2.48 ± 0.55^{C}
B	249.30 ± 3.44^{B}	169.60 ± 6.18^{BC}	1.48 ± 0.05^{B}	2.98 ± 0.51^{BC}
C	264.52 ± 14.22^{A}	173.58 ± 1.10^{AB}	1.52 ± 0.58^{B}	3.76 ± 0.34^{AB}
D	271.29 ± 9.05^{A}	182.77 ± 7.14^{A}	1.41 ± 0.03^{C}	3.95 ± 0.59^{A}
LCD	14.47	10.18	0.10	0.83
Cv	3.12	3.34	3.63	4.76

Means with different letters across a column are significantly different ($p < 0.05$).

Note: W = control 100% wheat flour; A = 2.5% pumpkin flour, 5% common bean and 92.5% wheat flour; B = 5% pumpkin flour, 10% common bean and 85% wheat flour; C = 10% pumpkin flour, 15% common bean and 75% wheat flour; and D = 15% pumpkin flour, 20% common bean and 65% wheat flour.

Table 5: Sensory properties of wheat, pumpkin, and common bean composite flour bread.

Treatments	Color	Taste	Aroma	Texture	Overall acceptability
W	6.33 ± 0.54^{A}	6.13 ± 0.62^{A}	6.23 ± 0.76^{A}	6.41 ± 0.56^{A}	6.36 ± 0.49^{A}
A	6.03 ± 0.71^{A}	6.00 ± 0.78^{AB}	5.83 ± 1.01^{B}	6.30 ± 0.59^{A}	6.30 ± 0.65^{A}
B	5.53 ± 0.77^{B}	5.60 ± 0.85^{BC}	5.80 ± 0.81^{B}	6.06 ± 0.94^{A}	5.83 ± 0.69^{AB}
C	5.36 ± 0.99^{B}	5.26 ± 0.85^{C}	5.56 ± 0.88^{C}	5.63 ± 0.66^{B}	5.70 ± 0.83^{B}
D	4.86 ± 1.01^{C}	5.20 ± 0.94^{C}	5.06 ± 1.01^{D}	5.40 ± 0.77^{B}	5.01 ± 0.84^{C}
LCD	0.42	0.42	0.46	0.36	0.36
Cv	14.72	14.67	16.15	12.10	12.01

Means with different letters across a column are significantly different ($p < 0.05$).
Note: W = control 100% wheat flour; A = 2.5% pumpkin flour, 5% common bean and 92.5% wheat flour; B = 5% pumpkin flour, 10% common bean and 85% wheat flour; C = 10% pumpkin flour, 15% common bean and 75% wheat flour; and D = 15% pumpkin flour, 20% common bean and 65% wheat flour.

portant in product development. Generally, the study indicates that the bread sample supplemented with up to 10% pumpkin and 15% common bean flour had good nutritional and acceptable sensory attributes. However, another study should be carried out on the product's mineral content and packaging material.

Acknowledgment

Authors are thankful to the Wollega University.

Data Availability

The datasets that support the findings of this study are available from the corresponding author upon reasonable request.

Financial Support

The study was funding by Wollega University.

Conflict of Interest

The authors declare no conflict of interest.

Ethical Statement

This study does not have impact on animal or human healthy.

Credit Author Statement

Abebe Daselegn Melese and Ebisa Olika Keyata: Conceptualization, Experiment design, Methodology, Experimentation, Data analysis, Data interpretation, Writing - original draft preparation, Writing - review and editing. All the authors read and approved the manuscript.

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