Effect of Blend Ratio on Chemical Composition and Sensory Characteristics of Composite Wheat, Pumpkin and Soya Bread

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Abstract

The study determines the effect of blend ratio on chemical composition and sensory characteristics of composite wheat, pumpkin and soya bread. The proximate compositions of bread produced with the different mix ratios of wheat, pumpkin and soybean flours were ranged from 11.07 to 13.19% for moisture, 1.15 to 2.15% for ash, 1.18 to 1.54% for fiber, 16.31 to 18.74% for fat, 14.22 to 17.33% for protein, 60.24 to 66.78% for carbohydrates and 470.79 to 478.95 kcal/100g for energy. The result shows that as the supplementation level of pumpkin and soybean flour increases, the ash, fiber, fat and protein of the composite bread produced increase. However, the carbohydrate contents of the produced bread decrease. The sensory evaluation of bread produced was in acceptable range even though it decreased as the supplementation level of the pumpkin and soybean increased. Generally, the study reveals that the composite bread produced was in acceptable range in 9-point hedonic scale. The result shows that supplementation of pumpkin and soybean in bread production can minimize the cost of wheat which is actually imported from different countries. Thus, it is recommended that since pumpkin and soybean had appreciable amounts of nutrients, improve the nutrients in the composite products, they can be used with wheat for different food product development.

Key words: composite bread, pumpkin, soybean, proximate composition and sensory evaluation

1. Introduction

The use of composite flours for commercial bread baking purposes and consumption are gaining much attention in developing countries including Ethiopia. Recently, bread consumption increased continuously in many of the developing countries. Many reasons are adduced for this trend, including a steadily growing population, an overall increase in income, changes in Ethiopia. Recently, bread consumption increased continuously in many

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of the developing countries. Many reasons are adduced for this trend, including a steadily growing population, an overall increase in income, changes in eating and work habits. This meant that a larger proportion of the family income could be spent on food.

Although, no other crop can achieve the absolute baking properties of wheat, composite flours have become the subject of numerous studies, for the developing countries. The use of composite flours has the following advantages: saving of hard currency, promotion of high-yielding native plant species, a better supply of protein for human nutrition and a simple production technology (Bugusu *et al*., 2001). Also, the formulation of composite flour with local staple crop results in value-added product. Thus, there is a need for studies on proper utilization of composite flours, including pumpkins and soybeans. This became a necessity of over reliance on imported wheat (Akpapunam and Darbe 1999). Ethiopia, moreover, grows staple crops other than wheat such as cassava, sweet potato, potato, pumpkins and cereals that can be used for bakery foods. It would, therefore, be economically advantageous if imported wheat could be reduced and the demand for baked foods such as bread could be met by the use of domestically grown products other than wheat.

Pumpkin is from genus *Cucurbita* of the family Cucurbitaceae. It includes squash and cucumbers which are grown throughout the tropical and sub-tropical countries. There are three common types of pumpkin world-wide, namely *Curcurbita pepo*, *Curcurbita maxima* and *C. moschata* (Lee *et al.,* 2003). The yellow-orange characteristic colour of pumpkin is due to the presence of carotenoid. Carotenoids are natural pigments responsible for the yellow, orange and red colour of many foods. Pumpkin provides valuable source of carotenoids, provitamin A and ascorbic acid which have major roles in nutritional aspect as well as an antioxidant. Current research indicates that a diet rich in foods containing beta-carotene may reduce the risk of developing certain types of cancer and offers protection against heart disease.

Pumpkin can be consumed in a variety of ways such as a fresh or cooked vegetable, as well as being stored frozen or canned (Figueredo *et al.,* 2000). Pumpkin can be processed into flour which has longer shelf-life. Pumpkin flour was being used because of its highly-desirable flavour, sweetness and deep yellow-orange colour. It has been used to supplement cereal flours in bakery products, soups, sauces, instant noodle, spice as well as a natural colouring agent in pasta and flour mixes. The composite flours are advantages to the developing countries because the flour could reduce wheat imports and increased the potential use of locally grown crop (Hugo *et al.*, 2003).

1.1 General Objectives

To determine the effect of blend ratio on thermo-physical, chemical composition, sensory characteristics of composite wheat, pumpkin, and soy bread

1.1.1 Specific Objectives

a) To produce breads from composite flours of wheat, pumpkin and soybean flours
b) To determine the acceptability of the bread produced organoleptially
c) To evaluate the chemical compositions and thermo-physical properties of the bread

1.2 Significance of the Study

Information obtained from this study is significant and helpful to bakery industries for decision making. To ensure affordable cost of baked items and food security, composite flour became of great need and interest to research scholars, to meet up the global food requirements. This study will necessitate by the fact that in spite of the vast potential of pumpkin production and utilization in food poverty reduction and minimization of the common ingredients it used in bread production and commercialization of the local crops for the developments of different kinds of foods.

2. Materials and Methods

Experimental Materials

The experiment was conducted at Wollega University Shambu Campus in Food science and Nutrition laboratory and at Jimma University College of Agriculture and Veterinary Medicine Department of Food Science and Postharvest Technology Laboratory. The samples for investigation 15 kg of pumpkin and soybean were collected from Bako Agricultural research center. Wheat flour, salt, sugar and oil were purchased from Jimma city.

Sample Preparation

Production of Pumpkin Flour

The pumpkin tubers were thoroughly sorted to remove foreign materials from the lot. The sorted tubers were washed to remove adhering soil, dirty and extraneous materials. The tubers were peeled and sliced to facilitate drying and ease milling operations. The sliced tubers were then blanched in order to inactivate enzymes that may cause browning reaction. These were then cooked and drained followed by drying. Following drying, the tubers were milled, sieved into fine flour and packaged for further use (FAO, 2011).

2.4. Experimental Plan

Treatment	Pumpkin flour (%)	Soybean flour	Wheat flour (%)
T_0	00	00	100
T1	3.5	1.5	95
T2	7.0	3.0	90
T3	10.5	4.5	85

Pumpkin roots
↓
Peeling
↓
Washing
↓
Mechanical grating
↓
Dewatering
↓
Crushing
↓
Drying
↓
Milling
↓
Sieving (200 µm)
↓
Pumpkin flour
↓
Package

Figure 1: Flow chart for the production Soybean

Soybean
↓
Washing
↓
Boiling (100°C for 30minutes)
↓
Dehulling
↓
Oven drying
↓
Milling
↓
Dryer sieving (300 µm)
↓
Package

Figure 2: Flow chart for the production of pumpkin flour

2.5 Methods

The preparation of the composite were followed the steps in Figure 3. Dough proofing was carried out for 45 to 50 minutes, proofed loaves were baked in oven preheated to set condition of 230^{O}C and baking spanned for 45 to 50 minutes.

Ingredients
↓
Mixing
↓
Kneading
↓
Dough proofing
↓
Baking (230^{o} C for 45 to 50 minutes
↓
Cooling
↓
Packaging

Figure 3: Flow chart for bread production (Oluwamukomi *et al*., 2005)

Chemical Composition

The chemical composition of the composite bread produced and the flour of wheat, pumpkin and soybean, including moisture, crude fat, crude protein, crude fiber and total ash were determined using AOAC official methods of 925.09, 4.5.01, 979.09 and 923.03, respectively (AOAC, 2000). Total carbohydrate was determined by difference. Results were expressed as g/100 g of dry matter. Energy value was calculated using Atwater's conversion factors, where carbohydrates and proteins give 4 kcal/g while lipids give 9 kcal /g.

Total Carotenoid Contents

Total carotenoids content of pumpkins flour and bread samples were determined according Bandy Opadhyay *et al.* (2008). Pumpkin flour and composite bread sample (5g) were mixed with 37.5 ml methanol and 12.5 ml of 50% potassium hydroxide solution in a flask for saponification. Then unsaponifiable materials were extracted twice with diethyl ether (20 ml each time) and the ether extract was washed twice with distilled water (40 ml each time). Next, the extract was dried over anhydrous sodium sulfate. The diethyl ether was evaporated on steam bath and the dried residue was then re-dissolved in petroleum ether (20 ml). The yellow to orange color of the petroleum ether was measured at wavelength of 450 mm with a Spectrophotometer. The Total Carotenoids content of samples was computed using the formula shown below and the result was reported in mg equivalent of β- carotene per kg of sample.

2.7 Sensory Evaluation of Bread from Blends of Wheat or Pumpkin or Soybean Flour

The organoleptic evaluation of the bread loaves samples were carried out for consumer acceptance and preference using 45 trained panelists at Jimma University College of Agriculture and Veterinary Medicine in the Department of Food Science and Post-harvest Technology Laboratory. They evaluated the sensory properties based on taste, aroma, mouth feel, crumb colour, crust colour, texture, appearance and overall acceptability using nine point Hedonic Scale where 1 represents “extremely dislike” and 9 “extremely like” respectively. During sensory evaluation, panelists rinsed their mouth with water to clear the palate after each sample evaluation.

2.8. Statistical Analysis

All the data obtained were subjected to analysis of variance (ANOVA). The mean ± standard error of mean were determined for all the data and were separated by least significance difference (LSD) at $P \leq 0.05$, using SAS computer software.

Result and Discussion

The functional properties determine the application and use of food material for various products. For instance, properties are very important for the appropriateness of the diet, particularly for growing children (Omueti *et al*., 2009). The functional properties of wheat, pumpkin and soybean flour are presented in the (Table 1). The respective results show significant ($P<0.05$) differences between wheat, pumpkin and soybean flour.

The bulk density value of wheat flour was 0.61 g/ml whereas those of pumpkin and soybean flours amounted to 0.51 and 0.55 g/ml respectively. There was significant ($P<0.05$) difference among all the flours. Bulk density was affected by the particle size and density of the flour and it was very important in determining the packaging requirement, material handling and application in wet processing food industry (Karuna *et al*., 1996). The lower the bulk density, the higher the amount of flour particles that can bind together leading to higher energy values (Onimawo and Egbekum, 1998).

The water absorption capacity and oil absorption capacity of the wheat flour were 2.01 and 1.39 g/ml respectively. Oil absorption capacity (OAC) of flour is important as it improves the mouth feel and retains the flavor. Flours of pumpkin and soybean have 0.51 and 0.55 g/ml water absorption capacity and 0.81 and 2.62 ml/g of oil absorption capacity. There were also significant differences between the flours in their water absorption and oil absorption capacity. The highest and lowest swelling index were recorded in wheat flour and soybean flour with values of (3.70 and 2.79) respectively. There were significant ($P<0.05$) differences among all the flours.

The highest total carotenoids and lowest were obtained in pumpkin flour (5.66) and in wheat flours with value of (0.07) respectively. There were significant ($P<0.05$) differences between the flours statistically.

Table 1: Functional Properties of Wheat, Pumpkin and Soybean Flours

Sample code	Bulk Density	Water Absorption	Oil Absorption	Swelling Index	Total Carotenoids
Wheat Flour	0.61+0.01a	2.01+0.02b	1.39+0.02c	3.70+0.01a	0.07+0.01b
Pumpkin Flour	0.51+0.01c	0.81+0.01c	1.63+0.01a	3.61+0.01b	5.66+0.02a
Soybean Flour	0.55+0.01b	2.62+0.02a	1.51+0.02b	2.79+0.01c	0.11+0.01c
LSD	0.03	0.06	0.05	0.04	0.04
CV	2.47	1.62	1.71	0.65	1.06

Where, LSD = least significance differences, CV = Coefficient of

Proximate Composition of Wheat, Pumpkin and Soybean Flour

The proximate composition of the wheat, pumpkin and soybean flour were analyzed for moisture content, ash, protein, fat, fiber, carbohydrates and energy (Table 2). The results reveal that the wheat flour contains 10.37% moisture, 1.92% Ash, 0.60% Fiber, 2.46% fat 10.46% protein, 84.56% carbohydrates and energy 402.25 kcal/100g respectively. The result of proximate analysis shows that pumpkin flour contains 11.52% moisture, 2.39% ash, 1.77% fiber, 0.56% fat, 2.31% protein, 92.96% carbohydrates and 386.13 kcal/100g energy, respectively. Similarly, soybean flour shows 9.61% moisture, 4.08% ash, 5.35% fiber, 16.47% fat, 34.98% protein, 39.12% carbohydrates and 444.65 kcal/100g energy, respectively. The moisture contents of wheat, pumpkin and soybean flour were significantly

(*P<0.05*) different from each other. The present study reveals that the moisture contents of the flours of pumpkin are high with 11.52% and soybean flour shows low (9.61%) moisture content. The low level of moisture contents of the flours could be the result of the extent of drying done on the samples. The ash contents of wheat, pumpkin and soybean flour were significantly (*P<0.05*) different from each other having values of 1.92% in wheat, 2.39% in pumpkin and 4.08% in soybean flours. Similar works have been done by Gerhard S and Saeleaw M (2010) who reported on composition, physicochemical and morphological characterization of pumpkin flour.

The fiber contents of wheat, pumpkin and soybean flour are significantly (*P<0.05*) different from each other. Soybean has greater crude fiber contents (5.35%) than wheat (0.60%) and pumpkin (1.77%). Dietary fiber has recently gained much importance as it reduces colon cancer, diabetes, heart diseases and the level of low density lipoprotein cholesterol in blood (Felicity and Maurica, 1992).

The crude fat content of wheat, pumpkin and soybean flours was 2.46, 0.56 and 16.47% respectively. The values of the soybean is significantly (*P<0.05*) higher than those of wheat and pumpkin flours. The protein contents of wheat, pumpkin and soybean flour were significantly (*P<0.05*) different from each other whereas the protein contents of soybean flour was significantly (*P<0.05*) higher than those of the wheat and pumpkin flour.

Table 2: Proximate Composition of Wheat, Pumpkin and Soybean Flour

Sample code	Moisture (%)	Ash (%)	Fiber (%)	Fat (%)	Protein (%)	Carbohydrate (%)	Energy (%)
Wheat Flour	$10.37{+}0.19^{b}$	$1.92{+}0.02^{c}$	$0.60{+}0.01^{c}$	$2.46{+}0.01^{b}$	$10.46{+}0.04^{b}$	$84.56{+}0.02^{b}$	$402.25{+}0.12^{b}$
Pumpkin Flour	$11.52{+}0.04^{a}$	$2.39{+}0.01^{b}$	$1.77{+}0.02^{b}$	$0.56{+}0.01^{c}$	$2.31{+}0.02^{c}$	$92.96{+}0.03^{a}$	$386.13{+}0.05^{c}$
Soybean Flour	$9.61{+}0.02^{c}$	$4.08{+}0.05^{a}$	$5.35{+}0.02^{a}$	$16.47{+}0.06^{a}$	$34.98{+}0.05^{a}$	$39.12{+}0.07^{c}$	$444.65{+}0.56^{a}$
LSD	0.40	0.11	0.05	0.13	0.14	0.16	1.15

Where, LSD = Least Significance Difference, CV = Coefficient of Variation

The carbohydrate contents of wheat flour, pumpkin and soybean flours were 84.56, 92.96 and 39.12% respectively. The result of the study shows that there is significant (P<0.05) difference between the contents of wheat, pumpkin, and soybean flour. Pumpkin flour contained higher carbohydrate contents than wheat and soybean flour. On the other hand, the energy contents of wheat, pumpkin and soybean flours 402.25, 386.13 and 444.65 kcal/100g, respectively and exhibits significant (P<0.05) differences among each other. The energy content differences could be due to variation in their protein, fat and carbohydrate contents (Giami et al., 2000).

Proximate Composition of Breads Produced from Blends of Wheat, Pumpkin and Soybean Flour

The proximate compositions of breads produced with the different mix ratios of wheat, pumpkin and soybean flours are presented in (Table 3). The values ranged from 11.07 to 13.19% for moisture, 1.15 to 2.15% for ash, 1.18 to 1.54% for fiber, 16.31 to 18.74% for fat, 14.22 to 17.33% for protein, 60.24 to 66.78% for carbohydrates and 470.79 to 478.95 kcal/100g for energy. Similar works were reported by Adriana and Simona 2014 on their works of physicochemical and sensory evaluations of wheat bread with pumpkin.

The highest (13.19%) and lowest (11.07%) moisture contents of composite bread produced from wheat, pumpkin and soybean flour were observed from samples with (10.5% pumpkin, 4.5% soybean and 85% wheat) and 100% wheat breads. There was significance ($P<0.05$) difference in moisture content of whole wheat bread as compared to the all treatments. However, there was no significance ($P<0.05$) between 3.5% and 7% pumpkin flour supplementations.

The highest ash contents were recorded in 10.5% pumpkin and 4.5% soybean flour supplementation and the lowest were recorded in 100% wheat flour breads. Results show that the ash contents of whole wheat bread were significantly ($P<0.05$) different from those of pumpkin and soybean treatments. The pumpkin and soybean composite bread shows significance ($P<0.05$) difference between the treatments. This finding is in agreement with the work of Aniedu and Agugo, (2010) who reported that the ash content increased with progressive increase in supplementation of root crop flour in wheat for bread production.

Table 3: Proximate Composition of Breads Produced from Blends of Wheat, Pumpkin and Soybean Flour

Sample code	Moisture	Ash	Fiber	Fat	Protein	Carbohydrate	Energy
B0	11.07+0.11[c]	1.51+0.02[d]	1.18+0.01[c]	16.31+0.01[d]	14.22+0.02[d]	66.78+0.06[a]	470.79+0.10[d]
B1	12.54+0.08[b]	1.71+0.02[c]	1.22+0.02[c]	17.11+0.01[c]	15.14+0.03[c]	64.81+0.06[b]	473.83+0.12[c]
B2	12.76+0.05[b]	1.80+0.01[b]	1.35+0.01[b]	17.65+0.02[b]	16.22+0.02[b]	62.98+0.04[c]	475.65+0.07[b]
B3	13.19+0.08[a]	2.15+0.03[a]	1.54+0.01[a]	18.74+0.04[a]	17.33+0.03[a]	60.24+0.08[d]	478.95+0.20[a]
LSD	0.28	0.07	0.04	0.08	0.08	0.20	0.42
CV	1.20	1.99	1.88	0.24	0.28	0.17	0.05

Where, LSD= Least Significance Difference, CV= Coefficient of Variation, B0 = 100%, Wheat Flour B1 = 3.5%, Pumpkin flour + 1.5%, soybean flour + 95%, Wheat flour B2 =7%, Pumpkin flour + 3%, soybean flour + 90%, Wheat flourB3 = 10.5%, Pumpkin flour + 4.5%, soybean flour + 85%, Wheat flour

The crude fiber obtained in 10.5% pumpkin and 4.5% soybean flour were higher than those of pure wheat bread samples, implying that addition of pumpkin and soybean flour increases crude fiber. The highest values were recorded in 10.5% pumpkin and 4.5% soybean flour supplementation with value of 1.54%. The crude fiber contents of the composite breads made by adding flours of both pumpkin and soybean exhibited significant (*P<0.05*) differences from that of pure wheat breads. The crude fiber contents increased progressively with increased proportion of pumpkin and soybean flour. This increase in crude fiber content of the breads of the composite flours was the effect of the relatively higher percentage (1.77 and 5.35%) of crude fiber present in pumpkin and soybean flours (Table 2).

The fat contents of bread made with addition of flours of pumpkin and soybean flours ranged from 16.31 to 18.74%. The result shows significance (*P<0.05*) differences between the whole wheat bread and among all the treatments. The results reveal that fat content of the breads of composite flours increased as the proportion of pumpkin and soybean flour addition increased. This is due to high level of fat in soybean flour.

The lowest protein content was found in whole wheat bread with value of 14.22% and highest were recorded in composite breads having 10.5% pumpkin and 4.5% soybean flour with value of 17.33%. There were significant (*P<0.05*) difference among the composite breads produced and with whole wheat breads. The protein content increased as percentage of pumpkin and soybean flours increased. This may have been due to the high protein content of soybean flours. This is similar to the works of Olaoye *et al.*, 2006 on their work of quality characteristics of bread produced from composite flours of wheat, plantain and soybeans.

Regarding carbohydrate contents of the breads made from the composite flours of wheat, pumpkin and soybean flours, significantly higher values were recorded in whole wheat breads as compared to the other treatments. As the supplementation level of pumpkin and soybean flour increases, the carbohydrate contents decreased. Similar findings were reported by Olaoye *et al.*, 2006.The energy contents of breads made from composite flours of wheat, pumpkin and soybean ranged from 470.79 to 478.95 kcal/100g, with significant (*P<0.05*) differences among them. The energy content increased with increase in proportion of pumpkin and soybean flour. The lowest energy content was recorded for whole wheat breads and the highest was recorded in 10.5% pumpkin and 4.5% soybean supplementation respectively.

Sensory Evaluation of Breads Made of Wheat, Pumpkin and Soybean Flour

Sensory acceptability data of breads produced by blending wheat, pumpkin and soybean flours are presented in Table 4. The taste acceptability score ranges from 5.36 to 7.09. There are significant ($P<0.05$) differences among the treatments and also with whole wheat breads.

The aroma acceptability score ranges from 5.18 to 6.78 in 10.5% pumpkin and 4.5% soybean supplementation and 100% wheat breads produced. Statistically aroma doesn't show significance differences between the whole wheat breads and 3.5% pumpkin and 1.5% soybean composite breads. However, there was significance ($P<0.05$) differences between the whole wheat breads and composite breads supplements with 7%, 10.5% pumpkin and 3% and 4.5% soybean flour breads.

The texture acceptability scores ranged from 5.40 to 6.42 and exhibited significance ($P<0.05$) differences between the whole wheat breads and among all the treatments in the composite breads produced. The highest texture score was recorded in 100% wheat bread and the lowest was recorded in 10.5% pumpkin and 4.5% supplementation of soybean flour. The crust and crumb colour of composite bread produced by supplementing pumpkin and soybean decreased when the addition of pumpkin and soybean flour increased. As the supplementation level of pumpkin and soybean flour increased, the brightness of the crust and crumb color of composite were recorded in the whole wheat breads and the lowest was recorded in 10.5% pumpkin and 4.5% soybean flour.

The overall acceptability evaluation of the breads which are presented in the same table show significant ($P<0.05$) difference between whole wheat breads and composite bread produced from addition of pumpkin and soybean at different level. The highest overall acceptability of breads was recorded in whole wheat breads and the lowest were recorded in 10.5% pumpkin and 4.5% soybean supplemented. In general, the overall acceptability of breads decreased, as the supplementation level of pumpkin and soybean flour increased.

Table 4: Sensory Evaluation of Breads Made Of Wheat, Pumpkin and Soybean Flour

Sample code	Taste	Aroma	Texture	Crust colour	Crump colour	Overall Acceptability
B0	7.09+0.02a	6.78+0.02a	6.42+0.02a	6.58+0.02a	6.80+0.01a	7.09+0.03a
B1	6.48+0.01b	6.38+0.01ba	6.19+0.02b	6.36+0.03b	6.18+0.01b	6.61+0.01b
B2	5.77+0.02c	5.97+0.33b	5.70+0.01c	6.48+0.01c	6.41+0.01c	6.42+0.01c
B3	5.36+0.03d	5.18+0.03c	5.40+0.01d	5.58+0.01d	5.76+0.01d	5.49+0.02d
LSD	0.08	0.55	0.05	0.06	0.04	0.06
CV	0.68	4.78	0.46	0.54	0.34	0.51

Where, LSD; Least Significance Difference, CV= Coefficient of Variation, B0 = 100% Wheat Flour; B1 = 3.5% Pumpkin flour + 1.5% soybean flour + 95% Wheat flour; B2 = 7% Pumpkin flour + 3%,
soybean flour + 90% Wheat flour; B3 = 10.5% Pumpkin flour + 4.5% soybean flour + 85% Wheat flour

Conclusion

The nutritional qualities and sensory attributes of pumpkin flour and soybean flour substituted breads were comparable to that of the whole wheat. It is recommended that up to 15% pumpkin flour and 3% soybean flour substitution could be adopted in bread making processes, without affecting the quality adversely. This will play great role in saving the scarce resources of most developing countries, where wheat production is less.

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