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Evaluation of proximate composition, physical and sensory properties of soybean supplemented wheat bread

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Abstract

This present study evaluated proximate composition, physical and sensory properties of soybean supplemented wheat bread in order to ascertain its nutritional quality. Standard analytical methods were used for the analyses. The formulation for the composition of soybean supplemented wheat bread were in the ratios of (100: 0:, 90:10, 80:20,70:30,60:40 and 50:50 %) for wheat and soybean flour blends. The result for proximate composition of soy supplemented wheat bread showed that samples with flour blends of 50:50% , 60:40%,and 70:30% had the highest value at ($P<0.05$) for protein (42.50- 45.50%), fibre (16.50-25.50%) and ash(1.05-1.90) when compared with the control sample(31.50,13.50,and1.25%) respectively . For physical properties the results revealed that the control sample (100% wheat bread) had the highest value for height, loaf volume and specific volume while 50:50% soybean supplemented wheat bread had the highest value for weight. The result for sensory properties evaluated in terms of all parameters assessed showed that soy supplemented wheat bread at 80:20 ranked best when compared with the 100% wheat bread and was generally accepted by the consumers. Thus it can be concluded that the supplementation of wheat flour with soya bean flour improved the nutritional component of the bread as revealed by the result obtained especially in relation to increase in protein, ash, and fibre, content which will boost the protein level of bread, improve mineral, enhance digestion and reduce constipation often associated with bread produced from refined wheat flour.

Keywords: Proximate composition; Physical properties; Sensory properties; Soy bean flour; Soybean supplemented wheat bread

1. Introduction

Bread is an important staple food in both developing and developed countries and constitutes one of the most important sources of nutrients such as carbohydrates, protein, fibre, vitamins and minerals. The consumption of bread and other baked goods such as biscuits, doughnuts and cakes produced from wheat flour is very popular, but the low protein content of wheat flour, which is the most vital ingredient used for the production of different kinds of baked goods has been a major concern in its utilization (Young, 2001). The enrichment of bread and other cereal based confections with legume flours particularly in regions where protein utilization is inadequate is very necessary. This is because legume, nutritionally are high in proteins, minerals, vitamins B and lysine, an essential limiting amino acid in most cereals (Jideani, and Onwubali, 2009). Legumes can therefore complement cereals when blended at optimum ratio (Jideani, and Onwubali, 2009). Formulation of foods from low-lysine staples supplemented with legumes has been proposed as a practical and sustainable approach to improving the protein nutritional value of foods for young children in developing countries (Akpara, and Ogbogo, 2015). High protein soy breads form a popular carrier of nutrition to vulnerable groups like pregnant and nursing mothers, young and school children in reducing the incidence of malnutrition (Islam *et al.,* 2007).

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Wheat consuming countries like Nigeria, rely on countries located in the temperate regions, mostly developed nations, for wheat importation. It is therefore, of economic importance to reduce wheat importation by substitution of wheat with cereals and legumes. Similarly, Wheat flour which is used for bread production is low in protein. Thus, fortification and enrichment could help in boosting the protein levels of bread.

. Thus, the objective of this study was to evaluate nutrient composition, physical properties and the sensory qualities of soy supplemented wheat bread in order to ascertain its nutritional quality and also reduce the cost of importation of wheat in Nigeria.

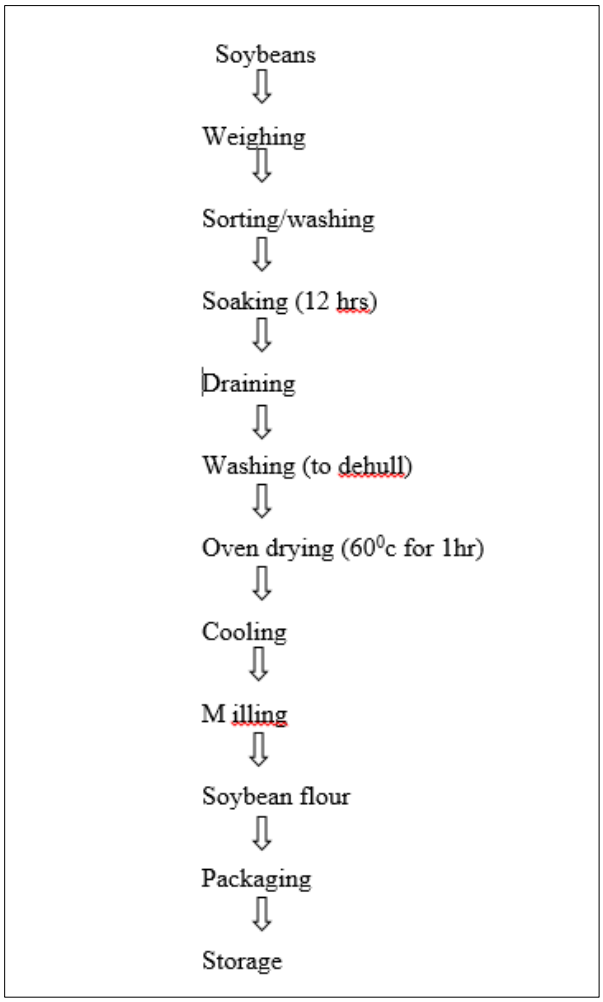
2. Material and methods

2.1. Sample collection

The ingredients used (Soybeans, wheat flour, baker's yeast, salt, margarine and sugar) were purchased from new market Wukari, Taraba State**.**

2.2. Sample preparation

2.2.1. Processing of Soybean flour



Source: (Akpara and 0gbogo, 2015)

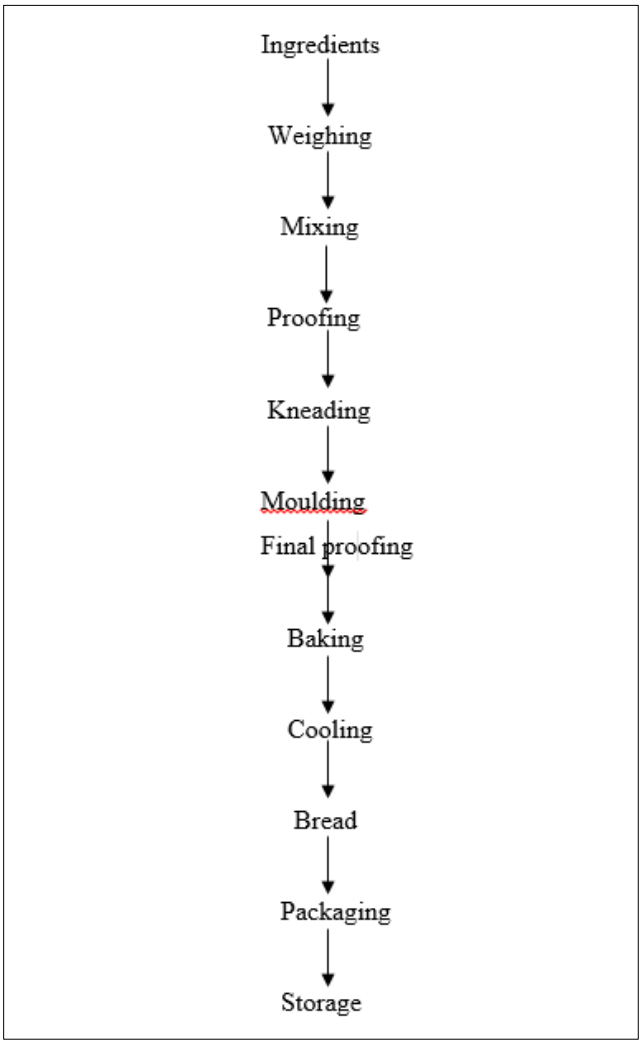
Figure 1 Flow chart of soybean flour processing

Soybean flour used was prepared according to the method described by ((Akpara, and Ogbogo, 2015). Soybeans were sorted to remove all debris from the beans and washed under running water. It was soaked for 12 hours to remove the

beany flavors and bitterness from the bean. After the soybeans were drained and put under running water to allow for easy dehulling. Dehulled soybeans were dried in an oven at 60^0C for 1 hour. Dried soybean were milled using an attrition mill, sieved with a sieve mesh of the size 0.15mm. Then it was packaged and stored at room temperature until when needed. The flour blends (wheat and soybeans) were in the ratios of 100: 0:, 90:10, 80:20,70:30,60:40 and 50:50 respectively.

2.2.2. Preparation of bread

The bread dough was prepared as described by (Akubor and Obiegbuna, 2014) using a recipe of flour (500g), sugar (45g), salt (7.5g), margarine (20g), water (180-220ml) and yeast (5g). The sponge dough method was used for the dry ingredients where the ingredients were weighed and yeast was creamed in a basin with the milk-water mixture. A hole was made in the Center of the flour blend and the dissolved yeast was added and mixed. This was then covered with cheese cloth and fermented at 35°C. The remaining milk-water mixture, butter, sugar and salt were added and kneaded manually until smooth dough free from stickiness was obtained. The remaining dough was returned to the basin, covered with cheese cloth and proofed at 35^0C for 10 minutes. This was then knocked down and kneaded again for proper mixing of ingredients. Then, the dough were molded and transferred into fat greased pans and allowed to proof for about 2 hours and then baked at 220°C for 10 min in a baking oven.



Source: (Akubor and Obiegbuna,2014).

Figure 2 Flow diagram for the production of bread

2.3. Evaluation of physical characteristics of bread

Physical characteristics of bread samples such as height, loaf weight and loaf volume of final bread mass were measured after cooling for 3hours at room temperature according to the method of American Association of Cereal Chemists (A.A.C.C, 2000). The specific loaf volume was determined by dividing the loaf volume by its loaf weight (cm3/g) as described by (Araki *et al*.,2009).

2.4. Proximate Analysis

Moisture, crude protein, crude fat, crude fibre and ash contents of the bread samples were determined by standard methods of the Association of Official Analytical Chemists (AOAC, 2010) while Nitrogen free extract was determined by difference using the formula; % Nitrogen free extract= 100-(% Moisture + % crude protein + % crude fat + % ash + % crude fibre).

2.5. Energy Content Determination

The energy content (E) of the bread samples were calculated using Atwater factor method as described by (Adegunwa et al., 2017). E = (9 x Protein) + (4 x Fat) + (4 x Carbohydrate).

2.6. Sensory evaluation of breads

All the bread samples including the control were assessed using a panel of 15 trained panelists who were randomly selected from students and staff of Federal university wukari, based on their familiarity with quality attributes of bread. A 9-point Hedonic scale where I represented dislike extremely and 9 like extremely was used to evaluate the color, texture, taste, flavor and overall acceptability of the bread as described by (Adeboye *et al*., 2013).

2.7. Statistical Analysis

The results were subjected to a one way Analysis of Variance (ANOVA) and Duncan's multiple range tests were used to establish if there were significant differences between mean values at ($P<0.05$) using the Statistical Product for Service Solution (SPSS) version 23.0.

3. Results and discussion

3.1. Proximate Composition of bread Supplemented with Soybeans flour

The proximate composition of bread supplemented with soybean flour is shown in Table 1. The protein content ranged from (31.50-45.50%), the moisture content (0.70-1.75%), fat (15.00-19.50%), Fibre(13.50-25.50%), ash content (1.00-1.90%) and carbohydrate (13.00-33.50%) for sample of 100% wheat flour. The flour blends (wheat and soyabean) were in the ratios of 100: 0:, 90:10, 80:20,70:30,60:40 and 50:50 respectively. The high protein values of the test breads were due to fermentation, type of supplements and mutual supplementation effects. It could as well be attributable to synthesis of new protein from hydrolyzed free amino acids during fermentation by microflora enzymes. It is known that when legumes supplement cereals they provided a protein quality comparable to or higher than that of animal protein (Hotz and Gibson, 2007). The higher protein for the sample with 50% soybeans flour blend over the other blends showed that it was superior to other blends. This increase is due to the fact that soybean flour is a rich source of protein and helps to retrieve back the nutritional protein lost during the process of manufacturing. The result obtained from this study is in agreement with the work of other researchers (Mashayekh *et al*., 2008 and Onoja *et al*., 2011) who also reported increase in protein content of wheat- based bread as a result of addition of soyflour.

The moisture content of the breads increased with sample of 10% soybeans flour having the highest value. Increase in moisture content decreases the shelf life of the product and this may lead to proliferation of micro-organisms which causes spoilage. The increase in moisture content of soybean flour obtained from, this study was in agreement with the work done by (Bansaland Kapoor, 2015) who reported increase in moisture content of bread supplemented with different levels of soyflour blends. However, there was much difference between the values obtained for this study with that reported by (Gupta *et al.,* 2011) which was 8.60%. The difference might be due to the method of drying or the pretreatment method given to the flours.

The crude fibre content showed increased with 30% soybeans flour blends having the highest value (25.50%) with significant difference ($p>0.05$) from each of the other samples. Increase in crude fibre shows that soybeans is also a good source of fibre and have several health benefit, as it will aid in digestion of the bread and reduce constipation often

associated with bread produced from refined wheat flour. This result is in line with that reported by (Jideani and onwubali,2009; Elleuch *et al.,*2011).

The fat contents increased significantly with 40% soybean flour (19.50%) having the highest value, with no significant difference between 100% wheat flour, 20%, 30% and 50% soybeans flour respectively. Increase in fat content shows that soybeans from which the soy flour was produced is an oil seed and is the main oil contributor to the increase in oil content that is fat of the product. The result obtained from this study was higher when compared with (Gupta *et al., 20*11), who reported 12.30% of fat in a similar work supplemented with soy flour.

The ash content increased with 30% soybeans flour having the highest value, and no significant difference between 20%, 40% and 50% soybean flour blends. Higher ash content of soybeans flour supplemented wheat bread is an indication of high mineral content. The result of this study is similar with the report of (Bansal and kapoor, 2015) who carried out bread fortification with different concentrations of soybean flour.

The energy content of the bread increased with 50% soybeans flour having the highest value (407^{a}). The energy value of a food is related to protein, fat and carbohydrate contents. The higher protein, fat and carbohydrate content of the soy flour bread may thus has contributed to its higher energy value. High carbohydrate level of bread might be ascribed to either individual food materials or microflora enzymes hydrolysis that led to the synthesis of complex carbohydrates from other nutrients carbon skeletons. The slightly lower values of carbohydrate for some blends could be attributed to its use as source of energy by the fermenting microflora or that the carbohydrate provided the required carbon skeleton for synthesis of other new nutrients particularly, protein (Hotz and Gibson, 2007). The result obtain from this study is in line with that reported by (Onoja et al., (2011).

Table 1 Proximate Composition of bread Supplemented with Soybean flour

W:S	Moisture %	Fat %	Protein %	Fibre %	Ash %	Carbohydrate %	Energy value (kcal/j
100:0	1.45^{ab}±0.35	18.50^{ab}±0.70	31.50^{d}±0.70	13.50^{d}±0.70	1.25^{b}±0.70	33.50^{a}±2.12	418.13^{b}
90:10	1.75^{a}±0.35	17.00^{c}±0.00	39.50^{c}±0.70	10.00^{e}±0.00	1.85^{a}±0.70	29.50^{b}±0.70	317.94^{f}
80:20	1.00^{ab}±0.00	16.50^{c}±0.70	40.00^{c}±0.00	20.50^{b}±0.70	1.00^{c}±0.00	21.00^{c}±1.41	387.25^{d}
70:30	1.40^{ab}±0.56	15.00^{d}±0.00	42.50^{b}±0.70	25.50^{a}±0.70	1.90^{a}±0.00	13.00^{d}±1.41	353.75^{e}
60:40	0.70^{b}±0.00	19.50^{a}±0.70	40.00^{c}±0.00	21.00^{b}±0.00	1.00^{c}±0.00	17.50^{c}±0.70	401.13^{c}
50:50	1.20^{ab}±0.00	17.50^{bc}±0.70	45.50^{a}±0.70	16.50^{c}±0.70	1.05^{c}±0.70	18.00^{c}±1.41	407^{a}

Values are means ± standard deviation of 2 replicates. Means within a column with the same superscript were not significantly different (p>0.05). W= Wheat flour%, S=Soybean flour.

3.2. Physical properties of breads supplemented with soybean flour

The physical properties of the breads supplemented with soybean flour is shown in Table 2 The height content ranged from 23.55-20.50%, Loaf weight increased from 828.40 – 1380.9%, Loaf volume decreased from 1920.5-1439% and specific volume also decreased from 2.40-1.21% respectively.

For height of the bread, decrease from 23.55- 20.50% with 50% soybeans flour having the lowest height (20.50%). There were significant differences (p<0.05) with all the samples. The decrease in samples of soybeans flour might be due to decrease in gluten strength with increase in soybean flour as gluten is known to form the network within dough that result in rising (height).This result is in line with (Taha et al., 2006) who also reported decrease in chickpea-bread bean soy protein flour blend.

The weight increased from 828.40-1380.9% with 50% soybeans flour having the highest loaf weight (1380.9%), high loaf weight shows the lightness of the bread. This result is in agreement with those for fermented wheat- cowpea blend (Akubor, 2008), and fermented composite flour blend (Onoja and Obizoba, 2009). There was significant (p>0.05) difference between these samples. Generally there was significant (p>0.05) weight difference (increase) with increased soybean flour. The difference might be due to increase protein content with increased level of soybean flour.

The loaf volume decreased from 1920.5_1439.5%, 50% wheat flour had the lowest loaf volume 1439.5%. There was significant difference (p>0.05) in loaf volume decrease with increased soybean flour which is the same as that reported by (Akubor, 2016), this difference may be as a result of decrease in gluten strength with increase in soybean flour. Gluten is also responsible for dough volume increase as a result of its extensibility, during bread production, gluten form networks which increases the volume of dough along with the action of yeast.

The specific volume decreased from 2.40-1.21%, the 100%wheat flour had the highest specific volume (2.40%). There was significant (p>0.05) difference in specific volume between bread samples. The specific volume decreased with increased in soyabean flour. The result obtained from this study is similar with that reported by (Elawad et al., 2016).

Table 2 Physical properties of bread supplemented with soyabeans flour

W: S	Loaf Weight	Specific Volume	Loaf Height	Loaf Volume
100:0	828.40^{f}±0.71	2.40^{a}±0.00	23.55^{a}±0.71	1920.5^{a}±0.71
90:10	833.20^{e}±0.42	2.32^{b}±0.01	23.50^{b}±0.64	1890.5^{b}±0.71
80:20	898.30^{d}±0.71	1.56^{c}±0.01	23.30^{c}±0.42	1779.5^{c}±0.71
70:30	950.80^{c}±0.71	1.43^{d}±0.01	22.20^{d}±0.35	1690.0^{d}±0.00
60:40	1197.2^{b}±0.85	1.21^{f}±0.01	21.50^{e}±0.71	1590.5^{e}±0.71
50:50	1380.9^{a}±0.71	1.37^{e}±0.01	20.50^{f}±0.71	1439.5^{f}±0.71

Values are means ± standard deviation of 2 replicates. Means within a column with the same superscript were not significantly different (p>0.05). W= Wheat flour%.S=Soybean flour%.

3.3. Sensory properties of breads supplemented with soybeans flour

The sensory properties of breads supplemented with soybeans flour are presented in Table 3.Colour values ranged from 4.93-8.53%, Taste ranged from 4.53-7.80%, Texture values were 5.40-7.73%, Flavor ranged from 5.07-7.87% and General acceptability values were 5.33-8.40% respectively. For colour values, 100% wheat flour had the highest scores with no significant difference between 10%, 20%, 30% and 40% of soybeans flour. High acceptability for colour on 100% wheat flour might be due to brightness of the bread. This result is similar with that reported by (Retapol and Hooker,2006).

The scores for the texture of the bread had 100% wheat flour as the highest acceptable sample, this might be due to the better texture the wheat flour produced and was accepted more by the consumers.

The score for texture of composite bread samples decreased as the soya content increases as the addition of soybean flour to the wheat flour affected the rheological properties of dough and hence affect the quality of the final bread. Hence sample 50:50% when compared with control had poor texture. During baking condition, the state of bread components such as starch, protein, gluten, amount of water absorbed during dough mixing all contribute to the final texture of the formulated bread. The addition of soybean flour had no significant difference (p>0.05) between 10% and 20% soybeans flour for the bread's crumb texture. The result of this study is similar with that reported by (Serrem et al., 2011) and (Eimam et al., 2008) who reported hard crumb texture caused by increased fibre from wheat bran substitution. For taste, 100% wheat flour had the highest value (7.80%) and each of the samples having significant difference (p>0.05) on taste of the breads. The significant (p>0.05) decrease for taste was similar with that 6.73% reported by (Mongi et al.,2011) who reported significant (p>0.05) decrease with increase cocoyam flour in bread.

100% wheat flour also had the highest value for flavour and 50% soybean flour having the lowest value. The incorporation of soybean flour had no significant difference (p>0.05) on flavour of the breads except for 100% wheat flour which serve as the control. This result is similar with the 8.2% reported by (Bansal and Kapoor, 2015).As the concentration of soybean flour increases, its beany aroma and flavor in the bread get more pronounced. In soybeans, enzymatic break down by lipoxygenase or auto oxidation of linoleic acid produces hydroperoxides such as ketones and aldehydes that may be responsible for many beany flavor which discourages soybean consumption (Bansal and Kapoor, 2015).

For general acceptability, 100% wheat flour and the 20% soybeans flour had similar values and were all accepted even though the 100% wheat flour was still preferred. There was no significant difference (p>0.05) between 10%,30% and

40% soybeans flour. Generally, there was slight decrease in sensory quality with increased soybean flour which is the same as that reported by (Okpala and Akpu, 2014) who reported decrease in sensory quality with increased orange peel flour. There was average mean non-uniform decrease in colour, crumb texture, taste, flavour and general acceptability with increased soybean flour. Generally, there was significant difference ($p>0.05$) with increase in soybean flour except for flavor.

Table 3 Sensory Properties of Breads Supplemented with Soybeans flour

W: S	Colour	Taste	Texture	Flavor	General Acceptability
100:0	8.53^{a}±0.	64 7.80^{a}±1.26	7.73^{a}±0.70	7.87^{a} ±1.41	8.40^{a}±0.63
90:10	6.80^{b}±1.57	6.13^{b}±1.41	7.00^{ab}±1.07	5.87^{b}±1.00	6.07^{bc}±1.58
80:20	7.70^{b}±1.22	7.50^{bcd}±1.25	7.00^{ab}±1.14	7.00^{b}±1.56	7.73^{b}±1.16
70:30	7.27^{b}±1.44	5.00^{cd}±1.85	5.93^{bc}±1.39	5.07^{b}±2.43	6.07^{bc}±1.87
60:40	6.80^{b}±1.37	5.67^{bc}±1.29	6.60^{b}±1.72	5.53^{b}±1.77	5.93^{bc}±1.75
50.50	4.93^{c}±2.12	4.53^{d}±1.19	5.40^{c}±1.68	5.87^{b}±1.64	5.33^{c}±2.32

Values are means ± standard deviation of 2 replicates. Means within a column with the same superscript were no significantly different ($p>0.05$).
W= Wheat flour% , S=Soybean flour%

4. Conclusion

There was notable increase in protein, crude fibre, ash and energy value in the soybean flour supplemented wheat bread as the levels of substitution of the soybean flour increased especially at 30% level of substitution than the whole wheat bread (100%).Thus,the addition of soybean flour in this product improved the nutritional content of the bread when compared with the whole wheat bread. Therefore, the addition of soybean flour in bread at 30% should be encouraged because this would go a long way in enhancing nutrition, health, wellbeing of the consumers and thereby reduce the over dependence on wheat flour for bread making. Further research on the storage stability of soy supplemented wheat bread should be carried out.

Compliance with ethical standards

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Disclosure of conflict of interest

There is no conflict of interest.

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