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Determination of nutrient composition and organoleptic evaluation of bread produced from composite flours of wheat and beans

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The study was conducted to compare the chemical composition and organoleptic evaluation of 5 bread samples (B_1, B_2, B_3, B_4 and B_5). The bread samples were made from composite flours of wheat and fermented ground bean flours (70:30), (60:40), wheat and fermented brown-eyed bean flours (70:30), (60:40) and 100% wheat flour. The samples were processed and milled into fine flours. The flours were used to produce different bread samples. The organoleptic evaluation was done using the nine hedonic scale assessment forms. The chemical analysis was done in triplicates. Mean, standard deviation of the samples were calculated and Duncan's multiple test was used to separate the means. The result indicated that the breads made from fermented brown-eyed bean and fermented ground bean were comparable. They contained (16.25 to 19.0%) protein higher than bread made with 100% wheat flour. Vitamin A content of the breads was highest in bread made from composites of fermented ground bean and wheat flours which had 47.56 mg/100 g and 28.37 mg/100 g according to their ratio combinations. The iron, phosphorus, and magnesium contents of all the bread were comparable. The 100% wheat flour was most acceptable amongst the bread samples, the 70:30 (wheat flour: fermented ground bean flour) was closer to the acceptability of the 100% wheat flour bread and contained higher percentages of protein and micro nutrients especially the Pro-vitamin A. The study concludes that ground bean flour is a good nutrient supplement of wheat flour in bread making.

Key words: Nutrient, organoleptic evaluation, bread, flour blend.

INTRODUCTION

Legumes are still minor crops despite their role as a source of protein and oil in the diet of people throughout the developing world (FAO, 1985). They rank second to cereals as source of human food which provides much needed protein to predominantly vegetarian population (Duke, 1981).Well known legumes include Pigeon peas (*Cajanus cajan*), Groundnut (*Arachis hypogea*), Brown-eyed bean (*Vigna unguiculata*), Soya bean (*Glycine max*) etc. Legumes are staple and essential for supplementing protein where there is no meat or inadequate meat. Brown-eyed bean flour is a convenient food ingredient with the potential to promote industrial utilization of

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brown-eyed bean. It can be prepared into various dishes.

Brown-eyed bean could become an important ingredient in other food applications such as baked foods, like cakes and bread, comminuted meat products, like sausages and hams, extruded products like macaroni and spaghetti and weaning foods. (Akubor, 2008). Brown-eyed bean (brown-eyed bean) flour could replace wet paste as the starting ingredient for some traditional West African brown-eyed bean foods (Akubor, 2008).

Groundbeans is not commonly known. In Nigeria, ground bean is only cultivated and consumed in Nrobo in Uzo-Uwani, Local Government Area (L.G.A.) of Enugu state. It is rarely cultivated in Obimo, Umulopka, Eziani and Edemani. In Nrobo, ground beans is an affordable legume which is available in the local market (Oye day). The seeds are small and leaves are broad. The seeds vary in colour. Ground bean can be eaten as pottage with other foods like rice and yam. It can be processed into paste and used to prepare Moimoi and Akara (Chikwendu, 2007). Consumption of bread in Nigeria as a fast food has been in the increase. Therefore, improving the nutritional quality of bread would help in enhancing the nutrients intake of the populace. Thus, bread could be a vehicle for delivery of important nutrients from these legumes (Akubor, 2008).

Malnutrition is one of the major problems reported mostly in the rural part of Nigeria. Malnutrition in form of micronutrient deficiency is highly prevalent in many parts of developed countries (ACC/SCN, 2000). The state of nutrition of most children in the developing countries can be linked to common form of malnutrition described as “a poor nutritional state”. It is characterized by smallness for age and poor muscle development. Poor earning power, poor management of money, poor knowledge of food and poor method of food preparation are causes of malnutrition in rural areas (Nnanyelugo, 1983).One way with which the problem of malnutrition can be combated is to improve the qualities of food consumed. As a result, attempt is being made to improve the nutritional value of a baked product which is commonly consumed by the population in order to solve the problem of under nutrition. Ground bean is one of the under exploited legumes identified as potential food for the future (National Academy of Science, 1979). Ground bean therefore should be used for preparation of other foods which is generally consumed so that it can be useful and cultivated by the nation and other countries. It is an affordable legume and therefore can be used effectively to promote the nutritional status of the poor and vulnerable group. The poor nutrition habits is attributed to ignorance of value, hard to cook phenomenon on of legumes and flatulence associated with legumes (Onoja, 1982). These can be corrected by appropriate processing methods and proper combination of foods. The general objective of the study was to chemically and organoleptically evaluate and compare bread, prepared from brown-eyed beans flour and bread prepared from ground bean flour. The specific objectives were:

1. To formulate composite flour from wheat flour, brown-eyed bean flour and ground bean.
2. To produce bread from the composite flours and 100% wheat flour.
3. To evaluate the organoleptic attributes and acceptability of products.
4. To compare the nutrient composition of the (brown-eyed bean) bread and ground bean bread.

The comparative study of the bread made from brown-eyed bean and ground bean flour would help the general public including those in the rural areas, urban areas, nutritionists, health educators, commercial food manufacturers to see the importance of the common legume (brown-eyed bean) and the uncommon legume (ground bean) available in our nation.

The study would also enable us to know the other methods of preparing food from the legumes and also help to curb malnutrition generally (Rural and Urban areas) by encouraging the use of the local legumes in food preparation by so doing; we tend to improve food diversification and food security in the nation. Using our local raw material in bread production is a feat along the benefits of bread production from indigenous crops. It becomes apparent when we realize that such a trend would stimulate the damage from artisanal agriculture for home use to industrialized commercial agriculture. This is because these crops would now be produced in large quantities producing oil free protein rich side products as bread ingredients. Also agricultural related industries would be powerful factors against under employment.

MATERIALS AND METHODS

Brown-eyed bean (*V. unguiculata*) and ground bean (*Kerstigella geocarpa*) were used for the study. Brown-eyed bean (*Potascum* beans) as well as wheat flour and other ingredients for the bread was purchased from Ogige local market, Nsukka. Ground bean were purchased from Nrobo Local Market, Uzo-Uwani, Enugu state, Nigeria.

Preparation of materials

Raw ground bean and brown-eyed bean flour preparation

The dried ground bean and the brown-eyed bean seeds were cleaned from extraneous materials and soaked in excess tap water at room temperature for 30 min respectively. The hydrated seeds were dehulled manually, washed in tap water and hot air oven dried at 50°C for 12 h. The dried kernels were milled into fine flours and screened through a muslim cloth/sheet respectively. The ground bean and the brown-eyed bean flours were mixed with tap water in a ratio of 5:8 (flour:water) as recommended by Ariahu et al. (1999) for soybean-African bread fruit flour blend subjected to a natural fermentation in a covered plastic basin at room temperature for 3 days respectively. They were oven dried at 50°C for 12 h milled and screened through a muslin cloth/sheet (Figures 1 and 2) respectively.

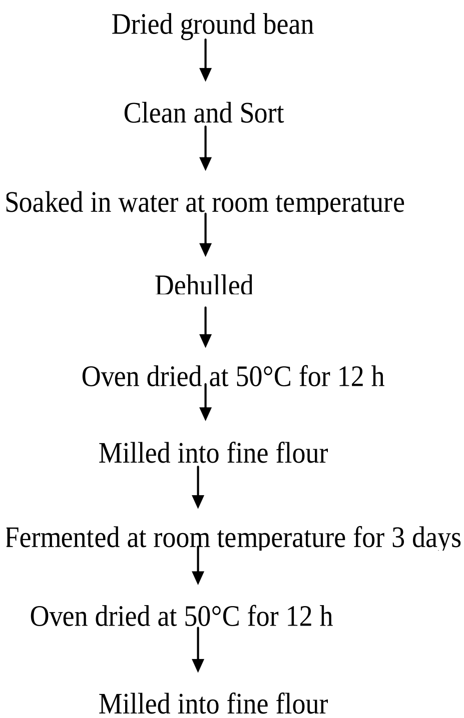

Figure 1. Preparation flow chart of Ground bean flour.

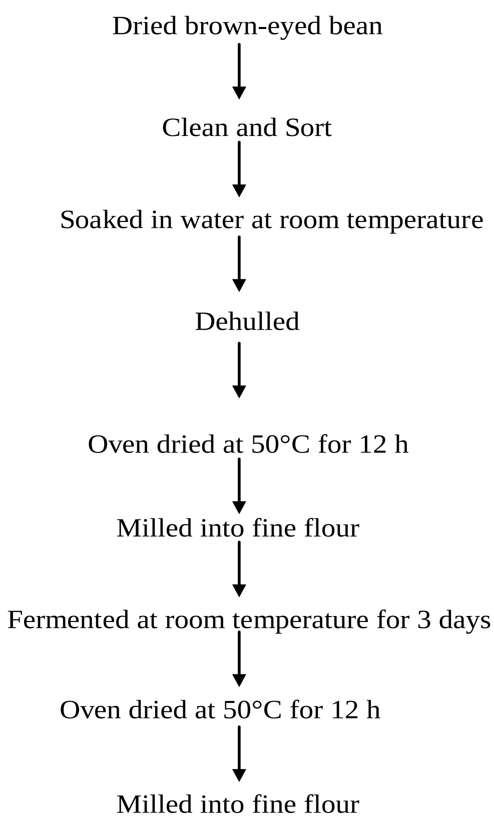

Figure 2. Preparation flow chart of brown-eyed bean flour.

Flour blending

The protein level of each flour (wheat flour, ground bean flour and brown-eyed bean flour) was determined by the micro kjedahl procedure (Pearson, 1976). The flours were blended in the ratio of 70:30 and 60:40 for wheat flour and brown-eyed bean flour to form composite flours.

Using 0.8 g/kg body weight as the protein requirement of an adult (FAO/WHO, 1985) and 65 kg as the ideal body weight (FAO/WHO, 1985), the protein requirement for an adult per meal was determined to be 17.33 g. The gram proportion of each blend was determined using simple proportion. The quantity of protein that should be supplied by each bread sample would be determined by the ratio of blend in Table 1 (using 17.33 g of protein as 100 g).

Bread preparation

Five bread formulations; bread 1 (30% ground bean flour and 70% wheat flour), bread 2 (40% ground bean flour and 60% wheat flour), bread 3 (30% brown-eyed bean flour and 70% wheat flour), bread 4 (40% brown-eyed bean flour and 60% wheat flour), bread 5 (100% wheat flour) in Table 2 were prepared using Ceserani et al., 1995 recipe. The control had 400 g wheat flour, 11 g yeast, 400 ml liquid (milk and water), 10 g of magarine, 60 g of sugar, 5 g of salt and 16 g of milk. Table 3 shows the calculated ratio and gramme weight of the flours while Table 4 shows the Ingredients and quantities.

Bread preparation procedures

The rubbing in method was adopted for the dried ingredients in Table 4. The ingredients were weighed appropriately. The yeast was creamed in a basin with milk water mixture. A hole was made in the center of the flour blend and dissolved yeast will be added. This was covered with a cheese cloth and left at room temperature for the yeast fermentation of the mixture. The remaining milk-water mixture, butter, sugar and salt were added and kneaded manually until smoothy dough free from stickiness was obtained. The dough was returned to the basin, covered with a cheese cloth and left at room temperature to proof. The dough was rolled into balls and baked at a temperature of 220°C for 10 min in a baking oven.

Organoleptic evaluation

Thirty undergraduate students from the Department of Home Science, Nutrition and Dietetics, University of Nigeria, Nsukka, Enugu State, Nigeria, were the test panelist. A nine point hedonic scale form was developed as an instrument for organoleptic evaluation.

The organoleptic attributes evaluated were, flavor, colour, texture, taste and general acceptability of the bread. The study was carried out at the food laboratory within the department. The bread were presented to the judges in dishes labeled with appropriate codes (B_1, B_2, B_3, B_4 and B_5). Water at room temperature was provided for each of the judges to rinse their mouth with before and after tasting to avoid being biased. The nine hedonic scale forms were filled by the judges accordingly and collected at the end of the evaluation.

Proximate analysis

The moisture and ash content of the samples were determined using the method of AOAC (1995). Protein content of the food samples were determined by the micro Kjedahl method (Pearson, 1976). Fat was determined using soxhlet method. Carbohydrate

Table 1. Protein contents of the flours.

Flours	Protein contents
Wheat flour	14.71
Ground bean flour	25.39
Brown-eyed bean flour	24.34

Table 2. Flour blending.

Code	Composite blends	Ratio
B_1	Wheat flour : Fermented ground bean flour	70:30
B_2	Wheat flour : Fermented ground bean flour	60:40
B_3	Wheat flour : Fermented brown-eyed bean flour	70:30
B_4	Wheat flour : Fermented brown-eyed bean flour	60:40
B_5	Wheat flour	100:0

Table 3. Calculated ratio and gramme weight of flour

Code	Gramme ratio	Gramme weight
B_1	329.872 : 81.896	411.768
B_2	282.748 : 109.196	391.944
B_3	329.872 : 85.432	415.304
B_4	282.748 : 113.912	396.660
B_5	400 : 0	400

$B_{1=}$70:30 Wheat flour/ground bean flour; $B_{2=}$ 60:40 wheat flour/ground bean flour; $B_{3=}$ 70:30 Wheat flour/brown-eyed bean flour; $B_{4=}$ 60:40 Wheat flour/brown-eyed bean flour; $B_{5=}$ 100:0 Wheat flour.

Table 4. Ingredients and quantities.

Ingredients	B1(g)	B2(g)	B3(g)	B4(g)	B5(g)
Wheat flour	329.872	282.748	329.872	282.748	400
Ground bean flour	81.896	109.196	-	-	-
Brown-eyed bean flour	-	-	85.432	113.912	-
Yeast	11	11	11	11	11
Milk	16	16	16	16	16
Water	200	200	200	200	200
Sugar	60	60	60	60	60
Salt	5	5	5	5	5
Margarine	10	10	10	10	10

$B_{1=}$70:30 Wheat flour/ground bean flour; $B_{2=}$ 60:40 wheat flour/ground bean flour; $B_{3=}$ 70:30 Wheat flour/brown-eyed bean flour; $B_{4=}$ 60:40 Wheat flour/brown-eyed bean flour; $B_{5=}$ 100:0 Wheat flour.

was determined by difference in value that is, Total Carbohydrate = 100 – (% of fat ± protein ± ash ± moisture)

Mineral determination

The standard method of AOAC (1995) was used to determine the calcium, phosphorus and magnesium composition. The phenanthroline method was used to determine the iron content, Dithizone method was used to determine the zinc content and Iodine was determined using the Leucocrystal violet method as described by AOAC (1995)

Vitamin determination

Pro-vitamin A (beta carotene) was determined using A.A.C.C.

Table 5. Proximate composition of breads prepared from different flour mixtures.

Sample code	Moisture (%)	Protein (%)	Fats (%)	Ash (%)	Fibre (%)	CHO (%)
B_1	19.26 ±0.05^a	18.59 ± 0.02^a	3.40 ± 0.01^{ab}	1.25 ± 0.00^a	0.25 ± 0.01^b	57.25 ± 0.02^a
B_2	19.22 ± 0.04^a	19.01 ± 0.04^a	2.60 ± 0.01^b	1.57 ± 0.02^a	0.21 ± 0.01^b	57.39 ± 0.01^a
B_3	19.63 ± 0.02^a	18.15 ± 0.04^a	2.01 ± 0.01^b	1.26 ± 0.01^a	0.05 ± 0.02^b	58.90 ± 0.02^a
B_4	21.02 ± 0. 0.41^a	16.25 ± 0.03^{ab}	2.31 ± 0.01^b	1.51 ± 0.01^a	0.21 ± 0. 0.01^b	58.70 ± 0.01^a
B_5	20.87 ± 0.02^a	14.81 ± 0.02^b	5.91 ± 0.01^a	1.36 ± 0.01^a	0.16 ± 0.01^b	56.89 ± 0.02^a

Mean ± standard deviation *Column values of different superscript are significantly different at P < 0.05.$B_{1=}$70:30 Wheat flour/ground bean flour; $B_{2=}$ 60:40 wheat flour/ground bean flour; $B_{3=}$ 70:30 Wheat flour/brown-eyed bean flour; $B_{4=}$ 60:40 Wheat flour/brown-eyed bean flour; $B_{5=}$ 100:0 Wheat flour.

(2000) method. The method of Pearson (1976) was used to determine thiamin content and the method of Onwuka (2005) was used to determine the riboflavin composition.

Statistical analysis

The data were analyzed using mean and standard deviation. Means were separated using the one way ANOVA and Duncan's multiple range tests to establish if there were significant differences between the samples.

RESULTS AND DISCUSSION

In Table 5, the moisture value for the products varied. The value ranged from 19.22 to 21.02%. The B_1, B_2 and B_3 had comparable values of 19.26, 19.22 and 19.63%. The B_4 had the highest moisture content (21.02%) followed by B_5 (20.87%). The moisture values for the products were similar at P > 0.05. The higher moisture value for the B_4 and B_5 explained that the products would have a low shelf life.

It is known that the higher the moisture contents of a given food, the lower its shelf life. Moisture content of foods is usually used as an indicator of food quality. It is important to measure the moisture content in breads because of its potential impact on the organoleptic, physical and microbial properties of the bread (Hathorn et al., 2008). Ideal moisture content has been reported to positively increase loaf volume of breads (Gallagher et al., 2003).

The protein content ranged from 14.81 to 19.01%. The B_5 had the least protein value which was significantly different from the other bread at P < 0.05 (14.81 vs 16.25, 18.15, 18.59 and 19.01%). The B_2 had the highest protein content (19.01%). The higher protein in B_2 (ground bean flour 40% and 60% wheat flour bread) is not surprising because National Academy of Science (1979) observed high protein in ground bean compared to white brown-eyed bean. It was also increased because the bread had higher percentage of ground bean flour. The flour protein quantity and quality of bread depend on variety and the extraction rate of flour used (Mohammed et al., 2009). The values for fat differed. The fat value for B_5 had the highest which was significant different from the other breads (5.91 vs 3.40, 2.60, 2.01 and 2.31%) (P < 0.05).

The B_3 had the least fat value (2.01%). The fat in content of B_5 had a higher value (5.91%) which was significantly higher than the other bread samples at P<0.05. This can be attributed to the combination in the other breads. The bread products which are a combination of legumes were lower in fat because legumes have lower fat content than cereals except some exceptions like soybeans, groundnut and other oil seeds that are in legumes. Hence, the bread with legumes has lower fat.

The ash values for the product differed from 1.25 to 1.57%. B_2 product had the highest value (1.57%) followed by B_1 product (1.51%). The B_1 had the least value (1.25%) whereas the B_3 and B_5 products had 1.26 and 1.36% respectively. The ash value for the products were similar at P > 0.05. The ash content of the products were 1.25 to 1.57% which is higher than the range of the ash content in all kinds of bread according to Mohammed et al. (2009) which is between 0.76 to 0.98%. The content of ash is an indication of extraction rate (Hoseney, 1986). The difference in ash content may also be as a result of degradation of complex CHO during fermentation process.

The fibre values varied from 0.05 to 0.25%. The B_3 product had the least value (0.05%) followed by B_5 (0.16%). B_2 and B_4 each had 0.21% respectively whereas the B_1 had the highest fibre value (0.25%). The fibre values of the products were similar at P > 0.05. The products had same ranges of fibre and they all had low fibre content. This is as a result of dehulling or removal of hulls and the milling processes.

The carbohydrate value for the products ranged from 56.89 to 58.90%. The B_3 product had the highest values (58.90%) followed by B_4 product (58.70%). The B_1 and B_2 had comparable values of 57.25% and 57.39% respectively whereas the B_5 had the least value (56.89%). These values were similar at P > 0.05. The carbohydrate content of the product varied with treatment. It might be as a result of fermentation. Bread is one of the most important source of carbohydrate in the form of starch, which is the most abundant

Table 6. Vitamin composition of bread from different flour mixtures.

Sample	Vitamin A	Vitamin B_1	Vitamin B_2
B_1	47.56 ± 0.01^{a}	3.01 ± 0.01^{a}	0.29 ± 0.01^{a}
B_2	28.37 ± 0.00^{ab}	Trace	0.24 ± 0.01^{a}
B_3	14.18 ± 0.00^{b}	Trace	0.12 ± 0.01^{a}
B_4	14.18 ± 0.00^{b}	Trace	0.25 ± 0.01^{a}
B_5	14.18 ± 0.00^{b}	Trace	0.09 ± 0.01^{a}

Mean ± standard deviation *Column values of different superscript are significantly different at P < 0.05; $B_{1=}$70:30 Wheat flour/ground bean flour; $B_{2=}$ 60:40 wheat flour/ground bean flour; $B_{3=}$ 70:30 Wheat flour/brown-eyed bean flour; $B_{4=}$ 60:40 Wheat flour/brown-eyed bean flour; $B_{5=}$ 100:0 Wheat flour.

Table 7. Mineral composition of bread from different flour mixtures.

Sample	Phosphorus	Iron	Magnesium	Calcium	Zinc	Iodine
B_1	91.25 ± 0.05^{b}	0.52 ± 0.01^{a}	57.12 ± 0.02^{a}	163.01 ± 0.04^{a}	12.41 ± 0.41^{a}	0.92 ± 0.01^{a}
B_2	273.20 ± 0.03^{a}	0.52 ± 0.01^{a}	43.21 ± 0.01^{b}	173.25 ± 0.41^{a}	12.86 ± 0.32^{a}	0.68 ± 0.00^{a}
B_3	273.20 ± 0.01^{a}	0.52 ± 0.01^{a}	38.21 ± 0.01^{b}	181.05 ± 0.04^{a}	14.01 ± 0.41^{a}	0.51 ± 0.00^{b}
B_4	182.41 ± 0.01^{ab}	0.52 ± 0.01^{a}	38.41 ± 0.01^{b}	179.29 ± 0.05^{a}	14.22 ± 0.61^{a}	1.21 ± 0.01^{a}
B_5	91.41 ± 0.01^{b}	0.35 ± 0.01^{a}	24.07 ± 0.06^{b}	177.53 ± 0.05^{a}	15.21 ± 0.02^{a}	1.41 ± 0.01^{a}

Mean ± standard deviation *Column values of different superscript are significantly different at P < 0.05.$B_{1=}$70:30 Wheat flour/ground bean flour; $B_{2=}$ 60:40 wheat flour/ground bean flour; $B_{3=}$ 70:30 Wheat flour/brown-eyed bean flour; $B_{4=}$ 60:40 Wheat flour/brown-eyed bean flour;$B_{5=}$ 100:0 Wheat flour.

polysaccharide and a major food reserve providing a bulk nutrient and energy source on the human diet (Shelton and Lee, 2000).

Table 6 showed that Vitamin A varied from 14.18 to 47.56 mg/100 g. B_1 had the highest value which was significantly different from the other breads at P, 0.05 [47.56 vs 28.37 and 14.18% (for three samples)]. B_3, B_4 and B_5 products each had 14.18 mg/100 g which was similar to B_1 (28.37 mg/100 g) at P > 0.05. Hence, the vitamin A contents where same in B_2, B_3, B_4 and B_5 and increased in B_1 and B_2 .

This might be as a result of type of the beans (ground bean). The B_1 product only had the thiamin content (3.01 mg/100 g). The riboflavin content varied from 0.09 to 0.29 mg/100 g. The B_5 had the least value (0.09 mg/100 g) followed by B_3 (0.12 mg/100 g). The other products (B_2, B_3 and B_4) had comparable values of 0.24 mg/100 g, 0.25 mg/100 g and 0.29 mg/100 g. Vitamin B_2 of these products was similar at P > 0.05. Riboflavin was least in B_5, B_1, B_2, B_3 and B_4 have same ranges and riboflavin being a heat labile vitamin might have been lost as a result of processing.

The mineral composition of the product is shown in Table 7. The phosphorus content varied from 91.25 to 273.20 mg/100 g. The high phosphorus values of B_2, B_3 and B_4 were significantly different from the other breads (273.20, 273.20 and 182.41 vs 91.41 and 91.25 mg/100 g) (P < 0.05). The B_1 product had the least phosphorous value (91.25 mg/100 g). The iron content varied. It varied from 0.35 to 0.52 mg/100 g. The B_1, B_2, B_3 and B_4 each had 0.52 mg/100 g respectively whereas the B_5 had 0.35 mg/100 g and B_5 had the least amount of iron. The iron content of the products were similar at P > 0.05. The magnesium content varied from 24.07 to 57.62 mg/100 g.

The B_1 had the highest value which was significantly different from the other breads at P < 0.05 (57.12 vs 24.07, 38.21, 38.41 and 43.21 mg/100 g). The B_3 and B_4 had comparable values of 38.21 and 38.41 mg/100 g respectively.

The calcium content varied from 163.01 to 181.05 mg/100 g. The B3 had the highest value (181.05 mg/100 g). The B_2, B_4 and B_3 had comparable values of 173.25, 179.29 and 177.53 mg/100 g, respectively. The B1 had the least calcium value (163.01 mg/100 g). The zinc composition ranged from 12.41 to 15.21 mg/100 g. The B5 had the highest value (15.21 mg/100 g). The B_3 and B_4 had comparable values of 14.01 and 14.22 mg/100 g respectively. The B1 had the least zinc value (12.41 mg/100 g) followed by the B2 (12.86 mg/100 g). The iodine composition varied from 0.51 to 1.41 mg/100 g. The B3 had the least value which was significantly different from the other bread samples (0.51 vs 1.41 1.21, 0.92 and 0.68 mg/100 g) (P < 0.05). The B_5 had the highest iodine value (1.41 mg/100 g). Minerals like phosphorus, magnesium, calcium and iodine were high in the products as compared to bread made with brown-eyed bean by Okaka and Potter (1977). This might be as a result of soaking process and a long period of fermentation. The B_1, B_2, B_3 and B_4 also had Iron present in them.

Table 8 showed the result of the organoleptic evaluation

Table 8. Organoleptic evaluation of bread prepared from different flour mixture.

Sample	Colour	Taste	Texture	Flavour	GeneralAcceptability
B_1	7.10 ± 0.29^a	6.70 ± 0.29^a	7.20 ± 0.26^a	6.10 ± 0.38^b	7.00 ± 0.32^a
B_2	6.10 ± 0.31^a	5.40 ± 0.35^b	5.80 ± 0.36^b	$5.90 \pm 0.0.37^b$	5.80 ± 0.31^a
B_3	6.30 ± 0.35^a	5.90 ± 0.39	6.40 ± 0.29^b	6.00 ± 0.33^b	5.90 ± 0.41^a
B_4	5.50 ± 0.38^b	$6.00 \pm 0.0.37^a$	5.20 ± 0.38^b	5.90 ± 0.43^b	5.50 ± 0.35^b
B_5	8.00 ± 0.29^a	7.80 ± 0.34^a	8.10 ± 0.33^a	8.40 ± 0.19^a	8.50 ± 0.16^a

Mean ± SEM (Standard Error of Mean) *Column values of different superscripts are significantly different from each other .$B_{1=}$70:30 Wheat flour/ground bean flour; $B_{2=}$ 60:40 wheat flour/ground bean flour; $B_{3=}$ 70:30 Wheat flour/brown-eyed bean flour; $B_{4=}$ 60:40 Wheat flour/brown-eyed bean flour;$B_{5=}$ 100:0 Wheat flour.

of the bread prepared from different flour mixture. The B_1, B_2, B_3 and B_4 products had slight difference in flavour, this slight difference is as a result of the combinations and some processing methods.

The products with lower legume flours than wheat flour had slight increase in preference. Fermentation produced dark brown bread which was similar to that produced by Akubor (2008). There was no wide range of differences between B_1, B_2, B_3, B_4 and B_5 in colour, texture, taste, and flavour. However, the B_5 had better texture than the rest of the bread. The low level of gluten in the blended flours might have affected the proper development of the dough which resulted to a difference in texture from other bread. The general acceptability for B_5 and B_1 were higher than that of B_2, B_3, and B_4. However, the 5 bread samples were generally acceptable and this was observed by Akubor (2003).

Conclusion

Fermented legumes flours (Brown-eyed bean and ground bean flours) could replace 30 to 40% wheat flour in bread formulation without adversely affecting the organoleptic quality of bread. Such bread had higher protein content than 100% wheat flour bread. This suggests that fermented brown-eyed bean flour and ground bean flour may be used as wheat flour supplement in bread making. This would enable the food industry to save wheat flour as well as opening new field of application for ground bean seeds. Keeping in view of the nutritional benefits, fermentation could be explored for commercial use in bread making.

Conflict of Interests

The authors have not declared any conflict of interests.

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