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Comparative Evaluation of Chemical Composition of Fermented Ground Bean Flour (*Kerstingella geocarpa*), Cowpea Flour (*Vigna unguiculata*) and Commercial Wheat Flour (*Triticum spp.*)

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Abstract: The study was conducted to compare the chemical composition of 3 flour samples: fermented ground bean flour, fermented cowpea flour and commercial wheat flour. Commercial wheat flour was purchased from a local market as well as cowpea and ground bean. The samples were cleaned and sorted, soaked in water at room temperature, dehulled, oven dried at 50°C for 12 h, milled into fine flour. The flours were fermented at room temperature for 3 days, oven dried at 50°C for 12 h and finally milled into flours. These flours were subjected to chemical analysis done in triplicates using standard assay. Mean, standard deviation of the samples were calculated and Duncan's multiple test was used to separate the means. The result indicated that the protein content ranged from 14.71 to 25.39%. The wheat flour had the least value (14.71%) while the ground bean flour and cowpea flour had 25.39 and 24.34%, respectively. The vitamin A composition varied from 10.80 to 29.60 mg/100 g. The wheat flour had the least vitamin A value which was significantly different from the other flours (10.80 vs 29.60 and 18.20 mg/100 g) ($p < 0.05$). The iron composition varied. It ranged from 2.51 to 6.80 mg/100 g. The ground bean flour and the highest iron value (6.80 mg/100 g) while the cowpea flour and wheat flour had 2.51 mg and 4.70 mg/100 g. The calcium composition ranged from 166.10-308.46 mg/100 g. The cowpea flour had the highest value which was significantly different from the other flours (308.46 vs 166.10 and 183.25 mg/100 g) ($p < 0.05$). The zinc composition differed. It varied from 8.30-28.05 mg/100 g. The wheat flour had the least value which was significantly different from the other flours at (8.30 vs 25.22 and 28.05 mg/100 g) ($p < 0.005$). The cowpea flour had the highest zinc value (28.05 mg/100 g). Fermented cowpea and ground bean flours showed higher nutrient content mainly in nutrients of public health importance like Vitamin A and iron. These nutritional qualities calls for a greater attention to the underutilized (ground bean) crop. These flours could as well be incorporated into wheat flour to improve the nutritional qualities of confectionaries and bakery products.

Key words: Comparative evaluation, chemical composition, fermented, ground bean, cowpea, wheat, flour

INTRODUCTION

Legumes seed constitute a part of the diet of nearly all the humans. They are probably the most important source of food and fodder next to the cereal grains (Elegbede, 1998). They form an important part of the indigenous diet and are activated worldwide. Though grown in smaller quantities than the staple cereals, their contribution to world supplies of dietary protein in regions densely populated and balancing the deficiencies of cereals protein makes it invaluable in stand point of nutrition (Sinha, 1977). Legumes have high protein content that varies from 17-25% in the dry grain with substantial amount of mineral (Bodghan, 1977). They have balanced essential amino acid that is high in lysine but limited in sulphur Amino acid (SAA), methionine and cysteine, these make them particularly valuable as complementary to cereals diet (AID, 1991). Legumes are not only rich in protein but also in iron and vitamin B, some contain carotene (pro vitamin A). Some are rich in oil, example groundnut (FAO, 1985). Wheat flour has been an age long meal for many people in different part of the world. It is used as the main material for many confectionaries. Whenever flour is

mentioned without specification, wheat flour is being referred to that time. The nutritional composition of wheat is extremely important as it is one of the most important among the few crop species being extensively grown as staple food sources. The significance of wheat is mainly due to the fact that its seed can be ground into flour which form the basic and most important raw materials for bread and other bakery products, as well as pastas and thus it presents the main source of nutrients to the most of the world population (Eurosianet, 2008).

Cowpeas are consumed extensively in South Eastern part of Nigeria. About 90% of poor families eat it at least twice a week since animal protein consumption is limited. This could be due to economic, cultural and religious factors (Elegbede, 1998). Today in Nigeria cowpea is used at household level for preparing various dishes. As food the seeds are known as "agwa" or "akidi" in Igbo speaking states of Nigeria. It is eaten along or with cereals roots and tubers. It can be processed into flour or paste to make exotic baked products or a variety of dishes (Akubor, 2008).

Ground bean is a leguminous seed locally called "Akidi ani". Its scientific name is *Kerstingella geocarpa*. It is one of the underutilized legume identified as potential food for the future (NAS, 1979). The ground bean plant is characterized with broad leaves (leaves are wider than bambara nut leaves) branched stem and flower along the stem. It is a creeping plant that develops its pod inside the ground. The pods are soft like cowpea. Maturity takes place within four months. It is planted between July and August and harvested between November and December. It is cultivated in sandy soil in windy environment and hot weather (Duke, 1981). Meals prepared with ground bean are very tasty. Such meals include, akara, moi moi, ayaraya azizi and others. Ground bean can be consumed alone or supplemented with foods from other groups (Chikwendu, 2007). It can be roasted with coconut can be palm kernel nuts. Due to its hard to cook nature, it takes about two to four hours and requires constant addition of water. It could also be processed into flour for making other exotic food products.

Fermentation changes the chemical composition and nutritional value of legume food products. These fermented foods play a major role in the diet of the people. This process has been identified as an economic processing method that could be used in the home to improve the nutritional quality of plant foods. The accessibility of such fermented products is important to practical nutrition (Obizoba, 1988). Fermented food may positively affect the level of absorption of various nutrients and may also defend against infectious diseases that limit growth potential (Donnone, 2001). Fermentation of foods plays an important role in providing food security enhancing livelihood and improving the nutritional and social well-being of millions of people around the world particularly the marginalized and vulnerable group. However, to the micro biologist, the term 'fermentation' describes a form of energy yielding microbial metabolism in which an organic substrate usually a carbohydrate is in completely oxidized and an organic carbohydrate acts as the electron acceptor.

The general objective of the study was to chemically evaluate and compare flours from fermented cowpea, ground bean and commercial wheat. The comparative study of the flours made from Cowpea 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 (cowpea) and the uncommon legume (ground bean) available in our nation. These flours could be used in combination with already popular wheat flour for the production of confectionaries as well as improve its nutritional quality.

MATERIALS AND METHODS

Materials: Cowpea (*Vigna unguiculata*) and ground bean (*Kerstingella geocarpa*) were used for the study.

Cowpea as well as commercial wheat flour and other ingredients for the bread was purchased from Ogige local market, Nsukka. Ground bean was purchased from Nrobo Local Market, Uzo-Uwani, Enugu state.

Preparation of materials

Raw ground bean and cowpea flour preparation: According to the method described by Ariaahu, Ukpabi, Mbajunwa (Ariahu *et al.*, 1999) the flow chart for the processing of the flours are shown in Fig. 1 and 2 below.

Proximate analysis

Moisture determination: The Moisture content of the samples were determined using the method of AOAC (AOAC, 1995). The Moisture determination was done by weighing 2 g of sample with silica dish which has been previously ignited and weighed. The sample was dried in the oven for 24 h at 100°C to constant weight. The sample was cooled in a desiccator each time just before weighing:

$$\% \text{ moisture} = \frac{100 \times \text{wt of sample} - \text{wt of dish} + \text{sample after drying}}{\text{wt. of sample taken}}$$

Ash determination: The AOAC (1995) method was used for determination of Ash. A silica dish was heat at 600°C, cooked in a desiccator and weighed 2 g of sample was transferred into the dish. The sample was heated in a fume cupboard. After preashing, the dish was placed in a cool muffle furnace. The temperature was increased to 600°C and the temperature was maintained until a whitish grey remained. The dish was left in a desiccator to cool and then weighed:

$$\frac{\text{wt. of dish} + \text{ash} - \text{wt. of dish}}{\text{wt. of sample used}} \times \frac{100}{1}$$

Protein determination: Protein content of the food sample was determined by the micro Kjeldahl method (Pearson, 1976) 2 g of each of sample were weighed into a 100 mL Kjeldahl flask. 5 mL copper sulphate (Na₂SO₄), Sulphuric acid were added in the Kjeldahl digestion flasks. The flasks were placed on electric coil heaters. Each mixture was gently boiled to remove carbon after which the heat was increased until the solution became colourless. The flasks were coded and shaken thoroughly. The contents were transferred with several washing into clean 100 mL volumetric flasks. The volumetric flasks were made up to mark with distilled water. This was followed by distillation.

Distillation: The micro Kjeldahl distillation apparatus was set. A 5 mL of digested samples were placed in the distillation apparatus. A 10 mL of 60% were sodium hydroxide (NaOH) was put in the digested sample. A beaker containing mixtures of methyl red and blue and 5 mL of boric acid was carefully brought closer to

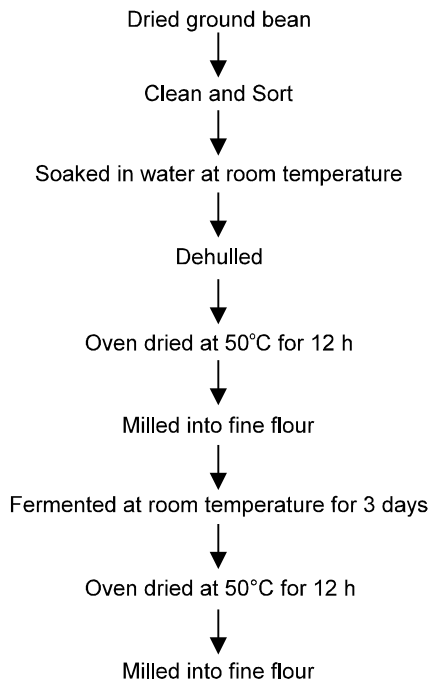


Fig. 1: Preparation flow chart of Ground bean flour

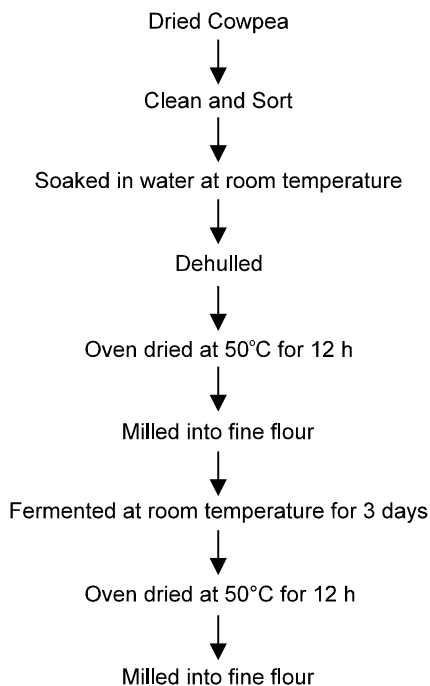


Fig. 2: Preparation flow chart of Cowpea flour

distillation apparatus. The tip of the glass tube from the condenser was introduced to the beaker such that it came close to the borate solution and methyl red and blue indicator. Steam was passed through the Markham distillation apparatus for about 10 min. The distillates were collected in the beakers. The first drop changed the

purple colour of the indicator to green. This process continued until 10 mL of the distillate was obtained.

Titration: The distillate was titrated with 0.01 NHCl until the neutral point was read. The quantity of HCl was read off the burette to obtain the titre value. However, the final burette reading, Initial burette reading = Tvalue (Akubor, 2008):

$$\text{Protein (\%)} = \frac{T \times 14.01 \times 0.01 \times 6.25 \times 20 \times 100}{1000 \times 0.2}$$

Where,

- T : Titre value
- 14.01 : atomic mass of nitrogen (gmN)
- 0.01 : Normality of the acid
- 6.25 : Protein conversion factor
- 20 : Dilution factor
- 100 : Percentage
- 2 : Weight of sample

Fat determination: Fat was determined using tecator soxtech method (AOAC, 1995). One gram of each sample was weighed and put into filter paper and inserted into a thimble. The tecator soxtech apparatus was set accordingly. The samples were extracted and put in an air oven for 30 min at 80°C to dry the solvent. The cups with extract were cooled in desiccators and reweighed. The weight of the lipids were then calculated as, Wt. of cup with fat-wt of cup without fat i.e., $X_2 - X_1$:

$$\text{Fat (\%)} = \frac{X_2 - X_1}{W} \times \frac{100}{1}$$

Where,

- X_2 : Final wt of cup
- X_1 : Initial wt of cup
- W : Weight of sample
- $X_2 - X_1$: Weight of fat

Carbohydrate determination: This was determined by difference in value i.e., Total Carbohydrate = 100 - (% of fat + protein+ ash + moisture).

Mineral determination

Calcium and magnesium determination: The standard method of AOAC (1995) was used. The sample solution was prepared by wet digestion. Ten milliliters of the test solution was pipetted into a 250 mL conical flask and to it 25 mL of $\text{NH}_3\text{-NH}$ buffer solution. Twenty-five milliliters of water was added to the mixture followed by 2-3 chops of Eriochrome Black T indicator and titrated against 0.01N EDTA solution. The volume of EDTA used is the volume equivalent of calcium and magnesium in the mixture.

The volume of magnesium = (vol. of Ca and Mg-vol.Ca).

Determination of calcium: Ten milliliters of the test solution was pipette into a 250 mL conical flask and 25 mL KOH, 25 mL after and a pinch of calcine indicator were added. The mixture was titrated against EDTA solution to an endpoint. The volume of EDTA is the volume of calcium in the solution.

Calculation:

$$\text{Ca (\%)} = \frac{\text{Vol. EDTA} \times \text{Mol. EDTA} \times \text{At wt of Ca} \times 100 \times \text{DF}}{1000 \times \text{weight of sample used}}$$

$$\text{Mg (\%)} = \frac{\text{Vol. EDTA} \times \text{Mol. EDTA} \times \text{At wt of Mg} \times 100 \times \text{DF}}{1000 \times \text{weight of sample used}}$$

Phosphorus determination: The spectrophotometer molybdate method as described by AOAC (1995) was used. The sample was prepared by dry combustion method. Phosphorus in the residue remaining after destruction of the organic matter of the plant was dissolved in HCL.

The concentration of phosphorus in the solution was determined spectrophotometrically as the yellow phospho vanado molybdate complex. The absorbance was read against the blank and the number of milligrams of phosphorus equivalent was calculated.

Calculation:

$$\text{Conc. of phosphorus} = \frac{\text{Absorbance of test sample} \times \text{Conc. of SD}}{\text{Absorbance of SD} \times \text{wt. of sample used}}$$

Determination of iron: The phenanthroline method was used as described by AOAC (1995). 5 mL of the digested sample was put in test tube and 3 mL of phenanthroline solution was added followed by 2 mL of concentrated HCl and 1 mL hydroxyl amine solution. The mixture was boiled for 2 min. 9 mL of Ammonium acetate buffer solution was added and diluted to same with water. The absorbance was read at 510 nm wave length.

Calculation:

$$\text{Conc. of Iron} = \frac{\text{Absorbance of test sample} \times \text{Conc. of SD}}{\text{Absorbance of SD} \times \text{wt. of sample used}}$$

Determination of zinc: The Dithizone method was used as described by AOAC (1995).

Principle: Zinc was separated from other metals by extraction with dithizone and then determined by measuring the colour of the zinc-dithizone complex in carbon tetrachloride, This separation was achieved by extracting at pH of 4.0-5.5 and by the addition of sufficient sodium thiosulphate. Zinc also forms a weak thiosulphate complex that tend to retard the slow and incomplete reaction between and dithizone.

Procedure: 5 mL of the digested sample was pipette into a test tube and 5 mL of acetate buffer was added. 1 mL of sodium thiosulphate solution was added and mixed after which 10 mL of dithizone solution was added. The mixture was shaken vigorously for 4 min. The absorbance was taken at 535 nm. The standard was prepared and the concentration of the sample found.

Calculation:

$$\text{Conc. of zinc} = \frac{\text{Absorbance of test sample}}{\text{Absorbance of SD}} \times \frac{\text{conc. of SD}}{\text{Wt. of sample used}}$$

Determination of iodine: Iodine was determined using the Leucocrystal violet method as described by AOAC (1995). Ten milliliters of the digested sample was put into a test tube and 2 mL of citric buffer was added followed by 1 mL of potassium peroxymonosulphate. The mixture was mixed thoroughly and allowed to stand for 1 min. Two milliliters of Leucocrystal violet indicator was added and it was made up to 50 mL with water. The mixture was allowed to stand for 5 min and the absorbance was read at 592 nm.

Calculation:

$$\text{Conc. of Iodine} = \frac{\text{Absorbance of test sample}}{\text{Absorbance of SD}} \times \frac{\text{conc. of SD}}{\text{Wt. of sample used}}$$

Vitamin determination

Vitamin B1 (Thiamin): The method of Pearson (AOAC, 1995) was used. One gram of the sample was measured out and 7 mL of 0.1M HCl was added. The sample was digested for 30 minutes in a water bath with frequent mixing. The extract was cooled to below 50°C and the pH adjusted to between 4 and 4.5 by addition of 2.5 sodium acetate solution using bromocresol green as external indicator. Five milliliters of freshly prepared phosphate was mixed and incubated at 45-50°C for 3 h. The mixture was cooled to room temperature and centrifuged until the supernatant liquid is clear and quantitatively transferred to 100 mL volumetric flask. The mixture is then diluted to 100 mL with water and 5 mL of 3% acetic was added. Five milliliter of alkaline potassium ferric amine solution was added followed by 25 mL of water saturated isobutyl alcohol. Five milliliter of 15% NaOH was added. The standard was prepared and the absorbance was read at 245 nm.

Calculation:

$$\text{Conc. of thiamin} = \frac{\text{Absorbance of test sample} \times \text{Conc. of SD}}{\text{Absorbance of SD} \times \text{Wt. of sample used}}$$

Determination of riboflavin (Vitamin B2): The method of Onwuka (2005) was used. One gram of the sample was weighed into 100 mL flask and 50 mL of 0.2 HCL was added into the sample and heated to boil. It was allowed

to boil for 60 min on a water bath, cooled and the pH adjusted to 6.0 using NaOH. One normal hydrochloric acid (1N HCl) was added to lower the pH to 4.5n then filtered into 100 mL flask and made volume up to the mark. In order to remove interference, two tubes were taken and marked, 1 and then 10 mL of filtrate were added into each tube. One milliliter of acetic acid (glacial) was added to each tube mixed and then 0.5 mL of 3% KMnO₄ solution. The mixture was allowed to stand for 2 min and then 0.5 mL of 3% H₂O₂ was added and mixed. The absorbance was read at 470 nm wavelength.

Concentration of test sample was calculated thus:

Riboflavin (mg/g) = $x/y \times 1/w$

X = reading sample-reading blank

Y = reading of the standard-reading of blank

Vitamin A determination: Pro-vitamin A (beta carotene) was determined using AACC method (A.A.C.C., 1992). A 10 g of each sample was weighed into a 250 mL conical flask and 50 mL of 50:50 acetones was added. This was allowed to stand for 2 h with occasional shaking and filtering. The filtrate was measured and equal volume of saturated NaCl (50%) was added to wash the filtrate (i.e., carotene extract). The mixture was shaken, transferred to a separating funnel and the layer of the extracted carotene was removed. The supernatant (upper layer) was washed again with equal volume of 100% potassium trioxocarbonate (IV) (K₂CO₃), separated and finally washed with about 10-20 mL of distilled water. Water carotene was separated and the extracted carotenoid (either beta carotene or lycopene) was collected. The absorbance was read in a spectrophotometer at 326 nm wavelength using 50:50 acetone low boiling petroleum ether solution as blank. The pro-vitamin A content was calculated as follows:

$$\text{Potency (units/g)} = 1900 \times E_{1\text{cm}}^{1\%} \text{ at } 328 \text{ nm}$$

The following correction was applied if the maximum lies in the same range, but the relative extensions are not within 0.02:

$$E_{328} \text{ (Corrected)} = 3.52 (2E_{328} - E_{316} - E_{340})$$

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

RESULTS

Table 1 presents the proximate composition of wheat flour, ground bean flour and cowpea flour. The moisture varied from 11.07 to 13.51%. The ground bean flour had the highest value (13.51%) followed by the cowpea flour (12.03%). The wheat flour had the least value (11.07%).

The protein content ranged from (14.71 to 25.39%). The wheat flour had the least value (14.71%) while the ground bean flour and cowpea flour had 25.39% and 24.34% respectively. The ash composition of the flour differed from 0.96 to 1.32%. The wheat flour had the highest value (1.32%) while the cowpea flour had the least value (0.96%) followed by ground bean flour (1.16%). The fibre composition varied from 1.22 to 2.01%. The ground bean flour had the least value (1.22%) followed by the cowpea flour (1.41%). The wheat flour had the highest fibre content (2.01%). The fat composition of the flour varied.

It varied from 1.89-2.20%. The wheat flour had the highest fat content (2.20%). The ground bean flour and cowpea flour had 1.89 and 2.12%, respectively. The carbohydrate composition ranged from 56.83-68.69%. The ground bean flour had the least value (56.83%) followed by cowpea flour (59.14%). However, the wheat flour had the highest value (68.68%).

The Table 2 shows the vitamin and mineral composition of wheat flour ground bean flour and cowpea flour. The vitamin A composition varied from 10.80 to 29.60 mg/100 g. The wheat flour had the least vitamin A value which was significantly different from the other flours (10.80 vs 29.60 and 18.20 mg/100 g) (p<0.05). The Vitamin B₁ ranged from 0.50 to 2.86 mg/100 g. The ground bean flour had the highest Vitamin B₁ value (2.86 mg) while the wheat flour had 0.50 mg/100 g. Vitamin B₂ value varied from 0.22-0.30 mg/100 g. The ground bean flour had the least vitamin B2 value (0.22 mg/100 g) while the wheat flour had 0.3 mg/100 g.

The phosphorus composition ranged from 321.12 to 415 mg/100 g. The wheat flour had the highest value (415 mg/100 g) followed by ground bean flour (345.45 mg/100 g). The cowpea flour had the least phosphorus value (321.12 mg/100 g). The iron composition varied. It ranged from 2.51 to 6.80 mg/100 g. The ground bean flour and the highest iron value (6.80 mg/100 g) while the cowpea flour and wheat flour had 2.51 mg and 4.70 mg/100 g. The magnesium composition varied from 1.27-160 mg/100 g. The wheat flour had the highest value which was significantly different from the other flours (160.00 vs 1.46 and 1.27 mg/100 g) (p<0.05). The cowpea flour had the least value (1.27 mg/100 g).

The calcium composition ranged from 166.10-308.46 mg/100 g. The cowpea flour had the highest value which was significantly different from the other flours (308.46 vs 166.10 and 183.25 mg/100 g) (p<0.05). The zinc composition differed. It varied from 8.30-28.05 mg/100 g. The wheat flour had the least value which was significantly different from the other flours at (8.30 vs 25.22 and 28.05 mg/100 g) (p<0.005). The cowpea flour had the highest zinc value (28.05 mg/100 g). The iodine content of the flour were quite low. It ranges from 0.27-0.59 mg/100 g. The ground bean flour had the highest value (0.59 mg/100 g) followed by the cowpea

Table 1: Proximate composition of wheat flour, ground bean flour and cowpea flour

| | Wheat flour | Ground bean flour | Cowpea flour |
|--------------|-------------------------|-------------------------|-------------------------|
| Moisture | 11.07±0.02 ^a | 13.51±0.03 ^a | 12.03±0.01 ^a |
| Protein | 14.71±0.05 ^b | 25.39±0.01 ^a | 24.34±0.02 ^a |
| Ash | 1.32±0.01 ^a | 1.16±0.01 ^a | 0.96±0.01 ^a |
| Fibre | 2.01±0.02 ^a | 1.22±0.02 ^a | 1.41±0.01 ^a |
| Fat | 2.20±0.01 ^a | 1.89±0.01 ^a | 2.12±0.01 ^a |
| Carbohydrate | 68.69±0.01 ^a | 56.83±0.02 ^a | 59.14±0.01 ^a |

Mean±standard deviation. ^aRow values of different superscript are significantly different at p<0.05

Table 2: Vitamin/mineral composition of the various flours

| Vitamins/Minerals (mg/100 g) | Wheat flour | Ground bean flour | Cowpea flour |
|------------------------------|--------------------------|--------------------------|--------------------------|
| Vitamin A | 10.80±0.02 ^a | 29.60±0.01 ^a | 18.20±0.01 ^b |
| Vitamin B ₁ | 0.50±0.01 ^a | 2.86±0.02 ^a | Trace |
| Vitamin B ₂ | 0.30±0.00 ^a | 0.22±0.00 ^a | Trace |
| Phosphorus | 415.00±0.00 ^a | 345.45±0.00 ^a | 321.12±0.05 ^a |
| Iron | 4.70±0.01 ^a | 6.80±0.02 ^a | 2.51±0.03 ^a |
| Magnesium | 160.00±0.01 ^a | 1.46±0.01 ^b | 1.27±0.01 ^b |
| Calcium | 166.10±0.61 ^b | 183.25±0.03 ^a | 308.46±2.16 ^a |
| Zinc | 8.30±0.03 ^b | 25.22±0.04 ^a | 28.05±0.06 ^a |
| Iodine | 0.27±0.00 ^a | 0.59±0.00 ^a | 0.41±0.01 ^a |

Mean±standard deviation. ^aRow values of different superscript are significantly different at p<0.05

flour (0.41 mg/100 g). The wheat flour had the least iodine value (0.27 mg/100 g).

DISCUSSION

Proximate composition of wheat flours, brown-eyed flour and ground bean flours: The result revealed that the ground bean flour had higher moisture content (13.51%) than the other flours. This shows that it can deteriorate faster than the other flours because it has a lower shelf life than the other flours. The higher protein value (25.39%) of the ground bean flour when compared with the other flours revealed that it is a better source of the nutrient than the other flours. The protein value is within the range (20-40%) found in most edible legume (Elegbede, 1998). This is similar to the result of Chikwendu (2007). The ash content of wheat flour (1.32%) was higher than the other flours. This indicates that it contains mineral availability than the other flours. The higher fiber content of the wheat flour (2.01%) when compared to the other flours implies that it is a better source of fibre than the other flours. The higher fibre content of wheat flour might inhibit absorption of some of the minerals, for example calcium. However, fibre helps in fighting cancer and in reducing serum cholesterol (Chikwendu, 2007). It also has positive effects on blood glucose and insulin concentration in both normal and diabetics and increases faecal bulk (Enwere, 1998; Nwokolo, 1996). The fat content of wheat flour (2.20%) was higher when compared with the other flours. This is in agreement with a similar work done by Wheat flour council (2005) where they discovered that the fat content of a wheat flour should not be more than 5%. The carbohydrate content of the wheat flour (68.69%) was higher than the other flours. This indicates

that it is a better source of this nutrient than the others. The high carbohydrate eyes of the flours showed that they contain a good quantity of reducing sugar (Chikwendu, 2007).

Minerals/Vitamins compositions of wheat flour, ground bean flour and cowpea flour: The higher vitamin A of ground bean flour was significantly different from the other flours at p<0.05 (29.60 vs 10.80 and 18.20 mg/100 g). This shows that it is a better source of this nutrient than the other flours. This is higher than the result of Chikwendu (2007) in a similar work. The ground bean flour had a higher thiamin composition than the other flours. Its thiamin composition is 2.86 mg/100 which is higher than the result of Chikwendu (2007) where she discovered that the thiamin range of the flour varieties of ground is 0.10 to 0.59 mg/100 g. The phosphorus composition of wheat flour is higher than that of other flours which indicates that it is a better source of this nutrient than the other flours. This indicates that wheat flours are rich in phosphorus. Wheat flour council (Wheat flour council, 2005) establishes that wheat flour are high in phosphorus. The iron content of ground bean flour was higher than that of other flours which indicates that it is a better source of the nutrient. The higher magnesium composition of wheat flour was significantly different from the others (160.00 vs. 1.46 and 1.27 mg/100 g) (p<0.05) which implies that it is a better source of the nutrient.

Conclusion: Fermented legumes flours (Cowpea and ground bean flours) could have higher protein content than pure wheat flour, this could be used to blend with wheat flour for improved nutritional value. This suggests that fermented Cowpea flour and ground bean flour may be used as wheat flour supplement in the production of confectionaries and baked products. This would enable the food industry to save wheat flour as well as opening new field of application for ground bean seeds. Cultivation of underutilized crops such as ground bean should be encouraged to prevent extinction.

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