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PRODUCTION AND QUALITY EVALUATION OF SEASONING FROM FERMENTED SOYBEAN AND ROASTED MORINGA SEED FLOUR BLENDS

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ABSTRACT

The aim of this present study is to evaluate attributes of seasoning produced from fermented soya beans flour and roasted *Moringa oleifera* seed flour. Four samples of seasonings were produced and labelled as follow AAA (100% soya beans). BBB (90:10% soya beans and *Moringa oleifera* seed flour), CCC (80:20% soya beans and *Moringa oleifera* seed flour) and DDD (70:30% soya beans and *Moringa oleifera* seed flour). Proximate, chemical and sensory evaluation were determined. The result of the proximate composition showed significant p<0.05 difference among produced seasoning samples. Crude fibre (1.31 -2.11%), moisture (8.07-10.04%), ash (1.15-1.55%), fat (22.45-24.75%), protein (30.34-38.85%) and carbohydrates (25.87-33.51%). The moisture, ash, crude fibre and carbohydrates content of seasoning increased with increase in the *Moringa oleifera* seed flour while fat and protein reduced. The antinutrients composition were lower among all samples and ranged from (1.74-2.69%) for saponin, (25.18-52.28mg/100g) for tannin, (1.84-3.71 mg/100g) for oxalate and (1.61-1.87%) for alkaloid content. The result of the pH and total titra table acidity were significantly (p<0.05) reduced and ranged from (5.40-5.60) for pH and (0.07-0.09) for TTA. Mineral composition including sodium, calcium, iron and zinc were analyzed and the result ranged from (32.65-92.05mg/100g), (156.93-234.01mg/100g), (29.76-59.64mg/100g) and (5.54-11.77mg/100g) respectively. The sensory results of sample indicate general acceptability of the produced seasoning samples in terms of taste, appearance, flavour and colour. The inclusion of *Moringa oleifera* seed flour into fermented soybeans flour had significant (p<0.05) effect on the chemical, minerals and sensory properties of the seasoning.

Key words: Soybean, Moringa Seed, Seasoning, Sensory Evaluation.

INTRODUCTION

Soya bean (*Glycine max MERILL*), first grown in Eastern Asia thousands of years ago, have long been important protein sources, complementing grain proteins, in Asian countries. In addition to essential nutrients, soybean products, especially fermented soybean products, contain various functional components including peptides, isoflavonoids and more (*Davis et al., 2005*). Due to these nutritional and functional facts, soybean products were included in the world's top 5 healthiest foods in magazine 'Health (2006)': Due to dozens of studies showing soy is good for your heart; the FDA even allows certain soy products to have a heart-healthy claim on their labels. A number of epidemiological studies have suggested that consumption of soybeans and soy foods is associated with lowered risks for several cancers including breast, prostate, and colon, and cardiovascular diseases (*Anderson et al.,1998; P.C. Butler et al., 2007; Messina, 1995; Peterson & Barnes, 1991, 1993*) and improves bone health (*Bhathena & Velasquez, 2002*).

In plant, the soybeans contain the most protein, and therefore, different methods of use have evolved. Soybeans can be used in their natural state, or by decomposing the protein into fusible substance, the most widely used method. This means the soybeans can be used as a seasoning or as nutrient source with added amino acid and peptide (*Donghwa & Doyoun, 2015*). In Korea, soybeans are boiled and made into fermented products, or used as an ingredient for rice with beans, Injeolmi (rice cake crumbs), soy milk, and soybean oil (*Shin and El-shemy 2011*). Fermented soybean products in particular, have become an essential part of the Korean diet, used as seasoning and found in side dishes and soups that are consumed daily (*Donghwa & Doyoun, 2015*).

Moringa oleifera is an underutilized plant and the whole seeds are highly restricted to eaten green, roasted or powdered and steamed in tea and curries (*Fahey JW 2005, Ogbe and Affiku 2011*). The pods and seeds often referred to as Moringa kernels have a taste that ranges from sweet to bitter and are most popularly consumed after frying to get a groundnut-like taste. The seeds contain a profile of important minerals, and are good source of protein, vitamins, beta-carotene, amino acids and various phenolics compounds (*Anjorin et al. 2010, Anwa and Rashid 2007*). Moringa seeds, although slightly bitter and astringent, are used for food seasoning or eaten as roasted nuts in some places (*Al-*

Kahtani and Abou Arab 1993). The widest known use of powdered moringa seeds as natural flocculent for purifying water has been well documented (*Sutherland et al. 1994, Muyibi and Okufu 1995, Ndbigengesere and Narasiah 1998, Okuda et al. 1999, Katayon et al. 2006*); but according to Surbhi et al., 2017, the dry seeds can be dried and made to powder for seasoning purposes. The aim of this study is therefore, to produce and evaluate the quality of organic seasoning from fermented soybean and roasted moringa seed flour blends.

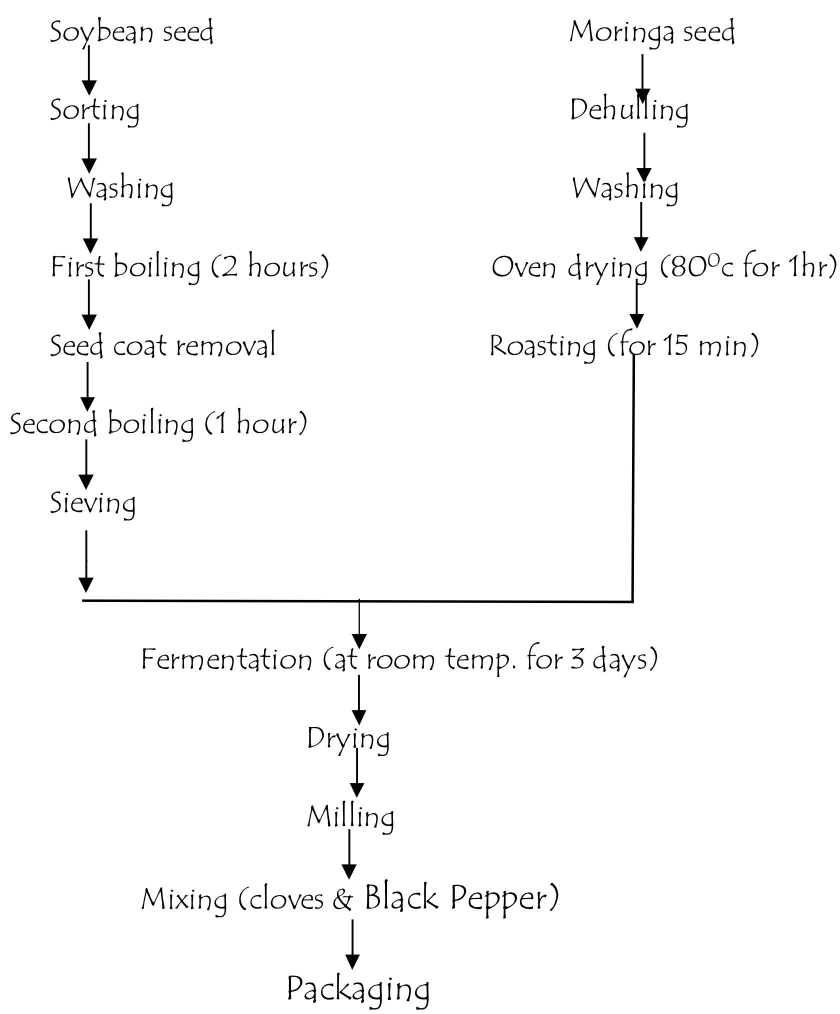

Fig. 1: Flow Chart for the production of seasoning from soybean and moringa seed flour, cloves and black pepper. A modified method of *Adelekanet al., 2013* and *Ijarotimiet al., 2013*.

MATERIALS AND METHODS

The raw materials used include: soybean purchased from Anyigba Market in Kogi State, moringa seed obtained from a nearby garden, cloves obtained from Anyigba Market in Kogi State, and black pepper purchased from Anyigba Market in Kogi Sate, Nigeria. A modified method of *ijarotimiet al., 2013* was used for the preparation of moringa seed flour. The Moringa oleifera was obtained from a garden in Anyigba, Kogi State, Nigeria. The fruit was dehulled to remove the seeds. The seeds where then washed to remove any impurities, then they were oven dried for 80°C for 1hour and roasted. The roasted seed was then added to the soybean and fermented together to produce the seasoning. A modified method of *Adelekan et al., 2013* was used for the preparation of soybean flour. The soybean was sorted and washed to remove any impurity from it. It was then boiled for two hours to aid the seed coat removal. The soybean was boiled again for an hour and then sieved. The roasted moringa was added to the soybean and fermentation was allowed to take place at room temperature for three days. After the mixture was fermented, it was then dried and milled into powder. Clove and black pepper flour were then added to the powder. This work involves the combination of different sample formulation to give four samples with sample AAA with the ratio 100:0 as the control, BBB with ratio 90:10, CCC with ratio 80:20, and DDD with ratio 70:30.

ANALYSIS OF SAMPLE

Proximate composition: Proximate composition of the resulting Seasoning were determined by the methods of Association of Official Analytical Chemists. (*A.O.A.C, 2010*). Ash, crude protein, fat and fibre were evaluated. All measurements were made in duplicate. Total carbohydrate was calculated by difference.

PH: The PH of the samples was determined using the method of AOAC (2010). 10 grams of each sample was mixed thoroughly with 120mls of distilled water and was decanted. The PH was read using an electrode PH meter with temperature compensation (uniscope model PH7-5B).

TTA: This measures the acidity in samples. It was determined according to the procedure described by AOAC (*AOAC 2002*). 10 ml of the sample was measured into a dried and weighed conical flask, and 50 ml of distilled water was added, followed by 0.5 ml phenolphthalein indicator and titrated against 0.1 M NaOH. The end point is reached when a faint pink colour is obtained.

MINERAL: The determination of selected elements or mineral constituents was investigated using Atomic Absorption Spectrometry method (*Fashakin et al., 1991*). About 0.5g of samples were digested in 100ml micro-Kjeldahl flask with 10ml of HNO_3 until the solution became colourless. The sample was cooled and diluted to volume in a 25ml volumetric flask with 0.1 M HCL solution. The digest was used to determine the elements (Calcium, sodium, iron and zinc) on the atomic Absorption Spectrophotometer (*Perkin Elmer, model 402*).

DETERMINATION OF ANTI-NUTRIENTS

SAPONIN: Determination of Saponin was carried out using the method reported by *Ejikeme et al., 2014* and *Obadoni and Ochuko 2002*. Exactly 100 cm^3 of 20% aqueous ethanol was added to 5 grams of each sample in a 250 cm^3 conical flask. The mixture was heated over a hot water bath for 4 hours with continuous stirring at a temperature of 55°C. The residue of the mixture was re-extracted with another 100 cm^3 of 20% aqueous ethanol after filtration and heated for 4 hours at a constant temperature of 55°C with constant stirring. The combined extract was evaporated to 40 cm^3 over water bath at 90°C. 20 cm^3 of diethyl ether was added to the concentrate in a 250 cm^3 separator funnel and vigorously agitated from which the aqueous layer was recovered while the ether layer was discarded. This purification process was repeated twice. 60 cm^3 of n-butanol was added and extracted twice with 10 cm^3 of 5% sodium chloride. After discarding the sodium chloride layer the remaining solution was heated in a water bath for 30 minutes, after which the solution was transferred into a crucible and was dried in an oven to a constant weight.

TANNIN: Determination of tannin was according to *Amadi et al., 2004 and Ejikeme et al., 2014*. By dissolving 50g of sodium tungstate (Na_2WO4) in 37cm^3 of distilled water, Folin-Denis reagent was made. To the reagent prepared above, 10g of phosphomolybdic acid ($H_3PMo_{12}O_{40}$) and 25cm^3 of orthophosphoric acid (H_3PO_4) were added. Two-hour reflux of the mixture was carried out, cooled, and diluted to 500cm^3 with distilled water. One gram of each sample in a conical flask was added to 100cm^3 of distilled water. This was boiled gently for 1 hour on an electric hot plate and filtered using number 42 (125 mm) Whatman filter paper in a 100cm^3 volumetric flask. Addition of 5.0 cm^3 Folin-Denis reagent and 10 cm^3 of saturated Na_2CO_3 solution into 50 cm^3 of distilled water and 10 cm^3 of diluted extract (aliquot volume) was carried out after being pipetted into a 100 cm^3 conical flask for colour development. The solution was allowed to stand for 30 minutes in a water bath at a temperature of 25°C after thorough agitation. With the aid of a Spectrum Lab 23A spectrophotometer optical density was measured at 700nm and compared on a standard tannic acid curve. Dissolution of 0.2 g of tannic acid in distilled water and dilution to 200 cm^3 mark (1 mg/cm^3) were used to obtain tannic standard curve. Varying concentrations (0.2–1.0 mg/cm^3) of the standard tannic acid solution were pipette into five different test tubes to which Folin-Denis reagent (5 cm^3) and saturated Na_2CO_3 (10cm^3) solution were added and made up to the 100 cm3 mark with distilled water. The solution was left to stand for 30 minutes in a water bath at 25°C. Optical density was ascertained at 700 nm with the aid of a Spectrum Lab 23A spectrophotometer. Optical density (absorbance) versus tannic acid concentration was plotted and then calculated.

ALKALOID: Determination of alkaloid was according to the methodology by Harborne 1973. Exactly 200cm^3 of 10% acetic acid in ethanol was added to each sample (2.50g) in a 250 cm^3 beaker and allowed to stand for 4 hours. The extract was concentrated on a water bath to one-quarter of the original volume followed by addition of 15 drops of concentrated ammonium hydroxide dropwise to the extract until the precipitation was complete immediately after filtration. After 3 hours of mixture sedimentation, the supernatant was discarded and the precipitates were washed with 20 cm^3 of 0.1M of ammonium hydroxide and then filterd using Gem filter paper (12.5cm). Using electronic weighing balance Model B-218, the residue was dried in an oven and the percentage of alkaloid was calculated.

OXALATE: The oxalate was determined as described by Pearson (2008). 2g of the sample was weighed into a 300ml flask. The 20ml of 30% HCl was added and allowed to stand for twenty minutes. Four grams ammonium sulphate was added to the solution and allowed to stand for 30 minutes. The solution was filtered into 250ml volumetric flask and made up to the mark with 30% HCl. The filtrate (10ml) was transferred into 100ml centrifuge tube and 30ml diethyl ether was added. The PH was adjusted to 7.0 with acetic acid. It was centrifuged at 10.00 rpm for 15minutes. The solution was decanted into 250ml conical flask, titrated with 0.1M potassium tetraoxomanganate ($KMnO_4$) and the volume was recorded, Oxalate was calculated.

SENSORY EVALUATION: The sensory attribute of the seasoning was determined by Ten (10) judges selected randomly from different department of Kogi State University, Anyigba, Nigeria. The nine (9) point hedonic scale was used with score "9" representing "like extremely" and Score "1" indicating "extremely dislike". Samples were presented in random order. Sachet water was provided to rinse the mouth between evaluations. The characteristics evaluated, were appearance, taste, colour, flavour and overall acceptability (*Akinjaiyeju, 2009*).

STATISTICAL ANALYSIS: All the data obtained were subjected to statistical analysis using Analysis of variance (ANOVA) and the means was separated Using list significant difference (LSD) where significant as described by *Ngoddy and Ihekonronye, 2002.*

RESULTS AND DISCUSSIONS

Proximate composition of seasoning

The proximate composition of the seasoning formulations shown in Table 1 prepared from fermented soya beans/*moringa oleifera* flour blends showed that all the analyzed components were significantly different (P<0.05) in the control (sample A) and other samples. Moisture content of the sample range from 8.07% to 10.04%, significant difference (P<0.05) in composition was observed among the samples, this can be due to subjection of the samples to drying. The moisture content significantly (P<0.05) increased with increased *Moringa oleifera* flour substitution percentage. This observed increase in moisture contents could be substitution effect of *Moringa oleifera* flour in the formulations. *Moringa oleifera* flour strongly attracts moisture and the product can reabsorb humidity during or after milling (*Amelle and Saint, 2010*). This is in agreement with the report of Asogwa (2013), who reported an increased moisture content of akamu supplemented with *Moringa oleifera* flour at increasing percentage. This also agrees with the work of Abioye and Aka (2015) who recorded an increased moisture content when maize-ogi was fortified with moringa leaf.

Significant difference was observed in sample AAA and BBB while between sample CCC and DDD there was no significant (P > 0.05) between them in their ash content which ranged from 1.15% in sample AAA to 1.55% in sample DDD. %). The observed increase in the ash content in the seasoning could be as a result of increase in the substitution levels of *Moringa oleifera* flour as *Moringa oleifera* is said to be rich in minerals (*Abbas et al., 2018*).

Table 1 Proximate composition of seasoning samples

Samples	Moisture (%)	Fat (%)	Protein (%)	Ash (%)	Crude fibre (%)	Carbohydrate (%)
A	8.07±0.04^{d}	24.75±0.07^{a}	38.85 ± 0.06^{d}	1.15±0.07^{d}	1.31±0.01^{d}	25.87±0.06^{a}
B	9.05±0.07^{c}	24.57±0.04^{a}	35.10 ± 0.04^{c}	1.33±0.04^{c}	1.69±0.01^{c}	28.26±0.01^{c}
C	9.58±0.03^{b}	23.19±0.01^{b}	33.59 ± 0.04^{a}	1.48±0.04^{b}	1.92±0.03^{b}	30.24±0.05^{d}
D	10.04±0.00^{a}	22.45±0.07^{c}	30.34±0.04^{b}	1.55±0.00^{a}	2.11±0.01^{a}	33.51±0.09^{b}

Values are average of duplicate determination ± standard deviation. Mean with the same superscript on the same column are not significantly (P>0.05) different.

Samples:
A= 100:0 Soybean – Moringa seed ratio
B = 90:10 Soybean – Moringa seed ratio
C = 80:20Soybean – Moringa seed ratio
D = 70:30Soybean – Moringa seed ratio

The observed increase with increased *Moringa oleifera* flour percentage is in accordance with the work of *Shiriki et al. (2014)*, and are within the limit stated by *Bassey et al. (2013)*. The observed increase in ash content after inclusion of *Moringa oleifera* flour implies that the potential ability of the formulated seasoning to supply essential minerals has been increased (*Netshiheni et al., 2019*). There was significant (P < 0.05) difference in the crude fibre from sample AAA having the least value of 1.31%. The fibre content significantly (P<0.05) increased with increased *Moringa oleifera* substitution. The significant (P<0.05) increase observed in samples with increased *Moringa oleifera* substitution may be due to high content of fibre in *Moringa oleifera* flour (Oduro *et al.*, 2008). This is in accordance with the study reported by Azhari*et al.* (2016) who also reported increased fibre content after supplementing sorghum flour with *Moringa oleifera* flour.

Fat content ranged from 24.75% in sample AAA to 22.45% in sample DDD. There was no significant (P > 0.05) difference between sample AAA and BBB while sample CCC and DDD had a significant (P < 0.05) difference. The fat content which significantly decreased from sample AAA with increased *Moringa oleifera* flour percentage could be as a result of substituting soya beans flour with *Moringa oleifera* of which soya beans flour has also been reported to have higher fat content than *Moringa oleifera* flour. This is in accordance with the work of *Mohajan et al. (2018)*. Fats are responsible for raising the calorie content of seasoning and also guarantee the adequate uptake of fat soluble vitamins (A, D, E and K) (*Monte and Giugliani, 2004*).

The result of the protein content showed significance ($P < 0.05$) difference among the samples which ranged from 30.34% to 38.85%. The protein content was significantly higher in sample AAA, and decreased significantly ($P<0.05$) with increased Moringa *oleifera* flour percentage. The highest protein content at the highest percentage of soya beans in the blend might be due to the high protein content of soya bean flour (*Ewolu et al., 2017).* The subsequent decrease in protein content with increased *Moringa oleifera* percentage could be as a result of substituting soya beans flour with *Moringa oleifera* of which soya beans flour has been recorded to be higher in protein content than *Moringa oleifera* (*Asogwa, 2013*). This is consistent with the report of *Ewoluet al. (2017)* and *Asogwa (2013)*. The values obtained although high, maybe a weakness to the scoring procedure as it does not take into account the digestibility and bioavailability of the protein in the human body (*Kayi, 2013*).

The carbohydrate content ranged from 25.87% to 33.51% with sample DDD having the highest value of 33.51% and sample AAA having the least value of 25.87%. A significant ($P < 0.05$) difference was observed in the carbohydrate content of the samples. The substantially lower carbohydrate content of samples AAA compared to sample BBB, CCC and DDD could be as a result of addition of *Moringa oleifera* flour (*Mohajanet al., 2018*).

Anti-Nutritional Composition of Seasoning

There was no significant ($p>0.05$) different in the saponin content of the seasoning in sample AAA and BBB while a significance ($P < 0.05$) difference was observed between sample CCC and DDD. The tannin content of sample AAA and DDD were observed to be significantly ($P < 0.05$) different while there was no significant difference ($P > 0.05$) difference in sample BBB and CCC. Significant ($P < 0.05$) difference was observed in the oxalate content of sample AAA and BBB but there was no significant (P > 0.05) difference in sample CCC and DDD. The alkaloid content of the samples were significantly (P < 0.05) different in sample AAA and DDD but no significant (P > 0.05) difference was observed in sample BBB and CCC.A decrease was observed in the saponin and tannin content from sample AAA to DDD and this can be due to the processing of fermentation, cooking, soaking, which helps to reduce the anti-nutritional factors (*Handa et al., 2017; Gupta et al., 2015*). This helps to enhance digestibility and nutritional value. *Makkar (1993)* defined anti-nutrients as "substances which by themselves or through their metabolic products arising in living systems interfere with food utilization and affect the health and production of animals". The antinutrients have been shown to have both adverse and beneficial effects in humans (*Soladoye and Chukwuma 2012*). Saponin has been shown to have both beneficial and deleterious properties and to exhibit structure dependent biological activities (*Price et al., 1987*). Phytates are known to pose threat to leguminous seeds and also associated with increased cooking time in legumes (Osagie, 1998). The study showed that the anti-nutrients of all samples were lower, except in tannin content. This observation shows that addition of *Moringa oleifer* flour significantly reduced the anti-nutrients components of *fermented* soybeans flour. Tannin contents of the samples were lower than those reported by *Fasoyiroet al. (2006)* for groundnut seeds (450.00 mg/100 g); *Ayodele and Kigbu, (2005)* for Cajanuscajan (550.00mg/100g) and *Elemoet al., (2001)* for sorghum grains (280.00 mg/100g).

Table 2 Anti-nutrient composition of seasoning samples.

Samples	Saponin (%)	Tannin (mg/100g)	Oxalate (mg/100g)	Alkaloid%
A	2.69±0.01^{a}	52.28±0.11^{a}	3.71±0.01^{a}	1.61±0.01^{d}
B	2.59±0.42^{b}	43.27±0.07^{c}	1.84±0.01^{c}	1.74±0.00^{c}
C	2.31±0.00^{c}	48.74±0.00^{b}	2.82±0.01^{a}	1.80±0.00^{b}
D	1.74±0.01^{d}	25.18±0.07^{d}	2.87±0.01^{a}	1.87±0.01^{a}

Values are average of duplicate determination ± standard deviation. Mean with different superscript on the same column are significantly (P < 0.05) different.

Samples:
A= 100:0 Soybean – Moringa seed ratio
B = 90:10 Soybean – Moringa seed ratio
C = 80:20Soybean – Moringa seed ratio
D = 70:30Soybean – Moringa seed ratio

Physicochemical Composition of Seasoning

There was significant (P> 0.05) difference in the pH and TTA value obtained among the samples, from sample AAA to DDD there was no significant (P > 0.05) difference in their pH and TTA. This can be due to the fact that they were all subjected to fermentation for a long period of time which enables the conversion of sugar into alcohol and in turn increase the total titratable acidity in the prepared seasoning.

Table 3 Physicochemical Composition of Seasoning Samples.

Samples	PH	%TTA
AAA	5.60 ± 0.00^{a}	0.07 ± 0.00^{b}
BBB	5.50 ± 0.00^{b}	0.09 ± 0.00^{a}
CCC	5.60 ± 0.00^{a}	0.09 ± 0.00^{a}
DDD	5.40 ± 0.00^{b}	0.07 ± 0.00^{b}

Samples:
A= 100:0 Soybean – Moringa seed ratio
B = 90:10 Soybean – Moringa seed ratio
C = 80:20Soybean – Moringa seed ratio
D = 70:30Soybean – Moringa seed ratio

Mineral Composition of Seasoning

Values for mineral composition of the sample presented in Table 4.4 indicated that there was significance (P < 0.05) difference the sodium content of sample BBB, CCC and DDD. Sample AAA with the highest value at 92.05% differed significantly (P < 0.05) from the other samples in terms of the sodium content. The calcium content were observed to be significantly (P < 0.05) different between all samples from AAA to DDD. The calcium content ranged from 156.93 to 234.01 mg/kg with sample CCC having the highest value of 234.01 mg/kg and sample A having the least value of 156.93 mg/kg. The body requires calcium to maintain strong bones and to carry out many important functions. According to *Thanonkaew et al. (2006)*, almost all calcium is stored in bones and teeth, where it supports their structure and hardness. The body also need calcium for moving muscles and for nerves to carry message between the brain and every other part of the body (*Raimundo and Vale, 2008)*. The high Ca/Na ratio observed in this study is of nutritional benefit, particularly for children and the aged who need higher intakes of calcium and phosphorus for bone formation and maintenance. Food is considered 'good' if the ratio is above one and 'poor' if the ratio is less than 0.5 while Ca/Na ratio above two helps to increase the absorption of calcium in the small intestine (Niemann *etal.*, 1992).

The iron (Fe) content of the samples were significantly different ($p<0.05$) and ranged from 29.76 to 58.64 mg/kg with sample CCC having the highest value and sample BBB having the least value of 52.32 mg/kg. Iron is primarily involved in the transfer of oxygen from the lungs to tissues. However, iron plays a role in metabolism as a component of some proteins and enzymes. The result showed higher iron content in chicken bone flour and is similar to that reported by *Rosa et al. (2005)*. In terms of zinc significant ($P < 0.05$) difference was observed in all the samples and the value ranged from 5.54 to 11.77mg/kg. Minerals are required for the maintenance of normal metabolic and physiological functions of living organisms. The main functions of essential elements in the body include the formation of skeletal structure, maintenance of colloidal systems, as well as regulation of acid base equilibrium. They are important components of hormones, enzymes and structural proteins (*Lall, 2002; Villanueva and Bustamante, 2006*).

Table 4 Mineral Composition of Seasoning Samples

Samples	Sodium	Calcium	Iron	Zinc
A	92.05 ± 0.78^a	156.93 ± 0.81^c	48.12 ± 0.07^c	7.06 ± 0.04^c
B	32.65 ± 0.07^d	187.53 ± 0.67^d	29.76 ± 0.01^d	5.54 ± 0.14^d
C	33.08 ± 0.04^c	234.01 ± 0.01^a	58.64 ± 0.05^a	11.77 ± 0.02^a
D	44.72 ± 0.26^b	206.18 ± 0.60^b	55.56 ± 0.01^b	9.11 ± 0.01^b

Values are average of duplicate determination ± standard deviation. Mean with the same superscript on the same column are not significantly (P>0.05) different.

Sample:
A= 100:0 Soybean – Moringa seed ratio
B = 90:10 Soybean – Moringa seed ratio
C = 80:20Soybean – Moringa seed ratio
D = 70:30Soybean – Moringa seed ratio

Sensory Evaluation of Seasoning

The sensory properties of sensory samples were highly rated as shown from the mean score of the panelist in Table 4.5. Sample AAA and BBB were not significantly (P > 0.05) different in terms of colour, taste and flavour. Sample AAA was more preferred for appearance and colour and there was significant (P < 0.05) difference between sample AAA and BBB in terms of appearance. Sample CCC and DDD were not significantly (P > 0.05) different in terms of colour but there was significant (P < 0.05) difference between them in terms of appearance, taste and flavour. All the samples were not significantly (P < 0.05) different in terms of general acceptability except for sample CCC. Sample DDD was more preferred in terms of flavour and taste; this could be due to the percentage of moringa seed in the sample.

The higher mean acceptability score for taste and flavour by the taste panellist for the samples could be due to the peculiar flavour imparted by the moringa seed in the seasoning. The result of sensory attributes (appearance, colour, taste, flavour, overall acceptability) showed that control sample AAA had higher acceptance than the *Moringa oleifera* flour substituted samples. Among the *Moringa oleifera* substituted samples, sample DDD with 30% *Moringa oleifera* was rated second to sample AAA in all the sensory attributes. Sample CCC was the least accepted for all the sensory attribute analyzed, this may be because of the high concentration of the dark green colour of *Moringa oleifera*, imparted by chlorophyll. The increase in likeness observed for flavour of

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the *Moringa oleifera* substituted samples could be attributed to the herbal flavour of the *Moringa oleifra* (*Otunolaet al., 2007*).

Table 5 Sensory Evaluation Result of Seasoning Samples

Seasoning	Appearance	Colour	Taste	Flavour	Overall Acceptability
A	8.00±0.8[a]	8.10±0.74[a]	7.80±0.79[b]	7.85±1.27[b]	7.85±0.64[a]
B	7.60±0.97[b]	8.00±0.82[b]	7.60±0.84[b]	7.50±0.85[c]	7.69±0.55[c]
C	7.10±0.57[c]	6.90±0.88[d]	7.00±1.63[c]	7.00±1.15[d]	7.00±0.79[d]
D	7.60±1.26[b]	7.30±1.06[c]	8.00±0.94[a]	7.90±1.29[a]	7.73±0.97[b]

Values are average of duplicate determination ± standard deviation. Mean with the same superscript on the same column are not significantly (P>0.05) different.

Samples:
A= 100:0 Soybean – Moringa seed ratio
B = 90:10 Soybean – Moringa seed ratio
C = 80:20Soybean – Moringa seed ratio
D = 70:30Soybean – Moringa seed ratio

CONCLUSION

Inclusion of *Moringa oleifera* seed in the fermentation of soya beans had a significant effect on the proximate composition, anti-nutrient composition, physicochemical properties, sensory properties and mineral composition of the produced seasoning samples. The incorporation improved the nutrient compositions in term of increased in ash and crude fibre content and decrease in fat content which will enable stability of seasoning and retard rancidity. The minerals composition was higher and within recommended range for seasonings. Also, the sensory evaluation showed general acceptability of the produced seasoning as none were rated below the mid-point of the 9-point hedonic scale. Therefore, it is recommended that moringa oleifera seed be included at 30% in food as source of crude fibre. More research work should also be carried out on the utilization and stability of moringa seed in seasonings and thus help increase the usability of *moringa oleifera* seed flour in spice producing industries. Also, it is recommended that *Moringa flour* can be incorporated to prepare homemade food in order to increase the flavour and taste of the food.

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