

Proximate composition and organoleptic properties of snack made from fermented complementary soybean (*glycine max*) and Bambara nut (*Vigna Subterranea*).

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Abstract

Snack was made from composite of roasted soybean and bambara nut using fermentation and baking as processing methods. This is aimed to introduce new nutritious, less health risk snack to the populace and as well improve utilization of bambara nut. The snack was evaluated for proximate composition and organoleptic properties. Protein, lipid, crude fibre and carbohydrate contents of the snack (Test Sample) were found to be significantly different ($p < 0.05$) from the two other treatments whereas ash content was not different significantly ($p > 0.05$) from the other treatments. Sensory evaluation by 16 panelists indicated moderate likeness for the product. The results showed that the snack can provide good nutrition to the consumers and complement to the available ones. The snack therefore can be of a good nutritive value and may be used as prescription for nutrition deficiency diseases after further nutritional studies are carried out.

Keywords: snack, nutrition, fermentation, soybean, Bambara nut

Introduction

Fermentation is a microbial process that breaks down complex food macromolecules into simpler ones that can easily be assimilated by the body (Ojokoh, Daramola and Oluoti, 2013) [16]. It adds texture and flavour to the food making other bioactive components readily available to the consumer (Ross, 2015). Various food products are being produced through fermentation by traditional and industrial methods. African dishes use natural fermented food products (Jones, *et.al*, 1996) [11]. Fermented food products are found to improve bowel function in patients suffering from constipation. They also have anticholesterol effect and improve digestion in human (Sahlin, 1999) [19]. Due to nutrients availability in fermented foods and potential health benefits, nutritionists are devising new fermented food products to improve the nutritional quality to meet nutritional challenges. Individuals with genetic defects resulting in nutritional deficiencies can have their food supplemented with these food products (Adams & Moss, 2008) [1] providing them with the deficient nutrient. Protein rich legumes such as soybean and Bambara nut can be used for the treatment of protein energy malnutrition. The high protein content of bambara nut can have high potential to improve malnutrition and boost nutritional status (Bamshaiye, 2011). To meet with effective nutritional need, food products can be obtained through combine effect. Nutritional values of diets are found to be improved through fortification with fermented food products especially the legumes (Mbata *et. al.*, 2009; Oyarekua, 2013) [13, 18]. Roasting and baking are factors that improve organoleptic properties, due to the heating process resulting from Millard reaction. This involves the reaction between amino acids and sugars as a result of excess heating condition. The aroma produced results from the combination of the different amino acids with sugars in the surface layer of foods (Fuller, 2001) [8]. The baking process involves the

cross linking of the proteins in the legumes (Nielson 2010) which alter the sensory properties of foods giving it a taste, aroma and texture and improving the palatability of the baked food (Fellow 2000) [7]. The taste improvement is contributed by the protein functionality of the food (Nielson 2010).

In our modern age, snacks has being used widely especially in conferences, workshops, offices and homes. Fermentation can serve as a way of improving the nutritional availability of snacks. This study was undertaken to introduce a novel nutritive snack to complement confectionery foods of better nutritive value in order to meet nutritional needs and to improve utilization of bambara nut (*Vigna subterranea*).

Materials and Methods

Sample collection

Soybean was obtained at Kagara Daily Market, while Bambara nut was obtained at Big Market, Bida, all in Niger State, Nigeria in the month of June, 2013.

Pretreatment of samples

The samples were sorted manually to remove stones and dirty. About 200g of soybean was placed in a pot placed on an electric stove. It was stirred continuously under heating on the stove until it turns pale brown. Bambara nut was not roasted. Raw soybean, roasted soybean and bambara nut were milled separately using ware blender.

Preparation of the Paste Composite

50g of roasted soybean and 50g of bambara nut were weighed and mixed to homogeneity. 50g of raw soybean (unroasted) and 50g of bambara nut were also mixed separately as different treatment to test for effect of roasting on the study. The pastes were made with 100ml of water as depicted in Figure 1.

An unfermented paste consisting of mixture of 50g roasted

soybean and 50g bambara nut was prepared prior to baking serving as second different treatment to test effect of fermentation on the product.

Fermentation Process

The pastes were covered and allowed to ferment naturally for 60 hours undisturbed in a transparent plastic container. A transparent container was chosen to monitor fermentation progress.

Addition of Ingredients

To give the snack a taste, ingredients were added to the fermented and unfermented products in amount presented in table 1 and then homogeneously mixed.

Table 1: Ingredients for Snack Production.

Salt	sugar	Ginger*
0.75g	1.10g	0.5g

*Dried Ginger was milled into powder

Baking Process

The fermented and unfermented products were wrapped separately in an aluminium foil paper and baked in baking oven at 250°C for 32 minutes. The surface area of the products was minimized by not making it into flat shape. Fellow (2000) [7] showed that nutritional loss is a factor of surface area to volume and that increase in surface area of baked foods leads to nutritional loss.

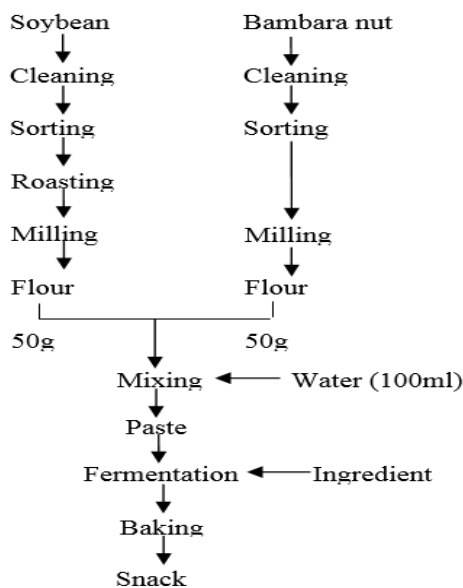


Fig 1: Flow Chart for the Production of Soybean-Bambara nut Composite Dough.

Proximate Analysis

Proximate analysis of the samples was analyzed by standard method of AOAC (1985). Moisture was determined by oven method, crude protein by the kjeldahl method, ash content by dry ashing method. Fat was determined as total lipid content by Soxhlet extraction and fibre content by incineration method. Carbohydrate content was determined by difference. All determinations were carried out in triplicate.

Organoleptic Scoring

Organoleptic assessment was carried out using six (6)

trained panelist and ten (10) semi-trained panelist to assess the Aroma, Colour, Taste and General Acceptability of the baked products. Students of Department of Biochemistry, Federal Univesity of Technology, Minna, Nigeria were used as trained panelist while the semi-trained panelists were drawn from Kagara and Minna towns of Niger state, Nigeria. The panelists were asked to rinse their mouth with water to neutralize the tongue before tasting the snacks. An 8 point hedonic scale (Weaver and Daniel, 2005) [21] was employed with 8, as the highest score and 1, as the lowest score. The hedonic scale used is as follows:

- 8 = like extremely
- 7 = like very much
- 6 = like moderately
- 5 = like slightly
- 4 = dislike slightly
- 3 = dislike moderately
- 2 = dislike very much and
- 1 = dislike extremely

Trained panelists were used because of their discipline in ability to score sensory characteristic of food while the use of untrained panelist is to access the acceptability of the new product to the populace.

Statistical Analysis

Data was analyzed with statistical package for social sciences (SPSS) version 16.0 using analysis of variance (ANOVA). Least significant difference (LSD) was used to compare the means of the values at 5% probability confidence level.

Results and Discussion

The products of the fermented samples are shown in Figures 1 and 2 whereas the snacks are shown in Figures 3 to 5.



Fig 1: Raw soybean and raw bambara nut after 60hrs of fermentation at room temperature (raw fermented).



Fig 2: Roasted soybean and raw bambara nut after 60hrs of fermentation at room temperature (roasted fermented).



Fig 3: Snack made from the fermented complementary raw soybean and raw bambara nut (Raw fermented).



Fig 5: Snack made from the unfermented complementary roasted soybean and raw bambara nut (Roasted unfermented).



Fig 4: Snack made from the fermented complementary roasted soybean and raw bambara Nut (Roasted fermented).

Proximate Composition

Proximate composition (moisture, protein, lipid content, ash content, crude fibre and carbohydrate) of the complementary snacks are presented in table 2. The results showed significant ($p < 0.05$) differences between the different treatments except ash content that has no significant ($p > 0.05$) difference between the values of the different treatments. Protein content of the test sample (Roasted fermented) is significantly higher than other treatments whereas moisture, lipid and crude fibre contents were significantly lower than those of the different treatments. The loss of water activity during roasting (Fellow, 2000) [7] can be attributed to the decrease in moisture content. However, the higher value of the moisture content of the test sample compared to the roasted unfermented may be due to water production during fermentation. In the review of Anil, (2019) who stated that intracellular material and cell of wall of fermented foods become solubilized due to the action of fungal enzymes such as carbohydratases, phytases, lipases and proteases.

Table 2: Proximate Composition of Complementary Snack

Proximate/ Treatment	Raw Fermented (Different Treatment)	Roasted Fermented (Test sample)	Roasted unfermented (Different Treatment)
Moisture (%)	10.39 ± 0.20 ^d	9.75 ± 0.05 ^c	9.56 ± 0.13 ^d
Protein (%)	27.5 ± 0.24 ^e	32.24 ± 0.23 ^d	31.08 ± 0.09 ^f
Lipid Content (%)	10.32 ± 0.18 ^d	9.54 ± 0.10 ^c	9.86 ± 0.04 ^e
Ash (%)	2.66 ± 0.18 ^b	3.31 ± 0.09 ^b	3.06 ± 0.05 ^b
Crude Fibre (%)	5.55 ± 0.13 ^c	3.73 ± 0.10 ^b	4.67 ± 0.05 ^c
Carbohydrate (%)	43.94 ± 0.64 ^f	40.78 ± 0.18 ^e	41.31 ± 0.06 ^g

*Values are mean ± standard error of mean (SEM) of triplicate determination. Values with the same superscript are not significantly different ($p < 0.05$).

Fermentation increase protein digestibility and leads to increase in protein content (Singh, Yadav and Sharma, 2012) [20] which may be due to proteolysis by the proteolytic enzymes while roasting and baking is reported to increase the protein value (Fellow, 2000) [7]. This combine effect of fermentation, roasting and baking may account for the significant ($p < 0.05$) increase in the protein content of the test sample compared to the other treatments. Bambara nut has the ability to increase protein value of food it is supplemented with as indicated by the study of Ayo, *et al.*, 2014. However, Sahlin (1999) [19] reported that it is the protein efficiency ratio (PER) that changed in the fermented food due to proteolytic activity but the protein content remains unchanged. Fermentation only has increased effect

in the content of protein and amino acids if ammonia or urea is added as a nitrogen source to the fermentation media. The fermentation process may increase the mineral availability and decrease value of the crude fibre. This can be attributed to the degradation of the macromolecules in the food and also made chelated mineral elements available. This can thus increase the mineral content and decrease crude fibre content. Increase in protein value and mineral content during fermentation was also reported by Adekunle and Adenike, 2012 [2] and Ojokoh *et al.*, 2013 [16]. On the other hand, Sahlin, (1999) [19] stated that fermentation has no effect on the mineral content of food unless salt is added or leaching occurs when liquid portion is separated from solid portion, or from the effect of metal container (fermentor).

Meanwhile, fermentation is found to reduce antinutritional factors (Hassa, Yusuf, Adebolu and Onifade, 2015) ^[10] in food which prevent mineral elements availability through chelation with the mineral element. The degradation of the antinutritional factors can lead to availability of the minerals chelated by the antinutritional factors, thereby increasing the availability of percentage of mineral content, even though the total mineral content of the food remains the same. Lipid oxidation is said to occur during fermentation (Wójciak,

Karwowska and Dolatowski, 2015) ^[22]. This may account for the reduction in lipid content of the test sample. This makes the snack to have reduced risk for atherosclerosis. The reduction of the percentage carbohydrate in the test sample can be attributed to the activities of the fermenting microbes that use carbohydrate as energy source (Gunawan, *et al.*, 2015) ^[9]. This is also in agreement with studies conducted by Adams and Moss 2008 ^[1] and Mbata, *et al.*, 2009 ^[13].

Organoleptic Scoring

Table 3: Organoleptic Scoring of the Complementary Soybean-Bambara Nut Snack from Trained Panelist.

Organoleptic Properties/Treatment	Raw Fermented (Different Treatment)	Roasted Fermented (Test Sample)	Roasted non-fermented (Different Treatment)
Colour	5.33 ± 0.21 ^{bc}	6.33 ± 0.21 ^b	6.33 ± 0.21 ^b
Taste	4.40 ± 0.51 ^b	5.83 ± 0.31 ^b	5.80 ± 0.37 ^b
Aroma	6.00 ± 0.21 ^d	6.33 ± 0.26 ^b	6.00 ± 0.26 ^b
General Acceptability	5.67 ± 0.33 ^{cd}	5.67 ± 0.33 ^b	6.00 ± 0.26 ^b

* Values are mean standard error of mean (SEM) of five (5) Panelists. Values with the same superscript are not significant different (P>0.05).

Table 4: Organoleptic Scoring of the Complementary Soybean-Bambara Nut Snack from Semi-trained Panelist.

Organoleptic Properties/Treatment	Raw Fermented (Different Treatment)	Roasted Fermented (Test Sample)	Roasted non-fermented (Different Treatment)
Colour	5.00 ± 0.26 ^b	6.40 ± 0.31 ^c	6.30 ± 0.15 ^b
Taste	4.30 ± 0.34 ^b	5.50 ± 0.27 ^b	6.10 ± 0.28 ^b
Aroma	5.10 ± 0.23 ^b	6.10 ± 0.23 ^{bc}	6.50 ± 0.37 ^b
General Acceptability	4.70 ± 0.21 ^b	5.60 ± 0.22 ^b	5.90 ± 0.23 ^b

* Values are mean ± standard error of mean (SEM) of ten (10) Panelists. Values with the same superscript are not significant different (P>0.05).

Organoleptic properties of snacks scored by 16 panelists (6 trained and 10 semi-trained), is shown in table 3 and 4. Sensory properties scoring by the trained panelist showed no significant (p>0.05) difference between roasted fermented and roasted non fermented but significance (p>0.05) existed between raw and roasted treatments. However, sensory properties for the semi-trained panelist indicated no significance difference except colour and aroma that significant difference existed between roasted fermented and roasted non-fermented treatments. Sensory scoring was higher in roasted treatments than in the raw treatment. This shows that palatability is increased in the roasted treatments. Nwosu, 2013 in her studied also showed that increasing the substitution of wheat flour by bambara nut was fairly accepted while 50% substitution was moderately accepted. However, the sensory properties produced depends on the combination of fats, amino acids and sugars present in the surface layers of food, the temperature and moisture content of the food throughout the heating period and the time of heating (Fellow, 2000 ^[7]). The differences in the aroma, taste and colour between the raw and roasted products are due to roasting that resulted from Millard reaction and caramelization of sugar during roasting of the soybean (Alais and Linder, 1999; Fellow, 2000) ^[3, 7]. The use of roasted legumes will enhance more appreciation of the snack to the populace.

Conclusion

The nutritional assessment the novel snack shows that it is of good nutritive value, with appreciable taste, aroma and colour. It can provide good nutrition to the consumers and complement to the available ones. It can have reduced risk

for cardiovascular diseases and also serve as nutritive preparation for nutrition deficiencies such as protein energy malnutrition and kwashiorkor.

Further research is encouraged to determine the amino acid profile, mineral composition, vitamin composition and fatty acids/lipid profile of this baked composite. To ensure safety before the general marketing of the product into the public, studies can be carried out on laboratory animals to determine the nutritional effect on their growth, body mass and organs functions. This will help determine toxicological effect on experimental animals through haematological and histological examination of the experimental animals' tissues.

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