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Organoleptic Attributes and Proximate Composition of Bean Ball (*Akara*) Produced from Composite Flour of Selected Legumes

Achebe, A.E.
Department of Home Economics
Niger State College of Education, Minna

and

Anyakoha, E. U.
Department of Home Economics and Hospitality
Management Education
University of Nigeria, Nsukka
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Abstract

This study evaluated the organoleptic attributes and proximate composition of bean ball *(akara)* produced from composite flour of cowpea *(Vigna unguiculata)* soybean *(Glycine max)*, and bambara nut (*Voandzeia subterrana)*. There were six ratios. Proximate analysis was carried out (moisture, ash, fat, protein, fibre and carbohydrates) using standard methods. Organoleptic attributes were ascertained using a 9-point hedonic rating scale by panel of 30 assessors. Data were analysed using mean and standard deviation and ANOVA. Proximate analysis showed that composite flour increased in protein content from 23.21 to 30.51% fiber1.37 to 1,38 fat 2.31 to 4.65%. ANOVA results indicate no significant difference in all the ratings of bean balls produced with composite of six different ratios at 0.05 level of significance, based on the organoleptic attributes.

Keywords: Organoleptic, Attributes, Proximate, Bean-Ball, Composite, Flour, Legumes.

Introduction

Legumes are plants of the pea or bean classed in the family leguminosae. Legume seed develops from a carpel and usually dehisces (opens along a seam) on two sides exposing the seeds to light (Alozie, Iyam, Lawal, Udofia, and Ani 2009). Legumes seeds are inexpensive sources of proteins with high nutritional profile and after cereals are the most important food sources for humans. They are also good source of

carbohydrates, minerals, vitamins, and fiber.

Legumes are regarded as low glycemic index which can prevent many diseases such as cardiovascular, hypertension, diabetes and cancer. Isoflavones are found in most legume seeds in high concentrations. Many studies have confirmed that isoflavones are involved in cancer prevention (Seidell, 2005). Legumes however, contain antinutrients such as phytic acid, phenolic acid and tannin that make legume utilization difficult. These can be removed by soaking in water without destruction of protein (Adepoju and Adeniji, 2008).

There are many classes of legumes, most classes of legumes include soybean (*Glycine max*), bambara ground-nut (*Voandzeia subterranea*), and cowpea *(vigne unguculata*). Generally, legumes are useful in traditional meals such as *(ayaraya),* plain bean pudding, (*ekuru)* soybean cheese *(wara)*. Each legume bean is eaten separately or as a mixture with cereals or tuber crops. Some of the dried beans can be ground into flour and be used for the preparation of moin-moin, foo-foo, bean soup {*gbegiri*). Beans are very important source of protein in Nigeria. Different types of meals have been produced from beans. One of such meals is bean ball pleasant for breakfast and dinner.

Bean ball (akara) is a delicacy and one of the most important meals in Nigeria where it is eaten at any time of the day. It is eaten by men, women, children and adult, rich and poor inrespective of age and status especially in places that many people particularly eat bean ball as their main food either alone as a snack or in combination with pap, 'agidi' bread and oat. According to Alozie, lyam, Lawal, Udofia and Ani (2009), bean ball made from cowpea and consumed singly is usually imbalanced because plant foods are deficient in one or more essential amino acid.

Therefore, bean ball commonly made from cowpea needs to be improved to curb energy protein malnutrition. Protein deficiency usually accompanies dietary energy deficiency and other nutrients due to insufficient food intake and deficiency of these nutrients are usually associated with some of the following diseases such as kwashiorkor, weakness in bone, partial blindness, stunted growth, which are common among those that take excessive cowpea ball. Deficiency here means that the evaluable nutrients in cowpea do not meet the required standard. In developing countries people often have diets low in energy as well as in protein (Hark and Deen. 2007).

People who consume too little protein and food energy are prone to developing protein – energy malnutrition (PEM). Animal products are nutrient-dense and good sources of protein. However, animal-based foods are very expensive and not

within the reach of most people on tight financial budget. Plant foods are cheaper and affordable alternatives to animal products. Vegetable proteins have other benefits besides low cost. They contain no cholesterol and little saturated fat. Regular use of plant foods high in protein makes a valuable contribution to a diet because these supply a variety of other nutrients. For instance, soybean protein is similar in quality to animal protein. It is a good plant source of omega-3 fatty acid, a-linolenic acid (7 to 8% of the total fat content) and a host of other benefits.

Bambara nut (*Voandzeia subterranea*), is a good source of protein Bambara nut is among the underutilized. The seed grain has a good balance of essential amino acids with a relatively high proportion of lysine. Stephens (2003) noted that Bambara groundnut protein contain higher essential amino acid, methionine than other grain legumes, while the oil content is less than half of the amount found in legumes like peanuts and soyabean. Recently, increased blood cholesterol, heart disease, and high blood pressure has been linked to consumption of nuts. The protective action of bambara nut probably stems from their lack of cholesterol and abundance of unsaturated fatty acids. This can be used to enrich cowpea bean flour as composite bean flour. Usually, the aim of producing composite flour is to get product that is better than the single component flour makes preparation easy unfortunately, in Nigeria composite flour are not readily available for bean cake.

The produced flour will be mixed into six ratios of (1 – 6) experimental such as combination of cowpea, soybean and bambara nut (CSBF) 90:5:5, 80:10:10:, 70:15:15, 60:20:20, 50:25;25 and 40:30:30. These will be used to prepare composite bean ball (cb). To improves taste and nutrient content of the composite bean ball when organoleptically and nutritionally tested.

The organoleptic attributes requires panels of human assessors, to taste the products and record their responses. By applying statistical techniques to the results it is possible to make inferences and gain insights into the products under test using hedonic scales

The knowledge of organoleptic attributes in food acceptability is important for many reasons including the health, marketing, sales and development of food products. All human senses help people in the evaluation of food and in determining whether or not to consume it.

Nutrient composition analysis is the partitioning of compounds in a food into categories based on the chemical properties of the compounds, such as proximate, (Onigboyi, Ogunseye, Nupo and Bello, 2011). Therefore, it is at the backdrop of these the researcher wants to carry out this research to see how legumes can be combined as composite flour to reduce the effects

caused by cowpea (blackeye) in bean ball, to reduce the problems and to add to the nutritional value of bean ball.

Purpose of the Study

The major purpose of the study was to evaluate the organoleptic attributes and proximate compostion of bean ball (*akara)* produced from six composite ratios of cowpea, soybean and bambara nut.

Specifically, the study determined the

1. proximate composition of six different ratios of composite flour.
2. organoleptic attributes of six different ratios of composite bean ball.

Research Questions

The study was guided by the following research questions:

1. What are the proximate composition of six different ratios of composite flour?
2. What are the organoleptic attributes of six different ratios of composite bean ball?

Methodology

***Design of the Study*:** The study adopted experimental design with treatment and control groups.

Materials and Method: Materials Three selected legumes of soybean, bambara nut and cowpea and other ingredients were purchased from Ogige market Nsukka.

***Methods*:** The legumes were picked, soaked, dehulled, sun dried, dry milled and sieved differently to obtain fine flour. The processed soybean, bambara nut and cowpea were measured with a standard scale to determine quantity into a bowl and mixed thoroughly into six different ratios CSBF: 90:5:5,CSBF 80:10:10, CSBF70:15:15, CSBF 60:20:20, CSBF 50:25:25, CSBF 40:30:30 of composite flour.

***Procedure*:** The processed six ratios of composite flours was used to produce bean ball, 1000gm of composite flour were measured into six bowls and mixed with 1500ml of warm water for 5 minutes, the mixed flour paste was placed in a moter and the puree stirred with a pestle in a circular motion, water was added little by little and the stirring continued until the desired consistency was achieved. Salt, pepper and onions were added to taste and the paste scooped with a spoon, into heated vegetable oil. The puree is deep fried until the underside is brown and then turned to fry other side till golden brown as well. The normal bean ball of only cowpea served as the control.

***Instrument for Data Collection*:** The sensory properties of the foods were assessed using a 9-point hedonic scoring form as the instrument for evaluation. The form included the test for flavor, colour, appearance, texture, taste, aroma, airspace, and general acceptability. A nine point hedonic scale was used to help the panelist fully expressed their degree of likeness/dislike of which 9 was the highest (like extremely) while the least (dislike extremely). Like

extremely to like slightly constitute good while dislike slightly to dislike extremely constitute poor. Neither like nor dislike showed that the product is neither good nor bad the guideline for this decision was based on 5.00

***Selection of judges*:** Organoleptic evaluation of the food samples was carried out using (30) panelists drawn from staff, postgraduate students and undergraduates and general public from University of Nigeria Nsukka. The acceptability of the foods was evaluated using the indices of flavor, colour/appearances, texture, airspace, oil, and general acceptability.

***Presentation of products to judges*:** The dish was presented for evaluation at a temperature of 40c (serving temperature). The composite bean ball (cbb) was properly coded for the judges in clean, odourless and tasteless containers. Each judge was given a glass of water to rinse his/her mouth after tasting to avoid interfering with the taste of the proceeding products. The laboratory was cleaned and free from distractions. Fluorescence light was used for uniform illumination and each judge was positioned independent of each other to avoid bias. The sensory evaluation form was placed near the products such that each judge will collect and use for evaluation. They were required to rate each of the attributes on the rating scale that was provided. Carrot and water were provided to rinse the mouth after each rating so that various tastes were distinguishable. The researcher collected the completed ratings forms, from the panellists.

The proximate composition of the composite bean ball (cbb) was analysed using proximate analysis according to AOAC (2010). The prepared samples analysis was carried out by the researcher and the food Technologists and values of analysis recoded as data collected.

Method of Data Analysis

All chemical analysis on the samples was carried out in triplicates. Means, and standard deviation was used to analyse research question 1-2 and analysis of variance (ANOVA) was used to test the hypotheses, using statistical package for social sciences (SPSS), version 21 and Duncan's multiple Range Tests was the statistical tools used to analyse all data generated from chemical analysis and sensory evaluation and the level, of significance was ascertained at $P>0.05$.

Result

Table 1: Proximate Compositions of Six Different Ratios of Composite Flour of Soybean, Bambara nut and Cowpea

Samples	Proximate Compositions (%)					
	Moisture	Ash	Fats	Protein	Fibre	Carbohydrates
100% Cowpea	7.436±0.003[a]	4.165±0.379[a]	1.850±0.007[a]	20.144±0.005[a]	1.243±0.004[a]	65.162±0.020[a]
CSBF (90:5:5)	6.880±0.007[b]	2.948±0.005[b]	2.314±0.004[b]	23.211±0.007[b]	1.135±0.003[b]	63.512±0.012[b]
CSBF (80:10:10)	6.490±0.005[c]	2.467±0.004[c]	2.785±0.004[c]	23.664±0.004[b]	1.148±0.007[c]	62.446±0.012[c]
CSBF (70:15:15)	6.337±0.004[d]	3.573±0.008[d]	3.619±0.007[d]	23.895±0.004[b]	1.145±0.008[c]	62.031±0.017[d]
CSBF (60:20:20)	5.749±0.006[e]	3.585±0.004[d]	3.766±0.003[e]	24.510±0.006[c]	1.224±0.007[a]	61.165±0.025[e]
CSBF (50:25:25)	5.648±0.009[f]	3.746±0.006[e]	4.180±0.008[f]	24.955±0.003[c]	1.375±0.002[d]	60.095±0.009[f]
CSBF (40:30:30)	5.246±0.003[g]	3.763±0.004[f]	4.652±0.006[g]	30.512±0.005[d]	1.384±0.101[d]	54.443±0.019[g]

n = 3
Results are expressed as Mean ± SD
Mean values having different letters as superscripts down the columns are considered significant at $p<0.05$.

Table 1 shows the proximate composition of the six composite flour ratios range from 5.246 – 6.880 for moisture, 2.467 to 3.763 for ash, 2.314 - 4.652 for fats, 23.211 - 30.512 for protein, 1.135 - 1.384 for fibre, 54.443 - 63.512 for carbohydrate. The control sample which is labelled 100% cowpea had the highest level of moisture (7.436±0.003%), ash (4.165±0.379%) and carbohydrate (65.162±0.020%) while CSBF (40:30:30) had the highest contents of fats (4.652±0.006%), proteins (30.512±0.005%) and fibre (1.384±0.101%). The lowest levels of fats (1.850±0.007%) and proteins (20.144±0.005%) were observed in the control sample (100% cowpea) while CSBF (40:30:30) showed the lowest levels of moisture (5.246±0.003%) and carbohydrate (54.443±0.019%). The lowest fibre (1.135±0.003%) and ash (2.467±0.004%) contents were observed in CSBF (90:5:5) and CSBF (80:10:10) respectively.

Table 2: Organoleptic Attributes of the Six Different Ratios of Composite Bean Ball Samples of Soybean, Bambara nut and Cowpea.

Samples	Organoleptic Properties						
	Flavour	**Air Space**	**Oil**	**Texture**	**Colour**	**Aroma**	**General Acceptability**
CSBP (90:5:5)	7.37 ± 0.81^{c}	6.20 ± 1.85^{b}	5.53 ± 1.41^{a}	6.63 ± 1.50^{a}	4.70 ± 1.44^{a}	7.40 ± 0.97^{b}	7.43 ± 1.31^{c}
CSBP(80:10:10)	6.90 ± 1.13^{bc}	6.63 ± 1.65^{b}	5.40 ± 1.48^{a}	6.40 ± 1.55^{a}	4.63 ± 1.54^{a}	6.70 ± 1.26^{ab}	6.90 ± 1.13^{bc}
CSBP (70:15:15)	6.60 ± 1.61^{abc}	6.73 ± 1.72^{b}	5.40 ± 1.67^{a}	6.17 ± 1.70^{a}	5.00 ± 1.64^{a}	6.73 ± 1.39^{ab}	6.43 ± 1.68^{ab}
CSBP (60:20:20)	6.53 ± 1.59^{abc}	6.50 ± 1.76^{b}	5.40 ± 1.94^{a}	6.10 ± 1.79^{a}	4.47 ± 1.28^{a}	6.67 ± 1.63^{ab}	5.80 ± 1.88^{a}
CSBP (50:25:25)	6.43 ± 1.78^{ab}	6.57 ± 2.13^{b}	4.90 ± 1.86^{a}	6.30 ± 1.97^{a}	5.27 ± 1.51^{ab}	6.67 ± 1.61^{ab}	5.80 ± 1.99^{a}
CSBP (40:30:30)	5.73 ± 2.12^{a}	6.53 ± 2.30^{b}	5.63 ± 2.16^{a}	5.87 ± 1.98^{a}	5.97 ± 1.69^{b}	6.40 ± 1.69^{a}	6.00 ± 1.84^{ab}
COP	6.13 ± 1.96^{ab}	4.53 ± 2.24^{a}	4.70 ± 2.09^{a}	6.03 ± 2.03^{a}	5.13 ± 1.68^{a}	6.07 ± 1.86^{a}	5.47 ± 2.40^{a}

n = 3

Results are expressed as Mean ± SD

Mean values having different letters as superscripts down the columns are considered significant at $p<0.05$.

Sample 1 = CSBP (90:5:5) = Cowpea (90%) + Soybean (5%) + Bambara (5%) Product

Sample 2 = CSBP (80:10:10) = Cowpea (80%) + Soybean (10%) + Bambara (10%) Product

Sample 3 = CSBP (70:15:15) = Cowpea (70%) + Soybean (15%) + Bambara (15%) Product

Sample 4 = CSBP (60:20:20) = Cowpea (60%) + Soybean (20%) + Bambara (20%) Product

Sample 5 = CSBP (50:25:25) = Cowpea (50%) + Soybean (25%) + Bambara (25%) Product

Sample 6 = CSBP (40:30:30) = Cowpea (40%) + Soybean (30%) + Bambara (30%) Product

Sample 7 = COP = Cowpea flour product.

Table 2 shows Organoleptic Attributes of the Six Different Ratios of Composite Bean Ball Samples. The ratios ranged from 5.73-7.37 for flavour, 6.20-6.73 for airspace, 4.90-5.63 for oil, 5.87-6.40 for texture, 4.70-5.97 for colour, 6.40-7.40 for aroma and 5.80-7.43 for general acceptability. As shown in Table 2, the highest number of respondents preferred sample 1 which contains 90% cowpea, 5% soybean and 5% bambara in terms of the flavour. Sample 6 (40% cowpea, 30% soybean and 30% bambara) recorded the lowest number of respondents for flavour. Sample 4 (70% cowpea, 15% soybean and 15% bambara) witnessed the highest number of respondents for air space. On the other hand, Sample 6 (40% cowpea, 30% soybean and 30% bambara) recorded the highest number of respondents for oil. There was no significant difference when the flavour property of the composite legume products were compared with 100% cowpea product. The only exception was in the composite legume product CSBP (40:30:30) which showed significant difference when compared to 100% cowpea product. There was no significant difference when the texture property of the composite legume products were compared with 100% cowpea product. There was no significant difference when the general acceptability of the composite legume products, CSBP (40:30:30), CSBP (50:25:25), CSBP (60:20:20) and CSBP (70:15:15) were compared with 100% cowpea product. The only exceptions were in the composite legume products CSBP (90:5:5) and CSBP (80:10:10) which showed significant difference when compared to 100% cowpea product.

Discussion

The sample in the study showed that the proximate compositions of the six ratios of composite flour are within the acceptable minimum level (standard) in food or flour. This is supported by dietary requirement of proximate requirement of individual as contained in dietary reference intake of individual (2002) the finding are also similar to that of Alozie, et al, (2009) in a study on utilization of bambara groundnut flour blends in bread production. In the study the proximate of moisture, ash, fat, fiber, protein and carbohydrates were determined using AOAC (2000) and found out that moisture, crude fiber, fat, fibre, protein and carbohydrate meet minimum body requirement and found out that the three composite flour of bread blend meet with the minimum standard. This study also found out that the proximate of the composite flour for the six ratios are lower than the Moisture (7.436), Ash (4.165) and Carbohydrate (65.162) of 100% cowpea. This is supported by the findings of Alozie (2009) in a study

of Utilization of bambara groundnut flour blends in bread production were it was found out that the proximate of moisture, ash, fibre, fats, protein and carbohydrate of bread made of wheat and bambara groundnut were lower than that of the blends.

Interesting, composite flour samples showed an increase in protein. The result obtained reveals that the constituent protein content of the composite flour of ratio csbf 40,30,30 value $30.512+0.005^{d}$ csbf 50,25,25value $24.955+0.003^{c}$ csbf 60,20,20 value $24.510+0.006^{c}$ csbf 70,15,15 value $23.895+0.004^{b}$ csbf 80,10,10 value 23.61% and csbf 90,5,5value 23.21% were found to be higher than 100% cowpea and meet with the body requirement of children. This implies that the legume composite samples with specific mention of cowpea soybean and bambara nut composite flour could help in improving the crude protein content. it was observed that the highest moisture, carbohydrate and ash contents were observed in the control sample (100% cowpea) than the flour sample. While protein fiber and fat contents were found to be relatively higher in the legume flour samples compared to the control100% cowpea.

The increases in crude protein could be due to enzyme hydrolysis of the insoluble protein available (Echendu *et al*., 2009). This is supported by the findings of Nwaosu (2011) in a study on proximate composition and acceptability of moinmoin made from cowpea and asparagus bean seed were it was found out that the crude protein for moinmoin substituted with 100% asparagus bean was slightly higher than the control 100% cowpea due to higher protein content of asparagus been seed.

The results of the present study indicated that legumes such as cowpea, soybean and bambara nut have good nutritional profile with high level of protein, lipid and fiber. The consumption of *cowpea fortified with other rich legumes*, could help combat the effect of malnutrition experienced in Nigeria and other developing countries across the world.

It was found out in this study that all the attributes of the six ratios of composite bean ball product such as flavour, texture, aroma, colour, airspace, and acceptability meet standard of five on a 9-point hedonic scale. This is also similar to what is obtained in the two ratios CSBP 40:30:30 and 70:15:15 of the composite bean ball when compared with ball from whole cowpea. Composite flour bean cake was evaluated for flavour, air space, oil, texture, colour, aroma and overall acceptability as presented in Table 2. The results of sensory attributes of the cowpea-soybean-bambara with a ratio of CSBP (90:5:5) showed significantly ($p < 0.05$) higher

preference for flavour, texture, aroma and general acceptability compared to other flour samples; but there was significantly ($p < 0.05$) lower preference for 100% cowpea flour which was followed by samples at a ratio of CSBP (40:30:30) and CSBP (60:20:20) compared to other flour samples.

This observation could be attributed to the fact that the panelist might have been familiar with the blend flour samples based on the taste and flavour; hence, this might have influenced their judgment in favour of the blend flour samples relatively to the 100% cowpea sample. Flavour is the main criterion that makes the product to be liked or disliked (Ogunmodimu *et al*. 2015). Quality score for the flavour of the legume samples revealed that the flavour of the biscuits varied significantly ($p < 0.05$) among different legume samples. However, the overall acceptability favoured CSBP (70:15:15) rated next to CSBP (70:15:15). The disparity observed between the sensory attributes of CSBP (90:5:5) sample (blend flour with the highest percentage of cowpea) over the 100% cowpea flour sample. Colour is very important parameter in judging properly blended legume samples that not only reflect the suitable raw material used for the preparation but also provides information about the formation and quality of the product.

Conclusion

From the outcome of the research, it could be deduced that the highest contents of moisture, ash, fats and fibre were observed in the legume product, than control (100% cowpea) the contents of flour samples were found to be relatively higher than the legume products while protein and carbohydrate contents were found to be relatively higher in the legume composite product samples compared to the control samples *(akara)* The highest number of respondents preferred CSBP (90:5:5) in terms of the flavour, texture, aroma and general acceptability. CSBP (40:30:30) recorded the lowest number of respondents for flavour, spice and texture. CSBP (70:15:15) witnessed the highest number of respondents for air space and spice. CSBP (40:30:30) recorded the highest number of respondents for oil and colour. The lowest number of respondents favoured 100% cowpea product because of the air space, oil, aroma and general acceptability. CSBP (60:20:20) recorded the lowest number of respondents for spice and colour.

Recommendations

Based on the findings and implication of the study, the following recommendations were made for implementations.

(1) Food industries should use the procedure of the finding to

manufacture composite flour of ratio 40% cowpea 30% soybean and 30% bambara nut for sale to people making bean ball.

(2) People should be enlightened by the Home Economist, nutritionist and relevant others on the use of bean ball composite flour ratios because of their improved nutritive value, organoleptic attributes and general acceptability through seminars, workshops and social medias like television and radio.

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