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Proximate Analysis and Sensory Evaluation of Yellow Maize-Based *Aadun* Fortified with Soybean Sweetened with Sugar

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Abstract

This study investigated proximate analysis and sensory evaluation of yellow maize-based *Aadun* fortified with soybean sweetened with sugar. Two objectives were raised and the products were in different percentages of 100% yellow maize used as the control, 90% yellow maize and 10% soybean, 80% yellow maize and 20% soybean, 60% yellow maize and 40% soybean, 50% yellow maize and 50% soybean, 40% yellow maize and 60% soybean with the addition of sugar (47gm), dried pepper (8gm), and palm oil (174gm) at constant rate using (AOAC 2005) method. Nine-point hedonic scale by 20 respondents was used and tested with ANOVA. The result of proximate composition showed ranged for moisture as 9.08% to 9.87%, 4.24% to 5.48% for ash, 18.74% to 19.55% for fat, 2.71% to 3.41% for fiber, 9.75% to 22.26% for protein and 41.25% to 53.76% for carbohydrate. The result of the sensory evaluation showed that sample ASS3 was the most preferred. In conclusion *Aadun* fortified with soybean and sweetened with sugar can be produce successfully. It was recommended that *Aadun* fortified with soybean should be introduced as snacks to the consumers at homes in schools and for entrepreneurial and wealth creation in Nigeria.

Keywords: *Aadun*, Proximate, Sensory, Acceptability, Soybeans, Entrepreneurial

Introduction

Aadun is a savoury snack of the Yoruba origin. It is a combination of roasted corn, palm oil and salt. *Aadun* actually translated to "sweetness" but the snack is a complete savoury. It is an energy giving snacks predominantly produced and commonly consumed in Yoruba speaking areas of south western Nigeria. It is known for its reddish colour, ease of disintegration in the mouth, fine texture and saltiness. It could be used for traditional marriages, naming ceremonies and eaten in the past by warriors, children, women and people of all ages in Yoruba land (Adedokun, 2006).

In Nigeria especially among the Yorubas, the production of *Aadun* has been limited to yellow maize flour and palm oil with the addition of salt despite the nutritional deficiency of yellow maize in lysine and tryptophan amino acids. The yellow maize grain will go through roasting and milling and then mixed with palm oil with addition of salt. The roasted yellow maize will form lumps and solidify. The solidified yellow maize is referred to as *Aadun* which is may be

wrapped in leaves and consumed (Abdulrahaman and Kolawole 2006).

Aadun contains approximately 72% starch, 10% protein and 4% fat, supplying an energy density of 365 Kcal/100g (Ranum, Pena-Rosas, & Garcia-Casal, 2014) which may not be enough to provide adequate protein for the individual. Therefore, soybean which is a leguminous product was added to increase the nutritional value that was lacking in yellow maize based *Aadun*.

Soybean is a leguminous vegetable of the pea family consists of more than 36% protein, 30% carbohydrates, and excellent amounts of dietary fibre, vitamins and minerals. It also consists of 20% oil, which makes it the most important crop for edible oil. (Institute of International Tropical Agriculture, 2009). This implies that addition of soybean with corn to produce *Aadun* might provide the necessary protein that was lacking in corn, sweetened with sugar instead of salt to give a sweeter taste to the product.

Sugar is the generalized name for sweet, short-chain, soluble carbohydrates. They are composed of carbon, hydrogen, and oxygen. There are various types of sugar derived from different sources. Simple sugars are called monosaccharide and include glucose (also known as dextrose), fructose, and galactose (*US Department of Agriculture, 2011*). The addition of sugar changes the salty traditional taste of *Aadun*.

Palm oil which is edible oil is derived from the palm fruit tree. The oil is extracted from the pulp of the fruit of oil palm which is naturally reddish in colour because of the high level of beta-carotene. Kheri, (1987) and Berger, (1992) cited in Imoisi, Ilori, Agho, Ekhator (2015) stated that Palm oil contains several saturated and unsaturated fats in forms of glyceryl laurate (0.1% saturated), myristate (1%, saturated), palmitate (44%, saturated), stearate (5% saturated), oleate (39% monounsaturated), linoleate (10% polyunsaturated) and linolenate (0.3% polyunsaturated). Palm oil is the largest natural source of tocotrienol. The addition of Palm oil to *Aadun* will give a reddish colour that may attract the consumption of the product. In spite of this production, consumers of yellow maize-based snack in large quantity may be faced with large intake of carbohydrate that may result into malnutrition, vitamin and protein deficiency common in yellow maize.

Idowu and Adedokun (2011) in their study titles process technology, chemical composition and quality of "*A*adun" maize- based Nigerian snack fund out that *Aadun*" generally had low total aerobic plate (1.2x 103 - 3.3x103 cfu/g) and fungi (< 10 sfu/g) counts. It contains low microbial load and it is rich in calorie, phosphorus and magnesium therefore is a need to standardize its ingredient composition by fortifying with high content leguminous product such as soya beans to increase the nutritional value of *Aadun* and to optimize its process through technology and packaging in order to upgrade the snack to an internationally acceptable product. Also in the study of Akinola and Enujiugha (2017), titled Physicochemical and sensory qualities of "*Aadun*" a maize based snack supplemented with defatted African oil bean seed flour, they found out that the substitution of maize with African oil bean seed flour influence the mineral content of a maize based snack . For the purpose of this study, *Aadun* was fortified with

soybean because of the high content in lysine and tryptophan to improve the quality and nutrient value of the product. The production could facilitate wealth creation through entrepreneurship.

Objectives of the Study

This study investigated the sensory evaluation and proximate analysis of yellow maize-based *aadun* fortified with soybean and sweetened with sugar. Specifically the study,

1. analyzed the proximate composition of *Aadun* with soybean and (YM) flour sweetened with sugar.
2. determined the sensory attributes of *Aadun* fortified with soybean sweetened with sugar.

Method and Materials

***Materials*:-**The ingredients required for *Aadun* include dried (YM), soybean, dried pepper, sugar, palm oil and leaves procured from Ipata market in Ilorin, Kwara state Nigeria.

***Preparation of Materials* :-**To formulate the fortification, 2.93kg of dried (YM) was washed, dried, grilled and milled while 1.250 of soybean was also sorted, washed, soaked in water overnight, dried, grilled and milled.

Recipes and Preparation Procedure

700g of (YMF) at 100% was the control
630g of (YMF) at 90% was mixed with 70g of soybean flour at 10%
560g of (YMF) at 80% and 140g of soybean flour at 20%
420g of (YMF) at 60% and 140g of soybean flour at 40%
350g of (YMF) at 50% and 350g of soybean flour at 50%
270g of (YMF) at 40% and 240g of soybean flour at 60% to obtained different percentages of flour blends.

Procedure for Preparation: This involved the following:

Production of roasted yellow maize flour: the yellow Maize was washed, dried and roasted in the laboratory oven at 70˚C for 15 min and dry milled to a particle size to obtain roasted maize flour according to Akinola and Enujiugha (2017).

Production of roasted soybean flour: soybean was sorted, soaked in water for about 8h to remove all the impurities. Then it was roasted and dried at 60 C until moisture content was removed and dry milled to obtain roasted soybean flour.

Production of Aadun: Composite flours (90:10 (ASS2), 80:20 (ASS3), 60:40 (ASS4), 50:50 (ASS5), 40:60 (ASS6)100% (ASS1) 100:0) were produced from the ratios of roasted maize flour and soybean flour. *Aadun* was produced by mixing the different percentages of flour blends samples with sugar (47gm), dried pepper (8gm), and palm oil (174gm) at constant rate. The mixtures were cooled and wrapped in leaves.

Summary formulation of Samples

ASS1 = 100% yellow maize the control
ASS2 = 90% yellow maize, 10% soybean
ASS3 = 80% yellow maize, 20% soybean
ASS4 = 60% yellow maize, 40% soybean
ASS5= 50% yellow maize, 50% soybean
ASS6 = 60% soybean, 40 yellow maize

Proximate and Chemical Analysis

The proximate composition of the *Aadun* samples was carried out using Association of Official Analytical Chemists (AOAC) 2005 method. This method of analysis is

used to identify the nutritional composition such as crude protein, carbohydrate content, crude fibre, ash and fat present in yellow maize-based *Aadun*. Analyses were done for the six samples carried out in the food science laboratory, Department of Home Economics and Food Science, university of Ilorin.

Sensory Evaluation

***Selection of Panel*: -** Taste panel evaluation of *aadun* was carried out using 20 judges selected from the students of the Department of Home Economics and Food Science, University of Ilorin Nigeria, comprising thirteen (13) female and seven (7) male students respectively. The attributes that were evaluated are colour, taste, appearance, aroma, texture and overall acceptability. The samples were placed in transparent plates for ease accessibility.

***Instrument for sensory evaluation*:** A 9-Point Hedonic scale and a multiple comparison test according to (Dias, Faria, Mercadante, Bragagnolo & Benass 2007) was used to assess the acceptability of yellow maize based *Aadun* fortified with soybean sweetened with sugar. The sensory evaluation was carried out using the nine-point hedonic scale where 9= like extremely, 8= like very much, 7= like moderately, 6=like slightly, 5= neither like nor dislike, 4= dislike slightly, 3= dislike moderately, 2=dislike very much, 1=dislike extremely.

***Data collection procedure*: -** Coded sample were served at room temperature and judge by each panel using the nine-point hedonic scale. The panellists rated *aadun* in parameters using the nine-point hedonic scale where the samples were presented to panelists in a randomized order and were evaluated for appearance, taste, aroma, texture, and overall acceptability.

***Data Analyses techniques*:** All determination was carried out in duplicates. The data collection from the panelist was analyzed using descriptive percentages. Comparisons between sample treatment and the indices were done using analysis of variance (ANOVA) with a probability $p \leq 0.05$.

Findings

Table1: Result of proximate Composition of Enriched *Aadun* (dry basis)

Code	Moisture (%)	Ash (%)	Fat (%)	Crude Protein	Fibre (%)	Carbohydrate (%)
ASS1	9.87 ±0.007^{e}	4.59±0.141^{c}	18.74±0.007^{a}	9.65±0.141^{a}	3.41±0.141^{a}	53.76±0.141^{c}
ASS2	9.74±0.212^{d}	4.40±0.007^{b}	18.86±0.205^{a}	11.85±0.141^{b}	3.31±0.007^{a}	51.88±0.212^{e}
ASS3	9.57 ±0.212^{c}	4.24±0.007^{a}	19.05±0.007^{ab}	14.03±0.141^{c}	3.19±0.141^{a}	49.97±0.354^{b}
ASS4	9.32 ±0.141^{b}	5.48±0.007^{e}	19.08±0.007^{b}	22.13±0.141^{d}	2.93±0.141^{a}	41.025±0.212^{a}
ASS5	9.29 ±0.141^{b}	4.75±0.007^{d}	19.22±0.007^{b}	20.58±0.141^{e}	2.81±0.141^{b}	44.26±0.141^{d}
ASS6	9.08 ±0.141^{e}	4.58±0.007^{c}	19.55±0.007^{c}	22.26±0.141^{f}	2.71±0.007^{c}	41.85±0.354^{f}

Means along the same subscripts are not significantly different ($p \leq 0.05$)

Key: ASS1 = 100% yellow maize (control), ASS2 = 90% yellow maize, 10% soybean, ASS3 = 80%

yellow maize, 20% soybean, ASS4 = 60% yellow maize, 40% soybean, ASS5= 50% yellow maize, 50% soybean, ASS6 = 60% soybean, 40% yellow maize.

Table 1 shows the proximate analysis results.

Moisture content: The moisture content of the *Aadun* samples ranged from 9.87% – 9.08%, sample ASS1 (90% yellow maize, 10% soybean) had the highest moisture content with the percentage 9.87% while sample ASS6 (40% yellow maize, 60% soybean) had the lowest amount of moisture percentage of 9.08%.

Ash Content: The ash content of the *Aadun* samples ranged from 4.24% – 4.75%, sample ASS5 (50% yellow maize and 50% soybean) had the highest ash percentage 4.75% while sample ASS3 (80% yellow maize and 20% soybean) had the lowest ash percentage 4.24%.

***Fat and Oil content*:** The fat content of the *Aadun* samples ranged from 18.74% – 19.55%. Sample ASS6 (40% yellow maize, 60% soybean) had the highest amount of fat and oil content 19.55% while sample ASS1 (100% yellow maize) with mean percentage of 18.74% had the lowest amount of fat and oil. Fat in food formulations binds the protein content and improve the mouth feel formation.

***Crude Protein Content*:** The protein content of the *Aadun* samples ranged from 9.65% – 22.26%. Sample ASS6 (40% yellow maize, 60% soybean) had the highest amount of protein content 22.26% while sample ASS1 (100% yellow maize) with mean percentage of 9.65% had the lowest amount of protein. The highest amount of protein derived from sample ASS6 might be as a result of the increased amount of soybean present in it.

***Carbohydrate Content*:** The carbohydrate content of the *Aadun* samples ranged from 53.75% – 41.85%, sample ASS1 (100% yellow maize) had the highest protein content with 53.75% and sample ASS6 (40% yellow maize and 60% soybean) had the lowest carbohydrate content with 41.85%. The high carbohydrate content present in ASS1 may be attributed to the high yellow maize percentage present in it.

Sensory Evaluation

Table 2: Result for Sensory Evaluation of Enriched *Aadun*

Sample	Colour	Taste	Appearance	Aroma	Texture	Overall acceptability
ASS1	6.95^{ab}	5.15^{a}	6.25^{a}	5.85^{a}	5.65^{a}	5.85^{a}
ASS2	7.55^{ab}	7.35^{c}	7.25^{a}	6.70^{b}	7.05^{b}	6.95^{bc}
ASS3	7.65^{b}	7.35^{c}	7.20^{a}	6.95^{ab}	7.20^{b}	7.65^{c}
ASS4	7.20^{ab}	6.80^{ab}	6.90^{a}	6.80^{b}	6.90^{b}	7.05^{bc}
ASS5	7.00^{ab}	6.75^{ab}	7.25^{a}	6.70^{b}	7.25^{b}	7.10^{bc}
ASS6	6.60^{a}	6.30^{b}	6.50^{a}	6.70^{b}	6.55^{b}	6.75^{b}

Means along the same subscripts are not significantly different ($p \leq 0.05$)

Key: ASS1 = 100% yellow maize (control), ASS2 = 90% yellow maize, 10% soybean, ASS3 = 80% yellow maize, 20% soybean, ASS4 = 60% yellow maize, 40% soybean, ASS5= 50% yellow maize, 50% soybean, ASS6 = 60% soybean, 40% yellow maize

Table 2 reveals the sensory analyses of *Aadun* samples.

***Colour*:** There was a significant difference between the samples, the sample ASS6 (40% yellow maize and 60% soybean) was the least preferred with the mean score of 6.60 and the most preferred in term of colour was ASS3 (80% yellow maize and 20% soybean) with the mean score of 7.65. The result could be because ASS6 had the highest amount of soybean.

***Taste*:** Sample ASS1 (100% yellow maize) was the least preferred in term of taste with the mean score 5.15 while sample ASS3 (80% yellow maize and 20% soybean) and sample ASS2 (90% yellow maize and 10% soybean) had the most preferred taste with mean score of 7.35. The preference could be because sample ASS3 and ASS2 had a small percentage of soybeans.

***Appearance*:** Sample ASS2 (90% yellow maize and 10% soybean) and ASS5 (50% yellow maize and 50% soybean) had the most preferred appearance with the mean score of 7.25 and the sample ASS1 (100% yellow maize) with the mean score 5.85 was the least preferred.

***Aroma*:** Sample ASS3 (80% yellow maize, 20% soybean) with the mean score 6.95 was the most preferred, while sample ASS1 (100% yellow maize) with the mean score 5.65 was the least preferred. This was due to sample ASS3 having a small percentage of soybeans.

***Texture*:** Sample ASS5 (50% yellow maize and 50% soybean) with the mean score 7.25 was the most preferred in term of texture and samples ASS1 (100% yellow maize) with the mean score 5.65 was the least preferred. This could be because sample ASS5 has the same percentage of yellow maize and soybean.

***Overall acceptability*:** The most acceptable of the *Aadun* samples was sample ASS3 (80% yellow maize, 20% soybean) with the mean score 7.65 and ASS1 (100% yellow maize) was the least acceptable with the mean score 5.85 and this could be because ASS3 was the most preferred in term of taste, appearance and aroma.

This result indicated that the fortification of *Aadun* with soybean and sugar increased the consumer's acceptance of the product in terms of taste, colour, appearance, texture, aroma and its overall acceptability.

Discussion of Findings

The highest amount of fat derived from sample ASS6 is as a result of the composition in the sample (40% maize, 60% soybean), the various samples have significant amount of fat and oil but the increase soybean percentage is what makes the crude fat differ from other samples. This finding agrees with the findings of Onimawo and Akubor, (2012) and Balogun and Olatidoye, (2010) that Oil absorption capacity (OAC) is an indication of the rate at which protein binds to fat in food formulations. Fat acts as a flavour retainer and helps improve the mouth feel of products. This finding is also in agreement with the findings of Lawal and Enujiugha (2016) which stated that chemical composition, functional and sensory properties of maize based snack *elekute* enriched with African oil been seed sample with 60% maize, 40% soybean had the highest fat content.

The findings of Ikya, Gernah and Sengev (2013) also agreed that proximate composition, nutritive and sensory property of fermented maize and full fat

soy flour, sample D with 70% maize and 30% soy flour had higher protein content than all the samples, this increase is due to the addition of plant protein (soybean). The study of Abegunde *et al*., (2014) is in agreement that the quality of evaluation of maize chips (kokoro) fortified with cowpea flour also adds to the increase of protein to maize. The findings showed that carbohydrate content decreased with increase in the level of cowpea while the level of protein increased with the increase in the level of cowpea flour. The difference between the samples was minimal. The author's further fund out that the quality evaluation of maize chips (kokoro) fortified with cowpea flour that is, the sample with 100% maize had the highest moisture content percentage while that of 60% maize and 40% cowpea flour had the lowest moisture percentage.

The proximate composition ranged from 9.08% to 9.87% for moisture, 4.24% to 5.48% for ash, 18.74% to 19.55% for fat, 2.71% to 3.41% for fiber, 9.75% to22.26% for protein and 41.25% to 53.76% for carbohydrate. This finding is in agreement with the findings of Onabanjo, (2007) that Ash content of food material represents the inorganic or mineral constituents of the foods. Proteins from animal foods are good sources of ash in that they contains adequate supply of calcium, phosphorus and iron, which are essential for the formation of bones, teeth and blood component. The ash content is the mineral present in *Aadun*. This finding agrees with the findings of Olaoye, Onilude, and Idowu (2006) that production of *Agidi*-a fermented cereal product from maize flour substituted with soy flour increase the nutritional Value of the maize. The ash content of produced *Agidi* increased with increasing substitution with African oil bean seed flours. The ash content is indicative of minerals present in the snack.

The protein from the *aadun* produced from 100% maize was significantly ($p \leq 0.05$) lower than other samples. The fat content from the *aadun* produced from 60% maize and 40% soybean was significantly ($p \leq 0.05$) higher than other samples. The carbohydrate content of the *aadun* produced from 100% maize was significantly ($p \leq 0.05$) higher than other samples. The study showed that soybean flour can successfully be used in the production of *aadun*. The sensory evaluation of samples ASS3 showed that the samples fortified with 20% soybean was most preferred in term of aroma, texture, overall acceptability, colour, and appearance.

The development of these yellow maize-based snacks through value added processes will establish appropriate and optimum conditions for improving the product quality. It may offer wider utilization which may lead to job creation both at home and at industrial level. There is a significant difference in the taste aroma, appearance, texture and overall acceptability of *Aadun* fortified with soybeans compared with the 100% maize sample.

Conclusion

Based on the findings it was concluded that the best *Aadun* sample was sample ASS3 made from 80% yellow maize and 20% soybean; it was the most acceptable in term of taste, aroma, appearance and overall acceptability. The study also showed that although all the samples with soybean showed superiority over the control sample in terms of protein, fat and

taste, the sample ASS5 was the most preferred in terms of color and texture. Therefore yellow maize flour and soybean flour will be very suitable for the production of *Aadun* that would be richer in protein than the traditional *Aadun* made from yellow maize only. The study showed that soybean flour can successfully be used in the production of *Aadun* to increase the nutritive value.

Recommendations

The following recommendation are made base on the findings.

1. Production of *Aadun* fortified with soybean and sweetened with sugar should be encouraged for the nutritional benefit to the consumers.
2. *Aadun* fortified with soybean and sugar could be sold as snacks to consumers at homes, schools, supermarket and the localities in Nigeria.
3. Preparation, production and packaging of *Aadun* should be modified using different packaging methods such as cellophane bags, plastic containers sealed and labeled. This could be a source of job creation and youth empowerment programme in Nigeria.

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