World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Tourists' acceptability of enriched aadun snack produced from maize, soybean and ginger flour at Idanre hill, Ondo state

Olatunji, C. A [1,*], Adetola, B. O [2] and Arowosafe, F. C [2]

[1] *Department of Leisure and Tourism Management, Rufus Giwa Polytechnic, Owo, Nigeria,*
[2] *Department of Ecotourism and Wildlife, Federal University of Technology, Akure, Nigeria.*

World Journal of Advanced Research and Reviews, 2023, 20(02), 553–562

Publication history: Received on 06 August 2023; revised on 19 September 2023; accepted on 22 September 2023

Article DOI: https://doi.org/10.30574/wjarr.2023.20.2.1874

Abstract

Blends of maize, soybean, and ginger flour were optimized. Aadun, a traditional snack made from maize that is high in starch but poor in protein, was made using the mixtures. For proximate composition and mineral composition, experimental runs (at various levels of substitution) were produced using the Response Surface Methodology's optimal mixture design. The flour mixtures were also utilized to make aadun, which was taste-tested by visitors to Idanre Hill and Resort. The findings showed that the enriched aadun had higher protein, fiber, ash, and fat levels, as well as higher mineral contents (sodium, potassium, phosphorus, and manganese), ensuring that the aadun was nutrient-sufficient for the tourists. The aadun will have a stable shelf life because of the snack's far lower moisture and carbohydrate content, which distinguishes it from most local snacks that are primarily starch-based and may contribute to obesity. The general acceptability of the enriched aadun revealed that it did not differ noticeably from the conventional aadun made from 100% maize flour in terms of acceptability.

Keywords: Acceptability Enriched Aadun; Composite Flour; Idanre Hill; Ondo state

1. Introduction

According to Okumus *et al.* (2007), tourist sites should work to promote sustainable tourism development in addition to increasing the number of visitors they receive. Therefore, several locations have incorporated regional cuisine within their official tourism management initiatives in this manner (Bjork and Kauppinen-Raiseken, 2016; Choe and Kim, 2018). Local cuisine is regarded as a representation of a place's culture and inhabitants. Along with attending to their fundamental requirements and expectations in rural places, travelers' main activities while there include eating the local cuisine (Raji *et al.,* 2017). Therefore, local cuisine can be utilized as a real instrument to boost local economies, encourage entrepreneurship, and enhance the reputation of the destinations. The majority of local meals at tourist areas in Nigeria are made from indigenous crops that are primarily starch-based with minimal protein, making the production of local foods to fulfill the nutritional and aesthetic needs of tourists a significant issue (Osabord *et al.,* 2009). Therefore, it is crucial to develop and produce locally grown meals that are aesthetically pleasing, nutritionally balanced, and appealing to tourists.

In order to increase the protein content of the snacks, numerous research projects have been undertaken to create maize-based snacks that have been enhanced with other protein-rich crops. Significant results were achieved in the studies of Awolu *et al.* (2017), Shakpo and Osundahunsi (2016), and Amodu *et al.* (2018). In this work, maize, soybean, and ginger flours were optimized to make Aadun, a regional snack exclusive to the Yoruba people of Southwest Nigeria (Adeyanju *et al.,* 2016). Idanre Hills in Ondo State, a popular tourist area, served as the location for sensory evaluation and the acceptance of the enriched snack. According to Akinola and Enujiugbo (2017), aadun is a snack made of maize.

* Corresponding author: Olatunji, C. A

According to Adedokun, Idowu, and Henuskuwa (2020), aadun is one of the traditional method-made treats manufactured from maize that is renowned for its quick disintegration in the mouth and appealing crimson hue from the use of palm oil. It is frequently used in marriage and naming rituals, has a fine texture, and is pleasant (Amanyunose *et al.,* 2021). Aadun, according to Adedokun (2016), has a low protein content but is a rich source of energy, phosphorus, and magnesium. Aadun's low protein content makes it maybe unsuitable for visitors' diets. Simon (1999) argued that native foods should have a high nutritional value when used as snacks, while Amanyunose et al. (2020) agreed that every traveler needs access to wholesome foods. According to Adeyanju *et al.* (2016), soybeans are a leguminous crop that is a great provider of protein and minerals. In addition to being a potent antioxidant with regenerative and bioceutical properties, ginger is also a good source of dietary fiber (Nwokolo, 1996; Shakpo & Osundahunsi, 2016).

Therefore, producing aadun with maize, soybean, and ginger flours will improve the snack's nutritional profile.

2. Material and methods

2.1. Material

Maize grains, soyabeans and ginger and the other ingredients used in the study were purchased from Owo Market in Owo, Ondo State Nigeria. All chemicals used were of analytical grade.

2.2. Production of Roasted Maize Flour

Maize grains were cleaned and roasted by the method adopted by Akinola and Anuonye, (2017). The maize grains were roasted in an oven at 70^{o}Cfor 15minutes. They were dried milled to obtain roasted maize flour.

2.3. Production of Soyabeans Flour

Soyabeans grains were washed, roasted in oven at 70^{0}c for 15minutes. They were therefore dried milled into soyabeans flour.

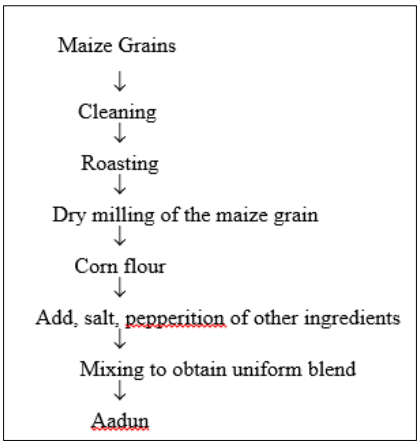
2.4. Production of Ginger Flour

Ginger flour was prepared according to the method of Adejuyitan (2011). The ginger were peeled and cut into pieces. They were milled and dried into ginger flour.

2.5. Experimental Design and Formulation of the Flour Blends

Optimum Mixture Design of Response Surface Methodology was used to formulate 16 experimental runs from which six best samples were obtained and subjected to proximate and mineral composition. The selected flour blends were used to produce aadun samples which were further subjected to proximate composition, minerals and sensory evaluations.

2.6. Production Process of Aadun



Source: Arotupin et al. (2018).

Figure 1 Flow Chart for the Production of Aadun

According to the method adopted by Shakpo and Osundahunsi (2016) one kilogram of the roasted maize grained were dry milled into maize flour, dry pepper, salt and 200ml of hot palm oil was added stirred to produce oily aadun.

2.7. Determination of Proximate Composition of the Composite Flours

Proximate compositions of the optimized flour blends were determined using the standard method of AOAC (2012).

2.8. Determination of Mineral Contents of the Flour Blends

Atomic Absorption Spectrophotometer was used for the analysis of Na, K, Ca, Fe, Mg, Zn, Cu, and Mn.

2.9. Determination of Acceptability of the Optimized Aadun Samples by the Tourist at the Selected Tourist Destination

Sensory evaluations by the tourists were carried by the tourists to determine the acceptability of the optimized Aadun samples. 15 semi trained panelists were selected in the tourist destination, Idanre Hills and Resort, Idanre in the Southwest Nigeria. This panelist size agreed with the recommendation of USA Association of Food Technologists on the number of semi trained panelists. The results from the panelists, 45 in number, were used for the analysis to determine the acceptability of the optimized Aadun snack by the tourists.

2.10. Statistical Analysis

Data generated were analyzed by one-way-Analysis of Variance (ANOVA) using SPSS (21.0) Software. Means compared using Duncan's New Multiple Range Test (DNMRT) at 5% of significance.

3. Results

3.1. Proximate Composition of the Composite Flour Blend of Maize, Soybean and Ginger

Table 1 displays the findings of the composite flour mixes' approximate components. The moisture percentage of the optimized samples ranged between 6.65 and 9.36%, whereas sample G (100% maize flour) had the maximum moisture content at 9.94%. The quality of the flour blends and the goods made from them will benefit from the optimized flour blends' decreased moisture concentrations. In comparison to the 1.30% found for 100% maize flour, the ash percentage of the flour blends ranged from 1.34 to 1.77%. The rise was caused by adding extra soybean flour and ginger flour. Ash is a sign that minerals are present. In comparison to the protein values of the flour mixes, which ranged from 9.69 to 15.19%, the protein content of the 100% maize flour was lower at 9.44%. Sample A, which included the most soybean flour (14.1%), had the greatest protein level of all the flour blends.

The optimized flour mixes had fat amounts that were higher than those of the 100% maize flour, which had the lowest fat percentage at 6.59%. While the fiber level of the 100% maize flour was 0.77, that of the optimal flour mixes ranged from 0.81 to 1.30%. The addition of ginger and soybeans contributed to the rise in fiber content. The optimized flour blends' carbohydrate contents, which ranged from 64.31% to 71.73%, were lower than the carbohydrate content of the 100% maize flour (71.96%), which was greater. The optimized flour mixes are more nutrient-dense than 100% maize flour due to a drop in carbohydrate and an increase in protein, ash, and fiber.

Table 1 Proximate Composition of the Optimized Flour Blends

Sample	M	S	G	Moisture	Ash	Protein	Fat	Fiber	Carbohydrate
A	85%	14.1%	0.9	7.03	1.58	15.19	9.0	1.30	65.90
B	86.449%	10.501%	3.0	6.98	1.59	14.55	9.5	1.22	66.16
C	88.026%	11.9713%	0	6.83	1.77	13.11	9.7	1.28	17.31
D	95.0431%	4.95689%	0	6.67	1.64	10.50	8.7	0.81	71.68
E	99.398%	0.169211%	0.432756	7.36	1.34	9.69	7.0	0.88	71.73
F	92.658%	5.61603%	1.69601	6.75	1.34	11.45	8.2	1.27	71.79
G	100%	0	0	9.94	1.30	9.44	6.59	0.77	71.96

Key: M – Maize flour%; SF – Soybean flourGF – Ginger flour

3.2. Mineral Composition of the Flour Blends

Table 2 displays the mineral makeup of the flour mixtures. The results showed that the optimal flour blends had sodium concentrations between 243 and 646 parts per million, which was greater than the sodium amount of 100 percent maize flour (209 ppm). Additionally, potassium content rose. The sample with the highest potassium level, sample F (9050 ppm), was made up of 92.658% maize flour, 5.61603% soybean flour, and 1.69601% ginger flour. The lowest potassium value was found in the sample with 100% maize content. However, 100% maize flour had a higher calcium level (892 ppm) than the flour mixes that had been optimized. Additionally, the zinc concentration of the 100% maize flour was higher than that of the flour blends that had been optimized. The iron level of the improved flour mixes was higher, ranging from 72 ppm to 147 ppm. The 100% maize flour had an iron level of 64 ppm. Aadun food samples were made using the improved flour blends' manganese content. The components of the two samples' nearest neighbors were then identified. Table 4 displays the findings of the two samples' approximate components. The enriched aadun had a moisture content of 3.50%, which was lower than the 8.43% moisture level of aadun made entirely of maize flour. This denotes that the shelf life of the enriched aadun would be stable. The shelf life of the product increases with decreasing moisture content. The enriched aadun had a greater ash concentration than the aadun produced entirely of maize flour (2.79%). This indicates that the enriched aadun has more minerals than aadun produced entirely of maize flour.

Aadun made from 100% maize flour had a protein content of 10.17%, whereas enriched aadun had a protein content of 14.52 percent. The enriched aadun's greater protein content was caused by its higher proportion of soybean flour. The enriched aadun has a higher fat content (31.02%) than the original aadun made entirely of maize flour. The higher fat level was caused by the larger proportions of soybean and ginger flours. The enriched aadun had a fiber content of 0.70%, which was higher than the aadun made entirely of maize flour. Colon cancer can be prevented in part by foods with increased fiber content. Aadun made entirely of maize flour had a greater carbohydrate content (55.16%), while enhanced aadun had a lower level (47.47% of carbohydrates). The enriched aadun's lower carbohydrate content was caused by the increased soybean and ginger flour inclusions.

Table 2 Mineral Contents of the Flour Blends

Sample	MF%	SF%	GF%	Na ppm	K ppm	Ca ppm	Fe ppm	Zn ppm	Mn ppm	P ppm
A	85	14.1	09	646	7500	251	147	18	5	239.80
B	66.499	10.501	3.0	544	8450	579	117	16	7	239.84
C	88.026	11.9713	0	512	8000	359	129	17	8	2201.60
D	95.0431	49.5689	0	556	7050	365	119	15	7	1752.30
E	99.398	0.169211	0.43226	234	6650	779	72	19	7	1852.30
F	92.658	5.61603	1.69601	473	9050	368	130	18	5	2517.00
G	100	0	0	209	6550	892	24	20	3	1985.00

MF: Maize flour, SF: Soybean flour, GF: Ginger flour

3.3. Proximate Composition of the Enriched Aadun Food Sample

In terms of the near composition and mineral content, sample B (66.499% maize flour, 10.501% soybean flour, and 3.0% ginger flour) in Table 2 was the most optimized flour blend. From 4.0 ppm to 8.0 ppm in the 100% maize flour. 100% maize flour had the lowest manganese concentration (3.0 ppm). In comparison to several of the optimal flour blends, Samples A, B, D, and E, which had phosphorus contents of 239.80 ppm, 239.84 ppm, 1752.30 ppm, and 1852.30 ppm, respectively, 100% maize flour had a phosphorus concentration of 1985 ppm, which was higher. In comparison to 100% maize flour, the optimized flour mixes had higher concentrations of sodium, potassium, iron, and manganese. In contrast to the optimal flour blends, 100% maize flour had higher calcium, zinc, and phosphorus concentrations.

Table 3 Proximate Composition of Enriched Aadun Food Samples Produced from Maize, Soybean and Ginger Flour Blends

Sample	MF%	SF%	GF%	Moisture%	Ash%	Protein%	Fat%	Fiber%	Carbohydrate%
D_1	100	0	0	8.43	1.87	10.17	23.78	0.59	55.16
D_2	86.499	10.501	3.0	3.50	2.79	14.52	31.02	0.70	47.47

D_1 – 100% maize Aadun, D_2 – Optimized Aadun, MF – Maize flour, SF – Soybean flour, GF – Ginger flour.

3.4. Sensory Evaluation of the Enriched Aadun Food Samples

Table 4 Result of Sensory Evaluation of Enriched Aadun

Samples		Colour	Aroma	Taste	Consistency	Acceptability
Sample 1	Mean	4.99[a]	5.29[b]	4.95[a]	4.96[a]	4.97[a]
	SD	2.449	2.358	2.375	2.386	2.328
Sample 2	Mean	5.20[a]	4.99[b]	4.84[a]	5.10[a]	5.10[a]
	SD	2.181	2.309	2.295	2.363	2.314
Sample 3	Mean	5.07[a]	4.77[a]	4.73[a]	5.13[a]	4.96[a]
	SD	2.298	2.426	2.335	2.349	2.275
Sample 4	Mean	5.23[a]	5.04[b]	5.05[a]	4.99[a]	5.30[a]
	SD	2.311	2.318	2.410	2.259	2.357
Sample 5	Mean	4.95[a]	4.78[a]	4.95[a]	5.03[a]	4.83[a]
	SD	2.392	2.316	2.325	2.323	2.358
Sample 6	Mean	5.09[a]	4.86[a]	5.04[a]	4.92[a]	4.95[a]
	SD	2.419	2.330	2.368	2.260	2.329
Sample 7	Mean	5.04[a]	4.82[a]	4.85[a]	4.86[a]	5.15[a]
	SD	2.335	2.428	2.285	2.353	2.309
F-ratio		0.596	1.926	0.753	0.513	1.353
Probability Value		0.734	0.073	0.607	0.799	.230

Mean with different superscript letter indicate significant difference (P<0.05)

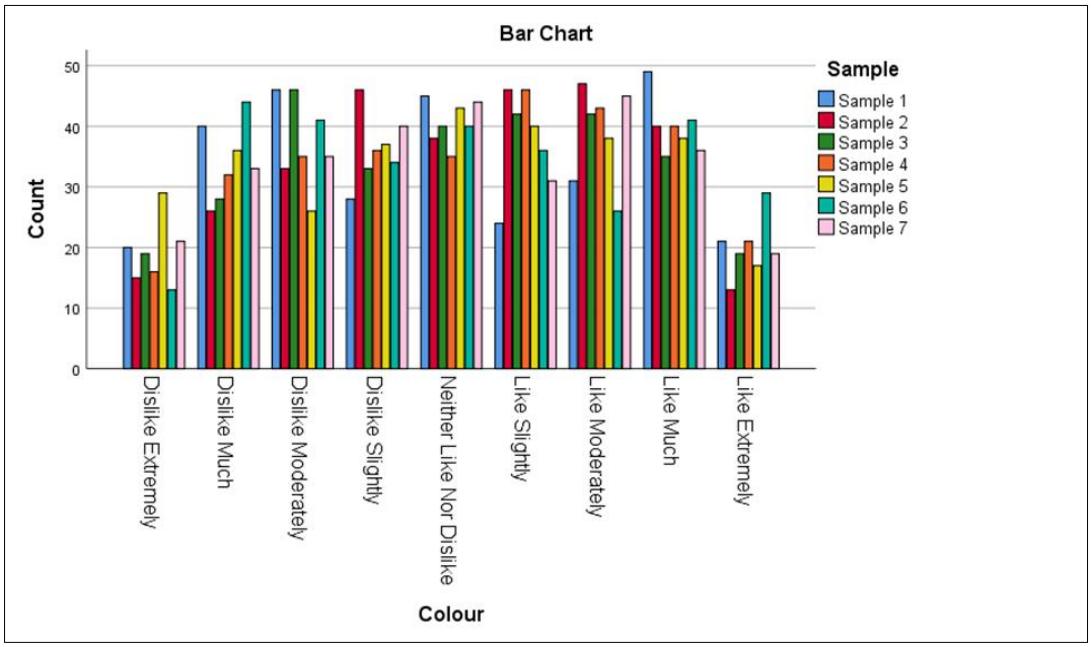


Figure 2 Color acceptability of the enriched aadun made from a blend of maize, soybean, and ginger flour

The sensory evaluation of the enriched aadun made from a blend of maize, soybean, and ginger flour is shown in Table 4 as a result. The substitution of soybeans and ginger at the various amounts of substitution that were looked at in this

study had a favorable impact on the sensory qualities of the samples. The snacks were identical in terms of their appearance, flavor, and scent. Additionally, there was no discernible difference between the enriched aadun samples and the aadun made entirely of maize flour in terms of overall acceptability, in terms of overall acceptability, flavor, and aroma, sample B, which contained 84.449% maize flour, 3.0% soybean flour, and 3.0% ginger flour, received the highest ratings. The enhanced flavor and aroma of the sample aadun can be attributed to the addition of more ginger flour (3%) to the composite flour mixture.

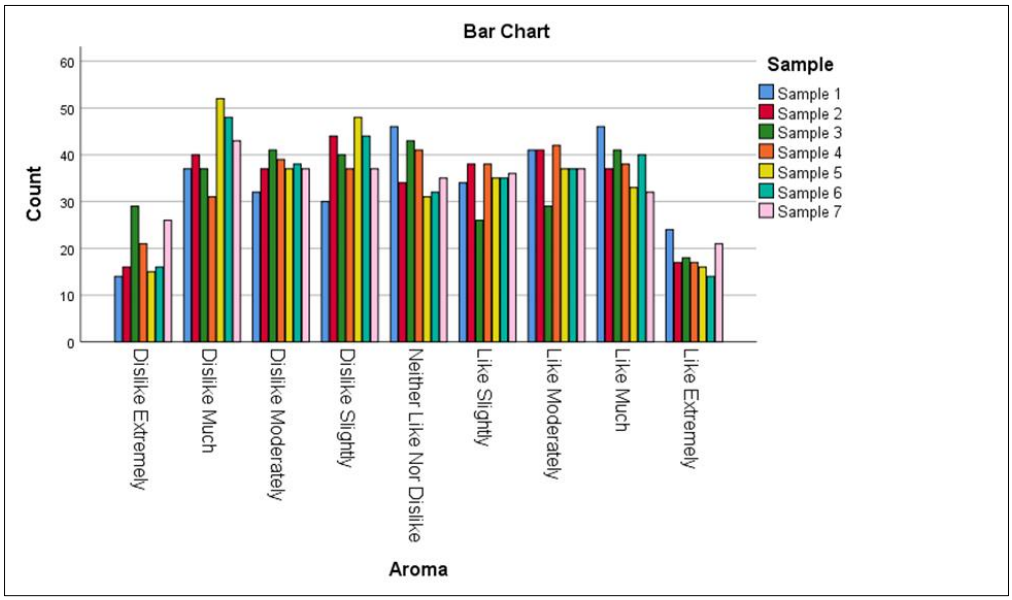


Figure 3 Aroma acceptability of the enriched aadun made from a blend of maize, soybean, and ginger flour

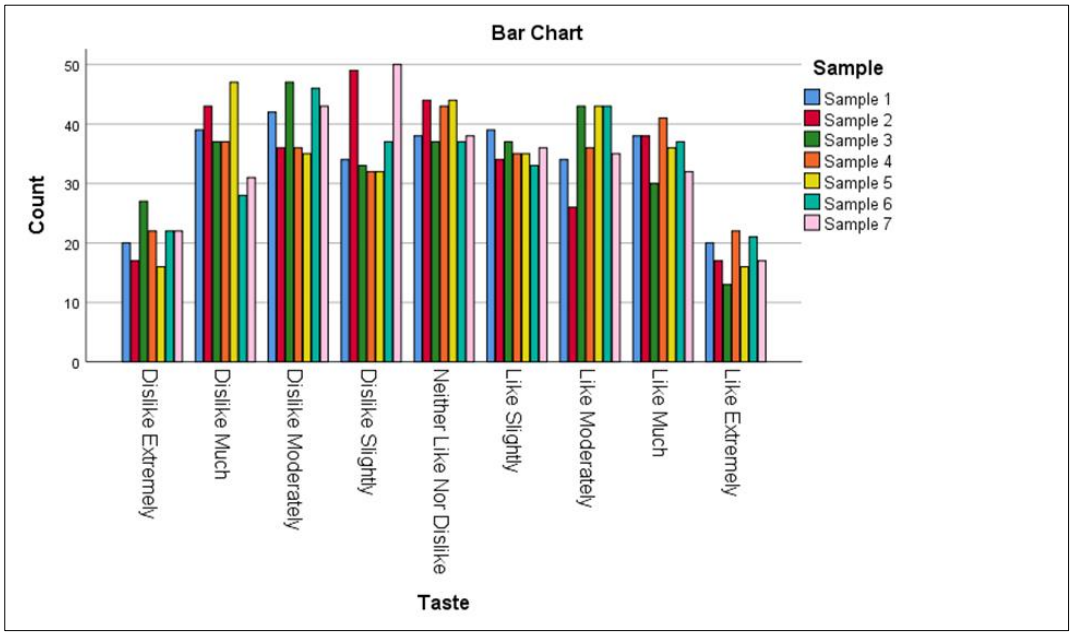


Figure 4 Taste acceptability of the enriched aadun made from a blend of maize, soybean, and ginger flour

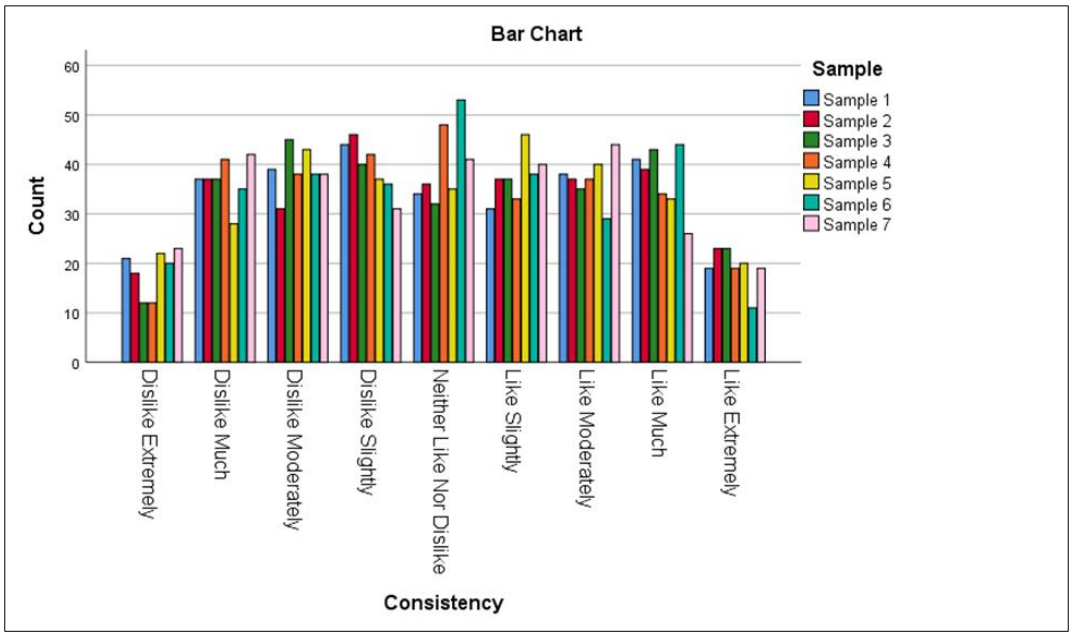


Figure 5 Consistency acceptability of the enriched aadun made from a blend of maize, soybean, and ginger flour

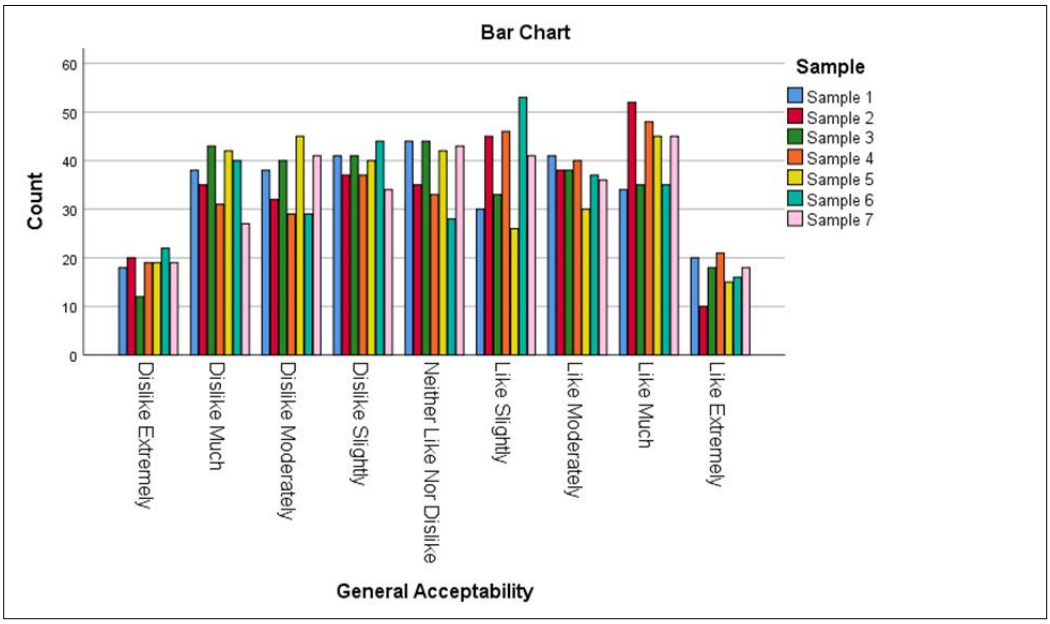


Figure 6 General acceptability of the enriched aadun made from a blend of maize, soybean, and ginger flour

4. Discussion

The investigation has demonstrated that the protein contents of the optimized flour blends increased significantly, ranging from 9.39% to 15.19%, with sample A having the highest (15.19%). This is evident from the proximate composition and mineral contents of the flour blends in Tables 1 and 2, respectively. These values were greater than the result for sample G (100 percent maize flour), which was obtained. The rise was caused by the addition of soybean flour. The findings showed that previous research (Singh et al., 2000) had found a comparable rise in the protein content of soy-composite flour mixes. According to Fagbemi et al. (2004), the majority of seeds from leguminous plants are nutrient-rich and contain a wide variety of amino acids. Akinola and Enuljugba (2017) also discovered that adding soybeans to diets high in carbohydrates increases the product's protein content. The ash concentrations of the improved flour mixes increased as well, varying from 1.09% to 1.59%. Ash is a sign of the mineral content of food, according to

Alabi and Anuonye (2007), and cereal meals with soy supplements have been found to be high in ash. The optimal flour blends had moisture percentages that were lower than 9.94% and varied from 6.65% to 6.98%. Obtained for the mixes of 100% maize flour. The samples' moisture levels were below the required threshold of 10% for flour (Ihekoronye and Ngoddy, 1985). Because the fiber levels of the optimized flour mixes were higher than those of 100% maize flour, the items made from them will have a stable shelf life. The addition of ginger flour to the flour mixes resulted in an increase in fiber content. The amount of fiber was adequate. Dietary fiber consumption for adult men and women should be 389 mg/day and 259 mg/day, respectively, according to Neha and Ramesh (2012). In comparison to 100% maize flour, the optimized flour blends had increased fat concentrations. The rise was caused by the addition of soybean and ginger flours. A good source of fat is soybeans. However, because the optimized flour blends contain more fat, the flour and the products derived from them are more likely to go rancid due to fat oxidation (Awolu et al., 2015). In comparison to 100% maize flour, the optimized flour blends had lower carbohydrate levels. The flour blends and the products derived from them are of greater nutritional quality since they have lower carbohydrate contents and higher protein contents.

The 100% maize flour had higher calcium and zinc contents than the optimized flour blends, according to Table 2's presentation of the optimized flour blends' mineral composition. In contrast, the optimized flour blends had higher sodium, potassium, iron, manganese, and phosphorus contents. According to Amanyunose et al. (2021), maize has a low salt concentration. Soybeans are high in sodium, potassium, iron, manganese, and phosphorus, according to research by Awolu et al. (2015). The rise in the mineral contents of the optimized flour blends was caused by the addition of soybean flour. According to Amanyunise *et al.* (2021), maize is an excellent provider of calcium and zinc. Soybeans, according to Corke and Wirlglay (2006), are high in phosphorus and manganese. In addition, ginger contains nutrients, according to Shakpo and Osundahunsi (2016). As a result, the mineral content of the optimized flour blends increased after the inclusion of soybean and ginger flour.

Table 5 displays the approximate composition of the enriched aadun meal sample. 14.52% of the protein was crude. This was more than the sample made with maize flour at 100%. The increase in protein value was caused by the substitution of soybeans in the flour mixture. According to Otunola et al. (2012), the addition of soybean to a composite flour made of maize and soybean increased the amount of protein in the product. The enriched aadun had a moisture level of 3.50%, which was lower than the 8.43% observed for aadun made entirely of maize flour. The food's shelf life is increased by the low moisture content, which serves to shield the food from microbial attack (Olapade et al., 2021). Additionally, it was discovered that the enriched aadun's ash concentration (2.79%) was higher than the aadun made entirely of maize flour (1.87%). Because soybean and ginger flours were added to the flour blends, the amount of ash increased. According to Akinbode and Origbemisoye (2020), ash content is a gauge of a food's mineral content. The fat level of the enriched aadun was 31.02%, compared to 23.78% for aadun made from 100% maize flour and 31.02% for aadun made from enriched flour. The enriched aadun had a larger fat content, which suggests that the snack can meet the daily energy needs of the tourists. A recommended daily energy value of 344 kcal was set by FAO/WHO in 1991. The enriched aadun had 0.70% dietary fiber, which was more than the 0.59% found in aadun made entirely of maize flour. According to Nassar et al. (2008) and Oluwatuyitan and Ijarotimi (2019), dietary fiber is crucial in preventing illnesses of the human digestive system. The amount of carbohydrates in the enriched aadun (47.47%) was less than the amount of carbohydrates in the aadun made entirely of maize flour (55.16%). The enriched aadun differs from the majority of local snacks, which are primarily starch-based and regarded as harmful due to their lower carbohydrate content (Adeleke & Okedeji, 2010).

According to Table 5, which details the results of the sensory evaluation conducted among visitors to Idanre Hill and Resort, the enriched aadun's sensory qualities were comparable to those of aadun made entirely of maize flour. As a result, the substitution of soybean and ginger had a good impact on the sensory attributes of the enriched aadun. However, the 3.0% level of ginger replacement in the enriched aadun was evaluated as having the best scent and flavor. Additionally, there was no discernible change in how well-liked the enriched aadun was by visitors at Idanre Hill and Resort. Both the traditional 100% maize-flour aadun and the enriched aadun were found to have the same levels of acceptance.

5. Conclusion

At varying levels of substitution, mixes of maize, soybean, and ginger flour were optimized. The flour mixtures were used to make aadun in order to increase the aadun's nutritional value. The substitution improved the items' nutritive value and sensory appeal. It was discovered that the substitutions reduced the moisture and carbohydrate contents of the enriched products while increasing the protein, ash, fat, and fiber levels. The boosted aadun's mineral content also dramatically increased. Iron, phosphorus, manganese, sodium, and potassium content all saw increases, whereas calcium and zinc concentration saw decreases. The goods' nutritional and organoleptic qualities have been improved through enrichment, which has increased their acceptability among visitors to the Idanre Hill and resort. According to

Liberato, Mendes, and Liberato, improving the nutritional value of a local snack at tourist places will give visitors memorable and genuine culinary experiences. By imparting their excellent travel experiences to other travelers in 2020, they will develop into devoted and trustworthy ambassadors.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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