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Nutritional Characteristics and Organoleptic Properties of Cassava Flour (Lafun) Enriched With Sesame Seed Flour

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Abstract

Lafun is one of the major food products of fermented cassava that is regularly consumed in many parts of West Africa. It has low nutrients in terms of protein, vitamins and mineral content. The limitations of cassava flour (lafun) as other cassava products include low protein content, low minerals, and vitamins and the presence of cyanide toxicity. In previous studies, enriching flours with sesame seed flour significantly improves the proximate, micronutrient composition and functional properties of the flours. The aim of this study is to assess the nutritional characteristics and organoleptic properties of cassava flour (lafun) enriched with sesame seed flour. Enriched lafun flour samples were prepared by thoroughly mixing the lafun and sesame seed flour in ratios 95:5, 90:10, 85:15 and 80:20 respectively. The samples underwent chemical and sensory evaluations using standard methods of AOAC. Analysis of variance was performed to calculate the significant difference between means, and multiple range test (Tukeys Least Significant Difference) was conducted on the results obtained. Level of significance was set at $p<0.05$. The results showed that the enrichment significantly increased the protein content, ranging from 5.2% to 7.60%, compared to the control sample with 1.160%.The hydrocyanic acid content was reduced from 0.58 mg/100g in the control lafun to a range of 0.082 mg/100g to 0.058 mg/100g in the enriched samples. Tannin content varied significantly among the samples, with sample 95:5having a lower value than other samples. Moreover, sample 95:5 had the lowest mean values for phosphorus, sodium, potassium, and magnesium, while sample 80:20 had the highest mean values for these minerals. Sample 95:5 generally showed higher values for phenolic content and antioxidant activity, while Sample 80:20 consistently had the lowest mean values for phenolic content, flavonoid content, and antioxidant activity. Sensory evaluation revealed that the sample enriched with 20 g of sesame seed flour had a lower appearance score. Overall, the control sample was rated as the best in terms of overall acceptability, followed closely by the sample enriched with 5 g of sesame seed flour. Therefore, the optimal ratio of lafun to sesame seed flour for the best chemical and sensory properties was determined to be 95 g of lafun flour with 5 g of sesame seed flour. Based on the findings of this study, incorporating sesame seed flour into lafun resulted in improved quality parameters, particularly in terms of nutritional and functional properties. Samples 95:5 and 90:10 exhibited desirable properties, suggesting their suitability for consumption .It has the potential to enhance protein nutrition and help mitigate the risks of Protein Energy Malnutrition in populations with limited access to animal protein sources.

Keywords: Sesame seed, chemical, functional Properties, sensory evaluations

Introduction

Root and tuber crops are the major important food crops in Africa. They are grown in varied agro-ecologies and production systems ranging from highland densely populated regions to lowland drier areas prone to droughts or floods. These crops account for about 95% of the total root and tuber crops production in Africa and produce more than 240 million tons annually on 23 million hectares (IITA, 2015).

Cassava is one of the world's most important food crops, with annual global production at approximately 276 million metric tons (MT) in 2013. The top producing countries globally in 2013 were: Nigeria (accounting for 19% of the total), Thailand (11%), Indonesia (9%), Brazil (8%) and the Democratic Republic of Congo (6%). Global demand for the commodity has been growing significantly between 2004 and 2013 because of its appeal as a food security crop for growing populations in emerging markets, and the growing demand for industrially processed cassava products. Africa accounts for less than 1% of total exports and the cassava production space is dominated by smallholder farmers (25% women). The root crop is a source of livelihood for at least 300 million people. Virtually all cassava (90%) produced in Africa is used as a staple food for human consumption, providing calories for ~500 million people and constituting ~37% of the population's dietary energy requirements (Ukeje et al., 2017).

Nutritionally, cassava is a major source of energy in the form of starch and can be consumed in various forms. However, the roots of the cassava contain cyanogenic glycosides that can potentially release cyanide ions which is toxic to man as they interfere with the functioning of certain organs and enzymes (Cliff et al. "Konzo 2011). *Lafun* is one of the major food products of fermented cassava that is regularly consumed in many parts of West Africa. It has low nutrients in terms of protein, vitamins and mineral content Sesame (*Sesamumindicum L.*) also known as sesamum or beniseed, is a member of the family Pedaliaceae, and one of the most ancient oilseed crops with a high level of antioxidants (Bourdouxet al. 1982). In Nigeria, the seeds are fried or used to produce soup for human consumption (Alobo, 2001; Abu-Jdayil et al., 2002). Uaboi et al., (2008) suggested that fermented Sesame seeds could be used as a soup condiment. Sesame has been valued as a healthy food additive preventing diseases. Its nutraceutical uses include cancer prevention (Myristic acid), prevention of heart disease (Sesame) and antioxidant, hepatoprotective (lecithin). It had been observed that the development of a simple processing method of enhancing the nutritional content of lafun will improve and secure its existence in the food value chain. The aim of this study is to evaluate the nutritional, functional, physicochemical and organoleptic properties of Lafun flour enriched with sesame seed.

Problem Statement

The limitations of cassava flour (*Lafun*) as other cassava products include low protein content, low minerals, and vitamins and the presence of cyanide toxicity. Cassava causes toxicity through hydrolytic breakdown and releases hydrocyanic acid. However, the glycosides present can be reduced to a safe level by an advanced method of processing. Efforts have been made to address the protein Inadequacy of cassava products including lafun. One possible solution is the incorporation of Sesame into cassava products.

Justification for the Study

In previous studies, enriching flours with sesame seed flour significantly improves the proximate, micronutrient composition and functional properties of the flours. Sesame as a valuable seed is said to have beneficial significance, as it is a rich source of many essential nutrients that have beneficial and have a positive effect on human health. Enriching lafun with sesame flour will reduce the risk of malnutrition.

Research Question

The Research Question is:

What are the nutritional characteristics and organoleptic properties of cassava flour (lafun) enriched with sesame seed flour?

Objective of the Study Main Objective

The main objective of this study was to evaluate the nutritional, functional, physiochemical and organoleptic properties of lafun flour Enriched with sesame seed.

Specific Objectives

The specific objectives of this study were to:

1. Assess the functional attributes of *lafun* flour enriched with sesame seed flour.
2. Determine nutritional Composition (proximate, mineral and antinutrient) composition of *lafun* flour enriched with Sesame seed flour
3. Assess the Consumer acceptability of amala lafun enriched with sesame seed flour.

Methodology

Study Setting

The University of Ibadan Main campus

Study Design

This is a laboratory-based study aimed atevaluating the nutritional, functional, physiochemical and organoleptic properties of Lafun flour Enriched with sesame seed.

Study Population

The study population are the trained panellists who are both undergraduate and postgraduate students of the University of Ibadan

Inclusion Criteria

- All consenting undergraduate and postgraduate students of the University of Ibadan
- Full time undergraduate and postgraduate students of the University of Ibadan
- Undergraduate and postgraduate students of the University of Ibadan who consumes *lafun* regularly

Exclusion Criteria

- Non-consenting undergraduate and postgraduate students of the University of Ibadan
- Part-time undergraduate and postgraduate students of the University of Ibadan

Sample Size and Sampling Techniques

The sensory evaluation was comprised of twenty (20) panellists who eat lafun regularly. Coded samples will be evaluated for the sensory attributes of colour, taste, flavour, textural quality (smoothness) and overall acceptability, using a 9-point hedonic scale (where 1 = dislike extremely, 5 = neither like nor dislike and 9 = like extremely). Water and tissue paper were provided to aid the evaluation process. The panellists were requested to wash their hands before the start of the sensory evaluation exercise and rinse their mouths using a slice of cucumber and water before and after evaluating the taste and overall acceptance of each sample. Simple random sampling technique was used to select the participants.

Sample Collection and Preparation

Raw material: Cassava and Sesame was purchased at Bodija Market, Ibadan Oyo State. The cassava roots were peeled manually with a knife. The peeled cassava roots was washed and diced. It was divided into three batches. The first batch was steeped for 72 hours (3 days) to ferment. The water used in steeping the first batch of cassava for 3 days was used to ferment the second batch of cassava and this water stands as a starter culture for fermenting subsequent batches of cassava. The steeped cassava was then oven-dried and milled to get the fermented cassava flour (lafun). (Adebayo-Oyetoro et al., 2017).

Processing of Germinated Sesame Seed Flour

The method used in producing the black sesame seed flour is as described by Makinde and Akinoso, (2013). At room temperatures (25±2°C), dehulled seeds of sesame seeds was sprouted for five days which was be kept in trays lined with wet filter paper. The sprouted seeds were exposed to a hot air oven to be dried at 40°C to a constant weight. Milling operation was done on the samples using an attrition mill so as to pass through a 0.5mm sieve.

Flour Formulation

Different ratios of Lafun flour and sesame seed flour was formulated as follows. Control=100:0 of Cassava flour
Sample A = 95:5
Sample B = 90:10
Sample C = 85:15
Sample D = 80:20

Analysis

Proximate Analysis

All determinations are made in triplicate

Proximate Analysis

All measurement wasmade in duplicate

Moisture Content: This parameter was determined according to the methods of AOAC(2000).

Crude Protein Determination: The crude proteins in the samples will be determined by the routine semi-micro Kjeldahl procedure (AOAC 2000)

Ash Content: The method of AOAC (2000) will be used.

Crude Fibre: The crude fibre will be determined using AOAC (2005)

Carbohydrate Content: Carbohydrate content was determined by difference AOAC (2005)

Physio-Chemical Analysis

Water Absorption Capacity: Water absorption capacity was carried according to AOAC (2000)

Determination of Residual Cyanide: This was determined as described by (O' Brien., et al 1991).

pH determination: The pH of the flour samples was determined with a pH meter (Hanna Instruments, Model 18521) at 20°C AOAC (2000)

Bulk Density: This will be done in accordance with AOAC (2000)

Titratable acidity (% lactic Acid): Titratable acidity was determined using AOAC (2000)

Pasting Analysis: Pasting properties were determined using Rapid Visco Analyzer (RVA) (Newport Scientific Instruments) Warriewood, Australia.

Mineral Analysis

The concentrations of the minerals in the Lafun flour, sesame flour and enriched sample flour was determined by Atomic Absorption Spectrophotometric method (AOAC, 2005). Vanado-molybdate colorimetric method will used to determine phosphorus (AOAC, 2005). All the measurements were made in Triplicate.

Determination of Anti-nutritional Factors

Saponin Determination

Saponin content was determined using a Spectrophotometric method described by (Brunner JH 1984).

Tannin Determination

Total tannin content was determined by the Spectrophotometric procedure described by (AOAC, 1984)

Oxalate Determination

The oxalate content of the samples was determined using the method described by (AOAC, 2005).

Phytate Determination

The oxalate content of the samples was determined using the method described by (AOAC, 2005).

Cyanide Determination

The total cyanide (mg/100g) was determined by the standard method of (AOAC, 2000).

Results

Proximate Analysis

The given table presents the mean values and standard deviations of various nutritional components in four different samples with the control.

Table 1: Proximate composition (g/100 g) of enriched lafun and Sesame Seed Flour

Parameter	Fat	Protein	Moisture	Crude fibre	Ash	CHO
A	2.33± 0.57^{b}	5.25±0.04^{d}	14.3±0.57^{a}	0.39±0.00^{d}	0.80±0.10^{a}	76.8±1.11^{a}
B	3.00±0.0^{b}	5.77±0.04^{c}	13.0±0.50^{b}	0.43±0.00^{c}	0.70±0.17^{ab}	77.08±0.48^{a}
C	3.33±1.15^{b}	6.52±0.04^{b}	12.8±0.28^{b}	0.49±0.00^{b}	0.56±0.05^{b}	76.2±1.01^{a}
D	5.33±0.57^{a}	7.61±0.03^{a}	11.6±0.57^{c}	0.57±0.02^{a}	0.66±0.05^{ab}	74.1±1.03^{b}
CT	0.44	1.16	13.01	0.63	0.84	82.92

Mean values along the same column with different superscripts are significantly different (p<0.05)

Table 2: Mineral Composition (mg/100 g) of enriched Lafun and Sesame Seed Flour

Parameter	P	Na	K	Mg	Ca	Zn	Cu
A	35.7± 0.42^{e}	707.2±1.1^{e}	488.0±5.1^{e}	312.6±0.1^{d}	23.26±0.5^{d}	0.25±0.0^{d}	0.00±0.0^{c}
B	45.5±0.61^{d}	811.5±2.96^{c}	519.3±2.34^{d}	322.6±0.54^{b}	32.8±0.52^{c}	0.21±0.0^{e}	0.01±0.0^{c}
C	56.5±0.87^{c}	1080.7±8.42^{b}	550.2±2.07^{c}	311.9±1.91^{d}	19.18±0.4^{e}	0.26±0.0^{c}	0.00±0.0^{c}
D	60.8±0.96^{b}	1171.7±4.95^{a}	590.8±1.69^{b}	315.9±2.31^{c}	39.6±0.44^{b}	0.21±0.0^{e}	0.01±0.0^{c}
CT	3.21±0.0	406.0±0.00	225.2±0.00	208.0±0.00	21.02±0.00	0.35±0.00	0.01±0.00

Table 3: Antinutrient composition (g/100 g) of enriched Lafun and Sesame Seed Flour

Parameter	Tannin	Phytate	Oxalate	HCN
A	5.77±0.31^{a}	1.85±0.05^{a}	1.53±0.01^{a}	0.15±0.00^{a}
B	5.84±0.71^{ab}	1.92±0.02^{a}	1.630±0.01^{b}	0.13±0.00^{b}
C	5.71±0.17^{bc}	1.72±0.06^{b}	1.50±1.02^{b}	0.11±0.05^{c}
D	5.92±0.52^{c}	1.5667±0.03^{c}	1.5247±0.01^{b}	0.08±0.00^{c}
CT	5.66±0.02^{a}	1.96±0.02	2.57±0.025^{c}	0.16±0.00^{a}

Mean values along the same column with different superscripts are significantly different (p<0.05)

Table 4: Physiochemical properties of enriched Lafun and Sesame Seed Flour

Parameter	WAC(g/100g)	Swelling Capacity(g/g)	Solubility(g/ml)	Bulk Density(g/ml)	TTA
A	96.3±1.52a	11.6±0.31a	24.1±0.38a	0.97±0.01a	0.03±0.2a
B	94.8±1.10ab	11.16±0.0ab	23.6±0.29ab	0.95±0.0ab	0.17±0.2a
C	93.0±1.0bc	11.0±0.4b	23.25±0.2bc	0.93±0.0b	0.04±0.01a
D	91.0±1.73c	10.5±0.05c	22.8±0.43c	0.89±0.0c	0.19±0.17a
CT	143.0	11.61	27.04	1.22	0.02273

Mean values along the same column with different superscripts are significantly different (p<0.05)

Table 5: Antioxidant composition (mg/100 g) of enriched Lafun and Sesame Seed Flour

Parameter	Phenolic	Flavonoid	FRAP
A	0.722±0.02^{a}	0.13±0.01^{a}	18.77±0.31^{a}
B	0.705±0.34^{a}	0.11±0.01^{a}	17.81±0.71^{ab}
C	0.696±0.15^{a}	0.9±0.01^{b}	16.70±1.16^{bc}
D	0.619±0.04^{b}	0.63±0.02^{c}	15.91±0.51^{c}
CT	0.87 ± 0.49	0.60 ± 0.00	4.44 ± 0:06

Mean values along the same column with different superscripts are significantly different (p<0.05)

Table 6: Organoleptic properties of enriched AmalaLafun with Sesame Seed Flour

Parameter	Colour	taste	Appearances	Flavour	texture	Overall acceptabilit
A	7.65±0.49^{a}	7.25±0.71^{b}	7.40±0.68^{b}	7.75±0.44^{a}	7.70±0.47^{b}	7.45±0.61^{b}
B	6.25±0.12^{b}	6.35±1.09^{c}	6.40±1.14^{c}	5.60±1.04^{b}	6.00±1.29^{c}	5.75±0.79^{c}
C	4.85±0.93^{c}	4.75±0.78^{d}	4.70±0.86^{d}	5.05±0.68^{c}	3.90±0.71^{d}	4.40±0.68^{d}
D	4.20±0.61^{d}	3.65±0.88^{e}	4.25±0.85^{d}	3.75±0.64^{d}	3.35±0.58^{e}	3.80±0.83^{e}
CT	8.00±0.56^{a}	8.30±0.57^{a}	8.10±0.44^{a}	7.50±0.68^{a}	8.25±0.55^{a}	8.10±0.44^{a}

Discussion

Overall, the findings suggest that enrichingLafun with sesame seed flour resulted in variations in nutritional composition, water absorption capacity, swelling, solubility, total titratable acidity, pH, phenolic content, flavonoid content, antioxidant activity, and sensory attributes. Sample A (95:5) generally exhibited favorable characteristics across these parameters, while Sample D consistently displayed lower values.

Conclusion

Based on the findings of this study, it is recommended to incorporate sesame seed flour into Amala lafun to enhance its nutritional and functional properties. Samples A (95:5) and B (90:10) showed promising functional properties, indicating their suitability for consumption. The addition of sesame flour to lafun can play a significant role in addressing protein deficiency and associated health issues, such as Protein Energy Malnutrition (PEM), particularly in developing regions.

Sesame flour, known for its high protein content, can serve as a valuable alternative protein source, especially in areas with limited access to animal-based proteins. By incorporating lafun-sesame flour into diets, it has the potential to improve protein nutrition and help reduce the risks of PEM in populations with limited access to animal protein sources. These findings highlight the potential benefits of incorporating sesame seed flour into cassava-based products like lafun to enhance their nutritional value and contribute to addressing protein-related health concerns.

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