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Physical Characteristics and Proximate Composition of *Manihot Esculenta* and *Sesamum Indicum* L. Flour Blends

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Abstract

This study evaluates the physical characteristics and proximate composition of cassava flour and sesame seed flour blends. Cassava roots (3750 g) were processed to obtain 80% cassava pulps, 20% peel and ∼41% flours while sesame seed (2250 g) yielded ∼69% cotyledon, ∼22% hulls and ∼10% flour. Four different samples were initiated from the blends of cassava and sesame seed flour respectively, viz: 90% cassava flour with 10% sesame seed flour; 70% cassava flour with 30% sesame seed flour; and 30% cassava flour with 70% sesame seed flour, with 100% CF and SSF as control. The moisture content of the blends ranged (7.51-15.04) %, protein (2.29-28.47) %, ash (2.78-10.84) % and crude fibre (0.31-0.95) %. It was observed that the nutritional composition of the blends increased due to the inclusion of sesame seed flour with 70% sesame seed flour inclusion showing the highest significant in term of protein, ash and crude fibre.

Keywords: Sesame Seed Flour; *Manihot Esculenta*; Yield; Proximate Composition; Protein Content; Crude Fibre

Introduction

Cassava, botanically known as *Manihot esculenta* Crantz is a perennial crop in the tropical America introduced into Africa by the Portuguese [1]. Currently, cassava supports the livelihood of 800 million people in the World [1]. Cassava often planted in-between perishable and semi-perishable crops and can be gathered/harvested between six months and three years after propagation. The bitter cassava contains a toxic substance (cyanogenic glucosides) that releases cyanide into cassava roots. The toxic substances are quite reduced during processing through different techniques such as grating, drying and fermenting [2].

Manihot esculenta Crantz is inexpensive and abundant source of carbohydrates, with high calories in low- and middle income countries. However, nutritional composition of cassava roots differs base on the variety/cultivar, age, soil conditions, climate, and location. According to Okwuonu et al. [3]. reported that cassava roots and its products contain low amount of protein and fat content. In line with this, people who regularly consume cassava products as staple food needed extra protein to ascertain the daily recommended intake as reported by 2025-2030 DGAs, so as to avoid malnutrition.

Sesame seed (*Sesamum indicum* L.) belongs to leguminous and sesame genu, Pedaliaceae. It is propagated in India, Sudan, China, Burma, as well Malaysia [4]. The seed has hollow stem or white pith with an erect annual herb (height, 60 -150 cm). The leaves are rectangular/ovate in shape with a slightly hairy surface, 3-10 cm long, 2.5-4 cm wide [5]. Sesame seeds can either be black or white, called based on its colour [6]. Several countries like India, Sudan, Myanmar, China, and Tanzania are global producers with geometrical increase in production in African countries [7].

Sesame seed is abundance in lipid, protein, minerals (iron and calcium), vitamins, and dietary fiber. Its oil content is predominant in unsaturated fatty acids, fat-soluble vitamins, amino acids, etc. Studies suggest that sesame seeds contain 21.9% and 61.7% protein and fat respectively [8]. Therefore, enriching with cassava flour (CF) will enhance its nutritional profile. Hence, the study is to assess the effect of SSF on the nutritional composition of cassava flour (CF).

Materials And Methods

Source Of Materials

Cassava tubers and sesame seeds were obtained from Kings market, Akure, Ondo State respectively.

Preparation of Cassava and Sesame Seed Flour

Production Of Cassava Flour (CF)

The tubers were peeled with stainless-steel knife, washed, cut into small pieces and evenly dried on a surface in the sun. The dried chips were milled using hammer mill, sieved with a mesh sieve and package in air tight container for further analysis [9].

Production Of Sesame Seed Flour (SSF)

The method of Folorunsho and Ogunjinmi [10] with slight modification was used in the preparation of sesame seed flours. The seed was thoroughly washed in clean water, dehulled and oven -dried at 600C for 8 h. The dried seed was milled and defatted with hexane, re-dried, re-milled and sieved to obtained defatted sesame seed flours.

Formulation Of Blends

Five different samples of sesame seed flour and cassava flour blends were generated viz: CF (100% cassava flour); SDF (90% cassava flour with 10% sesame seed flour); CSM (70% cassava flour with 30% sesame seed flour); PQZ (30% cassava flour with 70% sesame seed flour); SSF (100% sesame seed flour).

Physical analysis of cassava tuber and sesame seeds

Percentage Pulps and Peels of Cassava Roots

Percentage pulps and peels were carried out by the method reported by Omosuli et al. [11] with slight modification. The cassava roots were weighed with a weighing scale, peeled with knife and washed with clean tap water. The pulps and peels recovered were weighed separately and used in computing the percentage pulps and peel.

$$\text{Percentage pulps} = \left(\frac{\textit{weight of cassava pulps}}{\text{weight of cassava roots}}\right) \times 100$$

$$\text{Percentage peels} = \left(\frac{\textit{weight of cassava peels}}{\text{weight of cassava roots}}\right) \times 100$$

Percentage Cotyledon and Hull of Sesame Seeds

The sesame seeds (SSF) were soaked in water to ease peeling. The peeled cotyledons and the hull recovered were weighed separately.

$$\text{Percentage cotyledons} = \left(\frac{\textit{weight of cotyledons}}{\text{weight of sesame seeds}}\right) \times 100$$

$$\text{Percentage hulls} = \left(\frac{\textit{weight of hulls}}{\text{weight of sesame seeds}}\right) \times 100$$

Percentage yield of cassava roots and sesame seed flours

The total yield of flours was determined by weight of flour obtained from the whole cassava roots and sesame seeds.

$$\text{Percentage yield} = \left(\frac{\textit{weight of individual flours}}{\text{weight}}\right) \times 100$$

Chemical Analysis

Determination of proximate composition and caloric value

The flour samples were analysed for their moisture, crude protein, crude fat, ash and crude fibre contents according to the method described by [12].

Total Carbohydrate

Total carbohydrate was calculated by difference according to the method of Osborne and Voogt [13].

Determination of Calorie Content

The calories were estimated using AOAC (2021). The calorific values were obtained as shown below.

$$\text{Calorie value (kcal/100g)} = (\text{fat content } \times 9 \ \text{ protein content} \times 4 \ + \text{carbohydrate} \times 4\ )$$

Statistical Analysis

The analysis was done in triplicates. The statistically significant of the observed difference were evaluated using analysis of variance (ANOVA) at 5% level of significant.

Result and Discussion

Physical Characteristics of Cassava Roots and Sesame Seeds

The weight of cassava roots and sesame seeds used is presented in Table 1. The weight of cassava root used was 3750 g compared to the weight of sesame seed 2250 g. During peeling, the cassava pulp obtained was 3000 g, with total peels of 750 g. Likewise, after decortication of sesame seed, 1750 g of sesame cotyledon was obtained with 800 g of hulls.

Table 1: Weight of Cassava Root and Sesame Seed

Samples	Cassava	Peels/hulls	Pulp /cotyledon	
	roots/sesame	**obtained**	**Obtained**	
	seeds used			
weight of cassava (g)	3750	750	3000	
Weight of sesame seeds (g)	2250	800	1750	

Percentage Analysis of Cassava Roots and Sesame Seeds

The percentage analysis of cassava roots and sesame seeds are presented in Fig 1. The percentage cassava pulps, peels and flour yield are 80%, 20% and 41.33% while, the percentage yield of sesame flour, cotyledon and hulls are 9.8%, 68.6% and 21.6% respectively. The percentage cassava pulps were high (80%), this might be due to the careful peeling of cassava roots. The percentage pulps and peels were comparable to the 77.90% and 22.10% respectively presented by Omosuli et al. [11]. After processing, the percentage yield of cassava flour obtained was low, this might be attributed to the processing method such as peeling, drying and sieving. This agrees with the report of Omsuli et al. (2017) who observed reduction in yield of flour. Furthermore, high percentage of sesame cotyledon was recorded due to careful washing and sieving of the viable seeds and the low yield of sesame flour obtained after processing was as a result of the dehulling, sieving and defatting.

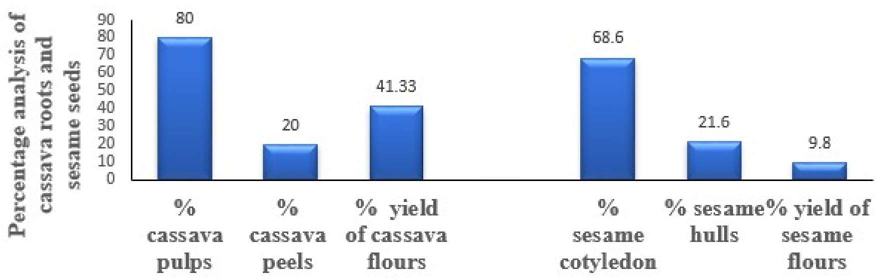

Figure 1: Percentage Analysis of Cassava Root and Sesame Seed.

Moisture Content

Moisture content of the flour blends ranged from (7.51-15.04) % with the sample SDF (90% cassava flour with 10% sesame seed flour) having highest moisture content and CSM and PQZ had the lowest moisture content (Fig 2a). The range obtained was comparable to 11.6-14.3% reported by Folorunsho and Ogunjimi [10] for enriched lafun and sesame seed flour. There was no significant difference (p<0.05) between CF and SSF as well as CSM and PQZ respectively. The moisture content obtained for 100% CF was lower than 12.35% cassava flour by Imoisi et al. [9]. However, it was observed that the moisture content was lower than the acceptable range (12%) except sample SDF that was a little higher. This indicate that the flour blends will have a better stability and prolong shelf life [14].

Protein Content

Fig 2b shows result of protein content of cassava and sesame seed flour blends. The protein content ranged between 2.29% and 28.47%. The increased observed in the flour blends was attributed to the proportion of SSF in the blends, with sample PQZ showing the highest level of protein content. The range obtained in this study was higher than 5.25-7.61% reported by Folorunsho and Ogunjimi [10] for lafun enriched with sesame seed flour which might be attributed to the cultivars, location and processing methods. The lowest value of protein content reported for 100% CF indicate that cassava belongs to root and tuber crops that is abundance in carbohydrate but low in protein [15]. The high protein content in the blends will enhance the value-added product as well expanding sesame seed flour usage in food product development. High protein content is important in functional properties such as water absorption capacity and foaming properties [14]. It can be of important in low-income country suffering from malnutrition.

Fat Content

Fig 2c presented the percentage fat content of cassava and sesame seed flour blends. The fat content ranged between 1.06-8.73%. There was significant difference (*p>0.05*) among the samples. The range was comparable to the value of *lafun* enriched with sesame seed flour by Folorunsho and Ogunjinmi [10]. The fat content increases as level of sesame seed flour increased where, SSF and CF had the highest and lowest fat content respectively. This is similar to the report of Awolu et al. [16]. Flour with significant fat content will reflect its ability to enhance flavour as well improved the product palatability to which it is introduced.

Ash Content

Ash content of cassava and sesame seed flour blends are presented in Fig 2d. There was an increased in ash content as the level of SSF increases. The value ranged from 2.78-10.84%, with PQZ and CF having highest and lowest values respectively. Sample SDF and CSM were not significantly difference (p<0.05) but differed significantly (p>0.05) from PQZ (30% cassava flour with 70% sesame seed flour). 100% CF had ash content higher than 0.60% fufu flour reported by Omosuli et al. [11] but comparable with the report of Imoisi et al. [9] for cassava flour.

Crude Fibre Content

The values ranged from 0.31-0.95% as shown in Fig 2e. The range was comparable to 0.39-0.57% reported by Folorunsho and Ogunjinmi for enriched lafun and sesame seed flour but lower than the value recorded by Akinyele et al. [17]. The fibre contents were appropriately improved as sesame seed flour was added into each level of substitution. No significant difference (p<0.05) observed in SDF and CSM but 70% sesame seed flour substitution shows high level of significant compared to other blends. Crude fibre is the insoluble part of food that contributes to the bulkiness of stool as well help in bowel movement.

Carbohydrate Content

Carbohydrate content ranged from 43.62-83.48% with 100% cassava flour (CF) and 100% SSF showing highest and lowest value respectively with significant difference (p>0.05). The carbohydrate content decreased with increases in the level of sesame seed flour (Fig 2f). The decrease observed was related to sesame seed flour higher in protein content, which in turn lower carbohydrate content of its blends. This is supported by the report of Oluwole et al. (2019) who reported similar trend. The carbohydrate content exhibited by PQR substituted with 70% sesame seed flour showed lower value than 20% sesame seed flour substation reported by Folorunsho and Ogunjimi (2025) for cassava flour (lafun) enriched with sesame seed flour.

Energy Value

The energy value of the flour blends ranged between 328.51-368.31kcal/ 100 g with significant difference ($p<0.05$) between CSM and SSF but differed significantly ($p>0.05$) from PQZ (Fig 2g).

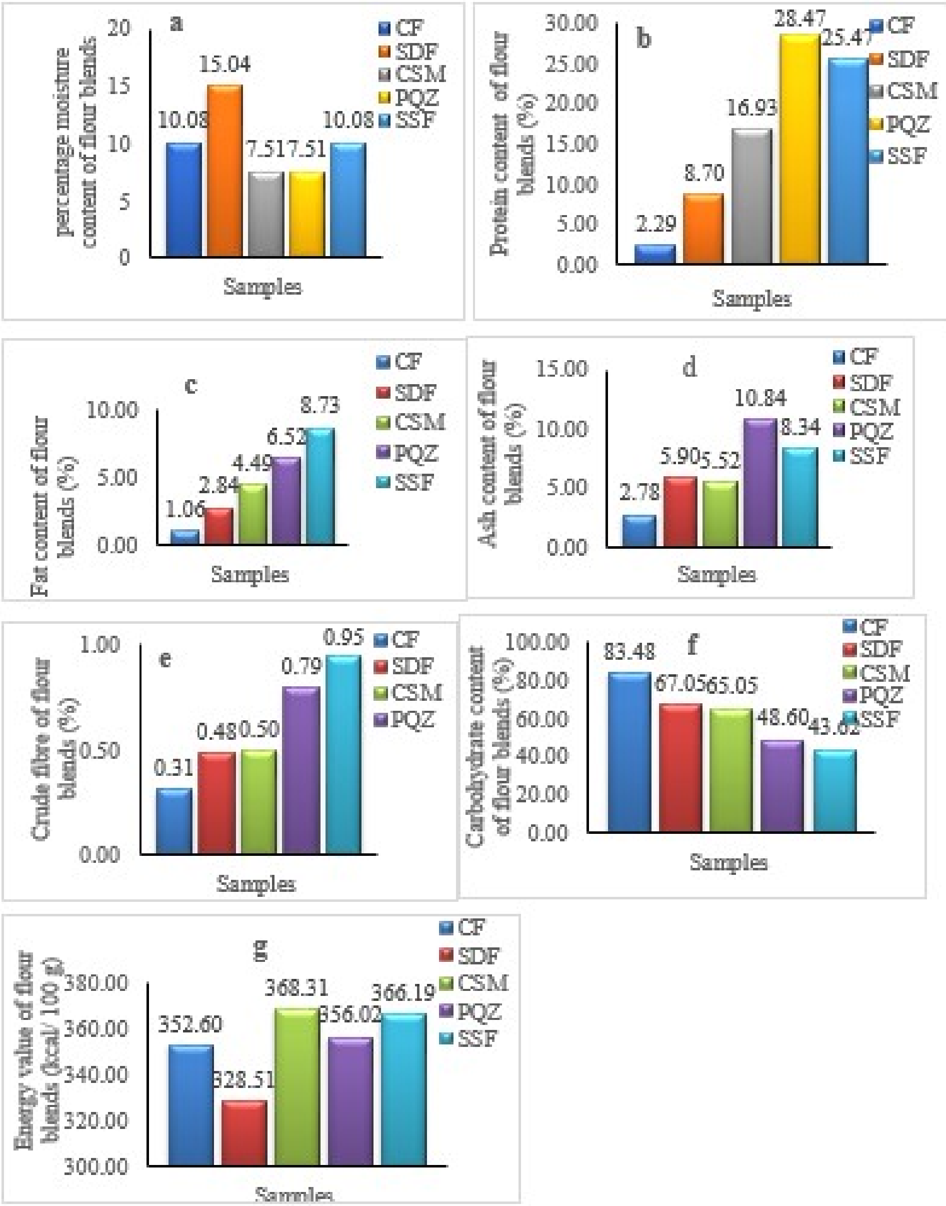

Figure 2 (a-g): Percentage Proximate Composition and Energy Value of Flour Blends.

Values are mean ± standard deviation from triplicate determinations. Key: CF- 100% cassava flour; SDF-90% cassava flour with 10% sesame seed flour; CSM-70% cassava flour with 30% sesame seed flour; PQZ-30% cassava flour with 70% sesame seed flour, SSF- 100% sesame seed flour.

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