



Proximate Composition and Microbial Analysis of “Abacha” Fortified with Groundnut and Coconut Flour

¹Ogundowole, O., ¹Omosuli, S.V., ²Aje, O.T., and ²Omotoye, A.C.

¹Department of Food Science and Technology, ²Department of Hospitality Management Technology, Rufus Giwa Polytechnic, Owo, Nigeria
Email: bodundowole@gmail.com

ABSTRACT

Abacha is a cassava-based food product made in the form of irregular lumps of partly gelatinized starch grits. Abacha was enriched with varying proportions of groundnut-coconut flour (100, 80:10:10, 70:15:15, 60:20:20 for Samples A, B, C and D respectively) to produce abacha groundnut-coconut. Proximate and microbial analyses were determined using standard methods. The proximate composition of abacha meals ranged from 7.67 to 8.86%; 1.03 to 23.46%, 0.24 to 7.89%, 1.26 to 4.02%, 1.08 to 7.52% and 48.25 to 88.72% for moisture, crude protein, fat, ash, crude fiber and carbohydrate respectively. There were increase in these values as the level of groundnut-coconut flour substitution increased and significant differences ($p < 0.05$) in values obtained for moisture, protein, fat, ash and crude fibre contents. The mean total aerobic plate count ranged from 4.8×10^{12} to 7.7×10^{11} , coliform count range from 9.5×10^{10} to 3.5×10^{11} and fungal count range from 6.6×10^9 to 3.7×10^{10} . Based on the specifications by International Commission for Microbiological Specification for Foods (ICMSF), the level of contaminations was unacceptable and could pose health challenge. Hence fortified abacha is recommended as safe, nutritious and acceptable food product that can enhance food and nutrition, security among cassava consuming population but should be produced in a more hygienic way.

Introduction

Cassava (*Manihot esculentus*) is a major staple food in the developing world, providing a basic diet for over half a billion people. It is one of the most drought tolerant crops, capable of growing on marginal soils. Nigeria is the world's largest producer of cassava, while Thailand is the largest exporter of dried cassava (Franquet *et al.*, 2010). Cassava is classified as either sweet or bitter like other roots and tubers, both bitter and sweet varieties of cassava contain anti-nutritional factors and toxins with larger amounts. They must be properly prepared before consumption as enough residual cyanide to cause acute cyanide intoxication, goiters and even ataxia or partial paralysis (Adebowale *et al.*, 2015).

Cassava root is essentially a carbohydrate source, however, they are poor in protein and other nutrients (Olumide, 2014). A typical composition of the cassava root is moisture (70%), starch (24%), fibre (2%), protein (1%) and other substances including minerals (3%) (Burell, 2013) and comparatively low content of vitamins and minerals. However the roots are rich in calcium and vitamin C and contain a nutritionally significant quality of thiamine. Cassava root can be cooked, eaten fresh or processed into flour (Montagnac *et al.*, 2019). Cassava is processed into a variety of products such as 'gari', 'fufu', 'elubo', 'abacha' and tapioca in Nigeria and some parts of the tropics (Balogun *et al.*, 2012).

Abacha is a snack or main meal in the eastern states of Nigeria. It is a shredded or sliced dry or wet product, obtained by shredding or slicing boiled cassava roots, soaking the shreds for 8-24 h in cold water and washing to remove the scum that causes sliminess. It may then be dried (FAO, 2015). It is a staple food commonly consumed with cow milk because of its low nutritive value and bland taste (Adeniyi *et al.*, 2017).

Groundnut (*Arachis hypogea*) is one of the most important leguminous crops in Nigeria and other tropical countries. It is rich in protein (22-30%), oil (35- 56%) (Zekeri and Tijjani, 2013; Gulluoglu *et al.*, 2016) and contains appreciable amounts of minerals (Phosphorus, Calcium, Magnesium and Potassium) and vitamins (E, K and B) (Gulluoglu *et al.*, 2016). Groundnut may be consumed in various forms (Ibrahim *et al.*, 2017), for example, it can be consumed raw or processed into a paste used as a spread for baked goods and the oil used for cooking. A popular product from groundnut in Nigeria is kulikuli, a snack produced by frying the residue obtained from groundnut oil extraction. Furthermore, the nut has various industrial uses including products such as food, feed, paints, lubricants and as insecticides (Variath and Janila, 2017). The term Coconut (*Cocos nucifera*) can be referred to the whole coconut palm or the seed, or the fruit, which botanically, is a drupe, not a nut (Rosengarten, 2014)). The various parts of the coconut have a number of culinary uses. The seed provides oil for frying, cooking and making margarine, the white, fleshy part of the seeds, the coconut meat is used fresh or dried in cooking, especially in confections and desserts such as macaroons. Coconut flour is a soft flour like product made from the pulp of a coconut. It's actually a by-product made during the coconut milk making process. Coconut flour is extremely high in fiber with almost double the amount found in wheat bran (Lalitha, 2014).

Coconut flour has also been developed for use in baking, to combat malnutrition (Trinidad *et al.*, 2011). According to Arancon (2019), nutrient composition of coconut flour is mentioned as; protein 13.41%, moisture 2.80%, crude fat 10.23% and crude fibre 19.3%. Trinidad *et al.*, (2016) reported that the dietary fibre content of coconut flour was 60.0 $\pm$ 1.0g/100g sample, 56% insoluble and 4% soluble. Tapioca pearls contain 8.79% of moisture 0.55% of protein, 0.345% fat, 0.32% ash, 0.10% crude fibre and 89.62% carbohydrate (Ojo *et al.*, 2017). Due to the poor nutritive value of abacha, hence fortifying abacha with groundnut and coconut flour may be a relatively cheaper way of enriching it nutrient. The objective of the study was to evaluate the nutritional properties and microbial contents of abacha fortified with different proportion of groundnut and coconut flour.

Materials and Methods

Collection of Raw Material

Cassava (*Manihot esculenta crantz*), coconut and groundnut used for this research were sourced from obada market in Emure-ile, Owo Local Government Area of Ondo State, Nigeria. While the water bath (Model HH-6), centrifuged, hot air and other equipment used for this research were from the food chemistry laboratory of the Department of Food Science and Technology, Rufus Giwa Polytechnic, Owo, Ondo State.

Preparation of Groundnut Flour

Groundnut flour was produced according to the modified method described by Mgbemere (2011). Shelled groundnuts were roasted in the oven at 170°C for 15 - 20 mins, allowed to cool and the skin was removed. The roasted kernels were then milled and defatted using hydraulic press. The defatted cake obtained was disintegrated, sieved to obtain fine flour and packaged in cellophane bag until require

Preparation of Coconut Flour

Coconut fruits were sorted and processed to extract coconut milk and the resulting shaft/residue was washed thoroughly with boiling water to enhance complete removal of milk and oil from the shaft. It was drained, dried and ground using a grinder (model HL 3294/C Phillips) to obtain fine particles.

Preparation of Abacha

The cassava roots were peeled and cut into small sizes of 7 inches length and washed with water. The washed sample was boiled for twenty (25) minutes and allowed to cool. After cooling, it was shredded into julienne shape of about 10cm using a locally made grater. The shredded product was then washed gently with water, drained and thinly spread on a tray and sun-dried for five days.

Formulation of Blends

Production of groundnut-coconut abacha was produced by the incorporation of Cassava, groundnut and coconut flour in ratio 100:0, 80:10:10, 70:15:15 and 60:20:20 respectively. The mixture was moistened with water in the ratio 2:1 of water to flour roasted into the damp just before roasting in the pan.

Proximate Analysis

Protein, fat, fibre, moisture and ash were determined by the method of analysis of the Association of Official Analytical Chemists (2005) while carbohydrate was determined by difference.

Microbiological Analysis

Ten gram (10g) samples were serially diluted 10^{-1} to 10^{-6} in sterile peptone water and aliquot 0.1ml volumes of each sample homogenate inoculated by spread plate method onto freshly prepared Nutrient agar, MacConkey agar and Potatoes Dextrose agar[PDA] (all from Biolab, Hungary), for Total Aerobic Plate Count, Coliform count and Fungal count respectively. Approximate 1g samples were inoculated into lactose broth in capped test tubes with inverted Durham tubes for coliform test. Manithol Salt agar, MRS agar, M17 agar, Bismuth sulphite agar (Biolab, Hungary) were inoculated with 0.1ml of samples homogenate for isolation of *S. aureus*, *Lactobacillus spp.* and *Streptococci*. Bismuth sulphite agar was inoculated for salmonellae after pre-enrichment in selenite broth (Biolab, Hungary). All culture plates were incubated at 37°C for 24 to 48h except however, PDA for fungal isolation which was incubated at 28 $\pm$ 2°C for 3 to 5 days. At the expiration of incubation period, culture plates were examined for enumeration and cultural identification of colonies.

Results

Table 1: Proximate composition of Abacha Fortified with Groundnut and Coconut Flour

Samples	Moisture content	Protein	Fat	Ash	Crude fibre	Carbohydrate
A	7.67 ^c ±0.03	1.03 ^a ±0.01	0.24 ^b ±0.02	1.26 ^c ±0.04	1.08 ^c ±0.05	88.72 ^a ±0.21
B	8.40 ^a ±0.12	12.65 ^a ±0.23	4.07 ^a ±0.12	2.62 ^b ±0.21	4.26 ^c ±0.12	65.98 ^b ±0.04
C	8.57 ^a ±0.03	18.74 ^c ±0.19	5.98 ^b ±0.01	3.33 ^b ±0.06	5.91 ^a ±0.01	57.47 ^a ±0.08
D	8.86 ^a ±0.11	23.46 ^b ±0.15	7.89 ^b ±0.03	4.02 ^b ±0.07	7.52 ^b ±0.04	48.25 ^b ±0.07

Values represent mean and standard deviation means with the same superscript are within the column are significantly different (P< 0.05)

Table 2: Mean total microbial counts Cf/g of Abacha Fortified with Groundnut and Coconut Flour

Sample	TAPC	Coliform Count	Fungal Count
A	4.8×10^{12}	3.5×10^{11}	3.7×10^{10}
B	8.7×10^{11}	8.5×10^{10}	9.6×10^9
C	3.8×10^{12}	2.5×10^{11}	3.8×10^{10}
D	7.7×10^{11}	9.5×10^{10}	6.6×10^9

Keys:

- Sample A = 100% Cassava starch,
 Sample B = 80% Cassava starch: 10% Groundnut flour: 10% Coconut flour
 Sample C = 70% Cassava starch: 15% Groundnut flour: 15% Coconut flour
 Sample D = 60% Cassava starch: 20% Groundnut flour: 20% Coconut flour

Discussion

The proximate composition of abacha fortified with groundnut-coconut flour was presented in Table 1. Moisture content ranged from 7.67% to 8.86% respectively. Sample D has the highest moisture content of 8.86% compared to sample C with 8.57% and the least moisture content was observed in sample A which is 7.67%. The values of the moisture content were significant different from each other as the increase in the level of addition of groundnut –coconut flour. The protein content increases with increase in the substitution of groundnut-coconut flour. This observation agrees with previous findings of (Iwe, 2013 and Balogun *et al.*, 2012). The protein content range from 1.03% to 23.46% respectively. Among the abacha produced, the control sample which is sample A has the lowest protein content of 1.03% while sample D has the highest protein content (23.46%).

The fat content of the abacha groundnut-coconut flour ranged from 0.24% to 7.89% respectively. Low fat content makes it suitable as a refreshing and a thirst quenching product which is a characteristic of a good beverage reported by Agarry *et al.* (2020). The ash content of abacha fortified with groundnut-coconut flour ranged from 1.26% to 4.02%. This follow similar trend observed in protein and fat content. This has shown that addition of groundnut and coconut flour increase the ash content. Samples A has low ash content 1.08% and sample D has the highest ash content of 7.52%. The crude fibre content ranges from 1.08% to 7.52% respectively and significant difference exist within the values. The fibre increases with an increase in the substitution of the groundnut-coconut flour. The increase was due to the high fibre in coconut flour.

The carbohydrate content of the abacha ranged from 48.25 % to 88.72% respectively. The control sample which is A had the highest value (88.72%) while sample D had the lowest carbohydrate content of 48.25%. This shows that carbohydrate content decreases with an increase in groundnut-coconut substitution. This observation agrees with the work of (Obadina *et al.*, 2020).

The total colony count for bacteria and fungi obtained in the different samples from sampling locations is shown in Table 2. All the samples had Total Aerobic Plate Count (TAPC), fungal count and Coliform counts above the tolerable 10^6 limit in foods. The locations for sample collection tends not to have influence on the level of microbial contamination of products as there seems to be no significant difference in levels of contamination of the samples. Coliform test reveals the presence of faecal coliforms able to tolerate and grow at 44°C.

The total microbial load of greater than 10^6 Cf/g sample recorded for TAPC, Coliform count and fungal count was above the ICMSF (1996) specification for tolerable level of microbial load in foods. The high counts could be associated to the fact that abacha is a product consumed raw with no heat treatment

to reduce microbial load. The addition of fermented products like 'abacha' and 'ogiri' could have contributed immensely to the high microbial load. 'abacha' and 'ogiri' has been reported to have high microbial load (Nwagu *et al.*, 2020).

Microorganisms involved in 'abacha' and 'ogiri' fermentation was reported to include predominantly *Bacillus*, *Micrococcus* and *Lactobacillus*. Other organisms also isolated from 'abacha' and 'ogiri' include *Pseudomonas*, *Staphylococcus*, *Enterobacters*, *Leuconostoc*, *Corynebacterium*, *Proteus*, *E. coli* and *Alkaligenes* (Enujiugba, 2019). 'Abacha' and 'Ogiri' as component ingredients of African salad could be the source of these organisms in the samples analyzed.

Conclusion

It can be concluded from the study that groundnut and coconut flour inclusion to the 'abacha' improved the protein, crude fibre, fat content and ash contents. Incorporation of groundnut-coconut flour into the abacha with varying ratio has effects on the nutritional properties of the product. Groundnut-coconut fortification resulted in improvement of protein, carbohydrates, fiber and mineral contents. Special care however, has to be taken in its preparation as contamination could be introduced through the ingredients used and proliferation of contaminants is easy due to its rich nutrients and conducive environment. Based on the findings of the research work, it is therefore recommended that the use of 20% groundnut and coconut flour. This study provides valuable information regarding the utilization of groundnut and coconut in food material, thereby preventing malnutrition and reducing wastages normally associated with this crop in Nigeria during production.

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