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Production, microbial and sensory qualities of biscuits produced from wheat-coconut-almond flour blend

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Abstract
Biscuits was produced from blends of wheat, coconut and almond flour. This study was carried out to evaluate the effect of varying the proportion of these flour on microbial and sensory qualities. Five blends were prepared by homogenously mixing wheat with coconut and Almond flour in the percentage proportions 90:5:5, 80:10:10, 70:15:15, 60:20:20 and 100% wheat as the control used to bake biscuits. Microbial analysis of the total viable count ranges from $2x10^2$ to $10x10^2$ cfu/g. The microbes increase slightly with increasing substitution of coconut and almond flour though all samples counts were not more than standard. The counts were minimal and within acceptable limits. The Sensory evaluation result of the biscuits showed they were "liked" by the panelist. Significant difference ($p< 0.05$) exist in aroma, taste, crispiness and overall acceptability while sample B was preferred among the biscuits.

Keywords: biscuits, coconut, almond seed, microbial, sensory

Introduction

Biscuits are one of the most consumed cereals food apart from bread, because they are readily available in local shops as ready to eat, convenient and inexpensive food products containing digestive and dietary principles of vital importance (Kulkarni, 2007) [11]. Biscuits are produced as nutritive snacks from unpalatable dough that is transformed into appetizing products through the application of heat in the oven (Olaoye *et al.*, 2007)[16] In Nigeria, ready-to-eat baked products (snacks) consumption is on the rise and there has been increasing reliance on imported wheat (Akpapunam and Darbe, 2009) [2]. In Nigeria, staple crops grown other than wheat such as cassava, sweet potatoes, coconut and cereals can be used for baked foods (Oluwamukomi *et al.*, 2011) [17].

The economy of any country importing wheat for the production of baked food such as biscuit would be improved if other staple food like coconut and almond flour that are grown locally are used in producing such products. Therefore, efforts are made to partially replace wheat flour with non-wheat flours as a possibility for increasing the utilization of indigenous crops cultivated in Nigeria and equally contribute to lowering cost of bakery products (Ayo and Gaffa, 2002) [3]. Mepba *et al.*, (2007) [14] stated that many researchers have studied the physical and baking properties of composite biscuits from starchy, legume and edible staples like cassava, coconut, almond seed and plantain.

Almond (*Terminalia catappa*) is one of the lesser known legumes found in the tropics and in Nigeria ecosystem. Almond is a large deciduous tree that thrives as an ornamental tree. Almonds are rich in healthy fat, protein, minerals and vitamins. It is also used by many rural dwellers in southern Nigeria to fortify the local complimentary foods, which are usually low in protein. (Mbah *et al*., 2013) [14].

Coconut (*Cocos nucifera*) is a member of the family Arecaceae (palm family) and the only species of the genus *Cocos* (Bawalan, 2000) [4]. Coconut plays an important role in the diet of people in Nigeria supplying about 22% of the total calories. Coconut flour is from coconut residue, a by-product of coconut milk extraction. The whitish residue that remains after the extraction of coconut oil from cold press can be milled to flour (Bawalan, 2000) [5]. It is extremely high in fiber with almost double the amount found in wheat bran (Barrett and Ramaswamy, 2004) [4]. Coconut flour provides not only value added income to the industry but also a nutritious and healthy source of dietary fibre, free of trans-fatty acids and low in digestible carbohydrates, it plays a role in controlling cholesterol and sugar levels in blood (Masa, 2001) [13].

Wheat (*Triticum aestivum*) is the third most important cereal crop after maize and rice, with world production of 695 million metric tons annually (FAO, 2013) [6]. Among the cereal flours, wheat is extensively used for bread making apart from its other uses.

The unique cookies properties of wheat flour are due to its gluten protein when hydrated, it forms strong, cohesive dough that retains gas and produces a light, aerated baked product (Hoseney, 2008) [7].

Wheat grain contains all essential nutrients; 12% water, carbohydrates (60-80%), proteins (8-15%) containing adequate amounts of all essential amino acids (except lysine, tryptophan and methionine), fats (1.5-2%), minerals (1.5-2%), vitamins and 2.2% crude fibers. Animal and animal products are very expensive as source of nutrients in developing countries. Discovery of alternative protein sources is a major need in Africa and Nigeria in particular. Food seeds and nuts rich in protein and vitamins will effectively reduce the level of malnutrition (Tropilab, 2015) [18]. This objectives of the research is an effort aimed at production of biscuit from wheat, coconut and almond seed composite flour. And also to determine the sensory characteristics and microbial quality of

the biscuit produced, so as to ascertain it overall acceptability and microbial safe for consumption.

Materials and Methods

Source of Material

All ready processed wheat flour used in this study was purchased in Ilaro and the coconut with other baking materials such as granulated sugar, salt, leavening agent, shortening (butter/fat) were purchased at the local market in Sayedero market, Ilaro. Almond seeds were picked in a neat environment at the east campus, it was cracked with a mallet, packed in sterile polythene bag and it was later transported to the food processing laboratory for further processing.

Preparation of Sample

Almond flour preparation

Almond seeds were conditioned for about 1 to 2 minute, and allow to cool. The almond was allow to completely dry in hot air oven 60ºc for 12hours. Once dried, the almond seed was place inside a food processor blender for 2 to 3 minutes. It was pulsed until finely textured flour was achieved. It was sieved, package and stored in air tight container until used as shown in Fig. 1(a).

Coconut flour preparation

Coconut was cracked, washed and then subjected to grating. Through the grating process, coconut milk was extracted and then spinned. The coconut residue was later defatted.

The residue was then subjected to drying in the hot air oven 60 ºC for 6 hours. The coconut flakes was milled and sieved. Finely textured coconut flour was later obtained and packaged in airtight container until it was used as shown in Fig. 1(b).

Biscuit Preparation

Coconut-almond flour was incorporated to replace refined wheat flour at different ratios (100:0:0, 80:10:10, 70:15:15, 60:20:20 and 50:25:25) in preparation for biscuits. 100% wheat flour serve as the control. Biscuits were produced from the five formulations using the method described by (Ihekoronye, 1999) [9] and modified. All the ingredients were weighed accurately. The pre-weighed flour, sugar, salt and baking powder were mixed thoroughly. Then shortening and egg were added and mixed properly to make adequate dough and then the dough was rolled to a uniform sheet of thickness. The sheet was cut according to the desired shape and size of biscuits with a cutter and baked in the oven at a temperature of 220 ºC for 15 mins. The biscuits were allowed to cool for 30 minutes and stored in polyethylene bags before further analysis as shown in Fig 2.

Microbial Analysis

Ten (10) grams of each biscuit samples was diluted in 90 ml of sterile distilled water in a conical flask to get the aliquot, a tenfold serial dilution was carried out. An aliquot of 1 ml from selected dilutions of each sample was inoculated aseptically into labelled triplicate agar plates of the media (Nutrient Agar for total viable count, Baidparker agar for *Staphylococcus* count, Bismuth sulphite agar for *Salmonella* count) using standard pour plate method and incubated at 37°C ±2°C for 24 to 48 hours. Potato Dextrose Agar was incubated at (28°C±2°C) for 3 to 5 days for isolation of fungi. Colonies were enumerated at the end of incubation period using digital colony counter (Gallenkamp England) (Lynne,2003) [12].

Sensory Evaluation

The sensory evaluation of the biscuit samples was carried out for consumer acceptability and preference using 10 semi-trained panelist comprised of students and staff of Food Technology Department, The Federal Polytechnic, Ilaro. They were to evaluate the sensory properties based on Taste, Flavor, Crispiness, Appearance and Overall acceptability using a nine point Hedonic scale where 1 represents "extremely dislike" and 9 "extremely like" respectively.

Statistical Analysis

Analysis of variance (ANOVA) was performed on the data gathered to determine differences, while the least significant test was used to detect significant differences among the means.

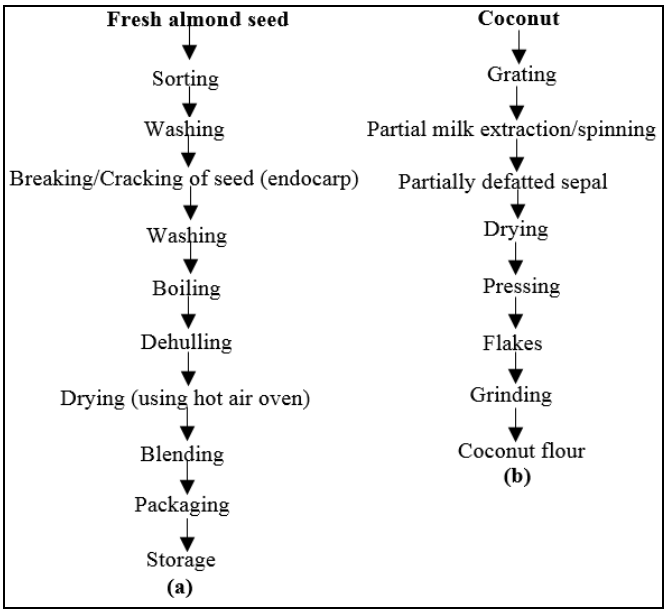

Fig 1: (a) Flow chart for the production of almond flour **(b)** Flow chart for production of coconut flour

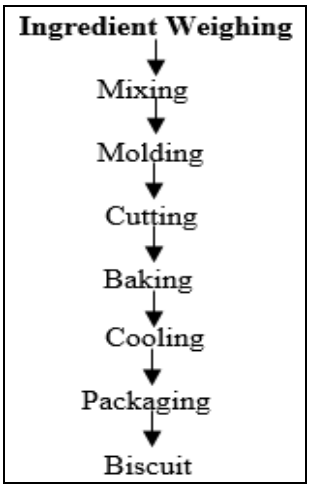

Fig 2: Flow chart for the production of biscuit

Table 1: Microbial analysis of biscuit made from wheat-coconut- almond flour

Samples	Total viable count cfu/g	Yeast and mould count cfu/g	*Staphylococcus* count cfu/g	*Salmonella* count cfu/g
A	2×10^2	1×10^2	Nil	Nil
B	3×10^2	2×10^2	1×10^2	Nil
C	4×10^2	2×10^2	2×10^2	Nil
D	6×10^2	3×10^2	2×10^2	Nil
E	10×10^2	4×10^2	3×10^2	Nil

Key:
A = Biscuit From 100%Wheat flour.
B = Biscuit From 80%Wheat, 10% coconut and 10% almond flour
C = Biscuit From 70%Wheat, 15% coconut and 15% almond flour
D = Biscuit From 60%Wheat, 20% coconut and 20% almond flour
E = Biscuit From 50%Wheat, 25% coconut and 25% almond flour

Table 2: Sensory evaluation of biscuit made from wheat-coconut-almond flour

Parameter	Sample A	Sample B	Sample C	Sample D	Sample E
Aroma	7.5^{ab}	7.3^{ab}	6.9^{b}	7.2^{ab}	7.5^{ab}
Taste	8.1^{a}	7.8^{a}	8.0^{a}	7.1^{ab}	8.1^{a}
Appearance	7.2^{ab}	7.1^{ab}	6.9^{b}	7.1^{ab}	7.3^{ab}
Crispiness	7.8^{a}	7.7^{a}	7.3^{ab}	6.8^{b}	6.5^{b}
Overall acceptability	8.3^{a}	8.1^{a}	7.7^{ab}	7.6^{ab}	7.2^{ab}

Means in the same row with different superscript are not significant differences at ($p<0.05$)

Results and Discussion

This study asses the microbial and sensory evaluation of freshly baked biscuits produced from wheat-coconut-almond composite flour as presented in Table 1 and 2. The mean total aerobic bacteria ranges from 2×10^2 cfu/g to 10×10^2 cfu/g. Yeast and mold count ranges from, 1×10^2 cfu/g to 4×10^2 cfu/g, *Staphylococcus* count ranges from 1×10^2 cfu/g to 3×10^2 cfu/g respectively while there was no growth of *Salmonella* count in all the sample. From the result of this study, all samples are within the microbial limit standard. As the almond seed flour increasing in substitution, microbial growth count was observed to increase slightly. It was observe that only sample A (100% wheat flour) has the least counts in all the attribute rated. This is due to the fact that increase in protein content encourages growth of microorganism. This simply depicts that total viable count of the biscuits are within the microbial limit of 10^4 to less than 10^6 cfu/g of ready to eat food product (ICMSF, 2002) [8]. Generally, the total viable count indicated that the microbiological quality of any food product and the presence of a high number of total viable counts is an indication for low expected shelf life of the product. Microorganisms play significant role in the determination of shelf lives of food products. They are usually responsible for spoilage of many food items. A high aerobic plate count could indicate the presence mixed population of microorganisms, which may consist of spoilage types (Olaoye, 2007) [16].

The presence of *Staphylococcus* in the biscuit samples was found as the increasing in almond flour and this is because of contamination that occurs during sun drying of the almond seed at the initial stage. Staphylococcus exists in air, dust, water, food or on food equipment, environmental surface, and humans. The appearance of mould and yeast on biscuit samples can be due to their widely distribution in the environment and can enter food through air borne contaminants. They can invade and grow on virtually any type of food at any time; they invade crops such as grains, nuts, beans and fruits in fields before harvesting and during storage. They also grow on processed foods and food mixtures.

The shelf life of the biscuit sample were determined, sample A (i.e. 100% whole wheat) biscuit has longest shelf life among samples, this is due to the fact that increase in protein content of the samples encourage the microbial action and this is caused by incorporation of almond seed and coconut blend in the other sample. Sensory evaluation of the biscuit were determined. The quality assessment is based on the aroma, appearance, taste, crispiness and overall acceptability. The result of sensory evaluation of biscuit made from wheat coconut almond flour shows that there was significant difference ($p<0.05$) in Aroma. Samples A and E have the highest mean score of 7.5 % while sample C recorded the least mean of 6.9% this shows that samples A and C are the most preferred in terms of aroma. Flavour is the main criteria that makes the product to be liked and disliked. (Ojinnaka and Agubolum, 2013) [15]. There is significant difference in Taste, samples A and E have the highest mean score of 8.1% while sample D has the least mean count of 7.1%. The sensation of taste and smell are function of flavour which is a complex of sensations (Iwe, 2007) [10]. Significant difference exist in Appearance. Sample E has the highest 7.3% while samples B and D have the lowest 7.1%. In cripsiness, Sample A has the highest score of 7.8% and sample E with the least score 6.5%. Overall acceptability of sample A has the highest score of 8.3% and sample E has the least score of 7.2%. The analysis of variance shows that the coconut-almond biscuits were not significantly different ($p<0.05$) from the wheat biscuit up to 10% in terms of all sensory attributes but it was observed that significant difference exist at 5% confidence level ($p<0.05$) in the aroma, taste, appearance crispiness and overall acceptability. The variation in the sample is due to the addition of almond and coconut flour which was not commonly eaten before by most people. The sensory result is similar to the findings of Ojinnaka and Agubolum (2013) [15] who reported in the sensory that increase in level of

cashewnut in cookies resulted in significant decrease in the sensory attribute of the biscuits. Similar findings were also made by Abu-salam and Aboluarb (2011) [1].

Conclusion

This research work has shown the microbial analysis of all samples are within the microbial limit standard of ready to eat food products. The sensory qualities of the biscuit clearly depicts the acceptability of biscuit made from the 100% wheat flour were generally acceptable followed closely by sample B 80% wheat 10% coconut and 10% Almond flour than the other biscuits samples. This research has clearly depicted the possibility of utilizing coconut and almond flour with wheat baked product. This would support industrial utilization and the consumption of under-utilized crops such as coconut and almond.

Recommendations

Further studies should be carried out on the Nutrient composition of the biscuit.

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