



The Functional and Sensory Evaluation of Biscuits Produced from Wheat, Defatted Soybean and Coconut Flour

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Authors' contributions

This work was carried out in collaboration between all authors. Author JUO designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors II and AO managed the analyses of the study. Author JUO managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Aims: The functional and sensory properties of biscuits produced from wheat flour, defatted soybeans and coconut flour were investigated to determine its quality and acceptability.

Study Design: The flour blends were formulated as sample A (100% wheat flour), sample B (80% wheat flour + 10% defatted soybean flour + 10% defatted coconut flour), and sample C (60% wheat flour to 20% defatted soybean flour, + 20% defatted coconut flour) respectively.

Place and Duration of Study: Department of Food Technology, Auchi Polytechnic, Auchi, Edo State; for a duration of 2 months, between August to October, 2014.

Methodology: The biscuit was baked using the straight dough method described by Chuahan et al. (1992). Sensory evaluation was determined according to the methods described by Ihekoronye and

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Ngoddy, (1985). Physicochemical evaluation was determined by the method described by AOAC (1990).

Results: The result of the sensory analysis recorded sample C as the most acceptable in all the qualities (color, taste, texture and general acceptability). The functional properties recorded sample B as the highest in bulk density with a mean score value of 46.27, while A and C recorded 26.71 and 26.67 respectively. Sample B recorded the highest solubility value at 73.62% while sample A and B recorded 69.14% and 57.24%. Sample C recorded the highest swelling capacity [87.97%], while sample A and B recorded 65.96% and 61.18% respectively. Sample C recorded the highest water absorption capacity [14.38%] while sample A and B recorded 12.37% and 12.60% respectively.

Conclusion: This research was therefore aimed at producing quality and acceptable biscuits from wheat flour, defatted soybean flour and defatted coconut flours. The potential of coconut and defatted soybean flour in biscuit production was also determined in this research.

Keywords: Biscuits; wheat flour; defatted soybean flour; coconut flour.

1. INTRODUCTION

Biscuits are nutritive snacks produced from unpalatable dough that is transformed into appetizing product through the application of heat in an oven [1]. They are ready to eat, convenient and inexpensive food product, containing digestive and dietary principle of vital importance [2]. The principal ingredients are flour, fat sugar and water; while other ingredients include milk, salt, flavoring agent and aerating agent.

Olaoye et al. [3], investigated the use of the supplementation of flours of soybean plantain and wheat in the production of biscuit. The research workers were able to obtain acceptable biscuit samples, with up to 15% supplementation of wheat with plantain flour. However, the quality attributes of the products tend to decrease with corresponding increase in the percentage substitution with wheat flour. Notwithstanding, a successful substitution of up to 15% of composite flour in the production of baked products will go a long way in reducing cost and enhancing its utilization. The consumption of biscuit and other western-styled bakery product such as bread and cake prepared from wheat flour has become very popular in Nigeria, especially among children [4]. The low protein content of wheat flour is of major concern in its utilization.

Defatted soybeans are obtained from soybeans. They are made from soybean meal that has been dehulled and defatted. Dehulled and defatted soybeans are processed into three kinds of high protein commercial products: soy flour, concentrates, and isolates. Soy protein isolate has been used since 1959 in foods because of

its unique functional properties. Recently, the popularity of soy protein has increased due to its uses in health food products, and many countries allow health claims for foods rich in Soy protein.

Defatted soybean is generally regarded as being concentrated in protein bodies, which are estimated to contain at least 60- 70% of the total soybean protein. Soybean contains a small but very significant 25 Albumin storage protein. Soybeans can also contain biologically active or metabolic proteins such as enzymes, trypsin inhibitors, hemagglutinins, and cysteine proteases very similar to papain.

Soy bean (*Glycine max*) a grain legume, is one of the richest and cheapest sources of plants protein that can be used to improve the diet of millions of people especially the poor and low income earners in developing countries because it produces the greatest amount of protein used as food by man. Soybeans can be processed into soy milk, soy sauce, tofu, (soybean curd) soy-yogurt, soy sprouts, soy flour, and many other soy products. Defatted soy bean flour can be used for the production of protein isolates and concentrates. Nutritionally, soy bean protein resembles animal protein more closely than other vegetable proteins. Soybean protein constitutes about 40% of the total solids and plays a very important role in the enrichment of cereal baked goods [5]. It is also a rich source of vitamin, minerals and is relatively low in crude fiber [6]. Soybean is one such protein sources, which when used partially to replace or complement wheat flour in the production of bakery products such as biscuits, bread and other confectionery could go a long way in improving the nutritional status of such products.

Defatted coconut flour is the ground solid residue/flakes obtained after immediate extraction of oil from dried communicated coconut meal that is processed under sanitary conditions. Defatted coconut flour usually has two market values and is normally sold as an animal feed and in some cases, just thrown away [5,6]. Coconut flour is now also being marketed as a functional food, and studies have shown that it has high dietary fiber content that aids in lowering cholesterol and providing other health benefits to the human body. The dietary fiber content of coconut flour and low fat desiccated coconut is much higher than oatmeal and flax seed.

Wheat (*Triticum* spp) is a grass that is cultivated worldwide. Globally, it is the most important human food grain and ranks second in total production as a cereal crop behind maize, the third being rice. Wheat grain is a staple food used to make flour for leavened, flat and steamed breads, cookies, cakes, pasta, spaghetti, macaroni, noodles, couscous and also for fermentation to make beer, alcohol, vodka or biofuel [7]. The husks of the grains are separated and milled to white flour, which is the bran. Wheat is planted to a limited extent as a forage crop for livestock and the straw can be used as fodder for livestock or as a construction material for roofing thatch.

Wheat is considered to be good source of protein minerals, 13-group vitamins and dietary fibre. It is an excellent health-building food. Thus, it has become the principal cereal, being more widely used for the making of bread than any other cereal because of the quality and quantity of the characteristic protein called "gluten". Gluten makes bread dough stick together and give it the ability to retain gas. The outer bran, which is the much needed roughage, is known to be the indigestible portion that helps easy movement of bowels. The bran, vitamin B, vitamin E and protein of wheat help to build and repair muscular tissues.

Biscuits are a rich source of fat and carbohydrate, hence are energy giving food and they are also a good source of protein and minerals [8]. The use of composite flour in biscuit making has been reported by many researchers. However, the inclusion of defatted soybean and coconut flour could improve the dietary composition in biscuit making. This research is therefore aimed at producing quality and acceptable biscuits from wheat flour, defatted soybean flour and defatted coconut flours.

2. MATERIALS AND METHODS

The raw materials used were soybeans, coconut, wheat, salt, butter, baking powder, milk and sugar, purchased from Uchi Market of Etsako West Local Government Area, Edo State.

2.1 Formulation of Flour Blends

Table 1 below shows the level of combinations of flour samples.

Table 1. Flour blend formulations

Wheat flour (g)	Defatted soy flour (g)	Coconut flour (g)
100	0	0
80	10	10
60	20	20

To each of the formulations, the following was added:

200 g of butter
0.1 g of sugar
5 g of baking powder
0.25 g of salt

2.2 Baking Procedure

The biscuit was baked using the straight dough method described by Chuahan et al. (1992). The fat and the sugar were mixed thoroughly; until both formed a homogenous mixture (fluffy). All the other ingredients (flour, salt, baking powder and milk) were properly mixed in separate bowls properly. The mixed fat and sugar were added to the ingredients and mixed thoroughly to form dough and kneaded. They were rolled out thinly on a cutting board and cut out into circular shapes and the diameter were measured using micrometer screw gauge (0.3 cm), and placed in a baking pan. The cut dough was transferred to the oven (SANS XY-880S) and baked at a temperature of 100°C for 15 minutes. The baked biscuits were allowed to cool at room temperature, and then packaged in an air tight container.

2.3 Sensory Evaluation

Twenty five semi-trained panelists from Auchi Polytechnic, Edo State were used to carry out the sensory evaluation of the samples using 9 points hedonic scale as described by Ihekoronye and Ngoddy [9] to evaluate color, flavor, taste,

texture and overall acceptability. All panelists were regular consumer of biscuits. They were asked to detect or state their degree of like or dislike. Triplicate determinations were made per sample.

2.4 Physicochemical Evaluation

The water absorption capacity, swelling index, bulk density, oil absorption, gelling point and boiling point were determined by the method described by AOAC [10].

2.5 Bulk Density

5 g of the sample was crushed in a crucible. A 10 ml capacity graduated measuring cylinder was cleaned and weighed. It was then gently filled with the sample and tapped gently to the bottom of the cylinder on the laboratory bench, to allow for even suspension, until there was no further diminution of the sample level after filling to the 10 ml mark.

$$\text{Bulk density} = \frac{\{(\text{Mass of cylinder + powder}) - (\text{mass of empty cylinder})\}}{\text{Volume of powder (cm}^3\text{)}}$$

2.6 Water Absorption Capacity

$$\text{WAC} = \frac{\text{Weight of wet mass}}{\text{Weight of dry matter}}$$

Water absorption capacity was measured using the same conditions in the determination of percentage solubility/swelling power but expressed as weight of the gel (wet mass) formed per sample, divided by treated sample weight.

2.7 Percentage Solubility and Swelling Power

- 40 ml of % sample suspension (w/v) was prepared in a previously tarred 50 ml centrifuge tube. The tube was placed in a water bath for 30 minutes at constant temperature of 60, 70, 80, and 90°C. Each suspension was centrifuged at 2120 g for 15 minutes. The supernatant was decanted and the swollen granules weighed.
- A 10 ml sample was taken from the supernatant, placed in a crucible and dried in an air convection oven (Imperial v) at 120°C for 4 hours to constant weight.

Percentage solubility and swelling power were calculated using the following formula:

$$\text{Percentage solubility} = \frac{\text{Dry weight after drying at } 120^{\circ}\text{C} \times 400}{\text{sample weight}}$$

$$\text{Swelling power or swollen granules} = \frac{\{\text{Weight of wet mass} \times 100 \times (100 - \text{solubility})\}}{\text{Sample weight}}$$

3. RESULTS AND DISCUSSION

Plates 1, 2, and 3 represents the biscuits produced from wheat flour, defatted coconut flour and defatted soybean flour at different proportions.



Plate 1. Biscuits produced from 100% wheat flour



Plate 2. Biscuits from 80%/10%/10% wheat flour/ defatted soybean/defatted coconut



Plate 3. Biscuits from 60%/20%/20% wheat flour/ defatted soybean/defatted coconut

3.1 Statistical Analysis

All data obtained from the analyses were subjected to one way analysis of variance (ANOVA) with a probability of level of ($P > 0.05$) using GENSTAT computer software package and SPSS (version 17) software package.

The results of the sensory evaluation of biscuit samples produced from wheat, defatted soybeans and defatted coconut flour are represented in Table 2.

The results of the analysis showed that the products were acceptable to consumers. However there was no significant difference ($P < 0.05$) in the texture of all samples. However, the mean value for texture in sample C (60% wheat flour / 20% defatted coconut flour/ 20% defatted soybean flour) was higher as compared to other samples. This result indicated that producing biscuit from all the formulations will give products with good textural acceptability as judged by assessors to be above average. Onuh and Abdulsalam [7], made similar observation when “apula” was produced from the inclusion of bambara groundnut in maize flour. For flavor, there was no significant difference ($P < 0.05$) between samples A and B. Sample C recorded highest mean value in flavor.

For colour assessment, the mean scores were at a range of 7.53- 8.32. However, sample A and B were not significantly different ($P < 0.05$). Sample C was rated to have had the best colour quality among the samples. The results of the study also revealed that samples A and B were not different significantly ($P < 0.05$) in taste. However, sample C, was rated highest than other samples taste.

The results of the functional properties of the sample were represented in Table 3. The functional properties showed that the samples were significantly different ($P < 0.05$) in bulk density. Bulk density is an indication of the porosity of a product which influences packaging design and could be used in determining the type of packaging material required [11]. It is also important in infant feeding where less bulk is desirable [12].

Results of the study recorded significant difference ($P < 0.05$) in solubility. Solubility was highest in sample B at a mean score value of 73.62%, while sample A and C recorded 69.14% and 57.24% respectively. The samples were significantly different ($P < 0.05$) in swelling capacity. Sample C recorded the highest value (87.97%) followed by sample A (65.96%) and sample B recorded the least value (61.18%). The results may be due to the variations of the

Table 2. Mean values of the sensory evaluation of biscuit

Sample	Parameters				
	Texture	Flavor	Colour	Taste	General accep.
A	7.44 ^a ±1.19	7.52 ^a ±1.05	7.53 ^a ±0.04	7.40 ^a ±0.91	7.52 ^a ±1.05
B	7.48 ^a ±1.16	7.28 ^a ±0.94	7.20 ^a ±0.94	7.72 ^a ±0.94	7.46 ^a ±1.10
C	8.08 ^a ±0.86	7.84 ^b ±1.34	8.32 ^b ±0.95	8.04 ^b ±0.73	8.20 ^a ±0.96

Means with the same superscripts in the same column are not significantly different ($P < 0.05$).

Values are means ± standard deviation.

A = 100% wheat flour; B = 80% wheat flour + 10% coconut flour + 10% soybean flour; C = 60% wheat flour + 20% coconut flour + 20% soybean flour

Table 3. Mean value of the functional properties of biscuits

Sample	Parameters			
	Bulk density (%)	Solubility (%)	Swelling cap. (%)	Water absorption cap. (%)
A	26.71 ^c ±1.00	69.14 ^a ±0.00	65.96 ^a ±0.46	12.37 ^c ±0.00
B	46.27 ^a ±0.58	73.62 ^b ±0.00	61.18 ^b ±0.00	12.60 ^b ±0.00
C	26.67 ^b ±0.00	57.24 ^c ±0.58	87.97 ^c ±0.00	14.38 ^c ±0.00

Means with the same superscripts in the same column are not significantly different ($P < 0.05$).

Values are means ± standard deviation.

A = 100% wheat flour; B = 80% wheat flour + 10% coconut flour + 10% soybean flour; C = 60% wheat flour + 20% coconut flour + 20% soybean flour

samples and the processing method adopted. High swelling capacity has been reported as part of the criteria of a good product [13]. The results of this study indicated that all the samples were of good quality, since they all had swelling capacity above average. There was significant difference ($P < 0.05$) in the water absorption capacity of all the samples studied. Sample C recorded the highest water absorption capacity (14.38%), while sample A recorded the lowest water absorption capacity (12.37%). Water absorption capacity is an indication of the extent to which protein can be incorporated into food formulation. Increase in water absorption capacity implies high digestibility of the starch. The water absorption capacity represents the ability of a product to associate with water under conditions where water is limiting, in order to improve its handling characteristics and dough making potentials [12,14].

4. CONCLUSION

The consumption of cereal foods such as biscuit has become very popular globally. Partial replacement of wheat flour with defatted coconut flour and defatted soybean flour will increase nutrient, diversify utilization of wheat flour, and also increase biscuit variety. Results of this study strongly indicated that quality and acceptable biscuits can be produced from defatted soybeans and defatted coconut flour, up to a substitution level of 40%. However, biscuit samples produced from 20% defatted soybeans and 20% defatted coconut flours were rated as the best in organoleptic quality. In comparison to biscuits produced from wheat flour, the functional properties of the biscuits produced from wheat flour substituted with defatted coconut and soybean flour were more enhanced. If made readily available biscuits produced wheat fortified with defatted coconut and soybean flour can be regarded as not only organoleptically acceptable, but also of functional benefits. It can also serve as vehicle for delivery of important nutrients.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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