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# Quality evaluation of bread produced from wheat and defatted coconut flour blends

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**Abstract**
This research was carried out to evaluate the quality of bread produced from wheat and defatted coconut flour. Coconut fruits were defatted, made into flour and incorporated into wheat flour in varying percentages of wheat: defatted coconut flour of 100:0, 97.5:2.5, 95:5, 92.5:7.5 and 90:10 to produce five different samples of bread coded as, $WDC_1$,$WDC_2$,$WDC_3$, $WDC_4$ and $WDC_5$ respectively using standard procedures. The result of proximate analysis showed that moisture and carbohydrate decreased significantly ($p<0.05$) with the substitution ranging from (9.20 to 9.60) % and (71.63 to 78.16) %, while ash, fat, protein and fiber increased from (1.11 to 1.46) %, (1.10 to 3.48) %, (9.30 to 13.13) %, (0.73 % to 1.10) % respectively. Results of functional properties showed that the swelling capacity, water absorption and oil absorption capacity increased significantly ($p<0.05$) with increase in the level of defatted coconut flour while the bulk density decreased. Physical properties decreased significantly with increase in the levels of supplementation in terms of loaf volume (836.90 to 503.00) ml and specific volume (4.64 to 2.74) ml/g, while the loaf weight increased from (180.00 to 184.00) g. Results of sensory analysis showed that the 100 % wheat bread ($WDC_1$) had the highest scores in all the parameters evaluated, however all the other samples ($WDC_2$, $WDC_3$, $WDC_4$ and $WDC_5$) compared considerably and were well accepted. These findings indicate that supplementation of bread with defatted coconut flour will improve the nutritional quality of bread.

**Keywords:** bread, defatted coconut, functional properties, proximate composition, wheat

## Introduction
Bread can be described as a fermented confectionary product produced mainly from wheat flour, water, yeast and salt by a series of processes involving mixing, kneading, proofing, shaping and baking [1]. Bread is an important staple food in both developing and developed countries and constitutes one of the most important sources of nutrients such as carbohydrate, protein, fiber, vitamins and minerals in the diets of many people worldwide [2]. The consumption of bread in Nigeria is on a steady increase because it is a convenient and ready to eat food [3] normally consumed at breakfast, lunch, and sometimes dinner.
Wheat grain (*Triticum spp*) is a staple food used to make flour, leavened, flat and steamed breads, cookies, cakes, pasta, spaghetti, macaroni, noodles, couscous and also for fermentation to make beer, alcohol, vodka or biofuel [4]. Wheat is considered to be good source of protein, minerals, 13-group vitamins and dietary fiber. 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" [5]. Gluten makes bread dough stick together and give it the ability to retain gas. Wheat, the basic ingredient in bread production is imported into Nigeria, involving huge expenditure of foreign exchange leading to high cost of the bread [6]. In order to make bread affordable, further cut down on the expense on wheat importation and add to its nutritive content, thus the use of different novel crops such as coconut flour, maize, cassava, potato and other substitute arise and are added to wheat flour to produce bread.
Coconut (*Cocos nucifera*), belongs to the palm family *Aracaceae* and is grown in the tropical climate. Coconut is classified as a fruit and frequently confused for being a nut. The coconut is actually a one-seeded drupe. Coconut is very healthy and contains different nutrients needed by the body for metabolic processes. It can also be processed into different forms such as coconut milk, oil and flour [7]. Defatted Coconut flour is the residue gotten after coconut milk and virgin coconut oil has been extracted, this is further dried and ground into powder and is used as flour. Studies have shown that defatted coconut flour has high dietary fiber content that aids in lowering cholesterol, prevention of colon cancers and providing other health benefits to the human body [5, 8]. The Food and Nutrition Research Institute of Department of Science and Technology (DOST-FNRI) looked into the potential of using coconut flour as an ingredient in the formulation of functional food such as bread, extruded snacks, processed meat, breakfast cereals and baked goods. The DOST-FNRI believes that increasing food products with coconut flour is one way to lower the cost of bakery products [9].

## 2. Materials and Methods
### 2.1 Sources of raw materials
Coconut fruits were purchased from Dutsinma local market in Dutsinma Local Government Area of Katsina State. The flour (Dangote flour), salt, fat, sugar, yeast used was obtained from Alhaji Bilya supermarket in Dutsinma Local Government Area of Katsina State.

### 2.2 Processing of defatted coconut flour
The defatted coconut flour was produced using the local, homemade process as described by [8].

### 2.3 Product formulation
The formulation of the product is in the following percentages of wheat to defatted coconut flour; 100:0,

97.5:2.5, 95:5, 92.5:7.5 and 90:10, labeled as $WDC_1$, WDC2, WDC3, $WDC_4$ and $WDC_5$ respectively. These samples were used to produce bread along with other ingredients such as 2 g yeast, 2 g salt, 6 g sugar, 2 g fat and 60 ml water using the straight dough method.

### 2.4 Determination of proximate composition
Proximate analysis was carried out on the wheat and defatted coconut flour blend to determine the moisture, ash, crude fiber, fat, protein and carbohydrate content using the method described by [10].

### 2.5 Determination of functional properties
The functional properties of flour were determined using the method described by [11] for water and oil absorption capacities, Swelling Capacity and Bulk density.

### 2.6 Physical characteristics of bread
The bread characteristics or baking qualities were evaluated by measuring the loaf volume, the loaf weight, and the loaf specific volume using the method described by [11].

### 2.7 Sensory evaluation of bread sample
Sensory evaluation was carried out using a 20 panelist to assess the organoleptic attributes (taste, crumb appearance, crust appearance, texture (mouth feel), aroma and overall acceptability) of the bread samples [12]. The panelists were selected randomly from the staff and students of the Federal University Dutsin Ma, Katsina State, Nigeria.

### 2.8 Statistical analysis
The data was subjected to analysis of variance (ANOVA) using Statistical Package for the Social Sciences, SPSS 16.0 software and the means were compared using Duncan Multiple Comparison test.

## 3. Result and Discussion
### 3.1 Proximate composition
The result of the proximate composition of flour blends from wheat and defatted coconut is as presented in Table 1.

**Table 1:** Proximate composition of flour blends from wheat and defatted coconut flour blend

| Concentration (%) | $WDC_1$ | $WDC_2$ | $WDC_3$ | $WDC_4$ | $WDC_5$ | LSD |
|---|---|---|---|---|---|---|
| Moisture | $9.60^a$ | $9.51^b$ | $9.34^c$ | $9.29^c$ | $9.20^d$ | 0.07 |
| Protein | $9.30^e$ | $10.39^d$ | $11.51^c$ | $12.38^b$ | $13.13^a$ | 0.24 |
| Fat | $1.10^e$ | $1.60^d$ | $2.26^c$ | $2.92^b$ | $3.48^a$ | 0.10 |
| Fibre | $0.73^d$ | $0.86^c$ | $0.92^c$ | $1.00^b$ | $1.10^a$ | 0.06 |
| Ash | $1.11^d$ | $1.18^c$ | $1.30^b$ | $1.41^a$ | $1.46^a$ | 0.06 |
| Carbohydrate | $78.16^a$ | $76.46^b$ | $74.67^c$ | $73.02^d$ | $71.63^e$ | 0.48 |

Values are expressed as means ±LSD of duplicate determinations. Means with different superscripts in the same row are significantly different (P< 0.05). WDC1= 100% wheat flour + 0% defatted coconut flour, WDC2= 97.5% wheat flour + 2.5% defatted coconut flour, WDC3= 95% wheat flour + 5% defatted coconut flour, WDC4= 92.5% wheat flour + 7.5% defatted coconut flour, WDC5= 90% wheat flour + 10% defatted coconut flour

The result shows that the moisture content of the sample ranged from 9.20 % to 9.60 % with sample $WDC_1$ having the highest values, while $WDC_3$ had the least moisture content.

The moisture content of sample decreased significantly ($p< 0.05$) with increasing levels of defatted coconut flour. This reduced moisture could be as a result of increase in the fibre and protein content with increase in the level of substitution from the results, as they both have the ability to bind water and make it unavailable.

This may be of an advantage as reduced moisture may increase the shelf life of the products by reducing water activity and discouraging microbial activities. The ash content of the sample ranged from 1.11 % to 1.46 %, $WDC_5$ recorded the highest value while $WDC_1$ recorded the least. The Ash content is indicative of the amount of minerals in any food sample [13].

Increased ash signifies that coconut contains higher mineral content as reported by [8].

Therefore, consumers of bread that has been produced from defatted coconut substituted wheat flour would not be predisposed to "hidden hunger". The fat content increased significantly with increasing level of defatted coconut flour, sample $WDC_5$ were found to have 3.48 %, while $WDC_1$ had the lowest fat content (1.10 %).

This increase in fat content may be due to the fat present in defatted coconut flour [14] Reported that, fat which is attached to the fibers remains with cell wall components resulting in high fat content in coconut flour. Similar result has been reported by [15] in the use of defatted coconut flour for wheat biscuits production. This increased fat content is an indication of higher energy supply from the product as a result of substitution with defatted coconut flour. The protein content of the samples $WDC_1$, $WDC_2$, $WDC_3$, $WDC_4$ and $WDC_5$ increased significantly with increasing level of defatted coconut flour from 9.30, 10.39, 11.51, 12.38 and 13.13 respectively.

This implies that defatted coconut flour is higher in protein content when compared to wheat flour and this result is in conformity with the claims of [15]. According to [16], cereal protein, including wheat, is limiting in some essential amino acid such as lysine, however, from this research, supplementation with defatted coconut flour may help to improve the protein content in products prepared from this combination.

The carbohydrate content of the sample reduced from 78.16 % to 71.63 %, with increased in the level of defatted coconut flour but was not significantly different in all samples ($p < 0.05$).

Sample $WDC_1$ had the highest value while $WDC_5$ had the least value. The high carbohydrate content of the products indicates that consuming these products will provide adequate supply of energy required for the day to day activities. The fiber content increased with significant difference ($p < 0.05$) from 0.73 % to 1.46 %, sample $WDC_5$ had the highest value while $WDC_1$ had the least values. The higher fiber content caused by the increase in the proportion of defatted coconut flour in the composite flour blend was so as defatted coconut flour has higher fibre content when compared to wheat flour [5, 8, 9]. Increased fibre content indicates that consumers of such products may have a better digestibility of the products.

### 3.2 Functional properties
The result of functional properties of wheat and defatted coconut flour blends are presented in Table 2.

**Table 2:** Functional properties of flour produced from wheat and defatted coconut flour blend

| Parameter | $WDC_1$ | $WDC_2$ | $WDC_3$ | $WDC_4$ | $WDC_5$ | LSD |
|---|---|---|---|---|---|---|
| S.C (%) | $65.00^d$ | $68.00^c$ | $70.00^b$ | $72.00^b$ | $75.00^a$ | 2.0 |
| B.D (g/ml) | $0.79^a$ | $0.78^a$ | $0.75^b$ | $0.72^c$ | $0.71^c$ | 0.01 |
| WAC (g/g) | $1.30^d$ | $1.36^c$ | $1.44^b$ | $1.46^a$ | $1.48^a$ | 0.03 |
| OAC (g/g) | $1.19^c$ | $1.34^b$ | $1.41^b$ | $1.50^a$ | $1.63^a$ | 0.15 |

Values are expressed as means ±LSD of duplicate determinations. Means with different superscripts in the same row are significantly different (P< 0.05). WDC1= 100% wheat flour + 0% defatted coconut flour, WDC2= 97.5% wheat flour + 2.5% defatted coconut flour, WDC3= 95% wheat flour + 5% defatted coconut flour, WDC4= 92.5% wheat flour + 7.5% defatted coconut flour, WDC5= 90% wheat flour + 10% defatted coconut flour, S.C = swelling capacity, B.D = bulk density, WAC= water absorption capacity, OAC= oil absorption capacity.

The results for swelling capacity of wheat and defatted coconut flour blends showed that the samples were not significantly different (P< 0.05) and were ranged from 65% to 75%. Sample $WDC_5$ recorded the highest value (75.00%) while $WDC_1$ recorded the least value (65.00%). The results may be due to the variations of the samples and the processing method adopted [17]. High swelling capacity has been reported as part of the criteria of a good product [17]. The results of this study indicated that all the samples were of good quality, since they all had swelling capacity above average. The bulk density decreased with increase in the defatted coconut flour substitution levels. The values for the samples ranged between 0.79 - 0.71 g/ml with sample $WDC_1$ had the highest value while sample $WDC_5$ had the least value. Bulk density is generally affected by the particle size and density of the flour. It is very important in determining the packaging requirement, material handling and application in wet processing in food industry [18]. Therefore increase in supplementation with defatted coconut flour reduced the bulk density of the flour composition and consequently would reduce the requirement for packaging of the composite flour with same weight as that of the 100 % wheat flour. The result of the water absorption capacity of all the samples ranged from 1.30 - 1.48 g/g. Sample $WDC_5$ recorded the highest water absorption capacity while sample $WDC_1$ had the least value. 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 [19, 20]. Therefore supplementation of flour with defatted coconut flour will improve reconstitution of flour for product processing.

The oil absorption ranged from 1.19 to 1.63g/g. Sample $WDC_5$ had the highest value while sample $WDC_1$ recorded the least value in the oil absorption capacity. The oil absorption capacity (OAC) of flour is important as it improves the mouth feel and the ability of products to retain flavor [13]. The increase in oil absorption capacity could be so as defatted coconut flour is gotten from coconut which has high fat content and hence has the propensity to absorb more fats in such a manner as to replace fats that was expressed from it.

### 3.3 Physical characteristics

The results for physical characteristics of bread produced from wheat and the defatted coconut flour presented in Table 3 for loaf volume, weight and specific volume of the loaf.

**Table 3:** Physical characteristics of bread produced from wheat and defatted coconut flour blend

| Parameter | $WDC_1$ | $WDC_2$ | $WDC_3$ | $WDC_4$ | $WDC_5$ | LSD |
|---|---|---|---|---|---|---|
| Loaf volume ($cm^3$) | $836.90^a$ | $754.00^b$ | $672.50^c$ | $600.20^d$ | $503.00^e$ | 57.50 |
| Loaf weight (g) | $180.00^b$ | $181.10^b$ | $182.25^a$ | $183.40^a$ | $184.00^a$ | 2.40 |
| Sp. Volume ($cm^3/g$) | $4.64^a$ | $4.17^a$ | $3.70^a$ | $3.24^b$ | $2.74^b$ | 1.00 |

Values are expressed as means ±LSD of duplicate determinations. Means with different superscripts in the same row are significantly different (P< 0.05). WDC1= 100% wheat flour + 0% defatted coconut flour, WDC2= 97.5% wheat flour + 2.5% defatted coconut flour, WDC3= 95% wheat flour + 5% defatted coconut flour, WDC4= 92.5% wheat flour + 7.5% defatted coconut flour, WDC5= 90% wheat flour + 10% defatted coconut flour

The result shows that the bread volume of all samples varied significantly (P<0.05) ranging from 503.00 $cm^3$ to 836.90 $cm^3$. The volume of the control sample ($WDC_1$) was significantly higher (P<0.05) than all the other treatments. [21] Defined loaf volume as the space occupied by the bread loaf. Gas retention is the main factor contributing to the loaf volume and crumb structure of bread. Gluten is essential for gas retention capacity in dough [22]. The interaction between gluten and fiber will weaken the gluten formation and result in a lower bread volume [23]. By increasing the percentage of defatted coconut flour in the bread, the formation of the gluten network was reduced thereby reducing the volume of the bread. The loaf weight ranges from 180 – 184 g indicating $WDC_5$ having the highest while sample $WDC_1$ had the least value. This is due to the decreased in volume with a corresponding increase in density and also a higher protein and fibre which will in turn increase the water holding capacity of defatted coconut flour than wheat flour [24]. The specific volume of the bread reduced with increasing amount of defatted coconut flour ranging from 4.64 to 2.74 $cm^3/g$ with $WDC_1$ and $WDC_5$ having the highest and least values repectively. This could be attributed to the decrease in structure forming proteins in wheat which lowered the ability of the dough to rise during proofing, hence leading to reduction in the bread volume.

### 3.4 Sensory qualities attributes

Table 4 shows the sensory qualities of the bread from wheat and defatted coconut flour which includes crust and crumb appearance, mouth feel, aroma, taste and overall acceptability of the bread.

**Table 4:** Sensory evaluation of bread produced from wheat and defatted coconut flour blend.

| Parameter | $WDC_1$ | $WDC_2$ | $WDC_3$ | $WDC_4$ | $WDC_5$ | LSD |
|---|---|---|---|---|---|---|
| Crust appearance | $8.15^a$ | $7.90^a$ | $6.80^b$ | $6.55^b$ | $6.25^b$ | 0.40 |
| Crumb appearance | $8.35^a$ | $8.10^b$ | $7.05^c$ | $7.05^c$ | $6.80^d$ | 0.15 |
| Mouth feel | $8.30^a$ | $8.00^b$ | $7.00^c$ | $6.80^d$ | $6.60^e$ | 0.10 |
| Aroma | $8.35^a$ | $7.60^b$ | $7.05^c$ | $7.00^c$ | $6.80^c$ | 0.35 |
| Taste | $8.80^a$ | $8.10^b$ | $7.40^c$ | $7.00^d$ | $6.70^e$ | 0.20 |
| Overall Acceptability | $8.75^a$ | $8.20^b$ | $7.40^c$ | $6.90^c$ | $7.00^d$ | 0.15 |

Values are expressed as means ±LSD of duplicate determinations. Means with different superscripts in the same row are significantly different (P< 0.05). WDC1= 100% wheat flour + 0% defatted coconut flour, WDC2= 97.5% wheat flour + 2.5% defatted coconut flour, WDC3= 95% wheat flour + 5% defatted coconut flour, WDC4= 92.5% wheat flour + 7.5% defatted coconut flour, WDC5= 90% wheat flour + 10% defatted coconut flour

The values for crust appearance of the bread ranged from 6.25 % to 8.15 %, sample $WDC_1$ had the highest scores, while $WDC_5$ had the least scores. These values decreased significantly ($P< 0.05$) as the level of substitution of defatted coconut flour increase. The crumb appearance values decreased significantly ($P< 0.05$) from 8.35 % in sample $WDC_1$ to 6.80 % in sample $WDC_5$. The values for aroma of the bread ranged from 6.80 % to 8.35 % with sample $WDC_1$ having the highest, while $WDC_5$ had the lowest score. The values for mouth feel ranges from 6.60 to 8.30% with $WDC_1$ as the highest and $WDC_5$ as the lowest scored. These values decreased with increase in the level of substitution of defatted coconut flour. The decreasing trend for mouth feel of the bread may be due to the proteins present in the defatted coconut flour as reported by [15]. The values for taste decreased with increase in the substitution of defatted coconut flour ranging from 5.60% to 8.80%, with $WDC_1$ (8.80%) as the highest, followed by $WDC_2$ with values 7.00% and $WDC_3$ (6.70%) while $WDC_4$ (5.60%) as the least value. The significant decreasing trend of taste may be due to the inherent taste of coconut flour which dominated when used in high amount, similar results were reported by [25].

The overall acceptability shows that the control sample $WDC_1$ which recorded 8.75% was most preferred, followed by $WDC_2$, $WDC_3$, $WDC_4$ and $WDC_5$ respectively, however, there was no significant deference between samples $WDC_4$ and $WDC_5$. The decrease in the overall acceptability could be due to the panelists' familiarity with 100% wheat bread as reported by [24]. The samples with defatted coconut flour substitution however, significantly changed the organoleptic properties of the produced bread.

## 4. Conclusion

The blends of wheat flour with defatted coconut flour produced bread with increased nutritional properties, this was observed from the proximate composition of the flour produced, which showed significant increase in the protein, ash, fat and fiber contents. Results from functional properties of the flour also showed that supplementation of wheat flour with defatted coconut flour, produced flour that has a good bulk density, increased water and oil absorption and good swelling capacity when left for longer period. Physical properties of the bread loaves were slightly affected as loaf volume decreases, similarly, increase in defatted coconut flour at different levels slightly altered the organoleptic properties of bread in terms of taste and mouth feel, although it was acceptable up to the 10% substitution level. It is therefore concluded that adding up to 10% defatted is advantageous as it increased nutritional quality of the bread in terms of protein, fat, ash and fibre without adversely affecting the physical and sensory properties of the bread.

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