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# Proximate and Organoleptic Evaluation of 30% Defatted Coconut Flour Supplemented Bread

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## ABSTRACT

*Coconut is a valuable food resource, but its usage is limited as a result of poor storage properties of the fresh fruits. Therefore there is need for conversion into flour to provide a more stable storage form as well as increasing its versatility. The defatted coconut flour was processed from fresh coconut by dehusking, grating, deoiling, drying and blending, it was then supplemented into with wheat flour to produce the 30% coconut bread. Proximate analysis was carried out on the coconut flours and the breads samples; control, 30% defatted and non-defatted coconut flour bread. Panel table of ten was used for the organoleptic evaluation of the baked breads. The proximate analysis result showed an increase in the nutritive value of the coconut flour supplemented bread compared to the wheat bread, with protein content of the non-defatted coconut flour 11.01% to the 10.24% of the wheat bread; fiber content (0.99-0.2%), ash content (0.98-0.78%), fat content (21.90-18.81) and a decrease in the moisture content (33.44-26.82%) with the addition of the coconut flour, hence prolonging the shelf life of the bread. The result obtained from the sensory evaluation, showed superior physical quality for the coconut flour supplemented bread compared to the wheat bread with the overall acceptability of 70% to the 30% of the wheat bread.*

**Keywords**: *Coconut flour, proximate analysis, organoleptic test, Supplemented bread, Wheat flour.*

## INTRODUCTION

Baked bread is a staple food in Nigeria among the rich and the low income earners. It is prepared from flour, sugar, butter, yeast, salt and other ingredients depending on the type of bread, the variation in these constituents also causes the changes in textural and taste of the bread, but it is relatively expensive as a result of high demand and being produced from imported wheat that is not cultivated in the tropics (Edema *et al*., 2005; Olaoye *et al*., 2006)). This challenge led to effort been made towards the use of composite flours in which flour from locally grown crops are used for bread production, thereby decreasing the demand for imported wheat and producing a protein-enriched bread (Giami *et al*., 2004). Composite breads are breads made from the blends of wheat and non-wheat flours, examples of breads prepared from composite flours includes breadnut flour (Oshodi *et al*., 1999); legume flour (Sadowska *et al*., 2003); peanuts and sunflower seeds (Fagbemi *et al*., 2005). In fact the International Institute for Tropical Agriculture (IITA) has a mandate to produce bread from wheat and cassava flours. These composite breads have the advantages of having additional nutritive values, reducing the importation of wheat flour and also adding values to the locally grown crops (Hugo *et al*., 2003).

Coconut palm (*Cocosnucifera L*.) is an important member of the monocotyledons mostly grown in the tropical and sub-tropical coastal areas. Products obtained from the fruit includes the copra, oil, lauric acid, coconut milk, fiber, flour, coconut water, which are used in several application, e.g. food, animal feed, soaps, detergents and cosmetics etc., making every part of the tree useful in one way or the other (Borsel *et al*., 2007).Coconut oil is edible oil, which has a long shelf life and a melting point of 76°F; it is used in baking industries. A negative campaign against saturated fats in general, and the tropical oils in particular, led to most food manufacturers abandoning coconut oil in recent years in favor of hydrogenated polyunsaturated oils, particularly soy, which contain trans- fatty acids. Coconut oil has >90% saturated fatty acids, hence is less attractive to consumers. Saturated fat is one that has no unsaturation or double bonds and tends to be

solid at room temperature. Coconut oil is rich in short and medium chain fatty acids. Shorter chain length allows fatty acids to be metabolized without use of the carnitine transport system. Various fractions of coconut oil are used as drugs. Butyric acid is used to treat cancer, while lauric acid is effective in treating viral infections. Usually, meal obtained after the extraction of oil, have been found in animal feed like poultry, fish and swine industry. However, meal obtained after oil extraction still possess good nutritional properties which could be utilized for value addition of various processed foods

Coconut water and milk have been used to treat a variety of health problems from the time unknown. It has been used for everything, from a medicinal tonic in tropical lotions to sports recovery drinks, because of its high content of potassium and antioxidants. Coconut milk is an excellent alternative to cow's milk, especially since most alternatives are high in PUFA's and anti-nutrients. It is a great source of saturated fat which helps with cardiovascular health, weight loss, absorption of calcium, liver health, nerve signaling (which helps with metabolism and insulin release), supports the immune system, brain and lungs.

Coconut flour is the kernel or chaff obtained from coconut after grating, drying and blending. Coconut flour contains zero grains, zero nuts, made up of completely pure coconut and unlike other flours made from nuts, seeds, dried vegetables etc., coconut flour is high in fiber, protein, and healthy fats and is free from wheat and other grains. It is also low in sugar, digestible carbohydrates and calories, and has a low score on the glycemic index.

Defatted coconut flour is the ground solid residue/flakes obtained after immediate extraction of oil and milk from coconut meal that is processed under sanitary conditions. But it has low market value and is normally sold as an animal feed and in some cases it is just thrown away (Wood roof, 2001). The dietary fiber content of coconut flour and low fat desiccated coconut has been shown to be higher than oatmeal and flax seed.

At present, there is a renewed quest for the consumption of natural food including baked products, which can be made more nutritious and economical by the use of value addition strategy. The main aim of this study therefore was to determine the ways by which the nutritive and the versatility status of coconut can be improved. Effort was geared towards adding values to coconut through the process of producing flour from the coconut (coconut flour) to bake bread; to determine the impact of supplementing specific percentage of coconut flour in the wheat flour bread and to determine level of public acceptance of coconut flour supplemented bread.

## Materials and Methods

### Preparation of Defatted Coconut Flour

Bunch of matured coconut fruits purchased from a local market in Ikare Akoko, Ondo State, Nigeria were processed into defatted coconut flourusing the wet method of oil extraction. The fruits were dehusked, cracked and the shell removed from the copra using a cutlass, a large rock and small knife. The copra was grated using a plastic grater and boiled for about 45 minutes thrice. The boiled water (emulsion) was collected and made to undergo prolonged boiling until a clear and distinct layer of oil and water was formed, the oil was schemed from the top into a separate pot. The kernel (meat) was collected and made to pass through a cheese cloth and squeezed to eliminate milk from the kernel. The kernel was dried using an oven for five hours at 1050C.and then blended into fine flour which was stored in an air tight container.

### Preparation of Non- Defatted Coconut Flour

The copra obtained from fresh set of coconut fruits (as described above) was grated and steamed using a steam generator (to inactivate the endogenous enzymes present in the coconut). The coconut chaff was oven dried at 105°C for about five hours to produce coconut flakes which were blended to produce the non-defatted coconut flour and stored in an air tight container.

**Table1.** *Recipe for wheat flour bread (control bread)*

| Ingredients | Percentage (%) |
|---|---|
| Flour | 87.75 |
| Sugar | 7.25 |
| Salt | 1 |
| Yeast | 2 |
| Margarine | 2 |

Ingredients: 351g of flour, 8g of margarine, 29g of sugar, 8g of yeast, distilled water, 4g of salt.

Procedures: To produce 587.46g (two loaves) of bread, appropriate measurement of the listed ingredients except yeast were measured into a clean bowl. 8g of yeast was dissolved in a separate bowl and added to the previously weighed ingredients and mixed using a pyramid

mixer at speed 3-4. It was transferred into a baking pan and allowed to proof at 30°C for about 30mins, it was then kneaded and allowed to proof again, after doubling its size during proofing, it was transferred directly to a pre-heated oven at 220°Cfor about 20mins.

**Table2.** *Recipes for the 30% coconut flour bread.*

| Ingredients | Percentage (%) |
|---|---|
| Wheat Flour | 57.75 |
| Coconut flour | 30 |
| Sugar | 7.25 |
| Salt | 1 |
| Yeast | 2 |
| Margarine | 2 |

Ingredients: 245.70g of wheat flour, 105.30g of defatted coconut flour, 29g of sugar, 4g of salt, 8g of yeast, 8g of margarine.

Procedure: To produce the 30% defatted coconut flour bread, procedure used for the control was followed for the coconut flour bread, except for the flour composition of the mixture, which was 245.70g (70%) of wheat flour and 105.30g (30%) defatted coconut flour.

## Proximate Analyses of the Coconut Flour and the Baked Breads Were Determined According to AOAC (2005) Method

### *Moisture*

*Procedure*

About 3g of the sample was measured in a pre-weighed evaporating dish (provided with cover) which was previously heated at 105°C. The sample was dried until a constant weight was observed in an oven maintained at temperature 105±5°C.

The covered crucible was then transferred into a desiccator to cool and weighed immediately after attaining room temperature. The loss of weight from sample was determined and the percent of moisture was calculated as follows:

$$\% \text{ Moisture content} = \frac{\text{moisture content}}{\text{wieght of sample}} X\ 10$$

### *Protein*

The protein content is the total amount of amino acids present in the sample.

Procedure: 10g of sample was weighed into a beaker and 100ml of water was added to the sample, the solution was filtered using whatmann filter paper fitted into a funnel. 0.5ml of phenolphthalein was added and titrated with 0.1M sodium hydroxide until a pink color is obtained. 2ml of formalin was added to the pink color to decolorize the mixture and titrated again until a permanent pink color was obtained.

1ml of 0.1M sodium hydroxide is equivalent to1 mg of nitrogen. A protein Conversion factor 6.25 was used to calculate the percentage protein from nitrogen determination. Percentage of nitrogen and protein was calculated by the following expression:

Nitrogen = Titre value × Nitrogen constant

Protein = Total nitrogen × conversion factor

### *Ash*

AOAC method (2005) was used to determine the total inorganic constituent and minerals present in the sample.

*Procedure*

1g of sample was weighed into clean, dry, previously weighed crucible. The sample was then placed in a muffle furnace at 550˚C and ignited until light gray ash resulted. The sample was then cooled in desiccators and weighed. The ash content was calculated as follows:

$$\% \text{ Ash} = \frac{\text{loss in wight}}{\text{weight of sample}} \times 100$$

**Fat:** This process is used to determine the total amount of the fatty acids present in the sample.

*Procedure*

1g of sample was dissolved in10ml of water in a flask. 2ml of ammonia was added to the solution to break the lipoprotein bonds; 10ml of ethanol was added and well shaken. 25ml of diethyl ether (extracting solvent) was added followed by the addition of 25ml of petroleum ether. The solution was shaken for 30secs before ethanol was added and supernatant was siphoned into a pre-weighed conical flask (via funnel which has a cotton wool in it to filter particles), 15ml of diethyl ether and 15ml petroleum ether was added to the sediment and then siphoned as previously done. Finally, the extract was made to undergo evaporation using a water bath.

$$\% \text{ Crude fat} = \frac{\text{Wa} - \text{Wb}}{\text{weight of sample}} \times 100$$

Where:

Wa = weight of conical flask + oil

Wb= weight of conical flask

### Fibre

This process is used to determine the amount of heterogeneous mixture of the non-starch

polysaccharides like the cellulose, hemi cellulose, pectin etc. present in the sample.

**Procedure:** The Weende method (James, 1995) was employed. 5g of the sample was boiled in 150ml of 1.25% sulphuric acid solution for 30mins under reflux.

The boiled sample was washed in several portion of hot water using a folded muslin cloth to trap the particles; the residue was returned to a flask and boiled again in 150ml of 1.25% of sodium hydroxide for another 30mins under the same condition.

After washing in several portion of hot water, the sample was allowed to drain before it is transferred to a weighed crucible where it is dried in the oven at 150˚C to a constant weight. It was thereafter taken to a muffle furnace where it was burnt until only ash was left in it. By difference, the weight of fiber was obtained and expressed as a percentage of the weight of sample analyzed.

$$\% \text{ crude fiber} = \frac{W2 - W3}{\text{weight of sample}} \times 100$$

Where:

W2 = weight of crucible + sample after washing, boiling and drying.

W3 = weight of crucible + sample after ashing.

### Total Carbohydrates

Carbohydrates was determined by subtracting all other proximate (protein, fat, moisture, ash and fibre) from hundred (Pearson, 1970).

### *Sensory Evaluations of Finished Product*

A sensory evaluation was conducted, to check the bread quality and acceptability; this was done by the use of questionnaire given to ten respondents that served as the panelists.

The baked breads which consist of both the control i.e. the whole wheat flour bread and the 30% defatted and non-defatted coconut flour breads were divided among the ten students and they were given questionnaire to fill according to the visual, textural and taste observed.

Samples were coded with three digit numbers and served at random to the panelists, to avoid the data collected from been biased. Panelists were then asked to rank the bread's characteristics and attribute based on their appearance. Acceptability of the breads was determined as shown in Table 3.

**Table3.** *Acceptability rating of the baked bread*

| Grading score | Acceptability rating |
|---|---|
| 81-100 | Excellent |
| 71-80 | Very good |
| 66-70 | Good |
| 51-65 | Fair |
| 40-50 | Poor |
| 0-39 | Very poor |

## RESULT

**Fig2.** *The defatted coconut flour*

**Table4.** *Result of the proximate analysis of Defatted and Non-defatted Coconut Flours*

| Component | Defatted coconut flour | Non-defatted coconut flour |
|---|---|---|
| Moisture (%) | 2.17 | 2.16% |
| Ash (%) | 0.9 | 1.9% |
| Crude fat (%) | 29.39 | 44.16% |
| Crude protein (%) | 13.66 | 14.88% |
| Crude fibre (%) | 7.51 | 3.54% |
| Nitrogen-free extract (%) | 46.37 | 33.36% |


**Fig4.***whole wheat and the 30% defatted coconut flour bread*

**Table5.** *Result for the proximate Analysis For 30% Defatted Coconut Bread and 30% Non-Defatted Coconut Flour Bread Compared with the Whole Wheat Bread.*

| Component | Whole wheat bread | 30% defatted coconut bread | 30% non- defatted bread |
|---|---|---|---|

| | | | |
|---|---|---|---|
| Moisture (%) | 33.44 | 26.82 | 28.43 |
| Ash (%) | 0.78 | 0.98 | 1.90 |
| Crude fat (%) | 18.81 | 21.90 | 30.39 |
| Protein (%) | 10.24 | 11.01 | 11.58 |
| Crude fibre (%) | 0.2 | 0.99 | 0.63 |
| Nitrogen-free extract (%) | 36.53 | 28.68 | 36.69 |

## Sensory Evaluation

Percentage value of 30% defatted, 30% non defatted coconut and whole wheat breads.

FORMULAR: $\frac{\text{RATING}}{\text{JUDGES}} \times 100$

**Table6.1.** *Attribute: color of baked bread*

| Sample | Excellent | Very good | Good | Fair | Poor | Very poor |
|---|---|---|---|---|---|---|
| Control | 6O% | 30% | 10% | - | - | - |
| 30% DF | 30% | 20% | 20% | 30% | - | - |
| 30% NDF | 20% | 70% | 10% | - | - | - |

**Table6.2.** *Attribute: crumb texture of baked bread*

| Sample | Excellent | Very good | Good | Fair | Poor | Very poor |
|---|---|---|---|---|---|---|
| Control | 60% | 20% | 20% | - | - | - |
| 30% DF | 10% | 30% | 40% | 20% | - | - |
| 30% NDF | 40% | 30% | 30% | - | - | - |

**Table6.3.** *Attribute: cell size of the baked bread*

| Sample | Excellent | Very good | Good | Fair | Poor | Very poor |
|---|---|---|---|---|---|---|
| Control | 30% | 50% | 10% | 10% | - | - |
| 30% DF | 20% | 60% | 20% | - | - | - |
| 30%NDF | 40% | 30% | 30% | - | - | - |

**Table6.4.** *Attribute: moistness of the baked bread*

| Sample | Excellent | Very good | Good | Fair | Poor | Very poor |
|---|---|---|---|---|---|---|
| Control | 40% | 20% | 40% | - | - | - |
| 30% DF | 50% | 30% | 10% | 10% | - | - |
| 30% NDF | 40% | 40% | 20% | - | - | - |

**Table6.5.** *Attribute: grittness of the baked bread*

| Sample | Excellent | Very good | Good | Fair | Poor | Very poor |
|---|---|---|---|---|---|---|
| Control | 50% | 20% | 30% | - | - | - |
| 30% DF | 40% | 40% | 20% | - | - | - |
| 30% NDF | 40% | 20% | 40% | - | - | - |

**Table6.6.** *Attribute: sweetness of the baked bread*

| Sample | Excellent | Very good | Good | Fair | Poor | Very poor |
|---|---|---|---|---|---|---|
| Control | 20% | 50% | 30% | - | - | - |
| 30% DF | 60% | 20% | 20% | - | - | - |
| 30%NDF | 70% | 20% | 10% | - | - | - |

**Table6.7.** *Attribute: coconut- like flavor of baked bread*

| Sample | Excellent | Very good | Good | Fair | Poor | Very poor |
|---|---|---|---|---|---|---|
| Control | - | - | 10% | 40% | 40% | 10% |
| 30% DF | 70% | 20% | 10% | - | - | - |
| 30%NDF | 80% | 20% | - | - | - | - |

**Table6.8.** *Attribute: eating quality of the baked bread*

| Sample | Excellent | Very good | Good | Fair | Poor | Very poor |
|---|---|---|---|---|---|---|
| Control | 30% | 20% | 50% | - | - | - |
| 30% DF | 70% | 10% | 10% | 10% | - | - |
| 30% NDF | 80% | 20% | | | | |

**Table6.9.** *Attribute: overall acceptability of baked bread*

| Sample | Excellent | Very good | Good | Fair | Poor | Very poor |
|---|---|---|---|---|---|---|
| Control | 40% | 50% | 10% | - | - | - |
| 30%DF | 70% | 20% | 10% | - | - | - |
| 30% NDF | 90% | 10% | - | - | - | - |

## DISCUSSION

The moisture content of the defatted and the non-defatted coconut flour is in close range to each other (2.16-2.17%). The samples generally have low moisture content which can extend the shelf life of the product in their raw form; since the moisture content in product affects the stability and overall quality of product (Folake and Bolanle, 2006).

Table 4 revealed that the non-defatted flour (with 44.16) contains more fatty acids than the defatted flour which has 29.39% fat, this can be said to be due to the prior extraction of the fat from the defatted coconut flour, hence its name. Ruehrmund (1995) reported that the fat content of dried coconut was 66% in contrast to what was gotten from this experiment; the difference in result may be due to the difference in the species and maturity of coconut used. Coconut flour is rich in fatty acids with approximately 50% content, most of these fats are the saturated fatty acids which are bad, but the saturated fats present in coconut are the medium chain fatty acids (MCFAs) which are rare i.e. hardly found in diets and they help in the prevention of arthlerosclerosis, this may be because they are metabolized without the carnitine system

High dietary fiber content is one of the major importance's of coconut flour, which gives it the functional properties with which it is known. McKee and Lather (2000) defined dietary fiber to be the cellulose, hemicelluloses, pectin, and hydro-colloid etc. which are not easily degraded by enzymes of the gastro intestinal tract. The dietary fiber have been reported to help prevent disease like diabetes, cancer etc. as a result of its ability to absorb water and cleanse away toxins from the stomach.

Table 3.1 shows that the fiber content of the defatted coconut flour (7.12%) is higher than that of the non-defatted (3.54%); the reason for this is yet to be adduce. The result gotten from this study is in close range with the one reported by Subrahmayan and Swaminathan (1989) and the Regional Research Laboratory in India, which reported the defatted and the non-defatted coconut flour to contain 7.00% and 3.9% of dietary fiber respectively. Sidorova *et al.* (2007) defined ash content of food to be the index of minerals constituents in food. As shown in the table five above, the non-defatted flour which contains 1.9% is higher in inorganic materials than the defatted coconut flour (0.9%), this slight difference in the ash content may be due to the inorganic materials lost during defatting process. This result varies from the one gotten by Subrahmayan and Swaminathan (1989), who reported the ash content of the coconut flour to be 3.26%, the difference noticed may be as a result of variety differences in coconut used, maturity of coconut and also regional factors.

Protein in coconut flour is one of the most important food nutrient present, this is because they are needed for body repair, growth and also majority being enzymes. Table 5 shows that the non-defatted coconut flour which has 14.88% is higher than the defatted (13.66%) in protein. The slight difference in them may be due to the inactivation of some enzymes during the process of defatting. The high protein content in the non-defatted coconut flour was reported to be as a result of the elimination or reduction in the moisture content and enzymes during the defatting and drying process (Wood roof, 2001).

The total carbohydrates content of the defatted and non-defatted coconut flour are 46.37% and 33.36% respectively as shown in Table 5. Since this value is the difference between the total proximate value and the other components, increase in the carbohydrate content may be as a result of the decrease in fat and protein due to the de-oiling of the coconut. Cereals like wheat are usually low in protein, and are lacking in the essential amino acids i.e. amino acids that cannot be synthesized by the body, but gotten from the diets, examples of which includes the luecine, lysine, phenylalanine, aspartate, glutamate, tryptophan, glycine, cysteine etc. (*Mac Evilly, 2003*). Coconut flour have been proved to contain these essential amino-acid, hence, incorporation into wheat flour (low level of protein), increases the protein content and thus improving the nutritive value of the bread. Table 5 shows that the control bread (whole wheat) has a protein content of 10.24% compared to the 11.58% observed in the non-defatted and the 11.04% in the defatted, the differences in the protein content observed may be due to the loss of some protein along with the

fat and also the inactivation of some enzymes during the fat extraction.

According to Rogers *et al*. (1988), moisture content in bread is inversely proportional to the rate of firming of bread, when moisture decreases; it accelerates the formation of crosslink between starch and protein and thus, the bread firm faster (Martin *et al*., 1989). The moisture content of the samples ranges from 26.82 – 33.44, with the 30% defatted coconut flour bread being the lowest with approximately 27% and the control (whole wheat bread) being the highest, this may be due to the high volume of moisture present in wheat flour. Low moisture content increases the shelf life of the bread by decreasing the activity of micro-organisms on it thereby preventing quick spoilage

As shown in Table 5, the fat content in the different bread samples varies significantly, with the 30% non-defatted coconut flour bread having the highest fat content with 30.39% and the control i.e. the 100% wheat flour bread having the lowest fat content with 18.81%, the defatted coconut flour bread contains 21.90% fat content, the defatted flour bread is obviously lower to the non-defatted as a result of prior extraction of oil from the coconut flour.

The increase in fat content is with the addition of the non-defatted coconut flour, and this may have an impact on the amount of margarine to be use thereby increasing its economic value. According to Yalegama *et al*. (2013) fat present in coconut flour is attached to its fiber and remains with the cell wall components, thus making the flour retain its fatty acid content.

The ash content which is the residue remaining after destroying the combustible organic matters and the total mineral element present in the food samples ranges from 0.78-1.90% with the whole wheat and the 30% non-defatted coconut flour bread having the highest and the lowest value respectively.

The defatted and the non-defatted coconut flour breads are not significantly different from each other with approximately 1.0% difference compared to the whole wheat bread; this difference may be due to the different formulation of the samples. A slight difference is observed from this value to the one given by Orator (2004) who reported the ash content to be within the range of 1.97-2.05%.

As shown in Table 5, the 30% defatted coconut bread is with the highest level of fiber (0.99%) compared with the 0.2% of the 100% wheat bread sample. The fiber content of the sample obviously increases with the quantity of defatted coconut flour in the formulation; the non-defatted coconut bread (0.63%) is slightly different form the defatted which might be due to the high content of fat present. Trinidad (2001), reported that coconut flour contains 68.9% total dietary fiber consisting of 65.1% insoluble and 3.8% soluble fibre. As earlier discussed, dietary fiber help in reducing the cholesterol level, risk of coronary heart diseases, colon and breast cancer.

The organoleptic evaluation of the baked bread is shown in Tables 6.1-6.9. Evaluation of the color of the different bread samples as observed by the panelists revealed that the color of the control sample (creamy white) was more favorable compared to that of the coconut flour supplemented breads (deep brown).

According to Raidi and Klein (1983), as the level of the coconut flour increase, the crust color of the bread changes from creamy white to the dull brown and this may be due to the greater amount of Millard reaction taking place between the reducing sugars and the amino-acids (e.g. lysine) present in the non-wheat flour, moreover, the coconut flour may also impact its off-whites color on the wheat flour thereby affecting the bread color.

The crumb texture refers to the feel of the internal part of the bread in texture, this study shows that the crumb texture of the control was generally favorable to that of the coconut flour bread, the slight difference in the texture of the test sample compared to the control may be as a result of the high moisture absorbing ability of the fiber present in the coconut flour.

Moistness is a sensory characteristic which cannot be measured with chemical or physical method. It can be defined as the sensation of “softness” or “wetness” that is gotten in the mouth when eating a product. The moistness of the coconut flour supplemented bread was more favourable in moistness compared to the control, this is due to the presence of water soluble pentosans; polymer of five carbon sugar which can bind water in a multiple of their own, thereby giving the flour more water-absorbing properties. Moreover, the high moisture content present in wheat flour which makes the bread rather too soft and unsatisfactory compared with the coconut flour supplemented bread that help in absorbing moisture as a result of the dietary

fibre content making it a moderately soft and satisfactory to touch and taste.

Grittiness means the presence of particle in bread affecting the bread smoothness. From Table 6.5, the panelist observed that the wheat bread is more smooth compared to the coconut bread, this may be due to the presence of the particle from the coconut flour in the bread, and also the fact that coconut flour is a gluten free flour, given it a bit gritty texture.

The panelist also observed that the 30% non-defatted supplemented bread was the sweetest compared to the control and the defatted flour supplemented bread. This may be due to the presence of reducing sugar which are mostly monosaccharides like the glucose, galactose etc. of about 1.29% in the coconut flour, thereby having an impact in the bread sweetness upon its addition compares to the wheat bread.

From Table 6.7, the panelist confirmed that the non-defatted and the defatted coconut flour supplemented bread contains coconut flavor while for the control, the taste was plain, the reason may be due to the fact that the addition of the coconut flour impacted its flavor on the bread and the differences in the flavor between the defatted and the non-defatted coconut flour bread may be due to the extraction of the fat.

Cell size in bread is defined as the spaces or holes within the bread crumb. Cell size are known to be created by gluten filled with carbon dioxide and alcohol; produced during the activities of yeast in the bread (fermentation period). In this study, the cell size of the coconut flour supplemented bread was more favourable (small cell size) than the control (large cell size), this may be due to the absence of gluten in the coconut flour.

Moreover, reduced activities of the yeast was observed in the 30% coconut flour bread, which reduced the cell size and the amount of the alcohol and the carbon dioxide produced thereby reducing the swelling of the bread during the proofing period. The coconut flour supplemented bread samples were more favourable in taste and more stomach filling than the wheat bread, this may be due to the fatty acids and the high fiber content present in the coconut flour. Overall, the panelist observed that the coconut flour supplemented bread was more acceptable in taste, smell, and stomach filling while the wheat bread was acceptable in color attribute.

## CONCLUSION

Conclusively, the substitution of wheat flour with the coconut flour was found to greatly improve the nutritive qualities and durability of the bread, as a result of increase in the protein, mineral content and the dietary fiber of the coconut flour supplemented bread. This would be of great importance in most developing countries like Nigeria, where people can hardly afford high proteineous food because of their expensive cost. Moreover, this result will also benefit growers of the crop economically as a result of the increase in the value of the coconut.

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