PROXIMATE AND SENSORY CHARACTERISTICS OF BREAD PRODUCED FROM WHEAT FLOUR AND COCONUT FLOUR

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Abstract

Bread is one of the most popular food consumed by most people of different age and economic status. This study was carried out to investigate the proximate composition and sensory evaluation of coconut-wheat composite breads at different substitution levels of coconut flour. Whole wheat bread (F1) and coconut-composite breads (F2, F3, F4 and F5) were produced in ratios of 0, 10, 20, 30%, and 50% coconut flours substitutes respectively, and assessed for proximate composition and sensory attributes. From the result, while composite bread generally recorded the highest ash (0.52%), fiber (1.11%), moisture (29.80%), protein (11.21%), fat (33.54), carbohydrate (52.72) and energy (480.00) content, the whole wheat bread attained the lowest for all proximate parameters. It was observed that carbohydrate, fat, moisture and energy contents of the composite breads increased significantly (p<0.05), while slightly increasing in fiber and ash contents when coconut flour was progressively increasing. The sensory results also revealed that formulation F3 was the most preferred sample in terms of its color, texture, flavor, taste and overall acceptability. While consumers generally disliked bread incorporated with more than 20% coconut flour, the incorporation of coconut flour below 20% was disclosed to have significant effect on the acceptability of the product. Composite bread of 80% wheat flour + 20% coconut flour is therefore recommended for commercial production, as it would meet both nutritional and aesthetic requirement of consumers.

Keywords: *coconut flour, proximate, sensory, wheat, composite bread*

1.0 INTRODUCTION

Fermented confectionary product such as bread are produced mainly from wheat flour, water, and fermentation agents such as yeast and salt by a series of processing techniques such as mixing, kneading, proofing, shaping and baking in an oven with a required temperature is gaining popularity progressively (Dewettinck et al., 2008). Consumer preference and willingness to consume healthy and a well-balanced food with additional ingredients providing additional health benefits is increasing rapidly (Ndife & Abbo, 2009). Wheat flour, the primary used ingredient for bread and other confectionary has recently been of major concern due to its low in nutrient required for growth and development [3]. Bread, which is an important and widely consumed cereal-based staple, is gaining attention as a potential functional food due to its widespread distribution as well as consumption [4,5]. According to Larsson et al. [6], bread is low in protein yet high in carbohydrates and has a high glycemic index, which can lead to obesity and an increased risk of diabetes and biliary-tract cancer. Bread consumption is increasing in many countries, particularly in Sub-Saharan Africa as a result of urbanization. However, there is a problem with meeting bread demand as well as supply in order to match individual eating habits [7].

Coconut (*Cocosnucifera*), a plant from the Arecaceae family contains higher amounts of naturally gluten free dietary fiber and other nutrients making it an alternative for incorporating in bakery products [8]. Dietary fiber in coconut and its impressive nutritional profile has been noted to have significant health benefit such as the prevention of cancer, cardiovascular diseases, diabetes mellitus and other chronic diseases, weight reduction effect, regulation of blood sugar, protection against diabetes [9,10] Due to the shortcomings of wheat in nutritional compositions, there is the need to substitute proportion with other locally available crops in food product as a means to provide the essential nutrient needed for growth and development, as well as limit diseases associated with higher gluten consumption [8]. The incorporation or use of coconut flour, which is available locally throughout all regions in Ghana for the production of bread will bring variety in bread and enhance the nutritional value of the bread including other confectionary products. The objectives of this study was to evaluate the functional properties, proximate and sensory quality of the composite bread produced from whole wheat and coconut flour.

2.0 MATERIALS AND METHOD

2.1 Raw material sources

Mature dried coconuts, wheat flour, margarine, sugar, baker yeast, baking powder, eggs salt was purchased from Agather market at Koforidua, Eastern Region of Ghana. The coconuts were transported in sacks and stored at room temperature until further processing**.**

2.2 Data Collection Tools

A well-structured questionnaire was employed to collect data needed from respondents as primary data. The questionnaire consisted of close-ended questions regarding the sensory characteristics (taste, color, texture, flavor and consumer overall acceptability) of the composite bread.

2.3 Preparation of Coconut Flour

Coconut flour was produced according to the method proposed by Osman [11], with slight modifications. All tools were sterilized and containers washed. The meat or kernel was cut into smaller pieces using a kitchen knife, and then transferred into a liquidizer containing 1.0L of boiling water for about 5min. This was blended for about 5min, until smooth pulp was obtained and then separated from the milk using cheesecloth. The pulp was again washed in hot water to reduce the oil content and was dried in an oven (Fisher Isotemp, senior model) at 60°C for 5hrs.

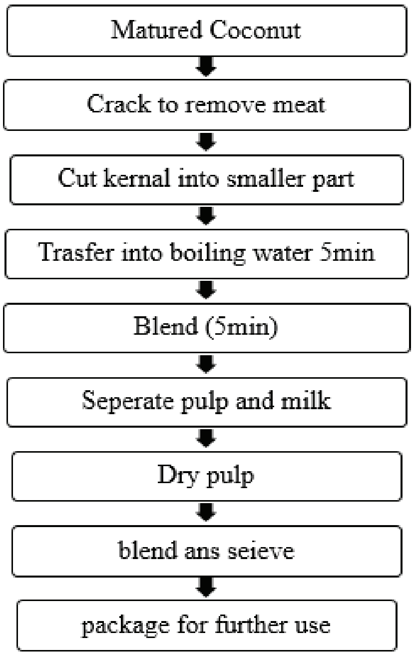

Fig 1. Flow chat for coconut flour production

2.4 Preparation of the Composite Bread

All ingredients were weighed accordingly and mixed to form dough. It was kneaded until the gluten was fully developed. The dough was cut to a desired weight approximately 35-50 grams and then rounded and rolled on the prepared crumbs. The dough was molded into aluminum thin, allowed to proof for about 1 – 1.5 hours and then introduced into a pre-heated oven (fisher Isotemp, senior model) and was baked at (about 200°C) for 45min according to the method of Oladunmoye et al [12].

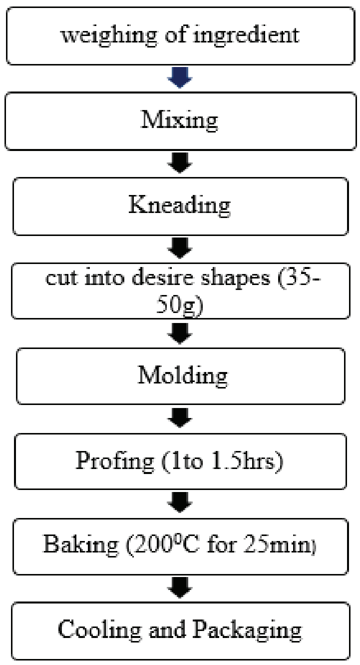

Fig 2. Flow chat for coconut flour production

2.5 Proximate Analysis

Each sample was ground into a coarse powder before analysis. While moisture content, ash content, crude fat and crude protein content were determined by AOAC [13], carbohydrate and energy contents were both determined by the method of difference and Atwater factor respectively using AOAC [14] prescribed approach.

2.6 Sensory Analysis

Composite bread was evaluated using 25 semi-trained sensory panelists who were selected from Koforidua Technical University. They were asked to evaluate the color, flavor, taste, texture and overall acceptability using a 5-point hedonic scale where 1= dislike very much, 2=dislike much, 3=neither like nor dislike, 4= like much and 5= like very much. The panelists were properly briefed and instructed to rinse their mouths with the warm water offered in between sample tasting.

2.7 Statistical Analysis

The data collected in this study was analyzed using SPSS (version 25) and presented by comparing means and standard deviation by using one-way analysis of variance (ANOVA) to compare the means.

3.0 RESULT AND DISCUSSION

3.1 Proximate Analysis

The samples were evaluated for moisture, crude fat, crude ash, crude fibre, crude protein, carbohydrate and energy. The value for moisture, fat, fiber and protein increased significantly ($p < 0.05$) with an increasing level of coconut flour supplement except for fiber and ash contents.

Formulation/ Parameters	F1	F2	F3	F4	F5
Moisture	23.50 ± 0.01^a	21.10 ± 0.01^b	28.03 ± 0.06^c	29.03 ± 0.01^d	29.20 ± 0.01^e
Fat	14.50 ± 0.01^a	16.03 ± 0.06^b	18.50 ± 0.01^c	22.03 ± 0.06^d	28.50 ± 0.01^e
Ash	0.45 ± 0.00^a	0.51 ± 0.00^b	0.51 ± 0.00^b	0.50 ± 0.00^b	0.52 ± 0.00^b
Crude Fibre	1.01 ± 0.00^a	1.10 ± 0.00^b	1.11 ± 0.00^b	1.10 ± 0.00^b	1.11 ± 5.72^b
Crude Protein	10.18 ± 0.00^a	11.19 ± 0.00^b	9.16 ± 0.01^c	9.15 ± 0.01^c	11.21 ± 0.01^b
Carbohydrate	50.30 ± 0.01^a	50.21 ± 0.00^b	52.72 ± 0.01^c	50.36 ± 0.01^d	50.26 ± 0.00^e
Energy (kcal)	372.50 ± 0.00^a	$389.60.06^b$	374.1 ± 0.02^c	396.00 ± 0.00^d	480.00 ± 0.02^e

Table 1. proximate analysis of composite bread

Each value is presented as mean ± standard deviation. Means within a row with the same letter superscript is not significantly different (P>0.05) whereas those with different superscripts are significantly different (P<0.05). F1=100% wheat flour + 0% coconut flour, F2=90% wheat flour + 10% coconut flour, F3=80% wheat flour + 20% coconut flour, F4=70% wheat flour + 30% coconut flour, F5=50% wheat flour + 50% coconut flour.

Moisture content increased from 23.50% to 29.20% with an increased level of coconut flour as shown in Table 1. The highest was obtained in formulation five (F5) whiles the lowest was obtain in formulation one (F1). The moisture contents showed significant difference ($p < 0.05$) from each other. The bread sample that recorded the lowest moisture content will have the longest shelf-life since lower moisture prolong shelf life by preventing microbial spoilage [15] and vice versa [16,15]. Similar trend in increase in moisture were observed by Julianti et al. [17] in wheat and sweet potato composite flours, and Dooshima, et al. [18] for wheat, defatted soy and banana flour bread. The result obtained in this study were also lower than the 29.92% to 33.32% reported by Ewunetu et al. [19] for composite bread from Wheat, Banana, and Carrot. The increased moisture content of the bread with the addition of coconut could be due to increased hydrophilic molecules [18].

Fat content increased from 14.50% for the control (FI) to 28.50% for formulation F5. The differences observed in the various formulation were significant ($p < 0.05$) when compared. The increase in crude fat content could be due to the blend proportions of the coconut flour addition which was in line with the finding of Okafor and Usman [20]. Ultimately, the increase in fat could be attributed to the fact that coconut is known to have high fat (medium-chain triglycerides) content in its meat, hence increasing the coconut flour would expectedly increase the fat composition in the product.

There was no significant increase ($p < 0.05$) in ash content and fiber content in the composite bread and vice versa between the composite and the control. While the highest ash and fiber content was recorded in F5 as 0.52% and 1.11% respectively, the lowest was recorded in F1 as 0.45% and 1.01% respectively. The difference in ash and fiber between the control and the composite sample could be as a result of the high fat and fiber composition known to be present in coconut kernel. To put a fine point on it, the increased in ash and fiber contents between the control and the composite samples could be attributed to the coconut which is rich in minerals and fiber [20]. Odunayo et al. [21] claims that eating a lot of fiber is good for the gastrointestinal tract (GIT) as well as promotes normal bowel motions, hence alleviating constipation. According to Berding et al. [22], crude fiber has been linked to improved glycemic control and morbidity in diabetic patients. This therefore puts relevance on the composite bread developed in this study, as its consumption in replacement of the usual wheat-only bread could help prevent constipation, and improve the health conditions of diabetic patients.

Protein content recorded was in range of 10.18% to 11.21%. While the highest was recorded in F5, and the lowest was recorded in F1 as indicated in Table 1. The addition of coconut flour increased the protein content of the composite bread as compared to the control. F3 (9.16%) and F4 (9.15%) showed no significant differences ($p < 0.05$) as well as F2 (11.19) and F5 (11.21). The result obtained in this study were also lower than the 8.01 % to 10.02% obtained by Ewunetu et al. [19] for composite bread from Wheat, Banana, and Carrot. Wheat is known to have good amount of protein, therefore the reduction in protein content of the bread could be due to the reduction in proportion of wheat flour in the formulation. The comparison between the control and the composite bread proved a significant enhancement of protein composition with the supplementation of wheat flour with coconut flour. Protein is important because it functions in the building and repair of the body parts [23].

Again, the quantity of carbohydrate present in the product increased from 50.30 for F1 to 52.72 for F3 as revealed in Table 1. The observed significant difference ($P<0.05$) in the carbohydrate content between the control and the composite sample is as a result of the high content of carbohydrate in both wheat flour and coconut flour as evidenced in a report on wheat and coconut flours by Makinde and Eyitayo [24]. The increase in carbohydrate could collectively as well be due to the difference in moisture, fat, ash and protein content in the product. The increase in carbohydrate shows that coconut flour is good for individual with low energy content and can be used as diet for higher energy required individuals, since carbohydrate feed the body with glucose, which is converted into energy utilized for supporting the body's processes and physical activities. Also, the total energy recorded in the products ranged from 372.50kcal to 480.00kcal. While the maximum was recorded in sample F5, the lowest was recorded in sample F1 (Control). The result demonstrates significant difference ($P<0.05$) between the control and the composite sample. The result suggests that food made with this composite flour would be energy rich, therefore well appropriate for persons with high energy requirements [25].

3.2 Sensory Evaluation

The various sample were subjected to a five-point hedonic scale where 1= dislike very much, 2=dislike much, 3=neither like nor dislike, 4= like much and 5= like very much. Appearance and texture was mostly preferred by the respondent for sample with 80% wheat flour and 20%coconut flour (T3) 4.30 and 4.44 respectively and was least preferred by the respondent in obtain in sample with 50% wheat flour and 50% coconut flour (T5) 3.59 and 3.35 respectively as shown in Table 2.

Table 2. Sensory evaluation of the composite bread

Formulation	Appearance	Texture	Aroma	Taste	Overall Acceptability
F1	$3.79{\pm}0.65^{c}$	$3.82{\pm}0.68^{c}$	$3.93{\pm}0.51^{b}$	$3.89{\pm}0.68^{b}$	$3.82{\pm}0.63^{b}$
F2	$4.05{\pm}0.65^{b}$	$4.07{\pm}0.61^{b}$	$3.94{\pm}0.76^{b}$	$3.91{\pm}0.72^{b}$	$4.33{\pm}0.61^{a}$
F3	$4.30{\pm}0.66^{a}$	$4.44{\pm}0.64^{a}$	$4.18{\pm}0.68^{a}$	$4.33{\pm}0.75^{a}$	$4.37{\pm}0.68^{a}$
F4	$3.77{\pm}0.68^{c}$	$3.42{\pm}0.79^{d}$	$3.71{\pm}0.61^{c}$	$3.59{\pm}0.68^{d}$	$3.59{\pm}0.57^{c}$
F5	$3.59{\pm}0.68^{d}$	$3.35{\pm}0.65^{e}$	$3.53{\pm}0.49^{d}$	$3.65{\pm}0.73^{c}$	$3.59{\pm}0.57^{c}$

T1=100% + 0% wheat flour, T2=90% wheat flour + 10% coconut flour, T3=80% wheat flour + 20% coconut flour, T4=70% wheat flour + 30% coconut flour, T5=50% wheat flour + 50% coconut flour. Values with the same column with different superscript letters are significantly different with each other ($p < 0.05$) & values are means ± SD.

There was an observed general increase in likeability by assessors in regards to all sensory parameters of the composite bread, as against the Control (F1) as revealed in Table 2. With the exception of formulation F1 and F4 which were not significantly different ($p < 0.05$) from each other for appearance score, all formulations were significantly different ($p < 0.05$) from each other when compared in terms of both appearance and texture. Assessors adjudged formulation T3 (80% wheat flour + 20% coconut flour) as having the better appearance and texture. The aroma and taste scores for formulation F1 and F2 were also not significantly different ($p < 0.05$) from each other, even though all formulations were significantly different from each other when compared. Assessors again voted formulation F3 as the bread with the better aroma and taste. Overall, formulation F3 was the most acceptable and preferred bread for the consumers, as it scored the highest in all the sensory parameters. This could be due to the flavor characteristics being added by the coconut flour. Addition of coconut flour of 20% and above creates roughness of the surface texture in bread and was dislike by the consumers which was in line with statement made in a study by [27]. The present study also agrees with this finding that the breads in 10% and 20% coconut added were more preferable than the control /wheat bread. [26]

4.0 CONCLUSION

Composite breads with coconut flour substitutions was found to be very nutritious because of the high protein, nutritional fat and crude fiber content of the coconut flour as compared to whole-wheat bread. Development of food product from coconut flour will be beneficial for individuals with less needed energy for physical activities. However, the scores for organoleptic attributes were superior to that of whole-wheat bread with moderate incorporation of coconut flour. For good product development and consumer preference, the result of this study suggests that coconut flour could be useful in composite bread and other baked product with quantity not more than 20%, and incorporating above this level may influence bread characteristics and properties negatively. Shelf-life, mineral and quality assessment of the most preferred bread could be analysed in other to determine the quality of the composite bread.

CONFLICT OF INTEREST

The authors have declared no conflicts of interest for this article.

REFERENCES

1. Dewettinck, K., Van Bockstaele, F., Kühne, B., Van de Walle, D., Courtens, T. M., & Gellynck, X. (2008). Nutritional value of bread: Influence of processing, food interaction and consumer perception. *Journal of Cereal Science*, *48*(2), 243-257.
2. Ndife, J., & Abbo, E. (2009). Functional foods: prospects and challenges in Nigeria. *J. Sci. Technol*, *1*(5), 1-6.
3. Ndife, J., Abdulraheem, L. O., & Zakari, U. M. (2011). Evaluation of the nutritional and sensory quality of functional breads produced from whole wheat and soya bean flour blends. *African Journal of Food Science*, *5*(8), 466-472.
4. Mert, I. D. (2020). The applications of microfluidization in cereals and cereal-based products: An overview. *Critical reviews in food science and nutrition*, *60*(6), 1007-1024.
5. Callejo, M. J., Benavente, E., Ezpeleta, J. I., Laguna, M. J., Carrillo, J. M., & Rodríguez-Quijano, M. (2016). Influence of teff variety and wheat flour strength on breadmaking properties of healthier teff-based breads. *Journal of Cereal Science*, *68*, 38-45.
6. Mudau, M., Ramashia, S. E., Mashau, M. E., & Silungwe, H. (2021). Physicochemical characteristics of bread partially substituted with finger millet (Eleusine corocana) flour. *Brazilian Journal of Food Technology*, *24*.
7. Ayele, H. H., Bultosa, G., Abera, T., & Astatkie, T. (2017). Nutritional and sensory quality of wheat bread supplemented with cassava and soybean flours. *Cogent*

Food & Agriculture, *3*(1), 1331892.

8. Trinadad, T., Masa, D., Encabo, R., Chua, M., Maglaya, A., Castillo, J., Loyola, A. (2006). Dietary Fiber from coconut flour: A functional food. Innovative Food Science and Emerging Tech. 7, 309-317.
9. Ramaswamy, L. (2014). Coconut flour, A low carbohydrate, gluten free flour. International Journal of Ayurvedic and Herbal Medicine.1426-1436.
10. Yalegama, L. L. W. C., Karunaratne, D. N., Sivakanesan, R., & Jayasekara, C. (2013). Chemical and functional properties of fibre concentrates obtained from by-products of coconut kernel. *Food Chemistry*, *141*(1), 124-130.
11. Osman, M. A. (2004). Chemical and nutrient analysis of baobab (Adansonia digitata) fruit and seed protein solubility. *Plant foods for human nutrition*, *59*(1), 29-33.
12. Oladunmoye, O. O., Akinoso, R., & Olapade, A. A. (2010). Evaluation of some physical–chemical properties of wheat, cassava, maize and cowpea flours for bread making. *Journal of Food Quality*, *33*(6), 693-708.
13. AOAC (2016). Official Methods of analysis. 20th ed. Association of Official Analytical Chemists. Washington, DC.
14. AOAC (1990). Official Methods of analysis. 20th ed. Association of Official Analytical Chemists. Washington, DC.
15. Akhtar, S., Anjum, F. M., Rehman, S. U., Sheikh, M. A., & Farzana, K. (2008). Effect of fortification on physico-chemical and microbiological stability of whole wheat flour. *Food chemistry*, *110*(1), 113-119.
16. Elleuch, M., Bedigian, D., Roiseux, O., Besbes, S., Blecker, C., & Attia, H. (2011). Dietary fibre and fibre-rich by-products of food processing: Characterisation, technological functionality and commercial applications: A review. Food chemistry, 124(2), 411-421.
17. Julianti, E., Rusmarilin, H., & Yusraini, E. (2017). Functional and rheological properties of composite flour from sweet potato, maize, soybean and xanthan gum. Journal of the Saudi Society of Agricultural Sciences, 16(2), 171-177
18. Dooshima, I. B., Julius, A., & Abah, O. (2014). Quality evaluation of composite bread produced from wheat, defatted soy and banana flours. *International Journal of. Nutrition and Food Sci*ence *3*(5), 471-476.
19. Ewunetu, M. G., Atnafu, A. Y., & Fikadu, W. (2023). Nutritional Enhancement of Bread Produced from Wheat, Banana, and Carrot Composite Flour. *Journal of Food Quality*, *2023*.
20. Okafor, G. I., & Usman, G. O. (2014). Production and Evaluation of Breakfast Cereals from Blends of A frican Yam Bean (S phenostylis stenocarpa), Maize (Z ea mays) and Defatted Coconut (C ocus nucifera). *Journal of food processing and preservation*, *38*(3), 1037-1043.

21. Odunayo, N. T., Abimbola, A., David, J., Banji, A., Ayodele, O., Oluwatosin, S., & Aderiike, A. (2017). Nutritional enrichment of wheat bread using various plant proteins. *International. Journal. of Multidisciplinary and Current research*, *5*.

22. Berding, K., Carbia, C., & Cryan, J. F. (2021). Going with the grain: Fiber, cognition, and the microbiota-gut-brain-axis. *Experimental Biology and Medicine*, *246*(7), 796-811.

23. Igbabul, B. D., Onoja, E. C., & Ukeyima, M. T. (2019). Quality evaluation of composite bread produced from wheat, water yam and brown hamburger bean flours. *African Journal of Food Science and Technology*, *10*(2), 42-48.

24. Makinde, F., & Eyitayo, A. O. (2019). The evaluation of nutritional composition and functional and pasting properties of wheat flour-coconut flour blends. *Croatian journal of food science and technology*, *11*(1), 21-29.

25. Igbabul BD, Num G, Amove J (2014). Quality evaluation of composite bread produced from wheat, maize and orange fleshed sweet potato flours. *American Journal of Food Science and Technology.* 2(4): 109-115.

26. Gunathilake, K. D. P. P., & Abeyrathne, Y. M. R. K. (2008). Incorporation of coconut flour into wheat flour noodles and evaluation of its rheological, nutritional and sensory characteristics. *Journal of Food Processing and Preservation,* 32(1), 133-142.

27. Omosebi, M. O., & Otunola, E. T. (2013). Preliminary studies on tempeh flour produced from three different Rhizopus species. *International Journal of Biotechnology and Food Science,* 1(5), 90-96.