Nutritional Composition and Sensory Quality of Bread Produced from Wheat Flour using Coconut Milk as Partial Substitute for Water

Elochukwu, Chinwe. U.

Department of Food Technology, Federal Polytechnic Oko, Anambra State, Nigeria

Abstract: **The use of wheat flour in combination with coconut milk in the production of bread was studied. The coconut milk was used to substitute water in different ratios of water: coconut milk, which is 100:0; 80:20; 50:50; 20:80 and 0:100. The bread loaves were produced using the straight – dough procedure and subsequently evaluated for proximate analysis, physical characteristics and sensory attributes. From the results of the proximate composition of bread samples, it was revealed that there were significant differences (p<0.05) in all the parameters analyzed. The moisture content of the bread samples fall within the range of 24.01% to 30.36%. The other nutrients includes protein, fat, crude fibre and ash were in the ranges of 7.66% to 14.01%; 5.01% to 24.59%; 2.08% to 6.27% and 1.02% to 3.01% respectively. From the results, is was observed the protein content, fat content, fiber content and ash content of the bread samples increased with increasing substitution of water with coconut milk, while carbohydrates decreased. In the same vein, the energy content of the bread samples increased as the level of fortification with coconut milk increased from 288KJ to 389.86KJ. The physical characteristics of the bread samples revealed a decrease in dough expansion from 410.00cm to 375.40cm as the level of substitution increases while that of the loaf weight increases with the increase in the level of substitution with coconut milk. In the sensory analysis, it was observed that the panelists liked all the bread samples although bread samples produced with 100% coconut milk was best preferred in terms of aroma and taste.**

Keywords: **wheat, bread, coconut milk, proximate analysis, sensory evaluation**

I. INTRODUCTION

Bread is an important staple food and the second most widely consumed non-indigenous food product after rice. The consumption is steady and increasing in Nigeria. A flour confectionary regarded as solid foam with a multitude of pockets of carbon dioxide distributed uniformly throughout its bulk [13]. It is basically a yeast-raised bakery product that has a honey comb structure. The consumption of bread and other baked goods such as biscuits, doughnuts and cakes produced from wheat flour has become very popular in Nigeria and most developing nations of the tropics especially among children [16]. The low protein content of wheat flour, which is the most vital ingredient used for the production of different kinds of baked goods has been of major concern in its utilization. The enrichment of bread and other cereal based confections with legume flours, particularly in regions where protein utilization is inadequate has long been recognized [4].

Coconut (*Cocos nucifera* Linn.; Family-*Palmae*) is one of the most extensively grown and used nuts in the world and is rated as one of the most important of all palms. Out of the 100 products that are directly or indirectly made from coconuts, eight are important in world trade [14].Coconut can also be used to produce desired texture in cookies, candies, cakes, pies, salads and desserts. Coconut is commercially viable because of its rich nutritive values. The health and nutritional benefits that can be derived from consuming coconuts are unique and compelling. Coconuts are used freely as a refreshing drink and as an ingredient of confectionary, ice, biscuits, cakes and bread. Coconut oil is used as cooking oil, hair oil and lamp oil and as an essential ingredient in soap making [2]. In the feeding experiments for malnourished children conducted in one of the poorest areas, coconut oil proved to be better source of dietary fat compared to soybean. Also worth mentioning was the use of coconut-based activated carbon in cleaning the Chernobyl victims system from radioactive elements [7].Coconuts are highly nutritious and rich in fibre, vitamins C, E, B1, B3, B5 and B6 and minerals including iron, selenium, sodium, calcium, magnesium and phosphorous. Unlike cow's milk, coconut milk is lactose free so can be used as a milk substitute by those with lactose intolerance [10]. The fats and oils in coconuts are, like those derived from other sources, made up of molecules called fatty acids. Coconut oil is composed predominately of medium-chain fatty acids (MCFA), or medium-chain triglycerides (MCT), while coconut milk is high in saturated fat, it is much healthier than other saturated fat products, and the fat is easily metabolized by the body [6]. Coconut milk also offers some particular health benefits. It is anti-carcinogenic, anti-microbial, anti-bacterial, and anti-viral. The main saturated fat that it contains, lauric acid, is also found in mother's milk and has been shown to promote brain development and bone health [5].

This study is therefore aimed at exploiting the use of coconut milk in bread production thereby fortifying the bread product and increasing the diversion and utilization of coconut as means of adding more value to the nut .

II. MATERIALS AND METHODS

Source of raw materials

The raw materials used for this project work were purchased at Onitsha, in Anambra State, Nigeria They include coconut, wheat flour (Golden penny), instant dried yeast (valine-instant yeast), baking fat, sugar and salt.

Production of Coconut milk

Ten heads of coconut was broken .The coconut white meat (flesh) was separated from the coconut shell. The white coconut meat was finely grated and milled in an attrition mill with about 3 litres of water to obtain the coconut slurry. Next, the coconut slurry was squeezed through cheesecloth and the filtrate collected was the coconut milk. About 300ml of coconut milk was used in the bread production of each batch.

Production of bread

The method reported by Ihekoronye [8] was modified and used for the production of bread as shown in Figure 1. The Wheat bread was produced by dissolving 50 g of sugar, 15.0 g of yeast and 6.0 g of salt in warm water / warm coconut milk and stirred thoroughly until all ingredients dissolved. 500 g of wheat flour were then mixed with 10 g of fats in a stainless steel bowl mixer using a wooden spoon. This was then mixed with the wet already prepared ingredients. The resultant dough was proofed in the bowl for 30 min, kneaded and transferred into an already greased aluminum loaf pan. The pan dough was rounded with a spatula, proofed again for 45 min and baked at 250°C for 15min. The baked bread was removed from the pan, cooled for 10 min and packaged in a polyethylene bag.

From the above method, five different formulations of wheat coconut milk bread were obtained by varying the ratios of water and coconut milk. The details of the ingredients used in the formulation are shown in Table 1.

Table 1: Recipe for the production of wheat/coconut milk bread

Code	Wheat(g)	Fat(g)	Salt (g)	Yeast (g)	Sugar (g)	Water/coconut milk (ml)
WWB	500	10	6	15	50	300/0
WCE	500	10	6	15	50	240/60
WCF	500	10	6	15	50	150/150
WCT	500	10	6	15	50	60/240
WCB	500	10	6	15	50	300/0

*****WWB Conventional wheat bread

*WCB Wheat bread produced with the ratio of 4:1 of water: coconut milk

*WCF Wheat bread produced with equal ratio of water and coconut milk

*WCT Wheat bread produced with the ratio of 1:4 of water: coconut milk

*WCB Wheat bread produced with only coconut milk

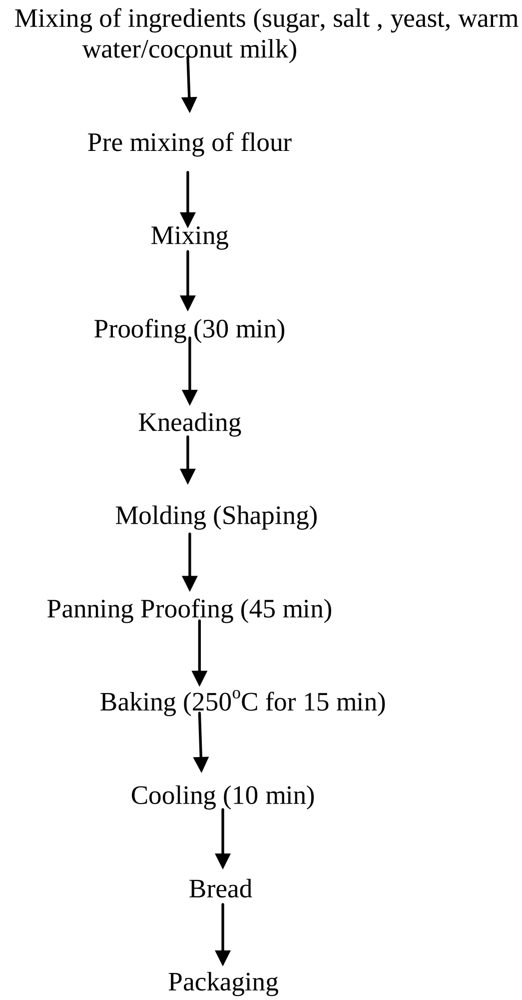

Figure 1: Flow chart for the production of Wheat bread.

III. CHEMICAL ANALYSIS

The moisture, protein, fat, ash and crude fibre contents of the bread samples was carried out according to the methods of AOAC [3] and this were determined in triplicates. The carbohydrate was determined by difference. The food energy was calculated using the Atwater factor 4 x protein, 4 x carbohydrates, 9 x fat [15].

Dough expansion

The determination of baking expansion capacity followed the procedures proposed by Maeda [11].The diameter of each dough ball was measured with a vernier caliper before and after baking. Baking expansion capacity was calculated by using the relation between the initial average diameter of the dough balls before baking and their final average diameter after baking.

Loaf weight determination

Loaf weight was determined by measuring the weight of the loaf sample in a calibrated weighing balance. This was read off in grams

Sensory Evaluation

Sensory evaluation of bread samples was conducted using a 20 member untrained panelists drawn from the federal polytechnic oko. The test was conducted while the samples were still fresh. The panelists were required to observe the sample, taste and score. Then rinse their mouth with water before tasting another sample. The products were analyzed based on the following parameters of appearance, aroma, taste, texture and overall quality using a nine-point hedonic scale where 1 = dislike extremely and 9 = like extremely [9].

IV. STATISTICAL ANALYSIS

The data obtained from proximate analysis and physical characteristics were statistically subjected to analysis of variance (ANOVA) and means separated using Duncan's multiple range tests The least significant difference (L.S.D) value was used to determine significant differences between means and to separate means at $p< 0.05$ using SPSS package version 16.0

V. RESULTS

Table 2: Mean Composition of the Chemical and Physical Analysis

		SAMPLES			
Parameters	WWB	WCE	WCF	WCT	WCB
Moisture content (%)	30.36^a ±0.556	28.01^b ±0.032	26.00^c ±0.010	25.00^d ±0.000	24.01^e ±0.026
Protein(%)	7.66^e± 0.035	9.56^d± 0.020	11.98^c ±0.025	13.58^b ±0.010	14.01^a ±0.015
Fat(%)	5.01^e± 0.026	8.45^d± 0.050	12.36^c ±0.020	20.97^b ±0.012	24.59^a ±0.023
Ash(%)	1.02^e± 0.020	1.89^d± 0.035	2.57^c± 0.020	2.88^b± 0.006	3.01^a± 0.011
Crude fibre (%)	2.08^e± 0.020	3.50^d± 0.035	4.67^c± 0.020	5.94^b± 0.040	6.27^a± 0.015
Carbohydrates(%)	53.20^a ±0.020	48.61^b ±0.031	42.40^c ±0.015	31.66^d ±0.015	28.11^e ±0.025
Energy(kj)	288.00 ^{e}±0.05	308.69 ^{d}±0.020	328.82^c±0.02	369.75 ^{b}±0.042	389.86 ^{a}±0.053
Dough expansion(cm)	410.00 ^{a}±0.04	400.01 ^{b}±0.032	395.00^c±0.015	386.00 ^{d}±0.006	375.40 ^{e}±0.010
Loaf weight(g)	204.00 ^{e}±0.01	206.00 ^{d}±0.017	210.00^c±0.00	212.99 ^{b}±0.01	215.00 ^{a}±0.01

Means of triplicate determination, Means with different superscripts along the row denote significant difference at $p \leq 0.05$ level

*WWB Conventional wheat bread

*WCE Wheat bread produced with the ratio of 4:1 of water: coconut milk

*WCF Wheat bread produced with equal ratio of water and coconut milk

*WCT Wheat bread produced with the ratio of 1:4 of water: coconut milk

*WCB Wheat bread produced with only coconut milk

Table 3: Mean values for the sensory scores of bread samples

		Sensory	Attributes		
Sample Code	Appearance	Aroma	Taste	Texture	Overall acceptability
WWB	8.15	7.45	7.68	7.70	8.10
WCE	8.00	7.45	7.64	7.70	8.00
WCF	7.88	7.65	7.40	7.63	7.80
WCT	7.89	7.73	7.30	7.80	7.75
WCB	7.50	7.90	7.20	7.80	7.70

*WWB Conventional wheat bread

*WCB Wheat bread produced with the ratio of 4:1 of water: coconut milk

*WCF Wheat bread produced with equal ratio of water and coconut milk

*WCT Wheat bread produced with the ratio of 1:4 of water: coconut milk

*WCB Wheat bread produced with only coconut milk

VI. DISCUSSION

Table 2 shows the chemical composition as well as physical characteristics of the bread samples. From the table, it can be observed that there were significant differences ($p<0.05$) in all the parameters analyzed. The moisture content of the conventional bread sample was the highest (30.36%) while the sample containing 100% coconut milk was the least (24.01%). This result implies that, the moisture content of the samples decreased with increase in the levels of coconut milk. The decrease in moisture level with increase in level of substitution might serve as an indication of increasing storage stability. The bread samples produced with 100% fresh coconut milk had the highest protein content (14.01%). This was expected because coconut is rated as a nut with high protein content. The substitution of water with fresh coconut milk resulted to the increment of the protein content of the bread samples. This will in turn improve the nutritional quality of the bread produced with fresh coconut milk. The high protein content in the bread would be of nutritional importance in most developing countries like Nigeria where many people can hardly afford quality proteinous foods because of their high cost. This addition effect was also observed for fat, ash and crude fibre. In other words, the fat, ash and fibre contents of the bread samples increased as the level of fortification with fresh coconut milk increased. Coconut milk has been reported to be high in minerals and vitamin content [12]. However, the opposite effect (subtraction effect) was observed for carbohydrate. The carbohydrate content of the bread samples decreased gradually with increasing level of substitution with coconut milk. A decrease was observed in the level of carbohydrate from 53.20% to 28.11% (Table 2). The energy content of the bread samples ranged from 288 KJ/l00g to 389.86KJ /100g. The increase in the energy content of the bread samples could be attributed to the high fat contents. Although coconut milk is high in saturated fat, it is much healthier than other saturated fat products, and the fat is easily metabolized by the body [10].

From Table 2, it was also observed that the dough expansion and loaf weight were significantly different ($p \leq 0.05$) from all the samples; The conventional bread sample had the highest dough expansion (410±0.04cm) while the least expansion was from the bread samples produced from 100% coconut milk(375±0.01cm). There was an increase in bread weight in the bread samples produced with 100% coconut milk (215±0.01g) than the conventional bread (204±0.01g). This increase can be attributed to the high calorific value.

The result of the sensory evaluation is shown in Table 3. From the result, the appearance of all the bread samples was good although the bread sample produced from 100% coconut milk had the least mean value (7.50) which can be attributed to fresh coconut milk colour. The best texture and aroma as indicated by the panelist was from the bread samples with 100% coconut milk which had a mean value of 7.80 and 7.90 respectively. In terms of overall acceptability, the conventional bread sample was rated the highest (8.10).

VII. CONCLUSION AND RECOMMENDATION

In Nigeria today, partial or total substitution of wheat flour with flour of other cereals, legume or oil seeds can serve as a means of diversifying and upgrading local agricultural food products. From the results of the proximate and sensory characteristics of bread samples from wheat coconut milk, it was observed that the use of coconut milk in bread production produced bread product of high nutritional value and sensory acceptability. Nevertheless, storage stability of bread produced using wheat coconut milk should be carried out in future to ascertain the shelf life and the level of acceptability of the loaf after the storage period.

REFERENCES

[1] Abdul, H. S and Zafar, M.I.(2011). Chemical composition of meat (kernel) and nut water of major coconut (cocos nucifera l.) Cultivars at coastal area of pakistan pak. J. Bot., 43(1): 357-363.

[2] Akubugwo, I.E., Chinyere G.C. and Ugbogu, A.E. (2008). Comparative Studies on oils from some common plant seeds in Nigeria. Pak. J. Nutr., 7: 570-573.

[3] Association of Official Analytical Chemists (A.O.A.C) (2000). Official Methods of Analysis 15th Edition. Arlington publishers, Washington D.C, USA. pp.62-102.

[4] Batista, K.A., Prudencio, S.H. and Fernandes, K.F. (2011). Wheat bread enrichment with hard-to-look bean extruded flours: Nutritional and acceptance evaluation. J. Food Sci. 76(1):5108-5113.

[5] Beck,J.(2016). Is Coconut Milk Healthy? Available from http://www.optiderma.com/articles/coconut-milk-healthy/ Accessed 14th March, 2016.

[6] Bruce Fife, N.D. (2003). Coconut oil and Medium Chain Triglycerides.Available from http://coconutresearchcenter.org/articles-and-videos/coconut-information/coconut-oil-and-medium-chain-triglycerides/ Accessed 29th December,2015.

[7] Eyzaguirre, P.B. (1996). Problems and potentials: Farmers, research, and industry viewpoints. Promoting multi-purpose uses and competitiveness of the coconut. Proceedings of a workshop 26-29 September, Chumphon, Thailand. 06-13.

[8] Ihekoronye, A. I. and Ngoddy, P.O.(1985).Integrated Food Science and Technology for the Tropics. Macmillan Education Ltd, London and Oxford.pp128-173

[9] Iwe, M.O. (2002). Handbook of Sensory Methods and Analysis. Rojoint Communication Services Ltd, Enugu. pp. 76 - 82.

[10] Lewin J.(2016). The health benefits of... coconut milk. Available from http://www.bbcgoodfood.com/howto/guide/ingredient-focus-coconut-milk Accessed 13th May,2016

[11] Maeda, K.C. and Cereda, M.P. (2001). Evaluation of two methods of expansion of the oven sour bread, Research center for Tropical Roots and Starches, Cerat Brazil. Available from http://dx.doi.org/10.1590/S0101-20612001000200003 Accessed 7th January,2016.

[12] Nieuwentus, R. and Nieuwelink, J. (2002). Soy and other leguminous crops. Agrodok series NO. 10 CTA. Netherlands. pp. 28–30.

[13] Okoye, J.I. and Okaka, J.C. (2009). Production and evaluation of protein quality of bread from wheat/cowpea flour blends. Continental J. Food Sci. Technol. 3:1-7.

[14] Onifade, A.K. and Jeff-Agboola, Y.A. (2003). Effect of fungal infection on proximate nutrient composition of coconut (*Cocos nucifera* Linn) fruit. Food, Agric. Environ., 1: 141-142.

[15] Onwuka, G.I (2005). *Food Analysis and Instrumentation: Theory and Practice.* Naphthali Publishers Ltd, Lagos. Pp. 89 - 90.

[16] Sanful, R.E. and Darko, S. (2010). Utilization of Soy bean flour in the production of bread. Pakis. J. Nutr. 9(8):815-818.