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Production and Evaluation of Composite Muffins From Wheat and Cocoyam Blends

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Abstract: *This study was design in production and analysis of composite muffins from cocoyam and wheat flour blends. The cocoyam was processed into flour and the proximate composition of the flour samples was determined. Muffins were produced from composite flours of cocoyam and wheat at the ratios of 100:0, 50:50 and 70:30 respectively, using 100% wheat flour as control. Sensory evaluation was carried out on the muffins samples. The proximate composition result of the flour sample indicated moisture content was ranged from 28.3-20.0%, ash content of 1.4-19%, fat content of 17.8-20.0%, protein content of 0.2-8.0% and carbohydrate content of 41.9-51.1%. The sensory properties of the muffin samples showed that the control was significantly (p≤0.05) different in colour, aroma, test and overall acceptability of 5.0 score of approximately and for each attribute had a mean score of 4.0. Sample C (70%wheat flour and 30% cocoyam flour) and sample B (50% wheat flour and 50% cocoyam flour) was least preferred in terms of colour aroma and texture with a score of approximately 3.0. While sample B (50% wheat flour and 50% cocoyam flour) had the mean value of approximately 5.0) for overall acceptability including the control and was not significantly (p≤0.05) different from the control. This indicates that cocoyam flour could be used in the production of quality muffins and could also be used for substituting wheat flour up to 50% level in muffin production without adversely affecting the sensory attributes of the product.*

Keywords: Composite flour, Cocoyam Flour, Muffins, flour blends, Ghana

Introduction

Intake of desserts and different baked aerated wheat flour merchandise has unfolded in Nigeria and different developing international locations of the sector. Wheat that's popular and specific amongst different cereals for making bread and different aerated baked products can handiest develop in only a few developing nations.

The exceptions are where there may be a temperate quarter because of excessive latitude or excessive altitude or each (examples are Mexico, Northern India, eastern Africa) (Dendy, 2001). Wheat is imported from temperate nations that have surplus due to urbanization and rapid populace increase; wheat imports to Ghana have grown rapidly. In line with America department of Agriculture, Ghana imported 41 million metric tons of wheat in 2011. These imports are paid for with scarce overseas currency. There is no doubt that the importation of wheat is depleting the country's external currency income and reserve within the bid to lower or prevent out-rightly imports of wheat, the government and food and Agriculture Organization (FAO) has advocated the use of composite flours and blends of wheatless flours or food for the manufacturing of aerated products consisting of bread, biscuit, cake, doughnut, and so on.

Fortunately, Ghana has big fertile arable lands in which meals vegetation are grown. Cassava, maize, rice, millet and sorghum are grown in huge quantity in Nigeria. Nigeria is the sector's largest producer of cassava (FAO, 2006). Flours from this and other meals crops are regularly mixed with wheat flour to form composite flours. Quality characteristics of aerated and non-aerated products crafted from composite flours and blends of wheatless flours had been studied and published in a few medical journals. There are but a few challenges militating towards business uses of composite flours and blends of wheatless flours or food.

Cocoyam (*Xanthosoma sagittifolium*) make contributions sizable portion of the carbohydrate content of the food regimen in lots of regions in growing nations and provide safe to eat starchy storage corms or cormels. Even though, they're much less crucial than different tropical root plants consisting of yam, cassava and candy potato, they're still a major staple in a few components of the tropics and sub-tropics (Opara, 2002).

Cocoyam have nutritional blessings over root vegetation and different tubers vegetation (Lyonga and Nzietchueng, 1986). It has greater crude protein than root and different tubers and its starch is

relatively digestible because of the small size of the starch granules, its contents of calcium, phosphorus, nutrients A and B nutrients are affordable. a lot of these are misplaced to nutrition due to low production and utilization.

Muffin is one of the popular bakery merchandise that is any short bread; it does no longer incorporate yeast, within the shape of a cup cake (cupcakes have frosting on top, even as cakes don't have any frosting, but desserts will have glaze on top). Due to the fact cakes normally are eaten as breakfast or as snacks, the outcomes of intake may be greater reported for sure meals or specific eating sample. The objective of the study was to produce muffins using composite cocoyam and wheat flour blends

Nutritional Value of Cocoyam

Cocoyam carries starch, which makes them an extraordinary source of carbohydrate. It includes nutritional fibre and better protein contents than the Magnesium, copper and riboflavin. Eating vitamins-packed meals like cocoyam is vital for retaining a wholesome immune gadget, which enables our body to utilize protein, carbohydrates and other vitamins general public of the tropical root vegetation. It additionally carries thiamine, calcium, niacin, manganese, vitamin B diet C, vitamin D, within the food we devour. Nutritional fiber continues a healthier digestive process and allows within the clean passage of stool.

Uses of Cocoyam

Cocoyam utilization can be much like that of potato in the western international and corms may be converted into numerous particular food and feed products and additionally for industrial purposes. Strategies for stabilizing and including price via conversion to semi-finished and stop merchandise encompass boiling, roasting, baking, frying in oil, pasting, milling and pounding. Arnaud-Vinas and Subhadhirasakul et al. (2001) said that taro starch can correctly replace maize as a binding agent in pill manufacture. Lawal (2004) has counseled cocoyam starches may be modified as for different commercial starches. The excessive digestibility of cocoyam starches and the small length of taro granules form a great foundation for processed toddler meals. In components of West Africa, boiled corms are mashed to form a weaning diet. Onwulata and Konstance (2002) have suggested on the method of formulation Lorenz (1999) have also taken into consideration the possibility of production of pasta from blends of wheat and taro flours.

A typical commonplace product is the Ghanaian fufu, a pounded mass of boiled cocoyam. It is also utilized in soup thickeners and baking flours, in beverages, as porridge and in producing meals for people with gastrointestinal disorders.

of weaning food with taro flour extruded with whey protein pay attention, whey protein isolate and lac-talbumin.

Mature aroids are processed into flour for fufu, commonly eaten in Nigeria with stew. In south Jap elements of Nigeria especially, tannia is utilized in small portions as a soup thickener after boiling and pounding to achieve a steady paste Onwueme (1978); Obiechina and Ajala, (1987).

Composite Flour

When different flours are mixed together, it is known as composite flour. It is usually a mixture of flours from crops that are rich in starch (e.g. yam and cassava) with those crops that are rich in protein (e.g. groundnuts and soya beans) and cereals (e.g. rice, wheat and maize) (Chandara, Singh, & Kumari, 2014).

MATERIAL AND METHODS

Research Design

An experimental research design method was adopted. With experimental research involves manipulation with an independent variable in order to assess its impacts on dependent variables. In this study, wheat flour muffin sample was used as an independent variable while cocoyam muffin samples were independent variable. Consumers were randomly selected to perform sensory analysis of the products.

Source of raw material

The cocoyam tubers were obtained from Takyiman central Market, the Bono East Region of Ghana. Other materials such as wheat flour, sugar, margarine, were obtained from the Sunyani market.

Processing of Cocoyam Flour

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Corm samples of cocoyam tubers (2 kg) were sorted, washed with potable water to remove adhering soil, and peeled manually with stainless steel knife. The peeled roots were washed with portable water and sliced into 2 mm thickness with a manual stainless steel slicer, and the thin slices were air dried in a c Convection Oven at 50 °C for 12 h, and milled using an electric hand mill and sieved using conical mesh. The flour obtained from the cocoyam was packaged separately in transparent polypropylene (50g) bags, sealed and stored at 4–7 °C.

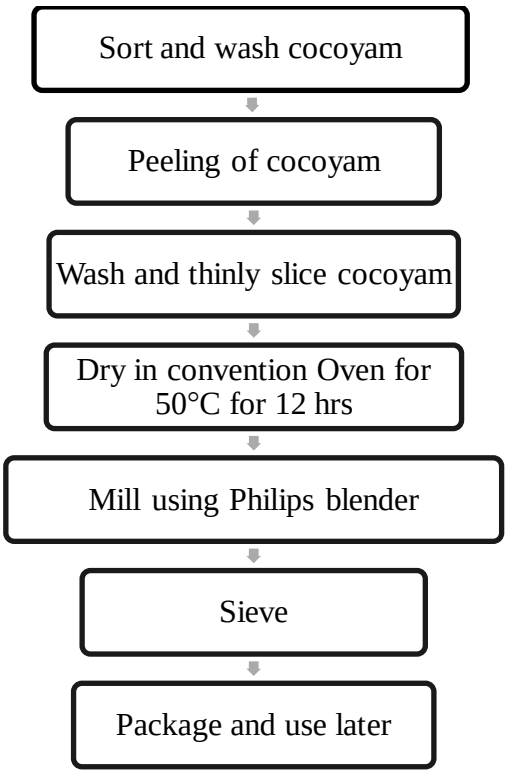

Figure 1: Flow Chart for Producing Cocoyam Flour

Formulation of Composite Flour and other Ingredients for Muffins Production

Three different samples of bread were produced and coded as A, B, and C. Sample A served as the control and contained 100% wheat. Samples B, and C consisted of wheat/cocoyam flours and the other ingredients for muffins production are presented in Table 1

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Table 2: Formulation of Composite Flour and other Ingredients for Muffins Production

INGREDIENTS	SAMPLE A 100% wheat flour	SAMPLE B = 50% wheat and 50% cocoyam flour	SAMPLE C= 70% wheat flour and 30% cocoyam
Wheat flour	200g	100g	140g
Cocoyam flour	-	100g	60g
Baking powder	½ teaspoon	½ teaspoon	½ teaspoon
Salt	1 teaspoon	1 teaspoon	1teaspoon
Butter	½ cup	½ cup	½ cup
Sugar	100g	100g	100g
Eggs	2 pieces	2 pieces	2 pieces
Vanilla	1 teaspoon	1 teaspoon	1 teaspoon

Milk	¼ cup	¼ cup	¼ cup

Production of Cocoyam Muffins

The muffins were prepared using a method suggested by the US Grain Council (2004) with little changes. First, oven was preheated to 400ºF (200ºC) and muffin cups were greased. Wheat flour and cocoyam flour were measured into a mixing bowl. 100g of sugar, ½ teaspoon of baking powder and 1 teaspoon of salt were added and blended together. After that milk, butter, eggs, vanilla where added and blended until ingredients were thoroughly moistened as paste. The paste was spooned evenly into muffin pan and ½ teaspoon of sugar was sprinkled on each muffin. The muffins were baked for 25 minutes or until tops of muffins are lightly browned the removed from the oven and allowed to cool for about 10 minutes. The muffins were gently removed from the pan and placed on wire rack to cool for another 10 minutes. Various composite flours were done using different measurement of the cocoyam and wheat flours. The muffin samples were produced and labeled as follows: **Sample A** contained 100% wheat flour (control sample); **Sample B** contained 50% of wheat flour and 50% cocoyam flour; **Sample C** was made of 70 % of wheat flour and 30% of cocoyam flour before sending for the proximate and sensory evaluation.

Sample A: 100% Wheat Flour Muffin. Sample B: 50% Wheat Flour And 50% Cocoyam Muffin

Sample C: 70% Wheat Flour And 30% Cocoyam Flour Muffin

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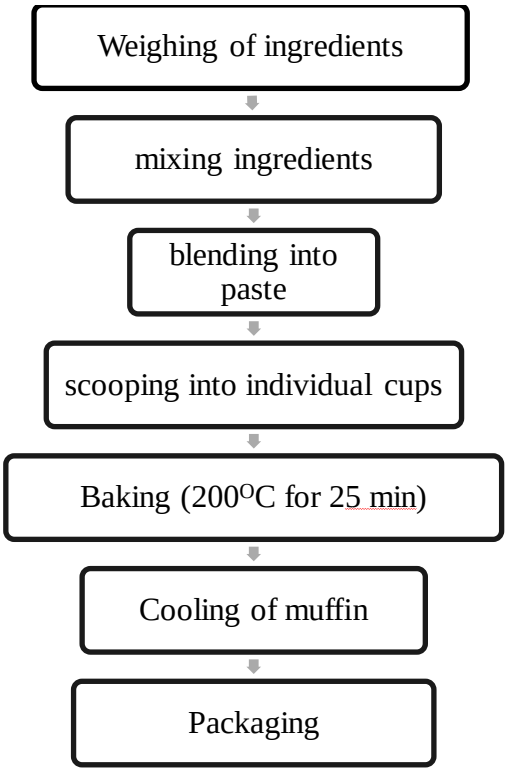

Figure 1: Flow Chart for Producing Cocoyam Composite Muffins

Validation of the Procedure

The muffin products were analysed by 50 respondents who are experts in the bakery industry after developing it four different times in order to perfect the procedure. They provided suggestions to improve on the procedure before the final product was developed. Those involved with the sensory evaluation were provided with a questionnaire to express their views on the produce and drinking water to rinse their mouth, before and after tasting each sample.

Sensory Analysis

The sensory evaluation was done on four different muffins samples: Sample A, Sample B, and Sample C. 50 consumers were randomly selected from among students and staff of Bolgatanga Polytechnic. They were asked to evaluate the four coded samples on a 5-point hedonic scale with 1 = Dislike very much, 2 = Dislike slightly, 3 = neither like nor dislike, 4 = Like slightly and 5 = Like very much in an experiment for sensory evaluation on the parameters (colour, taste, mouthfeel, flavour and overall acceptability). A sample of the ballot sheet is attached in appendix I. Analysis of Variance (ANOVA) was performed on the data gathered to determine differences, while the least significant test according to Ihekoronye and Ngoddy (1985) was used to detect differences among the means. Proximate analysis of samples was determined according to AOAC (1990; 2000). The samples were analysed for moisture content, ash, protein, fat, crude fibre.

Statistical Analysis

All analytical determinations were conducted in duplicates. Means and standard deviations were calculated. Data obtained was subjected to analysis of variance (ANOVA) where significant differences exist; Tukey's test was used in separating the means.

ANALYSI AND DISCUSSIONS

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Analysis of Demographic Data about the Respondents

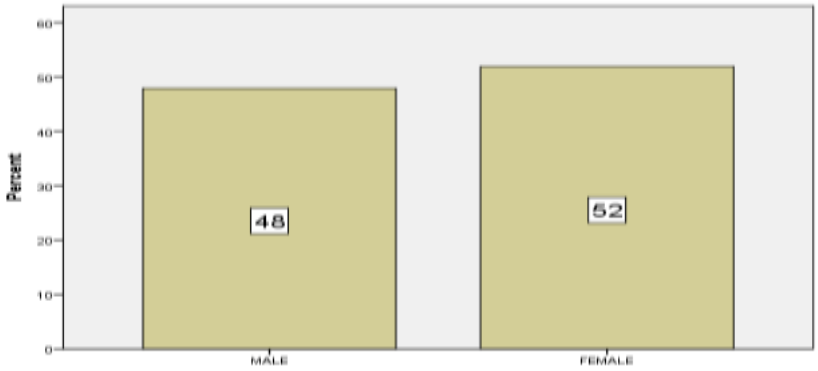

Figure 3: Sex Distribution of the Consumers
Source: Field survey, 2019

The figure above indicates the gender of the respondents from the study area. The figure indicates that, 52% of the respondents were female and 48% of the respondents represent the male's portion. This clearly indicates that, majority of the respondents from the study area were females while the remaining are males.

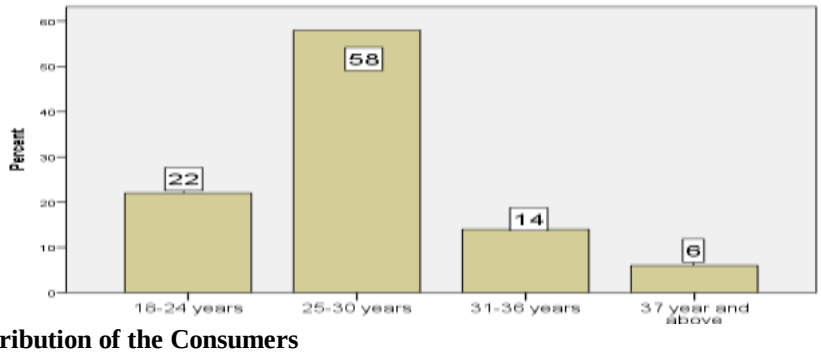

Figure 6: Age Distribution of the Consumers
Source: Field survey, 2019

The result on age distribution of the respondents is presented in the Figure above. As seen in the figure, majority of the respondent were in the age range of 25 –30 years and this represents 58% of the respondents. Some few (22%) of the respondents were in the age range of 18 –24 years, a few (14%) of the respondents were in the age group 31 –36 and only (6%) of the respondents are also in the age range of 37 years and above. This observation indicates that most of the respondents were in the active working group.

Table 3: Proximate Composition of Wheat and Cocoyam Muffins

Sample	Moisture	Ash	Fat	Protein	Carbohydrate
A	28.7±0.03	1.4±0.01	20.0±0.39	8.0±1.09	41.9±0.76
B	28.3±0.06	1.9±0.01	17.8±1.09	5.9±0.25	46.1±0.79
C	28.6±0.11	1.7±0.01	18.3±1.63	0.2±0.01	51.1±1.75

The table above presents the proximate composition of wheat-cocoyam flour supplemented muffins. The moisture content ranged from 28.3 to 28.7%, this may be due to the inconsistency of baking temperature and time, since it was the same baking condition that was used for all. The moisture content is considerably high and is not within the safe limits for the muffins in order to ensure shelf stability and also to prevent microbial contamination.

The protein content from the control (100% wheat flour is 8.0%). The wheat flour muffins has higher protein compared to 5.9% and 0.2% protein for wheat-cocoyam flour blends of 50:50 and 70:30 respectively. The protein content decreased with increased in the substitution level of cocoyam flour.

This could be due to the addition of flours from cocoyam. The protein content of the muffins can be improved by adding milk, butter and eggs content.

The ash content of the cookies increased from 1.4 to 1.9% with increase in the substitution of cocoyam flour. The increase in the ash content could make the product a good source of minerals as observed by other researchers.

Fat content decreased with increase in replacement percentage of wheat flour with cocoyam flour. In 100% wheat flour muffin, the fat content is 20.0% while 18.3 % and 17.8% for wheat-cocoyam flour blends of 70:30 and 50:50 respectively. This agrees with the findings of Darko et al (2010) in the effect of cocoyam flour on wheat flour cake characteristics.

The carbohydrate content increases with increased cocoyam flour from 41.9% in wheat flour muffins to 46.1% and 51.1% for wheat-cocoyam flour blends of 50:50 and 70:30 respectively.

4.2 Sensory Properties of the Muffins

The Mean sensory scores of muffin samples produced from varying percentage of cocoyam and wheat flour is shown in Table below.

Table 4: Sensory Properties of the Muffins

Samples	Colour	Aroma	Texture	Taste	Level of acceptability
A	4.44±1.13	4.06±0.87	3.78±1.11	4.48±0.76	4.86±0.50
B	3.24±1.18	3.80±1.03	3.88±1.04	3.24±0.96	4.32±0.81
C	3.36±1.18	3.80±1.03	3.60±1.20	4.06±1.10	4.50±0.70
LSD	1.207	1.721	1.408	2.417	1.844

Colour

The colour of the control sample (A) was significantly ($p \leq 0.05$) different from all other muffins samples (B and C) with the highest mean score of 4, that is "liked slightly". Samples (B and C) had the lowest mean score of 3.24 and 3.36 respectively which is "neither liked nor disliked".

Aroma

Aroma is another attribute that influences the acceptance of baked products. The control sample had the highest mean score of 4 that is "liked slightly". Sample (A and B) also had their mean score approximately 4 that is "liked slightly" There is no significant ($p \leq 0.05$) different between the control (A) from the other muffins samples produce from blended cocoyam flours (B and C)

Taste

The control sample (A) and sample (C) had the highest taste score of 4.0 which is "Liked slightly" and sample (B) was neither liked nor disliked with a taste score of 3. This result proves that both samples (A and C) were equally accepted in terms of taste. However, the control sample (A) and sample (C) were significantly ($p \leq 0.05$) different from sample (C). From the results, it could be observed that up to 30% of substitution with cocoyam flour could be accepted by the consumers (that is, "slightly liked" with mean score of 4.0).

Texture

It was observed that the texture of all the muffin samples (A, B and C) had approximately mean score 4.0 which is "liked slightly". There was no significant ($p \leq 0.05$) difference from the rest of the muffins samples including the control which were slightly liked.

Overall Acceptability

The quality of the muffins (Aroma, colour, texture and taste) indeed influence the overall acceptability of the muffins. The control sample (A) and sample (C) was significant ($p \leq 0.05$) different from samples (C) in the overall acceptability. The control sample (A) and sample (C) had the highest mean score of approximately 5.0 (liked very much) and sample (B) had the lowest score of approximately 4 (liked slightly).

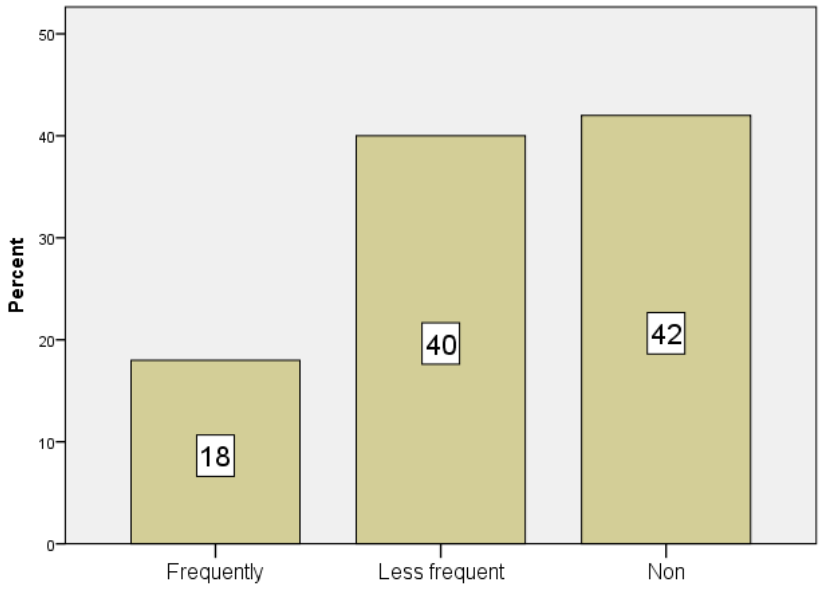

Figure 7: Consumption of Muffins
Source: Field survey, 2019

Figure 7 indicates the consumption level of muffins by consumers within a week. It was observed that, majority of the respondents (42%) were not in the interest of eating muffins even once a week. Some consumers (40%) said that they eat muffins less frequently within a week. However, few of the respondents (18%) indicate that they eat muffins frequently within a week. This observation testifies that majority of the respondents does no eat muffin from the study area

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Conclusion

Results from this research showed that cocoyam flour could be used in the production of quality muffins. Also, cocoyam flour could be used for substituting wheat flour up to 30% level in production of muffins without adversely affecting the sensory attributes of the products. Muffins made from 70% wheat flour and 30% cocoyam flour substitutions had average mean scores of approximately 5.0 and most of the attributes were slightly accepted by the respondents. Asides the control sample (A), sample (C) was the most accepted muffin sample by the respondents and had higher ratings in taste, aroma and texture with mean scores of approximately 4.0 for each attribute. The cocoyam flour also impacted a very good colour and nice aroma to the muffins which aided in increasing the overall acceptability of the muffins. The use of cocoyam flour to produce convenience foods like muffins will boost its production, utilization as well as the income of farmers and reduce the pressure on the use of wheat flour for muffins production.

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