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PROXIMATE COMPOSITION AND ACCEPTABILITY OF BREAD PRODUCED FROM BLENDS OF WHEAT AND MILLET FLOUR

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Abstract
The purpose of the study was to determine the proximate composition and consumer acceptability of prepared bread made with wheat and millet flour blends. The proximate and sensory properties of bread samples were made with varied proportions of 100:0%, 80:20%, 60:40%, 40:60%, and 20:80%. As a control, bread made with 100% wheat flour was used. The bread samples were prepared using AACCmethod. The protein content of wheat and composite flour bread samples ranged from 11.83-14.36% moisture,0.71-3.64% ash,11.07-11.50% protein, 5.07-10.15% crude fat,3.06-4.97% crude fiber and 56.05- 59.86% carbohydrate. The protein content of the bread samples varied greatly (P<0.05) from each other. A panel of twenty panelists was used to assess the colour, taste, texture, aroma, and overall acceptability of bread samples using a 9-point structured hedonic scale. The bread sample made with 100% wheat flour received the highest ratings. It was found that up to 20% millet flour can be included in wheat in pastry making without affecting the nutritional composition or sensory qualities.
Keywords: Composite flour, Millet, bread, nutritional composition, sensory evaluation

Introduction

Bread is a widely consumed cereal-based food that offers beneficial nutrients such as starch, protein, fiber, vitamins, and minerals (Bagdi et al., 2016; Callejo et al., 2016). Bread is also gaining popularity as a potential functional meal due to its widespread availability and usage (Irakli et al., 2015). Bread, on the other hand, is low in protein and high in carbohydrates, with a high glycemic index that can contribute to obesity, diabetes, and biliary-tract cancer (Larsson et al., 2016).Bread consumption is increasing in many countries, particularly in Sub-Saharan Africa, as a result of urbanization, but meeting the supply and demand of bread to fit consumer eating habits is a difficulty (Ayele et al., 2017). As a result of rising customer demand for high

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quality and healthful bakery products, the baking sector has the problem of creating bread with improved nutritional, physicochemical, and sensory properties (Mariotti et al., 2014).

A sequence of activities such as mixing, kneading, fermentation, proving, and baking are used to make bread from wheat flour, yeast, sugar, oil, salt, and water (Dewettinck et al., 2008). Though wheat is a temperate crop, it is impossible to discuss cereal grains in Africa without mentioning the rising demand for wheat flour in Africa, where the population is fed food that the country does not cultivate. Their little foreign exchange is being utilized to import wheat, machine spare parts, and foreign management to maintain and operate the flour mill (Hart et al., 1970).A lot of research has been done by several researchers (Odedeji and Odetayo, 2010) to make composite bread, which is bread made with wheat and non-wheat flours such as maize, millet, rice flour, and so on, to minimize the costly foreign exchange on wheat imports and flour mills.

Millions of economically disadvantaged individuals in Africa and Asia eat finger millet (Eleusinecorocana), which is one of the most important millets. Carbohydrates, protein, dietary fiber, vitamins B complex, and minerals including calcium, phosphorus, magnesium, and manganese are all abundant in it (OkwudiliUdeh et al., 2017). Finger millet has a higher nutritional fiber and mineral content than wheat and rice (Ramashia et al., 2018). Millet is mostly used in the United States, despite its promising potential as a food crop. Its nutritional and chemical qualities make it an excellent raw material for large-scale food manufacturing. It has a low glycaemic index and antioxidant activity, making it beneficial for celiac disease sufferers.The health advantages of millet and its potential as a dietary ingredient might be investigated further (Gulia et al., 2007; Basavaraj et al., 2010). Millets are underutilized due to the restricted dietary forms available and the absence of millet processing technologies (Shobana and Malleshi, 2007). In recent years, significant breakthroughs have been made to expand the diversity of uses for several native grain crops, including millet. In snacks and bakery items (Singh et al., 2012), noodles and pasta (Filli et al., 2011), and couscous,(Ma et al., 2014; Gull et al., 2015).Millet flour has been utilised to replace considerable amounts of wheat flour (Bora, 2013).

A prior study has shown that Finger Millet flour may be mixed with wheat flour in various amounts to prepare bread, biscuits, and snacks (Gavurnikova et al., 2011). The iron and calcium content of composite bread increases when wheat flour is partially replaced with flour from locally grown cereal grains (Oladele&Aina, 2009). Jensen et al. (2015) and Begum et al. (2011) found that replacing wheat flour with 30 and 20 percent cassava flour produced satisfactory composite bread with only a minor change when compared to 100% wheat flour bread. The purpose of the study was to assess the acceptability of bread made from wheat and millet flour blends.

Materials and Methods

Material Collection

Wheat flour and millet were purchased at Tafo market, while other materials such as granulated sugar, yeast, butter, salt etc where bought at a supermarket in Buokrom Estate both in Greater Kumasi, Ghana

Preparation of millet Flour

To grind finger millet grains into flour, the Jideani(2005) method was utilised. To eliminate foreign items and grit, 2 kg of grains were washed in distilled water. For 24 hours, the dehulled grains were dried at 50°C in a hot air oven dryer. In a Retsh ZM 200 ultra-centrifugal mill, the grains were milled for three minutes at 17000 x g and then passed through a mesh of less than 100 µm. After that, the millet flour was sealed in a polythene bag for use.

Formulation of composite flour

Five different bread samples were produced from wheat and finger millet flour blends in ratios, 100:0, 80:20, 60:40, 40:60 and 20:80. To achieve uniform mixing, the mixtures were carefully blended in a blender (Aboshora et al., 2016).Bread made completely of wheat flour served as the control sample.

Table 1: Formulation of ingredients for bread making

INGREDIENTS	A	B	C	D	E
Strong wheat flour (g)	100	80	60	40	20
Millet flour (g)	0	20	40	60	80
Sugar (g)	12	12	12	12	12
Yeast (g)	10	10	10	10	10
Salt (g)	1	1	1	1	1
Margarine (g)	10	10	10	10	10
Nutmeg (g)	1	1	1	1	1
Water (ml)	100	100	100	100	100

Keys: A(100% wheat flour), B(80% wheat flour and 20% millet flour), C(60% wheat flour and 40% millet flour), D(40% wheat flour and 60% millet flour) and E(20% wheat flour and 80% millet flour)

Bread making process

With minor adjustments, the straight dough method was utilized to prepare the bread from composite flours and 100% wheat flour using the (AACC, 2000) method. The bread was produced with wheat and millet composite flours, as shown in Table 1. All of the ingredients were manually mixed in a bowl with a little water to make soft dough, which was then kneaded and sheared for 15 minutes until it was consistent. The dough matured in a bowl covered with a simple polyethylene bag in a cabinet at 27°C and 75% relative humidity for 60 minutes. After 60 minutes, the dough was pressed back to remove any contained oxygen.The dough was then removed from the cabinet and divided into 100 g pieces, which were then molded by hand, proofed for 20 minutes, and baked for 20 minutes at 200°C. After cooling, the baked bread was placed in plastic bags for proximate and sensory evaluation.

Proximate Composition

AOAC (2000) was used to analyse the proximate composition (moisture, protein, fat, fiber, and carbohydrate) of the wheat-cocoyam-Bambara groundnut composite bread

Oven Drying Method Moisture Content and Total Solids

Two 2 grams (g) of the bread samples were transferred in to the previously dried and weighed dish. The bread was cooked for 5 hours at 105 degrees in a thermostatically controlled oven. The

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dish was removed and weighed after cooling to room temperature in a desiccator. It was then dried for another 30 minutes, chilled, and weighed once again. The process of drying, cooling, and weighing was repeated until the weight remained constant. (Alternatively, samples could be dried for at least 8 hours in a thermostatically controlled oven to produce a constant weight.) The results were double-checked, and the average was found.

Calculations

$$\% \text{ Moisture (wt/wt)} = \frac{\text{wt } H_2O \text{ in sample}}{\text{Wt of wet sample}} \times 100$$

$$\% \text{ Moisture (wt/wt)} = \frac{\text{wt of wet sample - wt of dry sample}}{\text{Wt of wet sample}} \times 100$$

$$\% \text{ Total solids (wt/wt)} = \frac{\text{wt of dried sample}}{\text{Wt of wet sample}} \times 100$$

Where wt = Weight of sample/spread

Ash content

Two grams (2g) of the bread sample was weighed into a tarred crucible and was pre-dried. Crucibles were placed in cool muffle furnace using tongs, gloves and protective eyewear. The crucibles Ignited for 2 hours at about 600 degrees Celsius. Muffle furnace was turned off and opened when temperature dropped to at least 250^{o}C preferably lower. The door was carefully opened to avoid losing ash that may be fluffy. Safety tongs was used to transfer crucibles to a desiccator with a porcelain plate and desiccant. Desiccator was closed and crucibles were allowed to cool prior to weighing.

Calculations

$$\%\text{Ash} = \frac{\text{wt of ash}}{\text{Wt of sample}} \times 100$$

$$\%\text{Ash} = \frac{\text{(wt of crucible + ash) – wt of empty crucible}}{\text{(wt of crucible + sample) – wt of empty crucible}} \times 100$$

Where wt = Weight of sample

Fat content: soxhlet extraction

Previously dried (air oven at 100°C) 250 ml round bottom flask was weighed accurately. Two grams (2g) of dried sample to 22 ×80mm paper thimble or a folded filter paper was weighed. A small piece of cotton or glass wool was placed into the thimble to prevent loss of the sample; 150ml of petroleum spirit B.P 40-60°C was added to the round bottom flask and assembled the apparatus. A condenser was connected to the soxhlet extractor and reflux for 4 - 6 hours on the heating mantle. After extraction, thimble was removed and recovered solvent by distillation. The flask and fat/oil was heated in an oven at about 103°C to evaporate the solvent. The flask and contents were cooled to room temperature in a desiccator. The flask was weighed to determine weight of fat/oil collected.

$$\% \text{ Fat (dry basis)} = \frac{\text{fat/oil collected} \times 100}{\text{Weight of sample}}$$

$$\% \text{ Fat (dry basis)} = \frac{\text{(wt of flask + oil) – wt. of flask} \times 100}{\text{Weight of sample}}$$

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Crude fibre determination

Two grams (2g) of the sample from crude fat determination was weighed into a 750ml Erlenmeyer flask. Two hundred milliliters (200ml) of 1.25% H_2SO_4 was addedand immediately flask was set on hot plate and connected to the condenser. The contents were boiled within 1 minute of contact with solution. At the end of 30 minutes, flask was removed and immediately filtered through linen cloth in funnel and washed with a large volume of water. Filtrate (containing sample from acid hydrolysis) was washed and returned into the flask with 200ml 1.25% NaOH solutions. Flask was connected to the condenser and was boiled for exactly 30 minutes. It was then filtered through Fischer's crucible and washed thoroughly with water and added 15ml 96% alcohol. Crucible and contents was dried for 2 hour at 105 °C and cooled in desiccator and it was weighed. Crucible was ignited in a furnace for 30 minutes and after that it was cooled and reweighed.

$$\% \text{ Crude fibre} = \frac{\text{weight of crude fibre} \times 100}{\text{Weight of sample}}$$

$$\% \text{ Crude fibre} = \frac{\text{wt of crucible + sample (before – after) ashing} \times 100}{\text{Weight of sample}}$$

Where wt= Weight of sample/spread

Protein Determination

Digestion Method

The Kjeldahl technique was used to determine the crude protein content of the samples. The process consists of three fundamental steps: (1) digestion of the sample in sulfuric acid with a catalyst, which results in nitrogen conversion to ammonia; (2) distillation of the ammonia into a trapping solution; and (3) titration of the ammonia with a standard solution to determine its concentration. Percentage of crude protein content of the samples equals percentage nitrogen 6.25, according to this approach.

Carbohydrate content

The calculation of available carbohydrate (nitrogen-free extract-NFE) was made after completing the analysis for ash, crude fibre, ether extract and crude protein. The calculation was made by adding the percentage values on dry matter basis of these analysed contents and subtracting them from 100%.

Calculation:

$$\text{Carbohydrate (\%)} = 100 - (\% \text{ moisture} + \% \text{ fat} + \% \text{ protein} + \% \text{ ash})$$

x. $$\text{Calculation for dry basis} = \frac{(100 - \% \text{ moisture}) \times \text{wet basis}}{100}$$

Sensory Analysis

The sensory aspects of the bread were evaluated using a 9-point hedonic scale scored 1–9 (1 = highly detest, 9 = extremely like). Twenty (20) semi-trained panelists judged the flavor, color, texture, taste, and overall acceptability of the product (Iwe 2002). The panelists were provided with the bread samples in a randomised order, with distilled water for mouth rinse after each sample taste. The panelists were asked to rank the traits based on how much they liked or disliked them.

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Statistical Analysis

A one-way Analysis of Variance (ANOVA) was performed on the data. Duncan's Multiple Range Test was performed to separate the means using the Statistical Package for the Social Sciences (SPSS) version 20. The significance threshold was set at P<0.05.

RESULTS AND DISCUSSION

The nutritional profile of bread enriched with millet flour is detailed in Table 2. The proximate composition of composite bread contains 11.83-13.73% moisture, 0.71-3.42 % ash, 11.07-11.39% crude protein, 5.07-8.88% crude fat content, 3.59-4.97% crude fiber, and 57.00-59.86% carbohydrate, while the content of moisture, ash, crude fat, crude protein, crude fiber, and carbohydrate in control sample bread was 14.36%, 3.64%, 11.50%, respectively. The results demonstrated that substituting millet flour for wheat flour has no significant effect on moisture, ash, protein, or fat content. Increased finger millet flour integration resulted in a significant reduction in moisture, ash, protein, and fat in the supplemented bread (p>0.05). It could be due to a decrease in the amount of gluten in the dough, which is an important protein for maintaining the elastic qualities of bread dough and assuring increased bread volume. However, there was a significant difference (p<0.05) between the control and all of the improved bread in all of the proximate analyses. However, substituting millet flour for wheat flour resulted in a modest increase in the bread's fiber and carbohydrate contents. The presence of several minerals in millet could explain why enriched bread has a higher carbohydrate and fiber content. Adubofuor et al., (2016) reported that simple wheat bread has moisture of 27.4%, protein of 5.96 %, fat of 7.19 %, crude fiber of 0.49 %, ash of 2.22%, and carbohydrate of 57.17%. It could be seen in (Table 2) that the moisture content of all types of bread was more or less similar. The carbohydrate level of the control bread sample was found to be the lowest, while the carbohydrate content of composite bread samples was reported to be the highest. Pawase et al. (2020), who studied the effect of Nigella sativa fortification in cookies, found comparable results in terms of moisture and carbohydrate content.The findings also support that of Rajiv et al. (2011) who found that adding finger millet flour to muffins decreased the protein and fat levels

Table 2: Proximate composition of wheat and millet blended bread

Sample	**Moisture**(g/100g)	**Ash**(g/100g)	**Protein**(g/100g)	**Fat**(g/100 g)	**Fibre**(g/100 g)	**CHO**(g/100 g)
A	14.36	3.64	11.50	10.15	3.06	56.05
B	13.73	3.42	11.39	8.88	3.54	57.00
C	13.09	3.20	11.28	7.61	4.02	57.93
D	12.46	2.99	11.17	6.34	4.49	58.91
E	11.83	0.71	11.07	5.07	4.97	59.86

Values represent means and standard deviation replicate readings for various parameters. Values in the same column with different superscripts are significantly different (p>0.05). Keys: A(100% wheat flour), B(80% wheat flour and 20% millet flour), C(60% wheat flour and 40% millet flour), D(40% wheat flour and 60% millet flour) and E(20% wheat flourand 80% millet flour)

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Sensory evaluation of wheat and millet blended bread

The sensory evaluation of millet-wheat composite flour bread in Table 3 demonstrated that the quantity of millet utilized affected the rating of the various breads, regardless of variation (Table 3). The control sample bread (100% wheat flour) and the composite bread samples exhibited a significant difference (p<0.05) in the various parameters examined. However, the main effect of variety and substitution level on the various qualities was considerable. Increasing the proportion of millet in the composite flour resulted in poorer attribute and acceptability scores for colour, aroma, and texture, according to the main effect of substitution level. The sensory evaluation of colour of the bread samples ranged from 4.56 to 8.60.The bread sample (A) produced entirely of wheat flour had the highest mean color score (8.60), while the bread sample E (20 percent wheat flour and 80 percent millet flour) had the lowest (4.56). According to Ayenor (1985) and Otegbayo et al. (2005), a flaw in the perceived texture of food has a significant detrimental impact on the consumers' hedonic response to the dish.As a result, the significant difference in texture observed in the fortified bread sample is likely due to millet flour inclusion, which lowers the overall gluten content of wheat flour. As the millet flour ratio increases, the gluten content in wheat flour is diluted, resulting in a reduction in dough rising capacity during proofing, resulting in a relatively hard texture. However, incorporationof millet flour up to 20% results in good-quality bread and an acceptable product.

Table 3: Sensory evaluation of wheat and millet blended bread

Sample	Colour	Aroma	Texture	Taste	Overall Acceptability
A	8.60	8.70	8.65	8.20	8.70
B	7.50	8.69	8.63	8.22	8.73
C	6.35	8.54	8.56	8.38	8.58
D	5.30	7.78	7.48	7.55	7.54
E	4.56	6.81	6.40	6.60	5.64

Values represent means and standard deviation replicate readings for various parameters. Values in the same column with different superscripts are significantly different (p>0.05). Keys: A(100% wheat flour), B(80% wheat flour and 20% millet flour), C(60% wheat flour and 40% millet flour), D(40% wheat flour and 60% millet flour) and E(20% wheat flour and 80% millet flour)

Conclusion

The results showed that substituting millet flour for wheat flour has no influence on moisture, ash, protein, or fat content. In the enriched bread samples, increased finger millet flour integration resulted in a substantial reduction in moisture, ash, protein, and fat (p>0.05). Except for MN2, all fortified bread samples showed a significant change in nutritional composition and consumer acceptance when compared to the control sample. As the millet flour ratio increases, the gluten content in wheat flour decreases, resulting in a loss in dough rising ability during proofing and a somewhat hard texture. However, including up to 20% millet flour resulted in good-quality bread and an acceptable product.

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