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Quality Characteristics Of Bread Made With Wheat, Plantain And Pigeon Peas

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Abstract

The goal of this study was to determine the proximate composition and consumer acceptability of 100% wheat bread and supplemented bread from composite flour of wheat, pigeon peas, and plantain in a ratio of 100:0:0, 90:4:6, 80:8:12, 70:10:20 and 60:15:25 respectively. Five bread samples were prepared and coded as PO1, PO2, PO3, PO4, and PO5, with the PO1 acting as a control. The AOAC (2005) techniques were used to determine the protein, fat, ash, moisture, and crude fiber content of bread samples. A 30-member panel of semi-trained Hospitality Management students evaluated the bread samples. Data were subjected to a one-way ANOVA and the means were separated using Fisher's Least Significant Difference test (LSD) at $p<0.05$. With the addition of pigeon pea and plantain flours, proximate composition revealed substantial ($p<0.05$) increases in fat (2.09-2.44%), fiber (1.80-2.05%), ash (1.15-1.48%) and protein (9.6-12.86%). However, there were considerable reductions in moisture (26.94-20.47%) and carbohydrate (76.54-70.44%) contents. The proximate compositions of the composite bread samples were statistically different from the control ($p<0.05$). The sensory evaluation of the bread samples revealed that the bread sample produced from a partial replacement of pigeon and plantain flour 8% and 12% was highly rated in terms of texture, taste, and overall acceptability.

Keywords: composite flour, pigeon peas flour, plantain flour, composite bread, proximate composition

Introduction

Bread is prepared by baking dough with wheat flour, water, yeast, and salt as the primary ingredients (Kent, 1983). Fat, sugar, soya flours or other grains, vitamins, milk, and fruits are among the elements that can be added to the dough. Without further processing, the resulting bread can be eaten. It is usually well-packaged and easy to transport, and because of its low fat level (Kent, 1983). Bread is also tasty, and because of its high carbohydrate and gluten content, it is related with a lower blood cholesterol level (Kent, 1983). Wheat flour (Triticumaestivum) is popular flour in the confectionery industry because of its elastic gluten protein, which aids in the production of a big loaf volume with a regular and finely crumb structure (Dabels et al., 2016). Composite flour is a blend of flours made from roots, tubers, cereals, and legumes, with or without wheat flour added (Julianti et al., 2015).

In Africa, the pigeon pea (Cajanuscajan) is an important yet underutilized legume (Fasoyiro&Arowora, 2013). It is drought tolerant and adaptable to a variety of environmental situations (Troedson et al., 1990). It includes 20%–22% of all necessary amino acids, notably lysine, and 18%–35% protein, making it ideal for combating protein-energy malnutrition in Nigeria (Elegbede, 1998; Okpala&Okoli, 2011). Cajanuscajan is an in expensive vegetable protein, mineral, and vitamin source that plays a significant role in human nutrition (Sangle, 2015).Adeyanju et al., (2018) have reported on the usage of pigeon pea in the replenishment of starchy foods, but there has been less research on adding plantain flour.

Because of its adaptability and nutritional worth, plantain (Musa paradisiaca) is a popular dietary staple. It is a less sweet, starchy banana cultivar that can be utilized ripe or unripe. It is a good source of energy, with carbohydrates accounting for roughly 32% of the total fruit weight, making it comparable to yam or potato in terms of nutritional value, and it's also high in iron, dietary fiber, calcium, vitamin A, B6, and C (Adegunwa et al., 2014). It is one of the most important sources of food energy in West and Central Africa, where plantains provide more than a quarter of a person's carbohydrate (IITA, 2014). Plantain is abundant in dietary fiber, which decreases serum cholesterol and lowers the risk of heart attack, obesity, blood pressure, appendicitis, and a variety of other ailments when consumed in human diets (Rehianan et al.,2004).

The nutritional quality of any cereal food can be increased by supplementing it with legumes because cereal proteins are weak in lysine. The use of pigeon peas, wheat, and plantain flour mixes in bread production could improve people's nutritional status, lessen reliance on imported wheat flour in areas where wheat isn't grown, and save the government money on foreign exchange. It will also allow us to make better use of the crops that we have on hand. Consumers' nutritional status is projected to improve as a result of the use of composite flours in food (Almanza-Bentiez et al., 2015). Composite flour technology is essential because it has the potential to save a lot of money by reducing the amount of money spent on wheat flour imports and allowing underutilized crops to be used (Arise et al., 2017). As a result, the development of composite flours is aimed at improving both economy and nutrition, necessitating the ongoing search for wheat additions. The objective of this study was therefore to determine the proximate composition, and sensory assessment of bread fortified with plantain and pigeon peas flour.

Materials and Methods

Materials

A shop outlet in Kumasi Central Market, Ghana, sold the pigeon pea, wheat flour, and plantain. All additional baking itemssuch as yeast, margarine, milk powder, sugar, salt, and nutmeg were bought from a supermarket in Tafo Municipal, Kumasi, Ghana.

Sample preparation

Pigeon pea flour (PF)

According to Echendu et al., (2004), the PF was produced after cleaning and soaking in water for 24 hours, the pigeon peas were dehulled by hand. The seeds were rinsed in portable water and oven dried at 50^{o}Cfor

12 hours (Beruk, 2015). The dry grains were ground until they were fine enough to pass through a sieve with a mesh size of 100 mm.

Preparation of plantain flour

Plantains (Musa paradisiaca) were hand peeled with kitchen knife and was cut into uniform pieces of roughly 1.5mm thickness following the Adeniji et al. (2007) process. The slices were dried for 24 hours at 105°C to achieve a consistent weight before being milled into flour with Philip's blender. After that, the flour was sieved using a 500-mesh sieve to obtain a fine, smooth grained flour. The flour was packaged in a plastic container and stored at 4° C until composite flours were needed.

Preparation of composite flour

The three different flours (wheat, Pigeon peas, and plantain) were combined to make composite flour (Hugo, 2003) Table 1. Combinations were PO1 (100%wheat flour, 0% pigeon peas and 0% plantain), PO2 (90% wheat,4% pigeon and 6% plantain), PO3 (80% wheat,8% pigeon peas and 12% plantain), PO4 (70%wheat, 10% pigeon peas and 20% plantain) and PO5 (60%wheat,15% pigeon peas and 25% plantain). As a control, one hundred percent (100%) wheat flour was used. Until the products were prepared and analysed, the flours were stored in transparent plastic containers.

Table 1: Ingredients for bread making

INGREDIENTS	A	B	C	D	E
Strong wheat flour (g)	100	90	80	70	60
pigeonpeas (g)	0	4	8	10	15
Plantain flour (g)	0	6	12	20	12
Sugar (g)	10	10	10	10	10
Yeast (g)	5	5	5	5	5
Salt (g)	0.5	0.5	0.5	0.5	0.5
Margarine (g)	10	10	10	10	10
Nutmeg (g)	2	2	2	2	2
Milk powder (g)	10	10	10	10	10
Water (ml)	120	120	120	120	120

Keys: PO1 (100% wheat flour, 0% pigeon peas and 0% plantain), PO2 (90% wheat, 4% pigeon and 6% plantain), PO3 (80% wheat, 8% pigeon peas and 12% plantain), PO4 (70% wheat, 10% pigeon peas and 20% plantain) and PO5 (60% wheat, 15% pigeon peas and 25% plantain).

Method of production

Varying quantities of wheat-pigeon pea-plantain flour blends were used to make the bread loaves, which were made using different ratios of wheat, pigeon pea, and plantain flour (Table1). Following that, the bread samples were prepared and baked using the procedure outlined by Adebowale et al. (2003). Weighed ingredients such as wheat, sugar, yeast, margarine, salt, milk powder and nutmeg were put together in a mixing bowl. Water was incorporated into the mixture to develop soft dough. The dough

was kneaded till it was free from sticking. It was proofed in a warm place for about 50 minutes at 30°C with a relative humidity of about 40%. After that, it was knocked back to expel any carbon dioxide. The dough was portioned, moulded and placed in a well-greased baking pan, and was then baked for 20 minutes at a temperature of 220-230°C in a baking oven. The same procedure was used for the composite bread samples. For proximate analysis and sensory evaluation, the baked loaves were taken from the tins, cooled, and packed.

Proximate analysis of bread

The AOAC (2005) techniques were used to determine the protein, fat, ash, moisture, and crude fiber content of bread loaves. Differences were used to determine carbohydrate content, and the analyses were done twice.

Sensory Evaluation

To determine which bread samples were the most accepted, a sensory study was conducted. The bread samples were judged by a 30-member panel of semi-trained Hospitality Management students. Bread samples were evaluated using parameters such as colour, flavour, taste, hardness, and general acceptability. Panelists worked in partitioned booths with no airflow, or no noise and under off-white light to mask the bread samples' varied attributes and therefore avoid prejudice. A nine-point hedonic scale was used to compare the differences between the bread samples.

Statistical data analysis

The data gathered were evaluated using SPSS version 20. A one-way ANOVA was used to look at the differences in the bread samples' proximate composition and sensory attributes. The means were separated using Fisher's Least Significant Difference test (LSD) at $p<0.05$.

Results and Discussion

Proximate composition of wheat, pigeon peas and plantain bread

Table 2 shows the results of the proximate composition of bread made from wheat-pigeon pea-plantain flour blends. The moisture level of the whole wheat bread and the supplemented bread samples ranged from 20.47 to 26.94%. Sample PO1 (100% wheat flour, 0% pigeon peas and 0% plantain) had the highest percentage of moisture (26.94%), while sample PO5 (60% wheat, 15% pigeon peas and 25% plantain) recorded the lowest percentage of moisture (20.47%). It was observed that when the composite flour blends increase it resulted in a corresponding decreased in the moisture contents of the composite bread samples. These findings are inconsistent with those of Udeme et al. (2014), who discovered that bread made from wheat potato flour blends showed an increasing tendency as supplementation levels increased. There were significant differences in all of the bread samples ($p<0.05$).

Fat content of the various bread samples ranged from 2.09-2.44% with sample PO5 (60% wheat, 15% pigeon peas and 25% plantain) having the highest percentage of fat (2.44) followed by bread sample PO4 (70% wheat, 10% pigeon peas and 20% plantain) with (2.38%). The lowest fat was recorded by the control sample PO1 (100% wheat flour, 0% pigeon peas and 0% plantain) with 2.09%. When the amount of pigeon

peas and plantain flour was increased, the fat levels increased. There were significant differences between the control bread sample and the composite samples ($p<0.05$).

All bread samples had crude fibre content ranging from 1.80 to 2.05%, with the composite bread sample PO5 (60% wheat, 15% pigeon peas and 25% plantain) having the greatest fibre content (2.44%). The fibre content of the 100 % wheat flour bread was low (1.80%), which contrasts with that discovered by Kayode et al 1995 in 100% wheat flour bread. The rise in plantain flour could be linked to the higher crude fibre content. This result is consistent with Adeola et al.'s (2017) findings. Fibre has several health benefits (Rehinan et al., 2004). The crude fibre content of plantain flour, according to Rehinan et al., (2004), indicates that when added to a human diet, they can help lower serum cholesterol, reduce the risk of heart attack, colon cancer, obesity, blood pressure, appendicitis, and many other disorders.

The ash level of the bread increased with the proportion of substitution, with values ranging from 1.15-1.48% and 1.80% of ash was found in the control sample bread. Composite bread sample PO5 (60% wheat, 15% pigeon peas, and 25% plantain) had the greatest value (1.48%), whereas control sample PO1 (100% wheat flour, 0% pigeon peas, and 0% plantain) recorded the lowest ash content (1.15%). The ash content of the composite bread samples increased as the quantity of pigeon peas and plantain flour in the samples increased. There were significant changes at $p<0.05$ in all the bread samples.

The bread samples had a protein composition that ranged from 9.6% to 12.86%. The bread sample with the highest protein content was made with 60% wheat, 15% pigeon peas, and 25% plantain flour blends. The protein level of the composite bread samples was higher than the protein content of bread made with 100% wheat flour. The protein value of the composite bread rises when the percentage of pigeon peas and plantain flour in the bread is increased. This mean value recorded is higher than the qualitative features of cookies made from composite flours of unripe plantain, wheat, and watermelon seed blends reported by Racheal and Margaret (2016), which ranged from 1.14 to 3.69%. There is a significant difference ($p <0.05$) between the samples.

The carbohydrate content of the bread samples ranged from 70.44% to 76.54%, with the control bread sample recording the highest mean value of 76.54% while the lowest was found in bread sample PO5 (60% wheat, 15% pigeon peas and 25% plantain) with 70.44%. The carbohydrate content in the composite bread samples reduced drastically, from 76.54 to 70.44% when pigeon peas and plantain flour blends increased. The drop could be related to the reduction in wheat flour in the composite bread samples. Dabels et al. (2016) found similar results in their composite cookies. The carbohydrate value differed significantly ($p<0.05$) between the bread samples.

Table 2: Proximate composition of wheat, pigeon peas and plantain bread

Sample	**Moisture**(g/100 g)	**Fat**(g/100 g)	**Fiber**(g/100 g)	**Ash**(g/100 g)	**Protein**(g/100 g)	**CHO**(g/100 g)
PO1	26.94	2.09	1.80	1.15	9.6	76.54
PO2	25.32	2.17	1.85	1.21	10.45	75.02
PO3	23.70	2.25	1.90	1.31	11.26	73.50
PO4	22.11	2.38	2.03	1.37	11.94	71.93
PO5	20.47	2.44	2.05	1.48	12.86	70.44

Keys: PO1 (100% wheat flour, 0% pigeon peas and 0% plantain), PO2 (90% wheat, 4% pigeon and 6% plantain), PO3 (80% wheat, 8% pigeon peas and 12% plantain), PO4 (70% wheat, 10% pigeon peas and 20% plantain) and PO5 (60% wheat, 15% pigeon peas and 25% plantain).

Sensoryanalysis of wheat and composite bread samples

Table 3 shows the results of the sensory qualities of bread samples. The sensory test revealed that 100% wheat bread had the best colour and aroma. The bread made with 80% wheat, 8% pigeon peas and 12% plantain flour was the most popular in terms of texture, taste and overall acceptability. However, there were no significant changes in the aroma, taste and overall acceptance of the bread between samples PO1 and PO2 ($p > 0.05$) but there were significant differences between the control bread sample and bread samples PO3, PO4 and PO5.

The overall acceptability of the fivebread samples as judged by the 30-member panel demonstrates that composite-based bread product PO3 (80% wheat, 8% pigeon peas and 12% plantain) outperformed the one made with the 100% wheat flour (control). The acceptance rating for bread sample PO3 was statistically different ($p>0.05$) than the control. In contrast, samples with a replacement level of 8and 12% were comparable to the control, indicating that this degree of substitution is best for bread production. This means that in bread bakery applications, up to 8% and 12% pigeon peas and plantain flour blends can be replaced with wheat flour. Despite this finding, increasing the percentage of pigeon peas and plantain flour in bread making more than 8% and 12% reduced the preference rating marginally.

Table 3: Sensory evaluation of wheat, pigeon peas and plantain bread

Sample	Colour	Aroma	Texture	Taste	Overall Acceptability
PO1	8.30	8.40	8.56	8.20	8.50
PO2	8.00	8.22	8.36	8.22	8.53
PO3	7.35	8.01	8.65	8.38	8.57
PO4	6.30	7.87	7.84	7.54	7.45
PO5	5.50	6.18	6.30	6.50	6.46

Conclusion

The study found that a blend of wheat, pigeon peas, and plantain flour blends can be used to make satisfactory bread. With the addition of pigeon peas and plantain flour, the fat, ash, fiber, and protein contents of the bread samples increased intensely. Bread samples manufactured with 80% wheat, 8% pigeon peas, and 12% plantain received a higher rating than bread made with 100% wheat flour in terms of texture, taste, and overall acceptability. The study concludes that acceptable bread could be produced from pigeon peas and plantain flour blends up to 8% and 12% with no adverse effect on the consumer acceptability and nutritional content**.**

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