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QUALITY EVALUATION OF BREAD MADE FROM SWEET POTATOES AND WHEAT COMPOSITE FLOUR

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ABSTRACT

Sweet potato is a source of protein and energy in the human diet. To increase its industrial application, sweet potato flour (SPF) has been produced for use in bakery products. The effect of inclusion of SPF in bread making at different wheat-potato blend ratios was studied. SPF was produced by washing, peeling, blanching, cutting, drying and milling (in that order) of the freshly harvested potato roots. Bread samples were produced from the blend of SPF and wheat flour at the following ratios: 5:95, 10:90, 15:85 and 20:80 respectively with bread from 100% wheat serving as control. Proximate analysis, anti-nutrient analysis and sensory evaluation were carried out on the bread samples while the wet gluten content and water absorption capacity was carried out on the flour sample. The result of the proximate composition showed that, as SPF percentage increased, moisture, protein, fat and fibre of bread increased while ash and carbohydrate decreased. Wet gluten decreased and water absorption capacity increased as the SPF increased with values ranging from 20.11 - 10.00g/100g and 50.65 - 80.65ml/100g respectively. The phytate, tannins and phenolic content were at the range of 0.10 - 0.27mg/g, 0.09 - 0.28mg/g, and 0.27 - 0.31mg/100g respectively. For sensory evaluation, though the control sample was the most preferred, no panellist showed a dislike for any attribute evaluated in the substituted samples. Hence, SPF could be used to substitute up to 20% of wheat flour in bread making without adversely affecting the quality or acceptance of the bread.

Keywords: Sweet potato, Bread, Proximate, Anti-nutrient, Sensory

INTRODUCTION

Sweet potato (*Ipomoea batatas*) is a tuber of tropical and subtropical climate with distinct characteristics such as easy cultivation by both large and small-scale farmers, with low production cost, great adaptability and resistance to diseases which makes it important for the agribusiness in developing countries. (Nogueira *et al.*, 2018). The development of appealing processed products from sweet potato plays a major role in raising awareness on the potential use of the crop around the world. Flour from sweet potato can serve as source of nutrients (carbohydrates, protein, dietary fibre, beta-carotene, minerals (Ca, P, Fe and K) and can also add natural sweetness, color and flavor to processed food products (Woolfe, 1992). It can thus be used as a substitute for wheat in bakery products. Countries like Nigeria spend a large amount of foreign exchange on wheat importation because the production of wheat is limited. Healthwise, there is an increasing awareness of reducing wheat consumption due to its high glycemic index and high gluten content. To achieve a reduction in wheat importation and improve nutritive value of bakery products, studies have been conducted on the use of composite flours, which consist of blending wheat flour with flours from legumes, oilseeds, cereals, or tubers. The use of composite flour is advantageous in bread making for developing countries as it promotes high-yielding native plant species, increases nutritional values and enhances domestic agricultural production (Jolaosho, 2010). Ijah *et al*, (2014) reported that composite flours made from tropical root and tubers such as cassava, yam and sweet potatoes produced good quality bread. The objective of this work is to assess the quality of bread produced from sweet potato-wheat composite flour.

MATERIALS AND METHODS

Collection of Samples

The dry starchy yellow-fleshed cultivar of sweet potato (*Ipomea batatas*) and wheat flour were purchased from Ojota market, Ikorodu road, Lagos State, Nigeria, in polythene bags, and transported to the laboratory for processing.

Production of sweet potato flour and composite flour

The sweet potato flour was prepared using the method of Adeleke and Odedeji (2010). The flour was packaged in a well labelled flour sack until required for composite flour preparation. Five blends were prepared by homogenously mixing sweet potato flour with wheat flour in the percentage proportions: 0:100, 5:95, 10:90, 15:85 and 20:100 (PF: WF) using a Kenwood food processor (Model A 907 D, Kenwood Ltd, England).

Bread production

All blend formulations were baked using straight dough method. The ingredients used included improver (1.5%), sugar (6%), salt (0.9%), yeast (0.6%), and water (43.6%). Bread with 100% wheat flour was the control. All ingredients were mixed, the dough was kneaded manually for 20mins, moulded and proofed for 90 minutes at 30^0C and baked in a gas oven at 250^0C for 30minutes.

Proximate Composition of Bread samples

The moisture, protein, ash, fat, fibre and carbohydrate contents of the bread samples were determined using the procedure described by AOAC, 2005. Protein content was determined by the Kjeldahl-Nitrogen analysis procedure, using 6.25 as a conversion factor while the crude fat was determined using the Soxhlet extractor. The carbohydrate content was obtained by difference.

Functional properties of the composite flour

The gluten amount was evaluated by the standard method of AACC, test procedure (AACC, 2000). Water absorption capacity was determined using the centrifuge method of Edema *et al.,* (2005).

Evaluation of the physical properties of bread samples: The loaf volume (VL) was measured by using seed displacement method (Mepba *et al.,* 2000). Loaf Weight (W) of bread were measured after cooling for one hour on weighing scale. The specific volume (volume to mass ratio) (cm^3/g) was thereafter calculated.

Anti-nutrients composition of Bread

The tannin, phytate and phenolic contents were determined using methods AOAC (2005).

Sensory Evaluation

Sensory Evaluation was performed within 24 hours after baking. The bread loaves were cut into slices and placed in white plates and the samples were coded. The mouth feel, taste, aroma, appearance and overall acceptability of the bread samples were evaluated. Twenty (20) semi-trained panellists composing of the students who are bread eaters were used for the test. The bread samples were scored using 9- point hedonic scale where 1= dislike extremely and 9-like extremely.

Data analysis

Results were subjected to analysis of variance ($p<0.05$). The Duncan (1955) multiple range test was then used to separate means. Statistical analysis was done using SPSS 17.

RESULTS AND DISCUSSION

Proximate Composition

Mean moisture content (Table 1) of bread ranged from 23.40 - 31.47%. Bread sample (20:80) with the highest sweet potato flour substitution level had the highest value (31.47%) while the control bread (0:100) had the lowest value (23.40%). The moisture content significantly increased ($p<0.05$) as substitution level of sweet potato flour increased. This is in line with reports by Aniedu and Agugo (2010) and Endrias *et al.,* (2016). The moisture contents of the bread samples are important as high moisture content leads to spoilage of food products.

The protein content (Table 1) ranged from 8.04 - 22.69%. The sample with 20:80 ratio had the highest value of protein content while the control bread sample (0:100) had the least protein content. Sweet potato is not rich in protein so this may be due to the effect of using nitrogen fertilizers which helps to improve the yield and nutrient composition of root tubers, especially sweet potato (Constantin *et al*., 1984).

The Ash content (Table 1) of bread sample decreased with an increase in substitution with sweet potato flour though not significantly statistically. Ash gives an idea of the amount of mineral elements present in food sample, this implies that substituting wheat flour with sweet potato flour might not significantly affect the mineral composition.

The fat content (Table 1) ranged from 0.54 - 1.97%. The control Sample (0:100) had the lowest fat content while sample 20:80 had the highest. The fat content significantly increased ($p<0.05$) with increasing level of substitution.

The fibre content (Table 1) ranged from 0.27 - 1.65%. The control sample coded (0:100) had the least fibre content (0.27%) while the bread sample 20:80 had the highest value of fibre content (1.65%). The fibre contents increased significantly ($p<0.05$) as substitution level increased. This could be due to high quality of fibre in sweet potato flour than that of wheat flour as was reported by Aniedu and Agugo (2010), El-zainy *et al*., (2010) and Endrias *et al*., (2016).

The carbohydrates content (Table 1) of bread ranged from 40.72 - 65.9%. The control sample (0:100) had the highest carbohydrate content (65.9%) while bread sample (20:80) has the least (40.72%).

Table 1: Proximate Composition of the bread samples

Sample (PF:WF)	Moisture (%)	Protein (%)	Ash (%)	Fat (%)	Fibre (%)	Carbohydrate (%)
0:100	23.40 ± 1.31^{ab}	8.04 ± 1.24^{a}	1.88 ± 0.29^{a}	0.54 ± 0.03^{a}	0.27 ± 0.20^{a}	65.91 ± 1.35^{d}
5:95	24.93 ± 1.42^{ab}	10.44 ± 0.24^{ab}	1.67 ± 0.29^{a}	0.85 ± 0.04^{b}	0.41 ± 0.11^{b}	65.69 ± 1.21^{d}
10:90	26.40 ± 0.20^{bc}	12.84 ± 1.06^{b}	1.67 ± 0.29^{a}	0.95 ± 0.0^{b}	0.45 ± 0.10^{ab}	57.70 ± 1.26^{c}
15:85	28.67 ± 2.12^{cd}	20.74 ± 2.19^{c}	1.50 ± 0.00^{a}	1.80 ± 0.08^{c}	0.65 ± 0.01^{b}	46.63 ± 0.58^{b}
20:80	31.47 ± 2.53^{d}	22.69 ± 2.38^{c}	1.50 ± 0.00^{a}	1.97 ± 0.07^{b}	1.65 ± 0.41^{c}	40.72 ± 3.93^{a}

Mean with superscripts on the same column are significantly different at ($p<0.05$)

Functional properties of Flour

The wet gluten content (Table 2) of the bread significantly ($p<0.05$) decreased from 20.11g/100g to 10.00g/100g from 0 to 20% substitution respectively. Generally, the mean wet gluten content significantly $p<0.05$) decreased as the level of sweet potato flour increased. This is expected as potato flour does not contain gluten. This report is similar to that of Kun-Lun *et al.,* (2009) and Endrias *et al.,* (2016)

The water absorption value (Table 2) of control and flour blends ranged from 50.65 - 80.00ml/100g. The water absorption capacity was significantly ($p<0.05$) increased as the level of sweet potato flour substitution increased. This compared favourably with the report of El-Zainy *et al.,* (2010), Singh *et al.,* (2008) and Endrias *et al.,* (2016).

Table 2: Functional properties of the composite flour

Sample (PF:WF)	Wet Gluten content (g/100g)	Water absorption capacity (ml/100g)
0:100	20.11 ± 0.25^{a}	50.65 ± 0.25^{e}
5:95	18.06 ± 0.10^{b}	57.02 ± 0.19^{d}
10:90	15.01 ± 0.19^{c}	65.60 ± 0.42^{c}
15:85	13.09 ± 0.15^{d}	72.08 ± 0.21^{b}
20:80	10.00 ± 0.06^{e}	80.65 ± 0.15^{a}

Mean with superscripts on the same column are significantly different at ($p<0.05$

Anti-nutrients composition of Bread Samples

The level of phytate in composite bread samples was in the range of 0.10 - 0.27 mg/g (Table 3). There was a significant difference in the phytate contents of control and composite bread samples at p <0.05. Phytates inhibit the absorption and utilization of some mineral elements. Tanin content of bread ranged from 0.09 - 0.28mg/g, there was a significant difference in tannin content between control and composite breads at p <0.05. Presence of sweet potato flour raised the tannin levels. Tanins are polyhydric phenols and their roles in the inhibition of trypsin, chymotrypsin, amylase and lipase have been confirmed. The tannin content of composite bread samples ranged from 0.18 - 0.42mg/g, this is in accordance with the results reported by Malomo *et al.* (2011) for bread from composite flours of breadfruit and breadnut. Phenolic content of the bread samples was from 0.27 - 0.31mg/100g (Table 3). Phenols are non-essential dietary components appearing in vegetable foods.

Generally, the levels of the anti-nutrients substances were not high enough to cause concern as above 80 mg/g diet is detrimental to health (Malomo *et al.,* 2011). However, these anti-nutrients can reduce nutrient metabolism or bioavailability in the body.

Table 3: Anti-nutrients composition of Bread

Sample (PF:WF)	Phytate mg/g	Tanins mg/g	Phenolic mg/100g
0:100	0.10 ± 0.01^{b}	0.09 ± 0.01^{d}	0.27 ± 0.01^{d}
5:95	0.23 ± 0.00^{a}	0.12 ± 0.02^{d}	0.30 ± 0.00^{c}
10:90	0.26 ± 0.02^{a}	0.14 ± 0.03^{c}	0.32 ± 0.00^{ab}
15:85	0.26 ± 0.00^{a}	0.22 ± 0.02^{b}	0.34 ± 0.20^{a}
20:80	0.27 ± 0.09^{a}	0.28 ± 0.04^{a}	0.31 ± 0.00^{bc}

Mean with superscripts on the same column are significantly different at (p<0.05)

Sensory Evaluation

Sensory evaluation provides valuable insights into the sensory attributes that influences the overall quality and acceptability of the bread (Nakakana *et al.,* 2023). The mean sensory scores for each quality attribute evaluated (mouthfeel, taste, aroma, appearance and overall acceptability) for the bread samples prepared from the composite flours are presented in Table 4. The statistical analysis of the data showed that there were significant differences ($P < 0.05$) among the bread samples. The scores also indicated that the control sample (0:100) was more acceptable than that from other blends. General acceptability scores of the composite flour breads showed that the samples were considered to be close substitutes of the 100% wheat bread with sample 5:95 being the most accepted.

Table 4: Sensory evaluation scores by panellist of the bread sample

Sample (PF:WF)	Mouthfeel	Taste	Aroma	Appearance	Overall acceptability
0:100	7.10 ± 1.33^{b}	6.70 ± 1.53^{b}	7.60 ± 1.05^{c}	6.60 ± 1.57^{b}	7.2 ± 1.32^{b}
5:95	6.90 ± 1.21^{b}	6.65 ± 1.31^{b}	7.10 ± 1.71^{bc}	6.60 ± 1.54^{b}	6.95 ± 1.32^{b}
10:90	6.35 ± 1.60^{ab}	5.95 ± 1.40^{ab}	6.35 ± 2.00^{ab}	6.25 ± 2.17^{b}	6.45 ± 2.40^{ab}
15:85	5.45 ± 2.52^{a}	5.25 ± 2.51^{a}	5.80 ± 1.99^{a}	5.10 ± 2.17^{a}	5.40 ± 2.39^{a}
20:80	6.80 ± 1.20^{b}	6.35 ± 1.60^{ab}	6.80 ± 1.40^{abc}	6.55 ± 1.15^{b}	6.55 ± 1.73^{b}

Mean with superscripts on the same column are significantly different at (p<0.05)

CONCLUSION

The results obtained from this study showed that sweet potato flour could be used to substitute up to 20% of wheat flour in bread making without adversely affecting the quality of the bread. The incorporation of potato flour to wheat flour improved the nutritional value of the bread. Hence, substituting wheat flour with sweet potato flour would be of benefit through improvement of the physicochemical and nutritional qualities of such products. Further investigation should be carried out on production of other wheat flour products using wheat-sweet potato composite flour.

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