Full Length Research Paper

Quality characteristics of African locust bean fruit pulp cakes

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Received 17 June 2014; Accepted 29 October 2014

Quality attributes such as proximate, functional and sensory qualities of wheat/African Locust bean fruit pulp cakes were investigated. Cakes were produced from ratios of 100:0, 75:25, 25:75 and 0:100 for African locust bean fruit pulp and wheat flour, respectively, with cake from 100% wheat flour used as a control. Samples were analyzed for proximate composition and sensory properties within 24 h of sample production. Flour blends were also analyzed for functional properties. Moisture, ash, fat, crude fibre and carbohydrates showed an increase in value with increase in substitution of wheat for African locust bean fruit pulp flour, while protein showed a decrease in value with increased substitution. Moisture ranged from 6.19 to 6.31%, ash from 1.42 to 2.07%, fat from 1.42 to 16.02%, crude fibre from 1.03 to 2.52% and carbohydrate ranged from 66.05 to 67.08%. Protein decreased from 8.30 to 8.07%. The functional properties of the flour blends also varied. Oil absorption ranged from 1.25 to 1.43%, water absorption from 1.33 to 1.56% as the substitution level increased. Bulk density decreased from 0.65 to 0.28%, and emulsion capacity from 80.30 to 70.50%. The gelation temperature was from 70.0 to 64.0°C. The results of sensory evaluation showed that the mean scores for taste ranged from 5.7 to 8.1, colour 6.2 to 8.2, texture 6.0 to 8.5 and overall acceptability from 5.8 to 8.3. The result shows that there was no significant (P<0.05) difference between the control and samples with 25% substitution in all the parameters investigated. Hence, acceptable cake can be produced at 25% substitution with African locust bean fruit pulp flour.

Key word: Quality, cake, characteristics, locust bean, fruit pulp.

INTRODUCTION

Cake is a product made from wheat flour, sugar, fat, baking powder and egg. It is a snack that is usually sweet and often baked (Eke, et al.,2008). It is also described as a desirable, delicate, tender, highly sweetened, non-yeasted baked product, (Okaka, 2005). Cake is a baked batter made from sugar, egg, shortenings, milk and leavening agent, mixed together in such a way as to produce a fluffy, fine grained baked product (Victor et al., 1995). Cake is often the desert of choice for meals at ceremonial occasions, particularly wedding anniversaries and birthdays (Eke et al., 2008).

In search for plant protein and vitamin substitute, the African locust bean (Parkia biglobosa) has found very popular use especially in fermented ‘Dawadawa’ which is

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the product of the seed. However, the yellow dry powdery pulp called “Dorowa” in Hausa language in Nigeria, has not attracted much attention. According to Uwaegbute (1996), the powdery fruit pulp contains more carbohydrate than the seeds. Similarly, Agu et al. (2007) reported that the carbohydrate of the pulp is primarily reducing sugar (19%), non-reducing sugar (9%) and other complex carbohydrate (36%). Locust bean pulp is sweet to taste which indicates the presence of natural sugar and thus a potential energy source. The attractive yellow colour indicates the presence of phyto-nutrients, possibly carotenoids, which are important precursors of retinol (Vitamin A). The pulp has a sour taste which indicates the presence of ascorbic acid (Vitamin C) (Gernah et al., 2007). The pulp is used in rural Africa during emergencies when the grain stores are empty which is an indication of its edibility and non-toxicity (Akoma et al., 2001).

The use of locust bean fruit pulp for the production of baked products will help to reduce total dependence on imported wheat and increase the utilization of the pulp and create variety. The aim of this study was to produce cake from African locust bean fruit pulp and wheat composite flour and to evaluate the functional, proximate and sensory qualities of cake so produced.

MATERIALS AND METHODS

Source of raw materials

The locust bean fruit pods were bought from Kasuwan Magani, a village in Chukun Local Government Area of Kaduna State. Wheat flour (Dangote Brand), baking powder, sugar, butter, egg and salt were bought from a commercial store in Abubakar Gumi Central Market, Kaduna.

Preparation of locust bean fruit pulp flour

Locust bean fruit pulp flour was prepared using the method of Gernah et al. (2007), as shown in Figure 1. The outer brown cover of the pods was manually stripped open and the yellow fruit pulp was separated from the seeds embedded within the pulp. The yellow pulp was dried in a hot air oven (GENLAB WIDNES, Model T1211) at 60°C for 9 h to a moisture content of 10%. The dried powder was milled with a laboratory hammer mill (Christy Hunt, England), and sieved through a 0.5 mm screen to obtain a fine flour. The flour was package in low density polythene bags and stored in air-tight container at room temperature.

African locust bean fruit pulp

Formulation of blends

Blends of different proportions of wheat flour (WF) and locust bean fruit pulp (LBFP) flour were produced with 100% wheat flour as the control (Table 1). Four recipe formulations were developed. Locust bean fruit pulp (LBFP) flour replaced wheat flour at 100, 75, 25 and 0% levels. These formulations were used for cake preparation following the method of Victor et al. (1995).

Preparation of locust bean fruit pulp cake

Cake samples were prepared using the recipe formulated above. The creaming method was used for the preparation of cake following the method described by Eke et al. (2008) and Anon (2004), using wheat-locust bean flour flour blend, sugar, margarine, baking powder, egg and salt. Figure 2 shows the production method.

Proximate analysis

Proximate composition (moisture, ash, fat, fibre, protein and carbohydrate) of the cake samples was determined by the AOAC (2000) methods.

Functional properties of the flour blends

The emulsion capacity was determined by the modified method of Okezie and Bello (1988). One gram of sample was suspended in 34 ml distilled water and blended for 30 s in a high-speed homogenizer. Refined vegetable oil (turkey brand, density 0.9008 g/ml) was added at the rate of 5 ml/min and stirred for 3 min. The mixture was transferred to a 50 ml graduated centrifuge tubes and centrifuged at 2500 rpm for 30 min. There was separation into two distinct layers. Emulsion capacity was expressed as gram of oil emulsified per gram of flour.

Oil absorption capacity was determined by a modified method of Beuchat (1977). One gram of flour was mixed with 10 ml of oil in a Kenwood blender for 30 s. The samples were allowed to stand at 25°C for 30 min and centrifuged at 3500 rpm for 30 min. The supernatant was decanted into a measuring cylinder and the volume noted. The oil absorption capacity was calculated as, oil absorption = initial volume of oil used – volume decanted.

Bulk density was determined using the method of Okezie and Bello (1988). A previously cleaned, dried and weighed measuring cylinder was filled to the 10ml mark with the flour samples. The bottom of the cylinder was tapped gently but repeated on a laboratory bench until there was no further reduction of sample level. The cylinder with the sample was weighed and the weight of the sample was determined. Bulk density was determined by:

\[
Bd = \frac{W_2 - W_1}{V}
\]
Table 1. Recipe formation.

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Quantity (g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flour (different ratios)</td>
<td>100</td>
</tr>
<tr>
<td>Fat</td>
<td>60</td>
</tr>
<tr>
<td>Granulated sugar</td>
<td>64</td>
</tr>
<tr>
<td>Milk powder</td>
<td>10</td>
</tr>
<tr>
<td>Baking powder</td>
<td>1.25</td>
</tr>
<tr>
<td>Whole liquid egg</td>
<td>7.5</td>
</tr>
<tr>
<td>Banana Essence flavor</td>
<td>1.25</td>
</tr>
</tbody>
</table>

Source: Clark and Herbert (1989).

Figure 2. Flow chart for the production of cake.

Where, Bd = Bulk density; \( W_1 \) = Weight of empty cylinder; \( W_2 \) = Weight of empty cylinder + Weight of sample; \( V \) = volume of the cylinder occupied by sample.

Gelling capacity was determined by the method of Narayana and Rao (1982). Three grams of flour samples were dispersed in distilled water in a 25 ml beaker and made up to 30 ml.

A thermometer was clamped on the retort stand with its bulb submerged in the suspension, with magnetic stirrers. The system was heated with a heating mantle. The heating and stirring continued until it began to gel and the corresponding temperature was recorded.

Sensory analysis

Sensory evaluation of the cake samples was conducted within 24 h of baking in nutrition kitchen of the Department of Food Technology, using a panel of 15 untrained members consisting of both staff and students of the Department of Food Technology. The panel was asked to score the products for taste, colour, texture and overall acceptability, using a 9-point Hedonic scale, where 9 represents like extremely and 1 represents dislike extremely. The pattern adopted was as described by Iwe (2002).

Statistical analysis

The mean scores of triplicate determinations were analyzed statistically using analysis of variance using SPSS version 17.0 and mean difference separated using the method of the Ihekoronye and Ngoddy (1985).

RESULTS AND DISCUSSION

The result of proximate composition of cake samples from composite blends of locust bean fruit pulp and
wheat flour is shown in Table 2. The moisture content of the cake samples ranged from 6.20 to 6.31%. The moisture content increased as the proportion of locust bean fruit pulp flour increased. There was no significant difference (p<0.5) in moisture content. The increase in moisture could be attributed to the initial high moisture content of locust bean fruit pulp flour. The slight increase in moisture with the increased proportions of locust bean fruit pulp flour could also be due to high sugar content of locust bean fruit pulp flour, which made the cake samples more hygroscopic. The ash content also varied. The ash content varied from 1.03 to 2.03%. The higher the proportion of locust bean fruit pulp, the higher the percentage of ash. The increase in ash content is an indication of high level of minerals in locust bean fruit pulp flour. Slight increases were observed in crude fibre content. This is good because fibre will add bulk and thereby facilitate bowel movement and hence prevents many gastrointestinal diseases in man (Gernah et al., 2007). Slight variations were also observed for fat and carbohydrate contents. The fat varied from 15.96 to 17.01%. The variation is significant at 5% level of probability. The carbohydrate of the products also varied from 65.70 to 67.08%. The result indicated that African locust bean fruit pulp is high in carbohydrate content.

The result of functional properties of the flour blends is shown in Table 3. Oil absorption capacity ranged from 1.25 to 1.43%. The oil absorption capacity is an important property in food formulations. The value for oil absorption capacity is in agreement with the report of Ubbor et al. (2010). The ability of food to absorb oil enhances sensory properties such as flavor retention and mouth feel. Oil absorption ranged from 1.25 to 1.43%.

The bulk density decreased with increased proportion of African locust bean fruit pulp flour. This indicates that the flour will be a good ingredient in baby food formulations. Bulk density has also been reported to be an important relative to sensory acceptability, handling and packaging requirement and shipping cost (Magda and Kim, 1989). The high emulsion capacity of 70.5 to 80.3% suggests better performance in texture of comminuted meats and baked products (Okezie and Bello, 1998).

Oil absorption capacity is an important property in food formulations. The value for oil absorption capacity is in agreement with the report of Ubbor et al. (2010). The ability of food to absorb oil enhances sensory properties such as flavor retention and mouth feel. Oil absorption ranged from 1.25 to 1.43%.

Table 2. Proximate composition of the cake samples.

<table>
<thead>
<tr>
<th>LBFP</th>
<th>WF</th>
<th>Moisture (%)</th>
<th>Ash (%)</th>
<th>Fat (%)</th>
<th>Crude fibre (%)</th>
<th>Protein (%)</th>
<th>CHO (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>0</td>
<td>6.31±0.21</td>
<td>2.07±0.05</td>
<td>16.02±0.02</td>
<td>2.52±0.00</td>
<td>8.07±0.02</td>
<td>67.08±0.00</td>
</tr>
<tr>
<td>75</td>
<td>25</td>
<td>6.23±0.14</td>
<td>1.97±0.09</td>
<td>15.96±0.01</td>
<td>2.03±0.02</td>
<td>8.11±0.00</td>
<td>65.70±0.02</td>
</tr>
<tr>
<td>25</td>
<td>75</td>
<td>6.20±0.12</td>
<td>1.46±0.01</td>
<td>16.72±0.07</td>
<td>1.06±0.00</td>
<td>8.21±0.01</td>
<td>66.35±0.01</td>
</tr>
<tr>
<td>0</td>
<td>100</td>
<td>6.19±0.01</td>
<td>1.42±0.00</td>
<td>17.01±0.02</td>
<td>1.03±0.03</td>
<td>8.30±0.00</td>
<td>66.05±0.03</td>
</tr>
</tbody>
</table>

Means ± SD; LBFP, Locust bean fruit pulp flour; WF, wheat flour; CHO, carbohydrate; SD, standard deviation.

Table 3. Functional properties of flour blends.

<table>
<thead>
<tr>
<th>LBFP</th>
<th>WF</th>
<th>Oil absorption (%)</th>
<th>Water absorption (%)</th>
<th>Bulk density (G/ml)</th>
<th>Emulsion capacity (%)</th>
<th>Gellation temperature (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>0</td>
<td>1.43±0.00</td>
<td>1.56±0.01</td>
<td>0.28±0.00</td>
<td>70.50±0.06</td>
<td>64.0±0.01</td>
</tr>
<tr>
<td>75</td>
<td>25</td>
<td>1.42±0.01</td>
<td>1.42±0.03</td>
<td>0.37±0.00</td>
<td>72.95±0.09</td>
<td>65.50±0.06</td>
</tr>
<tr>
<td>25</td>
<td>75</td>
<td>1.30±0.00</td>
<td>1.35±0.02</td>
<td>0.56±0.05</td>
<td>77.85±0.02</td>
<td>68.50±0.01</td>
</tr>
<tr>
<td>0</td>
<td>100</td>
<td>1.25±0.05</td>
<td>1.33±0.02</td>
<td>0.65±0.09</td>
<td>80.30±0.04</td>
<td>70.00±0.02</td>
</tr>
</tbody>
</table>

LBFP, Locust bean fruit pulp flour; WF, wheat flour.
Table 4. Result of sensory evaluation of cake samples.

<table>
<thead>
<tr>
<th>LBFP</th>
<th>WF</th>
<th>Taste</th>
<th>Colour</th>
<th>Texture</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>0</td>
<td>6.3\textsuperscript{a}</td>
<td>6.2\textsuperscript{b}</td>
<td>6.0\textsuperscript{c}</td>
<td>5.9\textsuperscript{b}</td>
</tr>
<tr>
<td>75</td>
<td>25</td>
<td>5.7\textsuperscript{ab}</td>
<td>6.5\textsuperscript{b}</td>
<td>6.7\textsuperscript{b}</td>
<td>6.8\textsuperscript{b}</td>
</tr>
<tr>
<td>25</td>
<td>75</td>
<td>8.1\textsuperscript{a}</td>
<td>7.8\textsuperscript{a}</td>
<td>8.5\textsuperscript{a}</td>
<td>8.2\textsuperscript{a}</td>
</tr>
<tr>
<td>0</td>
<td>100</td>
<td>7.3\textsuperscript{a}</td>
<td>8.2\textsuperscript{a}</td>
<td>8.2\textsuperscript{a}</td>
<td>8.3\textsuperscript{a}</td>
</tr>
<tr>
<td>LSD</td>
<td>3.78</td>
<td>1.78</td>
<td>0.35</td>
<td>1.08</td>
<td></td>
</tr>
</tbody>
</table>

Means not followed by the same letter in the same column are not significantly different (P≤0.05). LSD, least significant difference; LBFP, locust bean fruit pulp; WF, wheat flour.

Table 5. Weight and volume of the cake samples.

<table>
<thead>
<tr>
<th>LBFP</th>
<th>WF</th>
<th>Weight (g)</th>
<th>Volume (cm(^3))</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>0</td>
<td>67.05±0.03\textsuperscript{a}</td>
<td>173.00±0.07\textsuperscript{a}</td>
</tr>
<tr>
<td>75</td>
<td>25</td>
<td>67.03±0.00\textsuperscript{a}</td>
<td>172.02±0.05\textsuperscript{a}</td>
</tr>
<tr>
<td>25</td>
<td>75</td>
<td>67.02±0.01\textsuperscript{a}</td>
<td>171.04±0.03\textsuperscript{a}</td>
</tr>
<tr>
<td>0</td>
<td>100</td>
<td>67.00±0.01\textsuperscript{a}</td>
<td>170.01±0.02\textsuperscript{a}</td>
</tr>
<tr>
<td>LSD</td>
<td></td>
<td>1.08</td>
<td>4.05</td>
</tr>
</tbody>
</table>

Sensory characteristics of the cake samples

The results of the sensory evaluation of the cake samples are shown in Table 4. The cake samples produced from 100% wheat flour and those produced from 75:25 wheat/African locust bean fruit pulp flour composites had significantly higher (P≤ 0.05) scores for all the parameters investigated. No significant difference (P ≤ 0.05) was observed between them in all the sensory parameters tested. This indicates that the wheat flour can be substituted up to 25% substitution level with African locust bean fruit pulp flour without altering the sensory characteristics as well as consumer acceptability of the cake. Such substitution of wheat flour with non-wheat flours have been suggested by previous authors (Ihediohanma et al., 2009; Akpapunam and Darbe, 1994; Akubor et al., 2000; Gacco and D’Appoliano, 1978).

Physical characteristics

The mean values for the weight and volume of the cakes are shown on Table 5. The weight of the cakes ranged from 67.00 to 67.05 g and no significant difference (P≤ 0.05) existed between the weight of the samples. This was so because the same quality of batter was used for each of the sample. The same trend was observed for volume of cakes which ranged from 170.01 to 173.00 cm\(^3\). There was also no significant difference in the volume (P<0.05) of the cake samples. Cake does not require extensive dough development process which is common with yeast fermented products such as bread. This was responsible for no significant difference in volume of cakes from composite flour of African locust bean fruit pulp flour and wheat flour and those from purely wheat flour. This suggests that variations in the composition in the ratio of wheat flour and African locust bean fruit pulp flour have no significant difference in both weight and volume of the cakes so produced.

Conclusion

The results of this study has shown that African locust bean fruit pulp can be used in composite with wheat flour, up to 25% substitution level in the production of cake without altering the sensory characteristics and acceptability of the products. The research has also shown that the flour of the locust bean fruit pulp can be utilized in the production of other confectionaries and baby food formulations. It is therefore recommended that 25% African locust bean fruit pulp flour substitution be used by bakers to produce cakes and other confectionaries. This will help to reduce the cost of importation of wheat and create variety in cake and confectionary products.

Conflict of Interests

The author(s) did not declare any conflict of interests.

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