Evaluation of the Proximate, Pasting and Sensory Characteristics of Cassava Flour (Fufu) Fortified with Pigeon Pea Flour

S.S. Akoja and A.O. Mohammed
Department of Food Technology, The Federal Polytechnic, P.M.B. 50, Ilaaro, Nigeria

Abstract: The nutritious value of Fufu-fermented cassava flour was improved through supplementation with 10, 20, 30 and 40% pigeon pea flour and the products were subjected to proximate composition, pasting characteristics and sensory tests, with 100% cassava flour as control. The results showed that the pigeon pea Fufu flour contained 7.70% protein, 0.27% fat, 1.08% ash at 10% level of inclusion and this increased to 16.45, 0.54 and 1.24% for protein, fat and ash respectively at 40% level of inclusion. Meanwhile, the carbohydrate contents decreased from 90.28 to 80.81% at 10% and 40% inclusion of pigeon pea flour respectively. Pasting characteristic decreased with increased pigeon pea inclusion. Peak viscosity decreased from 341.92 to 219.80 (RVU) final viscosity from 301.71 to 191.00 (RVU), setback value from 82.29 to 58.21 (RVU) likewise the peak time from 4.93 to 4.33 min at 10% and 40% level of inclusion of pigeon pea respectively. There was a slight significant difference in overall acceptability between 10% level of inclusion and the control (100% cassava flour).

Key words: Fufu, pigeon pea flour, pasting characteristics and sensory evaluation

INTRODUCTION

Cassava (Manihot esculenta Crantz) is a root crop cultivated and consumed as a staple in many regions of the developing countries (Grace, 1977). Cassava plays a food security role in areas prone to drought, famine and in periods of strife and civil disturbance. The crop’s ability to provide a staple food base is a function of its flexibility in terms of planting and harvesting strategies and because of its relative tolerance of poor soils and pest/disease problems (Adebawale, 2005). Cassava is a major source of dietary energy for low-income consumers in many parts of tropical Africa, including major urban areas (Berry, 1993; Dahniya et al., 1994; Nweke, 1994a,b). However, the utilization of cassava is limited by its extremely low protein content and so the consumption of its products has been implicated in malnutrition. The low protein intake in Africa has been attributed to the increasing high cost of traditional sources of animal protein (Osbo, 2003). Legumes are some of the low-priced sources of protein-rich foods that have been important in alleviating protein malnutrition (Aykroyd et al., 1992). Accordingly the compositional evaluations of leguminous seeds such as soybean, cowpea, groundnut, pigeon pea, chicken pea and red gram have been carried out in different locations by many investigators (Ologhoho and Fettuga, 1982; 1984; Oloyo, 2002). Cultivation of pigeon peas which has started as far back as 3000 years ago, are now widely cultivated in all tropical and semi-tropical regions of both the old and the new world. It is a source of quality and inexpensive protein of about 14-28.9% and an excellent source of Vitamin B (Pushparajma, 1975). Therefore, Pigeon pea as one of the ideal source for protein supplementation of starchy foods has been proposed. The work reported here was aimed at determining the effect of different levels of pigeon pea flour substitution on the proximate, sensory and pasting characteristics of the pigeon pea-fufu dough.

MATERIALS AND METHODS

Matured and healthy cassava roots were obtained from a local farm in the outskirt of Ilaaro while pigeon peas (Cajanus cajan) were purchased from Abeokuta main market in Ogun State.

Processing method: The cassava roots were sorted and cleaned to remove dirt and soils. The following steps were adopted in the production of fufu: manual peeling of cassava roots, washing, soaking, sieving, sedimentation, decantation, drying and milling (Fig. 1).

Pigeon pea flour: The pigeon pea were sorted and handpicked to remove dirt and stones. The pigeon pea seeds were washed and soaked in 0.2% sodium hydrogen carbonate solution at temperature of 29°C for 8 h. The seeds were dehulled, oven dried at a temperature of 60°C for 24 h in an air drought oven. The dried seeds were milled and sieved through a 0.4 mm mesh screen (Fig. 2).

The blends were prepared (homogeneously) and labeled as shown in (Table 1).

Chemical analyses: Triplicate samples of each blend were analyzed for fat, protein (N x 6.25) crude fiber and ash in accordance with the procedures of AOAC (1995).
Fresh cassava roots
  →
  Peeling
  →
  Washing
  →
  (Retting) soaking (60 h)
  →
  Sieving
  →
  Sedimentation (12 h)
  →
  Dewatering (Decantation)
  →
  Drying
  →
  Milling
  →
  Fufu flour

Fig. 1: Production of Fufu

Pigeon pea
  →
  Soaking (1:8, 0.2% NaHCO₃) 8 h
  →
  Dehulling
  →
  Cleaning/washing
  →
  Drying (Hot air oven, 60°C 24 h)
  →
  Milling
  →
  Sieving
  →
  Pigeon pea flour

Fig. 2: Production of pigeon pea flour

| Table 1: Fufu and pigeon pea flour blends |
|------------------------|------------------------|
| Samples                | Fufu (%) | Pigeon pea (%) |
| FF₄                    | 100      | 0           |
| FF₅                    | 0        | 100         |
| FPF₁                   | 90       | 10          |
| FPF₂                   | 80       | 20          |
| FPF₃                   | 70       | 30          |
| FPF₄                   | 60       | 40          |

FF = Fufu flour; PF = Pigeon pea; FPF = Fufu-Pigeon pea blend

distilled water was dispensed into the canister containing the sample. The solution was thoroughly
mixed and the canister was well fitted into the RVA as recommended. The slurry was heated from 50-95°C with
a holding time of 2 min followed by cooling to 50°C with 2 min holding time. The rate of heating and cooling were
at a constant rate of 11.25°C per min. Peak viscosity, trough, breakdown, final viscosity, set back, peak time
and pasting temperature were read from the pasting profile with the aid of thermocline for windows software
connected to a computer (Newport Scientific, 1998).

Sensory evaluation: The sensory evaluation was carried out on the following parameters: appearance, taste, aroma, mouth feel (texture) and overall acceptability by a panel of ten members using a 9-point Hedonic scale. The rating of the samples ranged from 1 (Dislike extremely) to 9 (Like extremely).

Statistical analysis: The statistical significance of the observed differences among the means of triplicate readings of experimental results were evaluated by Analysis of Variance (ANOVA) while means were separated using Duncan’s Range Test. These analyses were carried out using SPSS (2001) Package (Version 11.0).

RESULTS AND DISCUSSION

Proximate composition of the samples are shown in Table 2. The results show that the blend FPF₁ (Fufu flour/Pigeon pea flour, 60:40) had the highest protein content while sample FPF₃ (Cassava flour/Pigeon pea, 90:10) has the lowest. There was significant difference (p<0.05) in protein content among the blends. The high protein content of the FPF₁ (Fufu flour/Pigeon pea flour 60:40) is due to the level of pigeon pea flour, which contains high protein content. According to Padrma and Jisha (2005), protein content of the Cassava based composite flours could be elevated through the incorporation of legume flours.

The blend FPF₁ (Fufu flour/Pigeon pea flour 90:10) had the highest carbohydrate content while the blend FPF₅ (Fufu flour/Pigeon Pea flour 60:40) had the lowest. There was significant difference (p<0.05) among the blends and the high carbohydrate content of FPF₁ and low carbohydrate content of FPF₅ explains the difference.

There was high content of fat in FPF₁ (Fufu flour/Pigeon pea flour 60:40) followed by FPF₅ (Fufu flour/Pigeon pea
Table 2: Proximate composition (%) of developed supplements

<table>
<thead>
<tr>
<th>Samples</th>
<th>Protein</th>
<th>Ash</th>
<th>Fat</th>
<th>Fiber</th>
<th>Carbohydrate</th>
</tr>
</thead>
<tbody>
<tr>
<td>FF₁</td>
<td>3.10⁺</td>
<td>0.96⁻</td>
<td>0.18⁻</td>
<td>0.34⁻</td>
<td>95.42⁻</td>
</tr>
<tr>
<td>FF₂</td>
<td>7.70⁺</td>
<td>1.08⁻</td>
<td>0.27⁺</td>
<td>0.67⁻</td>
<td>90.28⁻</td>
</tr>
<tr>
<td>FF₃</td>
<td>13.88⁻</td>
<td>1.13⁻</td>
<td>0.39⁻</td>
<td>0.79⁻</td>
<td>84.04⁻</td>
</tr>
<tr>
<td>FF₄</td>
<td>15.40⁻</td>
<td>1.17⁻</td>
<td>0.48⁺</td>
<td>0.88⁻</td>
<td>82.09⁻</td>
</tr>
<tr>
<td>FF₅</td>
<td>18.45⁻</td>
<td>1.24⁻</td>
<td>0.54⁻</td>
<td>0.98⁻</td>
<td>80.61⁻</td>
</tr>
</tbody>
</table>

Values are means of triplicates. Mean with similar alphabets are not significantly different from each other at the 5% statistical level (FF₁ = 100% Cassava (Fufu); FF₂ = 90:10% of Fufu and Pigeon pea; FF₃ = 80:20% of Fufu and Pigeon pea; FF₄ = 70:30% of Fufu and Pigeon pea; FF₅ = 60:40% of Fufu and Pigeon pea)

flour 70:30) and then FF₅ (Fufu flour/Pigeon pea flour 80:20). There was significant difference among the blends.

The protein content of Fufu increased significantly with the addition of pigeon pea flour. Thus, the proximate composition of pigeon pea-Fufu appears to be dependent on the level of pigeon pea inclusions. The protein was highest in sample FF₃ of 40% pigeon pea inclusion also the Ash content, fibre and fat. Sulphur carbohydrate content is higher in sample FF₅ at 10% inclusion of pigeon pea flour.

This work confirms earlier report by Fashakin et al. (1986) on the beneficial effect of vegetable protein supplementation.

Pasting characteristics: Amylographic studies (Table 3) showed that the Rapid Visco Analyses (RVA) viscosities of the Fufu-pigeon pea flours are generally lower than the FF₁ flour.

The peak viscosity, which is the maximum viscosity developed during or soon after the heating portion. The peak viscosity of FF₁ is 371.75 RVU at a temperature of 75.83°C in 4.33 min. The Fufu-pigeon pea flours had lower values in the range of 219.80-341.92 RVU. This suggests that the presence and interaction of components like fats and protein (from pigeon pea) with starch lowers its peak viscosity (Eqouleley and Aworn, 1991) and Karlson and Svaneberg (1982). High peak viscosity reflects fragility of the swollen granules, which first swell and then break down under the continuous mixing of the Rapid Visco Analyzer.

The apparent gelatinization (pasting) temperature of FF₁ flour was 75.83°C while those of Fufu-pigeon pea flours varied from 77.13-79.55°C. This may be due to the buffering effect of fat (from pigeon pea) on starch which interferes with the gelatinization process (Eqouleley and Aworn, 1991). The pasting temperature is one of the pasting properties which provide an indication of the minimum temperature required for sample cooking, energy cost involved and other components stability. It is clear from the results that the control sample FF₁ will cook faster and less energy consumed, thereby saving cost and time compared to other samples because of its lower pasting temperature.

The breakdown viscosity of FF₁ is 209.04 (RVU). The Fufu-pigeon pea flours had lower values in the range of 87.00-122.50 (RVU). Adebowale et al. (2005) reported that the higher the breakdown in viscosity, the lower the ability of the sample to withstand heating and shear stress during cooking. Hence sample FF₅ might be able to withstand heating and shear stress compared to other samples because of its low breakdown value.

The final viscosity ranged from 191.00-338.42 RVU. The control sample FF₁ had the highest (338.42 RVU) final viscosity, while sample FF₃ had the lowest. Shimels et al. (2008) reported that final viscosity is used to indicate the ability of starch to form various paste or gel after cooling and that less stability of starch paste is commonly accompanied with high value of breakdown. This implies that sample FF₁ will be less stable after cooling compared to Fufu-pigeon pea flours blend. The variation in the final viscosity might be due to the simple kinetic effect of cooling on viscosity and the re-association of starch molecules in the samples.

The extent of increase in viscosity on cooling to 50°C reflects the retrogradation tendency of the products. Of the FFP flours studied, FF₁ had the highest retrogradation tendency 82.28 RVU, followed by FF₃ (68.59 RVU) and FF₅ (62.50 RVU) while FF₃ had the lowest value 58.21 RVU. The increase in the set back value in Fufu-pigeon pea flours may be due to increased hydrogen bonding during cooling and the high amylose content of the starch of FF (Alas and Linden, 1988). This increased hydrogen bonding activity may be due to the hydrothermal treatment and the interaction between the polysaccharide and protein (peptide bonds). This leads
to the growth of gel micellar regions, hence increase in index of retrogradation (Hodge and Osman, 1971), making entrapped water more prone to expression. Table 4 shows the result of sensory evaluation. It was observed that there was significant difference between the control samples and other pigeon pea-Fufu flours in terms of overall acceptability. The control food sample was rated higher than pigeon pea-Fufu flours. This could be attributed to the fact that panelist have been used to control sample (FF1). FPF1 pigeon pea flour supplementation was rated next to the control food sample but there was no significant difference between FPF1 and FPF2 in overall acceptability.

**Conclusion:** This study has shown that the nutritional status of Fufu can be enhanced through Pigeon pea flour supplementation and the developed Pigeon pea Fufu flour were nutritious and can easily be prepared by using simple domestic processing techniques. The developed composite flour can be incorporated into the diet to prevent protein energy malnutrition in the community.

**REFERENCES**


