Proximate Composition, Energy Content And Sensory Properties Of Complementary Foods Produced From Blends Of Sorghum And African Yam Bean Flour

Okoye, Joseph Ikechukwu, Ojobor, Charles Chijioke

Abstract: the proximate composition, energy content and sensory properties of complementary foods prepared from sorghum and African yam bean flour blends were investigated. The sorghum flour (SF) was blended with African yam bean flour (AYBF) in the ratios of 90:10, 80:20, 70:30, 60:40 and 50:50 and used for the production of complementary foods. The complementary foods produced were evaluated for proximate composition, energy content and sensory qualities using standard methods. The proximate composition of the samples showed that the protein content of the complementary foods increased gradually with increased level of African yam bean flour addition from 8.64% in 90:10 (SF: AYBF) to 13.44% in 50:50 (SF: AYBF) samples, while carbohydrate decreased. In the same vein, the energy content of the samples also increased with increased supplementation with African yam bean flour from 368.84KJ/100g in 90:10 (SF: AYBF) to 382.98KJ/100g in 50:50 (SF: AYBF). The sensory evaluation carried out on different samples of complementary food after reconstitution into gruels with boiling water showed that the formulation prepared from 100% sorghum flour used as control was most acceptable by the judges and also differed significantly (p≤0.05) from the other samples in flavour, texture and taste. However, the sample fortified with 50% African yam bean flour was scored highest in colour.

Index Terms: Complementary foods, supplementation, proximate composition, energy value, sensory quality, sorghum-African yam bean composite flours.

1 INTRODUCTION
Cereals and legumes, individually or as composites, are the main source of nutrients for weaning children in developing countries [9]. Complementary foods used commonly for feeding infants in Nigeria are composed largely of sorghum (Sorghum bicolor) with a limited amount of dried-milk powder. However, such mixtures have been reported to be poor in protein content and quality [1]. The fortification of complementary foods with a variety of inexpensive vegetable proteins from legumes, nuts and oilseeds has received considerable attention from nutritionists and food scientists in several sub-Saharan African countries in recent times [23], [24]. This is because these grain legumes and oilseeds are relatively high in lysine and tryptophan, the essential amino acids deficient in most cereals [15], [22]. Whole legumes generally contain high amount of protein compared to other foods of plant origin [7]. Ideally, the ingredients for low cost complementary foods must be derived from dietary staples that are available and affordable in the region of interest. African yam bean (Sphenostylis stenocarpa) is one of the lesser known edible grain legumes that is widely cultivated and utilized in human and animal nutrition in Africa [5]. Like most grain legumes cultivated in Africa, African yam bean is rich in protein, carbohydrate, vitamins and minerals [11]. The protein of African yam bean is made up of over 32 percent essential amino acids, with lysine and leucine being predominant [19]. The supplementation of cereal-based complementary foods with adequately processed African yam bean flour would help to improve their protein content and quality. It could also help to extend the utilization of this lesser known and underutilized legume in the production of a wide range of food products especially in developing countries where there is acute shortage of protein. The objective of this study is to determine the proximate composition, energy content and sensory qualities of complementary foods produced from sorghum and African yam bean flour blends at different levels of substitution.

2 MATERIALS AND METHODS

2.1 Preparation of Sorghum Flour
The sorghum flour was prepared according to the method of [8]. During preparation, one kilogram of sorghum grains which were free from dirt and other foreign particles such as stones, leaves and sticks were weighed, cleaned and soaked in 3 litres of potable water at room temperature (30±20°C) for 18h with occasional change of soak water at intervals of 6h to prevent fermentation. The soaked grains were drained, rinsed and wet milled with 2 litres of potable water in a locally fabricated attrition mill into fine slurry. The slurry obtained was sieved with muslin cloth and allowed to sediment in a plastic bowl for 10h after which it was decanted. The decanted slurry was manually dewatered, spread on the trays and dried in the tray dryer (Model HC 409 G) at 60°C for 8h. The dried cake obtained was milled in the attrition mill and sieved through a 500 micron mesh sieve. The sorghum flour produced was packaged in an airtight plastic container for blending and preparation of complementary foods.

2.2 Preparation of Boiled African Yam Bean Flour
The boiled African yam bean flour was prepared according to the method [6]. During preparation, one kilogram of African yam bean seeds which were free from dirt and other foreign particles such as stones, leaves and sticks were weighed, cleaned and soaked in 3 litres of potable water containing 0.1% sodium metabisulphite solution (Na2S2O5) at room temperature (30±20°C) for 12h. The soaked seeds were drained rinsed and dehulled manually by rubbing in between palms. The dehulled, seeds were boiled in an electrically heated pot at 1000°C for 30min. The boiled seeds were drained, spread on the trays and dried in the tray dryer (Model HC 409 G) at 600°C for 8h. The dried seeds were milled in a locally fabricated attrition mill and sieved through a 500 micron mesh sieve. The boiled African yam bean flour produced was packaged in an airtight plastic container for blending and
preparation of complementary foods.

2.3 Preparation of Complementary Foods
The complementary foods were prepared according to the method [2]. During preparation, the sorghum flour (SF) was blended with African yam bean flour (AYBF) in the ratios of 90:10, 80:20, 70:30, 60:40 and 50:50 in a Kenwood mixer (Model NX 960G, Kenwood, Britain, UK) to obtain different samples of sorghum and African yam bean composite flour. After that, 5% of sugar (sucrose) was added to each of the flour blends and mixed thoroughly in a mixer for 10min to produce different samples of complementary foods. The complementary foods produced were packaged individually in an airtight plastic container and kept in a freezer until needed for analysis. The complementary food made with 100% sorghum flour was similarly prepared and used as control.

2.4 Chemical Analysis
The moisture, crude protein, fat, ash and crude fibre contents of the samples were determined in triplicate according to the method [3]. Carbohydrate was determined by difference [17]. The energy content of the samples was determined using Parr adiabatic oxygen Bomb calorimeter (Model XRY-1A, Britain, UK) according to the method [18].

2.5 Sensory Evaluation
The complementary food prepared from 100% sorghum flour and the samples fortified with different proportions of African yam bean flour were individually prepared into gruel with boiling water. During preparation, sixty (60) grams of each sample was suspended with 100mL of potable water in a small plastic bowl. After that, 60mL of boiling water was added to each of the suspended sample to produce hot gruel. After preparation, the hot gruels obtained in each case were individually coded and served in white ceramic plates of uniform size with white plastic spoons to a panel of twenty (20) semi-trained judges drawn from the University Community at ambient temperature (30±2°C) with cold water for rinsing for attributes of colour, flavour, texture, taste and over all acceptability. The judges were asked to indicate their acceptability and preference for the samples using a nine point Hedonic scale with 1 and 9 representing dislike extremely and like extremely, respectively [10].

2.6 Statistical Analysis
The data obtained were subjected to Analysis of variance (ANOVA) using statistical package for social science (SPSS version 20) to detect significant differences (p≤0.05) among the sample means. The Turkey’s least significant difference (LSD) test was used in separating significant means [20].

3 RESULTS AND DISCUSSION
The proximate composition and the energy content of complementary foods are shown in Table 1. The moisture content of the formulations ranged from 6.24 to 8.06%. The values obtained in this study were lower than those (8.26-10.04%) reported by [12] for powdered weaning foods fortified with germinated cowpea flour. The low moisture content enhances the storage stability of complementary foods and other flour-based food products [13]. The crude protein content of the samples increased significantly (p≤0.05) with increased level of African yam bean flour in the products. The result, however, indicates that African yam beans are good sources of protein [14]. The fat content of the formulations which ranged from 0.80 to 0.90% was generally lower than those (2.32-3.84%) reported by [21] for infant porridges prepared from pearl millet. The low fat content of the samples is an indication that they could be stored for a long period without the problem of peroxidation which is a major cause of fat instability [17]. The ash content of the samples increased significantly (p≤0.05) with increased level of African yam bean flour inclusion in the products. The high ash content of the samples implies that they are good sources of minerals [5]. The crude fibre content of the formulations which ranged from 2.12 to 3.62% increased significantly (p≤0.05) with increased level of African yam bean flour addition in the products. Fibre has been credited for promotion of increased excretion of bile acids, sterols and fats which have been implicated in the etiology of certain cardiovascular diseases in humans [17]. The carbohydrate content of the samples decreased significantly (p≤0.05) with increased supplementation with African yam bean flour. Such decrease in carbohydrate with increase in African yam bean flour has been reported in African yam bean and wheat composite flour cakes [6]. The energy content of the formulations ranged from 362.10 to 382.98KJ/100g. The variation in the energy content of the samples could be due to differences in their protein and carbohydrate contents [18]. Generally, the use of African yam bean flour in the preparation of complementary foods at a level up to 50% drastically improved their protein, ash, fibre and energy contents. Table 2 shows the sensory properties of complementary foods. The scores of the sensory attributes evaluated in all the samples of complementary foods formulated from sorghum and African yam bean flour blends were generally acceptable. However, the formulation made with 100% sorghum flour used as control was most acceptable by the judges and also differed significantly (p≤0.05) from the other samples in flavour, texture and taste. The differences could be attributed to the unique quality of sorghum flour in the preparation of complementary foods [21]. In addition, the result also showed that the sample fortified with 50% African yam bean flour had better colour than the other samples. The improvement in the colour of the sample could be due to the oxidation of some inherent colour pigments found in African yam bean seeds on exposure to heat during processing [4]. In essence, the fortification of cereal-based complementary foods with African yam bean flour produced good and acceptable results.

Table 1: Proximate Composition and Energy Content of Complementary Foods

<table>
<thead>
<tr>
<th>Samples</th>
<th>Moisture (%)</th>
<th>Crude Protein (%)</th>
<th>Fat (%)</th>
<th>Ash (%)</th>
<th>Crude Fibre (%)</th>
<th>Carbohydrate (%)</th>
<th>Energy (KJ/100g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>8.06±0.03</td>
<td>6.84±0.05</td>
<td>0.80±0.08</td>
<td>1.44±1.18</td>
<td>2.12±1.08</td>
<td>86.64±12.12</td>
<td>362.10±11.16</td>
</tr>
<tr>
<td>B</td>
<td>6.24±0.04</td>
<td>6.84±0.03</td>
<td>0.84±1.12</td>
<td>2.20±1.16</td>
<td>2.42±1.09</td>
<td>82.05±2.08</td>
<td>368.84±1.18</td>
</tr>
<tr>
<td>C</td>
<td>6.44±0.05</td>
<td>9.62±0.06</td>
<td>0.86±1.14</td>
<td>2.46±1.12</td>
<td>2.68±1.10</td>
<td>80.62±10</td>
<td>370.44±1.22</td>
</tr>
<tr>
<td>D</td>
<td>6.62±0.06</td>
<td>10.76±0.26</td>
<td>0.86±1.14</td>
<td>2.88±1.13</td>
<td>2.86±1.13</td>
<td>78.86±1.68</td>
<td>374.96±1.24</td>
</tr>
<tr>
<td>E</td>
<td>6.84±0.05</td>
<td>11.68±0.34</td>
<td>0.88±1.15</td>
<td>3.02±1.06</td>
<td>3.12±1.12</td>
<td>77.56±1.72</td>
<td>376.87±1.26</td>
</tr>
<tr>
<td>F</td>
<td>7.26±0.06</td>
<td>13.44±0.56</td>
<td>0.90±1.17</td>
<td>3.46±1.03</td>
<td>3.62±1.15</td>
<td>75.94±1.65</td>
<td>382.98±1.29</td>
</tr>
</tbody>
</table>
A – Complementary food made with 100% sorghum flour, B – Complementary food made with 90% sorghum flour and 10% African yam bean flour, C – Complementary food made with 80% sorghum flour and 20% African yam bean flour, D – Complementary food made with 70% sorghum flour and 30% African yam bean flour, E – Complementary food made with 60% sorghum flour and 40% African yam bean flour, F – Complementary food made with 50% sorghum flour and 50% African yam bean flour. Values are mean ± standard deviation of triplicate determinations. Means in the same column with different superscripts are significantly different (p<0.05).

Table 2: Sensory Properties of Complementary Foods

<table>
<thead>
<tr>
<th>Samples</th>
<th>Colour</th>
<th>Flavour</th>
<th>Texture</th>
<th>Taste</th>
<th>Overall Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6.0±0.04</td>
<td>8.2±0.02</td>
<td>7.8±0.06</td>
<td>8.4±0.03</td>
<td>8.6±0.03</td>
</tr>
<tr>
<td>B</td>
<td>6.6±0.05</td>
<td>7.6±0.06</td>
<td>7.2±0.06</td>
<td>7.6±0.06</td>
<td>7.8±0.06</td>
</tr>
<tr>
<td>C</td>
<td>7.2±0.06</td>
<td>7.0±0.06</td>
<td>7.0±0.06</td>
<td>7.0±0.06</td>
<td>7.2±0.06</td>
</tr>
<tr>
<td>D</td>
<td>7.8±0.06</td>
<td>6.6±0.05</td>
<td>6.4±0.05</td>
<td>6.8±0.05</td>
<td>6.6±0.05</td>
</tr>
<tr>
<td>E</td>
<td>8.0±0.02</td>
<td>6.0±0.04</td>
<td>6.2±0.05</td>
<td>6.2±0.05</td>
<td>6.2±0.04</td>
</tr>
<tr>
<td>F</td>
<td>8.6±0.03</td>
<td>5.4±0.07</td>
<td>5.8±0.07</td>
<td>5.8±0.08</td>
<td>6.0±0.04</td>
</tr>
</tbody>
</table>

4 CONCLUSION

Complementary foods of acceptable quality were prepared from sorghum and African yam bean composite blends. The observation from the study showed that the complementary foods prepared from the flour blends generally had high protein, ash, fibre and energy content and better colour than the formulation made with 100% sorghum flour. Furthermore, the study also revealed that African yam bean flour performed well as composite in the formulation of complementary foods and has the potential to be used as a nutritional supplement.

REFERENCES


[14] Nnam, N.M. (2001). Chemical, sensory and rheological properties of porridges processed from sorghum (Sorghum bicolor), bambara groundnut...
(Vigna sublerranea L. verde) and sweet potato (Ipomoea batatas) flours. Plant Foods for Human Nutrition; 56:251 – 265.


