Quality evaluation of “Ahuma”: a traditional breakfast porridge meal from African yam bean (Sphenostylis stenocarpa) sold in makurdi metropolis

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Abstract
The chemical and sensory properties of “Ahuma” porridge meal prepared from Africa yam bean (Sphenostylis stenocarpa) sold in different locations by vendors in Makurdi metropolis were investigated. “Ahuma” was purchased from vendors in North Bank, Asase North bank, High level, wadata and Kanshio areas were analyzed. The proximate composition of “Ahuma” in all the locations were significantly (P<0.05) different from each other. Mineral analysis showed phosphorus was the most abundant element in all the “Ahuma” samples. The highest phosphorus content (72.38 mg/100 g) was recorded in sample E (Kanshio area), sample B had the highest content of Magnesium (45.38 mg/100 g). The result of this study also revealed that sensory attributes of colour/appearance, aroma, taste, mouthfeel and overall acceptability were significantly (P<0.05) higher in samples collected from Kanshio than in samples collected from other areas. The study showed African yam bean have potentials for combating protein-energy malnutrition.

Keywords: Green computing, eco-friendly technology, carbon emissions, carbon foot print, e- waste, degradation

1. Introduction
African yam bean is an important ingredient of a balanced human diet in many parts of the world due to their high protein and starch contents (Adebowale et al., 2009) [4]. African yam bean has been reported to be a major source of protein, complex carbohydrates and minerals in developing countries. Africa yam bean have also been ascribed economic, cultural, physiological and medicinal roles owing to their possession of beneficial bioactive compounds. These useful bioactive compounds in African yam bean have Hypcholesterolaemic, antiathogenic, anticarcinogenic and hypoglycemic properties. African yam bean is an annual climbing or prostrate-vine legume with pods containing 20-30 seeds. (Anon 1979 and Porter 1992) [6]. It is one of the lesser-known legumes and widely cultivated in the tropical and subtropical regions (mostly in the southern part of Nigeria). African yam bean good source of dietary protein grown in mixed association with yam and cassava, and is cultivated both for the seeds and the tubers which grow as the root source and the actual yam bean seeds which develops tubers, in pods above the ground. It has many seed types, which vary in seed size, shape and seed coat colour. The colour of the seed coat varies from white to various shades of valuable cream, brown and grey. This beans contain considerable amount of essential protein (Amino acid, lysine and methionine) comparable to levels found in soybean and are easily preserved through drying or stored in earthenware (Adewale et al., 2012) [5]. It could be found in forests, open wooded grasslands, rocky fields, and marshy grounds as weed and cultivated crops (Porter 1992). African yam bean originated in Ethiopia, but both wild and cultivated types now occur in tropical Africa as far as Egypt and also throughout West Africa from Guinea to southern Africa. The seeds are highly proteinous and capable of growth in marginal areas where other pulses fail to thrive. Uguru and Madukaife (2001) [20] reported higher values of lysine and methionine in AYB seeds than in pigeon pea, cowpea and Bambara ground nut. African yam bean is also valued for its satiety over several hours after consumption, especially among farmers and the resource-poor. African yam beans, thus, has high potential to contribute to curbing hunger, and alleviating protein and micronutrient malnutrition in sub-Saharan Africa, if grown on a large scale. In ethno medicine, AYBs is indica- tioned for managing diabetes and high blood pressure. Neglected and underexploited indigenous crop such as African yam bean (AYB) have recently been receiving attention and currently being explored due to their nutritional and health potentials.
With the view of creating more awareness of the nutritional and health benefits of this crop, this study therefore seek to evaluate the nutritional quality and microbiological profile of “Ahuma”: a traditional breakfast porridge meal from African yam bean sold by vendors from different locations in Makurdi Local Government.

2. Materials and Methods

2.1 Source of Materials

“Ahuma” porridge meal were prepared by vendors mostly women of middle age between 30-40 years, in their homes overnight. The porridge meal was hawked by vendors who sell it to people and families beginning from the early hours of 7 am till 12 noon when the product cannot be seen for porridge. The “Ahuma” sample used for the study were purchased from various vendors, from different locations in Makurdi Metropolis such as: North Bank Market Area, Asase North Bank Area, High level Area, Wadata Area, and Kanshio Area in Makurdi Local Government. The samples were purchased and transported in clean plastic covered containers each day for 5days from different locations to Food Science and Technology laboratory, University of Agriculture Makurdi, dried and milled into powder for chemical analyses. Only samples for sensory evaluation were collected on the same day in different location for sensory analysis.

2.2 Preparation of “Ahuma” porridge as described by vendors in Makurdi Metropolis.

Fresh seeds of African yam bean were thoroughly cleaned of foreign materials and immature seeds removed. They were then boiled in distilled water (100 °C). After boiling, the water was drained off and boiled samples were mashed into paste using a ceramic mortar. In another smaller pot, the beniseed (Sesamum indicum) were fried and also mashed into paste and then added to the AYB paste in the mortar. Other ingredients (palm oil, black pepper, salt etc.) were also added for flavor and palatability. It was then stirred until fully mixed. The prepared porridge was then packaged into an air-tight container, ready for consumption.

Source: Personal Survey

2.3 Proximate analysis

Nutrient composition of the food samples was determined in triplicate using the standard procedures of Association of Official Analytical Chemists (AOAC, 2012) [1].

2.3.1 Determination of moisture content

Two (2) g of sample was weighed inside a clean dried crucible (W1) and was dried at 600 °C in a hot stimulating oven (Gallenkamp) for 24 hours to a constant weight. It was later cooled in desiccators for 30 minutes and weighed (W2). The crucible was washed, dried in the oven and the weight was recorded (W0). The Calculation was done as follows:

\[ \text{Moisture content} (\%) = \frac{W_1 - W_2}{W_1 - W_0} \times 100 \]

Where:

- W1 = Weight of sample + empty crucible
- W0 = weight of empty crucible
- W2 = Weight of dried sample + empty crucible

2.3.2 Determination of Crude Protein

The crude protein content (N x 6.25) was determined by Kjeldhal method. A quantity of 0.5 g of each sample was added to 10 ml of conc. sulphuric acid and 1 g of the catalyst mixture. It was then heated cautiously on digestion rack under fume hood until a greenish clear solution appeared. It was allowed to cool and then made up to 50 ml with distilled water. The digested sample was transferred into distillation apparatus and distilled. 10 ml of the distillate was titrated with 0.1M HCL to first pink colour. Temperature of digester was above 420 °C for about 30 min.

\[ \text{Nitrogen} \% = \frac{\text{Titrator} \times 14.01 \times 0.01 \times 100 \times 50}{100 \times 0.5 \times 10} \]

% crude protein = N x 6.25

2.3.3 Determination of Crude Fat (Soxhlet Method)

Crude fat was determined by exhaustively extracting each sample in petroleum ether in a soxhlet extractor. The weighed sample (W0) was poured into a thimble and covered with a clean white cotton wool. Petroleum ether (200 ml) was poured into a 250 ml extraction flask which was previously dried in the oven at 105 °C for 30 minutes and weighed (W2). The porous thimble was placed into the soxhlet and the rest apparatus were assembled. Extraction was done for 5 hours. The thimble was removed carefully and the extraction flask was placed in a water bath so as to evaporate the petroleum ether and then dried in the oven at a temperature of 105°C to completely free the solvent and moisture. It was cooled in a desiccator and reweighed (W1). The percentage crude fat was calculated using the following equation:

\[ \text{Crude fat} (\%) = \frac{W_1 - W_2}{W_0} \times 100 \]

Where:

- W1 = weight of sample (g)

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Fig 1: A generalized descriptive flow chat on the preparation of the porridge by vendors in Makurdi Metropolis.
\( W1 = \text{Weight of flask + oil (g)} \)
\( W2 = \text{Weight of flask (g)} \)

### 2.3.4 Determination of Ash Content
2 g of sample (W1) was transferred into a previously heated, cooled and weighed crucible (W0) and the content was placed into a Gallenkamp muffle furnace at 550 °C for 3 hours. It was allowed to cool in desiccators and weighed (W2).

\[
\% \text{ Ash} = \left( \% \right) = \frac{W2 - W0}{W1 - W0} \times \frac{100}{1}
\]

### 2.3.5 Determination of crude fibre
2g of the sample was defatted with petroleum ether, boiled under reflux for 30 minutes with 200 ml of a solution containing 1.25 g of H2SO4 per 100 ml of solution. It was then filtered with Whatmann No 1 filter paper, washed with boiled water until the washing was no longer acid. The residue was transferred to a beaker and boiled for 30 minutes with 200 ml of a solution containing 1.25g of carbonate free sodium hydroxide per 100ml. It was then filtered and transferred into a crucible. The residue was dried in the oven and weighed. The sample was eash at 600 °C in a muffle furnace and the dried weight recorded.

The calculation was done as follows:

\[
\text{Crude Fibre} (\%) = \left( \% \right) = \frac{W1 - W2}{W0} \times 100
\]

Where
\( W0 = \text{Weight of sample (g)} \)
\( W1 = \text{Weight of dried sample (g)} \)
\( W2 = \text{Weight of ash sample (g)} \)

### 2.3.6 Determination of Carbohydrate
Carbohydrate content was determined by difference (Ihekoronye and Ngoddy, 1985). This was done by subtracting the summed up percentage composition of moisture, ash, fat, protein and fibre contents from 100 g. This was done by using the equation below:

\[
\text{Crude Fibre} (\%) = \left( \% \right) = \frac{W1 - W2}{W0} \times 100
\]

### 2.4 Sensory Evaluation (Organoleptic Properties)
Sensory evaluation of Ahuma porridge produced from African Yam Bean (AYM) was performed by descriptive analysis and sensory evaluation (Ihekoronye and Ngoddy, 1985). Fifteen panelists were used for the assessment from University of Agriculture Makurdi, from students and staff who were familiar with the product. A 9 – point hedonic scale (1-dislike extremely, 9-like extremely) was used to rate the sensory attributes of appearance, taste, aroma, and overall acceptability of the products. Each panelists which was presented randomly with fresh tap water for mouth rinsing in between evaluations. The “Ahuma” porridge was stored in food flasks from where they were served to the panelists using coded transparent plastic plates and colourless transparent spoons.

### 2.5 Statistical analysis
All results were subjected to Analysis of Variance (ANOVA) using a pre-packaged Computer Statistical Software (SPSS version 20). LSD was used to separate the Means.

### 3. Results and Discussions

#### 3.1 Proximate Composition of “Ahuma” porridge sold by vendors from different locations in Makurdi Metropolis
Table 1 presents the proximate composition of the different “ahuma” porridge collected from selected locations in Makurdi metropolis. The moisture content of African yam beans porridge samples increased \( (p \leq 0.05) \) non-significantly across the samples. Results trends are in line with reports by (Abebe et al., 2018) [2]. Moisture content of sample E 13.89% was higher when compared with those of other samples. SON (2004) and Ezeama (2007) [23, 24] reported that low moisture levels positively affects long shelf life of foods as they discourage microbial proliferation that lead to spoilage. Result of the moisture content is within the range recommended by the Nigerian regulatory standard for food which is 40% (SON, 2004) [23]. The crude protein content of the samples increased \( (p \leq 0.05) \) significantly across the samples and it ranged from 20.94-33.08%. The protein contents of the sample from North Bank area were significantly \( (p \leq 0.05) \) higher than other samples. Increase in the amount of African yam bean used in preparing the porridge resulted in increase in the protein content progressively. This maybe because African yam bean is not as poor as cassava and other root crops and some leguminous crops in protein content (Habtamu, 2013 and Habtamu, 2014) [10]. This result also correlates with the study (Mashayekh et al., 2008) [17] who also reported increase in protein content of the African yam bean as a result of heat treatment (2008). Kumari and Sangeetha, 2017 [16] reported that protein will be increased when legumes are heated. Proteins are essential for growth and maintenance of body tissues and for the production of substances such as hormones and enzymes which help to control many functions within the body. If insufficient carbohydrate and fat are available in the diet, then protein may also be used as alternative source to provide the body with energy (WHO/FOA/UNU, 1994) [27]. The crude fat content of the samples decreased \( (p \leq 0.05) \) significantly across the samples. The value of the crude fat ranged from 3.68-5.49%. Sample D and E (African yam bean collected from Wadata and Kanshio areas) had the highest fat content 5.49% and 5.47% respectively. This may be because of the high ash content of the water of condiments increased at the porridge preparation, the ash content of the samples increased \( (p \leq 0.05) \) non significantly across the samples and it ranged from 20.94-33.08%.
condiments which indicates the high mineral contents in it. Total ash content is directly proportional to the amount of inorganic elements content of the African yam beans (Mesfin and Shimelis, 2013) [18]. Hence the samples with high percentages ash contents were expected to have high concentrations of various mineral elements, (FAO/WHO/UNU, 1994 and Habtamu, 2014) [27, 10]. The ash content of food material could be used as an index of mineral constituents of the food because ash is the organic residue remaining after the water and organic matter have been removed by heating in the presence of an oxidizing agent (Sanni et al., 2008) [24]. The carbohydrate content of the samples ranged from 54.61-65.26%. The decrease in the carbohydrate content for the samples collected from North bank area and Kanshio area of Makurdi (sample A and E) might be due to high utilization of energy by micro flora during processing, the decrease might also be due to the significant increase in the protein content. The carbohydrate contents of the samples were greater than the minimum carbohydrate requirement 37% recommend by regulatory standards in Nigeria (SON, 2004) [21].

Means followed by the same superscript along columns were not significantly different (P > 0.05)
A = North bank Market Area
B = Asase Northbank Area
C = High Level
D = Wadata Area
E = Kanshio Area

Mineral Content of “Ahuma” porridge sold by vendors from different locations in Makurdi Metropolis

The mineral composition of the “Ahuma” porridge is as shown in table 5. The samples significantly (P < 0.05) had higher magnesium content. The magnesium content ranged between 38.95-72.38 mg/100 g. The phosphorus content of the porridge samples decreased (P>0.05) significantly between sample A and D. There was no significant (P>0.05) difference between sample B, C and E. The phosphorus content ranged from 63.41-65.26 mg/100g agrees with the result of Haros et al. (2001) [11]. The sodium content of the samples increased (p<0.05) significantly among the samples across the different locations. The result of the sodium content of the samples ranged from 1.84-2.61 mg/100 g and is in agreement with Michael et al. (2013) [19]. Potassium is a mineral that functions as an electrolyte. It’s required for muscle contraction, proper heart function and the transmission of nerve signals. It’s also needed by a few enzymes, including one that helps the body turn carbohydrate into energy (UICEC/WHO, 2005) [27]. The potassium content of the samples increased (p<0.05) significantly across the samples. The potassium content of African yam bean porridge ranged between 21.05-26.91 mg/100 g and is in agreement with Michael et al. (2013) [19]. Potassium is a mineral that functions as an electrolyte. It’s required for muscle contraction, proper heart function and the transmission of nerve signals. It’s also needed by a few enzymes, including one that helps the body turn carbohydrate into energy (UICEC/WHO, 2005) [27].

Table 1: Proximate composition of “Ahuma” Porridge sold by vendors from different locations in Makurdi Metropolis.

<table>
<thead>
<tr>
<th>Samples</th>
<th>Moisture content</th>
<th>Protein</th>
<th>Fat</th>
<th>Fiber</th>
<th>Ash</th>
<th>Carbohydrate</th>
<th>Energy</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>12.21a</td>
<td>33.08a</td>
<td>4.90a</td>
<td>4.28a</td>
<td>3.11a</td>
<td>54.63c</td>
<td>344.01</td>
</tr>
<tr>
<td>B</td>
<td>13.20a</td>
<td>20.96d</td>
<td>5.46a</td>
<td>4.24b</td>
<td>4.08a</td>
<td>65.26a</td>
<td>345.14</td>
</tr>
<tr>
<td>C</td>
<td>12.12a</td>
<td>27.86a</td>
<td>3.68a</td>
<td>4.16a</td>
<td>3.84a</td>
<td>60.46b</td>
<td>352.63</td>
</tr>
<tr>
<td>D</td>
<td>13.65a</td>
<td>24.19a</td>
<td>5.49a</td>
<td>6.31c</td>
<td>3.13a</td>
<td>60.88b</td>
<td>352.62</td>
</tr>
<tr>
<td>E</td>
<td>13.89a</td>
<td>20.94c</td>
<td>5.47a</td>
<td>6.30b</td>
<td>3.83a</td>
<td>54.61c</td>
<td>338.57</td>
</tr>
<tr>
<td>LSD</td>
<td>0.35</td>
<td>3.23</td>
<td>0.56</td>
<td>1.02</td>
<td>2.03</td>
<td>4.38</td>
<td></td>
</tr>
</tbody>
</table>

Values are means of triplicate determinations.

Table 2: Mineral content (mg/100 g) of “Ahuma” porridge sold by vendors from different locations in Makurdi Metropolis.

<table>
<thead>
<tr>
<th>Samples</th>
<th>Magnesium</th>
<th>Phosphorus</th>
<th>Sodium</th>
<th>Iron</th>
<th>Potassium</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>38.95±0.71</td>
<td>67.22±0.45</td>
<td>13.60±0.01</td>
<td>1.84±0.01</td>
<td>21.23±0.02</td>
</tr>
<tr>
<td>B</td>
<td>45.38±0.09</td>
<td>72.16±0.01</td>
<td>10.21±0.09</td>
<td>1.87±0.01</td>
<td>26.91±0.01</td>
</tr>
<tr>
<td>C</td>
<td>43.65±0.07</td>
<td>70.15±0.01</td>
<td>9.60±0.01</td>
<td>1.88±0.01</td>
<td>25.72±0.01</td>
</tr>
<tr>
<td>D</td>
<td>45.23±0.48</td>
<td>63.41±0.01</td>
<td>14.15±0.01</td>
<td>1.94±0.03</td>
<td>21.05±0.01</td>
</tr>
<tr>
<td>E</td>
<td>42.16±0.07</td>
<td>72.38±0.01</td>
<td>14.12±0.02</td>
<td>2.20±0.01</td>
<td>24.44±0.01</td>
</tr>
<tr>
<td>LSD</td>
<td>5.80</td>
<td>0.05</td>
<td>0.06</td>
<td>0.09</td>
<td>0.06</td>
</tr>
</tbody>
</table>

Values are means of triplicate determinations.
highest in all the attributes. It also had the highest overall acceptability. It therefore meant that the sample collected from Kanshio area of Makurdi was most acceptable to the panelists. Iombor et al., (2009), Mahmoud and El Alanny, (2014) worked on sensory evaluation of porridges from African yam bean, sweet potato and peanut oil. Their findings agreed with the observation of this report.

Table 3: Sensory attributes of “Ahuma” porridge sold by vendors from different locations in Makurdi Metropolis.

<table>
<thead>
<tr>
<th>Samples</th>
<th>Colour</th>
<th>Aroma</th>
<th>Taste</th>
<th>Mouthful</th>
<th>Overall acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>6.10b±1.86</td>
<td>5.69bc±1.15</td>
<td>5.79ab±1.40</td>
<td>6.35ab±0.86</td>
<td>5.53b±1.30</td>
</tr>
<tr>
<td>B</td>
<td>5.15b±0.76</td>
<td>5.63c±1.40</td>
<td>5.43b±1.42</td>
<td>5.43b±0.96</td>
<td>5.74b±1.36</td>
</tr>
<tr>
<td>C</td>
<td>5.04b±0.92</td>
<td>6.01ab±1.45</td>
<td>6.13ab±1.04</td>
<td>5.59ab±1.06</td>
<td>6.29ab±1.10</td>
</tr>
<tr>
<td>D</td>
<td>6.26a±0.67</td>
<td>5.43b±1.15</td>
<td>4.88b±1.44</td>
<td>5.84b±0.98</td>
<td>5.84a±0.069</td>
</tr>
<tr>
<td>E</td>
<td>8.39a±0.67</td>
<td>7.16a±0.98</td>
<td>8.21a±1.08</td>
<td>7.72a±0.93</td>
<td>8.63a±0.85</td>
</tr>
</tbody>
</table>

Values are means of triplicate determinations.

Means followed by the same superscript along columns were not significantly different (P> 0.05)
A = North bank Market Area
B = Asase Northbank Area
C = High Level
D = Wadata Area
E = Kanshio Area

3. Conclusion and Recommendation

3.1 Conclusion

The proximate composition of individual “ahuma” porridge meal were significantly (P≤0.05) different from each other at different locations. The results of this study showed that “ahuma” porridges were rich in protein, carbohydrate fibre and had high low fat content. Mineral analysis showed phosphorus was the most abundant element in all the “ahuma” samples. The highest phosphorus content (72.38 mg/100 g) was recorded in sample E (Kanshio area), sample B had the highest content of Magnesium (45.38 mg/100 g). The various samples recorded low sodium contents. Product E = Kanshio Area of Makurdi was most acceptable to the sample collected from location E (Kanshio Area) when compared to others.

3.2 Recommendation

Further research analysis should be carried out on the microbial quality of “ahuma” porridges sold by different vendors to ascertain compliance with high hygienic standards during its preparation.

4. References

16. Kumari-Vasantha P, Sangeetha N. Nutritional...


