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<tr>
<td>Author 1</td>
<td>OBIZOBA, Ikemefuna Christopher</td>
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<td>Author 2</td>
<td>ODENIGBO, UM</td>
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ORIGINAL ARTICLE

EFFECTS OF FOOD PROCESSING TECHNIQUES ON THE NUTRIENT AND ANTI-NUTRIENT COMPOSITION OF Afzelia africana (akparata)

ODENIGBO UM and OBIZOBA IC.

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ABSTRACT
The thrust of this work was to determine the effects of roasting, boiling, combination of roasting and boiling and soaking on the nutrient and anti-nutrient composition of Afzelia africana. Two kilograms of Afzelia africana seeds were purchased from the local market, cleaned and divided into four equal portions for the four treatments. At the end of the treatments, the seeds were sun dried for 24 hours and hammer-milled into fine flours. The proximate, the individual minerals and anti-nutrients of the flours were determined using standard assay methods. Boiling alone caused the highest increases in protein, ash, total dietary fiber, insoluble fiber, iron, calcium and phosphorus as against other treatments. Combination of roasting and boiling reduced moisture to 0.45%, iron (0.13mg), copper to traces, potassium (0.16mg), tannins to traces and least viscosity as against other methods. Soaking decreased protein, moisture, fat, total dietary and soluble fiber, calcium, phosphorus, copper, tannins and viscosity. Roasting alone had advantages over other food processing techniques in food energy, soluble dietary fiber, potassium, viscosity and reduced anti-nutrients.

Key words: Afzelia africana, food processing, nutrient potentials, soluble dietary fiber.

INTRODUCTION
Afzelia africana is one of the local food plants grown in the eastern part of Nigeria. It is one of the traditional plant foods studied by very few researchers yet and was found possessing great nutritional potentials. These potentials included improved glycemic control and lipid lowering in diabetic patients. It is a tree legume plant in the family of caesalpiniaceae. It is a deciduous tree and is known as counterwood tree “akparata” amongst the Igbo.

It has black fruits in woody pods about 10cm long when matured (dry). The pod releases shiny black “mahogany bean” seeds when matured by mechanical explosion. The seed is glossy black with waxy orange aril around its base. Afzelia africana cotyledons are traditionally used in the thickening of soups. Its leaves are used in preparing potato yam with vegetable after house fermentation. The consumption of both the seeds and the leaves is common in Southeastern Nigeria.

Earlier studies had reported that Afzelia africana is a good source of protein as well as soluble dietary fiber. Many studies had demonstrated the beneficial
The effects of soluble dietary fiber on blood glucose and lipid levels in diabetes mellitus. It has relatively high iron, zinc, phosphorus and exceptionally high calcium (338mg -100g) content.

Nevertheless, legume foods comparable to other plant foods are very high in a variety of toxic constituents. But fortunately this toxic content can be neutralized with application of various traditional food processing techniques like roasting, boiling, soaking, sprouting and fermentation.

The thrust of this study was to determine the effects of roasting, boiling, combination of boiling and roasting and soaking in nutrient and anti-nutrient composition of *Acetil fibricinum*.

**MATERIALS AND METHODS**

1. Preparation of Samples:
   The *Acetil fibricinum* seeds were purchased from local markets in Nnewi, Anambra State of Nigeria. The seeds were de-stoned, cleaned and subjected to various traditional processing methods as shown in (figure 1) to obtain flour. All the samples were sun-dried for 24 hours and stored at room temperature to mimic the traditional methods of processing and storing *Acetil fibricinum* seeds and flours.

<table>
<thead>
<tr>
<th>Roasting</th>
<th>Boiling</th>
<th>Boiling &amp; Roasting</th>
<th>Soaking</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cracked and dehulled</td>
<td>Cracked and dehulled</td>
<td>Rinsed and sun-dried for 12h.</td>
<td>Cracked and dehulled</td>
</tr>
<tr>
<td>Milled into flour</td>
<td>Rinsed and sun-dried for 20-25mins</td>
<td>Roasted in pan with hot sand</td>
<td>Sun-dried for 24h</td>
</tr>
<tr>
<td>24h sun-dried and stored in air-tight container</td>
<td>Milled into flour</td>
<td>Milled into flour</td>
<td>24h sun-dried and stored in air-tight container</td>
</tr>
</tbody>
</table>

   ![Fig 1: Methods of processing *Acetil fibricinum* seeds into flour.](image)

2. Chemical Analysis:
The sample of the *Acetil fibricinum* flours was analyzed for moisture, crude protein, fat and ash content using methods of the AOAC. Carbohydrate was calculated by difference and the energy value was estimated by the "Atwater factor" (4 for carbohydrate, 9 for fat and 4 for protein). Two grams of each sample was weighed, then dried for 3 hrs. The samples were cooled in desiccator. Six molar HCL was added to each sample. This was followed by

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*Odenigbo & Obizoba, 2004*
determination of iron, calcium and potassium concentrations using a Perkin Elmer 372 atomic absorption spectrophotometer (AAS). Tannins were determined by the modified Vanillin-HCL method [6]. Phosphorus was determined by molybdenumate methods (AOAC) 9. Both soluble and insoluble dietary fibers were estimated by enzymatic gravimetric methods [11].

3. Statistical analysis:
All the statistical analyses of the data were done using standard deviation according to the procedures of Steel and Torrie [12].

RESULTS
Table 1 presents the effects of various food processing techniques on the chemical composition of *Afzelia africana*. The moisture values for both the control (unprocessed) and treated flour samples were different. The boiled (BAA) sample had the highest moisture (13.07%) when compared with the control (12.30%) while the other treated samples ranged from 0.45 to 4.55%. The roasted sample had a higher value than the soaked sample (4.55% vs 3.25%). The combination of boiling and roasting reduced moisture much more than others (0.45%).

The protein values for the treated samples were lower than that of the control (19.95 vs 16.20 - 19.63%) except for the boiled sample (21.14%). The fat for soaked sample was lower than those of the control and the other treatments. The values ranged from 18.75-27.5). The roasted sample had the highest fat (27.98%). The combination of boiling and roasting produced comparable fat as the control (21.32 and 21.20%) and slightly higher than that of the boiled sample (20.81%). The carbohydrate value for control (8.26%) was lower than that of any of the treated samples. Boiled samples had 13.57% and the combination of both boiling and roasting produced 17.57%. However, the soaked sample had the highest carbohydrate value (28.34%). Roasting increased the value when compared with the control (8.26%).

The ash content of the samples differed. It ranged from (0.16 - 2.13 %). Boiling or a combination with roasting had higher ash content than the control (2.13, 1.95% vs 1.88%) or other treatments (1.54 or 0.16%). The roasted sample had the least ash (0.16%). The energy values for the samples differed; it ranged from (1273.7 - 1580.3KJ).

The roasted sample had the highest energy of (1580.3KJ) and the control had the least (1273 7KJ). The combination of boiling and roasting produced much more energy than cooking alone (1419.5 vs 1563.4KJ). Soaked samples had slightly lower energy than that of the combination of roasting and boiling (1419.5 vs 1407.8KJ).

The value for the total dietary fiber was a function of treatments. All the food processing techniques, reduced the fiber when compared to the control (48.56 vs 34.81-42.32%). Soaking decreased the fiber to 34.81% when compared to the other treatments. The combination of boiling and roasting reduced fiber value to 39.20% when compared to the control which is 48.56% or boiling alone which are 42.3 and 40.5 % respectively. The total dietary fiber was analyzed into its components; soluble and insoluble (Table 1).

The soluble dietary fiber of both the control and the treated sample was more than 50%. It ranged from 56.11% - 66.32%. The insoluble dietary fiber was within 33.68% and 43.89%.

Table 2 presents the mineral, anti-nutrients and viscosity of the treated and untreated *Afzelia africana*. The iron values for both the control and the treated samples slightly differed. The values ranged from 9.13 to 10.74mg/100g. The boiled sample had a higher value than that of the other treated samples. The roasted and soaked samples had equal value (9.59 and 9.6mg/100g). The combination of boiling and roasting produced the least iron (9.13mg). The calcium values followed the same trend as iron. The values ranged from 12.63 to 15.22mg/100g. The boiled sample had slightly higher calcium than that of the
Table 1: Effects of food processing techniques on the chemical composition of *Afzelia africana* (% dry wt.)

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Samples</th>
<th>%Aa</th>
<th>%AaA</th>
<th>%AaAa</th>
<th>%AaAaA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein (%)</td>
<td>UAA</td>
<td>19.95±1.50</td>
<td>16.94±0.82</td>
<td>21.14±2.39</td>
<td>19.63±1.63</td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>RAA</td>
<td>12.30±0.80</td>
<td>4.55±0.62</td>
<td>13.07±0.41</td>
<td>0.45±0.10</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>BAA</td>
<td>21.32±3.95</td>
<td>27.99±0.32</td>
<td>20.81±0.18</td>
<td>21.20±0.85</td>
</tr>
<tr>
<td>Carbohydrate (%)</td>
<td>BRAA</td>
<td>8.62±0.94</td>
<td>14.62±0.10</td>
<td>13.37±0.62</td>
<td>17.57±0.47</td>
</tr>
<tr>
<td>Ash (%)</td>
<td>SAA</td>
<td>1.88±0.11</td>
<td>0.16±0.04</td>
<td>2.13±0.12</td>
<td>1.95±0.06</td>
</tr>
<tr>
<td>Dietary Fiber (%)</td>
<td>UAA</td>
<td>48.56±2.13</td>
<td>40.53±1.11</td>
<td>42.32±0.36</td>
<td>39.20±0.30</td>
</tr>
<tr>
<td>Energy(KJ)</td>
<td>RAA</td>
<td>1273.73±28.68</td>
<td>1580.26±10.9</td>
<td>1363.36±39.06</td>
<td>1419.53±7.90</td>
</tr>
<tr>
<td>Insoluble Dietary Fiber (%)</td>
<td>BAA</td>
<td>39.78±0.70</td>
<td>33.68±2.30</td>
<td>42.69±1.61</td>
<td>37.86±1.69</td>
</tr>
<tr>
<td>Soluble Dietary Fiber (%)</td>
<td>BRAA</td>
<td>60.22±1.16</td>
<td>66.32±1.10</td>
<td>57.31±1.25</td>
<td>62.14±0.74</td>
</tr>
</tbody>
</table>

*Means±SD of three determinations.

UAA = Unprocessed *Afzelia africana*  
RAA = Boiled *Afzelia africana*  
BAA = Boiled and roasted *Afzelia africana*  
SAA = Soaked *Afzelia africana*  

Table 2: Effects of treatment on mineral, anti-nutrients and viscosity of *Afzelia africana*.

<table>
<thead>
<tr>
<th>Nutrients</th>
<th>Samples</th>
<th>%Aa</th>
<th>%AaA</th>
<th>%AaAa</th>
<th>%AaAaA</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron(mg/100g)</td>
<td>UAA</td>
<td>10.74±0.84</td>
<td>9.56±1.24</td>
<td>10.15±0.24</td>
<td>9.12±0.83</td>
</tr>
<tr>
<td>Calcium(mg/100g)</td>
<td>RAA</td>
<td>15.22±2.10</td>
<td>14.08±1.27</td>
<td>14.59±0.77</td>
<td>12.63±2.58</td>
</tr>
<tr>
<td>Phosphorus(mg/100g)</td>
<td>BAA</td>
<td>11.33±0.59</td>
<td>11.31±0.47</td>
<td>11.99±0.44</td>
<td>11.30±1.39</td>
</tr>
<tr>
<td>Copper(mg/100g)</td>
<td>BRAA</td>
<td>0.49±0.14</td>
<td>Trace(-)</td>
<td>Trace(-)</td>
<td>Trace(-)</td>
</tr>
<tr>
<td>Potassium(mg/100g)</td>
<td>SAA</td>
<td>20.20±1.55</td>
<td>15.47±0.90</td>
<td>Trace(-)</td>
<td>0.16±0.04</td>
</tr>
<tr>
<td>Tannins(mg/100g)</td>
<td>UAA</td>
<td>Trace(-)</td>
<td>Trace(-)</td>
<td>Trace(-)</td>
<td>Trace(-)</td>
</tr>
<tr>
<td>Phytate(mg/100g)</td>
<td>RAA</td>
<td>3.47±0.40</td>
<td>0.41±0.11</td>
<td>2.93±0.42</td>
<td>4.02±0.19</td>
</tr>
<tr>
<td>Viscosity (μm)</td>
<td>BAA</td>
<td>1.80±0.17</td>
<td>1.99±0.17</td>
<td>1.86±0.10</td>
<td>1.10±0.10</td>
</tr>
</tbody>
</table>

*Means±SD of three determinations.

UAA = Unprocessed *Afzelia africana*  
BAA = Boiled and roasted *Afzelia africana*  
SAA = Soaked *Afzelia africana*  

roasted sample (14.59 vs 14.08mg). The soaked sample had the least. The combination of boiling and roasting had little edge over soaking (12.63 vs 10.30mg). The phosphorus value for the samples was similar except for the soaked sample which had the least (9.44mg). The boiled sample had the highest value of (11.99mg). Copper was detected only in the control (0.49mg/100g). All the treatments had adverse effects on the potassium concentration. The boiled sample had no potassium as well as copper. The potassium value ranged from 0.16 to 15.47mg for the treated samples and 20.20mg for the control.
Combination of boiling and roasting had the most adverse effect on potassium concentration (0.16 mg).

The tannins content of the *Afzelia africana* was reduced to immeasurable levels. On the other hand, the level of phytate was lowered considerably by roasting (0.41 mg/100g) as compared to the control which is 3.4 mg/100g. Boiling and roasting synergistically increased phytate up to one and half fold when compared to boiling alone (2.91 vs 4.02 mg). Surprisingly, soaking alone more than double the value for boiling (6.20 mg vs 2.93 mg).

The viscosity of the samples differed from one another. The roasted sample had the highest value. The combination of boiling and roasting had little edge over boiling alone (1.70 vs 1.60/μ/min).

**DISCUSSION**

This study has buttressed the fact that the under-exploited soup thickener (*Afzelia africana*) has many promising food potentials (Table 1).

It is known that the lower the moisture content of a given food, the higher is the shelf life. The higher moisture value for the control and the boiled samples, the lower would be their keeping quality. The low moisture contents in boiled with roasted sample (BRAA), soaked sample (SAA) and roasted sample (RAA) tend to have extended shelf life. This is in accordance with a study that stated that properly processed *Afzelia africana* could have a shelf life of one month or beyond. This will increase the ready availability and convenience in this food usage.

The protein values for the treated flours (Table 1) were as high as those reported previously in other legumes. The high protein for the boiled and roasted sample was not surprising. It has been shown that a combination of food processing techniques in most cases improves both chemical and nutritional quality of a given food. The lower protein content for the soaked sample might be attributed to loss of protein in soaking medium.

The high fat and energy of the roasted sample were expected. The high fat and energy of the roasted sample were expected. The lower dietary fiber of the soaked sample was not a surprise. The soaking time was short to activate the dormant enzymes in dry seeds to breakdown complex carbohydrate. The high levels of soluble dietary fiber and viscosity of the roasted sample are of great interest, especially in the area of dietary management of diabetes mellitus.

The lower dietary fiber of the soaked sample was not a surprise. The soaking time was short to activate the dormant enzymes in dry seeds to breakdown complex carbohydrate. The higher carbohydrate value for the soaked sample was not a surprise. Soaking and dehulling decrease anti-nutrients to safe levels in some cases and breakdown complex carbohydrate into much more free absorbable sugar due to activated enzyme activity during soaking.

The low dietary fiber of the soaked sample was not a surprise. The soaking time was short to activate the dormant enzymes in dry seeds to breakdown complex carbohydrate. The high levels of soluble dietary fiber and viscosity of the soaked sample are of great interest, especially in the area of dietary management of diabetes mellitus. Ene-Obong and Carnovale observed the same important nutritional quality of *Afzelia africana* in their study of unexploited plant legumes.

The low phytate and traces of tannins in all products of *Afzelia africana* might be the reason most of the amount of minerals increased except copper. It is a common knowledge that anti-nutrients chelate minerals and reduce their bioavailability. On the other hand, when these anti-nutrients are destroyed or reduced to safe levels during processing, most of the minerals they chelate would be made much more available for utilization for human or animal diets.

In conclusion, processing of *Afzelia africana* with roasting method has shown more advantages over the other methods. The high solubility and viscosity value will blunt post-prandial increase in blood glucose, a significant potential in diabetes mellitus management.

**REFERENCES**


