NUTRIENT COMPOSITION OF THREE COMMONLY CONSUMED
INDIGENOUS VEGETABLES OF NORTH-CENTRAL NIGERIA

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ABSTRACT

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This study evaluated the nutrient composition of Adansonia digitata, Ceratotheca sesamoides and Abelmoschus esculentus using standard analytical procedures. The result of the proximate analysis showed that moisture content was 9.52 mg/g for A. digitata, 11.7 mg/g for C. sesamoides and 26.0 mg/g for A. esculentus. Ash content ranged from 8.1 mg/g in A. digitata to 11.1 mg/g in C. sesamoides while crude fibre content was 4.3 mg/g in A. esculentus, 11.0 mg/g in C. sesamoides and 36.4 mg/g in A. digitata. Crude protein content was high, and was 20.8 mg/g in A. digitata, 21.8 mg/g in A. esculentus and 28.8 mg/g in C. sesamoides. Both C. sesamoides and A. digitata were low in fat content (1.7 and 2.12 mg/g respectively) but A. esculentus has high fat content of 17.2 mg/g. Carbohydrate content ranged from 21.7 mg/g in A. esculentus to 35.7 in C. sesamoides. Predominant minerals were Ca (18.2 to 170.6 mg/g), K (9.2 to 108.5 mg/g), Na (8.0 to 88.0 mg/g), Fe (3.6 to 45.1 mg/g) and Cu (13.0 to 30.9 mg/g). Lead (Pb) and Cadmium (Cd) were in trace quantities. These vegetables could serve as excellent sources of the major food components and essential minerals. Their regular consumption is recommended.

INTRODUCTION

Nigeria is in the tropical region of Africa; and is dominated with Rain forest land in the south, Sudan savanna in the north-central and Sahel savanna in the far north. Each of these three climatic zones is characterized with peculiar types of vegetables which are usually embraced and most commonly consumed by the people of that zone. Usually the people are composed of different tribes. However within each of these zones, the tribes have related cultures and traditions which with the available vegetables influence their selection and consumption patterns of vegetables. Nigeria is endowed with very many varieties of vegetables. The common ones include carrot and Irish potato (root tubers), cabbage, spinach, lettuce and amaranths (leafy vegetables) onion and garlic (bulbs), groundnut and fresh green bean (legumes), and pepper, pumpkin and tomato (fruits) (Schmidt, 1971; Eka, 1987; Fayeme, 1999).

Vegetables are very vital to human, both economically and nutritionally. Economically, they are relatively cheap to grow and act as a quick source of income to many rural women. Nutritionally, they are a good source of vitamins, minerals and dietary fibre; and water to aid digestion. Vegetables are rich in minerals such as potassium, sodium, calcium, iron, zinc and phosphorus. They also have high contents of thiamine, ascorbic acid, riboflavin and β-carotene. The water content is about 70% or more. They also contain many phytochemicals which are needed for health-promotion and disease prevention (Fayeme, 1999). Vegetables are consumed in very small quantities, and are used in almost every meal or used alone as salad or as a side dish with main meal.

The North-Central Nigeria is made up of the Federal Capital Territory, Abuja and six states, namely Niger, Kwara, Kogi, Benue, Nasarawa and Plateau, out of the 36 states of Nigeria. The North-Central Nigeria has some peculiar vegetables indigenous to the zone. The Most commonly consumed indigenous vegetables to this zone include Adansonia digitata commonly called baobab in English and Kuka in Hausa; Ceratotheca sesamoides commonly called Ridi in Hausa, and Abelmoschus esculentus commonly called okro in English. Adansonia digitata is one of eight species of baobab and is widespread throughout the hot dried region of tropical Africa, mostly in Sudan, Namibia, Ethiopia, Malawi, Zimbabwe and Nigeria (Danthu et al., 1995). In North-central Nigeria, the leaves are eaten both fresh and as dry powder, mostly in making a popular local soup called kuka soup. The fresh tender leaves are usually harvested during rainy season and up to last month of the rainy season into the dry season when part of it is sun-dried for future use (Nordeida et al., 1996). The dried leaves are pounded and sieved into flour for future use as green vegetable in soup preparation. Apart from the leaves as vegetable, the bark and root are used in many traditional medicines (FAO, 1988). Ceratotheca sesamoides is an exotic annual herbaceous plant of up to 100 to 120cm tall, sometimes with woody root stock. The leaves are the edible portion and are used in preparing a popular local soup called miyan karkashi. Abelmoschus esculentus is cultivated and consumed throughout the entire Nigeria. It is popularly called okra. The edible portion is the immature fruit. The fruit becomes fibrous and not suitable for consumption when fully mature but the seeds the matured fruit is used in propagating the next filial generation of the plant.
MATERIALS AND METHODS

Sample collection and preparation
The three vegetables namely *Adansonia digitata* (leaves), *Ceratotheca sesamoides* (leaves) and *Abelmoschus esculentus* (okra) (fruit) were purchased from rural farmers in the local market in Keffi, Nasarawa State, Nigeria. The vegetables were separately sorted to get fine grades which were cleaned, washed, drained and oven-dried at 55°C for 12hrs. They were packed in polythene bags and stored in air-tight containers for laboratory analysis.

Chemical analysis
Homogenous blends of each of the three vegetables were ground into fine powders; and triplicate samples of each analyzed for proximate composition using the standard methods of the Association of organic and applied chemists (AOAC) (2000). Moisture content was calculated from a weighed sample after heating at 105°C for 4hrs. Total nitrogen was determined by the Micro-Kjeldahl method, and crude protein estimated by multiplying the total nitrogen (N) by 6.25, a conversion factor. Total lipids were estimated by petroleum ether extraction, using Tecator Soxhlet apparatus. Carbohydrate content was estimated by difference. The total ash was estimated after incinerating in an ashing muffle furnace for 12hrs at 550°C. The mineral contents, namely calcium, iron, potassium, sodium, zinc, copper and cadmium were determined on the ash samples after dissolving in distilled water, using a Buck Model 200A flame atomic absorption spectrophotometer while phosphorus content was determined using the molybdenovate method (AOAC, 2000) as described by Onwuka, 2005. Data obtained were analyzed using descriptive statistics in the form of means, tables, graphs bar chart and standard deviation.

RESULTS AND DISCUSSIONS

Proximate composition of *Adansonia digitata* (baobab), *Ceratotheca sesamoides* (kuka) and *Abelmoschus esculentus* (okra)

Table 1 shows the proximate composition of the vegetables *Adansonia digitata*, *Ceratotheca sesamoides* and *Abelmoschus esculentus*; all within or higher than the recommended dietary allowance (RDA) (3-10 mg/g) (NRC, 1989). High moisture content in food is important to act as a solvent to aid in all biochemical reactions and physiological activities during digestion. However, foods with high moisture contents are prone to easy microbial spoilage and subsequent short shelf life (Uriah and Izuagbe, 1990; Adeyeye and Ayejugo, 1994). Moderate moisture content of ≤ 12mg/g is preferred for shelf stability of food on long storage. The ash content ranged from 8.14 mg/g in *A. digitata* to 10.95 mg/g in *C. sesamoides* while the fat content was as high as 17.22 mg/g in *A. esculentus* but 2.12 mg/g in *A. digitata* and 1.74 mg/g in *C. sesamoides*. The three vegetables had ash contents higher than the lowest RDA value of 6 mg/g. The vegetable *Abelmoschus esculentus* could serve as a good source of fat and oil, apart from its normal mineral and vitamin contents (Joslyn, 1970). The carbohydrate content ranged from 21.66 mg/g in *A. esculentus* to 35.72 in *C. sesamoides*, very much within the 7-100 mg/g RDA value. Vegetables are never good sources of carbohydrate but these vegetables could serve as good sources. Crude fibre content was 4.3 mg/g in *A. esculentus*, 11.07 mg/g (about 3 times the value in *A. esculentus*) in *C sesamoides* and 36.38 mg/g (about 8 times or more the value in *A. esculentus*) in *A. digitata*. The three vegetables had relatively low crude fibre content when compared with the RDA value of 109.63 mg/g. They are better consumed in combination with other high fibre food to meet the daily fibre requirement. Dietary fibre, though non-nutritive, confer laxative effect in the gastrointestinal tract, thereby shortening transit time of food in the tract, and increasing water-holding capacity of faeces. As a result, the likely incidence of the disorders such as constipation, diverticulitics, irritability bowel syndrome, gall stone and colorectal cancer is prohibited (Leveile, 2003; Anderson et al., 2003; Keys et al., 2006; Shailong and Uguwu, 2011). Crude protein contents were high; 28.83 mg/g in *C. sesamoides*, 21.81 mg/g in *A. esculentus* and 20.82 mg/g in *A. digitata*. Only *C. sesamoides* had protein content commensurate with the RDA value of 23 mg/g. However, these three vegetables had protein content higher than those in most commonly consumed legumes and cereals in Nigeria (Ihekloronye and Ngoddy, 1985).

Table 2 shows the mineral composition of *Adansonia digitata*, *Ceratotheca sesamoides* and *Abelmoschus esculentus*. Among the minerals screened, lead (Pb) was not detected in *A. digitata* and in *A. esculentus* while cadmium (Cd) was also not detected in *C. sesamoides*. Presence of both minerals at levels higher than their standard allowed for food substances (SAFS) in foods constitutes serious health problems. Their absence in these vegetables is advantageous. Unfortunately, lead content (0.20 mg/g) in *C. sesamoides* was twice as high as is the SAFS value of 0.1 mg/g. Also cadmium (Cd) content of 0.83 mg/g in *A. digitata* and of 0.22 mg/g in *A. esculentus* was several times higher than the SAFS value of 0.003 mg/g. Both mineral constitute health hazards when consumed in excess of the safe SAFS level. Lead and cadmium are inorganic metals that are naturally present in the environment. Both Pb and Cd in the body cause varying degrees of toxicity. The excess of lead and
cadmium in the body cause diseases including heart disease, anemia, skeletal weakening and depressed immune system. Thus, they are not needed at any reasonable amount in the diets.

Table 1: Proximate composition of *Adansonia digitata*, *Ceratotheca sesamoides* and *Abelmoschus esculentus* (g/100g)

<table>
<thead>
<tr>
<th>Parameters</th>
<th>A. digitata</th>
<th>C. sesamoides</th>
<th>A. esculentus</th>
<th>RDA (g/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moisture content</td>
<td>9.52 ± 0.08</td>
<td>11.69 ± 0.25</td>
<td>25.96 ± 0.75</td>
<td>3-10</td>
</tr>
<tr>
<td>Ash content</td>
<td>8.14 ± 0.26</td>
<td>10.95 ± 0.11</td>
<td>9.00 ± 1.18</td>
<td>6-10</td>
</tr>
<tr>
<td>Crude fat</td>
<td>2.12 ± 0.09</td>
<td>1.74 ± 0.13</td>
<td>17.22 ± 0.66</td>
<td>1-30</td>
</tr>
<tr>
<td>Crude fibre</td>
<td>36.38 ± 0.28</td>
<td>11.07 ± 0.41</td>
<td>4.30 ± 0.25</td>
<td>19-63</td>
</tr>
<tr>
<td>Crude protein</td>
<td>20.82 ± 0.17</td>
<td>28.83 ± 0.20</td>
<td>21.81 ± 2.10</td>
<td>23</td>
</tr>
<tr>
<td>Carbohydrate</td>
<td>23.02 ± 1.01</td>
<td>35.72 ± 0.19</td>
<td>21.66 ± 0.22</td>
<td>7-100</td>
</tr>
</tbody>
</table>

Each value represented the mean ± standard deviation of three replicate determinations.

Mineral composition

The calcium content of 18.2 mg/g in *A. digitata* and 50.05 mg/g in *C. sesamoides* were relatively low compared with the SAFS value of 99.0 mg/g. However, the 170.60 mg/g in *A. esculentus* was higher than the SAFS value. Frequent consumption of *A. esculentus* supplies the required amount of calcium needed in the body. Calcium contents in these vegetables are not comparable to the amounts commonly found in most legumes (Aremu et al., 2006). Calcium is an important mineral found mainly in bone and teeth. It has central role in many physiological functional integrity of the skeletal system. Calcium is also implicated in cell membrane integrity and permeability, blood clotting, transmission of nerve signal/impulse, regulation of enzymes, and hormones. Fall in serum calcium level below 8.5 mg/dl is referred to as hypocalcemia and is characterized by tetany. This is mostly due to hypoparathyroidism. Dietary deficiency of calcium is one of the predisposing factors to development of rickets in children.

Sodium content in the vegetables ranged from 8.00 mg/g in *A. digitata* to 88.0 in *A. esculentus*; both lower than the SAFS value of 200 mg/g. Potassium content was 9.15 mg/g in *A. digitata*, 9.66 mg/g in *C. sesamoides* and 108.50 mg/g in *A. esculentus*. Potassium content of *Abelmoschus esculentus* was many times higher than the recommended 18.0 mg/g daily requirement. Sodium, like potassium, is involved in the regulation of water balance in the body, maintenance of proper heart beat, contraction of muscles and conduction of nerve impulses (Aremu et al.; 2006b). Potassium regulates water balance, heart rhythm, muscles contraction and nerve-signal conduction. Potassium also influence glucose and lipid metabolism. Increase intake of potassium can lower blood pressure and may help prevent strokes. However excess potassium intake (hyperkalemia) may lead to heart failure and death. High sodium intake has been associated with high fluid retention, leading to hypertension and heart failure. A sodium-restriction diet often lowers elevated blood pressure. The three vegetables, *A. digitata*, *C. sesamoides* and *A. esculentus* had 45.10 mg/g, 16.55 mg/g and 3.60 mg/g iron contents respectively. Only *Abelmoschus esculentus* with 3.60 mg/g iron content was lower than the 15.0 mg/g recommended daily allowance. Iron is reported to be very important in normal functioning of central nervous system and in the oxidation of carbohydrate, protein and fats. In circulating red blood cells, iron is a major component of haemoglobin, which transports the respiratory gases; oxygen and CO<sub>2</sub> to the appropriate channels (Schauss, 1995). Deficiency of iron in the body fluid may lead to death.

Zinc content was 8.8 mg/g in *A. digitata*, 9.90 mg/g in *C. sesamoides* and 18.80 mg/g in *A. esculentus*; all much higher than the recommended daily allowance of 3 mg/g (Schauss, 1995). Zinc is involved in RNA and DNA synthesis, which influences cell division, repair and growth. Accordingly, zinc may help to prevent growth of abnormal cells associated with cancer. Zinc has been used to enhance wound healing and to prevent or treat impaired acuity of taste, smell and night vision. Lack of zinc in the body causes rapid egesting on the surface of wound which may delay quick healing. The value of copper is 13.00, 14.01 and 30.90mg/100g in *A digitata*, *C sesamoides* and *A esculentus* respectively. The concentration of copper appears to be high in *A. esculentus* with value of 30.90mg/100g among the different samples. These copper contents of the vegetables were very high compared to the required 2 mg daily requirement. Copper is a component of several enzymes needed for proper metabolism. Diagnosed deficiency is rare but when it become deficient, it may lead to anemia, impaired immunity and bone diseases. Copper and zinc compete for gastrointestinal transport, therefore, an excess of one can theoretically produce a deficiency of the other. There is no RDA for copper, and excess copper in the body will lead to convulsion in children (Shills, 1985; Shills and young., 1988).
### REFERENCES


