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Food Value Of Baobab (*Adansonia Digitata* L) Leaves

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Abstract

Baobab (*Adansona digitata* L), a big tree that grows principally in Africa was investigated for its nutritional composition. Stratified random sampling techniques were employed to identify the baobab trees from which samples were collected. Bauchi state was stratified according to its three ecological zones: Northern Guinea Savanna, Sudan Savanna and Sahel Savanna. Within each of these ecological zones, a Local Government Area (LGA) was randomly chosen to form the sampling unit. The three LGAs selected were Dass from Northern Guinea Savanna, Kirfi from Sudan Savanna and Katagum from Sahel Savanna ecozone. From these three LGAs, three Baobab trees each were identified and fifteen fresh leaves randomly collected with secateurs from each of the nine identified Baobab trees. Sample collection bags were used to convey the samples from collection areas to the laboratory (Forestry Technology Laboratory, Federal polytechnic, Bauchi) where the samples were dried under shade for two weeks. The dried leaves were grounded using pestle and mortar, mixed thoroughly to obtain a composite sample and pass through 2mm sieve. The analysis was conducted at Biochemistry Laboratory of Federal College of Animal Health and Production Vom, Plateau State - Nigeria using the instructions of Association of Analytical Chemists (2000). The results of the analysis reveals that at the time of the analysis, the Moisture Content was found to be 2.24%, Ash 8.30%, Crude protein 6.15%, Carbohydrate 9.25%, Crude Fat 3.36%, and Crude Fiber 2.42% respectively. The

observed nutrient levels and types may add value to the dietary needs of both human and animals. Considering its popularity among inhabitants of sub-Saharan Africa as a soup thickener, source of fibre and above all, its ecological attributes, its regeneration is highly encouraged and being the most populous tree in terms of usage among households in the Sahelian region, processing and packaging of the leaves will go a long way in promoting food security and add value to the product.

Introduction

Baobab (Adansonia digitata) is one of the tropical trees that grows massively in Africa with wide range of distribution. Adansonia is a generic name to eight species which belongs to the family Bombacaceae: *Adansonia grandideiri* Baila; *A madagascarensis* H.; *A. za* Bail; *A. gregoril* F. Muel; *A. perrier* Capuron; *A. fony var. rubrostipa* Jum and H. Perrier; *A. suarezensis* H and *A. digitata* L (Sanchez *et al*.,2010).

Adansonia digitata is a long lived tree as it can live up to more than ten decades and being dry zone species, it can shed leaves during the dry season as an ecological adaptation and can store many litres of water as reserve for future use during period of water scarcity (drought) in Sahel region (Wakili,2016). It is a massive deciduous tree growing up to thirty meters (30m) tall with corresponding diameter range of between 3-10m when fully mature and multipurpose in nature as it have many utility values ranging from food, medicine and cultural fulfillments. Baobab fruits are rich in Calcium, Potassium, Phosphorus, Vitamin C, Carbohydrates, fibres, Proteins and Lipids (Assogbadjo *et al*., 2011 and Rahul *et al*., 2015).

The black seeds of Adansonia digitata are embedded in a white and chalky pulp of its ovoid fruit popularly called monkey's bread. The seeds possesses hard impermeable layers which were developed during maturation and seasoning, and this makes natural regeneration difficult. However, when the dormancy is removed by softening the coat using water (cold and hot), mechanical or acid scarification, the seeds give uniform and quick germination. The repeated soaking of baobab seeds in Sulphuric acid (tetraoxosulphate VI acid) enhances germination and early growth performance of baobab plant (Usman and Asan, 2017).

The leaves and bark are important sources of medicine throughout African tropical regions (Kabore et al., 2011). The leaves of *Adansonia digitata* was reported to have being used throughout Africa as a major soup thickener without having much knowledge of the food value of the leaves as little or no literature is available among the rural populace most especially, and who most often used the leaves on daily bases.

In an effort to bridge this gap, this study was designed to investigate the proximate composition of baobab leaves with a view to sensitizing the populace on the food value of the most populous leaves in terms of utility in Africa.

MATERIALS AND METHODS

A brief about the study area

Bauchi state has a land area of 49,259.01 km^2 with a population of 4.6million people and located between latitude 9^0 30^1 and 12^0 30^1 north of the equator and longitude 8^0 50^1 and 11^0 east of the Greenwich meridian. The state has a typical tropical climate marked clearly by the dry and rain seasons. The average annual rainfall is 700 mm in the northern part and 1300 mm in the southern parts. The wettest months are July, August and September, dry season start in November and ends in April. This is a period of harmattan, when the dust loaded North East trade wind from Sahara desert has a marked drying effect on the vegetation and the general climate of the state. Bauchi state is one of the states in northern part of Nigeria that span three district vegetation zones, namely, the Northern Guinea Savannah, Sudan Savannah and Sahel Savannah with Sudan Savannah dominating. Guinea Savannah become manifest as one move along a belt that stretches from extreme western part of the state to the extreme southern part covering Local Government Areas of Toro, Tafawa Balewa, Dass and Bogoro.The Sudan Savannah type of vegetation covers LGAs of Ningi, Warji, Darazo, Kirfi, Alkaleri and Bauchi respectfully. The Sahel zone also known as Semi desert type, becomes manifest from the middle of the state as one moves from south to the north. The character vegetation of the zone is isolated stance of thorny shrubs interspersed by short trees (BSOD, 2019)

Collection and Preparation of Baobab Leaves for Analysis

Stratified random sampling techniques were employed to identify the baobab trees from which samples were collected. Bauchi state was stratified according to its three ecological zones: Northern Guinea Savanna, Sudan Savanna and Sahel Savanna. Within each of these ecological zones, a Local Government Area (LGA) was randomly chosen to form the sampling unit. The three LGAs selected were Dass from Northern Guinea Savanna, Kirfi from Sudan Savanna and Katagum from Sahel Savanna ecozone. From these three LGAs, three Baobab trees each were identified and fifteen fresh leaves randomly collected with secateurs from each of the nine identified Baobab trees. Sample collection bags were used to convey the samples from collection areas to the laboratory (Forestry Technology Laboratory, Federal polytechnic, Bauchi) where the samples were dried under shade for two weeks. The dried leaves were grounded using pestle and mortar, mixed thoroughly to obtain a composite sample and

pass through 2mm sieve. The powdered leaves were used in the determination of proximate composition.

The analysis was conducted at Biochemistry Laboratory of Federal College of Animal Health and Production Vom, Plateau State Nigeria.

Determination of Proximate Composition of Baobab Leaves

The analysis was conducted using the instructions of Association of Analytical Chemists (2000) to ascertain the moisture content, crude protein, crude fiber, crude fat, ash and carbohydrate content of the sample.

Determination of Moisture content

2g of leaf powdered sample were weighed and place in pre-weighed moisture can, it was dried to constant weight at 105^0C in a drying oven. The moisture content was determined by the formula.

$$MC = \frac{A-B}{B} * 100$$

Where MC = Moisture content

A = Original mass of dried leaves powdered sample

B = Oven dry mass of dried leaves powdered sample

Determination of Crude Protein (CP)

This analysis was conducted with an aid of micro Kjedhal system in accordance with AOAC (2000). A small quantity of the sample (Approximately 1g) was introduced in to the digestion tube (Kjeltec 2200 FOSS) and, a catalyst (2 tablets of 5gK_2SO_4 and 5g of Se) and 12ml of concentrated tetra oxosulphate VI acid (H_2SO_4) were added. The digestion was run for one hour at 420^{o}C. 80ml and 40ml of water and sodium hydroxide (NaOH) respectfully were used in the distillation using 2200 FOSS distillation unit and the distillate was collected in 4% Boric acid. Percentage Nitrogen was calculated thus:

$$\%N = \frac{(\text{Titre- Blank}) \times 14.007 \times 0.1 \times 100}{1000 \times \text{sample weight (mg)}}$$

$$\%CP = \%N \times 6.25$$

Determination of Crude Fiber (CF)

The crude fiber of the sample was determined according to AOAC (2000). 2g of the sample was defatted with petroleum ether and then boil under reflux for 30minutes

with 200ml of a solution containing 1.25g of H_2SO_4 per 100ml of solution. The solution was then filtered through linen on a fluted funnel. It is then washed with boiling water until the washings are no longer acid. The residue was then transferred to a beaker and boils for 30minutes with 200ml of a solution containing 1.25g of carbonate free NaOH per 100ml. the final residue was then filtered through a thin but close pad of washed and ignited asbestos in a Gooch crucible and dried in an electric oven and weigh. It was then incinerated, cooled and weighed. The percentage crude fiber was calculated as:

%CF = Loss of weight after incineration x 100

Determination of Crude Fat

The fat contents were determined using Fat extractor with automated control unit (FOSS Soxtec 2055) according to AOAC (2000). The equipment has six extraction units with each unit carrying a thimble which accommodate the samples and aluminum cups for collection of the extracted fat. These units enable six samples to be analyzed within 75minutes. Percentage of fat is the differences between weight of the pre-weighed cups and after extraction. One gram of the samples was weighed into the thimble and its mouth plugged with defatted cotton wool, after which it was inserted in to the extraction unit. 80ml of petroleum ether were dropped in to each cup and maintained at 135^{o}C. Each cup was aligned with its corresponding thimble. The extraction and rinsing were done for 30minutes each, after which the sample was aerated for 15minutes and crude fat calculated as:

$$\%Fat = \frac{W_3 - W_2}{W_1} \times 100$$

Where w_1 = weight of sample, W_2 = weight of empty cup and W_3 = weight of cup with the extracted oil

Determination of Ash

The instruction of AOAC (2000) was adhered to in the running of this analysis. Crucibles were rinsed and dried in hot air oven (SM9053) maintained for 30minutes at 105^{o}C. These were cooled in desiccators and weighed. 2.5g of the sample was burnt on a heater inside a fume cupboard to get rid of smoke. The samples were moved to pre-heated muffle furnace (SM9080) maintained at 550^{o}C until such a time when a light grey ash was noticed. The crucibles were cooled in a desiccators and weighed. The ash content was calculated as:

$$\%Ash = \frac{\text{(weight of crucible + Ash) – weight of empty crucible}}{} \times 100$$

Weight of sample

RESULTS AND DISCUSSION

Table 1. Nutritional composition of Baobab Leaves

Variable	Results (%)
Moisture Content	2.24
Crude Protien	6.15
Crude Fiber	2.42
Crude Fat	3.36
Ash	8.30
Carbohydrate	9.25

Moisture Content

The moisture content of baobab leaves in this experiment was found to be 0.14%. This moisture value was lower than that of *Pachira glabra* (0.17%) as reported by Oni et al., 2015. The reason for the variation may be as a result of plant part(s) used for the analysis. Oni et al., 2015 uses fruit of *Pachira glabra* which is high forest species while this research used leaves of baobab tree, and which was dried for two weeks prior to the analysis. The findings of Wakili et al., 2015 shows moisture value of some commonly used horticultural plants in Northern Nigeria: orange (87.12%), *Ananas comosus* (80.10%), *Solanum melongena* (78.95%) and *Cocos nucifera* (42.92%) respectively. These values were also higher than the value of this study. The variation may be attributed to the part(s) of the plant used for the analysis and the mode of drying. Wakili *et al.*, 2015, uses fruits which mainly contain water and the collected fruits were not subjected to long drying period of time as does in this methodology. In this work, the leaves were collected and subjected to drying process for a period of two weeks. This makes the moisture content to be too low compared to a day drying for conventional period for drying baobab leaves for domestic usage. Comparatively, the moisture content of this study is lower than the findings of many researchers reported above and therefore in powdered form the leaves of Baobab can be stored for a considerable period of time because biodegraders may find it difficult to operate and cause deterioration. This attribute may help to store baobab products especially the leaves for a long period of time in areas where modern storage facilities are not available.

Crude Protein

The protein content observed in this study was respectively lower (6.15%) compared to the findings of Ogunlade *et al.*, 2011, who reported protein value of 10.38% for *pachira glabra* and Oni et al., 2015, reported protein value of 7.67% for *pachira*

glabra. Wakili *et al.,* 2015 reported 18.48% for *Solanum melongena,* 12.81% for *Daucus carota,* 9.38% for *Citrus sinensis,* 8.32% for *Cocos nucifera* and *Ananas comosus* (2.77%) and thus giving protein range value of between 2.77% and 12.8% agrees with the findings of this work. Tabitha, 2013 reported a protein content of *Solanum melongena* from northern guinea savanna zone of Nigeria to be 16.25%. Oni et al., 2015 reported that protein content of *pachira glabra* was found to be 7.67% which is higher than the report of this study (6.15%). The variation may be as a result of the part of the tree used for the study. Fruits were used in the later studies while the former uses leaves. According to Ninfaa (2011), the protein content of the desert date leaves and fruit pulp were 17.06% and 3.85% respectively.

Crude Fiber

Table 1 reveals that baobab leaves have the value of 0.42%, for crude fiber. Crude fiber helps in the maintenance of cholesterol and lower blood sugar in addition to prevention of constipation among adults (Gopalane *et al.,* 1997). Amusa *et al.,* 2018 reported 7.92% as crude fiber value of *Talinium triangulae* which is relatively higher than the crude fiber of this study. The variation could be attributed to variation in ecological zone. This result was conducted in Sudan savannah zone of Northern part of Nigeria, whereas crude fiber reported by Amusa *et al., 2018* was carried out in low land high forest of Nigeria. According to the findings of Wakili et al., (2015), crude fiber of *cocos nucifera* has the value of 14%, *Ananas comosus*(7%), *citrus sinensis* (2.82%) *Daucus carota* (2.39%) and *solanum melongena* (2.28%). Therefore, the value of this finding were lower than the values reported by Wakili *et al.,* (2015).But higher than the findings of this study. The low crude fibre of baobab leaves could be due to the variation in plant species or plant part used for the experiment. Diplocka *et al.,* (1998) reported baobab leaves fibre (3.88%). This value was higher than value obtained in this present study. The reason for the variation could be attributed to mode of drying and different in geographical location, this work is subjected to two weeks drying before carrying out the laboratory analysis. The findings of Mona, (2014) reveal 5.64% as fibre value of baobab seeds.

Crude Fat

The result of the analysis indicated that the value of baobab leaves fat (0.36%) was found to be very low compared to the value of *Talinium triangulae* (7.34 ± 0.05%) as reported by Eleazu and Eleazu 2013 which could be attributed to climatic factors. *Talinium triangulae* is leafy vegetable of high rainfall area compared to Baobab tree growing wild in savannah region of Nigeria. Osman, (2004) reported that baobab seeds contains 12.25% fat, this value was higher than that of this work. According to Ajayi *et al.,* 2006 fat content of baobab seeds was found to be 33.60% which was also higher

than that of baobab leaves used for this study. The variation could be attributed to the plant part used for the experiment, Osman(2004) and Ajayi(2006) work on baobab seed, while this study was based on baobab leaves. Amusa *et al.*,(2018) reported 1.98% fat content for *Talinium triangulae* leaves which was also higher compared to the value reported in this study. According to the findings of Akindahunsi and Salawu (2005), fat content of *Talinium triangulae* and *Amaranthus hybridus* leaves were 5.90% and 4.80% respectively and were also higher than the report of this study. The variation could be attributed to species of the plant used for the study, *Talinium triangulae* and *Amaranthus hybridus* were leafy vegetables of rainfall area compared to Baobab tree growing wild in savanna region of Nigeria. The findings of Ninfaa, (2011) shows that the fiber content of the desert date leaves and fruit pulp as 16.02% and 8.27% respectively. This value was higher than the value of baobab leaves fat shown in this study. The variation could be due to location of the plant and species of the plant used to carry out the experiment.

Carbohydrate

The carbohydrate content of the present study was found to be 9.25% which is lower than 11.2% carbohydrate content of Baobab seeds as reported by Murray *et al.*, (2001). According to the findings of Proll (1998), the carbohydrate content of baobab seeds was found to be (56.75%). This shows that the carbohydrates present in baobab seeds is higher than that of sbaobab leaves. The low carbohydrates content of baobab leaves indicated a little role as a source of energy, a sample with high level of carbohydrates can regulate nerve tissue. According to the findings of Ninfaa, (2011) the carbohydrates content of the desert date fruit was 59.53% while that of the leaves was (30.92%). These values were higher than that of this study and therefore provide more energy than baobab leaves.

Conclusion

In conclusion, it would be said that Adansonia digitata leaves are full of the required nutrients for growth and development and therefore all efforts aimed at its regeneration should be championed with all seriousness it deserved.

Recommendations

Considering the dietary contributions of baobab in addition to its ecological and industrial values the following are here by recommended:

- There should be a massive effort toward production and distribution of *Adansonia digitata*
- *Adansonia digitata* should be made to be part of afforestation species in the sahelian region of the tropoics

- The conventional removal of the entire leaves from the crown is detrimental to the photosynthetic fortune of *Adansonia digitata* and should therefore be discouraged
- Being the most populous tree in terms of usage among households in the sahelian region, processing and packaging of the leaves will go along way in promoting food security and add value to the product

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