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**ORIGINAL ARTICLE**

# Antioxidant Activity, Proximate Composition and Lipid Quality of Baobab (*Adansonia digitata* L.) Seeds from North-Cameroon

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**Abstract**

The aim of this study was to determine the antioxidant activity, proximate composition and lipid quality of Baobab (*Adansonia digitata* L.) seeds. The seeds' oil was extracted and its quality and antioxidant activity were evaluated, alongside with the evaluation of the proximate composition of the seeds. The results obtained demonstrated that baobab seeds were a moderate antioxidant source and that its oil contained; 21.73 meq O2/kg of Peroxide value, 2.21 ppm of thiobarbuturic acid value, 53.35 g/100g of Iodine value, 5.80 % of Acid value and was white in colour. The proximate analysis showed that the seed contained 14.70 % Lipids, 67.3 % Carbohydrates, 12.34% Proteins, 0.96 % Fibers, and 4.70 % Ash. The major minerals elements present in baobab seeds included; Calcium 7.10 mg/100g, Potassium 1219 mg/100g, Phosphorus 68 mg/100g, Magnesium 167 mg/100g, Sodium 102 mg/100g, Zinc 34 mg/100g and Ion 689.01 mg/100g. These results suggest that baobab seeds could contribute partially to the overall daily intake of these minerals. Also, oil from baobab is saturated and it can be used in cooking since it is less prone to oxidation. Baobab seed been a good antioxidant suggest that it may provide protection against chronic diseases as cancers and cardiovascular diseases.

***Practical application***

Baobab seeds may have beneficial health effects on human health and can be used as an alternative sustainable raw material in food formulation or for industrial purposes since it is highly nutritive.

**Keywords:** *Adansonia digitata*, antioxidant, physicochemical properties, oil.



## 1. Introduction

Baobab (*Adansonia digitata* L.) is a very long-lived tree with multiple uses (Igboeli *et al.*, 1997). It is a high yielding, draught resistant and all season plant belonging to the Malvaceae family. It is native to arid central Africa (Yazzie *et al.*, 1994) and has a large distribution spread across large area of sub-Sahara Africa‟s semi-arid and sub-humid regions as well as in western Madagascar (Diop et *al.*, 2005). Baobab tree may grow as high as 18 m and may have a trunk with 9 m diameter. Its branches are short and stubby and its bark grey and thick. The significance of Baobab means "fruits with many seeds" (Ajayi *et al.*, 2003). Its fruits are used for the production of baobab juice, the seeds for oil extractions, flour production or eaten raw or roasted (Arnold *et al.*, 1985). Parts of this tree have been proven to have good medicinal properties.

Baobab seeds are rich in protein (about 33.7%), lipids (30.6%) and fibers (16.9%) (Murray *et al.* 2001). Baobab seeds oil is a good source of unsaturated fatty acids including oleic, linoleic and linoleic acid. They are also good sources of Vitamin A, D, E and K (Nkafamiya *et al.* 2007). Baobab bark, pulp, seed, roots, fruits and leaves have been demonstrated to have good medicinal properties among which antioxidant (Carlsen *et al.* 2010), anti-inflammatory (Ramadan *et al.* 1993), anti-microbial (Sanaa, 2008), anti-viral (Selvarani & James, 2009) etc.

Baobab seeds are globally underutilized in Cameroon despite their composition and interesting medicinal properties. Little or no attention is given to the use of those seeds as they are usually considered as waste. They can however be valorized in a way or another. New research on the development of new products based on by-products is very much required. With the nutritional problems facing the society today (hunger and increasing demography), reducing mishandling of food parts which can be used as food has been ignored over the years and is gradually becoming a priority these days. This is because proper use of these by- products as raw materials or food complements contributes to reduce malnutrition, generate economic gain and improve human health through food supplemented with bio-actives.

Several studies have previously been carried out on baobab. Abubakar *et al.* (2015) carried out a nutraceutical evaluation of baobab seeds from Nigeria and the physicochemical properties of its oil. A chemical and functional characterization of baobab seeds protein concentrate was done by Adenekan *et al.* (2017) still on Nigerian baobab. The antioxidant capacity and physicochemical properties of Sudanese baobab seed oil was investigated by Babiker *et al.* (2017). Studies on the physicochemical analysis of baobab seeds produce in Cameroon are rare to be found. In one study, Maptouom *et al.* (2020) evaluated the influence of different traditional production processes on the antioxidant capacity and vitamin C content of baobab juice. It is therefore necessary to evaluate the nutritional composition, the lipid quality and the antioxidant activity of baobab seeds produced in Cameroon so that, the knowledge derived can be used to encourage adequate consumption and utilization of these seeds in possible value added applications.

The objectives of this study, was to determine the physicochemical properties of baobab seeds from Cameroon for their valorization

## 2. Materials and Methods

### *2.1. Material*

The fresh baobab seeds were purchased at the Catholic University Institute of Buea (CUIB) trade fair, Douala, Cameroon, in March 2019. All chemicals and reagents used were of analytical reagent grade.



### *2.2. Methods*

#### *2.2.1. Sample preparation and processing*

The seeds were collected, cleaned and dried under sunlight to constant weight. The dried seeds were used for further studies

#### *2.2.2. Oil extraction*

The oil was extracted by maceration as described by Womeni *et al.* (2016). The seeds were separately ground to pass through 1 mm diameter sieve. 80 g of each powder was separately macerated in 400 ml of hexane at room temperature for 24 h with constant shaking. After that, the mixture was filtered using the wathman paper N°1, and the filtrate was

concentrated on a rotatory evaporator at 40 °C. The extracted oils were stored in the refrigerator at 4 °C for further analysis. The remaining solid fractions were dried in the oven at 50 °C for the determination of their proximate composition.

### *2.2.3. Evaluation of the antioxidant activity*

The radical scavenging activity of the extracts was assessed using the 2,2-diphényl-1-picrylhydrazyl as described by Braca *et al.* (2002). A 0.002% 2,2-diphényl-1-picrylhydrazyl methanolic solution was prepared and 4.5 ml of that solution respectively introduced in test tubes containing the methanolic extract solution at concentrations 2000, 1000, 500, 250 and 125 µg/ml also prepared using methanol as solvent. Butylated hydroxytoluene prepared under similar condition like the extract solutions served as control. The blanks were made of 0.5 ml of extract solution and 4.5 ml of methanol. After incubating at room temperature in the dark for 30 min, absorbances were measured at 517 nm using a spectrophotometer (HELIOS Epsilon-Thermo Scientific). Methanol was used to zero the device before use. The radical scavenging activity of the extracts was calculated as follow:

$$RSA\ (\%) = [(Abs_{DPPH} - Abs\ sample) \times 100 / Abs_{DPPH}]$$

Where,

RSA = Radical scavenging activity
$Abs_{DPPH}$ = Absorbance of the DPPH solution
$Abs_{sample}$: Absorbance sample

### *2.2.4. Oil characterization*

#### *2.2.4.1. Peroxide value*

Baobab seeds oil analysis was assessed as follow: The peroxide value was determined using the IDF standard method 74A: 1991 (IDF, 1991). About 0.01 g of oil sample was introduced in a 15 ml test tube containing 9.8 ml of a mixture chloroform-methanol (7:3 v/v). After stirring for 2-4 seconds, 50 µl of a 30% ammonium thiocyanate solution and ferrous chloride were respectively added. The mixture was kept at room temperature for 5 min and the absorbance recorded at 500 nm for the calculation of the peroxide value using the calibration curve. The analyses were performed under soft light for 10 min. The PV was calculated as follow:

$$PV = (As - Ab) \times m / 55.84 \times m_0 \times 2$$

Where,

As = absorbance of the sample; Ab = absorbance of the blank; m = slope, obtained from the calibration curve (in this experiment 38.40); m0 = mass in grams of the sample; 55.84 = atomic weight of iron

#### *2.2.4.2. Thiobarbituric acid value*

The thiobarbituric acid (TBA) value was evaluated using the method reported by Draper & Hadley (1990). About 1-2 g of oil was mixed with 1 ml of a 0.1% aqueous trichloroacetic acid solution. After stirring the solution for 10 seconds at room temperature, 1 ml of a 0.375% thiobarbituric acid solution was added, followed by 1 ml of a 15% trichloroacetic acid and 1 ml of a 0.25 N hydrochloric acid solution. After stirring for 10 seconds, the solution was incubated in a water bath at 95°C for 30 min until the pink color developed. After that, the samples were cooled in an ice bath for about 10 min and centrifuged at 4500 rpm for 15 min. The blank was prepared under similar conditions with distilled water. The absorbance of the supernatant was measured at 532 nm against the blank and the thiobarbituric acid value calculated following the formula:

$$TBA\ value = (Abs \times V_{TCA} \times 2 \times M \times 10^{-2}) / 1.56 \times m$$

Where,

TBA: thiobarbituric acid value, Abs: corrected absorbance of the sample, m : mass of sample and M: the molecular weight of malondialdehyde (72 g/mol).

#### 2.2.4.3. Acid value

The acid value (AV) was characterized using the AOCS method CD 1-25 (AOCS, 2003). A 1.4 g of oil was weighted into a 250 ml flask containing 100 ml of ethanol and two drops of a 1% phenolphthalein indicator solution was added. The content of the flask was titrated with a 0.1 N KOH solution. Titration was stopped upon appearance of a pink color persistent for about 10 seconds. The acid value was calculated as follow:

$$AV = (V_1 - V_0) \times 56.1 \times C / m$$

Where,

Ia: Acid value, $V_0$ (ml): Volume of KOH for the blank, V (ml): Volume of KOH solution for the sample, C: Concentration of the KOH solution used, m (g): Mass of the sample

### *2.2.5. Analysis of the proximate composition of Baobab Seeds*

#### *2.2.5.1. Determination of proximate composition*

The AOAC standard analytical methods (AOAC, 1990) were used for the determination of the moisture, ash, protein and fat content of Baobab Seeds flour samples. The moisture content was determined by drying the samples at 103°C in an electric air-dried oven till constant weight following the AOAC procedures 925.40. The ash content was evaluated according to the AOAC procedures 942.05. The samples were incinerated at 550°C to obtain the ash. The micro-Kjeldahl method was used for the determination of the nitrogen content of Baobab Seeds flour samples according to the AOAC procedures 984.13 and the protein content was calculated as nitrogen x 6.25. The lipid content was evaluated using a soxhlet apparatus with hexane, following the AOAC 963.15 procedures. The fiber content was assessed following the AOAC method (AOAC, 2005).

The carbohydrate content was obtained by difference (AOAC, 1990). In this regard, the crude protein, lipid, moisture, ash and fiber were deducted from 100 to obtain the carbohydrate content.

#### *2.2.5.2. Mineral composition*

Baobab Seeds flour was ashed at 550°C for the determination of minerals. The obtained ash was dissolved with 10 ml HCl 20% and filtered for the quantification of minerals. Magnesium, calcium, sodium, iron, potassium were quantified by atomic absorption using an atomic absorption spectrometer (Varian 220FS Spectra AA, Les Ulis, France). The colorimetric method using vanadomolybdate was used for the determination of phosphorus according to AOAC procedure 965.17 (AOAC, 2005). The mineral content of each sample was obtained from the calibration curve of standards minerals.

### *2.2.6. Statistical analysis*

Results (Mean ±Standard deviation) obtained in the present study were subjected to one-way analysis of variance (ANOVA) with Student-Newman- Keuls test using Graphpad-InStat version 3.05, to evaluate the statistical significance of the data. A probability value at $p < 0.05$ was considered statistically significant.

## 3. Results and Discussion

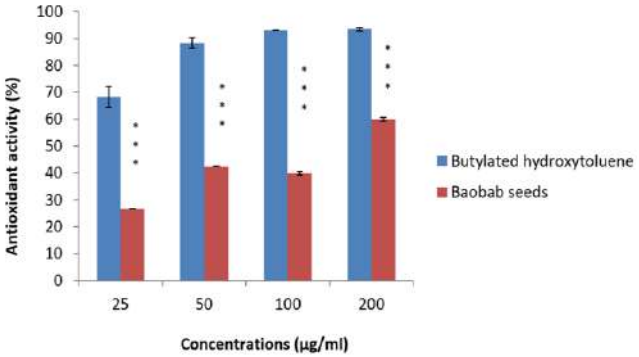
### *3.1. DPPH radical scavenging activity*

Figure 1 shows the DPPH radical scavenging activity of *Adansonia digitata* methanolic extract

compared to buthylated hydroxytoluene (BHT). It can be observed that at all concentrations the activity of the plant extract was significantly lower ($p < 0.05$) than that of BHT. This result is in line with that of Abubakar *et al.* (2015) who showed that the antioxidant activity of Vitamin C and BHA (Butylated Hydroxyanisol) are significantly higher compared to that of *Adansonia digitata* seed oil. Generally, the activity of both extract and BHT was increased with concentrations. The highest activity recorded with BHT can be attributed to its purity. In fact, Baobab seeds methanolic extract apart from the antioxidant naturally present contains other molecules that can be considered as impurities. The antioxidant activity of baobab seeds extract can be attributed to the presence of certain phytochemicals. Braca *et al.* (2018) showed that the butanolic extract of Baobab fruits has a total phenolic content range between 120.07 and 161.40 mg GAE/g with a DPPH radical scavenging activity range between 322.65 and 392.22 mg TE/g. They also showed that, this extract is rich in procyanidins and flavonol glycosides. Samatha *et al.* (2017) demonstrated that the metanolic/water extracts of leaf, floral parts, seeds, fruits wall and bark have a DPPH radical scavenging activity of 21.53, 26.15, 27.69, 20.69 and 24.61% respectively. This proof that baobab seeds have moderated antioxidant activity. Globally, the antioxidant activity obtained in this study with baobab seeds can be attributed to the phenolic antioxidant present as mentioned by Braca *et al.* (2018) and Samatha *et al.* (2017).

### *3.2. Characteristics of Baobab seed oil*

The data obtained from the characterization of baobab seeds oil showed that it has a peroxide value of 21.73 meq $O_2$/kg, a TBA value of 2.21 ppm, Iodine value of 53.35 g/100g and acid




**Mean values for a specific concentration are significantly different ($p<0.001$)*

**Figure 1**. DPPH radical scavenging activity of Baobab (*Andasonia digitata*) seed extract.

value of 5.8%. The peroxide value obtained in this study was significantly higher than the recommended value for virgin and cooled press oils which is 15 meq O2/kg (Codex alimentarius, 1999). This value was also significantly higher than 4.08 meq $O_2$/kg as reported by Babikar *et al.* (2017) with baobab seed oil. The differences in peroxide value observed can be attributed to the method used for their determination. In this study the spectrophotometric method was used for the determination of the peroxide value (IDF, 1991). It is important to note that the determination of the peroxide value informs on the primary oxidation state of oils and fats, especially in the quantification of hydroperoxides. The TBA value is generally used for the evaluation of the secondary oxidation state of edible oils and fats, especially malondialdehyde. In this study the TBA value obtained with baobab seeds oils was 2.21 ppm. From our knowledge there is no standard TBA value for vegetable oils. However, a standard value of 5 ppm in fish oil is the symbol of its freshness (Ukekpe *et al.* 2014).

**Tableau 1:** Characteristics of baobab seeds oil

| Quality parameter | |
|---|---|
| **Peroxide value (meq $O_2$/Kg)** | 21.73 ± 0.00 |
| **TBA value (ppm)** | 2.21 ± 0.00 |
| **Iodine value (g $I_2$/100 g)** | 53.35 ± 0.00 |
| **Acid value (mg KOH/g)** | 5.80 ± 0.00 |

The acid value obtained in this study (5.8%) was significantly higher than the recommended value which is 4.0% for cooled press and virgin oil (Codex alimentarius, 1999). However, this value was significantly lower than 6.8% as reported by Affo & Akande (2012) with *Adansonia digitata* seed oil. Concerning the Iodine value obtained in this report, it was significantly lower than 86 and 82.39 g/100g which are the values reported by Babikar *et al.* (2017) and Affo & Akande (2012) with baobab seed oil. However, it was similar to the iodine value obtained from Abubakar *et al.* (2015) (54.41 g/100 g) with the same plant seeds. The differences observed in this parameter can be attributed to factors such as the plants location, age, the extraction method etc. Globally the Iodine value informs on the degree of unsaturation of oils and fats.

### *3.3. Proximate composition of Adansonia digitata seeds*

Results of the proximate composition analysis (Table 2) showed that baobab seeds contain 14.70% of lipids, 12.34% of proteins, 0.96% of fibers, 4.7% of ash and 67.3% of carbohydrates. The amount of ash and fat contents obtained in this study were closed to 3.1 and 13.3% respectively as reported by Oyeleke *et al.* (2012) with the same part of the plant in Nigeria. Similar observation was noted with the report of Affo & Akande (2012). However, the protein (19.5%) and fibre (15.6%) contents obtained by these authors were significantly higher than the values recorded in this study (12.34 and 0.96% respectively for proteins and fibers). The carbohydrate content obtained in this study (67.3%) was significantly higher than the value reported by these same authors. However, the amount of carbohydrate found in this study was not far from 60.40% obtained by Affo & Akande (2012). The differences observed in the proximate composition of baobab seeds can be attributed to the origin of the seed, the geographical location, the maturation state, climate, the post-harvest processing method etc.

**Table 2**: Proximate composition of Baobab seeds

| Parameters | Quantity (%) |
|---|---|
| **Lipids** | 14.70 ± 0.00 |
| **Proteins** | 12.34 ± 0.00 |
| **Fibers** | 0.96 ± 0.00 |
| **Ash** | 4.70 ± 0.00 |
| **Carbohydrates** | 67.30 ± 0.00 |

### *3.4. Mineral composition of Baobab seeds*

The mineral content presented in Table 3 showed that *Adansonia digitata* seeds are very rich in Potassium and Iron. The high potassium content obtained in this study is in line with the report of Oyeleke *et al.* (2012). However, there is a contradiction between the Iron content registered in this study and that obtained by these same authors and by Affo & Akande (2012) (10.12 mg/100g). Generally the Potassium content obtained in this study was sigificantly lower and the recommended amount which is 4700 mg/100 g/day (WHO 1985). On the other hand the

Phosphorus, Calcium, Magnesium, Sodium were significantly lower than the value obtained with the same seeds in Nigeria as presented by Oyeleke *et al.* (2012).The variations observed from one study to another can still be explained by the maturity of the seeds, the environment, the climate, the location, the maturity state etc. It is important to know that these minerals are capital for the well-functioning of the body since they play multiple roles in cell metabolism. A deficiency in any of them can lead to nutritional disorders.

**Table 3:** Mineral composition of baobab seeds

| Parameters | Quantity (%) |
|---|---|
| Iron | 689.01 ± 0.00 |
| Phosphorus | 68.00 ± 0.00 |
| Calcium | 7.10 ± 0.00 |
| Magnesium | 167.00 ± 0.00 |
| Potassium | 1219.00 ± 0.00 |
| Sodium | 102.00 ± 0.00 |
| Zinc | 34.00 ± 0.00 |

## 4. Conclusion

The objective of this study was to evaluate the nutritional composition, antioxidant potential and oil qualities of baobab seeds produced in North Cameroon. Results showed that the methanolic extract of *Adansonia digitata* has a moderated antioxidant activity. These seeds contain a considerable amount of oil and have an interesting proximate nutritional composition. It will be good to carry out further studies of these seeds for their potential application as complements in food manufacturing.

## Conflict of interest

The authors declare that there are not conflicts of interest.

## Ethics

This Study does not involve Human or Animal Testing.

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