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# EXPLORING THE NUTRITIONAL AND MINERAL COMPOSITIONS OF BAOBAB (*Adansonia digitata L*) FRUIT PULP AND SEED

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**ABSTRACT**

This research presents the proximate and elemental compositions of Baobab fruit (*Adansonia digitata L.*) The proximate analysis gives the composition of the biomass in terms of gross components such as moisture, volatile matter, ash and fixed carbon. In this study, the proximate composition was determined using standard methods (AOAC) while the mineral content was analysed with the aid of an Atomic Absorption Spectrometry and Flame Photometry. Minerals are micronutrients that occur in foods in minute amounts but are very essential for body metabolism. The results revealed that Baobab seed and pulp are rich in crude protein, fat, carbohydrate and total ash contents. The high amount of total ash (3.15 $\pm$ 0.05 %) and (4.65 $\pm$ 0.55 %) present in the seed and pulp respectively suggests that they both possess high level of inorganic matter; thus, having high amount of minerals. The study also shows that Baoba seed and pulp have high economic value and are good and cheap sources of mineral element such as calcium, sodium, potassium, magnesium, copper and zinc. For these reasons, they can be incorporated into food supplements for both humans and animals, also could have industrial applications.

**Keywords**: Baoba, composition, economic value, proximate, spectrometry

## INTRODUCTION

Majority of sub- Saharan African countries including Nigeria are faced with food shortages. Despite various measures taken to alleviate the world hunger problem, food insecurity and under nutrition remain a serious problems in many countries (Pawlak and Kołodziejczak, 2020). The solution to the food problem should be sought through a combination of the available resources. Food and agricultural scientists are beginning to screen wild animals and under exploited native plants for potential sources of food to widen the narrow food base (Gadanya *et al*., 2014).

African baobab (*Adansonia digitata* L.) is a common, multifunctional tree native to West Africa's arid and semi-Arid regions (Asogwa *et al*., 2021). It is the most widely spread of the *Adansonia* species on the African continent which belongs to the family of *Bombacaceae* a sub family of the *Malvaceae* (John *et al*., 2021) (Abeer *et al*., 2020). *Adansonia* species comprises of 8 different species with large, spectacular, nocturnal flowers (Bamalli *et al*., 2014).

Due to its potential contribution to food security and household well-being baobab has been recommended as a priority species for domestication and commercialization (Darr *et al.*, 2020). In fact, it has been reported that every part of the baobab tree is useful, the leaves, roots, flowers, fruit pulp, seeds and bark of baobab are edible. Whereas, in Europe, only the fruit pulp is consumed as a food since its authorization as a novel food ingredient by the European parliament and council under the Regulation (EC) No. 258/97 (Commission Decision 2008/575/EC) (Cicolari *et al*., 2020).

The bark of baobab tree produces strong fiber used in the making mats, bags and ropes. The baobab leaves are considered as a food source in some parts of the African continent while the flowers are consumed raw (Erwa *et al*., 2019). Some studies demonstrated that Baobab fruit contains nutritionally significant levels of essential nutrients including fiber, protein, and minerals. Even though, baobab trees are extensively propagated in Africa and the consumption of baobab fruit pulp in different forms has been going on for quite a long time, the knowledge about the nutritional value and the composition of the seed is scarce and the importance of the tree remains unappreciated. There is considerable need to assess the minerals and nutritional value of seed and fruit pulp. Therefore, the objective of this study is to estimate the nutritional and elemental compositions of baobab seed and pulp. Due to its nutritional and health claims, baobab fruit pulp and seed has a good potential to become another innovative healthcare product.

## MATERIALS AND METHODS

### Sample collection and preparation

The plant samples were collected from the Keffi Local Government Area, Nasarawa State Nigeria and were taken to Nasarawa State University Keffi, Faculty of Natural and Applied Science, Department of Biological Science, Unit of Plant Science and Biotechnology for authentication. The fruit pod was then transferred to the laboratory for processing; the fruit was manually prepared by removing the seed and fiber from the fruit pulp to obtain pulp powder separately. The pulp obtained was kept for further analysis while the seed were sun dried for three weeks, ground then passed through a 2 mm sieve, and stored in airtight bags ready for further analysis.

### Chemicals and Reagents

The entire reagents used were of analytical grade obtained from BDH (British Drug House) pode England, the reagents include petroleum ether, sodium hydroxide, sulphuric acid, mixed catalyst phenolphthalein indicator, nitric acid, ammonium hydroxide, anti-bumping granule, mixed indicator, boric acid distilled water.

**METHODS OF ANALYSIS**

**PROXIMATE ANALYSIS**

The moisture content was determined according to AOAC 1995, the powder (100 g) was weighed into a hot air oven at 105 $^0$C to a constant mass, the differences in weight was recorded as the moisture content.

The moisture percentage in the samples was calculated according to the following equation:

$$\% \text{ moisture} = \frac{W_2 - W_3}{W_2 - W_1} \text{ X } 100 \quad \text{Eq. (1)}$$

Where $w_1$ = weight of crucible in grams (empty)

$W_2$ = weight of crucible + Sample before drying

$W_3$=weight of crucible + Sample after drying

For the Ash Content, the method of AOAC 1995 was adopted. About 3 g of the powder was placed in a pre-weighed porcelain crucible and ignited in an ash furnace maintained at 6000 $^0$C. The ash content was determined as soon as white ash was obtained and a constant weight was maintained. The percentage weight of the ash was calculated using Eq. (2).

$$\% \text{ Ash} = \frac{Weight\ of\ ash}{Weight\ of\ sample} \text{ X } 100 \quad \text{Eq. (2)}$$

The nitrogen content was determined by micro-kjeldahl method (Kjeldah, 1883)' Then multiplied by 6.25 to estimate the crude protein content. Carbohydrate content was also determined by the difference as described by AOAC, 1990. The % nitrogen was calculated using Eq. (3)

$$\% \text{ N} = \frac{0.014 \times M \times V}{Weight\ of\ sample} \times 100 \quad \text{Eq. (3)}$$

Where: M = Actual molarity of acid

V = Volume of 0.5 m $H_2SO_4$

AOAC, 1980 method was used to determine the crude fibre. About 2 g of the finely ground sample was weighed out into a round bottom flask, 100 ml of 0.25 M sulphuric acid under suction. The insoluble matter was washed several times with hot water until it was acid free. It was quantitatively transferred into a flask and 100cm$^3$ of hot 0.5 M NaOH solution was added and the mixture and quickly filtered under suction. The insoluble residue was washed with boiling water. Until it was base free. It was dried to a constant in an oven at 100$^0$C, cooled in a desiccator and reweighed as ($C_2$). The percentage crude fibre was calculated by Eq. (4).

$$\% \text{ crude fibre} = \frac{C_1 - C_2}{Wt\ of\ original\ sample} \times 100 \quad \text{Eq. (4)}$$

Where: $C_1$ and $C_2$ are the initial and final loss in weight, respectively.

Soxhlet extraction method (AOAC, 1983) was used for the extraction of crude lipid with slight modification. A clean dried fat free thimble was ($W_1$). A 250 cm$^3$ round bottom flask was weighed dried and weighed with some boiling chips ($W_2$). About 10 g of the sample was weighed into (40-60 $^0$C) was poured through the extractor in the flask. The condenser was connected to a heating mantle and the heat increased carefully and slowly until the solvent began to boil. The extraction process was continued for 5 hours by which time the solvent beside the thimble was not clear or not showing any colour of the presence of oil. Thimble and its content were then removed and first air dried before being transferred into the oven at 80 $^0$C and dried for 2 hours. It was then removed and cooled in the desiccator after which it was weighed, ($W_3$) also the flask containing the oil and the chip was air dried first before transferring into the oven and dried for 2 hours at 80 $^0$C.

$$\% \text{ Lipid from the thimble} = \frac{W_2 - W_3}{W_2 - W_1} \times 100 \quad \text{Eq. (5)}$$

**Elemental analysis**

Mineral analysis was carried out after 2 g of the seed and pulp samples were made to ash separately. About 10 ml of conc. $HNO_3$ was added to it and digested until a clear solution was obtained. The digest was allowed to cool and then transferred into a 100 ml standard flask and made up to mark with de-ionized water. The mineral elements were analysed with Atomic Absorption Spectrophotometer and Flame Photometry.

**Results and discussion**

The percentage proximate composition of baoba seed and pulp is presented in Table 1 below while the Table 2 shows the mineral composition of the baoba seed and pulp.

**Proximate composition**

From the results, baobab pulp and seed contain nutritional composition that include moisture content, ash, crude fiber, crude protein and carbohydrates in variable proportions (Table1).

Moisture content is one of the most commonly measured properties of food materials. It is a key factor influencing the quality of storage of food materials (Vera Zambrano *et al*., 2019).

The moisture content of the seed was found to be 3.35 $\pm$ 0.45 % which is lower than the value reported by (Milala *et al*., 2018) for water melon seed. The value of 10.16 $\pm$ 0.46 % was obtained for the pulp. This result is comparable to the result obtained by Oyeleke, 2012. The value of moisture content obtained indicates that the seed and pulp have a good shelf life consequently, it can be stored for a long time without spoilage.

Ash refers to the inorganic residue remaining after either ignition or complete oxidation of organic matter in a foodstuff. The ash content is a measure of the total amount of minerals present within a food (Afify *et al*., 2017). In this study, the value of ash content was 3.15 ± 0.05 for seed and 4.65 ± 0.55 % for pulp. These values are comparable to 3.1±0.1 and 4.5±0.1 % for baoba seed and pulp respectively reported by (Adeyeye *et al*., 2012) but lower than 8.92 % reported for raw baoba seed meal (Saulawa *et al*., 2014). The fat content was recorded in the range of 11.80 ± 0.10- 0.40 ± 0.01% for the studied seed and pulp respectively. Fibre is an important part of diet and the consumption of dietary fibre is important for optimal health (Dhingra *et al*., 2012). Crude fibre is made up largely of cellulose together with a little lignin which is indigestible in human. Although crude fibre enhances digestibility, its presence in high level can cause serious health problems. Foods with high fibre content are considered good for diabetic patients and also reduce blood cholesterol, obesity and diabetes (Okello, 2018). The crude fibre value in our study ranged between (16.46 ± 0.15 -3.85 ± 0.05) % for the seed and pulp. This result is higher than 7.89 % reported by (Danbature *et al*., 2014). For baoba seed and pulp, the protein observed was 17.85 ± 0.15% and 4.16 ± 0.05 % respectively, this is low compared to 19.5 ± 0.5% and 3.5 ± 0.1% of baoba documented by (Oyeleke, 2012). In this research, the seed has highest crude protein content compared to the pulp.

**Mineral composition**

The Tables 2 shows the mineral composition of baoba seed and pulp. Generally, both the seed and pulp of baoba revealed a fair deal of being a cheap source of nutritive element. The least and abundant mineral in the baoba were copper (Cu) and potassium (K) respectively. The potassium being the predominant element, was found to be 793.35 ± 0.45 Mg/100g and 1246.80 ± 1.40 Mg/100g for seed and pulp, respectively showing that the pulp contains higher amount of potassium, but all other elements are high in the seed than the pulp. For Sodium, the value obtained for the pulp was 27.04 ± 0.06 Mg/100g which is compared to 1898.52 and 1292.81 mg/100g reported by (Chabite *et al*., 2019) for baobab pulp.

Calcium (Ca) is an important constituent of body fluids also, it is involved in a large number of vital functions (Cormick and Belizán, 2019). It reported to be a coordinator among inorganic elements particularly potassium , magnesium (Mg) or sodium (Na) where calcium is capable of assuming a corrective role when such metals are in excessive amount in the body (Adeyeye *et al*., 2012). Calcium concentration obtained in this study was high in all the samples. The high level of calcium content of the seed and pulp makes the baoba fruit alternative as natural source of calcium supplementation for pregnant and lactating women, as well as for children and the elderly. In this study K, Ca and Mg are the most abundant micronutrient recorded. This kind of phenomenon has also been observed by (Muthai *et al*., 2017). The concentration of copper appears to be high in seed 1.95 ± 0.05 than pulp 1.6 ± 0.04. Zinc (Zn) is one of the minerals needed by the body. This mineral has a variety of benefits, such as helping heal wounds, play a role in the sense of taste and smell, strengthen the immune system, help cell growth, and break down carbohydrates. Zinc is known to be beneficial for cell growth and maintaining the body's metabolism. Zinc deficiency will reduce the body's resistance to infection and child development (Putri *et al*., 2020). Baoba seed and pulp in this study contained Zn in the range of 5.15 ± 0.05-1.80 ± 0.00 Mg/100g, respectively. Lead (Pd) was undetected in the studied samples.

**Table 1 Proximate composition of baoba seed and pulp (%)**

| Constituents | Seed mean ± SD | Pulp mean ±SD |
|---|---|---|
| Moisture | 3.35± 0.45 | 10.16 ± 0.46 |
| Ash | 3.15 ± 0.05 | 4.65 ± 0.55 |
| Fat | 11.80 ± 0.10 | 0.40 ± 0.01 |
| Crude fibre | 16.46 ± 0.15 | 3.85 ± 0.05 |
| Crude protein | 17.85 ± 0.15 | 4.16 ± 0.05 |
| Carbohydrate | 47.64 ± 0.04 | 76.78 ± 0.02 |

**Table 2 Mineral composition of samples (Mg/100g)**

| Element | Seed Mean ± SD | Pulp Mean ± SD |
|---|---|---|
| Na | 28.31 ± 0.41 | 27.04 ± 0.06 |
| Ca | 405.05 ± 14.92 | 99.55 ± 0.65 |
| Mg | 291.85 ± 9.35 | 59.96 ± 0.16 |
| K | 793.35 ± 0.45 | 1246.80 ± 1.40 |
| Cu | 1.95 ± 0.05 | 1.65 ± 0.04 |
| Zn | 5.15 ± 0.05 | 1.80 ± 0.00 |
| Pb | ND | ND |

**The value represents mean of triplicate determinations ± standard deviation.**

ND-Not Dictated

**CONCLUSION**

The result of this research work showed that Baobab pulp and seed are highly nutritive in terms of minerals, protein, fat and carbohydrate with the seed having the highest nutritional values than the pulp. Though people hardly crack the seeds to extract and eat the nutrient-rich kernel. Therefore, stakeholders should adopt nutritional policies that promote the consumption of roasted seeds or seed flour among children and communities facing malnutrition.

**Conflict of Interest**

None declared.

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