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Chemical composition ofo baobab *(Adansonia digitata L.)* seeds and physicochemical properties of it is oil

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Abstract
Proximate, mineral and selected physicochemical characteristics of baobab (*Adansonia digitata*) Seed - oil were determined using standard analytical methods. The proximate composition (%) of the seeds were as follows; moisture (3.5 ± 0.1), crude protein (12.9 ± 0.015), crude lipid (14.3 ± 0.05), ash (4.49 ± 0.05), crude fiber (20.42 ± 0.04) and carbohydrate (44.32 ± 0.25). The major mineral elements present in the seeds included phosphorus, calcium, potassium, zinc and iron (7.00, 9.61, 90.29, 0.268, and 0.227 ppm respectively). Vitamin C was found in baobab seeds with concentration = 70.9 mg/100g. The oil extracted from the seed had the following physicochemical properties: oil content 21.5 ± 0.00%, density 0.09154, specific gravity 0.9163, kinematic viscosity 33.69 cSt, calorific value 43.797Mg kg^{-1} cloud point +9, pour point -3, acid value, 1.7 ± 0.119 mg KOH g^{-1}, saponification value 275.05 ± 0.52 mgKOH g^{-1}, free fatty acid 3.8, peroxide value 7.6 ± 0.05 mEq kg^{-1}, and The iodine value (54 ± 0.1 mg g^{-1}). According to above result, baobab seeds could have a high potential uses.

Keywords: *Adansonia digitata*, proximate composition, oil, mineral elements, vitamin C, physicochemical, FFA

1. Introduction
Baobab (*Adansonia digitata* L.) is a chain very long-lived tree can live for up to a 1000 years with heights reaches up to 25 m high [1]. Baobab is the most widely spread of the *Adansonia* species on the Africa which belongs to Bombacaceae family the sub family of the *Malvaceae*. *Adansoni*a species comprises of 8 different species [2]. One of these species is the *A. digitata* L., it occurs throughout the drier parts of Africa. A second species is restricted to North-Western Australia (*A. gibbosa*), and the remaining six species are endemic to Madagascar [3]. In Sudan the natural distribution of baobabs are in the southern part of the country. They thrive on sandy and rocky soils, from the short-grass savannah to the deciduous savannah woodlands. they are also common on mountain slopes such as the Jebel ed Dair in central Sudan, in the Nuba Mountains, and In the eastern foothills of the Jebel Marra massif, baobabs are known to occur Along wadis and in depressions, where water collects during the rainy season, baobabs are found even in the very dry Northern parts of Darfur and Kordofan [4]. Every part of the baobab tree Fruits, leaves, flowers, bark, seeds, wood and roots is reported to be useful [4]. Baobab is multipurpose tree it provide food, beverages, shelter, clothing and medicine as well as material for hunting and fishing [5]. Recently the European Commission authorized the import of baobab fruit pulp as a food ingredient [6], in 2009 also approved by the Food and Drug Administration in the United States of America [7]. Baobab products have a growing market in Europe and the US, which offers income opportunities for baobab producers in Africa. The seeds are reproductive structure of all plants. In Africa, particularly in Nigeria are commonly used as coffee substitute [8], as a thickening agent in soups, they are also fermented and used as a flavoring agent, or roasted and eaten as snacks [3]. The uses of the seeds in Sudan is very rare it is almost waste after using the pulp in beverage called (*tabldi)* juice. Recently the seeds uses poorly developed by some research recommend using the seed oil in frying and in cosmetic applications. This study conduct in Sudan to presents a recent determine for chemical composition of baobab seeds (including proximate analysis, and elemental analysis), the physicochemical properties of baobab seed oil, and to evaluate the oxidation ability of seed oil, for possible development and uses [3].

2. Materials and methods
2.1 Collection and treatment of samples
Dried seeds of baobab were collected from research center of medicinal and aromatic plants in Khartoum, Sudan. They were cleaned to remove dirt, sun-dried for three days and finally ground in an electric mill. Then passed through a 50 mesh sieve and stored in room temperature.

2.2 Extraction of *A. digitata* seed oil
The oil was extracted using soxhlet, 100g of the ground *Adansonia digitata* seeds were packed in a muslin cloth and inserted into the soxhlet extractor, hexane was used as the extraction solvent for a period of eight hours. At the end of the period, the solvent was recovered by rotary evaporator and residual oil was oven dried at 75ºC for one hour. Odorless yellow seed oil was stored and allowed to warm up to room temperature before analysis [9].

2.3 Proximate analysis
The moisture content, ash, crude fiber, crude protein, and fat contents were analysis by AOAC [10]. 100g of the powder was weighed in hot air oven at 105ºC to a constant weight, the difference in weight was recorded as the moisture content. 3g

of the powder was placed in a pre-weighed porcelain crucible and placed in an ashing furnace maintained at 600ºC. The ash content was determined as soon as white ash was obtained and a constant weight was maintained. The nitrogen content was determined by micro-kjeldahl method and multiplied by 6.25 to estimate the crude protein content. Total fats were analyzed using acid hydrolysis as described by AOAC [10]. Carbohydrate content was also determined by difference.

2.4 Elemental analysis

Dry ashed sample (2g) and 5 ml of HCl 20% was added, a clear solution was obtained, the digest was allowed to cool and then standard solution prepared. The phosphorus analyezd using diacid digestion mixer of HNO_3 and $HClO_4$. All mineral elements were analyzed with atomic absorption spectrophotometer [11].

2.5 Fatty acid compositions

Fatty acid composition of seed oil was determined using GC-2010 gas chromatograph (SHIMADZU). Capillary column DB-1 (30m×0.25mm×0.25mm). The detector temperature was programmed at 300ºC with flow rate of 30.0 ml/min. The injection mode was split, the temperature was set at 250ºC, nitrogen and air were used as the carrier gas. The identification of the peaks Characteristic and Composition of Baobab seed Oil achieved by retention times by means of comparing them with authentic standards analyzed under the same conditions.

2.6 Determination of the physicochemical properties of the oil

The density, specific gravity, kinematic viscosity, cloud point, pour point and free fatty acid were determined using the procedures [12, 13, 14, 15, 16] respectively, calorific vale was calculated from density, while the procedure described by [17] was adopted for the determination of Saponification value, iodine value and peroxide value.

3. Results and discussions

Table 1 showed proximate composition of *Adansonia digitata* seeds. The values showed some levels of closeness to those reported by Oyeleke [18] of baobab seeds. The moisture and crude protein content 3.5 ± 0.1 and 12.97 ± 0.015 respectively were lower than those reported. The lower moisture content is a good indicate for long shelf life which is very useful in storage of food. The values of ash, crude lipid and crude fiber 4.49 ± 0.05, 14.3 ± 0.05 and 20.42 ± 0.04 were higher than reported, carbohydrate value is very close in both. The variation in values may be due to method of analysis and species and climatic conditions. However the result showed that seeds could serve animal nutrition because its relatively high carbohydrate, fat, ash, protein content and good source of energy.

Table 1: Proximate composition of *Adansonia digitata* seeds

Constituents	Percentage of each Composition %
Moisture	3.5 ± 0.1
Ash	4.49 ± 0.05
Crude lipids	14.3 ± 0.05
Crude fiber	20.42 ± 0.04
Crude protein	12.97 ± 0.015
Carbohydrate	44.32 ± 0.25
Total energy (K Cal/100g)	363.024 ± 0.51

Table 2 showed the concentrations of mineral composition of *Adansonia digitata* seeds samples. Trace elements such as calcium, potassium, iron, and zinc constitute essential part of any balanced diet and required for normal growth, potassium appears the highest concentration of detected elements (90.29 ppm) then calcium (9.61 ppm), iron showed the lowest concentration (0.227ppm). The lower concentration of seeds heavy metals iron (Fe) and zinc (Zn) is an indication of little or no toxicity. In general the low concentrations were within the safety limit according to WHO (1996).

Table 2: Mineral composition and vitamin C of *Adansonia digitata* seeds.

Minerals	Concentration (ppm)
P	7.00
Ca	9.61
K	90.29
Zn	0.268
Fe	0.227
Vitamin C (mg/100g)	70.9

Table 3 shows fatty acid composition of Boabab oil with 47.35% saturated fatty acids and 52.73% of unsaturated acid. The fatty acid profile of Boabab oil consist, mainly, of Palmitic, linoleic and palmitoieic acid. These acids are commonly available in vegetable oils.

Table 3: Free fatty acid composition of Boabab seed oil.

Fatty acid	Formula	Structure	Area %
Myristic acid	$C_{18}H_{34}O_2$	C14:0	7.15
Palmitic acid	$C_{16}H_{32}O_2$	C16:0	28.25
Palmitoleic acid	$C_{16}H_{30}O_2$	C16:1	12.4
Heptadecanoic acid	$C_{17}H_{34}O_2$	C17:0	9.69
cis-10-Heptadecenoic acid	$C_{17}H_{32}O_2$	C17:1	0.58
Linolelaidic acid	$C_{18}H_{32}O_2$	C18:2	0.18
Stearic acid	$C_{18}H_{36}O_2$	C18:0	10.75
Oleic acid	$C_{18}H_{34}O_2$	C18:1	14.33
Linoleic acid	$C_{18}H_{32}O_2$	C18:2	14.25
Elaidic acid	$C_{18}H_{34}O_2$	C18:1	0.3
Arachidic acid	$C_{20}H_{40}O_2$	C20:0	1.2

Table 4 showed physicochemical properties of *A. digitata* seed

oil. The oil percent is 21.5%. The acid value was lower than the Codex standard value (10.0 mg KOH/g Oil) for virgin Vegetable oils. The iodine value for *Adansonia digitata* seeds is 54±0.1 mg/g and this reflects the presence of low percentage of unsaturated fatty acids in the seed oil. The value obtained lower than Moringa seeds oil [19] and much lower than Jatropha oil [20]. low peroxide value7.60 ± 0.05 mEq/kg shows the fact that the oil has high resistance to oxidation and rancidity, the value falls within the range of codex standard value (the maximum value is 10Meq/kg) for refined vegetable oil {21]. High saponification value (275.05 ± 0.52) indicated that oils are normal triglycerides and very useful in production of soap industry [17].

Table 4: Physicochemical properties of *A. digitata* seed oil.

Parameters	Values
Oil content (%)	21.5
Color	Light yellow
Physical state at room temperature	Liquid
Free fatty acid	3.8
Density at 15^{o}C (g/cm^{3})	0.9154
S.G (specific gravity)	0.9163
Kinematic viscosity in 40^{o}C(cSt)	33.69 ± 0.067
Calorific value (Mj kg^{-1})	43.797
Cloud point (^{o}C)	+9
Pour point (^{o}C)	-3
Acid value (mg KOH g^{-1})	1.7 ± 0.119
Iodine Value (mg g^{-1})	54 ± 0.1
Peroxide Value (mEq kg^{-1})	7.60 ± 0.05
Saponification Value (mg/KOH g^{-1})	275.05 ± 0.52

4. Conclusion

In this study, the proximate and elemental analysis of *Adansonia digitata* seeds have been determined, also physicochemical characterization analyzed. From the results, seeds has a high oil content indicating that it is a promising source of oils and also has good nutritional composition. This can make it useful in various industries and for human and animal consumption.

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