DOI: 10.34101/ACTAAGRAR/2/14170

Baobab (*Adansonia digitata* L.) as a remedy to human livelihood challenges: a review

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SUMMARY

Baobab (Adansonia digitata L.) is a unique plant predominant in different ecosystems in Africa. This review assessed its value in relation to human nutrition, health, and related aspects. Our synthesis shows that baobab leaves, seed oil, and fruit pulp were utilised in different forms. Baobab tree products such as fruit pulp, leaves, and seed oil contain high levels of macronutrients, micronutrients, vitamins, carbohydrates, and proteins. Therefore, promoting the utilization and processing of baobab products for improved human nutrition is key. However, the determination of optimal parameters through elemental traceability as well as the relationship between geographical locations and nutrient composition of the baobab plant is required. Altogether, promoting innovative utilization of baobab products by exploring processing techniques to develop novel food and product formulation from Adansonia digitata tree products sheds a green light to sustain human livelihoods.

Keywords: *Baobab; fruit; leaves; seeds; nutrition; medicinal*

INTRODUCTION

Baobab (*Adansonia digitata* L.) is an African iconic tree with immense (Hendam et al., 2024; Lamien-Meda et al., 2008) belonging to the family of Bombacaceae and subfamily Malvaceae. It is commonly found in the Sahelian region (Baum et al., 2004; Caluwé et al., 2010) with a trunk diameter of up to 10 meters and a height of up to 25 meters. This tree is well known for its massive stature (*Figure 1*) and life expectancy that may exceed hundreds of years. It is widespread throughout tropical Africa's warm, arid zones (Gebauer et al., 2002). In fact, baobab is native to numerous sub-Saharan countries, predominantly thriving in the arid regions of savannas such as South Africa, Mozambique, Ivory Coast, Malawi, Sudan, Zimbabwe, Kenya, Cameroon, Burkina Faso, and Uganda (Sidibe, 2002). The common feature of the baobab tree is the possession of very large, spectacular, overnight flowers (Baum, 1995). This tree grows in clay or sandy soil and in varying ecological areas (El Amin, 1990).

Figure 1. **Baobab plant growing in the natural ecosystem in South Kordofan, Sudan**

Source: Author

PARTS OF THE BAOBAB PLANT AND THEIR IMPORTANCE

The Baobab tree has multiple benefits with most of its parts playing key roles in promoting people's livelihoods especially those who depend on it (Caluwé et al., 2010). The benefits of the baobab tree are recognized in over 300 African countries including Benin, Mali, Zimbabwe, Cameroon, Sudan, and others (Christine et al., 2010).

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Fruits

A plethora of literature indicates that baobab fruit contains a high level of vitamins, minerals, and several other unique healthy benefits. One of the most important parts of the tree is the powder from the fruit which is rich in vitamins such as vitamin C, and minerals like phosphorus (P) and potassium (K). Baobab fruit powder contains an abundant amount of carbohydrates and a source of amino acids, (Namratha and Sahithi, 2015). Similarly, the fruit pulp of baobab contains a high amount of vitamin C and all the important minerals such as calcium (Ca), phosphorus (P), potassium (K), and essential chemical components such as proteins, lipids sugar, and fiber (Chabite et al., 2019). *Adansonia digitata* fruit pulp or the powder may provide a good amount of 40 g of Vitamin C, providing 54–100% as a recommended dietary Intake ten times the values from orange (Namratha and Sahithi, 2015). According to (Williamson, 2011) the dried fruit pulp of *Adansonia digitata* provides about 3–499 mg/100 g of vitamin C. In this regard, *A. digitata* fruits serve as a source of food and beverages (Caluwé et al., 2010). Commercially, in industries or at home families, the pulp powder of baobab can be used as a crude agent in different types of beverages and other foodstuffs such as juice, mixed with jams product and ice-cream products (Gebauer et al., 2002). Meanwhile, the baobab fruits or pulp powder could also be used as a curdling agent. Mostly, the pulp or fruit powder has been used for seasoning traditional dishes (Ajayi et al., 2003).

The assessment of baobab fruit variance or characteristics, as well as nutritional quality, was carried with both the main goal of promoting and providing information about baobab trees that reflect attractive qualities for various uses. However, some chemical characters were determined such as total sugar, ash content and vitamin C. The eleven study areas in three African countries, Burkina Faso, Mali, and Niger, was covered by this research. Furthermore, the following physical characteristics were recorded; colour of the pulp, shape of the seeds, weight of the seeds, weight of the pulp, the size of the fruits, the colour of the bark, and the height of the trees. The smallest weight of fruit has been found in Mali with 130 g. However, the largest weight 496 g was found in Niger. The variation in fruit weight within all trees in the study site has been indicated and varied from 25 to 45%. The negative result of correlation was obtained among fruits size and both coordination's of longitude and latitude. All fruits parameters except fruit shape showed differences among all populations. The fruit size of all trees which have been included in the research study varied very highly. The chemical components have been examined and the result showed that there were significant differences among most parameters such as sugar in the range of 425 to 610 g/kg. There is no correlation found between vitamin C and sugar content (Hyacinthe et al., 2015). *Figure 2* shows baobab prepared for sale for human consumption. *Table 1* summarizes the mean values of different nutritional components from baobab fruit.

Figure 2. **Baobab prepared for sale for human consumption in Sudan. A) Fruit, B, and C) Fruit pulp**

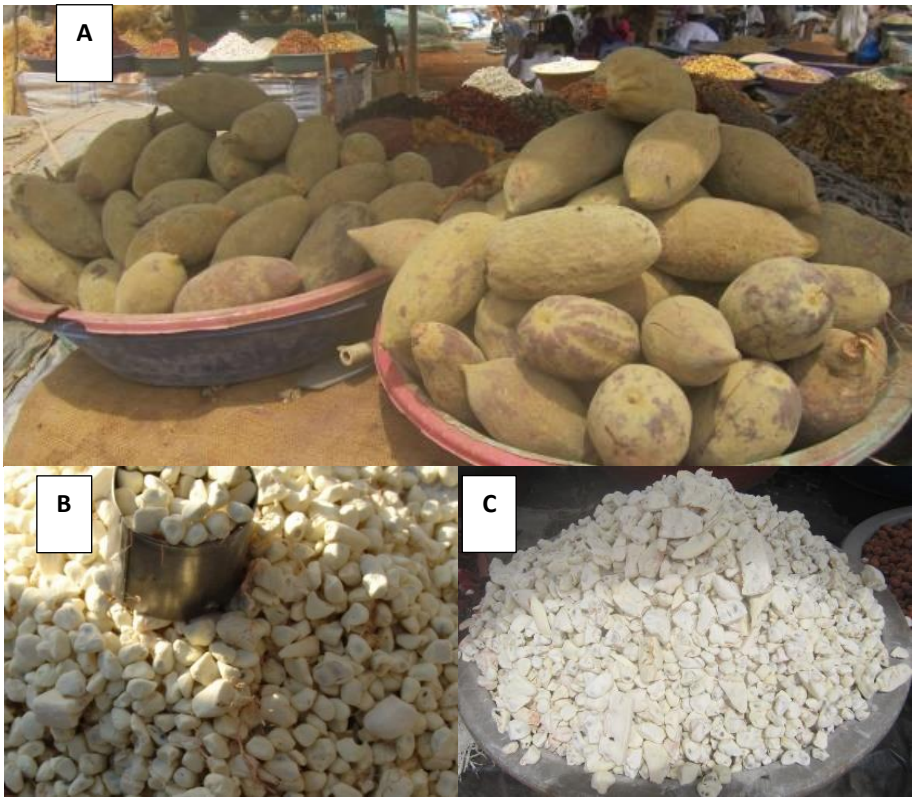

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Table 1. **Mean values of different nutritional components from baobab fruit**

Parameters	Mean value	References
Moisture (loss on drying) (g/100 g)	11.5	Soloviev et al., (2004); Wehmeyer, (1966)
	7.66	Gurashi et al., (2016)
	10.4	Osman, (2004)
	13.5	Ibrahima et al., (2013).
Protein (g/100 g)	5.3	Murray et al., (2001); Wehmeyer, (1966).
	3.2	Osman, (2004).
	11.72	Gurashi et al., (2016).
	2.5	Ibrahima et al., (2013)
Fat (g/100 g)	1.93	Gurashi et al., (2016)
	0.3	Osman, (2004)
	0.5	Ibrahima et al., (2013)
Ash (g/100 g)	4.9	Kalenga Saka and Msonthi, (1994); Murray et al., (2001); Nour et
	4.73	al., (1980); Obizoba and Amaechi, (1993); Wehmeyer, (1966) .
	4.5	Osman, (2004).
	5.3	Gurashi et al., (2016)
		Ibrahima et al., (2013)
Fiber (g/100 g dw)	13.7	Kalenga Saka and Msonthi, (1994)
	5.4	Osman, (2004).
	4.73	Gurashi et al., (2016).
	17.2	Ibrahima et al., (2013)
Total carbohydrate (g/100 g)	74.9	Murray et al., (2001); Wehmeyer, (1966).
	76.2	Osman, (2004)
	69.72	Gurashi et al., (2016)
		Ibrahima et al., (2013)
Total sugars (as glucose)		
Sodium (mg/100 g)	23.5	Gurashi et al., (2016).
	27.9	Osman, (2004).
	5.9	Ibrahima et al., (2013)
Calcium (mg/100 g)	302	Nour et al., (1980); Osman, (2004).
	555	Osman, (2004)
	295	Ibrahima et al., (2013)
	658	
Potassium (mg/100g)	1794	Kalenga Saka and Msonthi, (1994); Sena et al., (1998)
	1240	Osman, (2004)
	608	Gurashi et al., (2016)
	2728	Ibrahima et al., (2013)
Phosphorus	106	Kalenga Saka and Msonthi, (1994); Nour et al., 1980; Obizoba and
	57.5	Amaechi, (1993).
	116	Gurashi et al., (2016).
		Ibrahima et al., (2013)
Magnesium	543.3	Gurashi et al., (2016)
	90	Osman, (2004)
	224	Ibrahima et al., (2013)
Vitamin C	227	Gurashi et al., (2016)
	138	Ibrahima et al., (2013)

Baobab seeds oil

The baobab seeds oil is mostly used in the treatment of wounds and is used for hot oil hair bathtubs. However, the potential of baobab seeds oil related to the good proportion of linoleic acid stuff components in the seeds (Osman, 2004). However, the extracted baobab seeds oil represents nearly 1–2 mg/g linoleic acid, which is quite necessary for the body and supports the synthesis of essential fatty acids (Sidibe et al., 1998). Baobab seeds are used in their fresh stage or could be ground into a flour that can be used in soup or other stuff preparations as thickener agents (Sidibe, 2002). The baobab seeds may also be grilled and consumed or converted into a paste for use as flavor (Nnam and Obiakor, 2003). Baobab seeds can be boiled, fermented, and dried for later use as a flavoring agent. Moreover, the extracted baobab oils are huge amounts per fruit and have a wide range of uses (Sidibe,

DOI: 10.34101/ACTAAGRAR/2/14170

2002). The extracted Baobab oil is used for medicinal purposes in several regions of Africa continent (Kaboré, 2011).

According to the research which has been carried out by Idris et al. (2020) in Sudan objected to characterize the physical and chemical properties of baobab seed oil and the fatty acid contents, the soxhlet method has been used for baobab oil extraction. GC-MS methods have been conducted to assess the seed oil's physicochemical properties. Fatty acid components of the seed oil were assessed by the GC-MS methods. Moreover, different parameters have been resulted such as reddish yellow color with odor test of oil. The following physicochemical properties have been obtained; the melting point was 8 °C; yield was 33.83%; the boiling point was 227 °C; but the refractive index was 1.436; the value of iodine showed the result of 98.3 g/100 g in baobab seed oil; however, the peroxide value was 4.3 meq; the free fatty acid was 0.34%. For saponification, a quantity of 180.7 mg KOH/g of oil was obtained. The unsaponifiable matter is estimated as 1.7 mg. On the other hand, the result of physical properties revealed that the volatile value was (14.79 wt.%;) and moisture gave 14.79 wt.%; too, the density was 0.867 g/cm^3; the viscosity was 35.03 mm^2/s; the specific gravity showed 0.874. The result of fatty acid offered that linoleic acid amount was 30.63%.

Baobab leaves

This is the third important part of the baobab tree commonly cooked like spinach as well as processed and dried (Sidibe et al., 1998). Baobab leaves are often powdered and used for sauce. Moreover, available data and many studies show that the baobab leaves may contain dry weight 13–15% protein, 6–7% carbohydrate, fat was 4–10%, and about 11% of crude fiber, and the ash content was 16%. The energy values have been well, tend to range from 1180 to 1900 KJ/1g. (Sidibe et al., 1998).The baobab leaves are recognized to be a considerable source of protein and minerals particularly, (Mg) magnesium, (Mn) manganese, (Ca) calcium as well as (Fe) iron (Kayode et al., 2018). Previous studies reported that the ascorbic acid content of the baobab leaves is as high as this amount 856.8 mg/g. The baobab leaves also have a good amount of vitamin A, Vitamin B, and amino acids (Sidibe et al., 1998). According to Morakinyo et al. (2023), ethanol extract concentration did not significantly differ in baobab seeds and leaves. However, the utilization of baobab leaves is still limited at the international level. *Figure 3* shows fresh baobab leaf.

Figure 3. **Fresh baobab leaf ready for processing**

Source: Author

BAOBAB MEDICINAL PROSPECTS, AND MAJOR AREAS OF RESEARCH

The baobab tree has shown great amount of antiviral and antimicrobial efficacy such as methanolic extracts which can be extracted from the baobab root, bark and leaves. Alkaloid “Adansonin” substance which has been from the bark contains an active against malaria disease and fever (Namratha and Sahithi, 2015). Adegoke et al. (2017) reported that the medicinal benefits of the baobab tree were tested, however, the result was carried out *in vitro* examinations to examine the effects of methanolic extracted substance of the baobab leaves on the chemical component (SA) of sodium arsenate-induced poisoning in rat samples. At dose concentrations administered of the mentioned amount of 250 mg and 500 mg, they concluded that the methanolic substance of baobab leaves has the most potential to reduce the impact of toxicities produced from sodium arsenite (SA) intoxication, and offers good preservation in circumstances of arsenicosis. In addition, the protective influence of African baobab fruit pulp has been studied on oxidative effort-induced effects in rats by a high-fat diet. Interestingly, the result showed that baobab fruit pulp or powder may be consumed as an efficient foodstuff for the natural

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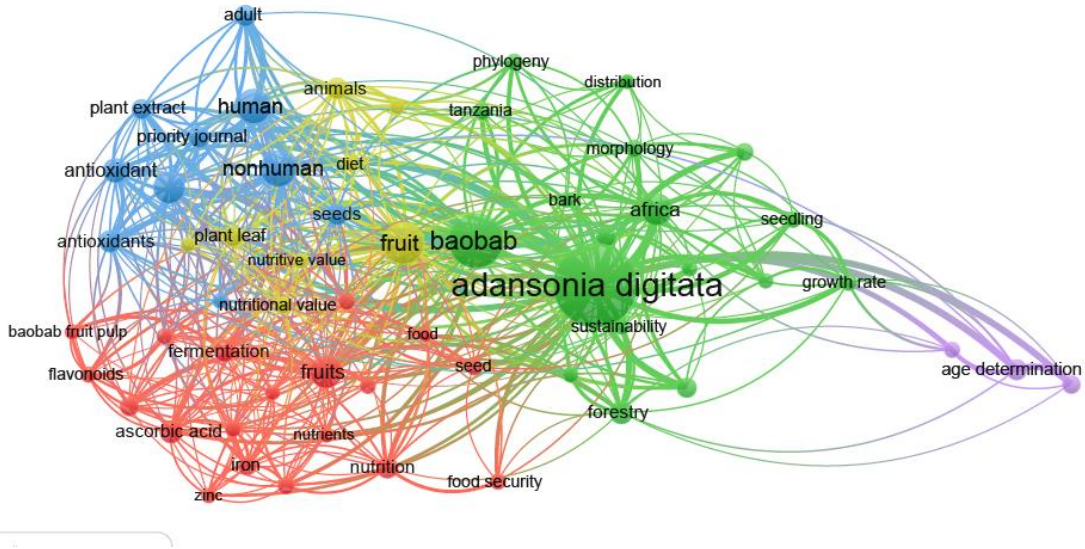
therapy and prohibition of hyperlipidemia-associated health abnormalities, by promoting the activities of antioxidant enzymes (Althwab et al., 2019). Our overview analysis of literature published by Vosviewer analysis revealed that although the nutritive value, and antioxidant activity derived from baobab fruits, seeds, and bark were utilised, the aspects of sustainability were a concern (*Figure 4*). Generally, limited investment, production levels, market, poor quality of baobab products, utilization, and market-limited research remain the key bottlenecks to baobab utilization (Assogbadjo et al., 2021). Overall, it appears that there is a need to expand and establish acceptable standards for global consumption of baobab products to ensure safety and enhanced quality baobab. According to (Baiyeri et al., 2019), native plant species merit robust research attention owing to their, health, food, nutritional and economic importance to the native populations as well as their biodiversity, and adaptation to local habitat. According to (Muthai et al., 2017), there is a need to prioritize specific germplasm collection for domestication and conservation efforts.

Figure 4. **Intersection of future areas of research on baobab**



Source: Author

CONCLUSIONS

Baobab tree products such as fruit pulp, leaves and seeds oil contain high level of macronutrients, micronutrients, vitamins, and protein. Therefore, promoting utilization of processed baobab products for improved human nutrition is key. However, determination of optimal parameters through elemental traceability as well as relationship between geographical locations and nutrient composition of baobab plant is required. Additionally, determination of the relationship between phenology and nutrient composition of baobab plants would widen the scope of parts of baobab utilised for human consumption. Overall, promoting innovative utilization of baobab products by exploring processing techniques to develop novel food and product formulations from *Adansonia digitata* tree products sheds a green light to sustain human livelihoods.

ACKNOWLEDGEMENTS

This project No. TKP2021-NKTA-32 has been implemented with support from the National Research, Development, and Innovation Fund of Hungary, Financed under the TKP2021-NKTA funding scheme.

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