



Ethnobotanical Survey of Medicinal Utilization and Phytochemical Composition of Baobab Tree (*Adansonia digitata* L.) in Zaria Local Government Area of Kaduna State, Nigeria

**A. I. Sodimu^{1*}, M. B. Usman¹, J. Appah², O. Osunsina¹,
R. A. Suleiman³, S. Maikano¹ and L. G. Lapkat¹**

¹*Federal College of Forestry Mechanization, Forestry Research Institute of Nigeria, P.M.B. 2273, Afaka, Kaduna, Nigeria.*

²*Department of Biological Sciences, Nigerian Defence Academy, Kaduna, Kaduna State, Nigeria.*

³*Trial Afforestation Project, Forestry Research Institute of Nigeria, Afaka, Kaduna, Nigeria.*

Authors' contributions

This work was carried out in collaboration among all authors. Author AIS and MBU designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors JA and OO managed the analyses of the study. Authors RAS, SM and LGL managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/EJMP/2020/v31i530233

Editor(s):

- (1) Sabyasachi Chatterjee, Burdwan University, India.
(2) Professor, Marcello Iriti, Milan State University, Italy.

Reviewers:

- (1) Jesus Miguel López Rodilla, University of Beira Interior, Portugal.
(2) Ochieng O. Anthony, Sumait University, Tanzania.

Complete Peer review History: <http://www.sdiarticle4.com/review-history/54421>

Original Research Article

Received 30 November 2019

Accepted 04 February 2020

Published 19 March 2020

ABSTRACT

Medicinal utilization and phytochemical composition of Baobab tree (*Adansonia digitata* L.) in Zaria Local Government Area of Kaduna State was studied. Twenty (20) questionnaires were randomly administered in each of the six (6) districts to make a total of one hundred and twenty questionnaires (120). Ninety (90) were retrieved. The result revealed that the plant parts (leaves; stem; bark and seed) can be used in treatment and prevention of various diseases such as tuberculosis; anemia; malaria; dysentery; diarrhea; joint pains; serves as anti-diabetic; fever; urinary infection e t c. Infusion is the major (43.33%) method of herbal preparation. Parts of the plants species used in preparing the herbs include: the leaves; bark; root; seeds and fruits. Majority

*Corresponding author: E-mail: akintundesodimu@yahoo.com;

of the herbal are consumed in a dried form. Demographic characteristic of the respondents were also examined. The percentage of Male was (43.34%) while that of their female counter part was (56.66%). Majority (43.33%) of the respondents were between 31 – 40 years age bracket and majority (44.44%) are married with majority (37.78%) having 1-5 house hold size. 45.56% of the respondents had secondary education while 2.22% had no formal education and majority (51.11%) are traditional healers. Quantitative phytochemical analysis revealed the presence of tannins; alkaloids flavonoids; terpenoids; saponins and phenolic acid in various concentrations as there were significant differences ($p < 0.05$) between these phytochemicals and their plants parts. The presence of varied active ingredients in the different parts of these plants explains their diverse use in the treatment of different disease conditions. However, it is recommended that due to the increased interest in baobab products (especially on its medical utilization) and slow growth of the plant research should be directed on how to develop a new cultivar with short maturation period. Also, the local population particularly the youth should be educated and also encouraged to learn more about the tradition medicine knowledge in order to preserve it from being lost with the old genera.

Keywords: Phytochemicals; ethnobotanical; utilization; baobab; Kaduna State.

1. INTRODUCTION

Traditional medicine refers to the knowledge, skills and practices based on the theories, beliefs and experiences indigenous to different cultural uses in the maintenance of health and in prevention, diagnosis improvement and treatment of physical mental illness [1]. Traditional medicine covers a wide variety of therapies and practices which varies from country to country and region. In some countries, it is referred to as alternative or complementary medicine. Traditional medicine has been used for thousands of years with a great contribution made by practitioners to human health particularly as primary health care providers at the community level. Traditional medicine has maintain its popularity worldwide since 1990s, its use surged in many developing countries [2] and interest has increased by researchers on the use of plant medicinally both for traditional uses and as potential new source of drugs and treatment. In the quest for conservation of lower scale of production of medicine and other important products, attention is being on indigenous tree species from graduation opinion; drugs are not readily available and affordable especially within the rural places. One of the indigenous plant species that constitute major sources of medicine uses in Nigeria is *Adansonia digitata* L. popularly known as Baobab tree [3] which also called tree of life because of its high importance to human and animals as its provide them with food, shelter, clothing and medicine as well as materials for county and fishery [4,5]. Various plant parts (e.g. leaves, back, fruit pulp), have traditionally been used for immune-stimulant, anti-inflammatory, analgesic insect repellent and

pesticide properties, in the treatment of diarrhea and dysentery in many African countries, and have been evaluated as a substitute for imported western drugs [6,7].

Adansonia digitata belongs to the Bombaceace which is regarded as the sub-family or Malvaceae. The family includes about 30 genera, six (6) tribes and about 250 species [3]. Baobab are drought tolerant, its mean annual temperature ranges between 20°C- 30°C. It can tolerate high temperature up to 40°C-42°C (in West Africa) and it's resistant to fire [8]. However, this adaptation allows it to grow in zones within 100-1000 m annual rainfall, but trees are often stunts in the lower rainfall areas [3]. Baobab is restricted to hot, semi-arid regions, dry wood land and sunning places with low rainfall (less than 1500 mm annually) [9] and grows on a wide range of well drained sands, where it is unable to obtain sufficient moisture or anchorage [10]. The fruit is said to have high Vitamin C content 10 times to that of orange, while leaves are high in mineral content and pro-vitamin fatty acid composition [8]. Baobab tree is widely distributed in hot savannah regions of sub-saharan Africa. It is a large iconic tree indigenous to African where it is found in many countries. It is an emblematic, culturally important and physically majestic sub-tropical tree. The Baobab has been referred to as "arbre a palabre", meaning the place in the village where the elders meet to resolve problem in the past decade, it has attracted the interest of several pharmaceutical companies and researchers due to its various traditional uses (medicinal, nutritional and cosmetic). Recently the European Union authorized the import of

baobab fruit pulp as a novel food [11] and it was approved in 2009 by the Food and Drug Administration as a food ingredient in the United State of America [12]. However, due to the high commercial demand of its products in EU and United States, this tree with its edible fruits needs to be conserved and treasured [13]. Baobab products (e.g fruits, seeds, leaves, bark) contribute to the livelihood of many populations in Africa as it is a source of food, fibre and medicine [14,15,16,5,17]. More than three hundred traditional uses have collectively been documented in Benin, Mali, Zimbabwe, Cameroon, the Central African Republic, Kenya, Malawi, South Africa and Senegal [11].

Various plant parts (e.g. leaves, bark, fruit pulp), have traditionally been used for immune-stimulant, anti-inflammatory, analgesic, insect repellent and pesticidal properties, in the treatment of diarrhea and dysentery in many Africa countries, and have been evaluated as a substitute for imported western drugs [7,18]. Baobab products exported around the world leads to increased pressure on this resource [16]. In India, powdered leaves are used to reduce excessive perspiration. The fruit is used internally with butter milk and mango to treat cases of diarrhea and dysentery. The efficacy of *A. digitata* in treatment of microbial infection had been demonstrated. The plant has a variety of medicinal uses which have been well documented. In Nigeria, the plant is found mostly in the Northern part of the country. Aqueous extract prepared from the bark of the plant is used in Nigeria traditional medicine for the treatment of fever. The aqueous extract of the stem-bark of *Adansonia digitata* produced a significant chemosuppressive effect against plasmodium Bergheim infection in mice. The powder obtained from the fruit of the plant is used traditionally to treat dysentery and diarrhea in Nigeria. Africa has an abundant novel plant species which are known to be rich in health-promoting compounds, many of which remain undiscovered or unused by the western society. The Baobab (*Adansonia digitata* L.) tree provides food, shelter, clothing and medicine as well as materials for hunting and fishing. The fruits is said to have high vitamin C content 10 times that of orange, while leaves are high in mineral content and provitamin A, the oils extracted from the seed are said to be edible due to the fatty acid composition. Knowledge of all these properties is limited due to the consumers and researchers. This research focused on phytochemical analysis and medicinal utilization

of the plant. The medicinal values of plant and their component photochemical such as alkaloids, tannis, flavonoids, phenolics and other compounds have been found to produce a definite physiological action on human body [19]. *Adansonia digitata* L. is one of the indigenous tree species in which its ethnobotanical values cannot be over emphasized. Here in Nigeria, little of its ethnobotanical utilization has been documented. The people (herbalist, herb sellers and trado medical centres who have the insight of these medicinal utilization of the tree learnt it by heart now that systematic search for useful bioactivities from medicinal plants is now considered to be a rational approach in nutraceutical and drug research. Thus, it is impetus to documents some of its medicinal utilizations for future generations. Therefore, this research aims at documenting the ethnomedicinal utilization of the part of the tree (leaves, barks, roots and the seeds) in Zaria Local Government Area of Kaduna State.

2. METHODOLOGY

2.1 Study Area

The study was conducted in Zaria Local Government Area of Kaduna State. It has a total land area of 46,053 square km and a projected population of 408,198 [20]. It comprises of six (6) traditional districts which include Birni da Kwaye (Zaria town and its environs) Dutsen Abba; Gyallesu; Tudun Wada; Tukar Tukur; Wuchiri and Zaria city. The main ethnic groups are Hausa and Fulani and they are predominantly Muslims.

2.2 Data Collection and Source

Primary data was used for the study. The primary data was collected using structured questionnaire. The questionnaire was designed to collect the following types of information.

- i. Demographic Characteristics of the sample respondents such as sex; age; marital status and so on.
- ii. Different diseases / ailment the species can cure; part used; mode of preparation and administration.
- iii. Constraints confronting the traditional healers / practitioners and so on.

2.3 Sampling Techniques

Simple random sampling techniques were used in selection of the respondents. Twenty (20)

questionnaires was distributed in each of the 6 districts (Birmi da Kewaye; Dutsen Abba; Gyallesu; Tudun Wada; Tukur Tukur; Wuchiri and Zaria city to make a sum total of sample size to be 120.

2.4 Processing of Plant Materials for Phytochemical Analysis

The different parts of the selected plants materials (leaves, stem, bark roots and seeds) was air dried in the laboratory. The dried sample was chopped into pieces and ground separately to powdered using blender. The powdered samples was then stored in small plastic air-tight containers which taken for analysis at National Research Institute of Chemical Technology (NARICT) for possible phytochemical analysis.

2.5 Phytochemical Screening

The tannins, terpenoids, and alkaloids determination were done using [21] while the flavonoid determination was by the method of [22]. Saponin was determined using the method of [23] and the method of Singleton and [24] was used to determine phenolic content.

2.6 Analytical Techniques

2.6.1 Simple descriptive statistics

Simple descriptive statistics such as percentage, frequency distribution tables, Mean and Standard error was used.

2.6.2 Anova

Two-way Analysis of variance (Anova) using GLM procedure (Proc GLM) of SAS (Statistical Analysis System) was used to show the comparison between the Phytochemical composition of the leaf, root and bark of the tree. The data was expressed as means \pm 1 Standard deviation (Means of 3 determinations) and differences were considered significant at $p < 0.05$.

3. RESULTS AND DISCUSSION

3.1 Demographic Characteristics of Respondents

Some demographic characteristics are known to influence the ethnobotanical survey of medicinal utilization and phytochemical composition of

baobab tree (*A. digitata*) in Zaria Local Government Area of Kaduna State. The variable employed in this study includes: age, sex, marital status, house hold sizes and level of education.

Table 1 revealed that 43.33% of the sampled respondents were between the age brackets of 31-40 years. This implies that they were at middle and economically active age which could have positive effect on their standard of living. 44.44% of the respondents are married, 41.11% are single, 4.45% are divorced while 10.00% are widow (er). This is an indication that married people know the value and economic importance of the medicinal utilization of Baobab tree for curing and prevention of diseases. Gender distribution further revealed that women are the majority (56.66%) in the ethnobotanical survey of medicinal utilization of baobab tree against their men counter parts (43.34%). 45.56% of the sampled respondents had Secondary education and 28.89% had tertiary education, 13.33% had primary education, 7.78% had Arabic education, 2.22% had adult education. [25] observed that formal education has positive influence on one's life. Furthermore, 37.78% of the respondents were between the household size of 1-5 while 18.89% of the respondents were in the household above 15.

3.2 Methods of Herbal Preparation of Baobab Tree (*Adansonia digitata* L.): Leaf, Bark, Stem, Root and Seeds

Over the decades, various methodology have been adopted by the traditional healers, herbs trader, people knowledgeable about the ethnobotanical utilization of medicinal of baobab tree etc. in herbal preparation of the part of the tree (roots, barks, fruit, seed, leaf and stem etc.) for prevention and curing of various disease in Zaria Local Government Area of Kaduna State. However, the most common adopted method in the study area is shown in Table 2.

Table 2 revealed that majority (43.33%) of the respondents adopted infusion methods of preparation. This implies that either or any of the parts of the tree are boiled or soaked in hot water before used. 33.33% used grinding method while 4.45% used crushing. However, majority of advocate of alternative medicine hold that various alternative methods are effective in treating a wide range of major and minor medical condition. This result is in accordance with that of [26,27,28] whose research proves the effectiveness of specific alternative treatments.

Table 1. Demographic characteristics of respondents

S/No	Variable	Respondents	Percentage (%)
1	Age in years		
	10-20	19	21.11
	21-30	16	17.78
	31-40	39	43.33
	41-50	13	14.45
	Above 51	03	3.33
2	Marital status		
	Married	40	44.44
	Single	37	41.11
	Divorce	04	4.45
	Widower	09	10.00
3	Gender		
	Female	51	56.66
	Male	39	43.34
4	Educational level		
	Tertiary	26	28.89
	Secondary School	41	45.56
	Primary School	12	13.33
	Arabic School	07	7.78
	Adult School	02	2.22
	Non Formal Education	02	2.22
4	Occupation		
	Traditional Healer	16	51.11
	Herbs Trader	30	33.33
	Civil Servant	10	11.11
	Famer	04	4.45
5	House hold size		
	1-5	34	37.78
	6-10	29	32.22
	11-15	10	11.11
	Above 15	17	18.89
	Total	90	100.00

Table 2. Responses to methods of herbal preparation of baobab tree (Leaf, bark, root, seed and stem)

Methods	Frequency	Percentage (%)
Infusion	39	43.33
Maceration	17	18.89
Crushing	04	4.45
Grinding	30	33.33
Total	90	100

3.3 Herbal Forms and Method of Administration of the Plant

The respondents show and claim that all the parts of Baobab tree (leaf, bark, fruits and stem) can be used to prevent and cure various ailments, forms and methods of preparing the parts varies depending on the ailments. However, advocate of alternative medicine hold

that various methods of administration are effective in treating a wide range of major and minor medical conditions [29]. The Table 3 shows various ailments form of preparation and method of administering baobab tree parts (herbs) in the study area.

Table 3 revealed various diseases that the tree plants (Baobab) can be used to cure in Zaria Local Government Area of Kaduna State. However, most of the practitioners learn and inherited the practices from their forefathers. Thus, they were very reluctant in disclosing some of the preparation and administration. Similar observation were reported by [29,30,31]. The diseases that can be cured by this species include tuberculosis; diarrhea; fever; malaria; anemia; skin diseases; urinary infection; joint pains and so on. However, some of the parts of the tree were used in fresh while other are used

in dry condition during the preparation of the herbal. The table further revealed that there is standardization of measurement in taking the herbal with the use of table spoon, tea spoon and sometimes with the use of short glass cup called "gasi" in Yoruba language.

Table 3. Ailments forms, preparation and method of administering baobab tree parts (Leaf, root, bark, seed and stem) herbal

S/No	Diseases	Part used	Preparation	Status	Method of Use
1	Tuberculoses	Leaves	Dried leaves boiled in water 30-40 Minutes	Dry	Short glass cup of the preparation is taken only for 24 days.
2	Anaemia	Bark	Air dry the bark and blends. Soak in water for 45-60 minutes	Dry	Two table spoon to be taken twice a day. Morning and late at night
3	Malaria	Bark Leaves	Powdered bark or leaves mixed with Pap or lemon drink	Dry	3 times daily. Two table spoon to be taken in the morning, afternoon and night
4	Dysentery / Fever	Seeds Fruits	Decoction of the Leaves	Fresh	Tables 2 Teaspoon at each meal
5	Blood Cleaning	Leaves	Infusion	Fresh	1 glass Cup taken per day
6	Diarrhea	Leaves	Infusion	Fresh	2 teaspoons to be taker in the Morning and Night
7	Skin diseases	Leaves	Soak fresh leaves in water for 40- 50 Minutes	Fresh	Dilute with water for bathing in the morning and night.
8	Urinary infection	leaves	Mix powdered leaf in water for about 24hrs before used	Dry	Take 1 glass each in the morning, afternoon and night
9	Cough	Seeds	Oil is extracted from the seed, store in a small air tied container for 12hrs before used	Dry	Take 1 table spoon after meals three (3) times daily
10	Joint pains	Leaves fruit pulp and seed	*leaves; wash the leaves with salt gently and soak it in hot water for 20-30 minutes *Fruit pulp seeds: After extraction of the pulp from the seed mix it with small quantity of H ₂ O before use	Fresh	Soak clean rag with the water and place it on the joint 3 times daily add the extracted powdered (2- teaspoon) in pap 3 times daily.
11	Hair dandruff	Leaves	Immersion of the leaf inside hot water for 40-30 minutes before use	Fresh	Wash the hair with the water 3 times daily.
12	Wounds	Leaves		Dry	Apply four (4) times daily
13	Tooth diseases and fume	Leaves	After air drying the leaves blend it into powdered and mix it with water allow it to stand for 30-40 minutes		Used the water to wash and rinse your month 4 times daily
14	Pile	Leaves	Soak the Fresh Leaves in water for 24hrs	Fresh	A glass is taken morning, afternoon and evening for 1 week

Table 4. Constraints of traditional medicine practitioners

S/No	Constraints	Frequency	Percentage
1	Deforestation	30	33.33
2	Insects/ Pest	10	11.11
3	Illiteracy	08	8.89
4	Transportation	05	5.56
5	Finance	02	2.22
6	Government Policy	35	38.89
	Total	90	100.00

Table 5. Quantitative phytochemical composition of baobab tree parts (*Adansonia digitata*)

S/No	Parts	Tanins (Mg/Kg)	Alkalows (Mg/Kg)	Flavoinoids (Mg/Kg)	Terpenoids (Mg/Kg)	Saponins (Mg/Kg)	Phenoic acid (Mg/Kg)
1	Leaf	177.0± 1.0a	4300.2± 1.6a	15867.5± 8.1a	173.0± 0.1a	758.0± o.1b	11.0 ± 0.1b
2	Root	37.7± 1.5b	1456.2± 7.2b	3518.6± 5.1b	118.1± 1.6b	169.0± 2.2c	8.0± 0.1c
3	Bark	20.3± 1.6c	970.0 ± 0.1c	192.1± 0.6c	60.0 ± 1.6c	1390.0± 4.9a	8.0 ± 2.1a

*Figures are expressed as mean ±SD

*Figures bearing different alphabets differ significantly ($P > 0.05$)

*Figures bearing the same alphabets are not significantly different ($P < 0.05$)

3.4 Constraints Confronting Traditional Medicine Practitioners

Various constraints were identified from the respondent's confronting traditional medicine practitioners in the study area. Some of the constraints identified were shown in the Table 4.

Table 4 revealed that government policy is the major (38.89%) constraint confronting traditional medicine practitioners in the study area, this is closely followed by deforestation (33.33%), insect/ pest (11.11%) while finance issues is the least with 2.22%. These observations were also reported in the work of [32] that government law and policies are the major challenges facing herbal practitioners.

3.5 Quantitative Phytochemical Composition of the Baobab Plants (Leaf, Root and Bark)

Phytochemical constituents of Baobab (*Adansonia digitata*) plants revealed the presence of medicinally active compositions in various quantified in the different plant part. However, the quantitative estimation of the crude phytochemical constituents in the plants parts study are presented in Table 5.

Table 5 shows the result of Phytochemical composition of leaf, root and bark of *Adansonia digitata* tree collected from the study site. The results show that significant differences ($P < 0.05$) exist between the plant parts. Leaves of *A. digitata*, had the highest composition of tannins; alkaloids, flavonoids and terpenoids while the bark had the highest composition of saponins and phenolic acid. However, *A. digitata* bark had the least composition of tannins; alkaloids, flavonoids and terpenoids while the root had least composition of saponins and phenolic acid. [33,34] reported the presence of tannins terpenoids; saponins and phenols in the bark and root extract of *A. digitata*. They thus, concluded that the presence of these chemical could possible explain the scientific basis of or the use of bark and root extracts in traditional treatment of diarrhea and diarrhea symptom of new castle disease [35,36].

Furthermore, [37,34] also revealed the presence of tannins; carbohydrate; saponins; flavonoids; terpenes and alkaloids. They also concluded that terpenes and flavonoids present in the tree may also be responsible for its usage in the traditional treatment of anti-diabetic activity. Gruenwald and Galizca [38] also documented that *A. digitata* as being an active tree species in relieving fever caused by malaria in humans.

4. CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

It is evident that the iconic African tree, Baobab, is an important medicinal resource used to treat or prevent a range of health problems. The use of herbal medicine has become a part of the world. However, about 80% of the world's populations use herbal production as medication. Some use herbal products with conventional indication while others use them as replacements. Although the high technological approaches of conventional medicines are especially useful for acute usage treatment, herbal medicines are more suitable for dealing with chronic ailment.

Furthermore, herbal medicine addressed an important health care need; its continued integration into main stream medicine should benefit everyone. Thus, this integration must require herbal medical education and training as well as improved regulatory system for herbal medicine.

4.2 Recommendations

Based on this study, it is recommended that:

1. Due to the increased interest in baobab products and slow growth of the plant, research should be directed on how to develop a new cultivar with short maturation period.
2. The local population particularly the youth should be educated and also encouraged to learn more about the traditional medicinal knowledge in order to preserve it from being lost with the old generation.
3. There is need to create awareness of environmental conservation and protection of medicinal plant species biodiversity.
4. Government should stop individuals from indiscriminate destruction of forest and encourage cultivation of medicinal plants. Similarly, sustainability of biodiversity and biological resources should be ensured so that individual plants do not go into extinction.

CONSENT

It is not applicable.

ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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