



ETHNOBOTANICAL, PHYTOCHEMICAL AND PHARMACOLOGICAL POTENTIAL OF *ADANSONIA DIGITATA* LINN. (BAOBAB) - A REVIEW

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Adansonia digitata Linn. or kalpavriksha is one of the important deciduous tree of angiosperm group that is a native to arid central Africa. Ethnobotanically and pharmacologically it is an important plant because its leaves, bark, fruits and seeds are rich store house of various types of phytochemicals such as proteins, carbohydrates, amino acids, fatty acids, flavonol, quercetin and minerals. Every part of baobab is useful in curing many diseases like fever, malaria, sickle cell anaemia inflammation and microbial diseases. The alkaloid “adansonin” is found in the bark and it is used for the treatment of malaria and other fevers as a substitute of quinine. The aim of the present review is to compile all the informations related to ethnic uses, phytochemicals and their pharmacological activity to highlight the possibilities of *A. digitata* as medicinal and non-medicinal potential for the benefit of human population.

Key words: *Adansonia digitata*, Ethnobotanical, Kalpavriksha, Pharmacological activity, Phytochemicals.

Introduction

Adansonia digitata Linn. (baobab) or kalpavrikshais a native to Africa and also found to Madagascar, Australia and in some parts of India like Bombay, Gujarat, Uttar Pradesh, Bihar, Ceylon and Coromandel coast¹⁻³. It is a flowering plant belonging to family Malvaceae, the mallows family. *Adansonia* (baobab) is also known as Senegal calabash, dead rat tree, monkey-bread tree, upside- down tree, Ethiopian sour gourd, judas’s bag, monkey tamarind, lemonade tree and represented by eight species^{4,5}. *A. digitata* is frequently found at low altitudes with 4-10 dry months every year in the thorn woodlands of African savannas. *Adansonia* is sensitive to frost and water logging. Where the trees are found, all

locations are arid or semi-arid⁶. Various plant parts of *A. digitata* having a nutritional, medicinal and pharmacological importance. *A. digitata* considered as a ‘Queen of all carbon storage trees’^{2,3}. The various plant parts of *A. digitata* are used as a treatment of many pharmacological activity like anti-bacterial, anti-Inflammatory, anti-oxidant activity etc. and also used as a bark fiber, food, medicinal and non- medicinal purposes⁷. Baobab fruit pulp is rich in vitamin c and leaves have good quality proteins and seeds contain high amount of fats. Leaves and fruit pulp of baobab has anti-oxidant activity⁸. The name of *A. digitata* is ‘cream of tartar tree’ due to presence of tartrate in fruit pulp^{7,9}. The fruit pulp is suggested in daily diet for the

children and pregnant woman as it is a rich source of protein, carbohydrates and energy¹⁰.

Taxonomic description

Adansonia digitata is an unusual or strange shaped, deciduous tree. *A. digitata* attains a height of 20-30 meters having a vast girth trunk and the trunk is characterized by swallow, smooth, shiny cylindrical and bottle shaped. Baobab plants have an extensive lateral root system, large irregular branches and the cork like bark with longitudinal fibers. The smooth bark is fibrous, soft and reddish brown to grey in colour¹⁰. The main roots of old plants are very sensitive to intense wind and can be pulled out by storms because the main roots are comparatively shallow and seldom extend beyond 2-meter depth⁷. Leaves are generally simple in young tree. Simple leaves produced by adult trees followed by 2-3 leaflets whereas mature leaves have 5-9 leaflets. Leaflets can be sessile or short petiolate and have decurrent base. At the ends of branches, leaves are alternate and occurring on the spur on trunk. Margin of leaf is entire. Stipules are characterized by early caducous, narrowly triangular, 2-5mm long or subulate⁷. Flowers are very large, white in colour, solitary, pendulous and occurring in the axil of leaf. Flowers have 5 leathery petals, cup shaped sepals, 7-10 rayed, stamens in large number and flowers are open during the late afternoon⁹. A sulfur fragrance is emitted by showy flowers of *Adansonia* that attract the pollinators specially the bats¹¹. The indehiscent, large fruit of baobab plant are egg-shaped capsules. The hard, black seeds are kidney-shaped and embedded in pulp of fruit with smooth test¹².

Ethnobotanical potential of *A. digitata*

Non medicinal importance

Adansonia digitata is deeply assembled within the traditional and culture of the people mainly living in Africa.

Traditionally, the baobab tree has non-medicinal and medicinal uses. Non-medicinally uses include the use of plant parts for milk substitute, food stuff, fuel, ropes and clothes etc. Its plant parts are used to cure many diseases such as fever, malaria, dysentery, sickle cell anemia, microbial diseases etc. The detailed uses of *Adansonia digitata* by ethnic people are tabulated in Tables-1.

Traditional medicinal importance

A. digitata is considered as a holly plant hence it has its own ethnic medicinal importance. Its different parts such as seeds, fruits, leaves and bark are used to treat various types of human diseases. Powder of raw seeds or mixed with water, and seed pulp mixed with water are used to cure hiccough in infants, fever, diarrhoea and dysentery respectively. Fruits eaten raw against dysentery and fever. Leaves decoction, juice, paste and infusion are used to treat various types of human diseases, tabulated in Table-2.

Phytochemical profiling of *A. digitata*

Phytochemicals of various parts of plant *Adansonia digitata* have been worked out in details by many researchers using different techniques for extraction and detection. Many phytochemicals are extracted from different parts of plant such as vitamins, fatty acid, amino acid, minerals etc. The detailed chemical constituents isolated from fruits, leaves, roots, seeds and bark are listed in table 3.

Pharmacological potential of *A. digitata*

Various plant parts of *Adansonia digitata* such as leaves, bark, stem, root-bark, fruit-pulp, seed, mucilage have various types of pharmacological potential. Baobab plant show many biological activities such as anti-sickling, anti-malarial, anti-inflammatory, anti-bacterial, analgesic activity etc. The detailed pharmacological uses include activity, preparation of extract and tested against or action showed in table 4.

S. No	Plant part	Preparation	Uses	References
1	Fruit	Husk of fruit	Making dishes, vessels, fuel	10, 13
	Fruit-pulp	Dissolved in water or milk	Food stuff drink, sauce for food, fermenting agent in local brewing, substitute for cream of tartar in baking	7
			Ingredient in ice products, juices and jams	14,15
		Soaked in water	Milk substitute	16
		Burning (produce smoke)	Insect repellent	10,13
		Fruit-pod	Burning	Fuel
		Ash(potash-rich vegetable salt)	Formation of Soap	16
2	Seed	Flour is prepared from dry seeds	Edible in different ways	7,17
		Milk is prepared by mixture of baobab and <i>Digitaria exilis</i> flour	Highly nutritious drink, infant milk powder	18
		Seed oil	Food oil, soap making	19
3	Capsule	Ash is prepared by burning and filtrate potash\ potassium carbonate	Binding agent as cooking	20
4	Young leaves	Powder is prepared by crushing dry leaves	Sauces over porridges, thick gruels of grains, boiled rice, staple food cooked as spinach	7
			Fresh vegetable	21
5	Bark	Bark fibre	Ropes, sacks, clothes, baskets and mats	7
			Manufacture bags and make sling slots	20
		Decoction	Cold drink or as bathing water to increase the weight and strength of infants	20
6	Flower		Eaten raw	
7	Wood		Floats for fishing nets, manufacture of light canoes, trays	10,13
8	Root		Provide ingredient for dyes	10,13

Table 1: Non- medicinal uses of *Adansonia digitata* Linn.

S. No.	Plant part	Preparation	Uses	References
1.	Seed	Powder of raw seeds	Hiccoughs in infants and children	22
		Mixed with water	Fever and Diarrhoea	23
	Seed- pulp	Mixed with butter milk	Diarrhoea and dysentery	22
	Seed-fruit	Decoction	Dysentery, fever	23
2.	Fruit	Eaten raw	Microbial disease	24
	Fruit-pulp	With figs made to syrup	Diminishing the heat and quenching the thirst	22
	Fruit-seeds	Decoction	Dysentery, fever, haemoptysis, diarrhea	17
3.	Leaves	Mucilage	Laxative	22
		Decoction	Diaphoretic, fever remedy	25
		Juice and paste	Diaphoretic, kidney and bladder diseases, asthma, insect bites	9
		Paste	Toothache, gingivitis	26
		Decoction, infusion	Diarrhoea, fever, inflammation, kidney and bladder diseases, blood clearing, asthma	27
		Decoction	Malaria, fever	23
	Infusion	Diarrhoea, fever, inflammation, kidney and bladder diseases, blood clearing, asthma	28	
Leaves and root	Decoction	Fever, dysentery	10	
4.	Bark	Aqueous extract	Sickle cell anemia	29
	Bark-stem	Powder	Substitute for cinchona bark	22
	Bark fibre	-	Musical instruments	22
	Bark-leaves	Powdered bark mixed with porridge	Malaria	30

Table 2: Traditional medicinal uses of *Adansonia digitata* Linn

S.No.	Plant part	Chemical constituents	References
.	Fruit	Epicarp (45%), fruit pulp (15%), seeds (40%) pH 3.3 Simple sugar (35.6%) Carbohydrates (\approx 70%), crude fibre (\approx 11.2%), protein (\approx 2.2%), fat(\approx 0.4%) energy, thiamine, nicotinic acid, pectins (average 56.2%), free tartaric acids, citric acid, tartarate, ascorbic acid, malic acid, ash (\approx 5.7%), succinic acid, fructose, saccharose and glucose	52 53 8 7

		Amino acids: - Aspartic acid (ASP) Glutamic acid (GLU), Serine (SER) Glycine (GLY) Histidine (HIS) Arginine (ARG) Threonine (THR) Alanine (ALA) Proline (PRO) Tyrosine (TYR) Valine (VAL) Methionine (MET) Isoleucine (ILE) Leucine (LEU) Phenylalanine (PHE) Lysine (LYS) Cysteine (CYS) Tryptophan (TRP)	54
		Fatty acid (84.10 mg/g dry weight): - linoleic acid (27), α -linolenic acid (<1), Myristic (0.18), Palmitic (27), Stearic (3.30), Oleic (25), Arachidic (0.69), Gadoleic (0.04), Total lipid content (127)	55
		Minerals: - Calcium (high content), Copper, iron, Magnesium, Mn (poor source), sodium, potassium, Zinc, Phosphorus	56
		Vitamins: - Vitamin-C (very high), vitamin- B B1, B2, B3, A	56
	Pericarp	Flavonol: - Epicatechin-(4 β →8)-epicatechin (B2), (-)-epicatechin, Epicatechin-(4 β →6)-epicatechin (B5), epicatechin-(4 β →8)epicatechin-(4 β →8)-epicatechin (C1)	15 57
2.	Leaves	Pro-vitamin A Iron (Yazzie et al,1994; Sidibe and Williams,2002) Protein 13.6%, Sugar 0.01%, Ash 4.08%, Moisture content 78.20%, Fat 2.71%, Crude Fibre 2.45%, Vitamin C 14.98mg/100g (Abiona D.L., 2Adedapo Z. 3 Suleiman M.K.) arginine (8.0%), valine (5.9%), lysine (5.7%), threonine (3.9%), methionine + cysteine (4.8%), tryptophan (1.5%), tyrosine + phenylalanine (9.6%), (Yazzie et al., 1994).	2,3
		Stigmasterol, friedelin, scopoletin, β - sitosterol, β -sitosterol-3-O- β -D-glucofuranoside and lupeol.	58
3.	Root	Quercetin-7-O- β -D-xylopyranoside, 3,7-dihydroxy-flavan-4-one-5-O- β -D-galactopyranosyl (1→4)- β -D-glucopyranoside, 3,3',4'-trihydroxy flavan-4-one-7-O- α -L-rhamnopyranoside	59,53
4.	Seed oil	n-alkanes (57.3%), squalene (39.5%), cholesterol, campesterol, isofucosterol, β -sitosterol, stigmasterol, Linoleic and oleic acids (High conc.) Palmitic, linolenic, stearic and arachidic acids (less amount)	60 61,56
5.	Bark	'Adansonin' alkaloid (antidote to strophanthus poisoning)	23

Table 3: Phytochemicals of *Adansonia digitata* Linn.

S. No	Plant part	Activity	Preparation	Tested against/ Action	References
1.	Leaves	Diuretic activity	Methanolic and aqueous extracts	Test on rat	31
		Anti-Inflammatory activity	Aqueous leaf extract	Inhibition against cytokine IL-8	32
			Methanolic extract	Inhibition of NF-KB activation	33
		Anti-insecticidal activity	Smoke from pellets	<i>Anopheles gambiae</i> (African malaria mosquito), <i>Musca domestica</i> (housefly) and <i>Periplaneta americana</i> (American cockroach)	19
2.	Bark	Anti-Sickling activity	Anthocyanin extract	Sickle blood cell	34 35
		Anti-malarial activity		<i>Plasmodium berghei</i>	36
		Anti-hyperglycaemic and anti-lipidaemic activities	Ethanollic extract	In alloxan induced diabetic female rats.	37
		Antidiabetic and hypolipidaemic	Solvent extract	Effects on type I diabetic animals	37
		Anti-fungal activity	Extract	<i>Aspergillus fumigatus</i> , <i>A. flavus</i> , <i>A. nidulans</i> , <i>A. ochraceus</i> ,	38
3.	Stem, root bark	Anti-bacterial activity	Extract	<i>Escherichia coli</i> , <i>Klebsiella</i> , <i>Pneumonia</i> , <i>Protus Mirabilis</i> , <i>Staphylococcus species</i>	39
		Anti- microbial activity	Aqueous and ethanolic extract	Gram positive bacteria, gram negative bacteria, yeast	40
4.	Stem bark, fruit pulp	Anti-Diabetic activity	Methanol extract	Against <i>Streptozotocin</i> induced diabetic rats	41
5.	Seed	Anti-Rheumatoid-Arthritic activity		Freund's adjuvant induced arthritis method	42
	Seed-oil	Analgesic activity	Petroleum ether extract	Tail-flick test on mice	43

6.	Root	Anti-Trypanosomal activity	The methanol root extract exerted	Reduce motility in <i>Trypanosoma congolense</i> , <i>Trypanosome brucei</i>	44 45
7.	Fruit pulp	Hepato protective activity	Water extract	Against chemical-induced toxicity with CCL4 in rats	46 44
		Anti-oxidant activity	Aqueous methanol extract	Due to Phenolic and flavonoid content	47
		Analgesic and Anti-Pyretic activity	Hot water extract	Experiment on mice	48
		Anti-inflammatory activity	DMSO extract	Inhibition against cytokine IL-8	32
		Anti-plasmodial activity	Aqueous extract	Against the chloroquine-sensitive and resistant strains of <i>P. falciparum</i>	30, 49
8.	Bark, fruit-pulp, seed	Antidote to Poison	Juice	Against <i>Strophanthus</i> species	22
9.	Fruit, leaves, Seeds	Anti-microbial activity	Extract	<i>Bacillus subtilis</i> , <i>Escherichia coli</i> , <i>Mycobacterium leprae</i>	22
10.	leaves, fruit-pulp, seed	Anti-Viral activity	Water, DMSO and methanol extract	Influenza virus(susceptible), herpes simplex virus and respiratory syncytial virus(resistant)	32
11.	Root, Bark	Anti-Viral activity	Methanolic extract	ND virus	22
12.	Mucilage	Drug Permeation Enhancer		-	22
13.	Stem, Root bark	Anti-fungal activity		<i>Penicillium crusto-sum</i> , <i>Candida albicans</i>	22
14.	Baobab red fibre	Anti-oxidant activity	Lipid soluble anti-oxidant capacity(high), the water-soluble anti-oxidant content and the ascorbic acid antioxidant capacity are determined.		50
15.	Mucilage	Drug permeation enhancer (excipient)	Extract		51

Table-4: Pharmacological uses of *Adansonia digitata* Linn.

Conclusion

Adansonia digitata (Baobab) is an important angiospermic plant which has high medicinal, non-medicinal, nutritional and pharmacological potential therefore, it has been used in medicine traditionally by the ethnic people. Different parts of this plant are used as food, fodder, nutritional drink, clothing as well as raw material for many useful items hence the plant is considered under religious significance. The fruit and fruit-pulp are rich source of vitamin C, calcium, carbohydrates, pectin, phosphorus, amino acid, linoleic, soluble and insoluble fibres and low amount of protein, iron and α -linolenic acid. The leaves of baobab plant contain high level of vitamin A and young leaves are used for sauce over porridges, boiled rice or thick gruels of grains and cooked like spinach. Various plant parts have many types of biological activities like anti-inflammatory, anti-viral, anti-oxidant, anti-microbial, Analgesic activity and Hepato protective activity etc.

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