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Albizia amara - A Potential Medicinal Plant: A Review

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Abstract: ***Albizia amara is an important medicinal plant found throughout India. The entire plant possesses pharmaceutical constituents of great significance. The present article gives an update on bioactive compounds and medicinal importance of Albizia amara. This plant has been used as an important folk medicine for the treatment of several diseases like diarrhea, gonorrhea, skin diseases, poisonous bites and leprosy. Further, phytochemical investigation revealed the presence of wide variety of bioactive compounds such as macrocyclic spermine alkaloids, triterpene saponins, phenols, flavonyl glycosides, tannins, sterols in the plant extract of A. amara. In addition, the plant extract possess the pharmacological properties like anticancer, antihyperlipidimic, antiinflammatory, antimicrobial, analgesic and antioxidant activities. Because of the presence of several phytoconstituents, pharmacological activities and wide distribution, this will be an ideal plant resource for the treatment of several endemic diseases.***

Keywords: *Albizia amara*, Medicinal Plant, Bioactive compounds, Pharmacological Properties

1. Introduction

The genuses *Albizia* is represented by more than 100 species and are mainly confined to tropical and sub- tropical regions of Asia, Africa and Australia. About 16 species of *Albizia* are indigenous to the Indian subcontinent and have been cultivated as avenue trees, shade trees in tea and coffee plantation. *Albizia* species are socially significant as high quality timber yielding and as a valuable resource for gum. Most importantly, *Albizia julibrissin, Albizia lebbeck, Albizia procera* and *Albizia amara* are some of the most considered species in Ayruvedic medicine.

Albizia amara (Nallaregoo, Chigaraku in language telugu) belongs to the family leguminaceae, is a valuable medicinal and multipurpose drought tolerant tree commonly found in dry forests of India. The wood of *Albizia amara* is purplish brown with lighter bands, very hard and strong and used for making cabinets in building and agriculture purpose (Gamble 1935). The plant extracts of *A. amara* are used extensively in traditional medicine (Reddy *et al.*, 1967).

Geographical Distribution

A. amara is a strong light-demander, intolerant of shade, very hardy and shows marked resistance to drought. It is widely distributed in Africa, occurring from Sudan and Ethiopia southwards to Zimbabwe, Botswana and the Transvaal. It mainly grows in sandy woodlands. In India, it is present in the dry regions of Tamil Nadu, Andhra Pradesh and Karnataka (Chakrabarthy T *et al.*, 1996).

Morphology

Albizia amara is a large deciduous tree, up to 10 meters tall, branches are densely yellowish or gray pubescent. Leaves 12cms long, petiole 1.3cm long, gland near middle and above petiole, rachis to 12cm long, pinnae 6 – 10pairs, leaflets 15 – 25 pairs, narrow – elliptic, overlapping, 8 x 2.5 mm, appressend, pubescent or glabrescent, base – sub acute, margin sparsely ciliate, apex obtuse. Flowers are creamy white to pale yellow, solitary or 2 – 3 fascicled in upper axis. Pods flat, compressed, greyish brown, 8 – 20cm faintly veined, straight or wavy along indehiscent contains 6 - 8 seeds (Orwa *et al.*, 2009).

Taxonomic Classification

Kingdom : Plantae
(Unranked) : Angiosperms
(Unranked) : Eudicots
(Unranked) : Rosids
Order : Fabales
Family : Fabaceae
Subfamily : Mimosaceae
Tribe : Ingae
Genus : Albizia
Species : amara

Table 1: Medicinal Significance of *Albizia* species

SNo	*Species*	*Phytoconstituents*	*Medicinal Importance*	*References*
1	*A.adinocephala*	Budmunchiamines L4 &L5.	Antimalarial	Ovenden SP *et al.*, 2002.
2	*A.adianthifolia*	Aurantiamide acetate	Antioxidant activity	Steinrut L *et al.*, 2011b
3	*A.amara*	Budmunchiamines A-C	Hepato protective	Umbrae *et al.*, 2009; Mar W *et al.*, 1991.
		macroscopic spermine alkaloids	Antimicrobial	Thippeswamy *et al.*, 2013.
4	*A.anthelmintica*	Ethanolic extract	Analgesic, antioxidant activity	Steinrut L *et al.*, 2011b.
5	*A.chevalieri*	Leaf extract	Antioxidant activity	Aliyu *et al.*, 2008
6	*A. chinensis*	Albizosides A-C	Cytotoxic activity	Rui L *et al.*, 2009.
		Kaempferol-3-O-α-L-rhamnopyranoside, Quercetin-3-O-α-L-rhamnopyranoside, Luteolin, Kaempferol, Quercetin		
7	*A.coriaria*	Oleanane type saponin coriariosides	Anticancer	Not OP *et al.*, 2009.
8	*A.grandibracteata*	Grandibracteosides A−C	Anticancer	Sabrina K, 2007.
9	*A. gummifera*	Vitalboside-A, vitalboside-A, 2'- methylglucuronate		
		3-O-{β-D-glucopyranosyl(142)-[α-L-arabinopyranosyl(146)]-β-D-glucopyranosyl}-oleanolic acid	Anti trypanosomal, anti cancer	Steinrut L *et al.*, 2011 a.
10	*A. inopinata*	Felipealbizine A, felipealbizine B	Neurologic activity	De Assis TS *et al.*,, 1999.
11	*A.inundata*	3-O-[α-1-arabinopyranosyl- (1→6)]-2 acetamido-2- deoxy-β-D-glucopyranosyl] echinocystic acid.	Cytotoxic activity	Zhang *et al.*, 2011.
12	*A. julibrissin*	Julibroside J1 & J9, J29**,** J30 and J31.	Cytotoxic activity, anticancer	Zheng L *et al.*, 2006;Zou K *et al.*, 2006.
		quercitrin and isoquercitrin.	Antioxidant, antidaibetic	Lau CS 2007 ; kang TH *et al.*, 2000.
		Albibrissinoside B		Jung MJ *et al.*, 2004.
		3, 5, 4'-trihydroxy, 7, 3- dimethoxy-3-*O*-β-D-glucopyranosyl-α-L-xylopyranoside.		Kang J *et al.*, 2007.
13	*A. lebbeck*	Albiziasaponins A, B and C	Antimicrobial	Varshney *et al.*, 1976
		Quercetin, kaempferol, 3-*O*-α-rhamnopyranosyl (1→6)-β-glucopyranosyl(1→6)-β-galactopyranosides.	Cytotoxic activity, Anticancer.	Ganguly NB *et al.*, 1993.
		Budmunchiamines L1-L3.	Anti inflammatory	Babu NP *et al.*, 2009.
14	*A. mollis*	Molliside A-B, Concinnoside A, Albiziasaponin A	Sedative	Zou K *et al.*,, 2000.
15	*A. myriophylla*	Albizzine A	Antioxidant	Steinrut L *et al.*, 2011b
		Albiziasaponins A-E		
16	*A. odoratissima*	7, 8-Dimeth+C20oxy-39, 49 methylenedioxyflavone, 7, 29, 49-Trimethoxyflavone	Leprosy, Ulcers, Cough	Zou K *et al.*, 2000.
17	*A. procera*	3-*O*-[β-Dxylopyranosyl-(1→2)-α-L-arabinopyranosyl- (1→6)-2 acetamido-2- deoxy-β-Dglucopyranosyl] echinocystic acid, 5, 2', 4'-trihydroxy-3, 7, 5'- trimethoxyflavonol-2'-*O*- β-D-galactopyranosyl- (1→4)-*O*-β D-glucopyranoside	Antioxidant, Anticancer.	Khatoon, 2013. Melek FR, 2007.
18	*A. subdimidiata*	Albiziatrioside A and B	Cytotoxic activity, anticancer	Abdel-Kader M *et al.*, 2001; Lau CS *et al.*, 2007.

2. Phytochemical Significance of *Albizia Amara*

Phytochemical Constituents:

Sastry etal (1966) reported that the petroleum ether extract of Heart wood has only fatty acid methyl ester where as ethanolic extract contained only triterpene saponin ((Reddy *et al.*, 1967).

The petroleum ether extract of leaves contained fatty acid methyl ester where the ethanolic extract had triterpene saponins, a phenolic glycoside and a flavonol glycoside

called 4'-0-methyl rutin (Deshpande *et al.,* 1977). Further hydrolysis of triterpene saponin gave oleanolic acid, echinocystic acid, glucose, arabinose and rhamnose.He also isolated β-sitosterol from the benzene extract ((Deshpande *et al.,* 1977). Further from the ethylacetate and acetone extracts different compounds like melanoxetin, 3'-0-methyl –melanoxetin, melacacidin, 3'-0-methyl –melacacidin tetra methyl ether, 4'-0-methyl –melacacidin tri methyl ether were isolated and characterized as potential phenolics. Extracts prepared from seeds were found to contain spermine macrocyclic alkaloids, Budmunchiamines D-I based on their interaction with DNA (Pezzuto *et al.,* 1991, 1992). The seed oil contain high content of linoleic acid and palamitic acid and low content of capric, lauric acid and lignoceric acid (Munir *et al.,* 1995). The chromatographic finger print analysis of methanolic leaf extract by HPTLC technique confirmed the presence of macrocyclic alkaloids Budmunchiamines L4 and L5 (Rajkumar *et al.,* 2010).

Anticancer Activity

The methanolic extract of seeds was found to contain macrocycic pithecolobine alkaloids (Mar *et al.,* 1991). Of these Budmunciamines A-C was found to have high cytotoxic potential towards cultured mammalian cell lines like Human Breast Cancer (UISO-BCA-1), Colon Cancer (UCISO-COL-2), Lung Cancer (UISO-LUC-1) and melanoma (UISO-MEL-2) cell lines (Mar *et al.,* 1991). In addition, the isolates inhibited the activity of the enzymes HIV-Reverse transcriptase and Cyclooxygenase. Further Budmunchiamines A-C were evaluated for its potential to inhibit human lymphocyte transformation, platelet aggregation and phorbal ester induced chemiluminiscence with human granulocytes (Mar *et al.,* 1991). Gopinath *et al.,* (2013) reported the anti cancerous activity of *Albizia amara* using Human Breast Cancer cells (MCF-7) by *in vitro* methods. The ethyl acetate leaf extract inhibited cell growth, cell survivability by depleting the protein levels of survivin and ORP 150 which in turn induced apoptosis. It also regulated the genes of BCl-2, TNF-α and IL-6 suggesting that *Albizia amara* might have reduced chemoresistance, antiangiogenic and anticachectic actions (Gopinath *et al.,* 2013). The extracts showing anticancerous activity contained Budmunchiamines which are macrocyclic spermine alkaloids and belong to the class of pithecolobine alkaloids reported by Wiesner and Coworkers (1952, 1968a, 1968b).

Antimicrobial Activity

The methanolic extract of seeds contained macrocyclic alkaloids which had strong bactericidal activity against *Salmonella typhmurium* TM677 strain (Mar *et al.,* 1991). Phytochemical analysis of the methanolic extract gave macrocyclic spermine alkaloids, echinocystic acid. Baltazy *et al.,* (2010) reported that the methanolic leaf extract has broadest antimicrobial spectrum and among the tested microbes, the most susceptible bacteria were *E.coli* and *Salmonella typhi* while the fungi was *Cryptococcus neoformans*. The extract contained saponins, tannins, alkaloids, terpenoids, glycosides, flavanoids, phenols, cardiacglycosides and quinones. Aqueous leaf extract of *A. amara* was more effective in treatment of diarrhea and other abdominal problems caused by *E.coli* and *S.typhi* (Gasper *et al.,* 2010). Praveen *et al.,* (2011) reported that chloroform leaf extract containing alkaloids and steroids showed a higher antibacterial and antifungal activity. He evaluated the activity against 21 microbes of which *Streptococcus faecalis* (NCIM 5025) and *Fusarium lateratum* was the most susceptible bacteria and fungus respectively (Praveen *et al.,* 2011). The antifungal and antiaflatoxigenic activities of Budmunchiamine-A (BUA) isolated from methanolic leaf extract was assessed by Thippeswamy *et al.,* (2013). *Aspergillus flavus* and its aflatoxin B1 production was completely inhibited *in vitro* by BUA at 1 mg/ml concentration (Thippeswamy *et al.,* 2013).. In addition Thippeswamy *et al,* (2014) reported the inhibitory effect of BUA on growth and fumonosin B1 production of *Fusarium verticillioides*, a phytopathogenic fungi. So, it was emphasized that BUA can be used as antifungal agent against post harvest fungal infestation of food commodities and mycotoxin contamination (Thippeswamy *et al.,* 2014).

Antioxidant Activity

Suresh Kumar *et al.,* (2008) and RajKumar *et al.,* (2012) reported that the methanolic leaf of *A. amara* possess strong anti oxidant and free radical scavenging properties. The preliminary screening of the extract showed the presence of saponins, tannins, alkaloids, flavanoids and phenolic compounds. Mulapalli *et al.,* (2012) reported the antioxidant activity of bark of *Albizia amara*. The ethanolic extract of bark increases the activity of super oxide dismutase and catalase which indicate it as good antioxidant which may be due to the presence of saponins, tannins and glycosides Mulapalli *et al.,* (2012). The free radical scavenging potential and antioxidant properties of methanolic leaf extract was studied by Raj Kumar *et al.,* (2012). The antioxidant activity of the extract were investigated by three different methods-2, 2, Diphenyl -1-Picryl hydrazil(DPPH) radical assay, free radical scavenging assay and reducing power assay. Further, total phenol content of the methanolic extract in terms of Gallic acid equivalent was found to be 243.47 µg. Thus a positive relationship between total phenols and antioxidant activity was found in *A. amara* Raj Kumar *et al.,* (2012). Kandhasamy *et al.,* (2012) reported that the acetone extract and sub-fractions of *A. amara* stem bark for their free radical scavenging potential and antioxidant properties. Of these, the ethyl acetate fraction exhibited higher 2, 2, Diphenyl -1-Picryl hydrazil(DPPH) and ABTS radical scavenging activities than the standard quercitin due to the presence of chemical constituents like Melanoxetin, melacacidin, 3'-0-methyl melanoxetin, 3'-0-methyl melacacidin trimethyl ether..

Larvicidal activity

Murugan *et al.,* (2006) reported the larval toxicity and smoke repellent potential of methanolic leaf extract at different concentrations against the different instar larvae and pupae of Dengue vector i.e *Aedes aegypti*. Further, the smoke repellent potential of the coils made from the leaves was very high and considerably affected the mosquito survival.Murugan *et al.,* (2006) reported that phytochemical analysis of the methanolic extract may contain macrocyclic spermine alkaloids, echinocystic acid.

Anti-inflammatory activity

Khan *et al.,* (2010) evaluated the ethanolic extracts (200mg/Kg) of *A. amara* was able to show significant anti-inflammatory and analgesic activity as compared with standard drug Aspirin 100 mg/kg. The percentage reduction in paw volume observed against Carrageenan induced paw oedema for *Albizia* was 15 %. In hot plate method, the percentage inhibition was 61.91% (Khan *et al.,* 2010).The ethanolic leaf extract showed the presence of oleanolic acids, echinocystic acid, 4`-0-methylrutin.

Antihyperlipedemic activity

Mulapalli *et al.,* (2012) reported the anti hyperlipedemic and antioxidant activity of bark of *A. amara*. The ethanolic bark extract had significant effect against high cholesterol diet induced hyper lipidemia and also decreased the level of serum cholesterol, triglycerides, LDL, VLDL, SGOT, SGPT, alkaline phosphatases and a significant increase in the level of serum HDL. The extract also increases the activity of super oxide dismutase and catalase which indicate it as good antioxidant (Mulapalli *et al.,* 2012). In addition Rohith *et al.,* (2014) also studied the anti hyperlipidemic activity of ethanolic bark extract on Triton X- 100 induced model of hyperlipidemia in rats and found significant decrease of LDL and increase of HDL in the serum. Phytochemical screening of the ethanolic bark extract reported the presence of glycosides, saponins and tannins.

Hepatoprotective Property

Sastry *et al.,* (1966) reported that the petroleum ether extract from Bark gave a fatty acid methyl ester and β-sitosterol where as ethanolic extract gave triterpine saponins, tannins and glycosides. In particular, saponins is known to elicit serum cholesterol lowering activity by causing resin like action, thereby reducing the entero hepatic circulation of bile acids. In the process, the conversion of cholesterol to bile acids is increased in liver resulting in concomitant hypocholesterolemia (Umbare *et al.,* 2009).

Skin Diseases

The seed oil contain high content of linoleic acid and palamitic acid and low content of capric, lauric acid and lignoceric acid (Munir *et al.,* 1995) and is used for the treatment of leprosy and leucoderma. Paste of leaf and root bark of Albizia amara is used to cure both skin diseases and poisonous bites (Ayyanar *et al.,* 2005). The flowers of Albizia amara have been applied to boils, eruptions, swellings and also regarded as an emetic. It is used as a remedy for dandruff (Mar *et al.,* 1991*).*

Other Phytochemical properties

Seeds of *Albizia amara* are regarded as astringent and used in the treatment of piles, diarrhea and gonorrhea. The flowers are used as a remedy for cough, ulcers, dandruff and malaria (Mar *et al.,* 1991). The bark of the tree yield gum which is used for ulcers (Kashyapa & Ramesh 1992) and molluscidal infection (Ayoub & Yankov, 1986).The bark extract may contain chemical constituents like saponins, glycosides, tannins. Aqueous leaf extract of *Albizia amara* was used by traditional healers of Tanzania for treatment of diarrhea, epilepsy, severe backache, loin pain and other abdominal problems (Mbuya *et al.,* 1994). Olapade *et al.,* (1995) published that some of the phytocomponents in the bark elicit a wide range of biological activities like hypoglycemia, hypoazetomia etc. The bark of Albizia amara is used as an astringent in diarrhea and dysentery and internally to check uterine bleeding and the discharge in gonorrhea as well as topically in Ophthalmia and as a wound dressing (Muchuweti *et al.,* 2006). The alkaloid extracts of Albizia amara was also found to exhibit antiarthritic activity (Akilandeswari *et al.,* 2009)

Table 2: Pharmacological Significance of the plant *Albiziaamara*

SNo	*Disease*	*Type of Extract/ Chemical constituent*	*Type of Chemical constituent*	*References*
1	Anticancer	Methanolic seed extract	Macrocyclicspermine alkaloids.	Mar *et al* ., 1991.(11)
		Methanolic seed extract	Macrocyclicspermine alkaloids.	Pezzuto*et al* ., 1991,1992(7,8)
		Ethyl acetate leaf extract	Macrocyclicspermine alkaloids	Gopinath*et al*., 2013(12).
2	Antimicrobial	Methanolic seed extract	Macrocyclicsperminealkaloids,echinocystic acids.	Mar *et al* ., 1991(11).
		Methanolic leaf extract	Saponins,tannins,alkaloids,terpenoids,glycosides,flavanoids,phenols,cardiac glycosides ,quinones.	Baltazy*et al* ., 2010(13)
		Chloroform leaf extract	Alkaloids & steroids.	Praveen *et al* ., 2011(15)
		Methanolic leaf extract	Macrocyclicspermine alkaloids	Thippeswamy*et al* ., 2013,2014 (16,17)
3	Antioxidant	Methanolic leaf extract	Saponins,tannins,alkaloids,terpenoids,glycosides,flavanoids,phenols,cardiac glycosides ,quinones.	Suresh Kumar *et al* ., 2012(18)
		Ethanolic bark extract	Oleanolic acids, Echinocystic acid.	Mullapalli*et al* ., 2012(20)
		Methanolic leaf	Saponins,tannins,alkaloids,terpenoids,glycosides,flavanoi	Raj Kumar *et al* .,

		extract	ds,phenols,cardiac glycosides ,quinones.	2012(19)
		Ethyl acetate bark extract	Melanoxetin,melacacidin,3'-0-methyl melanoxetin, 3'-0-methyl melacacidintrimethyl ether.	Kandhasamy*et al* ., 2012 (21)
4	Larvicidal activity	Methanolic leaf extract	Saponins,tannins,alkaloids,terpenoids,glycosides,flavanoids,phenols, cardiac glycosides ,quinones.	Murugan*et al* ., 2006(22)
5	Antiinflammatory activity	Ethanolic leaf extract	saponins,alkaloids,terpenoids,glycosides,flavanoids,cardiac glycosides ,quinones, 4`-0-methylrutin.	Khan *et al* ., 2010(23)
6	Antihyperlipidemic activity	Ethanolic bark extract	Oleanolic acids, Echinocystic acid.	Mullapalli*et al* ., 2012(20)
		Ethanolic bark extract	Oleanolic acids, Echinocystic acid.	Rohith*et al* ., 2014(24)
7	Hepatoprotective activity	Petroleum ether bark extract	Fatty acid methyl esters, β-sitosterol.	Sastry*et al* ., 1996(3)
		Ethanolic bark extract	Oleanolic acids, Echinocystic acid.	Umbare*et al* ., 2009(25)
8	Leprosy &Leucoderma	Seed extract	Linoleic acid &Palmitic acid.	Munir*et al* ., 1995(9)
9	Poisonous Bites	Leaf &Root bark paste	Glycosides,tannins, Triterpenesaponins.	Ayyanar*et al* ., 2005(26)
10	Astringent	Bark extract	Triterpenesaponins,phenols.	Muchuweti*et al* ., 2006(31)
11	Epilepsy	Aqueous leaf extract	Saponins	Mbuya*et al* ., 1994(29)
12	Molluscidal activity	Gum extract of bark	Saponins,glycosides,tannins.	Ayoub*et al* ., 1986(28)
13	Cosmetic	Flower &Leaf extract	Triterpenesaponins.	Mar *et al* ., 1991 (11)

3. Future Prospective

Globally the research on traditional medicine is gaining momentum. Herbal drugs are rapidly becoming popular in recent years as an alternative and safe therapy. In some cases the crude extract of the medicinal plant may be used while in other the bioactive compounds isolated are used in curing various diseases. The pharmaceutical compounds of seeds and leaves of *Albizia amara* has potential broad spectrum of anticancer activity which can be confirmed with *in vivo* animal models. Another bioactive compound Budmunchiamine A can be used as an alternative to chemical preservatives for the management of pre and post harvest fungal infestations and mycotoxin contamination in food grains. The future perspective demands on the isolation and identification of the active principle and elucidation of the mechanism of action of a drug. Hence research in both mixture of traditional medicine and single active compounds are very important. It may be concluded that *Albizia amara* shall be considered as a promising plant with various therapeutic properties and can be further explored in curing various diseases. This review would explore the immense utility of *Albizia amara* and encourages further research of its potential bioactive compounds for the evolution of preventive health care without any harmful side effects.

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