

Preliminary and Pharmacological Profile of *Melia azedarach* L.: An Overview

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ABSTRACT

The tree *Melia azedarach* (Family: *Meliaceae*) is known locally as bakain or drek (Hindi), Persian lilac or China tree (English), and Fleurs lilas (French). In South America is commonly known as "paraiso" or paradise, and in the US as Indian lilac or white cedar. The whole plant or its specific parts (leaves, stem, and roots) are known to have medicinal properties and have a long history of use by indigenous and tribal people in India. *Melia azedarach* is used as an ayurvedic medicine in India and Unani medicine in Arab countries as an antioxidative, analgesic, anti-inflammatory, insecticidal, rodenticidal, antidiarrhoeal, deobstruent, diuretic, antidiabetic, cathartic, emetic, antirheumatic and antihypertensive. It is highly nutritious having a calorific value at 5100 kcal/kg. Also, it is used to manufacture agricultural implements, furniture, plywood, boxes, poles, tool handles and fuel wood. It is widely planted as a shade tree in coffee and abaca (*Musa textilis*) plantations. It is a well-known ornamental tree. The present review is therefore, an effort to give a detailed survey of the literature on its botanical details, phytochemical reports, pharmacological studies and its therapeutic importance.

INTRODUCTION

The history of herbal medicine is as old as human civilization. Medicinal plants have been utilized as a constant source of medicaments for the variety of diseases. The plants are known to provide a rich source of botanical anthelmintics, antibacterials, and insecticides. (Satyavati *et al* 1976) *Melia* is a small genus of 2 species i.e. *azedarach* and *azadirachta*. *Melia azedarach* Family (Meliaceae) is the best known species. It has derived its name from the classical Greek word *melia* for the manna ash or flowering ash, referring to the similarity of the leaves to that plant and *azedarach* from the name of an ancient poisonous tree, *Azadaracht*, now unknown. It is native to upper Burmah region (Nahak & Sahu *et al.*, 2010). It is an original species of the South of Asia (Iran, India and South of China) that was introduced in the New World, cultivated and naturalized by tropical America, from Mexico to Argentina (Pennington, 1981). It has a wide natural distribution extending from China, India

and Japan to Indonesia, Northern Australia, Africa, North America, Tropical South America, and Southern Europe. (Nikoletta.2010; Chiffelle *et al.*,2009).

Fig 1. shows the whole plant of *Melia azedarach*, whereas Fig 2 portrays its individual parts.



Fig. 1: Whole plant of *Melia azedarach* .

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(A) *Melia azedarach* stem(B) *Melia azedarach* leaves(C) *Melia azedarach* flowers(D) *Melia azedarach* fruits**Fig. 2:** *Melia azedarach* (A) Stem (B) Leaves (C) Flowers (D) Fruits**Common names of *M.azedarach***

Bakain, *Ramyaka*, *Drek*, *Dharek*, *Karmuka*, *Keshamushti*, *Khammaga*, *Ghoranim*, *Kalo neem*, *Bakan Limado*, *Bakai Nimbu*, *Neem*, *Taruka vepa*, *Malaivernba*, *Karin vernbu*, *Serna veppu*, *Arbevuvu*, *Hutchu*, *Bakana Nimb*, (India); *Persian lilac*, *Lilac*, *Chinaberry*, *Paradise tree*, *White cedar*, *Umbrella tree*, *Bead tree*, *Syringa*, *Hoop tree*, *China tree*, *Pride of India* (England), *Lilas des indes*, *Lilas de chine*, *Lilas de perse*, *Paraiso*, *Margoiser*, (France); *Lelaila*, *Aleli*, *Pasilla*, *Violeta*, (Singapore) *Mindi kechil*, *Persischer zedrachbaurn*, (Malayasia) *Chiwesischer holunder*, *Poteronosterbaurn*, *Paradiesbaurn*, *Persischer fleider*, (Germany) *Cinarnorno*, (Brazil); *Ku /ian* (China); *giant paradise* (Argentina), *syringa tree* (South Africa). (Rishi & Singh., 2003; Yogender *et al.*, 2009; Lungu *et al.*, 2011).

Taxonomy (Joy *et al.*, 1998)

Subdivision : *Angiospermae*
Class : *Dicotyledonae*
Subclass : *Polygonae*
Series : *Disciflorae*

Order : *Geraniales*

Family : *Meliaceae*

Genus : *Azedarach*

Species : *Melia*

Botanical description

Melia azedarach is a small to medium deciduous tree attaining a height up to 45 m tall; bole fluted below when old, up to 30-60 (max. 120) cm in diameter, with a spreading crown and sparsely branched limbs. It is grown as an ornamental avenue tree and sometimes as a shade tree in coffee and tea plantation. The tree is hardy and draught resistant (Seth., 2004) and is found grown widely in the sub Himalayan region up to 2000 m above sea level. The plant regenerates freely from seeds during rain under natural condition. It can also be artificially propagated by direct sowing, transplanting seedlings from nursery or by cutting and root suckers. Bark are smooth, greenish-brown when young, turning grey and fissured with age. Leaves are alternate, 20-40 cm long, bipinnate or occasionally tripinnate. Leaflets 3-11, serrate, dark green on the upper surface and paler underneath. They produce a

pungent odour when crushed. Inflorescence a long, axillary panicle up to 20 cm long. Flowers are purple and fragrant, numerous on slender stalks, white to lilac; sepals 5-lobed, 1 cm long; pentamerous, each petal 5-lobed. 9 cm long petals 5-lobed, 0.9 cm long, pubescent; staminal tube deep purple blue brown. 0.6 cm long. Fruit or berries are small, yellow drupe, nearly round, about 15 mm in diameter, smooth and hard as a stone, containing 4 to 5 black seeds. Seed are oblongoid, 3.5 mm x 1.6 mm, smooth, brown and surrounded by pulp. (Sultana *et al.*, 2011; Al-Rubae *et al.*, 2009)

Microscopical Characteristics

Mature bark shows outer zone of rhytidoma, formed of alternating strips of dark brown cork cells and dead secondary phloem; cork cells compressed, almost rectangular and many layered; secondary phloem multilayered and compressed; cork cambium and secondary cortex almost absent; beneath rhytidoma a wide zone of secondary phloem present, with sieve tubes and compound sieve plates, and with groups of fibres; phloem parenchyma oval to irregular, thin-walled, colorless with intercellular spaces; phloem rays 2 to 5 cells wide; rosette and prismatic crystals of calcium oxalate present in phloem parenchyma and ray cells; a few very small, simple, round to oval, starch grains measuring 5 to 11 μ in diameter, having 2 or 3 components. Table 1 depicts the various physical constant values of *Melia azedarach*.

Table 1: Physical constant values of *Melia azedarach*.

Physical constants	Values
Foreign matter	Not more than 1 %
Total Ash	Not more than 11 %
Acid-insoluble ash	Not more than 1 %
Alcohol-soluble extractive	Not less than 6 %
Water-soluble extractive	Not less than 7 %

Traditional Uses

Melia azedarach is a well known ethnomedicinal tree used in Ayurveda. Its use in the traditional folk medicine is also well documented. Table 2 portrays the use of different parts of *M. azedarach* in traditional system of medicine.

Phytochemistry

Preliminary phytochemical screening of *Melia azedarach*, showed the presence of number of organic molecules i.e. terpenoids, flavonoids, steroids, acids, anthraquinones, alkaloids, saponins, tannins. (Rishi *et al.*, 2003, Bahuguna *et al.*, 2009, Suresh *et al.*, 2008). Roots of the plant showed the presence of terpenoids and limonoids like 6-Acetoxy-7 α -hydroxy-3-oxo-14 β , 15 β -epoxymeliac-1,5-diene, 6-Acetoxy-3 β -hydroxy-7-oxo-14 β , 15 β -epoxymeliac-1,5-diene-3- β -D-glucopyranoside, Azecin-1, Azecin-2, Azecin-3, Azecin-4. Roots also contain flavanoids like Apigenin-5-O- β -D-galactopyranoside; Steroids like 24-Methylenecycloartanol, 24-Methylenecycloartanone, 4-Stigmastan-3-one, 4-Campestene-3-one β -Sitosterol, β -Sitosterol-B-D-glucoside; Acids like Trans-cinnamic acid, Vanillic

acid (4-Hydroxy-3-methoxy benzoic acid). Root bark contain terpenoids and limonoids like 12-O-Acetyl azedarachin-A, 12-O-Acetyl azedarachin-B, 1-Acetyl-3-tigloyl-11-methoxy meliacarpinin, 12-O-Acetyl trichilin-B, 2 α -Acetyl-29-deacetyl-29-isobutyryl sendanin, Azedarachin-A, Azedarachin-C, 1-Cinnamoyl-3-acetyl-11-methoxy meliacarpinin, 1-Cinnamoyl-3-hydroxy-11-methoxy meliacarpinin, 1-Deoxy-3-methacrylyl-11-methoxy meliacarpinin, 1-Deacetyl nimbolin-B, 1,12-Diacetyl trichilin-B, 7,12-Diacetyl trichilin-B, 29-Isobutyl sendanin, Meliacarpinin, Nimbolidin-B, Salannal, Salamin, 1-Tigloyl-3-acetyl-11-methoxy meliacarpinin, 1-Tigloyl-3,20-diacetyl-11-methoxymeliacarpinin, 3-Tigloyl-1,20-diacetyl-11-methoxymeliacarpinin, Trichilin-B, Trichilin-D, Trichilin-H. They also contain steroids like 6- β -Hydroxy-4-canpesten-3-one, 6- β -Hydroxy-4-Stigmastan-3-one, Azeclarachol Fruits contain terpenoids and limonoids like 6-Acetoxy-14,15-epoxy-3,11-dihydroxymeliac-1,5-diene-7-one, Amoorastatin, Amorastatone, Azedirachtin-A, 1-Cinnamoyl-3, 11-dihydroxy- meliacarpinin, 1-Cinnamoyl melianolone, 1-Cinnamoyl melianone, Compositin, Compositolide, 1-O-Deacetyl ohchinolide-B, 29-Deacetyl sendanin, 1-Deacetyl nimbolin-A, 3-Deoxymelianone, 21,23:24,25-Diepoxy-tirucall-7-ene-21-ol, 3-Epimelianol, 3-Epimeliantriol, Gedunin, 12- α -Hydroxyamoorastatin, Meliandiol, Melianol, Melianolone, Melianone, Melianonin, Meliantriol, Meliatoxin-A1, Meliatoxin-A2, Meliatoxin-B1, Meliatoxin-B2, Nimbolidin-A, Nimbolin-A, Nimbolin-B, Ohchinal, Ohchinin, Ohchinin acetate, Ohchinolal, Ohchinolide-A, Ohchinolide-B, Sendanal, Sendandal, Sendanin, 3-O-Tigloylochinin, Vilasinin. 21- β -Acetoxymelianone, Methyl kulonate, 3- α -Tigloylmelianol. They also contain acids like Stearic acid (octadecanoic acid), Trans-cinnamic acid. Leaves contain terpenoids and limonoids like 1-Cinnamoyl-3-acetyl-11-hydroxy meliacarpin, 1-Cinnamoyl-3-methacrylyl-11-hydroxy meliacarpin, Deacetyl salannin, 1,3-Dicinnamoyl-11-hydroxy-meliacarpin, α -Pinene, β -Pinene, α -Terpinene, α -Terpineol, Kaempferol-3-O- β -rutinoside, Kaempferol-3-L-rhamno-D-glucoside, Rutin. They also contain acids like Palmitic acid (hexadecanoic acid). Stem bark contain terpenoids and limonoids like 7 α -Acetoxy-14 β ,15 β -epoxygedunanol-ene-3-O- β -D-glucopyranoside, 12-Acetoxyamoorastatin, Amoorastatin, Fraxinellone, 12-Hydroxyamoorastatone, 3-Hydroxy eupha-7,24-diene-21,16-olide, Kulactone, Kulinone, Kulolactone, Methylkulonate, α -Pinene, β -Pinene, α -Terpinene, α -Terpineol. They also contain flavonoids like 4', 5-Dihydroxy flavone-7-O-u-L-rhamnopyranosyl-(1-4)- β -D-glucopyranoside, Anthraquinone like 1,3,5,8-Tetrahydroxy-2-methyl anthraquinone; 8-Me ether, 3-O- α -L-rhamnopyranoside, 1,5-dihydroxy-8-methoxy-2-methyl-anthraquinone-3-O- α -L-rhamnopyranoside, 1,8-dihydroxy-2-methyl anthraquinone-3-O- β -D, galactopyranoside. Stem wood contain terpenoids and limonoids like Melianin-A, Melianin-B Seeds contain terpenoids and limonoids like 3 β , 7 α -Dihydroxy-21,23-epoxy-apotirucalla-14,24-diene-21-one, Meldenin. They also contain steroids like Campesterol, Cholesterol, Stigmasterol and acids like Linoleic acid, Linolenic acid, Oleic acid (9-octadecenoic acid)

Table. 2: Ethnomedicinal uses of different parts of *M. Azedarach*.

Plant parts	Traditional uses
Bark	Antidiarrhoeal, deobstruent, diuretic(Joy <i>et al.</i> ,1998) rheumatic pain, used in fever to relieve thirst, nausea, vomiting and general debility, loss of appetite, stomachache. (Rahmatullah <i>et al.</i> , 2010) Bark decoction is used as a remedy for fever aches and pains,(Kokwaro <i>et al.</i> ,2009, Najma Dharani <i>et al.</i> , 2010) Bark paste is used to treat piles, ¹²²⁾ used as lotion on ulcers, syphilitic (Way &Brandwijk. 1962; Sen <i>et al.</i> , 2010)
Stem	Asthma (Sen <i>et al.</i> , 2010)
Stem bark infusion	Used for gonorrhoea, treat malaria and to expel parasitic worms (Dharani <i>et al.</i> , 2010)
Root	Roots are bitter, astringent, anodyne, depurative, vulnerary, antiseptic, anthelmintic, constipating, expectorant, febrifuge, antiperiodic, and bitter tonic in low doses.(Sen <i>et al.</i> , 2010)
Root Bark	As anthelmintic, used to treat malaria(Dharani <i>et al.</i> , 2010, Handa <i>et al.</i> , 2006)
Leaves	Control many insect, mite and nematode pests, Antidiarrhoeal, deobstruent, diuretic.(Joy <i>et al.</i> , 1998) Used as fodder and are highly nutritious, Skin diseases like scabies, for brushing teeth, loosening or pain of tooth, rheumatic pain, fever, insecticide,(Rahmatullah <i>et al.</i> , 2010) applied externally on burns, used as mouth wash for gingivitis; pyrexia and bloody piles,(Khan <i>et al.</i> , 2011), hysteria(Kaneria <i>et al.</i> , 2009;Husain <i>et al.</i> , 2008) snake bite, (Handa <i>et al.</i> , 2006) diabetes, cure pimples, blood purifier.(Sultana <i>et al.</i> , 2011) Leaves are used in anemia, eczema and measles, jaundice, treat malaria and to expel parasitic worms. Decoction is used as astringent and stomachic (Sen <i>et al.</i> , 2010)
Fruit	Fruits are used for the preparation of tonic which is purgative, emollient. (Sen <i>et al.</i> , 2010) Fruits are sweetish, and though said by some to be poisonous, is eaten by children without inconvenience, and is reputed to be powerfully vermifuge (Cropley. <i>et al.</i> , 2007)
Dried ripe fruit	Used as external parasiticide, pericarp of fruit is very effective phytotherapy for the treatment of diabetes(Sultana <i>et al.</i> , 2011, Ahmad. <i>et al.</i> , 2011)
Flowers	Effective against bacterial skin diseases in children including cellulitis, pustules, and pyogenic infections. (Rahmatullah <i>et al.</i> , 2010, Saleem <i>et al.</i> , 2008) They are used as astringent, refrigerant, anodyne, diuretic, resolvent, deobstruent and alexipharmic (Sen <i>et al.</i> , 2010)
Flower oil	Antidiarrhoeal, deobstruent, diuretic (Joy <i>et al.</i> , 1998)
Seed	They are bitter, expectorant, anthelmintic and aphrodisiac and are useful in helminthiasis, typhoid fever, pain in the pelvic region and scrofula (Sen <i>et al.</i> , 2010)
Seed oil	Used as antiseptic for sores and ulcers. It is also used rheumatism and skin diseases such as ring worm and scabies. Internally the oil is useful in malaria fever and leprosy (Khan <i>et al.</i> , 2011)
Paste of Fresh fruits and leaves	It is given to cattle twice a day for 2-3 days to treat gas trouble and indigestion (Abbasi. 2010)
Whole plant	Used to stimulate hair growth, (Stillé, 1860) treat eruption of scalp

Table. 3: Pharmacological properties.

S.No	Pharmacological properties	Targeted insects/ Organism / Disease	Extracts
1	Antibacterial(Khan <i>et al.</i> , 2011, Kaneria <i>et al.</i> , 2009, Suresh <i>et al.</i> , 2008, Saleem <i>et al.</i> , 2002)	<i>Staphylococcus aureus</i> , <i>Bacillus subtilis</i> , <i>Escherichia coli</i> , <i>Klebsiella pneumoniae</i> , <i>Pseudomonas aeruginosa</i> and <i>Staphylococcus aureus</i> , <i>Proteus mirabilis</i> , <i>Shigella flexneri</i> , <i>Plesimonas shigellidis</i> , <i>Salmonella typhimurium</i> and <i>Enterobacter aerogenes</i>	Fruit, Leaf, Seed
2	Antifungal activity (Javid <i>et al.</i> , 2011, Jabeen <i>et al.</i> , 2011, Carpinella <i>et al.</i> , 2003a, Carpinella <i>et al.</i> , 2003b, Carpinella <i>et al.</i> , 2005)	<i>Macrophomina phaseolina</i> , <i>Ascochyta rabiei</i> , <i>Aspergillus flavus</i> , <i>Fusarium monitiform</i> , <i>Microsporium cans</i> , <i>Diaporthe phseolorum</i> , <i>Schlertina 3sclectiorum</i> , <i>Fusarium verticillioides</i>	Leaf, Seed, Fruit
	Insecticidal activities		
	Anti oviposition, Anti feedant (Chiu <i>et al.</i> , 1984)	<i>Orseolia oryzae</i> , <i>3Mythimna separata</i>	Seed
	Phagoinhobitory, Antimolting (Kelecom <i>et al.</i> , 1996)	<i>Rhodinis prolixus</i>	Seed
	Larvicidal (Gebre <i>et al.</i> , 1999)	<i>Busseola fuscala</i>	Seed, Leaf
	Larvicidal (Bohnenstengl <i>et al.</i> , 1999)	<i>Spodoptera littoralis</i>	Leaf
	Larvicidal, Pubicidal, Anti oviposition, Biting deterrency(Murugesan <i>et al.</i> , 2011, Nathan <i>et al.</i> , 2006)	<i>Anopheles stephensi</i>	Seed
	Larvicidal (Murugesan <i>et al.</i> , 2011)	<i>Culex quinquefasciatus</i>	Seed
	Anti oviposition, Anti hatchability (Gajmer <i>et al.</i> , 2002)	<i>Erias vitella</i>	Seed
3	Antifeedant properties, Anti oviposition, Pubicidal (Banchio <i>et al.</i> , 2003)	<i>Liriomyza huidobrensis</i>	Fruit
	Larvicidal, Inhibition of food consumption (Nathan. 2006)	<i>Cnaphalocrocis medinalis</i>	Seed
	Larvicidal & Anti oviposition (Murugesan <i>et al.</i> , 2011, Courreges <i>et al.</i> , 1994)	<i>Aedes aegypti</i>	Leaf, Fruit
	Biopesticidal (Abou-Fakhr <i>et al.</i> , 2000a, Abou-Fakhr <i>et al.</i> , 2000b, Abou-Fakhr <i>et al.</i> , 2001)	<i>Bamisia tabaci</i> , <i>Panonychus citri</i> , <i>Aleurocanthus spiniferus</i>	Fruit, Leaf, Seed
	Anticholinesterase (Breuer <i>et al.</i> , 2003)	<i>Spodoptera frugiperda</i>	Fruit
	Adulticidal and antifeedant (Chiffelle <i>et al.</i> , 2009)	<i>D. melanogaster</i>	Fruit, Leaf
	Antifeedant (Akhtar, Y <i>et al.</i> , 2008, Charleston <i>et al.</i> , 2005)	<i>Pseudaletia unipunctata</i> , <i>Trachiplusia ni</i> , <i>Spodoptera eridania</i> , <i>Plutella xylostells</i>	Seed, Fruit
4	Anthelminthal (Akhtar <i>et al.</i> , 2004a, Akhtar <i>et al.</i> , 2004b)	<i>Haemonchus contortus</i>	Leaf, Seed
5	Rodenticidal activity (Roop <i>et al.</i> , 2005, Keshri <i>et al.</i> , 2003)	Albino rat	Seed, Leaf

7	Hepatoprotective action (Rajeswary <i>et al.</i> , 2011, Ahmed <i>et al.</i> , 2008)	Carbon tetrachloride (CCl ₄) induced hepatic damage, Paracetamol Induced Hepatic damage	Leaf
8	Anti-Inflammatory activity (Vishnukanta. 2010)	Carageenan induced paw edema	Root
9	Anticomplementary activity (Benencia <i>et al.</i> , 1994)	Serum haemolytic activity on both classical and alternate Complement pathways in albino rat	Fruit
10	Analgesic activity (Vishnukanta. 2010)	Writhing induced by acetic acid	Root
11	Antilithiatic (Tina <i>et al.</i> , 2006)	Ethylene glycol-Induced Nephrolthiasis	Leaf, Seed
12	Antiulcer activity (Bahuguna <i>et al.</i> , 2009)	Aspirin induced ulcers in Albino rats	Leaf
13	Nitric oxide (Byeong <i>et al.</i> , 2000)	Lipopolysaccharide/interferon-gamma-stimulated RAW 264.7	Cortex
14	Antioxidant activity (Nahak <i>et al.</i> , 2010)	2, 2- diphenyl-2-picrylhydrazyl (DPPH) free radical	Root, Bark
15	Immunomodulatory activity (Courrèges <i>et al.</i> , 1998, Benencia <i>et al.</i> , 1997)	Proliferation of spleen and lymph node T cells was impaired when these cells were incubated in the presence of the extract using different mitogens as stimuli	Leaf
16	Cytotoxic and antiproliferative activity (Ntalli. 2010)	Human lung adenocarcinoma epithelial cell line A549	Fruit
17	Phytotoxic (Lungu <i>et al.</i> , 2011)	<i>Lactuca sativa L</i>	Leaf, Wood Mix, Fruit

CONCLUSION

Throughout the world there are several medicinal plants with proven beneficial claims towards different pathological conditions. However, the potential of herbal drugs as defined therapeutic agents is undermined by the difficulty in standardization, pharmacodynamics and pharmacokinetics of these multi-component mixtures. This review has covered the morphology, microscopy, ethanopharmacology, phytochemistry and pharmacology of the plant *M.azedarach* so as to make it useful to the health professionals, scientists and scholars working in the field of pharmacology and therapeutics to develop evidence-based alternative medicine to cure different kinds of diseases in man. Hence this article will be useful to those researchers interested in validating the hidden truth which has not been scientifically validated. In recent years, there is considerable interest to investigate pharmacological properties of herbal drugs from different sources. In view of the nature of the plant, a detailed and systematic study is required for identification, cataloguing and documentation of plants, which may provide a meaningful way for the promotion of the traditional knowledge of the herbal medicinal plants. More research work can be done on humans so that a drug with multifarious effects will be available in the future market.

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