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A REVIEW ON *MELIA AZEDARACH* FLOWERS: A HERB WITH POTENTIAL ANTIBACTERIAL AND ANTI-DEPRESSANT ACTIVITY

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ABSTRACT

Medicinal plants have long been used by human beings to treat various body diseases and disorders. The ethnobotanical studies reveal the usage of such plants by local and tribal peoples. *Melia azedarach* L. belonging to family Meliaceae has been used by native and tribal people in various parts of India for a very long time. Traditionally, this plant has been used to treat a number of ailments, such as cough, leprosy, piles, and itching. The pharmacological action of *Melia azedarach* plant sections includes antifungal, antibacterial, antimalarial, hepatoprotective, anti-oxidant, anti-fertility, anthelmintic, antipyretic, antiulcer, and cytotoxic properties. Strong antibacterial and antidepressant properties have been demonstrated by *Melia azedarach* flowers in a number of research investigations. The current review's goal is to draw attention to the *Melia azedarach* flower`s botanical description, traditional use, phytochemistry and pharmacological activity.

KEYWORDS: *Melia azedarach* flowers, Antibacterial, Antidepressant.

INTRODUCTION

Due to the extensive usage of antibiotics, resistant bacteria are becoming a clinical concern due to their emergence and dissemination. Many of the first widely used medications that were identified quickly cause resistance in certain infections.[1] Numerous plants may exhibit robust properties and promising therapeutic potential, allowing for the development of potent medications that could eventually minimize the need of antibiotics and replace their intake. In order to separate species with weak antibiotic activities that have no scientific value from

those with strong activities and good medicinal promise so they can be turned into useful medications, data must be established.[2]

Depression is a mental health condition marked by low mood, decreased interest, impaired cognitive function and vegetative symptoms such hunger loss or disturbed sleep. Globally, depression affects around 350 million people, and the number of those who experience depression increases annually.[3] Postpartum depression is the most prevalent type of depression that affects women more frequently than it does males.[4] The mainstay of treatment for depression is medication. Today, the most widely used kinds of antidepressants are: tri-cyclic antidepressants (TCAs), monoamine oxidase inhibitors (MAOIs), selective serotonin reuptake inhibitors (SSRIs), selective serotonin-norepinephrine reuptake inhibitors (SNRIs), and conventional antidepressants. Furthermore, a number of adverse effects, including headaches, nausea, dizziness, and gastrointestinal distress, are associated with these drugs. These side effects can also result in weight gain, sexual dysfunction, and sleep difficulties.[5][6]

The mahogany family of flowering plants, the order of Sapindales, includes *Melia azedarach* L. Its main applications are in woodworking and as a natural pesticide; its usage in traditional medicine is also well-established. Bitter and toxic are the fruit, root, and seed. All of the parts of *Melia azedarach*, including the bark, stem, root, and root bark, leaves, fruit, flower, including flower oil, seed, and seed oil, are used in traditional medicine and have been demonstrated to have a variety of pharmacological qualities both in vitro and in vivo.[7]

The current review aims to provide a thorough overview of the literature on the developing usage of *Melia azedarach* flowers as a natural-derived substance, drawing on recent studies that highlight the flower's potential as an effective antibacterial and antidepressant agent.

BOTANICAL DESCRIPTION

Melia azedarach tree is a small to medium-sized deciduous tree that may grow up to 45 meters tall. It has a spreading crown, sparsely branching limbs, and a bole that becomes fluted below as it ages, measuring up to 30 to 60 (maximum 120) cm in diameter. In coffee and tea plantations, it is grown as an aesthetic avenue tree and occasionally as a shade tree. In contrast to one another, leaves are tripinnate or biinnate. Lilac blossoms bloom, and ellipsod-globose 4-seeded drupes that turn yellow when ripe are the fruits.[8]

Taxonomic Classification[9]

Kingdom: Plantae

Order: Sapindales

Family: Meliaceae

Genus: Melia

Species: *Melia azedarach*

Binomial name: *Melia azedarach* Linn.

Vernacular names[8]

Sanskrit synonyms: Mahanimba, Himadruma, Paratanimba vraksha.

English: Persian lilac, Pride of China, Pride of India, common bead tree.

Hindi: Bakayan, Bakain, Mahanimb.

Gujarati: Bakan, limbodo.

Kannada: Bevu.

Malayalam: Mullay vaempu.

Panjabi: Drek.

Bengali: Ghora neem.

Tamil: Malai veppam.

Telugu: Taraka vepa.

Habitat

The wild forms of this tree can be found in Persia and the Western Himalayas of India.[10]

TRADITIONAL USES

Root bark is prepared as a decoction and given to kids as an anthelmintic in one-ounce doses every three hours in the morning and evening for a few days in a row, before a cathartic Leaf juice can also be administered internally as an anthelmintic. To ease tense headaches, flowers and leaves are placed as a poultice. A mixture of the 15 leaves used to induce hysterics Leprosy, scrofula, and other skin diseases are treated both topically and internally using leaves and bark, and eruptive skin conditions can benefit from a poultice made from the blossoms that is thought to have vermicide qualities. The root-bark decoction is used in quantities of ½ to 1 ounce as a bitter tonic. The bark is also used to make a syrup that is sweetened with vanilla to mask its disagreeable flavour. Bark, leaves, fruits, and berries—especially fresh ones—are all toxic in high amounts and can cause narcotism and death. Six to eight fresh berries have been known to cause death, although they can also be used to treat scrofula and leporid arthritis. Berries that have been dried and soaked in whisky have been

used to treat ascarides, tapeworms, and other worms. Berries that have been boiled in lard can be used to treat scorch head. The blossoms are used as a treatment to treat scalp eruptions and eradicate lice. Rheumatism makes use of seeds. Use of oil is comparable to neem. One treatment for splenic hypertrophy is gum.[10]

It is believed that pure chemicals, even those derived from plants, lack the inherent qualities of whole plants, which is why whole plants or mixes of them are utilized in Iranian traditional medicine. Flowers are used as a remedy for brain blockages, as a way to normalize temper in the elderly and those with cold dystemperament, and as a way to ease headaches and other head symptoms by inhaling their scent. Leaf is used as an antidote to all types of poisons, a cure for intestinal blockages that last a long time, a treatment for purulent sores, an anthelmintic, a kidney stone remedy, a treatment for vitiligo and leprosy, a diuretic, an emmenagogue, a hair growth inducer, and a lice killer. Fruits are used as a hair growth inducer, vitiligo and leprosy treatment, a medicine for tinea and head wounds, and a dipper for phlegm-producing fevers and coughs.[11]

Table No. 1: Major Phytochemicals present in flowers extracts of *Melia azedarach*.

List of Phytoconstituents	References
2-Pentylfuran, 2-Phenyl ethanol, 1,3-Diphenyl-propan-2-ol, 4-Hydroxybenzoic acid, Tetradecanoic acid, Hexadecanoic acid ME, Branched hexadecanoic acid, 5,15-Dimethyl-nonadecane, Hexadecanoic acid, 2,6,10,14-Tetramethyl-octadecane, 14-Methyl-heptadecanoic acid ME, Heptadecanoic acid Octadec-9Z-en-1-ol, 9Z,12Z,15Z-Octadecadienoic acid ME, Octadecanoic acid, Eicosanol, Tricosane, Eicosanoic acid ME, Docosanol, Eicosanoic acid, Tetracosane, 2-Methyltetracosane, Pentacosane, Branched hexacosane, Hexacosane, Heptacosane, Tetracosanoic acid ME, Branched pentacosanoic acid, Octacosane, Nonacosane, Triacontane, Hentriacontane, Dotriacontane, Tritriacontane	[12]

Table No. 2: Major phytochemicals compounds in essential oil of *Melia azedarach* flowers.

Sr. No.	Compounds	Extraction Method	Identification/Analysis Method	References
1.	n-Nonanal, n-Decanal, Isocaryophyllene, Beta-Caryophyllene, alpha-Acordiene, Cumarene, Bicyclogermacrene, cis-Nerolidol, trans-Nerolidol, Octadecane, Phytone, Ethyl hexadecanoate, n-Eicosane, n-Heneicosane, n-Docosane, n-Tricosane, n-Pentacosane, n-Nonacosane	Steam distillation	GC, GC-MS	[16]
2.	1,8-Cineole, beta-Thujone, Camphor, cis-Caryophyllene, beta-Caryophyllene, Aromadendrene, n-Pentadecane, Bicyclogermacrene, trans-Nerolidol, Viridifloro	-	GC-MS	[18]
3.	Hexnaol, Benzaldehyde, Benzyl alcohol, Phenylacetaldehyde, Chrysanthenone, cis-Chrysanthemyl alcohol, Benzene, 4-Anisaldehyde, Cyclohexene, α-Cubebene, α-Copaene, Cyperene, Caryophyllene, Naphthalene, Germacrene	Solid-phase micro-extraction (SPME)	MS-MS	[20]

Fig. 1: *Melia azedarach* flowers.

PHARMACOLOGICAL/THERAPEUTIC EFFECTS

(1) Antibacterial Activity

Gas chromatography-mass spectrometry and mass spectral library search were used to identify the components of eight distinct extracts and fractions that were produced from *Melia azedarach* flowers and tested for in vitro antibacterial activity. Thirty eight phytochemicals in total, all discovered for the first time from the flowers were identified. Of these, 24 were reported for the first time from any part of the plant, and only fourteen were known from portions of *Melia azedarach* other than flowers. These metabolites were discovered to differ from the components of its essential oil and contained aromatics, branching and n-hydrocarbons, fatty acids, fatty acid methyl esters, and fatty alcohols. From the ethyl acetate extract, one main ingredient, 4-hydroxybenzoic acid, was found and isolated as a pure chemical. The antibacterial potential of extracts, 4-hydroxy benzoic acid, and its derivatives, gallic acid and methyl gallate, was examined. *Staphylococcus saprophyticus* was susceptible to the antibacterial effects of gallic acid and methyl gallate. Additionally, methyl gallate showed some efficacy against *Corynebacterium hofmannii* and *Corynebacterium diphtheriae*. Only the methanol extract showed any action against *Pseudomonas* species among the preparations. Only dermatophytic fungi were inhibited in growth by the extracts.[12]

In a different investigation, several pathogenic bacteria and yeast were exposed to the antibacterial activity of essential oils (EO) isolated from the *Melia azedarach* tree in vitro. Because *Melia azedarach* seed oil has the best diameters of inhibitory halos for the three bacteria tested—30 mm, 25 mm, and 23 mm for *Staphylococcus aureus*, *Enterobacter areogenes*, and *Escherichia coli*, respectively—the results indicate that it is the most active. Additionally, leaves essential oil has an antibacterial effect on the three strains of *Staphylococcus aureus*, *Escherichia coli*, and *Enterobacter areogenes*, with diameters of 21 mm, 15 mm, and 20 mm, respectively. Regarding floral essential oil, the inhibitory halos have widths ranging from 17 to 19 mm. For 100 µl of *Melia azedarach* essential oil, the best percentages of fungal growth inhibition were attained. For *Candida albicans* strains to 100 µl, the highest inhibition was seen at 75%, 70%, and 75% for essential oil of leaves, flowers, and seeds, respectively. For essential oil leaves and seeds, *Saccharomyces* species exhibits a high percentage of 50% inhibition at a dose of 20 µl. More than 70% of *Fusarium oxysporum* and *Candida albicans* development was suppressed by the EO of leaves. For *Candida albicans*

and *Fusarium oxysporum*, the flower's essential oil exhibits growth suppression of 70% and 50%, respectively.[13]

Stapyhlococcus aureus-caused skin infections in rabbits were effectively treated with a methanol extract of *Melia azedarach* flowers. Comparable to neomycin were the observed healing effects.[14]

A methanolic HPLC-standardized extract of *Melia azedarach* flowers found in a herbal cream has been made and proven effective against bacterial skin illnesses in children, including cellulitis, pustules, pyogenic infections, and others. The outcomes were similar to what was observed with neomycin.[15]

The essential oil of *Melia azedarach* was produced in a different investigation by hydro distillation using a clevenger equipment, and gas chromatography (GC) and gas chromatography-mass spectrometry (GC-MS) were examined. Using the agar well diffusion method, the in vitro antimicrobial activity of oil was investigated against a variety of microbial strains, including one Gram-positive strain (*Staphylococcus aureus*) and five Gram-negative strains (*Proteus vulgaris, Pseudomonas aeruginosa, Escherichia coli, Salmonella enterica,* and *Klebsiella pneumoniae*) in addition to two fungi (*Pichia guilliermondii and Candida albicans*). Findings point to *Melia azedarach* flowers' prospective antibacterial qualities.[16]

A study described the use of Methanolic extract of *Melia azedarach* flowers (BFM) as a stabilizing agent in the manufacture of iron oxide nanoparticles (INPs). Using ceftriaxone and amoxicillin as standards, two distinct bacterial strains i.e. *Stapyhlococcus aureus* and *Escherichia coli* were subjected to the antibacterial assay of BFM synthesized INPs and BFM extract alone. The MIC and IC50 values showed notable decrease for BFM-INPs in the results than for extract alone. Therefore, it can be said that the methanolic extract of *Melia azedarach* is an easy, safe, and environmentally acceptable method for creating INPs with improved antibacterial activity against bacteria.[17]

(2) Antioxidant Activity

Using the 2,2-diphenyl-1-picrylhydrazyl (DPPH) radical test, a study was carried out to evaluate the antioxidant activity of the methanol extract of *Melia azedarach* flowers and fruits. The beta-carotene/linoleic acid bleaching test was used to assess the plant's capacity to

prevent lipid peroxidation. The methanol extract of the flowers with the beta-carotene-linoleic acid test system showed the highest activity among the three evaluated procedures.[18]

(3) Anxiolytic and Anti-depressant Activity

To investigate various activities on NMRI mice, methanolic extracts of flowers (BFM), twigs (BTM), and roots (BKB) were used as test medicines. "Elevated plus maze" and "Light and dark activity box" were used to determine the significant anxiolytic action and of the floral and root extracts (BFM and BKB, respectively). BFM observed antidepressant activity in the "forced swim test" (p=0.000). Positive controls included the use of imipramine and diazepam, respectively. In conclusion, studies on floral extract have demonstrated strong antidepressant and anxiolytic effects.[19]

One hundred undergraduate and graduate students willingly participated in a study to investigate the modulatory effects of fresh flowers and essential oil of *Melia azedarac*h Linn on human physiological and psychological behaviours. Salivary amylase activity was lowered after 20 minutes of inhaling fresh flowers. An investigation of electroencephalograms shows that breathing in fresh flowers boosted delta, theta, and gamma brainwaves but decreased alpha brainwaves. Furthermore, after inhaling flowers, there was a drop in heart rate (HR), diastolic blood pressure (DBP), and systolic blood pressure (SBP). Additionally, breathing in floral scents heightened parasympathetic nervous system (PSNS) activity while decreasing sympathetic nervous system (SNS) activity. Furthermore, study employed the solid-phase micro-extraction (SPME) method to extract volatiles from the flowers, and mass spectrometry was utilized to ascertain the chemical makeup. Out of the fifteen chemicals found, the two most prevalent ones were Phenylacetaldehyde (22.26 %) and Benzaldehyde (68.50 %). Similar to this, breathing in 0.25 percent benzaldehyde or phenylacetaldehyde decreased HR, SBP, DBP, and SNS activity while increasing PSNS. Moreover, the inhaling of fresh flowers was found to considerably reduce depression, perplexity, and tension, as supported by the profiles of mood states (POMS) scores. There was also a decrease in vigour, anger, and tiredness. These findings imply that *Melia azedarach* flowers, or their main constituents, may have new use in aromatherapy and as novel modulators of SNS dysfunction.[20]

(4) Toxicity Studies

The flower extract of *Melia azedarach* Linn was evaluated toxicologically by oral and intravenous administration in rats and mice, which are smaller laboratory animals. It was

shown that extracts, both alcoholic and aqueous, were non-toxic when given orally to mice and rats at a level of 1500 mg/kg. Mice and rats received intravenous injections of aqueous extract at LD 50 values of 395, 500 mg/kg for flowers and 700, 925 mg/kg for berries. Additionally, a modest central nervous system sedative effect was noted for both alcoholic and aqueous preparations of *Melia azedarach*.[21]

CONCLUSION

From the above mentioned research findings, we can conclude that the flowers of *Melia azedarach* (mainly Methanolic extract and Essential oil of flowers) has shown promising therapeutic effects in animals as well as clinical trial studies. Further studies are required to study the mechanism of action of active phytopharmaceuticals as well as its isolation in pure form.

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