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Review Article

An Eye-Catching and Comprehensive Review of *Melia azedarach* Linn's (Paradise Tree)

N.S. Disha, E. Karthikeyan

Department of Pharmaceutical Chemistry, Saveetha College of Pharmacy, Saveetha Institute of Medical and Technical Sciences, Saveetha Nagar, Chennai, Tamil Nadu, INDIA.

ABSTRACT

Numerous plants have therapeutic and pharmacological significance in the traditional system of medicine. Plants and their products, which are extremely helpful for a variety of animals and humans, are the primary source of food and medicine. Local names for the tree *Melia azedarach* (family: Meliaceae) include "bakain" or "drek" in Hindi, "Persian lilac" or "China tree" in English, and "Fleurs lilas" in French. It is widely referred to as "paraiso" or paradise in South America and as Indian lilac or white cedar in the US. Indigenous and tribal people in India have traditionally used the entire plant or specific parts of it (the leaves, stem, and roots) for medicinal purposes. *Melia azedarach* is used as an ayurveda and unani medicine in India and Arab nations, respectively, for its anti-inflammatory, analgesic, insecticidal, rodenticidal, anti-diarrheal, deobstruent, diuretic, antidiabetic, cathartic, emetic, antirheumatic, and antihypertensive properties. It is employed in the production of furniture, plywood, boxes, poles, tool handles, and fuel wood. It is frequently grown as a shade tree in abaca (*Musa textilis*) and coffee plantations. The tree is a well-known ornamental. Therefore, the current study aims to provide a thorough overview of the literature on its botanical information, phytochemical reports, pharmacological research, and therapeutic significance.

Keywords: Bakan, Drek, Botanical description, Pharmacological activities, *Melia azedarach*.

Correspondence:
Dr. E. Karthikeyan
Professor, Department of Pharmaceutical Chemistry, Saveetha College of Pharmacy, Saveetha Institute of Medical and Technical Sciences, Saveetha Nagar, Chennai-602105, Tamil Nadu, INDIA.
Email: karthikeyane.scop@saveetha.com; karthikeyanelumalai@hotmail.com

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INTRODUCTION

A long tradition of herbal medicine extends back to the dawn of human civilization. In the past, medicinal plants have been a trustworthy source of cures for a variety of diseases. The plants are well known for providing a rich source of organic pesticides, antibiotics, and anthelmintics.[1] Azadirachta and azedarach species are part of the small genus Melia. The *Melia azedarach* Family (Meliaceae) has the species with the most popularity. Its name, azedarach, comes from the name of an extinct dangerous tree named *Azadaracht* and the Greek word *Melia*, which refers to the plant's leaves, which resemble those of the manna ash or blossoming ash plant. It is local to upper Burma.[2] It is a species that is indigenous to South Asia (Iran, India, and South China), was carried to the new world, farmed there, and then spread spontaneously over tropical America from Mexico to Argentina. Its wide natural distribution ranges from China to India.[3,4]

Common names/vernacular names

The common names of the *Leucas zeylanica* in different languages have been showed in Table 1.

Taxonomical classification of *Melia azedarach*

The Taxonomical classification of *Melia azedarach* has been showed in Table 2.

Distribution

Asia's tropical regions are home to *M. azedarach*. In Pakistan, India, Indonesia, Southeast Asia, and Australia, it is commonly available. In the Philippines, the United States of America, Brazil, Argentina, and many other African and Arab nations, it has attained naturalisation.[11,12]

Botanical description

The *Melia azedarach* is a small to medium-sized deciduous tree that may grow up to 45 m tall. It has a spreading crown and sparsely branching branches, and its bole becomes fluted below as it ages. It is raised in coffee and tea plantations as a decorative avenue tree and occasionally as a shade tree. The tree can be found grown widely in the sub-Himalayan region up to 2000 m above sea level and is tough and draught-resistant (Seth., 2004). Under normal circumstances, the plant regenerates without restriction from

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seeds during rain. It can also be artificially multiplied via cuttings and root suckers, direct sowing, and transplanting seedlings from nurseries when young, the bark is smooth and greenish-brown, but as it ages, it becomes fissured and grey. The leaves are bipinnate or occasionally tripinnate, alternating, and 20-40 cm long. Serrated, 3-11, dark green on the outside and lighter on the inside leaflets. When crushed, they emit a strong aroma. A 20 cm long, long, axillary panicle serves as the inflorescence. Flowers range in colour from white to lilac, are abundant, and are purple and fragrant. Each petal of the pentamerous flowers has five lobes, and the sepals are 1 cm long. The staminal tube has a rich purple, blue-brown colour, and the petals are five-lobed and 0.9 cm long. Length by 0.6 cm. Fruit, sometimes known as berries, is a small, nearly spherical, yellow drupe that is about 15 mm in diameter. It is smooth and stone-hard, and it contains 4 to 5 black seeds. Oblongoid, 3.5 mmx1.6 mm, smooth, brown, and enclosed in pulp are the seeds.[13]

Microscopy

The outer zone of rhytidoma in mature bark is composed of alternating strips of dead secondary phloem and dark brown cork cells; cork cells are compressed, nearly rectangular, and numerous layers thick. Secondary phloem is multilayered and compressed; cork cambium and secondary cortex are almost nonexistent. Below the rhytidoma, a large zone of secondary phloem is present, with sieve tubes, compound sieve plates, and groups of fibres. Phloem parenchyma is oval to irregular, thin-walled, colourless, with intercellular spaces. Phloem rays are 2 to 5 cells wide. Table 3 depicts the various physical constant values of *Melia azedarach*.

Phytochemistry

Numerous chemical compounds, including flavonoids, terpenoids, steroids, acids, and anthraquinones, are present in *M. azedarach*. In the leaf extract of *M. azedarach*, several substances have been identified, including kampherol, quercetin (flavonoids), stigmasterol, campesterol (phytosterols), -sitosterol, pyrhtol (diterpene), 3-Methyldecane, heptadecane (alkane hydrocarbon), hexadecanic acid, pentadecanoic acid (n- Triterpenes 1-Eicosanol, 3,5, 11, and 15-Tetramethyl-2-hexadecen-1-ol Tables 4 and 5.[14-20]

Table 1: Vernacular/Common names of *Melia azedarach*.

Telugu	Kondavepa, Turakvepa
Kannada	Thumbe
Hindi	Bakan
English	Pride of China, Pride of India, China berry.
Bengali	Mahanim, Ghoramin
Sanskrit	Mahanimba
Punjabi	Drek, Chein, Kachen, Bakain
Marathi	Bahuphul
Malayalam	Malaveppu, Valiyaveppu
Tamil	Malaivempu, Malaivembu, Malaiveppam.
Gujarat	Bakam limbodo

Ethanobotany

Exuded gum from the *M. azedarach* trunk is believed to be helpful in spleen enlargement, and wood extract is given to patients with asthma. In paroxysmal fever, bark decoction is used to relieve thirst, nausea, vomiting, general malaise, loss of appetite, and skin conditions. Applying a leaf poultice can treat scalp eruptions and reduce tension headaches. Leaf decoction is astringent and stomachic and is used in the treatment of hysteria, leprosy, and scrofula. Leaf juice functions as an anthelmintic, diuretic, emmenagouge, expectorant, and vermifuge. Astringent, anodyne, refrigerant, emmenagogue, diuretic, resolvent, and deobstruent characteristics are all present in flowers. Fruits are recommended internally for indigestion, colic, and intestinal catarra, as well as being regarded an anthelmintic, diuretic, emollient, and purgative. Seeds are used to treat typhoid fever, helminthiasis, pelvic pain, scrofula, and are also given for rheumatism. They are also thought to be anthelmintic, expectorant, and aphrodisiac. Skin conditions are treated using seed oil. The roots are expectorant, febrifuge, anodyne, astringent, emmenagogue, and constipating. These are helpful for leuoderma, sciatica, lumbago, piles, cough, asthma, ulcers, wounds, diabetes, intermittent fever, and uterine postpartum pain.[31-34]

Pharmacological properties

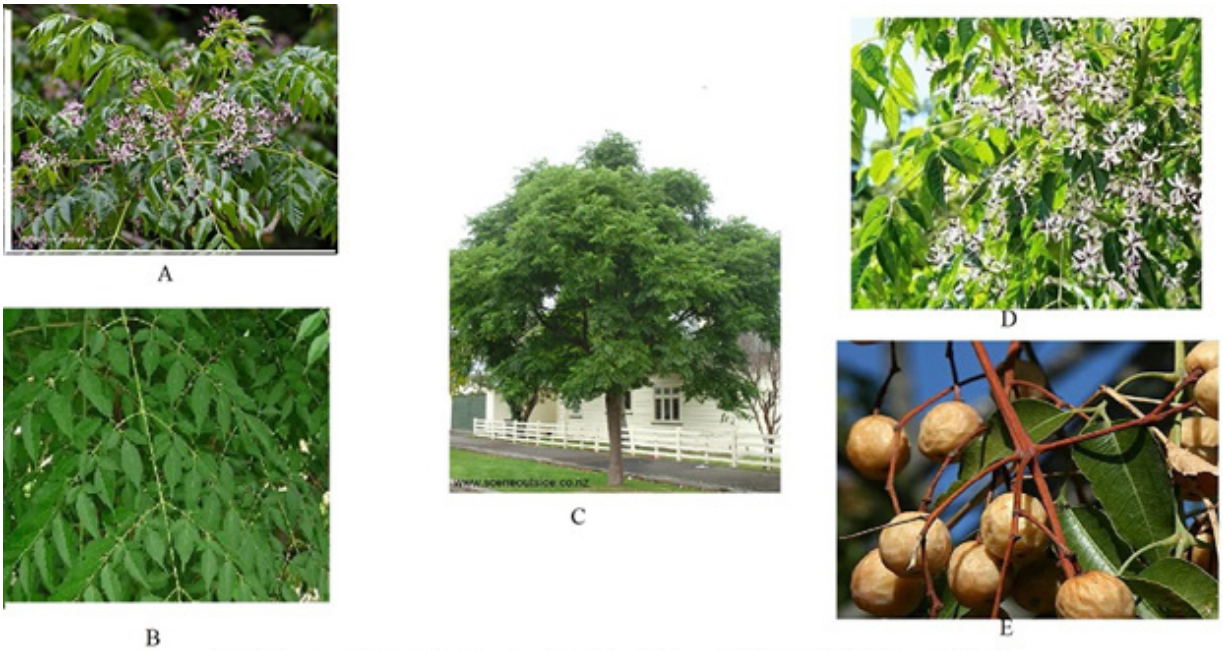
Infectious diseases cause 50% of deaths in tropical nations, according to statistics provided in a report by the World Health Organisation (WHO). Approximately 80% of people in developing nations use traditional medicine, which highlights the importance of looking into these plant species to learn more about their efficacy and safety. Below is a summary of the pharmacological effects of *M. azedarach*.[35]

Hepatoprotective activity

Azad *et al*., (2013) Exhibited the hepatoprotective activity against CCl_4 caused liver injury. Numerous chemicals and medications can harm the liver. Measurements of variables including SGOT, SGPT, ALP, and serum bilirubin were made, along

Table 2: Taxonomical classification of *Melia Azaderach*.[5-10]

Kingdom	Plantae
Subdivision	Angiospermae
Class	Dicotyledonae
Subclass	Polygonae
Order	Geraniales
Family	Meliaceae
Genus	Azedarach
Species	Melia



Pictorial representation of *Melia Azadarach* A) Stem B) Leaves C) Whole Plant D) Flowers E) Fruits

with a histopathological analysis. After treatment, biochemical parameters have improved, and histological alterations including fibrosis and steatosis, which were seen in the CCl_4-intoxicated group, have completely returned to normal levels. To pinpoint the precise phytoconstituents responsible for the hepatoprotective activity, additional research is being conducted.[36]

Male Contraceptive Potentiality

Azam *et al* (2013) found that male rats fed with 50 mg/kg and 150 mg/kg doses of *M. azedarach* seeds had considerably lower rates of sperm motility than the controls. The findings also demonstrated a substantial reduction in fertility rate at doses of 50 and 150 mg/kg (p 0.01) in comparison to the controls, indicating that *M. azedarach* can lower reproductive indices.[10]

Anti-fertility activity in females

Vishnukanta *et al*., (2009) demonstrated the anti-implantation, estrogenic/anti-estrogenic, and progestationalanti-progestational actions of the hydro-alcoholic extract of *M. azedarach* roots. Despite showing a large level of anti-implantation and anti-progestational activity, it was found that the extract did not demonstrate estrogenic or anti-estrogenic action. The extract was thought to have a specific compound that prevents the production, secretion, and effects of ovarian steroids. It also hinders the growth of oocytes and Graafian follicles, which hampers the implantation process. The chemical was assumed to be responsible for these side effects.[8]

Folliculogenesis inhibition

Roop *et al*., (2005) investigated the quantitative features of follicular growth in cyclic female albino rats using fractions of *M. azedarach* seed extract at 24 mg/kg frame weight day-1 for 18 days. When compared to control mice, there were substantially fewer typical single-layered follicles (p 0.05). These extracts considerably reduced (p 0.05) the overall number of regular follicles in *M. azedarach* seed as compared to the animal control group.[37]

Anti-cancer activity

Through testing *M. azedarach's* anti-cancer properties on normal cell lines, Jafari *et al*., (2013) were able to assess how well the compound protected humans from developing cancer. This study evaluated the cytotoxic potential of *M. azedarach's* three main fractions in leaf extracts against the MCF-7, HT-29, A-549, HepG2, and MDBK cell lines. The therapeutic anti-cancer action of *M. azedarach* may be caused by many chemically active components identified in it.[38]

Anti-bacterial activity

Rhaymah *et al*., (2006) employed the diffusion method to show the crude leaf extract of *M. azedarach* has antibacterial activity against Gramme (+) and Gramme (-) bacterial strains. Several solvents, including methanol, ethanol, dichloromethane,

Table 3: Physical constant values of *Melia azedarach*.

Sl. No.	Parameter	Values Obtained (% w/w)
1	Foreign matter	≤1
2	Total ash	≤11
3	Acid soluble ash	≤1
4	Water soluble extractive	Not less than 7

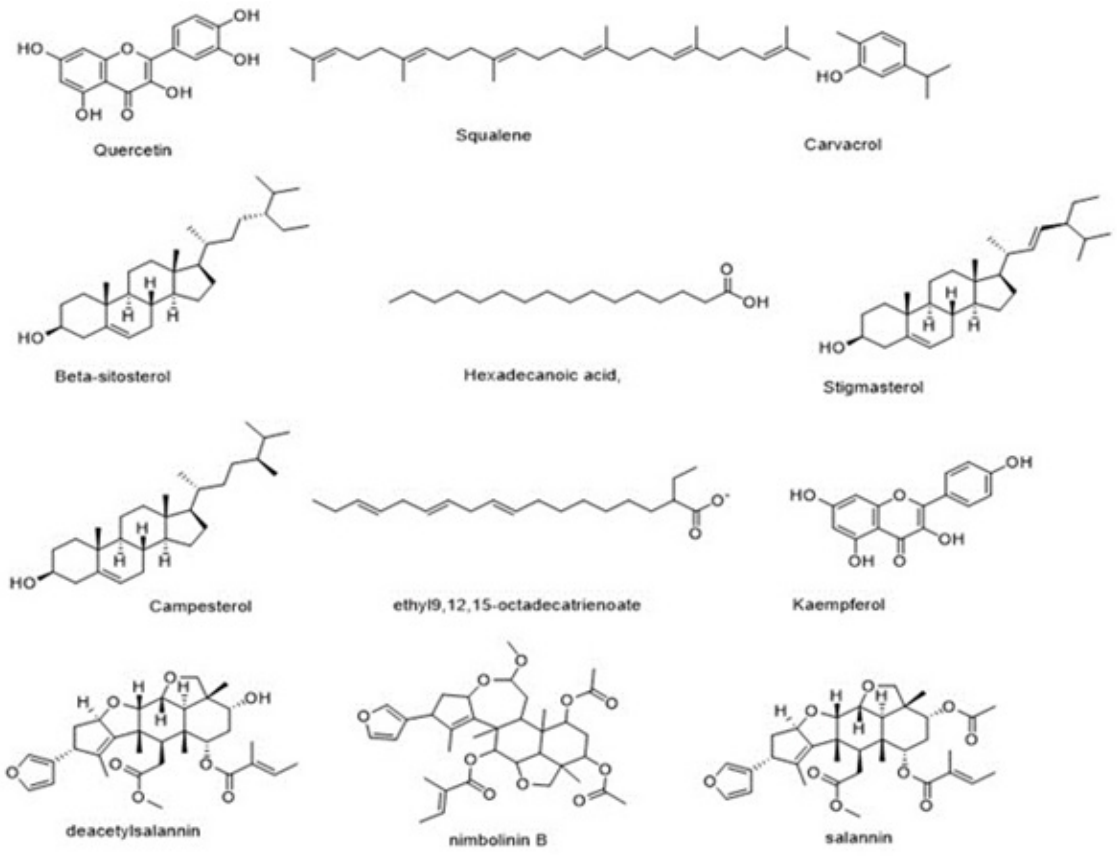


Figure 1: Presence of Chemical Structures in *Melia azedarach*.

ethyl acetate, and water, were used to make the extract. In a microorganism, the ethyl acetate extract and aqueous *Melia azedarach* shown substantial inhibitory activity.[39]

Anti-viral activity

Wachsman *et al*., (1998) showed that the viruses that cause foot and mouth disease might be suppressed by a peptide named "Meliacine" that was produced from *M. azedarach* leaves. The experiment had demonstrated that the isolated compound "Meliacarpin," which is the purified extract of *M. azedarach* leaves, inhibits the multiplication of both vascular stomatitis and herpes simplex virus, according to further investigation by Alche and his colleagues.[40]

Anti-malarial activity

The anti-malarial properties of a methanol extract of *M. azedarach's* fruit, bark, and leaves against the malaria parasite Plasmodium berghei were investigated by Chaturvedi *et al*., (2006) in mouse research. Fruit and bark extracts have been shown to both dramatically lower parasitaemia. The findings demonstrated that *M. azedarach* has potent anti-malarial activity, however it is not as effective as the widely used drug chloroquine.[41]

Anti-nephrolithiasis

In a rat model of ethylene glycol-induced nephrolithiasis, Christina *et al*., (2006) studied the effects of an aqueous extract of *M. azedarach*. Overall results from the experiment confirmed the theory that *M. azedarach* extract decreased oxalate, calcium, and phosphate levels in the urine. As shown by the levels of serum and urine creatinine, *M. azedarach* is therefore effective at inhibiting the development of induced nephrolithiasis.[42]

Anthelmintic activity

Using piperazine as the experiment's reference drug, it was shown that the ethanol extract of *M. azedarach* exhibits anthelmintic effect against the tapeworm Taenia solium and the earthworm Pheretima posthuma. The inquiry led to the discovery that the extract has activity towards both the earthworm and the tapeworm. Additionally, compared to piperazine phosphate, the results showed tapeworm treatment to be more effective.[43]

Anti-complementary activity

Kayastha BP *et al*., (1985) investigated the effects of *M. azedarach* aqueous fruit extracts on a complement of rats. Rat serum

Table 4: Various Isolated Physicochemical compounds and their Characteristics.[21-30]

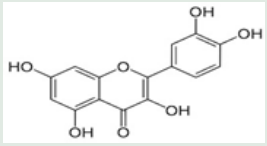
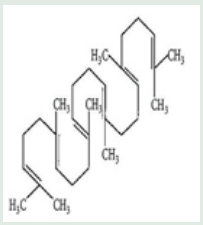
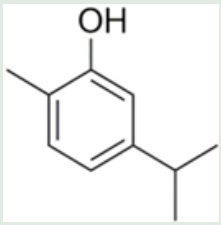
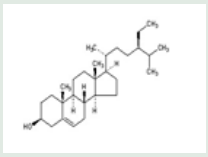
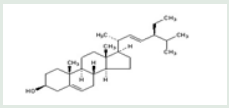
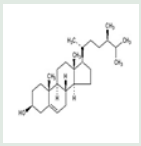
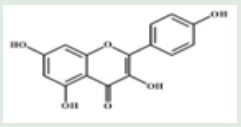
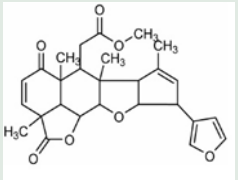
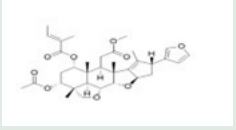
Sl. No.	Compound	MF	MW	Compound nature	References
1	Quercetin		303.23	Flavanoids Polyphenol	[21]
2	Squalene		410.7	Hydrocarbon, Tripentene	[22]
3	Carvacrol		105.21	Monoterpenoids Phenol	[23]
4	β-Sitosterol		414.71	Phytosterol	[24]
5	Hexadecanoic acid		254.41	Paimitic acid	[25]
6	Stigmasterol		412.7	Phytosterol	[26]
7	campesterol		400.68	Phytosterol	[27]
8	Kaempferol		286.23	Phytosterol	[28]
9	Nimbolinin B		640.8	Triterpene	[29]
10	Salannin		596.7	Triterpenoids	[30]

Table 5: Ethnomedicinal uses of different parts of *M. azedarach*.

Plant (Part)	Ethnic use
Bark	Anti-diarrhoeal, Diuretic, Nausea, Vomiting, Loss of appetite and pains.
Stem	Treatment of asthama.
Root	Antiseptic, Cough depressant, reduces fever.
Leaves	Rich in nutritional values, treatment of malaria, Diarrhoea, Skin diseases and blood purifier.
Fruit	Used as Purgative and Sweetening agent.
Flowers	In the treatment of inflammation of skin.
Seeds	In the treatment of typhoid, Aphrodisiac, Helminthiasis.
Whole Plant	Hair growth treatment, (Stillé, 1860) and scalp eruption.

was significantly affected by the extract's anti-complementary activities, although complete inhibition was only attained at higher concentrations of the *M. azedarach* extract.[44]

Anti-ulcer activity

In studies on rats employing the Gipsing-restrain stress ulcer paradigm, Moursi *et al*., (1984) investigated the effects of *M. azedarach* extracts' lipid fraction. The results showed that the phytosterol fraction of *M. azedarach's* lipid component, in particular, was able to dramatically lower the free and total HCl, which was also accompanied with a decrease in overall acidity and a large level of antiulcer activity.[45]

Suppression of inducible Nitric Oxide Synthase (iNOS)

The alkaloids B-carboline, 4, 8-dimethoxy-1-vinyl-B-carboline, and 4-methoxy-1-vinyl-B-carboline block inducible nitric oxide synthase in lipopolysaccharide-ride/interferon-activated RAW 264.7 cells, according to study done by Lee *et al*., (2000). This is achieved by suppressing the expression of the (iNOS) protein, which takes place.[46]

Antioxidant activity

Munir *et al*., (2012) investigated how the antioxidant activity of *M. azedarach* affected the situation. Dried extracts of *M. azedarach* were found to have TPC (Total Phenolic Contents) and TFC (Total Flavonoid Contents) contents that fell between the ranges of 74.43-112.10 mg GAE/g DW and 13.32-28.11 mg CE/g DW, respectively. The dried extracts of *M. azedarach* had a higher level of antioxidant activity than the other plant parts, including the stem bark, which was shown to have a higher level of antioxidant activity than the other plant parts in ambient dried TPC (Total Phenolic Contents) and TFC (Total Flavonoid Contents), according to the findings.[47]

Antipyretic activity

A hydro-methanolic extract of *M. azedarach* leaves showed substantial (p 0.0001) antipyretic effects when given at a dose of 500 mg/kg, according to research done by Sultana *et al*., (2013). In comparison to the common medication paracetamol, the leaf ex-tract showed a significant (p 0.0001) reduction in yeast-induced high body temperature. On the other hand, the 250 mg/kg dose of the leaves extract in resistance to brewer's yeast-induced pyrexia in experimental animals proved to be less effective than a greater dose. The antipyretic activity of *M. azedarach* was attributed to the flavonoids and/or alkaloids present in this extract.[48]

Wound healing activity

With the use of an alloxan-induced diabetic rat model, Vidya *et al*., (2012) investigated the ability of *M. azedarach* leaves to heal wounds. The ability of *M. azedarach* leaf extract applied topically to cure wounds was demonstrated in the alloxan-induced diabetic rat model. This was confirmed by the outcomes. The study's control drug was povidone-iodine, and the trial results showed that administering a topical extract of *M. azedarach* leaf to diabetic rats facilitated wound healing. The anti-bacterial properties of *M. azedarach* leaf extract may be the cause of the diabetic rats' model's faster wound healing.[49]

Anti-feedant activity

El-Lakwah *et al*., (1995) investigated the reduction of Sitophilus oryzae F1 offspring and adult repellency by powdered *Melia azedarach* fruits and extracts in petroleum ether and acetone. The research showed that fatalities related to the powder exposure were initially quite low for the first week of treatment before gradually rising to a moderate percentage.[50]

CONCLUSION

There are many medicinal plants in the globe that have been proven to be successful in treating a range of illnesses. The potential of herbal remedies as defined medical agents is, however, undermined by the difficulties associated with standardisation, pharmacodynamics, and pharmacokinetics of complicated multi-component mixtures. This review has examined the morphology, microscopy, ethanopharmacology, phytochemistry, and pharmacology of the plant *M. azedarach* in order to be helpful to health practitioners, researchers, and academics working in the disciplines of pharmacology and therapeutics. These factors will aid in the development of evidence-based complementary medicine for the treatment of diverse human ailments. Therefore, this page will be useful for academics trying to verify a myth that hasn't been verified by science. Examining the pharmacological properties of herbal medications produced

from various sources has recently attracted a lot of attention. Plant identification, categorization, and documentation require a careful and methodical inquiry due to the nature of the plant. This could be a practical way to advance our understanding of natural medicines. To create a drug with a range of effects for the market in the future, more human research can be conducted.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

ABBREVIATIONS

WHO: World health organization; **SGPT:** Serum glutamic-pyruvic transaminase; **SGOT:** Serum glutamic-oxaloacetic transaminase; **ALP:** Alkaline Phosphatase; **TPC:** Total Phenolic content; **TFC:** Total Flavonoid content.

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