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Mesua Ferrea: An Ethnobotanically Important Plant

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ABSTRACT

Mesua ferrae Linn. (Fam. Clusiaceae) is an ornamental plant which possessing high medicinal value in Indian system of medicines. it is commonly known as Nagkesara in Hindi Ceylon iron wood in English. *Mesua ferrea* is a large tree with hard wood also known as shade provider and radiation modifier. It is native to tropical Sri Lanka and Tripura but slowly disappearing from India. Traditionally, flowers and aromatic leaves of paint are known for their antiseptic, anti-inflammatory, blood purifier, anthelmintic, cardiotonic, diuretic, expectorant, antipyretic, purgative, antiasthmatic, antiallergic, antispasmodic, antineoplastic, hepatoprotective properties. The plant is a powerful antidote for snake bite. Bioguided screening of plant shows the presence flavonoids along with other compounds such as coumarins, triterpenoids, xanthines biologically active constituents. *M. ferrea* is an ingredient of various ayurvedic and unani formulations.

Keywords: *Messua ferrea,* Nagkesara, cardiotonic. antispasmodic, antineoplastic

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INTRODUCTION

Mesua ferrae Linn. Fam. Clusiaceae) is a beautiful Indian evergreen tree planted for its fragrant white flowers. Tree is commonly known as Nagkesara (Hindi and Gujrati) Ceylon iron wood (English), Nãgapuṣhpa (Sanskrit); Nagesvara (Bengali), and Nageswar (Punj), Naugu (Tam). The plant is widely distributed in tropical countries like India, Burma, Thailand, Indochina and New Guinea. Nagakesara is a medium to large sized tree that can attain a height between 18 and 30 m, with reddish-brown to grey coloured bark that peels off in thin flakes, the wood is extremely hard. Along with its ornamental usage, whole plant possess multiple medicinal value in traditional system of medicines. Drug consists of dried stamens and leaves of *Mesua ferrea* Linn. Var. *ferrea.*[1,2,3] The plant especially flowers and leaves are a rich source of volatile oil and other phytoconstituents.

Distribution

The plant is widely distributed in tropical countries like India, Burma, Thailand, Indochina and New Guinea.[4] In India, it is distributed in Eastern Himalayas and East Bengal, Assam, Burma, north Kangaroo, Andhra Pradesh, Andaman and Nicobar Islands, forests of South Konkan, Western Ghats from South Canara to Travancore.[1, 3]

General description

Nagakesara is a medium to large evergreen tree at an altitude of 1.5 m. Stem bark is reddish-brown to grey that peels off in thin flakes, the wood is extremely hard. The leaves are elliptical, lanceolate, coriaceous, covered with a waxy bloom underneath, opposite and simple with an entire margin. Flowers are cream, 2.5-7.5 cm in diameter, bracteates, axillary or terminal with short pedicel, solitary or in cluster and, bisexual and buds are sub-globose. The fruits are oval nearly woody with a prominent beak with persistence calyx. Pericarp is hard, warty. Seeds are angular with smooth surface, 1-4 in number, dark brown, up to 2.5 cm diameter, cotyledons are fleshy and oil. Stamens are copper or golden brown, 0.9-1.9 cm long, soft, brittle and consist of anther filament and connective which is invisible with naked eyes.[4] The plant is also known for its strong shade bearing importance, which makes it a valuable element of the middle storey in forest.

Ethnomedicinal/traditional uses

The plant possess its market value due to commercial production of seeds oil, known as *Kesar oil* used for cutaneous infection, sores, scabies, wounds and rheumatism. In north Canada, oil of the seeds is used as an embrocation in rheumatism and found useful in the treatment of itch.[4] The plant is antispasmodic, diuretic, [5,6] abortifacient[7], anti-inflammatory, astringent[8] and used in fever,

dyspepsia, renal disorders, asthma, snake bite[9] and cosmetics[10]. The decoction of bark and roots is useful in gastritis, bronchitis

In India, tribal's of Assam use the plant for its antiseptic, purgative, blood purifier, worm control, tonic properties[11]. In Thai traditional medicine, it is used as carminative, antiasthmatic, expectorant, cardiotonic, diuretic and antipyretic agent. The ashes of leaves are used for sore eyes. Seed kernels are used as poultice for wounds and skin eruptions. A paste of the flowers with butter and sugar is used in bleeding piles and burning of the feet.

Herbal formulations

M. ferrea is an ingredient of various ayurvedic formulations like dasamoolarishta, mahakaleshwara rasa, Nagakeshara-adi-churna (dysentry), Vyaghrihareetaki avaleha (shwasa), Eladi churna (stomach disorder), Kanakasava (respiratory disease).[2]

In Unani system, the drug is one of the ingredient of "Jawarish Shehryaran" a stomach and liver tonic, "Hab Pachaluna", an appetiser, "Halwa-i-supari pack" a general tonic

Reported phytoconstituents of *Messua ferrea* Linn.

The constituents of oil depend on the plant part e.g., oil extracted from bark contain predominantly (E)-α-bisabolene (31.3%) and α-selinene (12.2%), oils of tender and mature leaves contain α-copaene (19.3% and 9.9%) and β-caryophyllene (18.8% and 26.0%) whereas oil from bud and flower α-copaene (28.7% and 20.2%) and germacrene D (19.0% and 16.1%). Seed and kernel oil contained octadecatrienoic acid and octadecanoic acid (18:1) and hexadecanoic acid (26.8%).[13] Coumarin named as mesuarin (I) was also isolated from the seed oil of *M. ferrea.*[14]

A yellow crystal compound, Mesuol, obtained from *M. ferrea* oil.[15,16] A 4-phenylcoumarin, Mesuagin, was isolated from the seed oil of *Mesua ferrea* with structural formula, 5-hydroxy-6-isobutyryl-8,8-dimethyl-4-phenyl-2H,8H-benzo[1,2- b:3,4-b']dipyran-2-one.[17] Phenolic components of the seed oil are mammeigin (I) and mesuol (II).

From the stem bark of *Mesua ferrea* betulinic acid, (-)-epicatechin, 1,6-dihydroxyxanthone, pyranojacareubin and two bis-xanthones namely, (E)- 2ξ-methyl-2 ξ-{2-(2,7,9-trihydroxyxanthon-8-yl)ethen}-dioxan-({5,6c:2,3e-}-7-hydroxy-4,9-dimethoxyxanthone), (I, mesuabixanthone-A) and its monomethyl ether (E)-2 ξ-methyl-2 ξ -{2-(7,9-dihydroxy-2-methoxyxanthon-8-yl)ethen}-dioxan-({5,6c:2,3e}-7-hydroxy-4,9 dimethoxy xanthone) (II, mesuabixanthone- B),[18] mesuferrol A and a flavonoid (-)- epicatechin}. The heartwood of *M. ferrea* contains 1, 5- dihydroxyxanthone, euxanthone 7-Me ether and β- sitosterol, ferruol A (C23H30O5), a 4-alkylcoumarin was isolated from the trunk bark of *M. ferrea* L. Flavones glycoside identified as 5'-C-Me eriodictyol 3'-O-β-D-

galactopyranosyl(1→4)-α-L-rhamnopyranose were isolated from the leaves of *M. ferrea*. Mesuien is the first flavanone glycoside having a C-Me substituent in the B-ring.[19]

Hexane extracts of *M. ferrea* stamens possess β-amyrin, β-sitosterol, and mesuaferrol (I), cyclohexadione.[20] hexane and benzene fractions of flowers and stamens contain triterpenoids and resins, while the alcoholic and water extracts possess reducing sugars, tannins and saponins, respectively.[21] From the acetone extract of *Mesua ferrea* stamens, a carboxylic acid (I) namely mesuanic acid was isolated. The amino acids present in fruit are cystine, arginine, serine, citrulline, hydroxyproline, proline, alanine, methionine, phenylalanine, isoleucine, leucine. Total protein content of fruit is 23%. The fatty acid obtained from *Mesua ferrea* L (malabar) is myristic acid (1.8%), palmitic acid (6.3%), stearic acid (10.7%), oleic acid (49.2%), linoleic acid (7.3%) and unsaponifiable (24.7%) whereas *Mesua ferrea* (Bengal) contain myristic (1.4%), palmitic (7.5%), stearic (9.2%), arachidic (1.7%), oleic (58.7%), linoleic (9.9%) and unsaponifiable (11.6%).

Reported pharmacological activities of *Mesua ferrea* Linn.

a) **Immunomodulatory activity**

Mesuol isolated from *M. ferrea* seed oil was evaluated for immunomodulatory activity in experimental animals on sensitized + cyclophosphamide (50 mg/kg, i.p, 9th and 16th day) induced SRBC (sheep red blood cells) specific and non-specific immune response models. Constituent showed a significant dose dependent increase in antibody titer and paw volume in humoral and cellular immune response models, respectively. Hematological profile and neutrophil adhesion in rats and phagocytosis in carbon clearance assay also improved demonstrating immunomodulatory activity of mesuol.[22]

b) **Analgesic activity**

Three extracts of *M. ferrea* leaves, *n*-Hexane, ethyl acetate and methanol extracts (125 and 250 mg/kg) exhibited analgesic activity in acetic acid induced writhing in mice.The mesuol exhibited significant inhibition of acetic acid induced writhing in mice in hot plate as well as tail immersion models. The mesuol was also found to reduce the carrageenan induced paw edema in rats.[23]

c) **Antispasmodic activity**

In *in vitro* studies, petroleum ether extract of *M. ferrea* seed oil inhibited acetycholine and carbachol induced contractions in rat ileum. The effect was found to be more significant compared to that obtained with atropine.[24]

d) **Hepatoprotective activity**

In a study, methanolic extract of dried flowers of *M. ferrea* (100 and 200 mg/kg) showed significant increase in liver SOD and AST, and reduction in catalase, GPX, GR, and ALT activity without any effect on CPK and creatinine levels in hepatotoxicity induced in *S. aureus* infected animals.[25]

e) **Antioxidant activity**

In *in vitro* and *in vivo* experiments, *M. ferrea* expressed antioxidant activity mediated by inhibition of nitric oxide (NO)[26] and lipid peroxidation. In other *in vitro* antioxidant studies, ethanolic extracts of stem bark of *Mesua ferrea* Linn. showed significant radical scavenging activity against DPPH (89.70%), ABTS (77.64%) and nitric oxide 89.28%.[27]

f) **Anti-venom activity**

The aqueous extract of *M. ferrea* leaves investigated for their anti-venom activity against *Heterometrus laoticus* scorpion venom induced fibroblast cell lysis offered protection against venom induced lysis in cells pre-incubated with *H. laoticus* venom confirming its use against snake bite.[28]

g) **Anti-ulcer activity**

Xanthones pre-treated animals exhibited anti-ulcer activity in pyloric ligated in albino rats only.[29] Petroleum ether, ethyl acetate and alcohol extract of *M. ferrea* showed a potent protective effects against formaldehyde and Complete Freund's Adjuvant (CFA)-induced arthritis model of rats. All haematological changes WBC, RBC and haemoglobin count improved in treated rats compared to control (increase in the WBC count, a decreased RBC count, a decreased haemoglobin).

h) **Antibacterial efficacy**

Leaf and fruit extracts of *Mesua ferrea* displayed good antibacterial activity against *S. aureus* with a inhibition concentration of 0.048 mg/ml offering bacteriostatic effects at concentration of 0.39 mg/ml.[30] The *M. ferrea* seeds methanolic extract was found to be effective at the concentration of 125 µg/disc for *C. albicans*, and *Trichosporon beigelli* (125, 250 and 500 µg/disc) against moulds *A. candidus* (500 µg/disc), *A. flavus* (125 and 250 µg/disc), *A. niger* (125 and 250) and *Mucorheimalis* (250 and 500 µg/disc).

Whole flower extract was found to be bactericidal against *S. Typhimurium* NCTC 74. The extract also reduced viable count of the strain in liver, spleen and heart blood of challenged mice.[31] Mesuol, mesuone, two constituents of *M. ferrea*, and oils of kernel and seed when tested against some strains of fungi *A. niger, C. lunata, A. solani, H. sativum* and bacteria such as *S. aureus, E. coli, E. typhosa, V. chloreae, M. phlei, B. friedlanderi* was found to devoid of anti fungal activity.

i) **Wound healing activity**

Topical application of ethanolic extract of dried flowers of *Mesua ferrea* (5% and 10% w/w) ointment of bark extract in simple ointment base) showed significant wound healing activity compared with the control group in excision and incision model in albino rats.[32]

j) **Anti-inflammatory activity**

The ethanolic extract of flower of *Mesua ferrea* Linn at 400mg/kg b.w. showed the maximum anti-inflammatory action in comparison to standard anti-inflammatory agents in carrageenan induced rat paw edema model of rat.[33] The methanol extract of the of stem bark of *Mesua ferrea* L exhibited significant anti-inflammatory activity for HRBCs membrane stabilization (78.20%), heat induced hemolysis (47.40%), albumin denaturation (70.58%) and proteinase inhibitory activity (50.73%).

k) **Anti-cancer activity**

The crude ethanolic extract of *M. ferrea* showed potent antiproliferative activity against human cholangio carcinoma (CL-6), human laryngeal (Hep-2), and human hepatocarcinoma (HepG2) cell lines in *in vitro* studies. In other studies also, potent cytotoxic activity against Hep-2 and HepG2 were observed.[34,35] In another study, crude extract of *M. ferrea* L. showed strong cytotoxic activity toward leukemia cells and weak antimicrobial activity against bacteria, namely *Staphylococcus aureus*, *Bacillus subtilis* and *Pseudomonas aeruginosa*.

a) **Anti-convulsant activity**

Ethanolic extract of *M. ferrea* flowers significantly inhibited MES-induced convulsions in maximum electroshock seizure (MES) of albino mice. Increase in the onset time and decrease in duration of electroconvulsive shock seizures were observed.[36]

b) **Anti-histaminic activity**

A phenol containing fraction of *Mesua ferrea* seed oil was reported to lack bronchodilatory activity but potentiated isoprenaline-induced relaxation of guinea-pig tracheal smooth muscle both *in vitro* and *in vivo*. The phenolic fraction also inhibited the release of histamine in passive peritoneal anaphylaxis and chopped lung anaphylaxis.[37]

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