WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

REVIEW ON PHYTOCONSTITUENTS & THERAPEUTIC ROLE OF LAWSONIA INERMIS PLANT

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ABSTRACT :

Lawsonia inermis (Family: Lythraceae) is rich in various compounds, including carbohydrates, polyphenols, flavonoids, saponins, proteins, alkaloids, terpenoids, quinones, coumarins, xanthones, fats, resins, and tannins. Notably, 2-hydroxy-1,4-naphthoquinone (lawsone) has been identified within the plant. This species is known to contain a wide array of substances such as flavonoids, phenolics, alkaloids, and naphthoquinone derivatives.Lawsonia inermis demonstrates a broad spectrum of pharmacological effects, including antibacterial, antifungal, antiparasitic, molluscicidal, antioxidant, hepatoprotective, neuroprotective, analgesic, anti-inflammatory, antipyretic, wound and burn healing, immunomodulatory, antiurolithiatic, antidiabetic, hypolipidemic, antiulcer, antidiarrheal, diuretic, and anticancer properties. This review will explore the chemical composition and pharmacological effects of Lawsonia inermis.

Keywords: Lawsone, constituents, Lawsonia inermis, pharmacology, and naphthoquinone.

INTRODUCTION :

Lawsonia inermis (family: Lythraceae) contains a variety of compounds, including carbohydrates, polyphenols, antioxidants, saponins, flavonoids, proteins, alkaloids, terpenoids, quinones, coumarins, xanthones, fats, resins, and tannins. Additionally, 2-hydroxy-1,4-naphthoquinone (lawsone) has also been identified. This plant encompasses numerous components previously discovered, such as flavonoids, phenolics, alkaloids, and naphthoquinone derivatives. *Lawsonia inermis* is recognized for its wide range of pharmacological effects, including antibacterial, antifungal, antiparasitic, molluscicidal, antioxidant, hepatoprotective, neuroprotective, analgesic, anti-inflammatory, antipyretic, wound and burn healing, immunomodulatory, antiurolithiatic, antidiabetic, hypolipidemic, antiulcer, antidiarrheal, diuretic, and anticancer properties. This overview will examine the chemical constituents and pharmacological effects of *Lawsonia inermis.*

Figure:1 ***Lawsonia inemis***

LITERATURE REVIEW

Plant Profile

Biological Source: Lawsonia inermis, commonly known as henna, is derived from the dried leaves of the plant, which belongs to the family Lythraceae.

Botanical Classification:
Kingdom: Plantae
Class: Magnoliopsida
Subclass: Asteridae
Order: Myrtales
Family: Lythraceae
Genus: Lawsonia
Species: inermis

Common Names:
Henna tree, inai, hinai, mignonette tree, Egyptian privet, hinna, and pacar kuku.
Binomial Name*: Lawsonia inermis*

Synonyms:
Lawsonia alba Lam.
Lawsonia coccinea Sm.
Lawsonia falcifolia Stokes.
Lawsonia purpurea Lam.
Lawsonia spinosa L.

Vernacular Names:
English: Henna, Samphire, Cypress shrub
Sanskrit: Mendhi, Mendika, Timir
Arabic: Alhenna, Hinna
French: Alcana d'orient
Greek: Kypros
Gujarati: Medi
Hindi: Hena, Mhindi
Marathi: Mendhi, Mendi
Tamil: Alvanam, Aivani
Telugu: Goranta, Kormmi

Geographical Distribution:

Lawsonia inermis is found in Punjab, Haryana, western Rajasthan, Madhya Pradesh, and Gujarat. It thrives in coastal regions of India and Sri Lanka and is currently naturalized along the coasts of Australia, China, and Myanmar. In Kerala, it is prevalent in districts such as Wayanad, Thrissur, Ernakulam, Alappuzha, Kasaragod, Kollam, Palakkad, Kannur, Thiruvananthapuram, Malappuram, and Kozhikode. In Karnataka, it can be found in Chikmagalur, Hassan, Mysore, North Kanara, and South Kanara.

Plant Description:

(A) Bark
The bark contains naphthoquinone, isoplumbagin, triterpenoids such as hennadiol, and aliphatics including 3-methylnonacosan-1-ol.

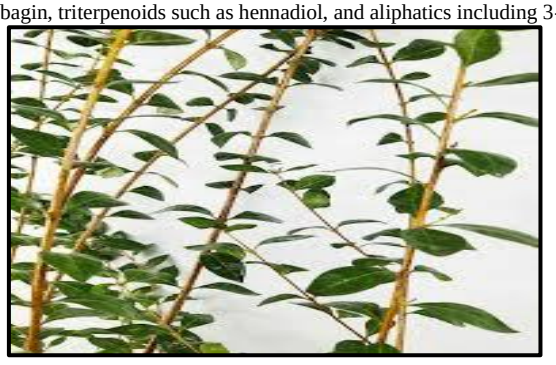


Figure: 2 ***Lawsonia inermis*** **Bark**

(B) Leaves
The leaves of Lawsonia inermis contain 2-hydroxy-1,4-naphthoquinone (lawsone), which is the principal natural dye, present at concentrations of 1.0-1.4%. Other related compounds found in the leaves include 1,4-dihydroxynaphthalene, 1,4-naphthoquinone, 1,2-dihydroxy-glucoyloxynaphthalene, and 2-hydroxy-1,4-diglucosyloxy naphthalene. Additionally, the leaves contain flavonoids such as luteolin, apigenin, and their glycosides; coumarins

including esculetin, fraxetin, and scopletin; and steroids like β-sitosterol. They are also reported to contain soluble matter, tannins, gallic acid, glucose, mannitol, fat, resin, and mucilage.

Figure 3 *Lawsonia inermis* Leaves

(C) Flowers

The flowers of *Lawsonia inermis* are highly fragrant and are used to extract perfume, serving as a base for local scents. An infusion of the flowers is beneficial for treating bruises, while a decoction is noted for its emmenagogue properties. Steam distillation of the flowers yields an essential oil (0.02%) that is rich in ionones, with β-ionones being the predominant component (90%).

Figure: 4 *Lawsonia inermis* Flowers

(D) Fruits

The fruit of Lawsonia inermis is enclosed in a receptacle similar to an egg cup and consists of four nutlets that fit together. The fruit measures approximately 10-20 mm in length and 7-15 mm in width. The calyx remains at the bottom, forming a cup-like structure with a circumference of 7-12 mm. The length of the radicle ranges from 0.5 to 1 mm, while the cotyledons measure about 5 mm long, being both broader and longer.

Figure 5 *Lawsonia inermis* Fruits

(E) Seeds

The seeds of Lawsonia inermis are deodorant in nature. When powdered and mixed with ghee (clarified butter), they are effective in treating dysentery. Additionally, powdered seeds serve as a beneficial remedy for liver disorders and related issues.

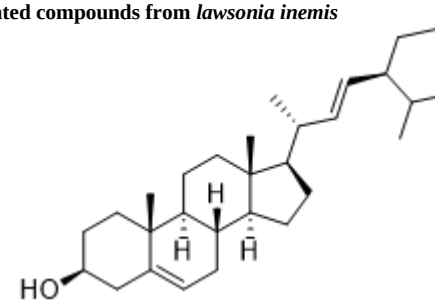
Figure 6 *Lawsonia inermis* Seed

(F) Roots

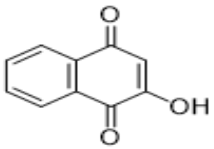
The roots of Lawsonia inermis are regarded as a potent remedy for gonorrhea and herpes infections. They possess astringent properties and can be pulped for use in treating sore eyes. Additionally, the pulped root may be applied to children's heads for boils. In Cambodia, a decoction of the root is consumed as a diuretic. When combined with prepared indigo, the root decoction is known to act as a powerful abortifacient. It is also believed to be beneficial in the treatment of hysteria and nervous disorders.

Figure 7 *Lawsonia inermis* Roots

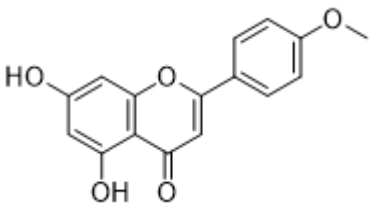
Some stractures of isolated compounds from *lawsonia inemis*



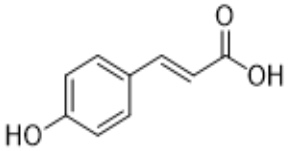
Stigmasterol



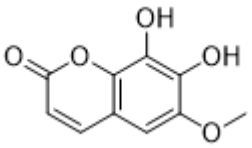
lawsone



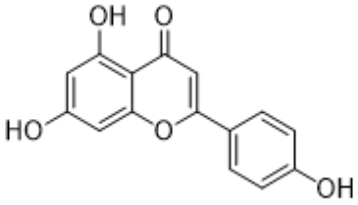
Acacetin



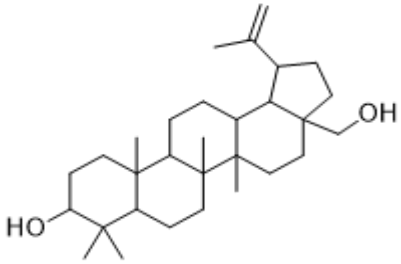
Beta coumaric acid



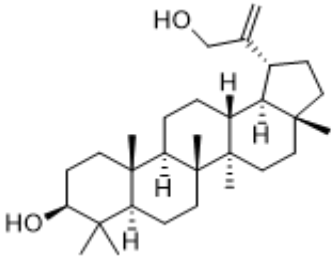
Fraxetin



Apigenin

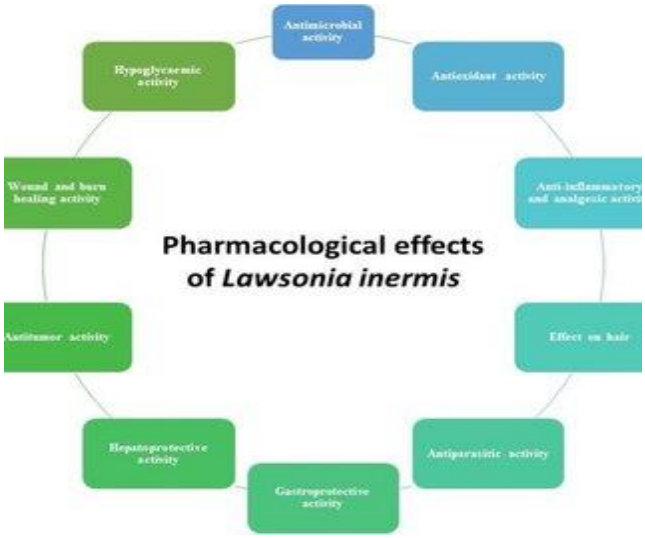


Betilin



Hennadiol

PHARMACOLOGICAL ACTIVITIES



1.Effect of Immune Modulation

The methanol extract of henna leaves at a concentration of 1 mg/ml demonstrated immunostimulant effects, as evidenced by an increase in T-lymphocyte proliferative responses. Using the lymphocyte transformation assay (LTA) to guide the extraction of the total methanolic extract from henna leaves, seven chemical compounds were identified. The naphthoquinone fraction from L. inermis exhibited significant immunomodulatory effects.

2.Anti-inflammatory Activity

Isoplumbagin and lawsaritol, isolated from the stem bark and root of L. inermis, displayed anti-inflammatory activity against carrageenan-induced paw edema in rats. When administered at an oral dose of 100 mg/kg, phenylbutazone, isoplumbagin, and lawsaritol exhibited 61%, 60%, and 40% inhibition, respectively, compared to controls. Isoplumbagin showed significant anti-inflammatory activity comparable to that of phenylbutazone. Butanol and chloroform fractions demonstrated more potent anti-inflammatory, analgesic, and antipyretic effects than the aqueous fraction of the crude ethanol extract of L. inermis in a dose-dependent manner. The leaves also showed notable anti-inflammatory effects due to their active principles.

3.Antifertility Activity

The ethanol extract of powdered seeds from L. inermis did not show any antifertility activity. However, subsequent studies revealed that powdered leaves, when administered as a suspension or incorporated into the diet, inhibited fertility in rats, with the effects appearing to be permanent.

4.AntimicrobialActivity

Leaf samples of Lawsonia inermis collected from the Dammar region in northern Sudan were examined for their antimicrobial potential. Crude extracts in water, methanol, and chloroform were obtained in varying concentrations and bioassayed in vitro against six human pathogenic fungi and four types of bacteria. Despite fluctuations in activity, the water extract was clearly superior. Phytochemical analyses indicated the presence of anthraquinones as the main constituents of the plant leaves, which are known for their antimicrobial properties.

5.AntifungalActivity

Thirty plant species' barks were tested against Microsporum gypseum and Trichophyton mentagrophytes; only the extract from L. inermis exhibited complete toxicity. When tested against 13 ringworm fungal infections, this extract demonstrated a broad spectrum of fungitoxicity. Notably, the extract's fungitoxicity remained stable even after prolonged storage and high-temperature autoclaving. The whole plant's ethanolic extract showed antifungal activity against Aspergillus niger, Trichophyton mentagrophytes, Candida albicans, Microsporum canis, and Cryptococcus neoformans. In comparative in vitro evaluations, the henna solution showed no antifungal activity, while the lawsone aqueous solution exhibited fungistatic properties. Additionally, henna bark decoction inhibited both polygalacturonase and protopectinase activities.

6.AntibacterialActivity

The 50% ethanolic extract of the complete aerial parts of L. inermis did not show reactivity against Salmonella typhi, Agrobacterium tumefaciens, Bacillus subtilis, or Staphylococcus aureus. The antibacterial potential of henna's quinonic compounds was evaluated in vitro. The aqueous extract of L. inermis leaves exhibited effective antibacterial action, and crude leaf extracts in aqueous, methanol, and chloroform demonstrated dose-dependent antimicrobial properties, reducing the growth of four distinct types of bacteria and six human pathogenic fungi.

7.Antiviral Activity

The ethanol-soluble fraction of L. inermis fruits exhibited highly potent activity against the Sembiki Forest virus (SFV) in Swiss mice and chick embryo models, showing 100% to 65% efficacy after 10 to 25 days of viral exposure.

8.Immunomodulatory Activity

Significant immunostimulant effects were observed in mice administered a methanolic extract of henna leaves. The introduction of T-lymphocyte proliferative responses was a clear indicator of the immunostimulant effects of the henna leaves' methanol extract at a dosage of 1 mg/ml. Using the lymphocyte transformation assay (LTA) to guide the separation of the total methanolic extract, seven compounds were identified, with the naphthoquinone fraction from L. inermis demonstrating notable immunomodulatory effects.

9.Wound Healing Activity

Microorganisms responsible for burn wound infections were inhibited by chloroform and aqueous extracts of the plant leaves. In studies evaluating the plant's capacity to treat ulcers using excision, incision, and dead space wound models, rats were administered an ethanol extract of the plant (200 mg/kg/day). The results indicated significant increases in granulation tissue weight, hydroxyproline content, skin breaking strength, and wound contraction rates. Histological analysis revealed that the experimental samples had more fibroblasts and better-organized collagen bands with fewer inflammatory cells compared to controls.

10.Anticoagulant Effect

Lawsone and its oxazine derivatives extracted from L. inermis leaves showed promise as potential anticoagulant agents.

11.Hepatoprotective Activity

The bark of L. inermis demonstrated protective effects against CCl4-induced hepatotoxicity. The extract increased serum bilirubin, liver lipid peroxidation, glutathione peroxidase, glutathione-S-transferase, glycogen levels, and the activities of superoxide dismutase and catalase without affecting total serum protein or liver glutathione levels. The ethanolic extract and its fractions (petroleum ether, ethyl acetate, butanol, and butanone) were investigated for their protective effects against CCl4-induced hepatotoxicity in mice. Compared to controls, the ethanolic extract and its fractions significantly reduced liver weight and the activities of SGOT, SGPT, and SAL, along with total bilirubin levels.

12.Enzyme Inhibitory Activity

The leaves of L. inermis and lawsone, obtained via ethanol extraction, were reviewed for trypsin inhibitory activity, with IC50 values of 64.87 and 48.6 µg/ml, respectively.

13.Memory and Behavioral Effects

L. inermis demonstrated significant effects on behavior and memory, primarily influencing monoamine neurotransmitters.

14.Tuberculostatic Activity

The herb henna (Lawsonia inermis Linn.) was studied both in vitro and in vivo for its tuberculostatic properties. At a concentration of 8 µg/ml, the herb inhibited the growth of M. tuberculosis H37Rv and tubercle bacilli from sputum on Lowenstein Jensen medium. In vivo studies showed that a dose of 5 mg/kg body weight effectively eliminated experimental tuberculosis in mice and guinea pigs infected with M. tuberculosis H37Rv.

15.Antisickling Activity

The aqueous extract of L. inermis leaves was found to inhibit sickling and increase the oxygen affinity of HbSS blood.

DISCUSSION :

The world is rich in medicinal and herbal plants, and the survival and well-being of humanity are closely linked to the plant kingdom and its active constituents. Lawsonia inermis L., commonly known as henna, is not only valued as a coloring agent but also exhibits a wide range of biological activities. A thorough review of the literature highlights L. inermis's reputation as a universal remedy in herbal medicine, showcasing its diverse pharmacological properties. This versatile plant is a unique source of various chemical compounds that contribute to its medicinal effects.While crude extracts from different parts of henna have demonstrated therapeutic applications, there is significant potential for the development of modern pharmaceuticals. This requires in-depth research into its biological activities, mechanisms of action, pharmacotherapeutics, and toxicity, along with proper standardization and clinical trials. As the global trend shifts towards the use of non-toxic plant products with traditional medicinal backgrounds, it is essential to focus on the development of modern drugs derived from L. inermis for the treatment of various diseases.Given henna's potential as a medicinal plant and its rich array of pharmacologically active compounds, extensive research is warranted to uncover its hidden therapeutic potentials. Efforts should be directed toward the practical clinical applications and development of henna and its derivatives for better economic and therapeutic utilization, ultimately benefiting humanity.

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