Review Article

Essential Perspectives of *Lawsonia inermis*

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ABSTRACT

The present attempt is to review and compile updated information on various aspects of *Lawsonia inermis* (Linn), a plant used all over the world. This plant is commonly known as Henna or Mhendi and abundantly available in tropical and subtropical areas. Ancient history of India describes its diverse uses and also plays appreciable role in Ayurvedic or natural herbal medicines. Henna has been used cosmetically and medicinally for over 9,000 years. Traditionally in India, henna is applied to hands and feet. Henna symbolizes fertility. Its use became popular in India because of its cooling effect in the hot Indian summers. Henna leaves, flowers, seeds, stem bark and roots are used in traditional medicine to treat a variety of ailments as rheumatoid arthritis, headache, ulcers, diarrhoea, leprosy, fever, leucorrhoea, diabetes, cardiac disease, hepatoprotective and colouring agent. *Lawsonia inermis* L. is a much branched glabrous shrub or small tree, cultivated for its leaves although stem bark, roots, flowers and seeds have also been used in traditional medicine. The plant is reported to contain carbohydrates, proteins, flavonoids, tannins and phenolic compounds, alkaloids, terpenoids, quinones, Coumarins, xanthones and fatty acids. The plant has been reported to have analgesic, hypoglycemic, hepatoprotective, immunostimulant, anti-inflammatory, antibacterial, antimicrobial, antifungal, antiviral, antiparasitic, antitrypanosomal, antidermatophytic, antioxidant, antifertility, tuberculostatic and anticancer properties. It is now considered as a valuable source of unique natural products for development of medicines against various diseases and also for the development of industrial products. This review gives a bird's eye view mainly on the traditional uses, Phytochemistry and pharmacological actions of the plant.

Keywords: *Lawsonia inermis,* traditional uses, pharmacological activities.

INTRODUCTION

Lawsonia inermis belonging to family Lythraceae is native of North Africa and south-west Asia, widely cultivated as an ornamental and dye plant throughout India , is commonly called as Henna and the synonym is *Lawsonia alba* Linn. In India, it is known by various names in different languages viz., Mehndi in Hindi, Mendika, Rakigarbha in Sanskrit, Mailanchi in Malayalam, Maruthani in Tamil, Benjati in Oriya, Mayilanchi in Kannada, and Mehedi in Bengali . It is a glabrous, much branched shrub or small tree and grows wild. The plant part used are bark, leaves, flowers and seeds. Henna is cultivated in many tropical and warm temperate regions as a hedge plant. The leaves that yield the dye are confined to India, mainly in Punjab and Gujarat and to a small extent in Rajasthan and Madhya Pradesh. It is used in cosmetic preparation in many ways as a colouring and cosmetic ingredient. It has been in use for nearly three millennia as a hair colour, nail colour, and the decoration of the soles of the feet and palm of hands. The drug is widely used in cosmetology for its dyeing properties due to the strong binding of lawsone to hair, probably be attributed due to the reaction of thiol group with keratin. It is also used in the form of shampoo and hair lotion. Henna is used in Ayurvedic preparations for the treatment of skin ailments, burns and wounds. Mahaneela gritha, Madayanti churna and leaf powder are some of the formulations of Henna. A decoction is used as gargle for relaxed sore throat. it has been claimed to have immunomodulatory, antiviral, antibacterial, antifungal, nootropic, antifertility, hepatoprotective, antimitotic, analgesic and anti-inflammatory properties. The main constituents reported are naphthoquinone derivatives, aliphatic components, triterpenes, sterols, phenolic derivatives, coumarins, xanthones, and flavonoids. This hair care plant is reported to possess immunomodulatory, nootropic, antifertility, antimitotic, analgesic and anti-inflammatory, anticarcinogenic and antioxidant properties. Henna is an important source of phytochemicals of immense medicinal and pharmaceutical significance such as naphthoquinone derivatives, aliphatic components, triterpenes, sterols, phenolic derivatives, coumarins, xanthones, flavonoids, gallic acid, hennotannic acid and mannitol

which are effective as immunomodulators and other allied agents. Hence, in view of the immense medicinal significance of the plant, this review is therefore an effort to compile all the information reported on its phytochemical and pharmacological activities, so that interest could be diverted towards this potential dye herb, for the treatment and relief from various ailments and diseases.

SCIENCETIFIC CLASSIFICATION

Kingdom- Plantae
Division- Magnoliophyta
Class- Magnoliopsida
Order- Myrtales
Family- Lythraceae
Genus- Lawsonia
Species- L. inermis

Description

Henna is a tall shrub or small tree, 2.6 m high. It is glabrous, multibranched with spine tipped branchlets. Leaves are opposite, entire, glabrous, sub-sessile, elliptical, and broadly lanceolate (1.5–5.0 cm x 0.5–2 cm), acuminate, having depressed veins on the dorsal surface. Henna flowers have four sepals and a 2 mm calyx tube with 3 mm spread lobes. Petals are obvate, white or red stamens inserted in pairs on the rim of the calyx tube. Ovary is four celled, style up to 5 mm long and erect. Fruits are small, brownish capsules, 4–8 mm in diameter, with 32–49 seeds per fruit, and open irregularly into four splits.

Cultivation

The henna plant is native to tropical and subtropical regions of Africa, southern Asia, and northern Australasia in semi-arid zones. Henna's indigenous zone is the tropical savannah and tropical arid zone, in latitudes between 15° and 25° N and S from Africa to the western Pacific rim, and produces highest dye content in temperatures between 35 °C and 45 °C. During the onset of precipitation intervals, the plant grows rapidly; putting out new shoots, then growth slows. The leaves gradually yellow and fall during prolonged dry or cool intervals. It does not thrive where minimum temperatures are below 11 °C. Temperatures below 5 °C will kill the henna plant.

Traditional uses

Lawsonia inermis (henna) has been used in traditional medicine, wherever it is grown, to treat a vast number of ailments ranging from beriberi to burns and bruise. In Siddha system of medicine. Siddha physicians consider parts of henna to be astringent, detergent, deodorant, cooling and a sedative. Fresh leaves mixed with vinegar or lime juice are bandaged onto the soles of the feet to treat 'burning feet', a symptom of beriberi. Ground leaves are applied to sore joints to ease rheumatism. The juice of the plant can be applied to the skin for headaches, and the oil is applied to hair to prevent it from going grey. Its flower oil relieves muscular pains, while its seeds are used as a deodorant and to regulate menstruation. Henna flowers induce sleep, cure headaches and bruises. Leprosy has been treated by henna bark, as well as by an extract of leaves, flowers and shoots. The bark has also been used to treat symptoms of jaundice and enlargement of the liver and spleen. It can be applied to the skin to treat eczema, scabies, fungal infections and burns.The Ayurvedic system uses the henna leaves to treat vitiligo (pale patches on the skin where pigment is lost), and the seeds are used to cure fever. In folk medicine, henna leaves are used as an ointment, decoction or tea. Henna leaves have been used in India to treat wounds, ulcers, mouth ulcers, bruises, sprains, swelling, burns, stomach pain caused by childbirth, sore throats, gonorrhoea, and obesity, to promote menstruation and to induce abortion. Fruit oil is a folk remedy used in disorders causing hardening of the liver and diaphragm, and an ointment made from young fruit is used to prevent itching. Henna or Mehandi is a medicinal plant. Its bark and seeds are used in Unani and Ayurvedic medicines. Henna is a middle-sized shrub with many branches. It yields small white or pinkish fragrant flowers in large terminal bunches and small round fruits. This fascinating plant known world-wide for the beautiful colouring dye used by the Orientals to colour their hands and body. It Contains 0.55–1.0% lawsone (2-hydroxy-1, 4-naphthoquinone); 1, 4-naphthoquinone; 2-methoxy-3-methyl-1, 4-naphthoquinone; flavonoids, coumarins, and phenolic acids; 5–10% gallic acid and tannin; about 11% sugars, resin, and others. Two xanthones (laxanthone-I and laxanthone-II) and a substituted coumarin named lacoumarin (5-allyloxy-7-hydroxycoumarin) have been isolated from the whole plant and are probably present in the leaves. The aerial parts also contain the triterpenes lawsonin (3-α-*E*-ferulyloxy-urs-11-en-13-β-ol) and lawsonic acid (3-α-*E*-ferulyloxy-lup-20(29)-en-28-oic acid). Lawsone is the major active principle (coloring and pharmacological) in henna. It is not present in the bark, stem, or root of the henna plant. Its concentrations in the leaves vary with climatic conditions, hot localities yield

henna with higher lawsone content than temperate areas. There has been a report indicating lawsone to be a degradation and autoxidation product of primary glycosides called hennosides A, B, and C.

Pharmacological activities

The plant has various pharmacological activities; however few pharmacological studies have been reported.

Antidiabetic activity

Ethanol (70 %) extract of *L. inermis* showed significant hypoglycaemic and hypolipidaemic activities in alloxan induced diabetic mice after oral administration. It's decreased the concentration of glucose, cholesterol and triglycerides to normal. Methanol (95 %) extract of leaves of *L. inermis* showed significant *in-vitro* antihyperglycemic effect.

Immunomodulatory effect

Methanolic extract of Lawsonia inermis leaves at 1 mg/ml concentration had displayed immunostimulant action as indicated by promotion of T-lymphocyte proliferative responses, fractionation of the total methanolic extract of henna leaves. Naphthoquinone fraction obtained from leaves L. inermis showed significant immunomodulatory effect.

Analgesic activity

The ethanolic extract of leaves of Lawsonia showed significant analgesic as well as antipyretic activity. The fixed oil obtained from seeds were screened for pharmacological activity both *in-vitro* and *in-vivo.* It was concluded that seed oil is devoid of behavioral and CNS effects and failed to produce any effect on isolated tissue though it possess significant analgesic activity.

Anti-Inflammatory activity

Isoplumbagin and lawsaritol, isolated from stem bark and root of *L. inermis* L. showed anti- inflammatory activity against Carrageenan induced paw oedema in rats. The compounds phenylbutazone, isoplumbagin and lawsaritol at the oral dose of 100 mg/kg exhibited 61, 60 and 40 percent inhibition in comparison with controls. Isoplumbagin showed significant anti-inflammatory activity similar to that of phenylbutazone. Butanol and chloroform fractions showed more potent anti-inflammatory, analgesic and antipyretic effects than aqueous fraction of crude ethanol extract of *L. inermis* in a dose dependent manner. Leaves showed significant anti-inflammatory effect with some active principles.

Cytotoxic activity

Isoplumbagin exhibited up to a 1000 fold range of differential sensitivity, which represents distinct fingerprint of cellular responsiveness. At concentration of 10.5–10.8 M, the compound typically produced LC50 – level responses against a majority of the melanoma and colon cancer cell lines as well as against several of the non- small cell lungs, colon, CNS, and renal cell lines. Isoplumbagin showed an interesting profile of cytotoxic activity. Chloroform extract of leaves of *L. inermis* displayed the cytotoxic effects against liver (HepG2) and Human breast (MCF-7) with IC50 values of 0.3 and 24.85µg/ml by micro culture tetrazolium salt assay (MTT). [42] CAT assay, a zone of inhibition test of bacterial growth and colony-forming efficiency test of transformant *Escherichia coli* strains that express mammalian catalase gene derived from normal catalase mice (Csa) and catalase-deficient mutant mice (Csb), Ames mutagenicity assay and H2O2 generation assay are carried out.

Antifungal activity

During screening of barks of 30 plant species against *Microsporum gypseum* and *Trichophyton mentagrophytes*, only *L. inermis* L. extract exhibited absolute toxicity. The extract showed broad fungitoxic spectrum when tested against 13 ring worm fungi. Further the fungitoxicity of the extract remained unaltered at high temperature on autoclaving and after long storage. The leaves of *L. inermis* L. were also found to exhibit strong fungi toxicity and non-phytotoxicity. The minimum effective dose against test organism was found to be 1000ppm. Ethanol, methanol and aqueous extract of leaves of *L. inermis* are involved in defensive mechanism against spore germination of *Drechslera oryzae*. Lawsone isolated from the leaves of *L. inermis* has shown significant antifungal antibiotic effect. Aqueous extract of leaves of *L. inermis* was tested for the antifungal potential against eight important species of *Aspergillus w*hich isolated from sorghum, maize and paddy seed samples. *A. flavus* recorded high susceptibility and hence solvent extracts viz., petroleum ether, benzene, chloroform, methanol and ethanol extracts of the plant showed significant antifungal activity. Essential oil obtained by hydro-distillation from leaves of *L. inermis* growing in Iran were analysed by GC-MS and showed an antifungal activity. Ethanol extract of leaves of *L. inermis* showed significant antifungal effect against phytopathogenic fungi. Ethanol extract could be used as alternative source of antifungal agents for

protection of plants or crops against fungal infection.

Antiviral activity
The ethanol soluble fraction of *L. inermis* fruits displayed highly potent activity against Sembiki forest virus (SFV) in swiss mice and chick embryo models exhibiting 100 to 65 % activities after 10 to 25 days of virus challenge. Antitrypanosomal activity Crude Methanolic extract of leaf of *L. inermis* showed Invitro activity against Trypanosoma brucei at concentration of 8.3 mg/ml of blood in mice but not in-vivo. The treatment tends to ameliorate the disease condition, but did not affect the level of parasitaemia and pack cell volume.

Antiparasitic activity
During an ethno pharmacological survey of antiparasitic medicinal plants used in Ivory Coast, 17 plants were identified and collected. Polar, non-polar and alkaloidal extracts of various parts of these species were evaluated Invitro in an antiparasitic drug screening. Antimalarial, leishmanicidal, trypanocidal, antihelminthiasis and antiscabies activities were determined. Among the selected plants, L. inermis L. showed interesting trypanocidal activities.

Antifertility activity
Ethanol extract prepared from the powdered seeds of L. inermis L. failed to show any antifertility activity. However in subsequent studies it was observed that the powdered leaves of when administered as suspension or incorporated into the diet inhibited the fertility of rats. The fertility induced appeared to be permanent.

Tuberculostatic activity
The tuberculostatic activity of henna was tested in-vitro and in-vivo. On Lowenstein Jensen medium, the growth of Tubercle bacilli from sputum and of Mycobacterium tuberculosis H37Rv was inhibited by 6 µg/ml of the herb. In vivo studies on guinea pigs and mice showed that the herb at a dose of 5 mg/kg body weight led to a significant resolution of experimental tuberculosis following infection with Mycobacterium tuberculosis H37Rv.

Abortifacient activity
Methanol extract of roots of L. inermis was most effective in inducing abortion in mice, rats and guinea pig. The effect apparently was dosage dependent. The results of the whole animal experiments support the methanol extract effectiveness as an abortant due to its maternal and foetal toxic effects.

Enzymes Inhibitory activity
The ethanol extract of L. inermis L. leaves and lawsone tested for trypsin inhibitory activity showed an IC50 value of 64.87 and 48.6µg/ml, respectively.

Nematicidal effect
A suppressive effect was obtained by L. inermis against Meloidogyne incognita development. Henna reduced tomato root gall numbers, number of the egg-laying females and rate of the nematode reproduction, when tomato and henna were grown together same reduction in the nematode biological processes was found, when tomato plants were grown in soil containing root exudates of henna, but with less amount. When henna was grown alone, root gall index and the rate of nematode production reduced to 75% and 99%, respectively, compared with those of tomato grown alone.

Anticoagulant effect
Lawsone and its oxazine derivatives isolated from leaves of L. inermis had proven to be potential anticoagulant agent.

Wound healing effects
Chloroform and aqueous extracts of leaves of the plant were capable of inhibiting the growth of microorganisms that are involved in causing burn wound infections. [80-81] Ethanol extract of the plant (200 mg/kg/day) was used to evaluate the wound healing activity on rats using excision, incision and dead space wound models. Extract of *L. inermis* when compared with the control and reference standard animals: a high rate of wound contraction, a decrease in the period of epithelialization, high skin breaking strength, a significant increase in the granulation tissue weight and hydroxyproline content. Histological studies of the tissue showed increased well organized bands of collagen, more fibroblasts and few inflammatory cells when compared with the controls which showed inflammatory cells, scanty collagen fibres and fibroblasts.

Protein inhibitory activity glycation
Ethanol extract of the plant tissues was evaluated in-vitro for protein glycation inhibitory activity using the model system of bovine serum albumin and glucose. The extract and its components showed significant effect on protein damage induced by a free radical generator in in-vitro assay system. It

was found that the alcoholic extract, lawsone and gallic acid showed significant inhibition of Advanced Glycated End Products (AGEs) formation and exhibit 77.95%, 79.10% and 66.98 % inhibition at a concentration of 1500µg/mL, 1000µg/mL and 1000µM respectively.

Antisickling activity

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

Antioxidant effect

Modulator effect of 80 % ethanol extract of leaves of henna on drug metabolizing phase I and phase II enzymes, antioxidant enzymes, lipid peroxidation in the liver of Swiss Albino mice. The hepatic glutathione S-transferase and DTdiaphorase specific activities were elevated above basal level by L. inermis extract treatment. With reference to antioxidant enzyme the investigated doses were effective in increasing the hepatic glutathione reductase (GR), superoxide dismutase (SOD) and catalase activities significantly at both the dose levels. Reduced glutathione (GSH) measured as non-protein sulphydryl was found to be significantly elevated in liver. Among the extra hepatic organs examined (forestomach, kidney and lung) glutathione S-transferase and DTdiaphorase level were increased in a dose independent manner. Chloroform extract of leaves of Lawsonia inemris had shown the highest activity (87.6 %) followed by α-tocopherol (62.5 %) by using FTC method and based on TBA method significant activity (55.7 %) compared to α- tocopherol (44.4 %). Total phenolic compound was 2.56 and 1.45 mg tannic per mg of Henna dry matter as extracted with methanol and water respectively. In effect of different concentrations of methanolic extract of henna in comparison with synthetic antioxidant. 2-hydroxy-1, 4- naphthoquinone (HNQ; lawsone) is the main ingredient of L. inermis. During the oxidation of 100µM phenanthridine by guinea pigs aldehyde oxidase formation of superoxide anion (SO2) and hydrogen peroxide (H2O2) at 6-10 % and 85-90 % resp. HNQ inhibits the production of superoxide anion and substrate oxidation more potently than hydrogen peroxide. The IC50 value of HNQ with phenanthridine oxidation by aldehyde oxidase was 9.3 ±1.1µM, which in excess of 15 fold of maximal plasma concentrations of HNQ, indicating a high degree of safety margin.

Antibacterial activity

Ethanol extracts of 20 plants species used by Yemeni traditional healers to treat infectious diseases were screened for their antibacterial activity against both gram positive and gram negative bacteria. The ethyl acetate extract of L. inermis L. was found to be the most active against all the bacteria in the test system. Quinonic compounds from henna were studied in-vitro for antimicrobial properties. Genotoxic studies on lawsone suggested that it was a weak bacterial mutagen for Salmonella typhimurium strain TA98and was more clearly mutagenic for strain TA2637. Overall, the weight of evidence suggested that henna and hydroxy napthaquinone possess no genotoxic risk to the consumer. Aqueous extract of leaves of L. inermis showed the significant antibacterial effect against. Aqueous, methanol and chloroform crude extracts of leaf showed the in-vitro antimicrobial activity to inhibit the growth of 6 human pathogenic fungi and 4 types of bacteria in dose dependent manner.

Nootropic activity

The acetone fraction of the petroleum ether extract of Henna inhibited prominent nootropic activity, potentiating clonidine induced hypodermia and decreased lithium induced head twitch. The fraction modified 5-HT and NA mediated behaviour. However haloperidol induced catalepsy was not modified.

Molluscicidal activity

Leaf, bark and seed of henna against *Lymnaea acuminata* and *Indoplanorbis exustus* were studied. Seed powder was more toxic than leaf and bark against *I. exustus.* Binary combinations of henna seed with *Cedrus deodara Roxh* and *Azadirachta indica* A. Juss oil, or powdered *Allium sativum*, or *Zingiber officinale* rhizome oleoresin was more toxic to snails *L. acuminata* and *I. exustus* than their single treatment. The highest increase in the toxicity was observed when henna seeds powder and *C.deodara* oil (1:1) were tested against both the snails. The combination with neem oil was also more toxic than their individual components and other combinations.

PLANT- LAWSONIA INERMIS

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