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LAWSONIA INERMIS LINN. (MADAYANTI): A CRITICAL REVIEW ON PHYTOCHEMICAL AND TRADITIONAL IMPORTANCE

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ABSTRACT

Lawsonia inermis Linn. Family-Lythraceae is popularly known as Henna or Mehndi. It is native to North Africa, Lawsonia inermis plant is used all over the globe. It is a branched glabrous shrub or small tree, mainly cultivated for its leaves even though stem bark, roots, flowers, and seeds have also been used traditionally for cosmetically and medicinally, the tree growing up to 10-15feet. It became popular in India due to its cooling effect in the hot Indian summer. Henna has various pharmacologically active constituents ie. phytochemicals. From various parts of the henna plant, more than 70 phenolic compounds have been isolated. Among them are naphthoquinones, which include the main dyeing compound ie. lawsone. The structural elucidation of Lawsonia inermis explored the presence of several phenolic derivatives, triterpenes, sterols, flavonoids, coumarins, mannitol, gallic acid, plumbagin, aliphatics, hennotanic acid, etc. These phytochemicals alone or in combination exhibits numerous pharmacological properties. Lawsonia inermis formulations are widely used as antimicrobial agent, antidiabetic and antioxidant agent, antiurolithiatic, anticonvulsant agent, anthelmintic agent, trypsin inhibitory, abortifacient agent, hepatoprotective agent and wound healing agent, etc. The review is an attempt to explore the various phytochemicals present in henna and their application in the treatment of diseases and to find out new compounds for the betterment of human society.

KEYWORDS

Henna, Lawsone, Flavonoids, Antimicrobial, Antioxidant, Immunomodulation, etc.

INTRODUCTION:

Medicinal plants are part of human society to alleviate diseases, from the development of civilization. Traditional medicine plays an appreciable role in *Ayurvedic* or natural herbal medicines as described in the ancient history of India [1]. Herbal medicines are in great demand in developed as well as developing countries for primary healthcare because of their wide biological and medicinal activities, high safety margins, and less cost of treatment. Approximately 80 % of the population of developing countries is unable to afford pharmaceutical drugs; they rely mainly on plant-based traditional medicines to bear their primary health care requirements. [2]. Henna plants used all over the globe, in the present study attempt to review and explore various updated information. *Madayanti* (Lawsonia inermis Linn.), is a well-known herbal medicinal plant mentioned for therapeutic use. It belongs to the Lythraceae family and it is best known for its natural orange-red color contained in the leaves. For more than 9000 years, this plant has been used cosmetically and medicinally. Leaves of henna have long been used in traditional herbal medicine. This plant is a worldwide-known cosmetic agent used to colour hair, skin, and nails [3]. The application of henna to feet heals a month-long destruction and alleviation of the fungus (ie. antifungal activity). It also helps in the healing of chronic ulcers and discomfort in the feet of diabetic patients and prevents moisture loss and skin cracking [4]. *Henna* remained used for many medicinal purposes such as a cooling agent, astringent, antimicrobial, antihemorrhagic agent, hypotensive, and sedative, and used as a dye, and protective for hair, skin, and fingernails. *Henna* contains tannic acid, mucilage, gallic acid, mannitol, and lawsone, the main phytochemical constituent of henna is 2 hydroxy-1, 4 naphthoquinone (ie. lawsone) [5,6]. 1, 4 naphthoquinones (Lawsone) molecule present in henna, has a high affinity for binding with the blood proteins (ie. Fibrinogen and Thrombin) [7].

Experimental studies on rats revealed that local application of henna leads to an increased amount of collagen fibers that give integrity to the tissue matrix, and strength, and play a vital role in the final phase of wound healing during epithelialization and homeostasis[8].

Traditionally, *henna* leaf paste, powder, or oil formulations have been widely used for hand, hair, nails, and foot dyeing. Besides, due to its therapeutic efficacy, it is used for alleviating jaundice, smallpox, skin and venereal diseases, etc. Thus, this sacred plant represents the subject of several scientific studies. *Henna* leaf extracts have shown various biological activities such as antioxidant [9,10], antidiabetic [11,12] antifungal [13], antiviral[14], and anti-inflammatory [15], effects and hence they may be a potential material for biomedical production. Lawsonia inermis has a cellular damage-repairing effect due to antioxidant and anti-inflammatory activities.

Vernacular names: [16,17]

- English: *Henna*, Egyptian privet
- Sanskrit : *Mendhi, Mendika, Timir*
- Hindi: *Henna, Mehandi*
- Punjabi: *Henna, Mehndi*
- Gujrati: *Mehndi*
- Kannada: *Madurang*
- Malayalam: *Mailanci*
- Telugu : *Goranta, Kormmi*
- Arabic: *Alhenna, Hinna*
- French : Alcana d' orient
- Greek: *Kypros*
- Tamil : *Alvanam, Aivani*
- Kashmir: *Mohuz*
- Marathi : *Mendhi, Mendi*
- Orissa: *Manghati*

Botanical description of the plant (Lawsonia inermis Linn):

It is a spinescent shrub or small tree, branched, deciduous and glabrous. It is 4-6 meters in height and the stem is greyish-green in color. It is grown as a commercial crop in certain states of India for its dye and as a hedge plant throughout India. Leaves are 2-6 cm in long, elliptical and lanceolate, acute/obtuse, often mucronulate, with very short petioles and tapering base. Flowers are numerous, less than 1.3 cm. white or rose-colored, scented, short pedicels and terminal pyramidal panicled cymes. Flowers have four sepals, 3-5 mm long, campanulate. Petals are obovate, white, or red stamens. Stamens implanted in pairs on the calyx tube. Capsules are 6 mm in diameter, supported by the persistent calyx and tipped with the style, globose, slightly veined outside [18]. Seed capsules are about the size of a pea, with numerous tiny pyramidal red, globose, brown pitted seeds [19].

Habitat:

Henna has been used comprehensively over the centuries for medical and cosmetic purposes in Africa, Asia, the Middle e East, and various other parts of the world as a traditional product with religious associations. *Henna* powder is a brown/green powder obtained from dried leaves of the plant after pulverization. The henna plant is cultivated in dry tropical and subtropical zones including India, Sri Lanka, the Middle East, and North Africa [20].

Propagation and cultivation: Propagation by seeds [21]. It is mainly cultivated for its leaves.

Parts used: The plant bark, leaves, and seeds are used medicinally [22,23].

Chemical Constituents: From different parts of the plant more than 70 phenolic phytochemicals have been identified [24]. Phenolic compounds are abundant in henna extracts such as coumarins,

flavonoids, naphthoquinones, etc. Henna is diversified in chemical constituents.

Leaves:
Henna leaves contain 2-Hydroxy-1, 4-naphthoquinone (ie. Lawsone) is the principle natural dye contained at 1.0-1 .4 % in the leaves [25,26]. It is necessary to store dry henna in the most appropriate conditions because lawsone becomes unstable upon exposure to light and oxygen [27]. Other related compounds present in the leaves are lawsochrysin (5-hydroxy-6-n-pentyl-7-n-pentyloxy-flavone), lawsochrysinin (5-hydroxy-7-(4″-pentenyloxy-flavone), lawsonaringenin (40,5-dihydroxy-7-(4″-pentenyloxy)-flavanone), 30,40 -dimethoxyflavone, 7-hydroxy flavone, 3,30,40,7-tetrahydroxyflavanone,rhoifolin (apigenin-7-O-β-neohesperidoside) [28]. 1, 4dihydroxynaphthalene, 1, 4- naphthoquinone, 1, 2-dihydroxy-glucosyloxynaphthalene and 2-hydroxy-1,4-diglucosyloxynaphthalene. Flavonoids (luteolin, apigenin, and their glycosides), coumarins (esculetin, fraxetin, scopoletin), steroids (βsitosterol) [29]. The soluble matter tannin, gallic acid, carbohydrate, mannitol, lipids, resin, and mucilage are reported in the leaves of Lawsonia inermis [30].

Stem:
Small number of naphthalenes, lawsoniaside (1, 2, 4-trihydroxy naphthalene-1, 4-di-β-D-glucopyranoside [31,32].

Bark:
Napthoquinone, isoplumbagin, triterpenoids-Hennadiol, and aliphatics (3- methyl nonacosane-1-ol) are isolated from bark [33].

Flower:
Essential oils isolated from flowers are rich in ionones (90 %) in which β-ionones predominated [34], isoplumbagin (2-methyl-8-hydroxy- 1, 4-naphthoquinone) [35], terpenoids and terpene.

Seed:
Seeds contain proteins (5.0 %), carbohydrates (33.62 %), fibers (33.5 %), fatty oils (10- 11 %) composed of behenic acid, arachidic acid, stearic acid, palmitic acid, oleic acid, linoleic acid, Lawsowaseem, Lawsoshamim, Lawnermis acid, etc [36,37], lawnermis acid methyl ester [38], harmine, and harmaline alkaloids [39].

Whole plant:
Phytochemicals Isolated from the whole plant are 1, 3-dihydroxy-6, 7-dimethoxyxanthone (Laxanthone-I), 1-hydroxy-3,6-diacetoxy-7-methoxyxanthone (Laxanthone-II) and 1-hydroxy-3,7-dimethoxy-6-acetoxyxanthone (Laxanthone-III) [40,41].

Root:
From roots of henna phytochemicals 1, 2, 3, 6-tetra-O-galloyl-β-Dglucose and 1,2,3,4,6-penta-O-galloyl-β-D-glucose have been isolated and Tannic acid also identified from roots [42], lawsaritol [43,44].

Chemical constituents of Lawsonia inermis:[45,46,47]

Part of Plant	Chemical compounds
	Naphthoquinone derivatives
Leaves	Lawsone (2-hydroxy 1,4-naphthoquinone); 1,3-dihydroxy naphthalene; 1,4-napthaquinone; 1,2-dihydroxy-4- Glucosyl naphthalene
Stem bark	Isoplumbagin
	Phenolic compounds
Bark, Leaves	Lalioside (2,3,4,6-tetrahydroxyacetoxy-2-β-D-glucopyranoside); Lawsoniaside (1,3,4-trihydroxynaphthalene 1,4-di-β-D-gluco-pyronoside); Lawsoniaside B (3-(4-O-a-D-glucopyranosyl-3,5-dimethoxy) phenyl-2E-propenol); syringinoside; daphneside; agrimonolide 6-O-β; D-glucopyranoside; (+)-syringaresinol; O-β-D-glucopyranoside; (+)-Pinoresinol; di-O-β-D-glucopyranoside; Syringaresinol; di-O-β-D-glucopyranoside; isoscutellarin; daphnorin
	Terpenoids
Bark, Seeds	3β, 30-dihydroxylup-20(29)-ene (hennadiol-triterpenes); (20S)-3β, 30-Dihydroxylupane; Lupeol; 30-*nor*-lupan-3β-ol-20-one; betulin; betulinic acid; lawnermis acid (3β-28β-hydroxy-urs-12, 20-diene-28-oic acid) and its methyl ester
	Sterols
Roots, Leaves, Bark	Lawsaritol (24β-ethycholest-4-en-3β-ol); Stigmasterol and β-sitosterol
	Aliphatic constituents
Stem bark	3-methyl-nonacosan-1-ol; n-tricontyl n-tridecanoate
	Xanthones
Whole plant	Laxanthone I (1,3 dihydroxy-6,7 dimethoxyxanthone); Laxanthone II (1-hydroxy-3,6 diacetoxy-7-methoxyxanthone);Laxanthone III (1-hydroxy- 6-acetoxy xanthone)

Traditional Importance of Henna:
This plant has been described in ancient ayurvedic literature for the treatment of epilepsy and jaundice, dyeing grey hairs, etc. In *Sushruta Samhita*, it has been recommended for the treatment of *Dustavrana* (ie. chronic ulcers) [48]. The use of leaves in dysuria, bleeding disorders, prurigo (A type of skin disorder), and other obstinate skin diseases is mentioned in Ayurvedic Pharmacopoeia of India [49]. The taste of the *henna* leaves is bitter and useful in wounds, amenorrhoea, scabies, splenic diseases, headache, hemicranias, lumbago, bronchitis, boils, ophthalmia, syphilitic conditions, promotes the growth of the hair, and also used as a vulnerary, diuretic, etc. The flowers are vulnerary; an infusion cares for headaches [50]. Flowers are used as a refrigerant and for insomnia [51]. The bark is given in jaundice, splenomegaly, and calculus, and also as an alternative in leprosy and obstinate skin diseases [52]. Because of the attributed antifungal, antibacterial, antiamoebiasis, antihemorrhagic, astringent, sedative, and hypotensive effects, *henna* is acknowledged as a medicinal plant [53].

In a study, the local application of an ethanolic extract of *henna* on wounds of rats in the treatment group revealed that 71% reduction in the wound area as compared with the control group (58 %). Use of Lawsonia inermis in the management of wound healing due to improved wound contraction, increased skin-breaking strength, hydroxyproline, and histological findings [54]. Another study showed that in burn wound infections, the application of *henna* leaves extracts inhibits the growth of microorganisms (ie. antimicrobial activity) and findings suggested the use of *henna* in the treatment of infections in burn patients [55].

CONCLUSION:
The Lawsonia inermis is a versatile tree species, widely used for dyeing and medicinal purpose. All the part of the L. inermis tree is reported to be useful. Globally demand for L. inermis products has increased dramatically. *Henna* oil has been useful for hair growth formulations since ancient times. Formulations (extract /oil/paste etc.) from L. inermis leaves, bark, roots, and fruits have shown interesting activities such as antimicrobial activity, antioxidant, antidiabetic, anticancerous, anticonvulsant activities, trypsin inhibitory activity, anthelmintic, abortifacient activities, etc. There are various phytochemicals obtained from different parts of the plant that exhibit several pharmacological activities. It is anticipated that this review article will be a strong stimulus for researchers toward better understanding and utilization of the plant Lawsonia inermis for the welfare of human beings.

REFERENCES:

1) Lavhate MS, Mishra SH. A review: nutritional and therapeutic potential of Ailanthus excelsa.PharmacogRev.2007; 1(1):105-113.
2) Goyal BR, Goyal RK, Mehta AA. Phyto-Pharmacognosy of Archyranthes aspera: A Review. Pharmacog Rev. 2008; 1:1.
3) Hanna Rostkowska a., Maciej J. Nowaka, Leszek Lapinski a, Ludwik Adamowicz b. Molecular structure and infra-red spectra of 2-hydroxy- 1,4-naphthoquinone. Experimental matrix isolation and theoretical Hartree-Fock and post-Hartree-Fock study,Spectro. Acta 1998, 54: 1091-1103.
4) Mutluoglu, M., Uzun, G., 2009. Can henna prevent ulceration in diabetic feet at high risk? Experimental diabetes research 2009,107496.
5) B.S. Nayak, G. Resistor, E.M. Davis, G.K. Pillai, The evidence-based wound healing activity of Lawsonia inermis Linn, Phytother. Res. 21 (9) (2007) 827–831.
6) S.F. Albaayit, Y. Abba, A. Rasedee, N. Abdullah, Effect of Clausena excavata Burm. f. (Rutaceae) leaf extract on wound healing and antioxidant activity in rats, Drug Design and Dev. Therapy 9 (2015) 3507–3518.
7) J.E. Kelmanson, A.K. Jäger, J. van Staden, Zulu medicinal plant with antibacterial activity, J. Ethnopharmacol. 69 (3) (2000) 241–246.
8) T.K. Hunt, D.R. Knighton, K.K. Thakral, W.H. Goodson 3rd, W.S. Andrews, Studies on inflammation and wound healing: angiogenesis and collagen synthesis stimulated in vivo by resident and activated wound macrophages, Surgery 96 (1) (1984) 48–54.
9) Das gupta, A.R. Rao, P.K. Yadava, Modulatory effect of Henna leaf (Lawsonia inermis) on drug metabolizing phase I and phase II enzymes antioxidant enzymes, lipid peroxidation, and chemically induced skin and for stomach papilloma genesis in mice, Mol. Cell. Biochem. 245 (2003) 11–22.
10) A. Adetutu, O.A. Owoade, O.S. Oyekunle, Comparative effects of some medicinal plants on sodium arsenite-induced clastogenicity, Int. J. Pharm. Bio.Sci. 4 (2013) 777–783.
11) I. Syamsudin, H. Winarno, The effect of Inai (L. inermis Linn) leaves extract on blood sugar level: an experimental study, Res. J. Pharmacol. 2 (2008) 20–23.
12) M.S. Arayne, N. Sulthana, A.Z. Mirza, M.H. Zubri, F.A. Siddiqui, In vitro hypoglycemic

activity of methanolic extract of some indigenous plants, Pak. J. Pharm. Sci. 20 (2007) 268–273.
13) V.K.P. Subbaiah, N. Savithrmma, Bio-prospecting and documentation of traditional plants used to treat itching, psoriasis, and wounds by ethnic groups of Kurnool district, Andhra Pradesh, India, Asian J. Pharm. Clin. Res. 5 (2012) 127–131.
14) Z.S. Khan, S. Nasreen, Antibacterial activity of some medicinal plants, J. Pure Appl. Microbiology-4, 2010, 393–396.,
15) H. Imam, N.U. Mahbub, M.F. Khan, H.K. Hana, M.M. Sarker, Alpha amylase enzyme inhibitory and anti-inflammatory effect of Lawsonia inermis, Pak. J.Biol. Sci. 16 (2013) 1796–1800.
16) Kirtikar K.R. and Basu B.D. (2005). Indian Medicinal Plants. 2nd edition, International book distributors, Dehradun, vol.II. 1076-1086.
17) Nadkarni K.M. (1982). Indian Materia Medica, Vol. 1. Popular Book Depot, Bombay, India, 730-73.
18) Nadkarni K.M. (1982). Indian Materia Medica, Vol. 1. Popular Book Depot, Bombay, India, 730-73.
19) Sukh Dev (2006). A selection of prime Ayurvedic Plant Drugs, Ancient- modern concordance. Anamaya Publishers, New Delhi, 276-279.
20) Jallad K.N. and Jallad C.E. (2008). Lead exposure from the use of Lawsonia inermis (Henna) in temporary paint-on-tattooing and hair dying. Science of the Total Environment 397: 244-250.
21) Nadkarni K.M. (1982). Indian Materia Medica, Vol. 1. Popular Book Depot, Bombay, India, 730-73.
22) Kirtikar K.R. and Basu B.D. (2005). Indian medicinal plants, Second edition. International book distributor, Dehradun, vol-II, 1076-1086.
23) Nadkarni K.M. (1982). Indian Materia Medica, Vol. 1. Popular Book Depot, Bombay, India, 730-73.
24) Ruchi Badoni Semwal, Deepak Kumar Semwal, Sandra Combrinck, Catherine Cartwright-Jones, Alvaro Viljoen, Journal of Ethnopharmacology, Volume 155, Issue 1, 8 August 2014, Pages 80-103.
25) Kirkland D. and Marzin D. (2003). Assessment of the genotoxicity of 2-hydroxy 1, 4-naphthoquinone, the natural dye ingredient of Henna. Mutation Research, 537: 183-199.
26) Ashnagar, A., Shiri, A., 2011. Isolation and characterization of 2-hydroxy-1,4-naphthoquinone (lawsone) from the powdered leaves of henna plant marketed in Ahwaz city of Iran. International Journal of Chem. Tech. Research 3, 1941–1944.
27) Cartwright-Jones, C., 2006. Making Guidelines for Henna: A Geographical Approach (Masterarbeit). Master of Liberal Studies. Kent State University, Kent, Ohio, USA.
28) Uddin, Siddiqui, B.S., Begum, S., Bhatti, H.A., Khan, A., Parveen, S., Choudhary, M. I., 2011. Bioactive flavonoids from Lawsonia alba (henna) leaves. Phytochemistry Letters 4, 454-458.
29) Sukh Dev (2006). A Selection of premium Ayurvedic herbal medicines, ancient and modern in harmony. Anamaya Publishing House, New Delhi, 276-279.
30) Nayak BS, Isitor G, Davis EM Pillai G.K. (2007). Evidence-based wound healing activity of Lawsonia inermis Linn. Phytotherapy Research, 21: 827-831.
31) Takeda, Y., Fatope, M.O., 1998. Novel phenolic glucosides from Lawsonia inermis, Journal of Natural Products -51,725-729.
32) A. B. Hsouna, M. Trigui, G. Culioli, Y. Blache, S. Jaoua, 2011. Food Chemistry-125, 193–200.
33) Sukh Dev (2006). A selection of premium Ayurvedic herbal medicines, the harmony of ancient and modern. Anamaya Publishing House, New Delhi, 276-279.
34) Sukh Dev (2006). Selection of premium Ayurvedic herbal medicines, ancient and modern in harmony. Anamaya Publishing House, New Delhi, 276-279.
35) Gupta, S., Ali, M., Alam, M.S.A., 1993a. Naphthoquinones from Lawsonia inermis stem bark. Phytochemistry 33:723–724.
36) Aggarwal SR, Ghatak SN, Dingla DR. Homogeneous chemical study of Lawsonia alba. Indian Wolf Journal J. 1959; 25: 145.
37) Siddiqui BS, Kardar MN, Khan S. Two new triterpenoids from Lawsonia inermis. Helvetica Chemical Acta. 2005; 86(6) 2164–2169.
38) Handa, G., Kapil, A., Sharma, S., Singh, J., 1997. Lawnermis Acid: New anticomplementary triterpenoids from Lawsonia inermis seeds. Indian Journal of Chemistry B36, 252–256.
39) Jacob, P.P., Saral, A.M., Two harmala alkaloids from Lawsonia inermis seeds. Chemistry of natural products 2013, 49: 780.
40) Bhardwaj, D.K., Seshadri, T.R., Singh, R., 1977. A xanthone from Lawsonia inermis. Phytochemistry 16, 1616–1617.
41) Mahmoud, Z.F., Abdel Salam, N.A., Khadafy, S.M., 1980. Henna leaf (Lawsonia inermis L.) species observed in Egypt. Phytotherapy 51, 153–155.
42) Bakkali A.T., Jaziri, M., Ishimaru, K., Tanaka, N., Shimomura, K., Yoshimatsu, K., Homes, J., Vanhaelen, M., 1997. Tannin production. http://dx.doi.org/10.1037/0033-2909.151.505–508.
43) Gupta, S., Ali, Mohd., Sarwar Alam, Niwa, M., Sakai, T., 1992. S., Ali, M., Alam ,M.S. , Niwa ,M. , Sakai ,T. Natural Product Letters 4, 195-201.
44) Galani VJ and Panchal RR. Antiurolithic activity of Centratherum anthermintcum (L.) Kuntze seed against ethylene glycol-induced urolithiasis in rats. International Journal of Phytotherapy Research. 2014; 4(1):29-38.
45) Hussain M, Lal M, Ahmed S, Zafa N, Naqvi SA, Abid-ul-Hussan, and Rizvis. Management of urinary stones associated with renal failure. August 1995. 45(8):205-208.
46) Dilip Rajas bladder stones, kidney stones, renal calculus, lithotripsy, urinary stones. 2014.
47) Sastri Ambika Dutta, Sushruta, Chaukhambha Sanskrita Sansthan, Varanasi, reprint edition 2013, Su.Chi.2/91.p.26.
48) Khare C.P. (2007). Indian Medicinal Plants: An Illustrated Dictionary, Publisher Springer, New York 2007.
49) Kirtikar K.R. and Bass B.D. (2005). Indian medicinal plant, Second edition. International Booksellers, Dehradun, Vol. II, 1076-1086.
50) Gothe V.M. (2000). Ayurvedic Pharmacology and Therapeutic Use of the Medicinal Plants (Dravyaguna vignyan), 686-687.
51) Nadkarni K.M. (1982). Materia Medica of India, Vol. Popular Book Depot, Bombay, India, 730-73.
52) Abdul Moneim M.A. (2007). Evaluation of Lawsonia inermis (Sudan henna) leaf extract is blended as an antibacterial agent. Research Journal of Biological Sciences, 2:417-423.
53) Nayak BS, Isitor G, Davis EM, Pillai GK (2007). Lawsonia inermis , Evidence-Based Wound Healing Activities. Phytotherapy Research, 21:827-831.