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A phytopharmacological review on *Lawsonia inermis* (Linn.)

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Abstract

Medicinal plants are being widely used, either as single drug or in combination in health care delivery system. *Lawsonia inermis* Linn. is commonly known as henna, which is recognized in traditional system of medicine. It consists of various categories of phytoconstiuents like flavonoids, coumarins, triterpenoids, steroids, xanthones. It has been traditionally reported in use of headache, hemicranias, lumbago, bronchitis, boils, ophthalmia, syphilitis, sores, amenorrhea, scabies, diseases of the spleen, dysuria, bleeding disorder, skin diseases, diuretic, antibacterial, antifungal, anti-amoebiasis, astringent, anti-hemorrhagic, hypotensive and sedative effect. Several studies are being carried towards it activates like cytotoxic , hypoglycaemic , nootropics, antimicrobial, antibacterial , trypsin inhibitory , wound Healing , antioxidant , anti-corrosin , anti-inflammatory, analgesic and antipyretic , anti-parasitic, tuberculostatic , protein glycation inhibitory , hepatoprotective , anti-tumoral activity. With all these potential benefits, this plant is not widely utilized. Hence this review is carried out to explore the hidden potential and its uses, towards the benefit of mankind.

Key-Words: Awareness, Blood glucose, Diabetes, Education, Therapeutic

Introduction

Many of today's modern drugs have their origin in traditional plant medicine[1]. The therapeutic efficacies of many indigenous plants for various diseases have been described by practitioners of traditional herbal medicines. Natural products are a significant source of synthetic and traditional herbal medicine and are still the primary health care system[2]. The traditional medicinal methods, especially the use of medicinal plants, still play a vital role to cover the basic health needs in the developing countries. In recent years there has been a phenomenal rise in the interest of scientific community to explore the pharmacological actions of herbs or to confirm the claims made about them in the official books of Ayurveda[3].

Common names

English	: Henna, Samphire, Cypress shrub
Sanskrit	: Mendhi, Mendika, Timir
Arabic	: Alhenna, Hinna
French	: Alcana d' orient
Greek	: Kypros
Gujrat	: Medi
Hindi	: Hena, Mhindi
Marthi	: Mendhi, Mendi
Tamil	: Alvanam, Aivani
Telugu	: Goranta, Kormmi [5, 6].

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Fig. 1: *Lawsonia inermis* Linn.

Plant descriptions

Botanical description

It is much branched, deciduous, glabrous, sometime spinescent shrub or small tree with grayish brown bark, attaining a height of 2.4-5 m. It is cultivated as a hedge plant throughout India, and as a commercial crop in certain states of India for its dye[7]. Leaves are 1.3-3.2 by 0.6-1.6 cm, elliptic or broadly lanceolate, acute or obtuse, often mucronulate, base tapering; petioles very short. Flowers are numerous, less than 1.3 cm. across fragrant, white or rose-colored, in large terminal pyramidal panicled cymes; pedicels short, slender. Calyx 3-5 mm, long broadly campanulate; lobes 2.5-3 mm, long, suborbicular or subreniform, undulate. Stamens 8, inserted in pairs on the calyx-tube.

Capsules 6 mm, diameter; hlobose, slightly veined outside, supported by the persistent calyx and tipped with the style[6]. Seed capsules are red, globose, about the size of a pea, with numerous tiny pyramidal, brown pitted seeds[7].

Habitat

Henna, a traditional product with religious associations, has been widely used over the centuries for medical and cosmetic purposes in Africa, Asia, the Middle East and many other parts of the world. Henna is a finely ground brown or green powder originating from dried leaves of the plant *Lawsonia inermis* which is grown in dry tropical and subtropical zones, including North Africa, India, Sri Lanka, and the Middle East[8].

Propogation : by seeds[6].

Parts used: The bark leaves and seeds of the plant are used medicinally[5-6].

Chemical Constituents

Leaves

2-Hydroxy-1, 4-napthoquinone (HNQ; Lawsone) is the principle natural dye contained at 1.0-1 .4 % in the leaves of Henna[9]. Other related compounds present in the leaves are: 1, 4dihydroxynaphthalene.1,4-naphthoquinone, 1,2-dihydroxy-glucoyloxynaphthalene and 2-hydroxy-1,4-diglucosyloxynaphthalene. Flavonoids (luteolins, apigenin, and their glycosides). Coumarins (esculetin, fraxetin, scopletin). Steroids (β-sitosterol)[7]. The leaves of *Lawsonia inermis* also reported to contain soluble matter tannin, gallic acid, glucose, mannitol, fat, resin and mucilage[2].

Bark

Bark contains napthoquinone, isoplumbagin, triterpenoids-Hennadiol, aliphatics (3-methylnonacosan-1-ol)[7].

Flower

Flowers on steam distillation gave an essential oil (0.02 %) rich in ionones (90 %) in which β-ionones predominated[7].

Traditional uses

This plant has been described in Charaka Samhitaa for the treatment of epilepsy and jaundice, and for dyeing grey hair. In Sushruta Samhitaa it has been recommended as a remedy for malignant ulcers[7]. The Ayurvedic Pharmacopoeia of India indicated the use of leaves in dysuria, bleeding disorder, prurigo and other obstinate skin diseases[10].

The leaf have a bitter bad taste and used in vulnerary, diuretic, headache, hemicranias, lumbago, bronchitis, boils, ophthalmia, syphilitis, sores, amenorrhoea, scabies, and spleen diseases and favours the growth of the hair. The flowers are vulnerary; an infusion cares headache[5]. Flowers are used as refrigerant and in insomnia[11]. The bark is given in jaundice and enlargement of the spleen, also in calcalous affections and as an alternative in leprosy and obstinate skin diseases[6]. It is used as medicinal plant because of its attributed antibacterial, antifungal, antiamoebiasis, astringent, antihemorrhagic, hypotensive and sedative effect[12].

Pharmacological activities

Hypoglycaemic activity

This is a study of the effect of Inai (*Lawsonia inermis*) leaves extract on glucose, total cholesterol and triglyceride of blood of mice induced by alloxan of 70 mg kg^{-1} BW. Inai leaves extract was obtained by the percolation of dried inai leaves using 70% ethanol. Sample treatments were done at day of 0, 3, 7, and 14th after the mice underwent the hyperglycaemic condition. The results showed that the feeding of 0.8 g kg^{-1} BW of inai extract decreased the glucose concentration from 194 mg dL^{-1} to normal condition after the 14th day. A similar result occurred on total cholesterol concentration in which the total cholesterol concentration decreased from 148.9-55.3 mg dL^{-1} and triglyceride concentration decreased from 225.7-76.9 mg dL^{-1} [13].

Nootropics activity

To investigate the effect of acetone soluble fraction of petroleum ether extract of *Lawsonia inermis* leaves on memory, anxiety and behaviour mediated via monoamine neurotransmitters. The effect of acetone soluble fraction of pet. ether extract of *Lawsonia inermis* on memory was assessed using elevated plus maze and passive shock avoidance paradigms. The effects on clonidine induced hypothermia lithium induced head twitches and haloperidol induced catalepsy were observed to study the effect on noradrenaline, serotonin and dopamine mediated behaviour respectively.The acetone fraction of pet. ether extract exhibited prominent nootropic activity. The fraction modified 5-HT and NA mediated behaviour. It is concluded that the leaves of *Lawsonia inermis* possess a potential for exploring a nootropic principle[14].

Antimicrobial Activity

Leaf samples of *Lawsonia inermis* were collected from Dammar region, north of Sudan to examine their antimicrobial potential. Water, methanol and chloroform crude extracts in different concentrations were obtained and bioassayed *in vitro* for its bioactivity to inhibit the growth of 6 human pathogenic fungi and 4 types of bacteria. The differences in bioactivity of the 3 types extracts were analyzed. Despite extreme fluctuations in activity, the extract of water was clearly superior. Phytochemical analyses showed the presence of anthraquinones as major constituents of the plant

leaves and are commonly known to posses antimicrobial activity[12].

Antibacterial Activity

Ethanolic extracts of 20 selected plant species used by Yemeni traditional healers to treat infectious diseases were screened for their antibacterial activity against both Gram-positive and Gram-negative bacteria, as well as for cytotoxic activity. Fourteen of the ethanolic extracts showed variable degrees of antibacterial activity. The active ethanolic extracts were partitioned between ethyl acetate and water for a first separation. The ethyl acetate extract of *Lawsonia inermis* was found to be the most active one against all bacteria in the test system[15].

Trypsin inhibitory activity

Soxhlet ethanolic extract of *Lawsonia inermis* (yield: 18.5 dried weight). Preliminary phytochemical screening of the extract gave positive tests for Lawsone (naphtoquinone), sugars, and tannis. *Lawsonia inermis* alcoholic extract and lawsone have shown a significant Trypsin inhibitory effect[16].

Wound Healing Activity

The ethanol extract of *Lawsonia inermis* (200 mg/kg/day) was used to evaluate the wound healing activity on rats using excision, incision and dead space wound models. The animals were divided into three groups of six each in the excision model and two groups of six each in the incision model and dead space models. The topical application was made in the case of excision wound model, whereas, oral treatment was done with incision and dead space wound models. The extracts-treated animals showed 71% reduction in the wound area when compared with controls which was 58 %. Enhanced wound contraction, increased skin breaking strength, hydroxyproline and histological findings suggest the use of *Lawsonia inermis* in the management of wound healing[2].

The present study showed that henna leaves extracts were capable of inhibiting the growth of microorganisms that are involved in causing burn wound infections. This finding therefore support the use of henna in the management of burn wound infections. The effects of water and chloroform extracts of the leaves of *Lawsonia inermis* (henna plant) against the primary invaders of burnt wounds was investigated[1].

Cytotoxic activity

Chloroform extract of leaves of *L. inermis* displayed the cytotoxic effects against liver (HepG2) and Human breast (MCF-7) with IC_{50} values of 0.3 and 24.85 µg/ml by microculture tetrazolium salt assay (MTT) [17].

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 H_2O_2 generation assay are carried out. Lawsone generated H_2O_2 slightly in phosphate buffer system and was not mutagenic in Ames assay using TA98, TA100 and TA102, both in the absence and presence of metabolic activation. Lawsone exposure inhibited the growth of both Csa and Csb strains in a dose-dependent manner. Oxidative stress probably arises when napthoquinone part in lawsone reduced to a semiquinone by enzymatic systems[18].

Antioxidant Activity

The effect of 200 and 400 mg/kg body weight of 80 % ethanolic extract of the fresh leaves of *Lawsonia inermis* were examined on drug metabolizing phase-I and Phase-II enzymes, antioxidant enzymes, glutathione content, lactate dehydrogenase and lipid peroxidation in the liver of 7 weeks old Swiss albino mice. With reference to antioxidant enzymes the investigated doses were effective in increasing the hepatic glutathione reductase (GR), superoxide dismutase (SOD) and catalase activities significantly (from $p < 0.05$ to $p < 0.005$) at both the dose levels. Among the extrahepatic organs examined (forestomach, kidney and lung) glutathione S-transferase and DT-diaphorase level were increased in a dose independent manner (from $p < 0.05$ to $p < 0.005$). There was a significant inhibition of tumor burden in both the tumor model system studied (from $p < 0.01$ to $p < 0.001$). Tumor incidence was also reduced by both the doses used in our experiment in both the model system[19]. 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[20].

Anticorrosin Activity

The inhibitive action of henna extracts (*Lawsonia inermis)* and its main constituents (lawsone, gallic acid, α-D- Glucose and tannic acid) on corrosion of mild steel in 1 M HCL solution was investigated through electrochemical techniques and surface analysis (SEM/EDS). Polarization measurements indicate that all the examined compounds act as a mixed inhibitor and inhibition efficiency increases with inhibitor concentration. Maximum inhibition efficiency (92.06 %) is obtained at 1.2 g/l henna extract. Inhibition efficiency increases in the order: lawsone > α-D-Glucose > tannic acid. Also, inhibition mechanism and thermodynamic parameters are discussed[21].

Anti-inflammatory, Analgesic and Antipyretic activity

Crude ethanolic extract of *Lawsonia inermis* L. (0.25-2.0 g/kg) produced significant and dose-dependent anti-inflammatory, analgesic, and antipyretic effects in rats. Using a liquid-liquid extraction procedure, the extract was fractionated into chloroform, butanol, and water fractions, and these were tested for the above activities. The butanol and chloroform fractions showed more potent anti-inflammatory, analgesic, and antipyretic effects than the crude extracts, while the aqueous extract showed significantly less effect. As compared with the other extracts, the butanolic extract (500 mg/kg) was the most effective in the analgesic test. From the chloroform extract, a pure compound was isolated and identified, using chromatographic and spectroscopic techniques, as 2-hydroxy-1,4-naphthaquinone (lawsone). The isolated compound was found to possess significant anti-inflammatory, analgesic, and antipyretic activity[22].

Lawsonia inermis leaves which are used in indigenous system of medicine were found to possess anti-inflammatory activity[6]. The isolated and identified seven crystalline compounds from the chromatographic fraction of the alcoholic extract of the *lawsonia inermis* leaves. Fraction gave luteolin (m.p. 237°C), yield 0.95 %. the mother liquor on concentration gave traces of lawsone. The ethyalacetate extract after removal of laxanthone I and lawsone was extracted with saturated solution of sodium carbonate (100ml). The alkaline layer was neutralised by concentrated sulphuric acid and extracted with 130ml. of ethyalacetate which on concentration gave laxanthone II (m.p. 180°C), yield 0.47 %. Fraction on concentration gave crystals of 3-O-glucoside of β-sitosterol (m.p.285°C), yield 1.87 % [23].

Antiparasitic activity

During an ethnopharmacological 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 *in vitro* 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[24].

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. *Invivo* 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[25].

Protein glycation inhibitory activity

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. L. inermis, Compounds 1 and 2 were found to be glycation inhibitors with IC50 82.06±0.13µg/mL, 67.42±1.46 µM and 401.7±6.23 µM respectively[26].

Hepatoprotective activity

Alcoholic extract of the bark of *L. inermis* showed hepatoprotective effect against the carbon tetrachlorideinduced elevation in serum marker enzymes (GOT and GPT), serum bilirubin, liver lipid peroxidation and reduction in total serum protein, liver glutathione, glutathione peroxidase, glutathione-s-transferase, glycogen, superoxide dismutase and catalase activity. The results suggest hepatoprotective and antioxidant activity of extract of *L. alba* bark. Pretreatment of rats with the extract also inhibited the peroxidation of microsomal lipids in a dose-dependent manner[27].

Antitumoral activity

In this study, we planned to research the effect of *Lawsonia inermis* that is an oxidant agents against development of cancer, by constituting peritontitis carcinomatous with Ehrlich ascites cells. The animals were divided to three groups and *Lawsonia inermis* extract and tap water were given to mice for 5 day, all of animals were decapitated by cervical dislocation and their liver tissues were sampled to measure reduced glutathione (GSH) level. Mean survival times (MST) and Average survival times (AST) were calculated; peritoneal liquid pH was measured; Ehrlich Ascites Carcinoma (EAC) cells were counted with hemocytometer. As the result, the longest life period was detected on the group which was given 10 mg/kg/day *Lawsonia inermis* [28].

Lawsonia inermis can destroy cancer cells by induction of apoptosis due to decreasing of intracellular H^+ ion level or increasing intracellular free radicals and H_2O_2 levels in cancer cells as a result of oxidative effect or not. We used 70 females Swiss albino mice and divided them into four groups. Group 1 was given only tap water. Group 2 was given only *L. inermis*. Group 3 was given Ehrlich Ascites tumor (EAT) cells + tap water and Group 4 was givan EAT + *L.inermis*. At the result of this study the thickness of subcutaneous lipid tissue, diameters of gluteal mass, the pH levels of

gluteal mass, the GSH levels at the liver tissue samples and the MDA levels of the liver tissue samples of these groups were measured. This study showed and that, *L.inermis* can be used as a supplementary agent for cancer treatment[29].

Immunomodulatory activity

The immunomodulatory bioassay-guided fractionation of the methanolic extract of henna (*Lawsonia inermis* L.; syn. *Lawsonia alba* L.) leaves resulted in the isolation of seven compounds; three have been isolated for the first time from the genus, namely *p*-coumaric acid, 2-methoxy-3-methyl-1,4-naphthoquinone and apiin, along with the previously isolated compounds:lawsone, apigenin, luteolin, and cosmosiin. Structural elucidation of the isolated compounds was based upon their physical, chemical as well as spectroscopic characters. Their immuomodulatory profile was studied using an *in vitro* immunoassay, the lymphocyte transformation assay[30].

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