IJPSR (2014), Vol. 5, Issue 2 **(Review Article)**

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 29 September, 2013; received in revised form, 29 October, 2013; accepted, 16 January, 2014; published 01 February, 2014

AN UPDATE ON AYURVEDIC HERB HENNA (*LAWSONIA INERMIS* L.): A REVIEW

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Keywords:

Lawsonia inermis, pharmacognosy, microscopy, macroscopy, phytochemistry, pharmacology

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ABSTRACT: *Lawsonia inermis* L. is a much branched glabrous shrub or small tree, cultured for its leaves although stem bark, roots, flowers and seeds have also been used in traditional medicine. 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. The plant is reported to contain Lawsone, Esculetin, Fraxetin, Isoplumbagin, Scopoletin, Betulin, Betulinic acid, Hennadiol, Lupeol, Lacoumarin, Laxanthone, Flavone glycosides, two pentacytic triterpenes. 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 measured as a valuable source of exclusive natural products for growth of medicines against various diseases and also for the development of industrial products. This review gives a bird's eye vision mainly on the pharmacognostic characteristics, traditional uses, phytochemistry and pharmacological actions of the plant.

INTRODUCTION: Medicinal plants are part and parcel of human society to combat diseases, from the dawn of civilization [1]. There exists a plethora of knowledge, information and benefits of herbal drugs in our ancient literature of Ayurvedic (Traditional Indian Medicine), Siddha, Unani and Chinese medicine.

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.5(2).330-39

Article can be accessed online on: www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.5(2).330-39

According to the World Health Organization, 2003 about 80 % of the population of developing countries being unable to afford pharmaceutical drugs rely on traditional medicines, mainly plant based, to sustain their primary health care needs [2]. Herbal medicines are in great demand in the developed as well as developing countries for primary healthcare because of their wide biological and medicinal activities, higher safety margins and lesser costs [3].

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 [4]. *Lawsonia inermis* Linn (Family: Lythraceae) is a much branched glabrous shrub or small tree (2-6 m in height), cultivated for its leaves although stem bark, roots, flowers and seeds have also been used in traditional medicine. This plant is a worldwide known cosmetic agent used to stain hair, skin and nails [5].

The present attempt is to review and compile updated information on various aspects of *L. inermis* Linn. a plant used all over the world. This plant is commonly known as Henna 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 [6].

Plant profile:

FIG. 1: *LAWSONIA INERMIS* LINN.

Synonym: *Lawsonia alba* Lam.

Vernacular names [7]:

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.

Scientific classification [8]:

Kingdom: Plantae

Subkingdom: Viridaeplantae

Division: Tracheophyta

Subdivision: Spermatophytina

Class: Magnoliopsida

Order: Myrtales

Family: Lythraceae

Genus: Lawsonia

Species: inermis

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. 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. Seed capsules are red, globose, about the size of a pea, with numerous tiny pyramidal, brown pitted seeds [9].

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 [10].

Propagation: by seeds [11].

Chemical constituents: Table 1 [12].

TABLE 1: CHEMICAL CONSTITUENTS

S no.	Plant Parts	Chemical constituents
1.	Leaves	2-Hydroxy-1,4-napthoquinone, 1,4dihydroxynaphthalene, 1,4-naphthoquinone, 1,2-dihydroxy-glucoyloxynaphthalene, luteolins, apigenin, and their glycosides, esculetin, fraxetin, scopletin, β-sitosterol, tannin, gallic acid, glucose, mannitol, fat, resin and mucilage.
2.	Barks	napthoquinone, isoplumbagin, triterpenoids-Hennadiol, aliphatics (3-methylnonacosan-1-ol)
3.	Flowers	essential oil (0.02 %) rich in ionones (90 %), β-ionones.
4.	Roots	24β-ethylcholest-4-en-3β-ol
5.	Seeds	Linoleic acid, Arachidic acid, Stearic acid, Palmitic acid
6.	Whole plant	Laxanthone I, Laxanthone II, Laxanthone III, n-Triacontanol,

Traditional uses [13, 14, 15]**:**

1. It is used for the treatment of epilepsy and jaundice, and for dyeing grey hair.
2. It is used as a remedy for malignant ulcers.
3. The Ayurvedic Pharmacopoeia of India indicated the use of leaves in dysuria, bleeding disorder, prurigo and other obstinate skin diseases.
4. The leaf is used in vulnerary, diuretic, headache, hemicranias, lumbago, bronchitis, boils, ophthalmia, syphilitis, sores, amenorrhoea, scabies, and spleen diseases and favours the growth of the hair.
5. 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.

Medicinal importance [16]**:**

1. It is used for antidiarrheal.
2. It is used for antidysenteric.
3. It is used for astringent.
4. It is used for emmenagogue.
5. It is used for liver tonic.
6. It is used for antifungal.

Ethnobotanical Uses [17]**:**

1. Henna leaf has an orange-red dye and leaf paste or powder is widely used for decorating hands, nails and feet with patterns.
2. **Flowers** are very fragrant and used to extract a perfume, which is used as base for local scents. 3. An infusion of the flowers is a valuable application to bruises. Decoction of the flowers is describes as an emmenagogue.
3. **Seeds** are deodorant. Powered seeds with real ghee (clarified butter) are effective against dysentery.
4. The bark is applied in the form of a decoction to burns and scalds. It is given internally in a variety of affections, such as jaundice, enlargement of the spleen, calculus, as an alternative in leprosy and obstinate skin affections.
5. **Root** is considered as a potent medicine for gonorrhoea and herpes infection. Root is astringent may be pulped and used for sore eyes. Pulped root may also be applied to the heads of children for boils.
6. The root is supposed to be useful in treatment of hysteria and nervous disorders.

TABLE 1: PRELIMINARY PHARMACOLOGICAL ACTIVITIES OF ALCOHOLIC EXTRACTS OF *L. INERMIS* L.

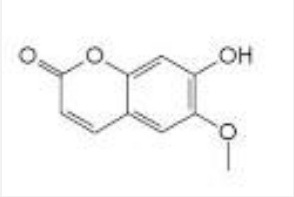
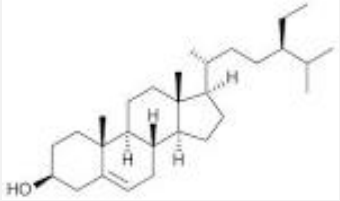
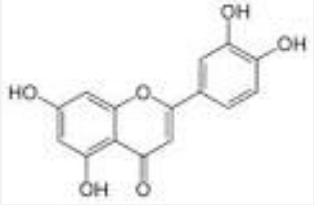
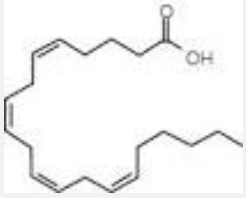
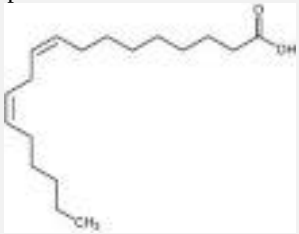
S No.	Activity	Plant part/ Extract	Dose/ Model	Standard drug	Result
1.	Antiviral Activity	Fruits / Ethanol	swiss mice and chick embryo models	Sembiki forest virus	It exhibiting 100 to 65 % activities after 10 to 25 days of virus challenge [18]
2.a.	Wound Healing Activity	Leaves / Ethanol	200 mg/kg/day / excision, incision and dead space wound models.	Topical application, Oral treatment	The extract-treated animals showed 71% reduction in the wound area when compared with controls which was 58% [19]
2.b.	Wound Healing Activity	Leaves / Chloroform	200 mg/kg/day / excision, incision and dead space wound models.	Topical application, Oral treatment	The effects of chloroform extracts against the primary invaders of burnt wounds was investigated [20]
3.	Protein Glycation Inhibitory Activity	Leaves / Ethanol	1500µg/mL, 1000µg/mL and 1000µM / the model system of bovine serum albumin and glucose.	AGE fluorescence intensity	The alcoholic extract, showed significant inhibition of Advanced Glycated End Products (AGEs) formation [21].
4.a	Anti Diabetic Activity	Leaves / Ethanol	800 mg/kg / alloxan induced model	Glimepride	The extract decreased the glucose concentration after the 14th day and decreased total cholesterol and triglyceride concentration [22].
4.b	Anti Diabetic Activity	Leaves / Methanol	800 mg/kg / alloxan induced model	Glimepride	It show the inhibitory effect of glucose utilization, and use as hypoglycemic agents [23].
5.	Nootropics activity	Leaves / Acetone	Elevated plus maze and passive shock avoidance paradigms.	Haloperidol	The leaves of *Lawsonia inermis* possess a potential for exploring a nootropic principle [24].
6.a	Antimicrobial Activity	Leaves / Methanol	Staphylococcus aureus Staphylococcus epidermidis	Tetracycline, Ampicillin	The presence of anthraquinones in the plant leaves are commonly known to possess antimicrobial activity [25].
6.b	Anti-Microbial Activity	Leaves / Alcoholic	Staphylococcus aureus Staphylococcus epidermidis	Tetracycline, Ampicillin	Alcoholic extracts had the highest antibacterial activity against ß-hemolytic streptococci [26]
6.c	Anti-Microbial Activity	Leaves, Seeds / Ethanol	Staphylococcus aureus, Escherichia coli and Pseudomonas aeruginosa.	Tetracycline, Ampicillin	Omani henna does possess in-vitro antibacterial activity against a wide spectrum of bacterial strains and C. albicans [27].
7.a	Antibacteria-l Activity	Leaves / Ethyl acetate	E.coli ATCC 8739, S.aureus 6538 / Cup plate Model	Tetracycline	Ethyl acetate extract of *Lawsonia inermis* was found to be the most active one against all bacteria in the test system [28].
7.b	Antibacteria-l Activity	Leaves, seed / Ethanol	*Pseudomonas aeruginosa* (NCTC 10662)	Tetracycline	The highest susceptibility was against *P. aeruginosa* with henna samples obtained from Al-sharqyia region [29].
8.	Trypsin Inhibitory Activity	Leaves / Ethanol		Aralast	*Lawsonia inermis* alcoholic extract and lawsone have shown a significant Trypsin inhibitory effect [30].
9.a.	Cytotoxic Activity	Leaves / Chloroform	microculture tetrazolium salt assay	*Escherichia coli*	It displayed the cytotoxic effects against liver (HepG2) and Human breast (MCF-7) with IC50 values of 0.3 and 24.85 µg/ml [31].
9.b.	Cytotoxic	Leaves /	Ames mutagenicity	*Escherichia coli*	Lawsone exposure inhibited the growth of

	Activity	Ethanol	assay		both Csa and Csb strains in a dose-dependent manner [32].
10.a.	Antioxidant Activity	Leaves / Ethanol	200 and 400 mg/kg / 1, 1-diphenyl-2-picryl- hydrazyl model.	Ascorbic acid	The doses were effective in increasing the hepatic glutathione reductase, superoxide dismutase and catalase activities [33].
10.b.	Antioxidant Activity	Leaves / Methanol	200 and 400 mg/kg / 1, 1-diphenyl-2-picryl- hydrazyl model.	Ascorbic acid	In effect of different concentrations of methanolic extract of henna in comparison with synthetic antioxidant [34].
10.c	Antioxidant Activity	Leaves / Methanol	200 and 400 mg/kg / 1, 1-diphenyl-2-picryl- hydrazyl model.	Ascorbic acid	It was shown extraction method has significant effect on phenolic compound and antioxidant activity of Henna extract [35].
10.d	Antioxidant Activity	Leaves / Methanol	free radical scavenging assay	Ascorbic acid	It resulted in the isolation of seven compounds; three have been isolated for the first time from the genus, namely *p*-coumaric acid [36].
11.	Anticorrosi-n Activity	Leaves / Ethanol	SEM/EDS		Maximum inhibition efficiency (92.06 %) is obtained at 1.2 g/l henna extract [37.]
12.	Anti-Inflammatory, Analgesic And Antipyretic Activity	Leaves / Chloroform	500 mg/kg	Ibuprofen	The isolated compound was found to possess significant anti-inflammatory, analgesic, and antipyretic activity [38]
13.	Tuberculost-atic Activity	Leaves / Ethanol	5 mg/kg	*Mycobacterium tuberculosis*	The growth of *Tubercle bacilli* from sputum and of *Mycobacterium tuberculosis* H37Rv was inhibited by 6 µg/ml of the herb [39].
14.a	Hepatoprote-ctive Activity	Bark / Alcohol	carbon tetrachloride induced model	Silymarine	Pretreatment of rats with the extract also inhibited the peroxidation of microsomal lipids in a dose-dependent manner [40]
14.b	Hepatoprote-ctive Activity	Leaves / Ethanol	CCl4-induced liver toxicity.	Silymarine	The effects of the extract on hexobarbitone-induced sleep, BSP clearance, and on certain biochemical parameters indicated its protective role [41].
15.	Immunomo-dulatory Activity	Leaves / Methanol	mice lethality test, indirect hemagglutination test.	Levamisole	The immuomodulatory profile was studied using an *in vitro* immunoassay, the lymphocyte transformation assay [42].
16.	Anticarcino-genic Activity	Leaves / chloroform	microculture tetrazolium salt (MTT) assay	Sulforaphane	The extract displayed the cytotoxic effects against HepG2 and MCF-7 with IC_{50}-value of 0.3 and 24.85 µg ml^{-1} [43].
17.	Molluscicid-al Activity	Seed / ethanol	Biomphalaria alexandrina snails	indomethacin	Highest toxicity was observed in the seed of Lawsonia inermis [44].
18.	Antifungal Activity	Bark / Ethanol	Microsporum gypseum and Trichophyton mentagrophytes	Voriconazole	The extract was found to possess fungistatic nature at its maximum inhibitory dilution of 1:30 (W/V) against both the test pathogens [45]
19.	Antitrypano-somal Activity	Leaf/ Methanolic extract	*invitro* activity against *Trypanosoma brucei*	*Trypanosoma brucei* / 8.3 mg/ml of blood in mice	The treatment tends to ameliorate the disease condition, but did not affect the level of parasitaemia and pack cell volume [46]
20.	Antisickling Activity	Leaves/ Aqueous extract	sickle cells counting	pentoxifylline	It found to inhibit sickling and to increase the oxygen affinity of HbSS blood [47]
21.	Abortifacie-nt	Roots /	Ovariectomized		The methanol extract effectiveness as an

	Activity	Methanol extract	rats.	abortant due to its maternal and foetal toxic effects [48]

Chemical Review [49]**:** The principal colouring matter of henna is lawsone, 2- hydroxy-1:4 napthaquinone ($C_{10}H_6O_3$, m.p.190º decomp.) besides lawsone other constituents present are gallic acid, glucose, mannitol, fats, resin (2 %), mucilage and traces of an alkaloid. Leaves yield hennatannic acid and an olive oil green resin, soluble in ether and alcohol. Flowers yield an essential oil (0.01-0.02 %) with brown or dark brown colour, strong fragrance and consist mainly of α- and β- ionones; a nitrogenous compound and resin. 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 and linoleic acid. The unsaponified matter contains waxes and colouring matter. The root contains a red colouring matter. Phytochemicals reported in *L. inermis* L. are listed in **Table 2** with their structures.

TABLE 2: PHYTOCHEMICAL STRUCTURES PRESENT IN *L. INERMIS* L.

S no.	Chemical Name	Chemical Structure
1.	Scopletin	 Scopoletin is a coumarin found in root of plants in the genus scopolia.
2.	β-sitosterol	 β-Sitosterol is one of several phytosterols (plant sterols) with chemical structures similar to that of cholesterol. It is used in treating hypercholesterolemia
3.	Luteolins	 Luteolin can be found in *Terminalia chebula*. It is most often found in leaves, but it is also seen in rinds, barks, clover blossom, and ragweed pollen
4.	Arachidic acid	 Arachidonic acid (AA, sometimes ARA) is a polyunsaturated omega-6 fatty acid 20:4(ω-6). It is the counterpart to the saturated arachidic acid found in peanutoil
5.	Linoleic acid	 Linoleic acid belongs to one of the two families of essential fatty acids; it is an unsaturated n-6 fatty acid.

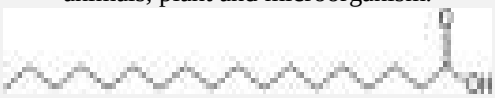
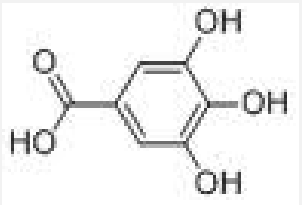
6.	Palmitic acid	 Palmitic acid also called hexadecanoic acid, is the most common fatty acid found in animals, plant and microorganism.
7.	Stearic acid	 Stearic acid is the saturated fatty acid with an 18-carbon chain and has the IUPAC name octadecanoic acid.
8.	Gallic Acid	 Gallic acid is a trihydroxybenzoic acid, a type of phenolic acid, a type of organic acid, also known as 3,4,5-trihydroxybenzoic acid, found in gallnuts, sumac etc.

TABLE 3: PHYSICAL ANALYSIS OF *L. INERMIS* L. [50 – 53]

Parameters	Values
Alcohol soluble extractive value	3.8 % w/w
Aqueous extractive value	5.0 % w/w
Loss on drying	4.5 % w/w
Total ash	14.60 % w/w
Acid insoluble ash	4.50 % w/w
Water soluble ash	3.0 % w/w
Swelling Index	Absent
Foaming Index	Less than 100
Ph 1% solution	7.22
Ph 10% solution	7.53
Extractive value	Hot Extraction (w/w)
Methanol	12.34 %
Aqueous	15.50 %

TABLE 4: PRELIMINARY PHYTOCHEMICAL TEST OF ALCOHOLIC EXTRACTS OF *L. INERMIS* L. [54 – 55]

Phytochemical Tests	Results
Test for Alkaloids	-
Test for Glycosides	+
Test for Carbohydrates	+
Test for Saponins	-
Test for Fats & oils	-
Test for Volatile oils	-
Test for Tannis & phenolic compounds	+
Test for Protein	-
Test for Gums & mucilage	+
Test for Steroids	-

Morphological characters: The leaf of *Lawsonia inermis* L. is short, smooth, compound, ovate-lanceolate, acute, symmetrical, entire, pinnate, opposite, sweet smelling, characteristics or bitter in taste and varies in length, Lawsone is mainly present in the marginal vein or petiole in large quantity [56, 57, 58]. **Fig. 1** shows a photograph of *Lawsonia inermis* L.

Microscopic characters:

1. The leaf of *Lawsonia inermis* L. is short and smooth. The midrib is distinct from the lamina. It is broadly shallow on the adaxial side and convex on the abaxial side.

2. It also consists of unicellular covering trichome. Diacytic stomata are present on both the surface.

3. The leaf of *Lawsonia inermis* L. is dorsiventral as oblong palisade cells are present below the upper epidermis and absent on lower epidermis.

4. Tannin is seen in some of the cells. The vascular strand is single, small, collateral and hemispherical in shape.

5. It consists of a thick horizontal band of xylem and a fairly wide band of phloem. Xylem elements are narrow, angular, thin walled and somewhat diffuse.

6. The lamina is uniformly flat with even surface. Both adaxial and abaxial epidermal layers are thin and distinct.

7. The mesophyll tissue is differentiated into palisade and spongy parenchyma.

8. Some of the epidermal cells are smaller and have dark tannin content. The stomata are present on both surfaces.

9. Stomata are abundant. The stomata are Dicytic type. Each stoma is surrounded by two subsidiary cells the long axis of which is perpendicular to the long axis of stoma pore. The stomata are elliptical with wide opening.

10. The surface of the petiole is even and smooth. The epidermal layer is thin and very distinct.

11. The ground tissue is homogeneous and parenchymatous, the cells are thin walled and compact [59]. **Figure 2** shows a photograph of T.S of *Lawsonia inermis* L. leaf.

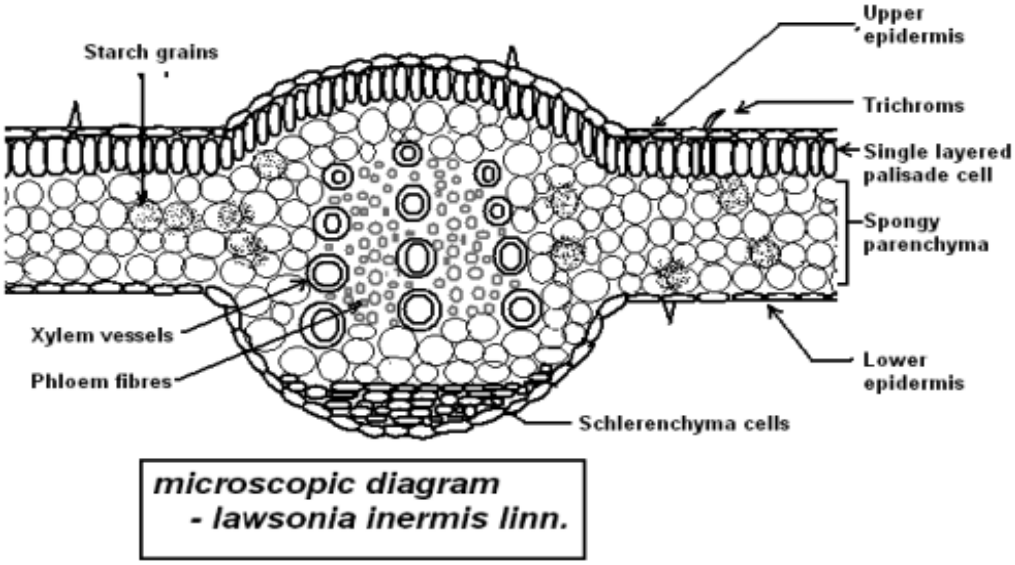


FIG. 2. PHOTOGRAPH OF T.S OF *LAWSONIA INERMIS* L. LEAF

CONCLUSION: The widespread survey of literature exposed that *L. inermis* L. is highly regarded as a universal solution in the herbal medicine with diverse pharmacological activity range. This versatile medicinal plant is the unique resource of various types of chemical compounds, which are responsible of the various activities of the plant. Hence extensive investigation is needed to develop their therapeutic utility to combat diseases. As the global scenario is now altering towards the use of non-toxic plant products having traditional medicinal use, development of modern drugs from *L. inermis* should be emphasized for the organize of various diseases. Further evaluation needs to be carried out on *L. inermis* L. in order to discover the concealed areas and their practical clinical applications, which can be used for the benefit of the mankind.

ACKNOWLEDGEMENT: The authors are thankful to the authorities of Bundelkhand University Jhansi for providing support to the study and other necessary facility like internet surfing, library and other technical support to write a review article.

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How to cite this article:
Agarwal P, Alok S and Verma A: An update on Ayurvedic herb henna (*Lawsonia inermis* L.): a review. *Int J Pharm Sci Res* 2014; 5(2): 330-39.doi: 10.13040/IJPSR.0975-8232.5(2).330-39