International Journal of Pharmaceutical research and Applications
Volume 8, Issue 4, Jul.-Aug. 2023, pp: 137-143 www.ijprajournal.com ISSN: 2456-4494

"A Perspective on Anticancer Potential Of Lawsonia Inermis (Henna)"

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Date of Submission: 27-06-2023 Date of Acceptance: 08-07-2023

ABSTRACT

Chemoprevention potential of plant *Lawsonia inermis L*, commonly known as 'Henna',is a cosmetically renowned plant of the oriental region that possesses diverse pharmacological activity including anti-carcinogenic, antimicrobial, anti-inflammatory, analgesic, antipyretic, hepatoprotective, anti-tuberculostatic. In search for new anticancer drugs from natural sources, researchers have reported the anticancer and chemopreventive properties of Henna extracts/compounds in their pre-clinical studies. Lawsone (2-hydroxy-1,4-naphthoquinone) one of the major constituents of henna, is the reddish-orange pigment artifact formed during the extraction or preparation of the dye from henna leaves and is believed to be the active component.

Lawsone is used as a starting material in the synthesis of a variety of clinically valuable anticancer drugs such as atovaquone, lapachol, and dichloro allyllawsone. This plant contains other chemicals such as isoplumbagin, apigenin, apigenin glycosides, luteolin, luteolin-7 glycosides, p-coumarin, and lupeol among which many are reported for their cytotoxicity and chemopreventive activity against a different type of cancer cell. The current review recapitulates some important findings on the anticancer potential of Henna. Future investigation on novel molecules from Henna may offer great hope for discovering new chemopreventive agents from this miraculous plant.

Keywords: *Lawsonia inermis*, Lawsone, Chemoprevention, Pharmacology, Anticancer.

I. INTRODUCTION

The associated intolerable side effect of radiation and some chemotherapeutic agents take away the 'Quality of Life', of a cancer patient, though they provide effective control over cancer. Some of them are effective agents of choicefor the oncologist. However, the pain and agony through which the cancer patient goes due to side effects are unexplainable. Hence, the other side effect of cancer is compiled to take a look and give a thorough process to alternate medicine. Given ancient claims about the utility of plant material in understanding the molecular mechanism of cell multiplication and testing chemical entities for the targeted interruption in cell proliferation in cancer, modern research indeed revealed some effective phytochemicals for cancer therapy[1,2].

The therapeutic efficacies of many indigenous plants for various diseases have been described by practitioners of traditional herbal medicines. Natural products are a significant synthetic and traditional herbal medicine source and are still the primary health care system[3].

Traditional medicinal methods, especially the use of medicinal plants, still play a vital role to cover the basic health needs in developing countries. In recent years there has been a phenomenal rise in the interest of the 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 (HENNA)

Lawsoniainermis Linn (Family: Lythraceae) which is commonly known as Henna, is mainly present in subtropical and tropical areas and is used all over the world. It was used for over 9000 y for its cosmetic value as a dye. The phytochemical analysis of *Lawsonia inermis* revealed the presence of carbohydrates, phenolic, flavonoids, saponins, proteins, alkaloids, terpenoids, quinones, coumarins, xanthones, fat, resin, and tannins. It also contained 2-hydroxy-1,4-naphthoquinone (lawsone). Many alkaloids, naphthoquinone derivatives, phenolics,

International Journal of Pharmaceutical research and Applications
Volume 8, Issue 4, Jul.-Aug. 2023, pp: 137-143 www.ijprajournal.com ISSN: 2456-4494

and flavonoids were isolated from different parts of *Lawsonia inermis*.

The pharmacological studies showed that *Lawsonia inermis* showed antibacterial, antifungal, antiparasitic, molluscicidal, antioxidant, hepatoprotective, central nervous, analgesic, anti-inflammatory, antipyretic, wound and burn healing, immunomodulatory, antiurolithiatic, antidiabetic, hypolipidemic, antiulcer, antidiarrhoeal, diuretics, anticancer and many other pharmacological effects.

FIG. 1: HENNA PLANT

Synonyms

Alcannaspinosa, Casearia multiflora, Lawsoniaalba, Lawsoniaspeciosa, Lawsoniaspinosa, Lawsonia and Rotanthscombretoides[5]

Common name

Arabic	henna
Bengali	mendi, mehedi
English	Egyptian-privet, henna
German	Hennastrauch
Hindi	mehndi
Indonesian	inai, paar kuku
Portuguese	hesia, hena, alfeneiro
Spanish	alcana, alhena
Swedish	Henna[6]

Taxonomical classification

Kingdom	Plantae
Subkingdom	Viridiplantae
Infrakingdom	Streptophyta
Superdivision	Embryophyta
Division	Tracheophyta
Subdivision	Spermatophytina
Class	Magnoliopsida
Superorder	Rosanne

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Order	Myrtales
Family	Lythraceae
Genus	Lawsonia
Species	Lawsonia inermis[7]

Chemical constituent

The preliminary phytochemical analysis of the aqueous extract of *Lawsonia inermis* revealed the presence of carbohydrates, phenolic compounds, flavonoids, saponins, proteins, alkaloids, terpenoids, quinines, coumarins, xanthones, 6% fat, 2-3% resin, and 7-8% tannins [8,9].

Lawsonia inermis contained 2-hydroxy-1,4-naphthoquinone (lawsone). HPLC analysis showed that the extracts of *Lawsonia inermis* flowers, leaves, and branches contained 116.9, 486.2, and 5.4 µg/g lawsone[10].
Other naphthoquinone derivatives: 1,3-dihydroxy naphthalene, 1,4-naphthoquinone, 1,2-dihydroxy-4-glucosylnaphthalene, and 1,2,4-trihydroxynaphthalene-2-O-β-D-glucopyranoside were also isolated from the leaves of *Lawsonia inermis* [11,12,13].

Flavonoids isolated from *Lawsonia inermis* were: apigenin, apigenin-7-glucoside, apigenin-4-glycoside, apigenin-4-glycoside, apigenin-4'-O-β-D-glucopyranoside, luteolin, luteolin-7-glucoside, luteolin-3-glucoside, kampferol, quercetin, isoscutellarin, tricin, kaempferin, isoquercitrin and [-]-catechin, 7-hydroxy-3,5-dimethoxy-6,8-dimethyl flavones, 3,7,4',5'-Tetrahydroxy-6-methoxyflavone and 4'-hydroxyflavanone [14,15].

Tannin analysis of henna leaves powder showed that the tannins content, nontannin, total soluble, and the total solid was 11.12%, 22.64%,33.76%, and 36.72% respectively

Coumarins, cou (5-allyoxy-7-hydroxycoumarin), and carbonates A and B were isolated from the whole *Lawsonia inermis*[16,17].

Physiochemical Characteristics

Physiochemical investigation of the leaf showed that the total ash was (14.60%), acid-insoluble ash (4.50%), water-soluble ash (3.0%), loss on drying (4.5%), alcohol soluble extractive value (3.8%w/w) and aqueous extractive value (5.0%w/w) [18].

Parts used medicinally

Whole plant, roots, fruits, stem, leaves, bark, inflorescence, rhizome, bulbs, latex, seeds, flowers, and oil were used in different ailments [19].

Geographical sources

Lawsonia inermis is generally considered a native of Africa and Asia.
It is widely cultivated in tropical regions of the world, North and East Africa, the Arabian Peninsula, the Southern areas of the Middle East, and South Asia [20].

Traditional uses

Leaves of *Lawsonia inermis* provide an important cosmetic dye. Henna leaves were extensively used for centuries in the Middle East, the Far East, and Northern Africa as a dye for nails, hands, hair, and textile. Henna was also used in treating skin problems such as headaches, jaundice, amebiasis, and enlargement of the spleen [21,22].

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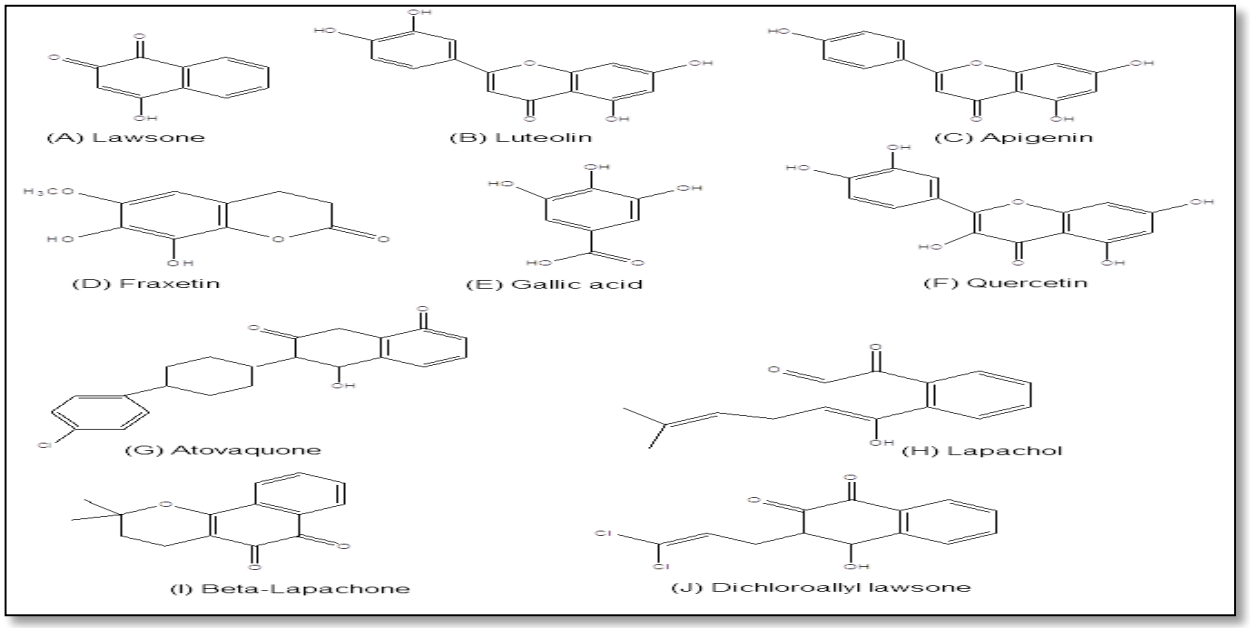
II. MOLECULES FROM *LAWSONIA INERMIS* AND SOME DERIVATIVES OF LAWSONE HAVING ANTICANCER ACTIVITY



III. ANTICANCER ACTIVITY OF *LAWSONIA INERMIS*

Lawsone and juglone inhibited the growth of HCT-15 (human colon cancer cells) by blocking the S-phase of the cell cycle. Lawsone was used as starting compound in the synthesis of many anticancer drugs (atovaquone, lapachol, and dichloro allyl lawsone). Amino-derivatives of lawsone and lapachol were found to be cytotoxic against Ehrlich carcinoma and human K562 (leukemia cells). Allyi-amine derivatives of lawsone and lapachol were found potent cytotoxic with IC50 values of 23.89 and 16.94 µM respectively. Dichloroallyl lawsone, an analog of the lapachol, and acivicin inhibited the biosynthesis of nucleotide and showed anticancer activity in experimental tumor models [23,24].

The anticancer effect of total methanolic extract of *Lawsonia inermis* and octreotide was studied in hepatocellular carcinoma induced by nitrosamine in mice. Methanolic extract of *Lawsonia inermis* and octreotide treatment possessed effective chemopreventive action due to their ability to alleviate oxidative stress, desensitizing cellular growth receptors to SST [25].

Quinones (arbutin in the benzoquinone group, juglone and lawsone in the naphthoquinone group, alizarin, emodin, 1,8-dihydroxy-anthraquinone, and anthraquinone in the anthraquinone group, and xanthone) were studied for their growth inhibitory effect on cultured HCT-15 cells derived from human colon carcinoma. Anthraquinones and naphthoquinones used in these experiments were more effective than monocyclic quinine.The 50% suppression dose was less than 12.5 µg/ml for them. Flow cytometric histograms revealed a specific pattern; lawsone and juglone in the naphthoquinone group and alizarin and 1,8-dihydroxy-anthraquinone in the anthraquinone group blocked mainly the S phase, and emodin in the anthraquinone group blocked the G1 to S phase of the cell cycle [24].

The cytotoxicity of fifteen compounds isolated from the flower of *Lawsonia inermis* was studied against four cancer cell lines (MCF-7, Hela, HCT-116, and HT-29) using an MTT assay. The IC_{50} values of two of them against MCF-7, Hela, HCT-116, and HT-29 were (2.24, 1.42, 24.29, and 7.02 µM) and (6.1, 2.44, 5.58, and 10.21 µM) respectively. They possessed stronger inhibitory activity than the positive control 5-fluorouracil (IC_{50}= 7.34, 11.50, 36.17, 18.83 µM) against the tested cell lines [26].

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The growth inhibition of various cancer cell lines was achieved to varying extents when exposed to the water extract of *Lawsonia inermis* leaves. The activity was promising against colon cancer COLO-205 cells (GI_{50} 121.03 µg/ml) [27].

The anticancer effects of hexane, chloroform, and methanolic extracts of henna seeds were studied against colon cancer cell line HTC-116. Chloroform seed extract showed the best cytotoxic effect with an IC_{50} value of 45 mg/l, while, hexane and methanol extracts possessed low activity (IC_{50} value >100 µg/ml) [28].

The anticancer efficacy of *Lawsonia inermis* leaves was studied in Ehrlich ascites tumor-bearing mice. Administration of 10 mg/kg bw of *Lawsonia inermis* to tumor-bearing mice increased the mean survival period of tumor-bearing mice. *Lawsonia inermis* also caused a significant ($p<0.05$) reduction in the total number of tumor cells. The diameters of the gluteal solid tumor mass were higher on the 12th day in animals given ware when compared with the mice receiving *Lawsonia inermis* extract [29,30].

Henna extracts showed activity against human breast cancer cells (MCF7), MIC for the ethyl acetate extract was (27 mg/I) and petroleum extract was (22 mg/I) [31].

The cytotoxic effect of the extracts of *Lawsonia inermis* was studied against human colon cancer cell lines (Caco-2), liver cancer cell lines (HepG2), hormone-dependent breast cancer cell lines (MCF-7), and hormone-independent breast cancer cell lines (MDA-MB-231) and Chang Liver cell lines using MTT assay. The chloroform extract of henna was active against human colon cancer cell lines (Caco-2) and liver cancer cell lines (HepG2) with an IC50 value of 25.1 and 28 µg/ml, respectively. The cytotoxic mechanism was studied by determining the effect of the extract on the c-myc gene expression. It caused down-regulation of c-myc expression [32].

The effect of extract and essential oil of henna on the apoptotic phenomena was studied in a human liver cancer cell line, HepG2. Henna-induced apoptosis in HepG2 cell lines, many apoptotic bodies, DNA fragmentation, and chromatic condensation were observed in the treated groups through the fluorescence microscope and confocal laser scanning microscope [33].

The effect of an aqueous extract of *Lawsonia inermis* against the development of cancer was studied in Ehrlich ascites cells in mice. The longest life period and decreasing total number of cancer cells were detected in the group which was given 10 mg/kg/day *Lawsonia inermis* aqueous extract [29].

The essential oil from the leaves of *Lawsonia inermis* exhibited strong cytotoxicity on HepG2 with an IC_{50} value of 24 µg/ml in the MTT test [34].

The methanolic extract of *Lawsonia inermis* possessed a significant inhibitory effect toward melanogenesis in B16 melanoma 4A5 cells. Luteolin, quercetin, and (±)-eriodictyol isolated from the methanolic extract, showed stronger inhibitory activity. The methanolic extract, luteolysis, and spiraeoside showed antiplasmin activity, which played a key role in UV-stimulated melanogenesis in human skin [35].

Henna extract (20 µg/ml) was screened for in vitro photo cytotoxic activity utilizing a cell viability test using a human leukemia cell line HL60. *Lawsonia inermis* extract was able to reduce the in vitro cell viability by more than 50% when exposed to 9.6J/cm^2 of a broad-spectrum light [36].
Oriental regions of the world to dye hair and in body art. Future investigation on these aspects of *Lawsonia inermis* may offer great hope for the discovery of new anticancer agents from this plant.

IV. CONCLUSION

This article represents that the *Lawsonia inermis* (Henna) or species plant possesses Anticancer potential as well as other activities. *Lawsonia inermis* used as a cosmetic agent in the

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