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Lawsonia Inermis (Henna) Extract: A Potent Natural Antifungal against Plant Pathogenic Fungi

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Abstract: Regular and excessive use of chemical fungicides has created several serious health problems as well as deterioration of fertility of land. Use of plant extract for the management of plant diseases is a safer alternative to get rid of these problems. One of these plants is Lowsonia inermis which is commonly known as "Henna", reported to be a potent antifungal agent. This plant already used as coloring agent in many Indian rituals. Literature suggested that antifungal activity of this plant mainly due to the presence of natural chemical like Lawsone (2-hydroxynaphthoquinone), mucilage, mannite, gallic acid and tannic acid. This plant has been used to formulate herbal preparation to control crop destruction caused by several phytopathogens. This comprehensive review study encompasses the details on phytochemical profiling, antimicrobial activity and bioformulation available of this plant.

Keywords: antifungal, plant extract, bioformulations, plant diseases, crop destruction

I. INTRODUCTION

Plant based medicines have been used to manage several human and plant pathogens causes severe effects. Extract or decoction of plant parts have been used to treat various diseases caused by fungal pathogens. As chemical control methods are no more useful due to their harmful impact on environment and development of resistance in most of fungal pathogens against same. In this respect, Lawsonia inermis Linn, is a plant known for antimicrobial potentials and is now the subject of intense scientific study (Muhammad and Muhammad, 2005). Though it was used for various purposes, reports on the antifungal property are scanty. Thus, this review was conducted to discuss its antifungal potential against plant pathogenic fungi, described in published data as well as in observed data. Lawsonia inermis (Henna) is an ornamental evergreen plant cultivated in the tropics (Jallad and Espada-Jallad, 2008). It belongs to the family Lythraceae. Conventionally, it is used for development of red or black coloring to hands, feet, and hair in a number of occasions such as weddings and religious festivals. Diverse species of henna are found and cultivate in Oman, at the south-eastern tip of the Arabian Peninsula. Omani henna is common in Eastern and central areas of Oman.

Lawsonia inermis is a much-branched glabrous shrub or small tree 2.6 m in height, with spine tipped branchlets. The plant leaf have a red-orange color constituent, lawsone (2-hydroxy-1, 4-napthoquinone), that is also identified as hennotannic acid. The components of the oil primed from leaves have eugenol (17.5%), hexadecanoic acid (15.2%), Phytol (10.3%), α-terpineol (8.3%) and Etherphenylvinyl (6.7%). Of these most important components, eugenol, hexadecanoic acid, phytol and α-terpineol are quite frequent used for essential oils of higher plants. In the earlier report, from the essential oil of L. inermis Linn leaves, α-terpineol (Rahmat et al., 2006) and Phytol (Oyedeji, 2005) were found to be key components.

1) *Phytochemical Screening Of Lawsonia Inermis:* Phytochemical screening of this plant extract reveals the presence of cardioglycosides, terpenoids, carbohydrates, proteins, phenols, quinines and tannins. Occurrence of these secondary metabolites is accountable for antimicrobial action of this plant (Gonzalez-Lamothe et al., 2009). The active components of these plant produced secondary metabolites comprise phenolic compounds and tannins (Edwin, 1996). Existence of these active molecules in diverse extracts of *Lawsonia inermis* is determined by phytochemical examination. These metabolites are solubilized in solvent on the basis for polarity. Among these metabolites the water soluble components involves starches, tannins, saponins, polypeptides, terpenoids, lectins and different ions (Darout et al., 2000), whereas alcoholic extract involves flavonol, alkaloids, tannins, sterols polyphenols etc. (Ivanovska et al., 1996)). Most imperative chemical component of henna includes Lawsone (2-hydroxynaphthoquinone), mucilage, mannite, gallic acid and tannic acid (Al-Rubiay et al., 2008).
2) *Problems Caused By Plant Fungal Pathogens:* Agriculture works make available edible plant and crop product which accomplish the everyday desires of population. Plant and crop fungal diseases lead severe losses which not only influence overall supply but also affect quality and cost of product. This may lead to enforced dislodgment of food, move monetary scenario of countries, effect political ambiguity and obligatory relocation of humans (Singh et al., 2012). Plant pathogenic funguses deteriorate the quality of seeds, fruit and overall assembly. Usual control procedures are use of chemical fungicides

which deteriorate the quality of obtained plant product as well as residual effects causes serious health implications. In 1996, the universal sales of fungicides account to about 5.9 billion US dollars (Martinez, 2012). Per annum, the USA spends above 600 million US dollars on man-made chemicals (Gonzalez-Fernandez et al., 2010). In 2002, Japan had the prevalent market of 818 million US dollars in the world for fungicides (Ishii, 2006). Fungicides are regularly poisonous to non-target organisms like earthworms, microbes and humans (genotoxicity) leading imbalances in the ecosystems (Nega, 2014, Patel et al., 2014). A lot of these chemicals are recycled at slow rate and are very difficult to remove from environment. These may also cause pollution of water systems and rivers (Stamatis et al., 2010). Hence need of hour is to identify safe and natural compounds to control these problems.

3) *Antimicrobial Activity Of Lowsonia Inermis:* As "heena" have been used for hands and hairs in several Indian rituals for many years. It has very significant health benefits as well as religious importance. The antimicrobial (Borade et al., 2011)and fungicidal (Rahmatullah et al., 2009; Hema et al., 2010)consequence of henna has long been recognized . In adding up to its utilization as a cosmetic, henna leaves are also employed for fevers, as a limited anesthetic (Nirmalan and Baldwin, 1997) anti-inflammatory and for curing mouth ulcers (Ali et al., 1995). Quinones exist in Lowsonia, (Fessenden and Fessenden, 1998) have aromatic rings with two ketone substitutions. They are omnipresent in environment and are typically very much active. These constituents, being colored, are accountable for the browning response in incise or wounded fruits and vegetables and are a intermediary in the melanin production pathway in human skin (Scherer and Kumar, 2010). Due to presence of quinones in Lawsonia gives the substance its dyeing characteristics (Fessenden and Fessenden, 1998). The switch between diphenol (or hydroquinone) and quinone occurs effortlessly throughout oxidation and reduction reactions. The individual redox prospective of the particular quinone-hydroquinone duo is extremely imperative in numerous biological systems. Hydroxilated amino acids may be prepared into quinones in the existence of appropriate enzymes, such as a polyphenoloxidase (Thastrup et al., 1985). In adding up to providing a resource of stable free radicals, quinones are identified to complex irrevocably with nucleophilic amino acids in proteins (Tan and Berridge, 2008), frequently leading to inactivation of the protein and failure of function. Therefore, the probable series of quinone antimicrobial property is immense Portable targets in the microbial cell are surface-exposed adhesions, cell wall polypeptides, and membrane-bound enzymes. Quinones may also make substrates unavailable to the microorganism. In adding up, they were revealed to slow up cell development in culture (Córdoba-Pedregosa et al., 2006). Natural naphthoquinone goods like alkannin and shikonin are the substance accountable for antibacterial action of Lawsonia inermis. Numerous studies on Lawsonia inermis leaves extractions revealed that it had antibacterial action against Gram positive bacteria (Bacillus spp., Staphylococcus aureus, Staphylococcus epidermidis MRSA, Streptococcus pyogenes, Streptococcus pneumoniae, Bacteriodes fragilis, Clostridium perfringens, Streptococcus mutans, Micrococcus, Streptococcus salivarius, Bacillus subtilis, Staphylococcus epidermidis and Streptococcus gordonii); and also against Gram negative bacteria (Escherichia coli, Salmonella spp, Klebsiella spp., Shigella sonnei, Pseudomonas, aeruginosa, Citrobacter frewndii, Vibrio cholerae, Neisseria meningitides, Haemophilus influenzae, Aeromonas hydrophila, Micrococcus spp and Corynebacterium diphtheriae) (Gull et al., 2011; Mastanaiah et al., 2011; Saadabi, 2007) and antifungal action against Candida albicans, Cryptococcus neoformans, A. niger and F. oxysporum (Jain and Sharma, 2016). Lawsonia extracts has also been known for antifungal activity in literature. It was previously found that lawsone purified from the leaves of L. inermis has revealed a considerable antifungal effect (Dixit et al., 1980). During antifungal screening of higher plants, the leaves of L. inermis were observed to reveal strong fungitoxicity. The antifungal feature was observed to be lawsone (Tripathi et al., 1978). Though, it should not be unspecified that lawsone, the mainly active constituent, accounts just for the mass of the action of the ethanol extract. It was observed that the mainly active constituent present is not inevitably accountable for the main part of the outcome. It is imperative to conclude the concentration of every compound and associate it with its dose-response features in the test scheme (Houghton et al., 2007). Amongst the diverse mycotoxin producing fungi, species of Apsergillus and Penicillium are found to be most significant fungi cause destruction in herbal drugs, stored grains and other commodities (Sessou et al. 2012; Avasthi et al. 2010; Mishra and Dubey 1994). Numerous herbal plants have been observed to have antifungal actions against Aspergillus sp. (Panda and Ray 2012). Several research studies suggested that antifungal activities of plant extracts can be detected using various techniques such as agar well diffusion method, disc diffusion method etc using ethanol, aqueous and chloroform extracts (Sessou et al. 2012).

4) *Bioformulations Based On Lawsonia Inermis:* Exploitation of the plant goods for the execution of plant diseases has a unique importance in the context of environmental pollution, buildup of deadly substances in the product and builds up of resistance by plant pathogens. Bioformulations prepared by combining suitable proportions of active plant extract fraction, elicitors, binders and other natural additives. Elicitors mixed to elicit the activity of plant extract. Usually used elicitors are oil cakes like neem

oil cake, mustard oil cake, cotton oil cake, sesame oil cake, ground nut oil cake and coconut oil cake. Binders usually employed as a binder or mixing agent for plant extract to easily applied on plant and crop. Binders usually employed for this purpose are guar gum, gum acacia and cow dung. Zaker and Mosallanejad (2010) deliberated that methanol extracts of peppermint, eucalyptus and lavandula might be potent materials for natural formulations in controlling Alternaria leaf spot of potato in the field. Aqueous extract of leaves of *L. inermis* was detected for the potency of antifungal capability against eight important species of *Aspergillus* that purified from sorghum, maize and paddy seed samples. *A. flavus* has observed to posses high vulnerability towards solvent extracts viz., petroleum ether, benzene, chloroform, methanol and ethanol extract prepared from test plant (Raveesha et al., 2007). Sharma and Sharma (2011) also demonstrated that L. inermis has antifungal competence against a number of isolated i.e. Alterneria solani, Drechslera halodes, Rhizoctonia solani, Fusarium solani, Curvularia lunata, Dreschlera graminae, Fusarium moniliformae, Aspergillus flavus, A. parasiticus var. globosus, Trichophyton rubrum, Aspergillus fumigatus. Deena and Thoppil (2000) and Sharma and Kumar (2009) also demonstrated that Lantana extract was more or less active against different fungal strains. S. angustifolia extract was inactive against Mucor species and did not inhibit its growth.

5) *Toxicological Evaluation Of Lawsonia Inermis Extract:* Acute toxicity of L. inermis extract checked for acute toxicity in animals. These experiments were performed in the animal house of Institute of Biochemistry and Biotechnology, University of the Punjab, Lahore, Pakistan after the authorization of departmental ethical commission. It was done by assigning two groups, each one of the two groups comprised of 10 male albino mice (weighing 150-200 g) were exploited to assess the acute toxicity of *Lawsonia inermis* ethanol extract. Caged experimental animals were served with appropriate diet which fulfills the all international standards. First group was treated with ethanol extract of *Lawsonia inermis* (300 mg/Kg) and other group administrated with equal volume of DMSO daily during subcutaneous way for 2 weeks by subcutaneous injection. All the animals were incessantly checked for the development of any signs of toxidromes such as aggression, sedation, rising fur, increased respiration, altered cardiac rate, excitation, convulsion, stupor, vomiting, etc. or death in first 2 hours and then after 24 hours. Herbal medicines are generally supposed to be safe and natural mean to control plant diseases. Though, it is imperative to assess their biological security previous to utilize to circumvent fatal consequences (Kunle et al., 2012). There is no doubt that extract of *Lawsonia inermis* has medical properties but its toxicological evaluation is also obligatory. *In vivo* acute toxicity of *Lawsonia inermis*extracts was detected in mice. No mortality was detected throughout the study. All the symbols of toxidrome were negative.
6) *Future Prospectus:* Purified active molecule of Lawsonia inermis extract that is responsible for antimicrobial can be used in drug designing via bioinformatics tools. Further advancements in the technologies such as X-ray crystallography, NMR spectroscopy and structural genomics have improved the determination of the exact chemical composition of the compounds and selection of potential drug targets. This gradual advancement in understanding the molecular basis of compound structure and drug targets has channelized the drug discovery pipeline with optimization and testing steps Such traditional drug discovery process includes screening, separation, characterization, and synthesis of the molecules with desired therapeutic activity on cultured cells or animals.

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