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A COMPREHENSIVE REVIEW ON THE WOUND HEALING POTENTIAL OF LAWSONIA INERMIS(HENNA)

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ABSTRACT

Lawsonia inermis, often referred to as Madayanti or henna, is a medicinal plant esteemed in traditional medicine for its therapeutic qualities. This extensive analysis examines the wound healing capabilities of Lawsonia inermis, emphasizing its phytochemical components, pharmacological mechanisms, and therapeutic uses. The plant has abundant bioactive constituents, including lawsone (2-hydroxy-1,4-naphthoquinone), flavonoids, tannins, and phenolic derivatives, which enhance its antioxidant, anti-inflammatory, antibacterial, and tissue-regenerative properties. These qualities collectively enhance its capacity to aid wound repair by increasing epithelialization, and collagen deposition, and inhibiting microbial proliferation at wound sites. Preclinical and clinical research indicate that extracts and formulations from Lawsonia inermis facilitate successful healing in several wound types, including burns, wounds, and ulcers. Ethno-pharmacological documents from diverse cultures substantiate their traditional application in the treatment of cuts, burns, and chronic wounds. Certain studies evaluate the safety profile, potential limits, and knowledge gaps in existing studies, including the necessity for standardized extraction procedures and extensive clinical trials to confirm efficacy and determine optimal therapeutic dosages. This article emphasizes Lawsonia inermis as a promising natural agent for wound treatment and discusses potential avenues for future research to incorporate it into contemporary medical practice.

KEYWORDS: Lawsonia inermis, bioactive components, lawsone, flavonoids, wound healing, etc.

INTRODUCTION

A wound is characterized as any bodily lesion, often including damage to the epidermis, which disrupts its normal architecture and function. Wounds are classified as acute or chronic according to the physiology of wound healing. Acute wounds, encompassing surgical incisions and accidental injuries such as burns and chemical or electrical trauma, progress through standard healing stages. Chronic wounds necessitate prolonged healing and recovery periods due to interruptions in the standard healing process and local infection. These wounds are typically induced by chronic conditions such as diabetes mellitus, autoimmune disorders, hypoxia, trauma, and insufficient early wound care.[1] Traditional herbal medicine practitioners have documented the medicinal efficacies of numerous indigenous herbs for various disorders.[2] People around the world cultivate Lawsonia inermis Linn, a shrub, and native to North Africa, the Middle East, and South Asia, for both cosmetic and medicinal purposes. The components of henna are employed in traditional Chinese medicine as a therapeutic option for treating numerous ailments.[3] Perfumes and oils frequently incorporate henna leaves and flowers due to their delicate fragrance. When applied to the skin, henna leaves and flowers provide a cooling sensation, making them popular in hot climates to alleviate heat-related discomfort. Traditionally, this plant has been utilized in Ayurveda, Unani, and folk medicine to treat wounds, burns, and various skin ailments as described in Ayurvedic texts. Henna is believed to comprise many active compounds, including fatty acids, proteins, carbohydrates, and phytochemicals. It functions as a natural resource for the manufacture of industrial goods and medications designed to address several diseases.[4] There is an increasing interest in natural wound healing agents, particularly in light of rising antibiotic resistance and the prevalence of chronic wounds. Compounds such as lawsone and flavonoids are known to exhibit anti-inflammatory, antimicrobial, and tissue regeneration properties. The aim is to synthesize current knowledge regarding its wound healing properties, bridging traditional wisdom with scientific validation. Additionally, several studies reported that phytochemical variations exist across the leaves (particularly rich in lawsone), bark, seeds, and roots.

Synonyms: Mention alternative names like henna, Madayanti, Mehndi, etc.

Morphology of Henna: The plant known as "Lawsonia inermis" or "Mehndi" is a member of the Lythraceae family utilized for cosmetic and therapeutic purposes. Despite its North African origins, Lawsonia inermis is cultivated worldwide, including India, Egypt, and Morocco. The plant grows as a glabrous shrub or small tree (2-6 meters). Specific phytochemical variations are seen across leaves (rich in lawsone), flowers, seeds, stems, bark, and roots used medicinally.

Part Used: Each component of the plant is significant, and every constituent has been documented as utilized in the therapy of ailments, akin to other plants.[5&6] A TLC-densitometric investigation revealed varying quantities of lawsone in the dried leaves of L. inermis; nevertheless, TLC image analysis indicated fluctuations in the concentration of this dried substance. This variation indicates that elements such as harvesting timing, ambient circumstances, and processing techniques may affect the concentrations of lawsone in the leaves.[7]

Phytochemistry of Lawsonia inermis[8] & [9]

Lawsonia inermis contains several bioactive constituents, including flavonoids, coumarins, triterpenoids, steroids, xanthones, polyphenols, carbohydrates, fatty acids, alkaloids, quinones, tannins, leucocyandin, epicatechin, catechin, and quercetin.

Key Components and Action of Phytochemicals: 1) Naphthoquinones: Lawsone (2-hydroxy-1, 4-naphthoquinone) as the primary active compound.2) Flavonoids: Quercetin, catechin, epicatechin.3) Phenolics: Gallic acid, tannins. 4)Terpenoids: Lupeol, betulinic acid.5) Glycosides 6) Others: Alkaloids, coumarins, xanthones, fatty acids, etc. Lawsone and phenolic compounds inhibit pathogens in wound infections, reduce pro-inflammatory cytokines, and protect tissue from oxidative stress. Flavonoids and tannins lower the levels of pro-inflammatory cytokines, and increasing the activity of genes like IGF-1 and GLUT-1 helps cells take in more glucose and grow faster. Increased hydroxyproline and fibroblast activity promote extracellular matrix formation.

Wound Healing Mechanism

Wound healing is a natural physiological reaction to tissue injury. The process of wound healing encompasses various phases of wound healing: 1) Haemostasis (clot formation), 2) Inflammation (immune response and debris clearance), 3) Proliferation (tissue regeneration, angiogenesis, collagen synthesis), 4) Remodelling (maturation of scar tissue).

The wound healing process is intricate, including complicated interactions among many cell types, cytokines, mediators, and the vascular system. The primary sequence of vasoconstriction in blood arteries and platelet aggregation aims to halt hemorrhage. Diverse inflammatory cells, beginning with neutrophils, are involved in this process. These inflammatory cells then generate diverse mediators and cytokines to promote angiogenesis, thrombosis, and re-epithelialization. The fibroblasts subsequently secrete extracellular components that serve as scaffolding.[10] The inflammatory phase includes hemostasis, immune cell recruitment, and increased vascular permeability, which reduces additional harm, aids healing, removes necrotic cells and pathogens, and enhances cellular motility. The inflammatory phase generally endures for multiple days.[11] The maturation or remodelling phase commences approximately in the third week and may persist for up to twelve months. The surplus collagen deteriorates, and wound contraction reaches its zenith around the sixth week. Wound contraction is significantly more pronounced during secondary healing than during primary healing. The incision wound reaches its peak tensile strength approximately 11 to 14 weeks post-surgery. The final scar will never possess 100% of the original wound's strength, achieving only approximately 80% of its tensile strength.[12] The complex process of wound healing requires that a good wound dressing has several important features: it should keep the wound moist, allow air to pass through, be safe for the body, break down naturally, not be harmful, help stimulate healing, be easy to put on and take off, deliver helpful substances to the wound, and protect against infections and germs.[13] The rise of infections that are resistant to multiple drugs makes it harder to create better wound dressings that are both effective at fighting bacteria and helping wounds heal well. These challenges necessitate innovative approaches in materials science and microbiology to create dressings that not only combat resistant pathogens but also promote tissue regeneration. Researchers are studying nanotechnology and bioactive compounds to improve these dressings and clinical efficacy. Bioactive compounds in medicinal plants possessing antibacterial and antifungal characteristics can facilitate a more rapid and effective wound healing process. Certain herbal medications appear to operate through many mechanisms and demonstrate their therapeutic effects at different phases of the wound healing process. Herbal medication also promotes angiogenesis, fibroblast cell proliferation, and the creation of provisional extracellular matrix (ECM). Herbal extracts and natural products have immunomodulatory and anti-inflammatory properties that expedite the wound healing process.

Ethnobotanical uses of L. inermis

Researchers have utilized the leaves as an expectorant and hematinic for the treatment of febrile illnesses, hemicranias, cephalgias, and leukoderma ophthalmia.[14] Traditional practitioners utilize the leaves to treat wounds and ulcers, as well as to prevent skin inflammation.[15] The bark has been employed to prevent dermatological issues, calculous disorders, splenomegaly, hepatomegaly, and jaundice. Warrier et al. (2004) indicate that its blooms possess refrigerant, cardiotonic, febrifuge, soporific, analgesic, cognitive impairment, and insomnia effects. Acharya Sushruta has mentioned L. inermis (Madayanti) as a remedy for chronic wounds, malignant ulcers, etc.[16]

Wound Healing Potentials

Certain animal studies utilizing A) excision wound models have demonstrated that ethanol extracts (e.g., 200 mg/kg) expedite wound contraction, achieving a 71% reduction in wound area compared to 58% in control groups, as well as promoting epithelialization; B) incision wound models exhibited increased skin breaking strength and hydroxyproline content, a marker for collagen; C) dead space models indicated improved granulation tissue formation; D) histological analyses suggested enhanced collagen organization, an increased presence of fibroblasts, and reduced inflammatory cell counts in the treated groups.[17] Addition of L. inermis extract to gelatin gels and films increased the antioxidant activity in wound tissues by boosting the levels of antioxidant enzymes like catalase(CAT), superoxide dismutase(SOD) and glutathione(GSH) peroxidase which helped accelerate wound healing.[18]

DISCUSSION

The article explores the use of L. inermis extracts in modern wound management, highlighting their therapeutic potential. It advocates for synergistic approaches, mechanistic studies, clinical trials, and the standardization of extracts. Integrating traditional knowledge with modern scientific research can unlock the benefits of L. inermis, improving patient outcomes and fostering innovation in wound care therapies. This holistic approach enhances the credibility of traditional remedies and encourages collaboration among scientists, healthcare providers, and indigenous communities, revolutionizing wound care.

CONCLUSION

The field of wound care is rapidly evolving, with technological advancements and new products significantly enhancing the healing process. We advocate for using henna as a wound-healing agent, highlighting its various mechanisms of action. Emphasize its alignment with the global trend toward natural therapies. Encourage further research to transform traditional knowledge into evidence-based healthcare practices. This review examines the phytochemicals in henna and their potential applications in treating infections, such as chronic wounds, and in developing new products for various health concerns.

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