Current Research in Pharmaceutical Sciences
Available online at www.crpsonline.com

ISSN: 2250 – 2688

Received: 07/01/2026
Revised: 09/02/2026
Accepted: 20/02/2026
Published: 08/04/2026

Mukul Rakse[1], Prashant Pachori[1], Tejram Basor[1], Jasvan Meena[2]
1.Department of Pharmacy, Swami Vivekanand College of Pharmacy, Madhya Pradesh, India

2.Shri vaishnavi institute of pharmacy, Madhya Pradesh, India

Correspondence

Mukul Rakse
Department of Pharmacy, Swami Vivekanand College of Pharmacy, Madhya Pradesh, India

Email: mukulrakse05@gmail.com

DOI: 10.24092/CRPS.2026.160101

Website: www.crpsonline.com

Quick Response Code:

MEDICINAL PLANTS IN WOUND HEALING: A COMPREHENSIVE REVIEW OF PHYTOCHEMICALS, MECHANISMS, AND THERAPEUTIC POTENTIAL

Mukul Rakse, Prashant Pachori, Tejram Basor, Jasvan Meena

ABSTRACT

Wound healing is a complex and coordinated biological process involving hemostasis, inflammation, proliferation, and tissue remodeling. Delayed or impaired healing remains a significant challenge, particularly in chronic and infected wounds. Medicinal plants have attracted scientific interest as potential sources of natural wound-healing agents because of their diverse pharmacological activities and phytochemical composition. This review summarizes available scientific evidence on medicinal plants used in wound management, with emphasis on bioactive constituents and mechanisms of action. Flavonoids, tannins, alkaloids, terpenoids, saponins, and phenolic compounds have been associated with antioxidant, antimicrobial, anti-inflammatory, and tissue-regenerative activities. These constituents may support fibroblast proliferation, collagen synthesis, angiogenesis, re-epithelialization, and wound contraction while reducing oxidative stress and excessive inflammation. Aloe vera, Azadirachta indica, Curcuma longa, Centella asiatica, and Calendula officinalis have shown promising wound-healing properties in experimental and some clinical studies. Plant-based formulations and advanced wound-dressing systems are also being investigated. Further clinical studies, extract standardization, dose optimization, quality control, and safety evaluation are required for wider clinical use.

Key words: Medicinal plants; wound healing; phytochemicals; herbal medicine; wound management; antioxidant; anti-inflammatory; collagen synthesis.

1 INTRODUCTION

Wound healing is a complex and dynamic biological process through which damaged tissue restores its structural integrity and protective function. Skin acts as the primary barrier between the internal environment of the body and external surroundings; therefore, any disruption caused by trauma, burns, surgery, infection, or other injuries can compromise this protective function. Successful wound repair requires the coordinated interaction of inflammatory cells, keratinocytes, fibroblasts, endothelial cells, extracellular matrix components, and numerous signaling molecules. The healing process is generally described as four overlapping and interconnected phases: hemostasis, inflammation, proliferation, and tissue remodeling[1].

Immediately after tissue injury, hemostasis occurs to control bleeding and to establish a temporary fibrin-rich matrix at the wound site. This is followed by the inflammatory phase, during which immune cells migrate into the injured area and help remove microorganisms, damaged tissue, and cellular debris[2]. The proliferative phase involves fibroblast activity, formation of granulation tissue, angiogenesis, collagen deposition, and re-epithelialization.

Finally, during the remodeling phase, the newly formed extracellular matrix undergoes reorganization and maturation, resulting in increased tensile strength of the repaired tissue. Although these stages are commonly presented separately, they overlap considerably and are regulated by complex cellular and molecular interactions[3].

Disruption of any stage of the normal healing cascade can lead to delayed healing, excessive scarring, or chronic wounds. Factors such as microbial infection, persistent inflammation, oxidative stress, impaired angiogenesis, and inadequate collagen formation may interfere with tissue repair. Chronic wounds represent an important clinical challenge because they may remain in an inflammatory state and fail to progress normally toward tissue regeneration and remodeling. Consequently, the development of effective, affordable, and safe approaches for wound management remains an important area of biomedical and pharmaceutical research[4].

Medicinal plants have been used traditionally for the treatment of wounds and other skin disorders for centuries. Their continued use has attracted scientific interest because plants contain a wide range of biologically active secondary metabolites that may act on different stages of the healing process. Important phytochemical groups associated with wound-healing activity include flavonoids, phenolic compounds, tannins, alkaloids, terpenoids, and saponins[5]. These constituents have been reported to possess antioxidant, antimicrobial, anti-inflammatory, and tissue-regenerative properties, which may collectively support wound repair.

The potential wound-healing activity of medicinal plants may involve several mechanisms. Plant-derived compounds can help control microbial contamination, reduce excessive inflammatory responses, neutralize reactive oxygen species, stimulate fibroblast proliferation, enhance collagen synthesis, and support angiogenesis and re-epithelialization[6]. Such multiple biological activities are particularly relevant to wound repair because successful healing depends on the timely coordination of several physiological processes rather than on a single molecular target.

Several medicinal plants, including Aloe vera, Centella asiatica, Curcuma longa, Azadirachta indica, and Calendula officinalis, have been investigated for their potential wound-healing effects in experimental and clinical research. Studies have evaluated different plant parts, extracts, isolated phytochemicals, and topical formulations, with evidence suggesting that certain preparations can influence wound contraction, collagen deposition, inflammatory responses, microbial growth, and tissue regeneration[7-9]. However, the activity of a medicinal plant can vary considerably depending on species, plant part, extraction method, phytochemical composition, dosage, formulation, and method of application[10].

In recent years, research has increasingly focused on combining traditional medicinal knowledge with modern pharmacological and formulation approaches. Novel delivery systems, including advanced topical formulations and nanotechnology-based systems, are being investigated to improve the stability, bioavailability, targeted delivery, and therapeutic effectiveness of plant-derived compounds[11-12]. Despite promising experimental findings, differences in extract standardization, dosage, study models, and clinical evidence remain important limitations[13]. Therefore, systematic evaluation of the available evidence is necessary to better understand the therapeutic potential and safety of medicinal plants in wound management[14-16].

The present review aims to summarize the available scientific literature on medicinal plants used in wound healing, with particular emphasis on their major phytochemical constituents, pharmacological properties, mechanisms of action, and evidence from experimental and clinical studies. The review also discusses the potential advantages, limitations, and future prospects of plant-based approaches for the development of effective wound-healing therapies.

2. MATERIAL AND METHODS

2.1 Literature Search Strategy

A comprehensive literature search was conducted to identify published scientific information concerning medicinal plants and their potential role in wound healing. Relevant literature was searched using electronic databases including PubMed, Scopus, Web of Science, ScienceDirect, and Google Scholar. Additional relevant articles were identified by screening the reference lists of selected publications. Similar database-based approaches have been used in previous reviews of medicinal plants and wound healing[17].

The search was performed using combinations of the following keywords and related terms: “medicinal plants,” “wound healing,” “wound repair,” “plant extracts,” “phytochemicals,” “herbal medicine,” “skin regeneration,” “antioxidant,” “anti-inflammatory,” “antimicrobial,” “collagen synthesis,” and “tissue regeneration.” Boolean operators such as AND and OR were used to broaden or refine the search.

2.2 Selection of Literature

Articles were initially screened on the basis of their titles and abstracts. Potentially relevant publications were then assessed through full-text evaluation. Studies were selected when they provided information regarding medicinal plants, plant-derived

compounds, phytochemical constituents, mechanisms of wound healing, or experimental and clinical evidence related to wound repair[18].

2.3 Inclusion Criteria

The following types of literature were considered:
Peer-reviewed research articles and review articles related to medicinal plants and wound healing. In vitro, in vivo, and clinical studies investigating wound-healing activity. Studies describing phytochemical constituents associated with wound repair. Publications discussing antioxidant, antimicrobial, anti-inflammatory, collagen-promoting, angiogenic, or tissue-regenerative effects. Articles available in English with sufficient scientific information.

2.4 Exclusion Criteria

Articles were excluded when they were unrelated to wound healing or medicinal plants, lacked sufficient scientific information, were duplicate publications, or were non-scientific sources. Publications for which the full text or relevant data could not be evaluated were also excluded[19].

2.5 Data Extraction and Analysis

Relevant information from the selected literature was systematically extracted and organized according to plant species, family, plant part used, major phytochemicals, type of extract or preparation, experimental model, reported wound-healing activity, proposed mechanism, and available clinical evidence. Particular attention was given to the relationship between phytochemical composition and biological activity. The collected evidence was synthesized narratively to compare the wound-healing potential of different medicinal plants and their major bioactive constituents[20].

2.6 Evidence summary

The findings from the reviewed literature indicate that medicinal plants possess considerable potential as supportive therapeutic agents in wound healing. A wide range of medicinal plants and their bioactive constituents have demonstrated wound-healing effects through multiple pharmacological activities, including antioxidant, antimicrobial, anti-inflammatory, and tissue-regenerative actions. These properties are important because oxidative stress, microbial infection, and prolonged inflammation can interfere with the normal progression of wound repair. Several plants, including Aloe vera, Centella asiatica, Curcuma longa, Azadirachta indica, and Calendula officinalis, have been frequently investigated for their wound-healing properties. Experimental evidence suggests that their extracts or isolated constituents may enhance wound contraction, fibroblast proliferation, collagen deposition, angiogenesis, and re-epithelialization. The reported activities are generally associated with phytochemicals such as flavonoids, phenolic compounds, tannins, terpenoids, saponins, alkaloids, and polysaccharides. The reviewed studies also demonstrate that medicinal plants may influence more than one phase of the wound-healing process. Their antimicrobial effects may help control wound contamination, while antioxidant and anti-inflammatory activities may reduce tissue damage and excessive inflammatory responses. In addition, certain plant-derived compounds have been associated with enhanced collagen synthesis, extracellular matrix formation, and tissue remodeling, thereby supporting the restoration of damaged tissue.

However, the strength of available evidence varies considerably among medicinal plants. A substantial proportion of the available research is based on in vitro and animal models, whereas comparatively fewer studies have established efficacy and safety through well-controlled clinical trials. Differences in plant species, geographical origin, plant parts, extraction methods, phytochemical composition, dosage, formulation, and experimental models also make direct comparison between studies difficult.

3. RESULTS AND DISCUSSION

Medicinal plants have been used traditionally for the management of wounds because of their wide range of biological activities. In recent years, scientific investigations have focused on identifying the phytochemicals and molecular mechanisms responsible for the wound-healing effects of these plants. Available evidence from in vitro, in vivo, and clinical studies indicates that several medicinal plants may influence different stages of wound repair, including inflammation, cell proliferation, collagen formation, angiogenesis, re-epithelialization, and tissue remodeling.

The wound-healing activity of medicinal plants is generally associated with secondary metabolites such as flavonoids, phenolic compounds, tannins, alkaloids, terpenoids, saponins, and polysaccharides. These constituents may provide antioxidant and antimicrobial effects, regulate inflammatory responses, and stimulate cellular processes involved in tissue regeneration. Flavonoids and phenolic compounds, for example, have been investigated for their ability to reduce oxidative stress and inflammatory mediators, while certain terpenoids and polysaccharides have been associated with collagen production, fibroblast activity, and tissue repair.

Among the medicinal plants investigated for wound healing, Aloe vera has received considerable attention because of its polysaccharides and other bioactive constituents. Experimental

studies suggest that Aloe vera preparations may support fibroblast proliferation, collagen deposition, angiogenesis, and re-epithelialization. Centella asiatica has also been widely investigated, particularly for its triterpenoid constituents and their potential role in collagen synthesis and tissue regeneration.

Curcuma longa is another important medicinal plant studied for wound management. Curcuminoids, particularly curcumin, have demonstrated antioxidant and anti-inflammatory activities and have been investigated for their effects on tissue repair. Similarly, Azadirachta indica contains several bioactive constituents and has traditionally been used in the management of skin disorders and wounds. Calendula officinalis has also been evaluated for its anti-inflammatory and tissue-repairing properties.

The mechanisms through which plant-derived compounds influence wound healing are diverse. At the molecular level, phytochemicals may modulate signaling pathways associated with inflammation, oxidative stress, cellular proliferation, angiogenesis, and extracellular matrix remodeling. NF-κB, MAPK, Nrf2, TGF-β, and VEGF-related pathways have been discussed in relation to the biological effects of different plant-derived compounds.

Despite promising findings, considerable variation exists among studies with respect to plant species, plant parts, extraction procedures, extract concentrations, formulations, experimental models, and outcome measures. Therefore, the observed wound-healing effects cannot always be directly compared between studies. Standardization of plant materials and extracts, identification of active constituents, appropriate dose determination, toxicity evaluation, and well-designed clinical studies are necessary to establish the therapeutic value of medicinal plants.

4. FUTURE SCOPE

The increasing interest in medicinal plants for wound management provides significant opportunities for future research and therapeutic development. Although several medicinal plants have demonstrated promising wound-healing properties in experimental studies, further research is required to establish their clinical effectiveness and safety. Future investigations should focus on the identification and characterization of specific bioactive compounds responsible for wound-healing activity and on understanding their molecular mechanisms of action.

Standardization of medicinal plant materials and extracts is another important area for future development. Variations in plant species, cultivation conditions, geographical origin, harvesting time, extraction procedures, and phytochemical composition can influence therapeutic activity. Establishing standardized extraction methods, quality-control parameters, dosage ranges, and marker compounds may improve the reproducibility and reliability of plant-based preparations.

Advanced drug-delivery approaches may further enhance the therapeutic potential of medicinal plants. The development of herbal gels, creams, hydrogels, films, nanofibers, nanoparticles, and other advanced wound-dressing systems could improve the stability, controlled release, penetration, and localized delivery of plant-derived bioactive compounds. Such approaches may be particularly useful for chronic, infected, or difficult-to-heal wounds.

Future studies should also place greater emphasis on well-designed clinical trials to validate findings obtained from laboratory and animal studies. Clinical research should evaluate parameters such as wound-closure rate, healing time, infection control, scar formation, patient safety, tolerability, and quality of life. Long-term safety and possible interactions with conventional medicines should also be investigated.

CONCLUSIONS

Medicinal plants represent a valuable and promising source of therapeutic agents for wound healing. The literature reviewed in this article indicates that various medicinal plants possess multiple pharmacological properties, including antioxidant, antimicrobial, anti-inflammatory, and tissue-regenerative activities, which may contribute to the different stages of wound repair. Bioactive constituents such as flavonoids, phenolic compounds, tannins, terpenoids, saponins, alkaloids, and polysaccharides have been associated with important processes such as wound contraction, fibroblast proliferation, collagen synthesis, angiogenesis, and re-epithelialization.

Plants such as Aloe vera, Centella asiatica, Curcuma longa, Azadirachta indica, and Calendula officinalis have shown encouraging wound-healing potential in experimental investigations. Their ability to influence several biological pathways simultaneously makes medicinal plants attractive candidates for the development of complementary and novel wound-care therapies.

Despite these promising findings, the available evidence is not sufficient to establish all plant-based preparations as standardized clinical treatments. Variations in plant materials, extraction methods, phytochemical composition, dosage, formulations, and experimental models remain major challenges. In addition, many reported effects are based on in vitro and animal studies, while robust clinical evidence is comparatively limited.

Therefore, future research should focus on standardization of plant extracts, identification of active constituents, detailed mechanistic investigations, toxicity

assessment, advanced drug-delivery systems, and well-designed clinical trials. Overall, medicinal plants have substantial potential in wound management, and systematic scientific investigation may contribute to the development of safe, effective, affordable, and evidence-based plant-derived wound-healing therapies.

The authors sincerely thank the faculty members and mentors for their valuable guidance, encouragement, and support throughout the preparation of this review article. We also acknowledge the contributions of researchers whose published scientific literature provided valuable information for this review. The authors are grateful to the institution for providing the necessary academic resources and facilities to complete this work.

REFERENCES

1. González AC, Costa TF, Andrade ZA, Medrado ARAP. Wound healing—A literature review. Anais Brasileiros de Dermatologia. 2016;91(5):614–620. doi:10.1590/abd1806-4841.20164741.
2. Sagaste CA, Montero G, Coronado MA, Ayala JR, León JÁ, García C, Rojano BA, Rosales S, Montes DG. Creosote Bush (Larrea tridentata) extract assessment as a green antioxidant for biodiesel. Molecules. 2019 May 8;24(9):1786.https://doi.org/10.3390/molecules24091786.
3. Thangapazham RL, Sharad S, Maheshwari RK. Phytochemicals in wound healing. Advances in wound care. 2016 May;5(5):230-41.https://doi.org/10.1089/wound.2013.0505.
4. Suntar I, Akkol EK, Nahar L, Sarker SD. Wound healing and medicinal plants: A review. Journal of Ethnopharmacology. 2012;143(2):448–462.
5. Dwivedi S, Kumar V, Paliwal S. Plant medicines of Indian origin for wound healing activity: A review. Wounds. 2003;15(10):304–313.
6. Boakye YD, Agana TA, Oteng-Amankwah EA, Boamah VE, Agyare C. Evidence-based review of medicinal plants for the management of onchocerciasis. Natural Products in Vector-Borne Disease Management. 2023 Jan 1:27-49.https://doi.org/10.1016/B978-0-323-91942-5.00004-5.
7. Thakur R, Jain N, Pathak R, Sandhu SS. Practices in wound healing studies of plants. Evidence-Based Complementary and Alternative Medicine. 2011;2011:438056. doi:10.1093/ecam/nep029.
8. Arribas-López E, Zand N, Ojo O, Snowden MJ, Kochhar T. A systematic review of the effect of Centella asiatica on wound healing. International Journal of Environmental Research and Public Health. 2022;19(6):3266. doi:10.3390/ijerph19063266.
9. Orsolic N. A comprehensive review of the therapeutic potential of medicinal plants in wound healing. Phytotherapy Research. 2023.
10. Suntar I, Khan H, Patel S, Celik G, Sureda A. An overview of the phytochemical and therapeutic potential of medicinal plants in wound healing. Biomedicine & Pharmacotherapy. 2018.
11. Vitale S, Colanero S, Placidi M, Di Emidio G, Tatone C, Amicarelli F, D'Alessandro AM. Phytochemistry and biological activity of medicinal plants in wound healing: an overview of current research. Molecules. 2022 Jun 1;27(11):3566.https://doi.org/10.3390/molecules27113566.
12. Witkowska K, Paczkowska-Walendowska M, Garbiec E, Cielecka-Piontek J. Topical application of Centella asiatica in wound healing: Recent insights into mechanisms and clinical efficacy. Pharmaceutics. 2024;16(10):1252. doi:10.3390/pharmaceutics16101252.
13. Vijayakumar G, Kim HJ, Jo JW, Rangarajulu SK. Macrofungal mediated biosynthesis of silver nanoparticles and evaluation of its antibacterial and wound-healing efficacy. International Journal of Molecular Sciences. 2024 Jan 10;25(2):861.https://doi.org/10.3390/ijms25020861.
14. Sivamani RK, Lam ST, Isseroff RR. Phytochemicals and naturally derived substances for wound healing. Advances in Wound Care. 2012;1(4):213–217.
15. Atalay MS, Avcıkurt AS, Tosun SG. The effects of Althaea officinalis L. extract on cell viability, invasion, and apoptosis in prostate cancer. Journal of Uludağ University Medical Faculty. 2025 Aug 12;51(3):457-65.https://doi.org/10.32708/uutfd.1760397.
16. Quave CL, Lyles JT, Kavanaugh JS. Wound healing with botanicals: A review and future perspectives. Current Dermatology Reports. 2018;7:287–295.
17. Swastini DA, Martien R, Fachiroh J, Nugroho AE. Ethnopharmacology and bioactive evidence of medicinal plants for wound healing in Indonesia: a scoping review. Journal of Applied Pharmaceutical Science. 2025 May 5;15(6):010-30.https://dx.doi.org/10.7324/japs.2025.211952.
18. Pazyar N, Yaghoobi R, Kazerouni A. Skin wound healing and phytomedicines: A review. Journal of Dermatological Treatment. 2014;25(2):113–120.
19. Nair SS, Mathew M, Sreena K. Evaluation of wound healing activity of medicinal plants and their phytoconstituents. International Journal of Pharmaceutical Sciences Review and Research. 2012.
20. Dutta P, Dasgupta D, Banerjee S, Roy T, Saha P, Patra S, Bandyopadhyay S, Majumdar S. advancing therapeutics through a: integrating pharmacological mechanisms and natural product research. Genetics and Molecular Research. 2026 Aug 12.https://doi.org/10.4238/c4q51r71.