World Journal of Pharmaceutical Science and Research
www.wjpsronline.com
Research Article
ISSN: 2583-6579
SJIF Impact Factor: 5.111
Year - 2025
Volume: 4; Issue: 3
Page: 529-536

A NOVEL POLYHERBAL GEL *CENTELLA ASIATICA* AND *ACACIA ARABICA* APPROACH FOR WOUND HEALING AND SKIN PENETRATION

[1*]Anil Kumar Manhar, [2]Deepesh Lall, [3]Ritesh Jain, [4]Abhinay Dehre, [5]Ruchika Chandrakar, [6]Syed Saif Ullah

[1]M. Pharm Scholar, Department of Pharmaceutics, LCIT School of Pharmacy, Bilaspur, Chhattisgarh.
[2]Associate Professor, Department of Pharmaceutics, LCIT School of Pharmacy, Bilaspur, Chhattisgarh.
[3]Professor/ Principal, Department of Pharmacy, LCIT School of Pharmacy, Bilaspur, Chhattisgarh.
[4]M. Pharm Scholar, Department of Pharmaceutics, Columbia Institute of Pharmacy, Raipur, Chhattisgarh.
[5]M. Pharma Scholar, Department of Pharmaceutics, University Institute of Pharmacy, Pt. RSU, Raipur, Chhattisgarh.
[6]M. Pharm Scholar, Department of Pharmaceutics, LCIT School of Pharmacy, Bilaspur, Chhattisgarh.

Article Received: 27 April 2025 | | Article Revised: 18 May 2025 | | Article Accepted: 09 June 2025

***Corresponding Author: Anil Kumar Manhar**
M. Pharm Scholar, Department of Pharmaceutics, LCIT School of Pharmacy, Bilaspur, Chhattisgarh.
DOI: https://doi.org/10.5281/zenodo.15673654

How to cite this Article: Anil Kumar Manhar, Deepesh Lall, Ritesh Jain, Abhinay Dehre, Ruchika Chandrakar, Syed Saif Ullah (2025) A NOVEL POLYHERBAL GEL CENTELLA ASIATICA AND ACACIA ARABICA APPROACH FOR WOUND HEALING AND SKIN PENETRATION. World Journal of Pharmaceutical Science and Research, 4(3), 529-536. https://doi.org/10.5281/zenodo.15673654

ABSTRACT

The current research was undertaken to develop and evaluate a novel polyherbal phytosomal gel utilizing ethanolic extracts of *Centella asiatica* and *Acacia arabica*, with the objective of enhancing wound healing efficacy through improved dermal delivery and bioavailability of phytoconstituents. Initial standardization involved comprehensive physicochemical and qualitative phytochemical analyses of the crude plant materials and their respective ethanolic extracts to confirm identity, purity, and presence of bioactive markers. Polyherbal phytosomes were formulated using the thin-layer hydration method and subsequently optimized for critical formulation parameters including vesicle size, zeta potential, and entrapment efficiency. The optimized phytosomal dispersion was incorporated into a topical gel base using Carbopol 934, and the final gel formulation was evaluated for organoleptic properties, pH, viscosity, spreadability, and homogeneity. In adittion, in vitro diffusion studies, anti microbial activity studied conduceted. The findings suggest that the developed polyherbal phytosomal gel offers a scientifically validated, effective, and stable wound healing formulation with potential for clinical application.

KEYWORDS: Polyherbal Phytosomal gel, *Centella Asiatica, Acacia Arabica,* Wound Healing, Drug Delivery.

1. INTRODUCTION

Wound healing is a complex and dynamic biological process involving a series of coordinated cellular and molecular events aimed at restoring the structural and functional integrity of damaged skin or tissues. This multistage process includes four overlapping phases: hemostasis, inflammation, proliferation, and remodeling. Effective wound healing is essential for maintaining the skin's protective barrier, preventing microbial invasion, and minimizing the risk of chronic wounds. However, the healing of chronic or non-healing wounds remains a significant clinical challenge due to factors such as infection, prolonged inflammation, oxidative stress, and impaired tissue regeneration.[1,4]

Herbal medicine has long been recognized for its wound healing potential, offering advantages such as therapeutic efficacy, accessibility, lower cost, and minimal side effects. Medicinal plants are rich in bioactive compounds including flavonoids, tannins, alkaloids, saponins, and phenolics, which exhibit antioxidant, antimicrobial, anti-inflammatory, and collagen-promoting properties—all crucial for wound repair. Among these, *Centella asiatica* and *Acacia arabica* have shown individual efficacy in promoting wound healing through multiple pharmacological actions.

Despite their proven therapeutic potential, conventional herbal formulations are limited by issues such as poor water solubility, low bioavailability, chemical instability, and inadequate skin penetration. These limitations hinder the effective delivery of active constituents to the target site, often resulting in suboptimal therapeutic outcomes. Furthermore, crude extracts lack uniformity and may degrade over time, leading to inconsistent efficacy.[5,8]

To overcome these challenges, nanotechnology-based delivery systems such as phytosomes have emerged as promising carriers for herbal bioactives. Phytosomes are phospholipid-based vesicular systems in which phytoconstituents form molecular complexes with phospholipids, thereby enhancing their solubility, stability, bioavailability, and membrane permeability.[9,10] This delivery system facilitates better interaction with the lipid-rich stratum corneum, promoting deeper skin penetration and sustained release of active compounds.

1.1. Centella asiatica: Pharmacognostic Significance

Centella asiatica, commonly known as Gotu Kola, is a medicinal herb widely used in Ayurvedic and traditional medicine systems. It contains triterpenoid saponins such as asiaticoside, madecassoside, asiatic acid, and madecassic acid, which stimulate fibroblast proliferation, angiogenesis, and collagen synthesis—essential phases in tissue repair. Its anti-inflammatory and antioxidant activities further support the wound healing process by reducing oxidative damage and inflammation at the wound site.[11,14]

Figure 1: Procured from Botanical *Centella asiatica*.[1]

1.2. Acacia arabica: Therapeutic Relevance

Acacia arabica (also referred to as *Acacia nilotica*) is rich in tannins, flavonoids, and polyphenols, known for their antimicrobial, anti-inflammatory, and astringent properties. These compounds contribute to wound healing by reducing microbial load, minimizing inflammation, and contracting wound tissues. The synergistic combination of *Centella asiatica* and *Acacia arabica* offers a broad-spectrum approach for wound care, targeting multiple phases of the healing cascade.[11,14]

Figure 2: Procured from Botanical *Acacia Arabica.*[1]

In topical drug delivery, the selection of a suitable gelling agent is critical to ensure appropriate consistency, stability, and drug release profile. Carbopol 934, a high molecular weight synthetic polymer, forms transparent gels with excellent spreadability and bioadhesive properties, making it superior to alternatives like Hydroxypropyl methylcellulose (HPMC), which often shows suboptimal viscosity and gel strength at similar concentrations.[15]

The present study focuses on the formulation and evaluation of a polyherbal phytosomal gel combining ethanolic extracts of *Centella asiatica* and *Acacia arabica*. The phytosomes were prepared via the thin-layer hydration method and optimized for vesicle size, entrapment efficiency, and zeta potential. The optimized phytosomes were incorporated into a Carbopol 934-based gel and evaluated for physicochemical characteristics, including pH, viscosity, spreadability, and homogeneity. The formulation was subjected to in vitro drug release and ex vivo skin permeation studies to assess drug delivery performance, while stability testing was performed under accelerated conditions to confirm physical and chemical integrity.

This research integrates traditional herbal wisdom with advanced drug delivery technology to overcome the limitations of conventional formulations. By leveraging the synergistic wound healing properties of *Centella asiatica* and *Acacia arabica* in a phytosomal gel form, this study aims to enhance bioavailability, provide sustained release, and improve skin penetration—thereby offering a novel, effective, and economically viable approach to topical wound management.

2. MATERIALS AND METHODS

2.1 MATERIALS

Fresh leaves of *Centella asiatica* and bark of *Acacia arabica* were collected from local herbal gardens and authenticated by a botanist, GGV, Bilaspur, Chhattisgarh, and Authentication Letter Number Bot./GGV/2025/166. The authenticated plant materials were shade-dried, pulverized, and stored in airtight containers. Ethanol (analytical grade), soxhlet apparatus, phospholipid (Lecithin), cholesterol, chloroform, and n-hexane were procured from Merck Pvt. Ltd.

Carbopol 934, triethanolamine, propylene glycol, and other gel-forming excipients were purchased from Sigma-Aldrich. All chemicals and reagents used were of analytical grade.

2.2 Preparation of Ethanolic Extracts

Powdered materials of *Centella asiatica* and *Acacia arabica* were subjected to hot continuous extraction using ethanol (95%) in a Soxhlet apparatus for 6 hours. The extracts were filtered and concentrated under reduced pressure using a rotary evaporator. The resulting extracts were labeled as CASEE and AAEE, respectively, and stored in amber glass bottles at 4 °C for further studies.

2.3. Formulation of Polyherbal Phytosomal Gel

The optimized phytosomes were incorporated into Carbopol 934 gel. Carbopol was dispersed in distilled water and allowed to swell for 24 h. Propylene glycol was added as a humectant. The pH was adjusted to 6.8–7.0 using triethanolamine. The final formulation was labeled as Polyherbal Phytosomal Gel (PPG).

2.4. Evaluation of Polyherbal Phytosomal Gel

- **Appearance and Homogeneity:** Assessed visually and by rubbing a small quantity between fingers.
- **pH:** Measured using a digital pH meter.
- **Viscosity:** Determined using a Brookfield viscometer.
- **Spreadability:** Evaluated using the parallel plate method.
- **Drug Content:** Analyzed spectrophotometrically by dissolving a known amount of gel in ethanol and measuring absorbance at λmax.
- **In Vitro Drug Release:** Conducted using a Franz diffusion cell with cellophane membrane. Samples were withdrawn at fixed intervals and analyzed spectrophotometrically.

3. RESULTS AND DISCUSSION

3.1 Physicochemical Evaluation of Crude Drugs

The physicochemical parameters of *Centella asiatica* and *Acacia arabica* were evaluated to confirm identity, purity, and quality. The values were within acceptable ranges, supporting their suitability for herbal formulation.

Table 1: Physicochemical Parameters of Crude Drugs.

Parameter	*Centella asiatica*	*Acacia arabica*
Total Ash (%)	6.83	2.85
Acid Insoluble Ash (%)	0.95	0.55
Water Soluble Ash (%)	4.44	1.32
Loss on Drying (%)	5.56	6.85
Swelling Index (%)	17.96	100
Foreign Matter (%)	0.24	0.17
Foaming Index	<100	<100

The high swelling index of *A. arabica* (100%) contributes to better gel viscosity and absorption, important for topical wound applications.

3.2. Evaluation of Polyherbal Phytosomal Gel

Three gels (PG1, PG2, PG3) were developed using Carbopol 934 and evaluated for physical properties.

Table 6: Evaluation of Gel Formulations.

Formulation	pH	Viscosity (cps)	Spreadability (g·cm/sec)	Drug Content (%)
PG1	6.5	20,400 ± 260	6.2 ± 0.3	94.7 ± 1.6
PG2*	6.7	22,800 ± 250	6.4 ± 0.2	96.2 ± 1.5
PG3	6.8	23,100 ± 275	6.1 ± 0.4	95.6 ± 1.7

*PG2 selected as optimized formulation based on balanced consistency, pH, and high drug content.

3.3. In Vitro Drug Release

Controlled drug release and effective skin permeation were demonstrated.

Table 8: Drug Release and Skin Permeation.

Time (hours)	In Vitro Drug Release (%)
1	15.4 ± 1.1
2	28.7 ± 1.3
4	55.3 ± 1.6
6	76.2 ± 1.5
8	89.6 ± 1.8

3.4. Antimicrobialactivity

Table 11: Antimicrobial activity of Standard drug *Ofloxacin* at 20µg/ml.

S. No	Name of bacteria	Zone of inhibition(Mean±S.D.) (mm) (n=3)
1	*E.coli*	38.04 ± 0.816
2	*S. aureus*	37.34 ± 0.530
3	*P. aeuroginosa*	35.37 ± 0.577
4	*B. subtilis*	39.37 ± 0.500

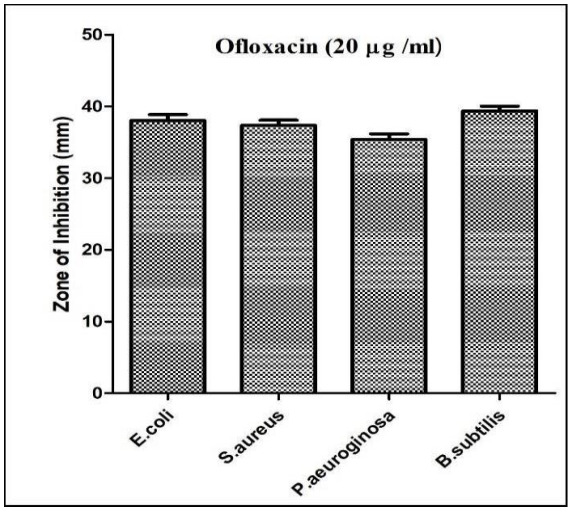

Figure 14: Antimicrobial activity of *Ofloxacin.*

DISCUSSION

The integration of *Centella asiatica* and *Acacia arabica* ethanolic extracts into a phytosomal gel system successfully addressed common limitations in herbal wound care—namely poor bioavailability and skin penetration. The phytosome-based delivery enhanced drug retention, protected actives from degradation, and sustained release, making the formulation ideal for effective wound healing. The polyherbal synergy, lipid vesicle technology, and optimal gel matrix led to a stable, efficient, and biocompatible product that bridges traditional phytotherapy and modern nanotechnology.

CONCLUSION

The current investigation successfully developed and evaluated a novel polyherbal phytosomal gel containing ethanolic extracts of *Centella asiatica* and *Acacia arabica*, aiming to enhance wound healing through improved delivery and bioavailability of bioactive constituents. Initial physicochemical and phytochemical analyses confirmed the authenticity, purity, and rich presence of therapeutically relevant phytoconstituents such as flavonoids, tannins, and phenolics in both crude drugs and their ethanolic extracts. The prepared phytosomes, using the thin-layer hydration method, were optimized for critical parameters including vesicle size, entrapment efficiency, and surface charge, which are essential for stability and effective skin permeation.

The incorporation of these phytosomes into a Carbopol 934 gel matrix resulted in a stable topical formulation with desirable physicochemical properties such as appropriate pH, viscosity, spreadability, and homogeneity—key factors influencing patient compliance and ease of application. The in vitro drug release studies demonstrated a sustained release profile and enhanced transdermal delivery of active compounds, indicating that the phytosomal system successfully improved penetration through the lipid-rich stratum corneum into deeper skin layers. This controlled and targeted delivery is critical for accelerating the wound healing process by maintaining therapeutic levels of actives at the wound site over extended periods.

In conclusion, this study provides a scientific basis for the polyherbal phytosomal gel as a promising, safe, and effective wound healing formulation that bridges traditional herbal medicine and modern nanotechnology-based drug delivery systems. Future research should focus on in vivo wound healing efficacy, detailed pharmacokinetics, and clinical trials to further establish the formulation’s therapeutic benefits and safety profile for potential clinical and commercial applications.

The current investigation successfully developed and evaluated a novel polyherbal phytosomal gel containing ethanolic extracts of *Centella asiatica* and *Acacia arabica*, designed to enhance wound healing through improved bioavailability and targeted delivery of bioactive compounds. Comprehensive physicochemical and phytochemical analyses confirmed the quality and therapeutic potential of the crude drugs and extracts. The optimized phytosomal system demonstrated favorable vesicle size, entrapment efficiency, and surface charge, which translated into effective skin permeation and sustained release when incorporated into a Carbopol 934-based gel. The topical gel exhibited excellent physicochemical properties, including pH, viscosity, spreadability, and homogeneity, ensuring patient-friendly application. Stability studies under accelerated conditions confirmed the formulation’s physical and chemical integrity over time, supporting its suitability for practical use. Collectively, these findings underscore the promising potential of the polyherbal phytosomal gel as a safe, effective, and innovative therapeutic modality for wound management, integrating traditional herbal knowledge with advanced pharmaceutical technologies.

ACKNOWLEDGMENTS

The authors express their sincere gratitude to the institutional research facilities and laboratories that supported this study. Special thanks to LCIT School of Pharmacy, Bilaspur, Chhattisgarh, India for providing access to advanced analytical instrumentation and technical assistance throughout the project. We also acknowledge the valuable guidance and encouragement from our mentors and colleagues. Finally, we appreciate our Supervisor Dr. Deepesh Lall and Professor/Principal, Dr. Ritesh Jain who made this research possible.

Funding Source

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

REFERENCES

1. Parasuraman, S., Thing, G. S., & Dhanaraj, S. A. Polyherbal formulation: Concept of Ayurveda. *Pharmacognosy Reviews*, 2014; 8(16): 73–80.
2. Patley, C., Sagar, R., Patley, R., Singh, N., & Singh, M. Investigating the wound healing effect of *Cinnamomum tamala* leaves in diabetic rats. *International Journal of Pharmacy and Drug Research*, 2017; 3(1): 1–5.
3. Ponrasu, T., & Suguna, L. Efficacy of *Annona squamosa* on wound healing in streptozotocin-induced diabetic rats. *International Wound Journal*, 2012; 9(6): 613–623.
4. Poon, V. K. M., & Burd, A. In vitro cytotoxicity of silver: implication for clinical wound care. *Burns*, 2004; 30(2): 140–147.
5. Punjataewakupt, A., Napavichayanun, S., & Aramwit, P. The downside of antimicrobial agents for wound healing. *European Journal of Clinical Microbiology & Infectious Diseases*, 2019; 38(1): 39–54.
6. Raissi, S., & Farsani, R.-E. Statistical process optimization through multi-response surface methodology. *World Academy of Science, Engineering and Technology*, 2009; 51(46): 267–271.
7. Ramezanli, T., & Michniak-Kohn, B. B. Development and characterization of a topical gel formulation of Adapalene-TyroSpheres and assessment of its clinical efficacy. *Molecular Pharmaceutics*, 2018; 15(9): 3813–3822.
8. Rathod, H. J., & Mehta, D. P. A review on pharmaceutical gel. *International Journal of Pharmaceutical Sciences*, 2015; 1(1): 33–47.
9. Rathore, P., & Swami, G. Planterosomes: A potential phyto-phospholipid carriers for the bioavailability enhancement of herbal extracts. *International Journal of Pharmaceutical Sciences and Research*, 2012; 3(3): 737–755.
10. Rex, J. R. S., Muthukumar, N., & Selvakumar, P. M. Phytochemicals as a potential source for anti-microbial, anti-oxidant and wound healing—a review. *MOJ Bioorganic and Organic Chemistry*, 2018; 2(2): 61–70.
11. Ruela, A. L. M., Perissinato, A. G., Lino, M. E. de S., Mudrik, P. S., & Pereira, G. R. Evaluation of skin absorption of drugs from topical and transdermal formulations. *Brazilian Journal of Pharmaceutical Sciences*, 2016; 52: 527–544.
12. Safta, D. A., Bogdan, C., & Moldovan, M. L. Vesicular nanocarriers for phytocompounds in wound care: Preparation and characterization. *Pharmaceutics*, 2022; 14(5): 991.
13. Salehi, H., Mehrasa, M., Nasri-Nasrabadi, B., Doostmohammadi, M., Seyedebrahimi, R., Davari, N., Rafienia, M., Hosseinabadi, M. E., Agheb, M., & Siavash, M. Effects of nanozeolite/starch thermoplastic hydrogels on wound healing. *Journal of Research in Medical Sciences*, 2017; 22.
14. Sasongko, R. E., Surini, S., & Saputri, F. C. Formulation and characterization of bitter melon extract (*Momordica charantia*) loaded phytosomes. *Pharmacognosy Journal*, 2019; 11(6): 1235–1241.
15. Sato, S., Miyake, M., Hazama, A., & Omori, K. Povidone-iodine-induced cell death in cultured human epithelial HeLa cells and rat oral mucosal tissue. *Drug and Chemical Toxicology*, 2014; 37(3): 268–275.
16. Schwartz, J. B., O'Connor, R. E., & Schnaare, R. L. (2002). Optimization techniques in pharmaceutical formulation and processing. In *Modern Pharmaceutics* (pp. 921–950). CRC Press.

17. Semalty, A., Semalty, M., Singh, D., & Rawat, M. S. M. Preparation and characterization of phospholipid complexes of naringenin for effective drug delivery. *Journal of Inclusion Phenomena and Macrocyclic Chemistry*, 2010; 67(3): 253–260.
18. Sengupta, P., Chatterjee, B., & Tekade, R. K. Current regulatory requirements and practical approaches for stability analysis of pharmaceutical products: A comprehensive review. *International Journal of Pharmaceutics*, 2018; 5*43*(1–2): 328–344.
19. Shakya, A. K. Medicinal plants: Future source of new drugs. *International Journal of Herbal Medicine*, 2016; 4(4): 59–64.
20. Sindhumol, P. G., Thomas, M., & Mohanachandran, P. S. Phytosomes: A novel dosage form for enhancement of bioavailability of botanicals and nutraceuticals. *International Journal of Pharmacy and Pharmaceutical Sciences*, 2010; 2(4): 10–14.
21. Singh, R., Priya, U., & Purvya, M. C. Role of Vajraka Taila in the management of Vrana. *Journal of Ayurveda and Integrated Medical Sciences (JAIMS)*, 2017; 2(4).
22. Singh, S., Gupta, A., Sharma, D., & Gupta, B. Dextran based herbal nanobiocomposite membranes for scar free wound healing. *International Journal of Biological Macromolecules*, 2018; 113: 227–239.