Jurnal Ilmu Farmasi dan Farmasi Klinik
(Journal of Pharmaceutical Science and Clinical Pharmacy)
ISSN 1693-7899 (print) - 2716-3814 (online)
DOI: 10.31942/jiffk.v21i1.9529

Nanoformulations of Plant Extracts for Psoriasis Treatments: A Systematic Review

M Ainun Najib Aly[1], Jauharotus Shobahah[2], Febyana Noor Fadlilah[3], Tristiana Erawati[1,4], Sukardiman[1]*

[1] Department of Pharmaceutical Sciences, Faculty of Pharmacy, Airlangga University, Surabaya, East Java, Indonesia
[2] Department of Mathematic and Natural Science, Faculty of Science and Technology, Airlangga University, Surabaya, East Java, Indonesia
[3] College of Bioengineering, Chongqing University, Chongqing, 400030, China
[4] Skin and Cosmetic Technology (SCT) Centre of Excellent, Faculty of Pharmacy, Airlangga University, Surabaya, East Java, Indonesia

ABSTRACT: Psoriasis is a chronic inflammatory skin disorder that affects the cutaneous and immune systems. The inflammatory responses play a vital role in the pathophysiology and progression of psoriasis. The disease manifests as flaking, hardened, and erythematous plaques. Herbal medicines from plant extracts offer a promising treatment for psoriasis with extensive benefits and minimum toxicity. Nanoformulations have been expansively utilized for improving topical drug absorption from plant extracts because of the ability to increase epithelium permeability and bioavailability, thus extending the bioactivity of drugs in the subcutaneous skin. This study aim to illustrate excellent evidence of the effectiveness and safety of plant extracts nanoformulations for psoriasis management to encourage its clinical application. Numerous databases were systematically explored, including PubMed, ScienceDirect, SpringerLink, Scopus, and Google Scholar, from December 2024 to January 2025 using the keywords "Nano AND Plant Extracts AND Psoriasis". Overall, only six (6) articles met the inclusion criteria. Nanoformulations appear nontoxic and effective in psoriasis treatment and have a significant positive effect on the pathophysiology of the disease. Research reveals that it eliminates skin lesions, reduces the severity of pruritus, and lowers the recurrence rate. This study will give insight into the valuable medicinal plants and provide a reference for future studies on psoriasis treatment. A precise pharmacological and clinical evaluation of these medicinal plants is mandatory to assess their active compounds.

Keywords: Autoimmune; Nanoparticle; Nanotechnology; Plant Extracts; Psoriasis.

*Corresponding author:
Name : Sukardiman
Email : sukardiman@ff.unair.ac.id
Address : Faculty of Pharmacy, Airlangga University, Surabaya, East Java, Indonesia

INTRODUCTION

Psoriasis is a chronic papulosquamous cutaneous skin and an inflammatory skin disease mediated by the immune system, so the inflammatory response portrays a vital role in the progress and severity of this disease (Terhorst et al., 2015). The global prevalence of psoriasis is around 2–3% of the world population. According to the World Psoriasis Day consortium, there were 125 million cases of psoriasis recorded worldwide (Sewerin et al., 2019; Armstrong et al., 2021; Damiani et al., 2021).

There are several subtypes of psoriasis that can affect various age groups, but the most common is the plaque type, or psoriasis vulgaris (Griffiths et al., 2021). Psoriasis generally covers the scalp, back, and extensors of the extremities, especially the knees, elbows and lumbosacral area. Psoriasis has distinctive characteristics that are different from other skin diseases. This condition is indicated by the presence of red, scaly plaques due to hyperproliferation and unusual keratinocyte differentiation (Nair and Badri, 2023; Armstrong and Read, 2020).

The National Psoriasis Foundation defines severe psoriasis as affecting more than 10%, while 3 to 10% is considered moderate, and less than 3% of the body is mild. However, the severity of psoriasis is also measured by how it affects a person's quality of life. Nearly one-quarter of people with psoriasis have cases that are considered moderate to severe (Helmick et al., 2014). About 60% of patients with psoriasis reported their disease to be a large problem in their everyday life (Stern et al., 2004).

Currently, there has been significant progress in the treatment of psoriasis. However, this approach encourages adverse side effects and recurrent relapses. Some conventional treatments (antihistamines) are only limited to treating itching symptoms in psoriasis patients or even worsen the prognosis of psoriasis if treatment is stopped (Armstrong and Read, 2020). Biological agents, such as TNF-α and Interleukin-17 (IL-17) inhibitors, effectively treat itching symptoms in psoriasis patients, but some patients cannot obtain these drugs because they are costly and have a high risk of side effects. Therefore, the development of effective and efficient drugs for psoriasis is still a big challenge.

Herbal medicine is now starting to attract the attention of many patients with its high value of treatment effectiveness with the benefit of minimal side effect (Salm et al., 2023). The topical route of administration is the best route of administration, especially for treating diseases involving changes in skin etiology (Kim and Jesus, 2023). Unfortunately, topical preparations have weaknesses, including low drug levels that enter the skin due to poor penetration of the active drug ingredients through it. However, this can be overcome using a nanoparticle system as an advanced drug delivery system, because of its capability to increase the penetration of bioactive molecules into the skin, enhance drug admission in the target area, increase the chemical and physical stability of drugs and switch the discharge of active compounds (Chiangnoon et al., 2022).

Nanoformulations are one of the most promising efforts to achieve controlled drug release, simultaneous delivery of drug therapy and minimizing dose of drug (Elmowafy, 2021). So, nanoparticle-based herbal preparation formulations are critical to help increase the bioavailability and permeability of active medicinal ingredients derived from plant extracts (Algahtani et al., 2020). Nanoformulations start develop very widespread with researchers recently. This review summarizes several studies that have carried out plant extracts nanoformulations.

METHODS

This review article was directed using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines (Page et al., 2021). This article focused on nanoformulations of plant extracts for psoriasis treatment.

Exploring, Screening and assembling articles were accomplished online from December 2024 to February 2025 using the keywords "nano" AND "plant extracts" AND "Psoriasis" in numerous online databases, such as PubMed, ScienceDirect, SpringerLink, Scopus and Google Scholar. The primary sequence of screening involved systematic inspection of the article results to classify any cases of duplication.

Afterward, we separated and detached the notorious duplicate articles from the others. After the article separation procedure, the arranging process remained, including deleting articles that fall within the exclusion criteria: 1) The article is review articles, systematic reviews, case reports, conference abstracts, editorials, letters to the editor and proceedings, 2) Does not use nanoformulations, 3) Without *in vivo* studies of psoriasis, 4) Using active compound from natural resources. While the inclusion conditions for this study: 1) Nanoformulations for psoriasis treatment, 2) The article was issued from 2000 until 2025, 3) Using plant extracts and, 4) The article is in English.

RESULTS AND DISCUSSION

The initial exploration identified a total of 7656 articles, including 524 articles in Scopus, 159 articles in ScienceDirect, four articles in PubMed, 39 articles in SpringerLink, and 6930 articles in Google Scholar. Of the thousands of articles, there are still too rare researches that discuss nano formulations of plant extracts for psoriasis therapy. Only six articles that fulfilled the inclusion criteria were detected, and these articles were resumed in this literature review, as displayed in Table 1.

Table 2 presents a comparison of the formulations of the six articles. They use different surfactants and methods to form stable polymers. The best preparation among all nanoformulations is nanogel of *Pongamia pinnata* with particle size around 116 nm and zeta potential around -21.40 mV. The resulting nanogel preparation is quite stable as observed from the characteristics of the preparation. Stability studies revealed that all the formulation endured stable under various storage conditions, ensuring prolonged shelf life.

Ex vivo drug retention studies confirmed that the nanoformulations significantly improved retention on psoriatic skin, ensuring prolonged drug availability compared to the conventional extracts. The ex vivo permeation studies from Non-aqueous nanoemulsion (NANE) of *Alpinia galanga* using porcine skin revealed a 10-fold increase in drug flux for the nanoemulsion compared to the crude extracts, confirming improved bioavailability. This is the best improvement among the other six formulations. The higher bioavailability of drug makes it a more effective vehicle for delivering it to psoriatic skin. Table 1 displays the *in vivo* psoriasis results of nanoformulated plant extracts.

Table 1. *In vivo* psoriasis results of nanoformularted plant extracts

Plant	Dosage form	Experimental Animal Induction	Results	References
Alpınıa galanga (Zingiberaceae)	Non-aqueous Nano Emulsion NANE (Topical)	Mice were induced with 62.5 mg 5% Imiquimod (IMQ) cream for 7 days, once a day on hairless dorsal part of the mice and the behind part of the right ear.	• PASI score, ear thickness, spleen to body weight index, histological investigation of abaxial skin and antioxidant enzyme assess stated the comprehensive healing of psoriatic injuries.	Ramanunny et al., 2022
Artemisia monosperma (Asteraceae)	Nanoemulsion (Topical)	Mice were induced with 62.5 mg 5% Imiquimod (IMQ) cream for 7 days, once a day on mice's hairless skin area.	• Decreased PASI Score and Repaired histopathological changes in psoriasis skin. • Upgraded systemic side effects including decreasing body weight and escalating the spleen weight and spleen index. • Ameliorated skin inflammatory cytokines involve IL-6, IL-17 and TNF-α. • Downregulated NF-κβ, GSK-3β and Ki67 expression level.	Tawfik et al., 2024
Boswellia serrata (Bruseraceae)	Nano Emulsion Gel (Topical)	Mice were induced with 62.5 mg 5% Imiquimod (IMQ) cream for 10 days, once a day onto the right ear superficial male Balb/c mice.	• Decreased body weight and also the psoriatic itch, length, thickness of inflammation skin. • Escalated manifestation levels of three genes including IL-23, IL-17 and TNF-α	Fereidouni et al., 2024
Hedyotis corymbosa (Rubiaceae)	Nanophytosomal Gel (Topical)	Rats were induced with 80 mg 5% Imiquimod (IMQ) cream for 7 days, several times a day on rat ears or dorsal skin.	• The treatment successfully repaired hyperkeratosis, epithelial width (acanthosis), and inflammatory cell permeation. • Downregulated Inflammatory Cytokines mediators (IL-1β, IL-17, IL-6, IL-22, monocyte chemotactic protein 1 (MCP-1/CCL2) and TNF-α.	Singh et al., 2024
Hypericum perforatum (Hypericaceae)	Nanophytosomal Gel (Topical)	Mice were induced with 62.5 mg 5% Imiquimod (IMQ) cream for 7 days, once a day on shaved skin measuring 2 cm × 3 cm.	• Reduced PASI scores and recovered skin integrity • The cream also inhibited inflammatory markers such as IL-6, IL-17, MCP-1, and IFN-.	Singh et al., 2024
Pongamia pinnata (Fabaceae)	Nanogel (Topical)	Mice were induced with 62.5 mg 5% Imiquimod (IMQ) cream for 7 days, once a day on shaved backs skin measuring 2 cm × 3 cm.	• Improved PASI score • The skin appearance was restored by reducing the significant thickening of the stratum corneum and irregular keratin and decreased granular layer, hyperkeratosis and parakeratosis	Telange et al., 2024

Table 2. Nanoformulations of plant extracts for psoriasis treatment.

Nanoformulations	Methods	Formulation	Results	References
Non-aqueous Nano Emulsion NANE of *Alpınıa galanga*	Spontaneous emulsification	Oil phase: Medium-chain triglycerides (MCT oil) Surfactant: Cremophor RH 40, Co-surfactant: Transcutol P Non-aqueous polar phase: Glycerin	Particle Size: 60.81 nm Zeta potential: -7.99 mV Polydispersity index (PDI): 0.113 Drug release: 82.72%in 30 hours pH: 5.88 Viscosity: 1.450 mPa.s Spreadability: 1,685.39 mm	Ramanunny et al., 2022
Nanoemulsion of *Artemisia monosperma*	Phase inversion method	Surfactant: Tween 80 Co-surfactant: Ethanol	Particle Size: 228 nm Zeta potential:-9.4 mV Polydispersity index (PDI): 0.406 pH: 5.8 Viscosity: 12.50 cp	Tawfik et al., 2024
Nano Emulsion Gel of *Boswellia serrata*	Ultrasonic Method	Oil phase: Isopropyl myristate Surfactant: Tween 80 Co-surfactant: Ethanol	Particle Size: 38.75 nm Zeta potential: 0.33 mV Polydispersity index (PDI): 0.2 pH: 6.5 Viscosity: 47,000 cps	Fereidouni et al., 2024
Nanophytosomal Gel of *Hedyotis corymbosa*	Thin film hydration process	Oil phase: Leciva-S90 Surfactant: Tween 80 Co-surfactant: Ethanol and Chloform (2:1)	Particle Size: 86.11 nm Zeta potential: -10.40 mV Polydispersity index (PDI): 0.116 Entrapment Efficiency: 73.05% Drug release: 83.09%in 24 hours pH: 6.5	Singh et al., 2024
Nanophytosomal Gel of *Hypericum perforatum*	Ultrasonic Method	Gelling agent: Carbopol 980P Chelating agent: Triethanolamine	Particle Size: 168 nm Zeta potential: -10.37mV Entrapment Efficiency: 69.68%	Singh et al., 2024
Nanogel of *Pongamia pinnata*	Ultrasonic Method	Silver nanoparticles (AgNPs) Gelling agent: Carbopol 980P Chelating agent: Triethanolamine Emollient: Propylene glycol Preservatives: Metyl and propylparaben (1:1)	Particle Size: 116 nm Zeta potential: -21.40 mV Polydispersity index (PDI): 0.393 Entrapment Efficiency: 79.35% Drug release: 89.19%in 24 hours pH: 6.8 Viscosity: 56,000 cps	Telange et al., 2024

This improvement is attributed to the nano-sized particles ability to penetrate deeper into the epidermal layer, forming a submicron film that disrupts the stratum corneum structure for better absorption. Non-nanoformulations typically exhibit lower retention and faster clearance, necessitating frequent application and reducing therapeutic

efficiency. Additionally, dermatokinetic modeling exposed higher drug retention in the epidermis and dermis layers, suggesting that the nanoformulations enhance localized drug concentration while reducing systemic absorption. Overall, these studies provide compelling evidence that nanoformulations outperform conventional formulations in treating psoriasis due to their enhanced skin penetration, stability, and therapeutic effects.

The *in vivo* study using an imiquimod-induced psoriasis mouse model provided further evidence of the nano-formulation's superiority. Utilizing an imiquimod-induced psoriasis mice model, the treated mice exhibited significant amelioration of psoriasis symptoms, including reduced scaling, erythema, and epidermal thickness. Histopathological analysis confirmed that treated skin had near-normal architecture, while non-nano treatments failed to achieve similar healing. Additionally, gene expression analysis exposed a significant reduction in inflammatory cytokines (IL-17, IL-22, IL-6, TNF-α, and MCP-1/CCL2) which play a crucial role in psoriasis pathogenesis.

Several natural compounds have demonstrated potential as anti-psoriatic agents, offering alternative or complementary approaches to conventional treatments. Quercetin and Gallic acid, both flavonoids (with quercetin also being listed separately as Hc flavonoid) from *Hedyotis corymbosa*, possess notable anti-inflammatory and antioxidant properties, which can help modulate the inflammatory pathways involved in psoriasis. The compound 1'-acetoxychavicol acetate (ACA), an fenilpropanoid from *Alpınıa galanga*, has also shown promise in suppressing pro-inflammatory cytokines relevant to the pathogenesis of psoriasis.

Similarly, Karanjin, a flavonoid from *Pongamia pinnata*, exhibits anti-inflammatory and immunomodulatory effects that may alleviate psoriatic symptoms. Furthermore, Acetyl-11-keto-b-boswellic acid (AKBA), a Boswellia triterpene, is known for its strong ability to block pro-inflammatory enzymes, which may help reduce the inflammation and rapid skin cell growth seen in psoriasis. While *Artemisia monosperma* aromatic compounds as a broad category may contain substances with anti-inflammatory or other beneficial properties. These natural compounds warrant further investigation for their potential integration into anti-psoriatic therapeutic strategies.

Overall, this study highlights the promise of nanoformulations from plant extracts an effective alternative for psoriasis treatment. These studies suggest that nano-based formulations can overcome the limitations of conventional herbal treatments, offering better efficacy and stability with reduced side effects. However, forthcoming research should explore clinical trials to validate these results, establish the formulation's long-term safety and efficacy in human subjects to discover their potential in human applications.

CONCLUSION

This systematic review shows that research regarding nanoformulations of plant extracts for psoriasis treatment is still infrequent. In fact, nanoformulations of plant extracts have proven to be very effective and efficient as psoriasis therapy. All studies have proven that nanoformulations reveal better results in psoriasis recovery compared than the others. It verifies that the nanoformulations are able to increase bioavailability and enhance drug permeability through the skin. In conclusion, nanoformulations of plant extracts possibly will be a promising candidate for psoriasis therapy.

ACKNOWLEDGMENT

The authors are grateful for the research funding delivered by Indonesia Endowment Fund for Education Agency, Ministry of Finance, Republic of Indonesia.

AUTHOR CONTRIBUTION

MANA: Concepts or ideas; design; manuscript preparation.
MANA, JS, FNF: literature search; data analysis.
JS: Manuscript editing; manuscript review.
TE, S: Supervision.

ETHICS APPROVAL

None to declare

CONFLICT OF INTEREST

None to declare

REFERENCES

Algahtani, M. S., Ahmad, M. Z., Nourein, I. H., & Ahmad, J. 2020. Co-Delivery of Imiquimod and Curcumin by Nanoemugel for Improved Topical Delivery and Reduced Psoriasis-Like Skin Lesions. Biomolecules, 10(7), 968. https://doi.org/10.3390/biom10070968

Armstrong, A. W., & Read, C. 2020. Pathophysiology, Clinical Presentation, and Treatment of Psoriasis: A Review. JAMA; 323(19), 1945–1960. https://doi.org/10.1001/jama.2020.4006

Armstrong AW, Mehta MD, Schupp CW, Gondo GC, Bell SJ, Griffiths CEM. Psoriasis Prevalence in Adults in the United States. JAMA Dermatol. Published online June 30, 2021. doi:10.1001/jamadermatol.2021.2007

Chiangnoon, R., Samee, W., Uttayarat, P., Jittachai, W., Ruksiriwanich, W., Sommano, S. R., Athikomkulchai, S., & Chittasupho, C. 2022. Phytochemical Analysis, Antioxidant, and Wound Healing Activity of Pluchea indica L. (Less) Branch Extracts Nanoparticles. Molecules (Basel, Switzerland); 27(3), 635. https://doi.org/10.3390/molecules27030635

Damiani, G., Bragazzi, N. L., Karimkhani Aksut, C., Wu, D., Alicandro, G., McGonagle, D., Guo, C., Dellavalle, R., Grada, A., Wong, P., La Vecchia, C., Tam, L. S., Cooper, K. D., & Naghavi, M. 2021. The Global, Regional, and National Burden of Psoriasis: Results and Insights from the Global Burden of Disease 2019 Study. Frontiers in medicine; 8, 743180. https://doi.org/10.3389/fmed.2021.743180

Elmowafy M. 2021. Skin penetration/permeation success determinants of nanocarriers: Pursuit of a perfect formulation. Colloids and surfaces. B, Biointerfaces; 203, 111748. https://doi.org/10.1016/j.colsurfb.2021.111748

Fereidouni, M., Shadi, M., Mahmoudian, R. A., Ghasemi, J., Mahzoon, M. E., Faraji, S., & Mansouri, A. 2024. Topical formulation of Boswellia nano emulsion in psoriasis mouse model. Archives of dermatological research; 317(1), 144. https://doi.org/10.1007/s00403-024-03565-1

Griffiths, C. E. M., Armstrong, A. W., Gudjonsson, J. E., & Barker, J. N. W. N. 2021. Psoriasis. Lancet (London, England); 397(10281), 1301–1315. https://doi.org/10.1016/S0140-6736(20)32549-6

Griffiths, C. E., & Barker, J. N. 2007. Pathogenesis and clinical features of psoriasis. Lancet (London, England), 370(9583), 263–271. https://doi.org/10.1016/S0140-6736(07)61128-3

Kim J, De Jesus O. Medication Routes of Administration. [Updated 2023 Aug 23]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK568677/

Helmick CG, Lee-Han H, Hirsch SC, Baird TL, Bartlett CL. Prevalence of psoriasis among adults in the U.S.: 2003-2006 and 2009-2010 National Health and Nutrition Examination Surveys. American journal of preventive medicine. 2014;47(1):37-45.

Nair PA, Badri T. Psoriasis. [Updated 2023 Apr 3]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing; 2025 Jan-. Available from: https://www.ncbi.nlm.nih.gov/books/NBK448194/

Page M J, McKenzie J E, Bossuyt P M, Boutron I, Hoffmann T C, Mulrow C D et al. 2021. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews BMJ 2021; 372 :n71 doi:10.1136/bmj.n71

Ramanunny, A. K., Wadhwa, S., Kumar Singh, S., Kumar, B., Gulati, M., Kumar, A., Almawash, S., Al Saqr, A., Gowthamarajan, K., Dua, K., Singh, H., Vishwas, S., Khursheed, R., Rahana Parveen, S., Venkatesan, A., Paudel, K. R., Hansbro, P. M., & Kumar Chellappan, D. 2022. Topical non-aqueous nanoemulsion of Alpinia galanga extracts for effective treatment in psoriasis: In vitro and *in vivo* evaluation. International journal of pharmaceutics; 624, 121882. https://doi.org/10.1016/j.ijpharm.2022.121882

Salm S, Rutz J, van den Akker M, Blaheta RA and Bachmeier BE. 2023. Current state of research on the clinical benefits of herbal medicines for non-life-threatening ailments. Front. Pharmacol. 14:1234701. doi: 10.3389/fphar.2023.1234701

Sewerin, P., Brinks, R., Schneider, M., Haase, I., & Vordenbäumen, S. 2019. Prevalence and incidence of psoriasis and psoriatic arthritis. Annals of the rheumatic diseases; 78(2), 286–287. https://doi.org/10.1136/annrheumdis-2018-214065

Singh, N., Shaikh, A. M., Gupta, P., Kovács, B., Abuzinadah, M. F., Ahmad, A., Goel, R., Singh, S., & Vinayak, C. 2024. Nanophytosomal Gel of Heydotis corymbosa (L.) Extracts against Psoriasis: Characterisation, In Vitro and *In vivo* Biological Activity. Pharmaceuticals (Basel, Switzerland); 17(2), 213. https://doi.org/10.3390/ph17020213

Singh, N., Yadav, S. D., Gupta, P., Ali, F., & Arora, S. 2024. Dermal Delivery of Hypericum perforatum (L.) Loaded Nanogel: Formulation to Preclinical Psoriasis Assessment. Recent advances in drug delivery and formulation; 18(2), 138–154. https://doi.org/10.2174/0126673878288239240415041832

Stern RS, Nijsten T, Feldman SR, Margolis DJ, Rolstad T. Psoriasis is common, carries a substantial burden even when not extensive, and is associated with widespread treatment dissatisfaction. J Investig Dermatol Symp Proc. 2004;9(2):136-139.

Tawfik, N. F., Abdel-Rashid, R. S., El-Sayed, E. K., Abdel-Moneum, R., Khattab, M. A., Ahmed, A. A., Lai, K. H., Hashad, N., & Moharram, F. A. 2024. Artemisia monosperma essential oil nanoformulations alleviate imiquimod-induced psoriasis-like dermatitis in mice. International immunopharmacology; 139, 112733. https://doi.org/10.1016/j.intimp.2024.112733

Telange, D. R., Mahajan, N. M., Mandale, T., More, S., & Warokar, A. 2024. Pongamia pinnata seed extracts-mediated green synthesis of silver nanoparticle loaded nanogel for estimation of their antipsoriatic properties. Bioprocess and biosystems engineering; 47(8), 1409–1431. https://doi.org/10.1007/s00449-024-03058-5

Terhorst, D., Chelbi, R., Wohn, C., Malosse, C., Tamoutounour, S., Jorquera, A., Bajenoff, M., Dalod, M., Malissen, B., & Henri, S. 2015. Dynamics and Transcriptomics of Skin Dendritic Cells and Macrophages in an Imiquimod-Induced, Biphasic Mouse Model of Psoriasis. Journal of immunology (Baltimore, Md.: 1950); 195(10), 4953–4961. https://doi.org/10.4049/jimmunol.1500551