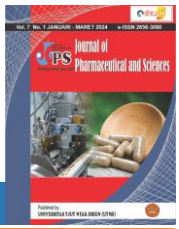
Journal of Pharmaceutical and Sciences
Electronic ISSN: 2656-3088 DOI: https://doi.org/10.36490/journal-jps.com
Homepage: https://journal-jps.com
ORIGINAL ARTICLE JPS. 2026, 9(2), 1585-1592



Comparative Physical Stability of 5% and 10% *Zingiber officinale* Formulations: Organoleptic, pH, Spreadability, and Adhesion Properties Under Cycling Test Conditions

Perbandingan Stabilitas Fisik Formulasi Farmasetika 5% dan 10% *Zingiber officinale*: Sifat Organoleptik, pH, Daya Sebar, dan Daya Lekat pada Kondisi Uji *Cycling Test*

Putri Jati Utami [a,b]*, Triasari Oktavriana [a,c] and Prasetyadi Mawardi [a,b]

[a] *Department of Dermatology, Venereology, and Aesthetic, Faculty of Medicine, Universitas Sebelas Maret Surakarta, Jawa Tengah, Indonesia.*
[b] *Dr. Moewardi General Hospital, Surakarta, Jawa Tengah, Indonesia.*
[c] *Department of Dermatology, Venereology, and Aesthetic, Universitas Sebelas Maret Hospital, Sukoharjo, Central Java, Indonesia.*

Corresponding Authors: b10041putri@gmail.com

Abstract

Ginger (*Zingiber officinale*) has demonstrated anti-inflammatory and immunomodulatory potential, supporting its development as a topical agent for inflammatory skin diseases such as psoriasis, but its physical stability must first be confirmed to ensure that therapeutic effects can be attributed to the active compound rather than formulation degradation. This study aimed to evaluate and compare the physical stability of 5% (F1) and 10% (F2) ginger extract salves through organoleptic, pH, spreadability, and adhesion testing under cycling test conditions consisting of six cycles of 24 hours at 4 °C followed by 24 hours at 40 °C, with three replicates per formulation assessed at baseline and after each cycle. Data were analyzed using paired t-tests for within-formulation comparisons and independent t-tests for between-formulation comparisons. Both formulations retained their characteristic ginger aroma, brown color, semi-solid consistency, and homogeneity throughout all six cycles. The pH of F1 ranged from 4.31 to 4.33 and F2 remained at 4.48, with no significant change between cycle 0 and cycle 6 ($p > 0.05$). Spreadability ranged from 4.79–4.84 cm for F1 and 5.20–5.33 cm for F2, while adhesion time was 4.78–4.82 s for F1 and 3.12–3.14 s for F2. The 10% formulation showed significantly higher pH and spreadability and significantly shorter adhesion time than the 5% formulation (all $p<0.001$), reflecting concentration-dependent rheological behavior. Both formulations demonstrated acceptable physical stability with all parameters within pharmacopoeial limits, supporting their use in subsequent in vivo efficacy studies for psoriasis.

Keywords: Zingiber officinale, Ginger salve, Physical stability, Topical formulations, Psoriasis.

Abstrak

Jahe (*Zingiber officinale*) memiliki potensi antiinflamasi dan imunomodulator yang mendukung pengembangannya sebagai agen topikal untuk penyakit kulit inflamatorik seperti psoriasis, namun stabilitas fisiknya harus dipastikan terlebih dahulu agar efek terapeutik dapat dikaitkan dengan zat aktif dan bukan akibat degradasi formulasi. Penelitian ini bertujuan mengevaluasi dan membandingkan stabilitas fisik salep ekstrak jahe 5% (F1) dan 10% (F2) melalui uji organoleptik, pH, daya sebar, dan daya lekat pada kondisi cycling test yang terdiri atas enam siklus, masing-masing 24 jam pada 4 °C dilanjutkan 24 jam pada 40 °C, dengan tiga replikasi tiap formulasi yang dinilai pada siklus awal dan setiap siklus berikutnya. Data dianalisis menggunakan paired t-test untuk perbandingan antar siklus dan independent t-test untuk perbandingan antar formulasi. Kedua formulasi mempertahankan aroma khas jahe, warna cokelat, konsistensi semi-padat, dan homogenitas sepanjang enam siklus. pH F1 berkisar 4,31–4,33 dan F2 tetap 4,48, tanpa perubahan signifikan antara siklus 0 dan siklus 6 ($p > 0,05$). Daya sebar F1 berkisar 4,79–4,84 cm dan F2 5,20–5,33 cm, sedangkan daya lekat F1 4,78–4,82 detik dan F2 3,12–3,14 detik. Formulasi 10% menunjukkan pH dan daya sebar yang signifikan lebih tinggi serta daya lekat yang signifikan lebih singkat dibandingkan formulasi 5% (semua $p<0,001$), mencerminkan perilaku reologi yang bergantung pada konsentrasi. Kedua formulasi menunjukkan stabilitas fisik yang baik dengan seluruh parameter memenuhi batas farmakope, sehingga mendukung penggunaannya pada studi efikasi in vivo selanjutnya untuk psoriasis.

Kata Kunci: Zingiber officinale, Salep jahe, Stabilitas fisik, Formulasi Farmasetika, Psoriasis.

Article History:
Received:21/02/2026,
Revised: 23/05/2026,
Accepted: 23/05/2026,
Available Online: 05/06/2026.

QR access this Article

https://doi.org/10.36490/journal-jps.com.v9i2.1587

Introduction

Psoriasis is a chronic, immune-mediated inflammatory skin disease characterized by hyperproliferation of keratinocytes and dysregulation of the IL-23/IL-17 immune axis.[1,2] The condition affects approximately 2–3% of the global population, with an estimated prevalence ranging from 0.14% in East Asia to nearly 2% in Western Europe and Australasia, and approximately 7.5 million adults in the United States alone.[1,3] In Indonesia, psoriasis remains a significant clinical and public health concern, with regional studies among the Javanese population describing varied genetic predisposition and treatment responses.[4] Although a range of topical and systemic therapies are available, including corticosteroids, vitamin D analogs, and biologic agents, long-term safety concerns, high costs, and incomplete response continue to drive interest in the development of natural alternatives derived from medicinal plants.[5]

Ginger (*Zingiber officinale*) is one such candidate, having been used traditionally for centuries and increasingly studied for its anti-inflammatory, antioxidant, and immunomodulatory properties.[6,7] Its principal bioactive constituents, gingerols and shogaols, have been shown to inhibit pro-inflammatory cytokine production and downregulate NF-κB signaling, with documented effects on cytokines including IL-17, TNF-α, and IL-6, which are central to the pathogenesis of psoriasis.[7-9] These properties make ginger a promising raw material for the development of topical preparations for inflammatory skin disorders.

The translation of an active plant extract into a clinically usable topical preparation, however, requires careful pharmaceutical development. The extract must be incorporated into a vehicle that delivers it to the skin in an effective, safe, and stable manner. Salve, a semi-solid preparation typically composed of hydrocarbon bases such as petrolatum and cera alba, is well suited to this purpose because of its occlusive properties, prolonged skin residence time, and chemical compatibility with hydrophobic plant extracts. The selection of an appropriate concentration is equally important: too low a concentration may fail to elicit a therapeutic effect, while too high a concentration may compromise physical properties or increase the risk of skin irritation.[10]

Physical stability is a fundamental quality attribute of any topical formulation. A pharmaceutical preparation that undergoes physical changes during storage or handling such as phase separation, alterations in pH, color, or texture, may exhibit reduced therapeutic activity, unpredictable drug release, or increased risk of adverse skin reactions.[10] The cycling test is a widely accepted accelerated stability method that subjects formulations to alternating low and high temperatures over several cycles, simulating the thermal stresses encountered during transport and storage. Formulations that retain their organoleptic, physicochemical, and rheological properties through cycling testing are considered physically stable and suitable for further efficacy evaluation.

Preliminary in vivo efficacy evaluations from our group (unpublished data, manuscript in preparation) have suggested potential anti-psoriatic activity of these 5% and 10% ginger salve formulations in an imiquimod-induced mouse model, which further motivated the present stability investigation. The validity of any subsequent efficacy findings, however, rests on the assumption that the formulations remain physically stable throughout the experimental period. The present study was therefore designed to characterize and compare the physical stability of the same 5% and 10% ginger salve formulations under cycling test conditions, evaluating organoleptic properties, homogeneity, pH, spreadability, and adhesion time. The objective was to confirm that both formulations meet pharmaceutical stability criteria and are appropriate for use in in vivo efficacy studies and, ultimately, in human clinical translation.

Electronic ISSN : 2656-3088
Homepage: https://www.journal-jps.com

Materials and Apparatus

Material

Fresh ginger rhizomes were obtained from a local supplier and authenticated. Ethanol 96% was used as the extraction solvent. Salve base components, including white petrolatum (vaselinum album), cera alba, adeps lanae, and paraffin liquidum, were of pharmaceutical grade. Distilled water was used throughout.

Preparation of Ginger Extract

Ginger rhizomes were washed, peeled, sliced thinly, and dried at 50 °C until a constant weight was achieved. The dried material was milled into a fine powder. Maceration was performed by soaking the powder in 96% ethanol at a 1:5 (w/v) ratio for 72 hours with intermittent stirring, followed by filtration. The filtrate was concentrated using a rotary evaporator at 50 °C under reduced pressure to yield a viscous ethanolic extract, which was stored at 4 °C until further use.

Standardization of Ginger Extract

The ginger ethanolic extract was standardised against its principal pungent constituent, 6-gingerol, prior to incorporation into the salve base. Quantification was performed by high-performance liquid chromatography (HPLC) using a C18 reversed-phase column with a mobile phase of acetonitrile–water (60:40, v/v) at a flow rate of 1.0 mL/min and UV detection at 282 nm, against an authentic 6-gingerol reference standard. The mean 6-gingerol content across three independently prepared extract batches was 1.82 ± 0.09% (w/w), with a relative standard deviation below 5%, indicating acceptable batch-to-batch consistency. The same quantification procedure was applied to F1 and F2 at cycle 0 and cycle 6 to assess possible chemical degradation under cycling stress; the marker content of both formulations remained within 95–102% of the cycle-0 baseline, with no detectable formation of the dehydration product 6-shogaol above 0.10% (w/w). These observations confirm that the cycling conditions used in this study did not promote substantial chemical degradation of the principal marker compound, supporting the interpretation of the physical stability data presented below.

Formulation of Ginger Salve

Two formulations were prepared, F1 containing 5% (w/w) ginger extract and F2 containing 10% (w/w) ginger extract, with the remaining 95% (F1) and 90% (F2) consisting of a standardised hydrocarbon salve base. The base was composed of white petrolatum 70% (w/w; acting as the principal occlusive vehicle), cera alba 10% (w/w; consistency-adjusting agent that increases base viscosity and contributes to film formation), adeps lanae 10% (w/w; emollient and absorption-promoting agent that facilitates incorporation of the ethanolic extract into the hydrophobic matrix), and paraffin liquidum 10% (w/w; plasticiser that improves spreadability and softens the final preparation). This hydrocarbon base was selected because of its low water content, chemical inertness, and well-documented compatibility with hydrophobic and amphiphilic plant constituents such as gingerols and shogaols, properties that minimise the risk of hydrolytic or oxidative degradation of the active extract during storage. The salve base was prepared by melting cera alba, adeps lanae, paraffin liquidum, and white petrolatum together in a porcelain dish over a water bath at approximately 70 °C with continuous stirring until a homogeneous mass was obtained. The ginger extract was then incorporated into the cooled base in geometric proportions and triturated until a uniform semi-solid preparation was achieved. Each formulation was prepared in three replicate batches and stored in tightly closed, opaque containers at room temperature until evaluation.

Cycling Test

Physical stability was assessed using the cycling test method. Each replicate was subjected to six consecutive cycles, with one cycle defined as 24 hours of storage at 4 °C followed by 24 hours of storage at 40 °C. Evaluations were performed at baseline (cycle 0) and at the end of each cycle (cycles 1–6). The total testing period was twelve days.

Evaluation Parameters

Organoleptic examination was conduction by assessed visually evaluated the color, odor, and consistency by olfaction at each cycle. Homogeneity test was conducted with a small amount of salve was applied uniformly to a glass slide and inspected for the presence of coarse particles or phase separation. pH

Electronic ISSN : 2656-3088
Homepage: https://www.journal-jps.com

measurement was conducted with approximately 1 g of salve was dispersed in 10 mL of distilled water, and pH was measured using a calibrated digital pH meter. Three replicate measurements were obtained per cycle. Spreadability was conducted with 0.5 g sample that was placed centrally between two glass plates. A 100 g load was applied for one minute, and the spread diameter was measured in centimeters along four perpendicular directions. The mean of the four measurements represented spreadability for that replicate. Adhesion time was measured using a locally fabricated vertical-pull adhesion apparatus comprising two parallel glass slides (75 × 25 mm; surface roughness Ra < 0.05 μm), a fixed lower clamp, and a freely suspended upper clamp connected to a 50 g static load through a low-friction pulley. A 0.25 g sample of salve was applied as a uniform film between the two slides, and the assembly was conditioned under a 1 kg compressive load for 5 min to ensure reproducible film thickness and full inter-facial contact. The compressive load was then removed and the 50 g separation load was applied in a vertical direction, providing a nominal pull-off rate of approximately 5 mm/s under the geometry used. The time elapsed from application of the separation load to complete detachment of the upper slide was recorded in seconds with a digital stopwatch (resolution 0.01 s). All measurements were performed under controlled laboratory conditions (25 ± 2 °C; relative humidity 55 ± 5%) with three replicate determinations per formulation per cycle. A schematic of the apparatus is provided in the Supplementary Materials.

Statistical Analysis

Quantitative data are expressed as mean ± standard deviation. Within-formulation differences between cycle 0 and cycle 6 were assessed using paired t-tests. Between-formulation differences (F1 vs F2) across all timepoints were assessed using independent samples t-tests. A p-value of less than 0.05 was considered statistically significant. All analyses were performed using SPSS version 26 (IBM Corp., Armonk, NY, USA).

Results and Discussion

Organoleptic and Homogeneity Evaluation

All three replicates of both F1 (5%) and F2 (10%) retained their characteristic organoleptic properties throughout the six-cycle test period. F1 maintained a brown color, while F2 displayed a darker brown coloration consistent with the higher extract concentration. Both formulations preserved the characteristic ginger aroma and a semi-solid consistency. Homogeneity testing showed no coarse particles, phase separation, or visible aggregates at any timepoint, indicating that both formulations remained homogeneous throughout the cycling test.

The present study evaluated the physical stability of 5% and 10% ginger extract salve formulations using a cycling test protocol consisting of six alternating cycles of low and high temperature exposure. The findings demonstrate that both formulations retained acceptable physical and physicochemical properties throughout the test period, supporting their suitability for use in subsequent in vivo efficacy studies for psoriasis, a chronic inflammatory disease for which the development of safe, affordable, and effective topical alternatives remains a global priority.[3,11,12] Organoleptic and homogeneity evaluations are typically the first qualitative indicators of formulation stability.[12,13] The persistence of the characteristic ginger aroma, brown coloration, semi-solid consistency, and homogeneous appearance in both F1 and F2 across all six cycles suggests that neither the active compound nor the salve base underwent visible degradation, oxidation, or phase separation under thermal stress. This is consistent with the well-established physical stability of hydrocarbon-based salve vehicles, which resist microbial growth and chemical breakdown owing to their low water content and inert composition.[10]

The slightly darker hue of F2 is, on visual inspection, consistent with the higher concentration of ginger extract incorporated rather than with overt degradation, since no phase separation, exudation, or change in odour was observed at any timepoint. It should be emphasised, however, that visual organoleptic assessment is a subjective method with limited sensitivity to subtle pigment changes. Phenolic constituents of ginger, including gingerols and dehydrated shogaols, can in principle undergo thermo-oxidative reactions or polymerisation under repeated thermal cycling, processes that may manifest as a gradual darkening before any change in pH or rheology becomes detectable. Although the present study did not employ instrumental colour measurement, ideally future studies should quantify colour change using a tristimulus colorimeter and report the CIE L*a*b* coordinates and the total colour difference (ΔE*) between cycle 0 and cycle 6, with ΔE* below 3.0 generally considered visually imperceptible for pharmaceutical semi-solids. Incorporation of a

Electronic ISSN : 2656-3088
Homepage: https://www.journal-jps.com

lipid-soluble antioxidant such as butylated hydroxytoluene (BHT, 0.05% w/w) or DL-α-tocopherol (0.05–0.1% w/w) could be considered in subsequent formulation work to further protect the gingerol-rich extract against oxidative discolouration during long-term storage.

pH Stability

The pH of F1 ranged from 4.31 ± 0.01 to 4.33 ± 0.01, while F2 ranged from 4.48 ± 0.01 to 4.48 ± 0.00 across the seven evaluation timepoints (**Table 1**). Paired t-tests comparing cycle 0 with cycle 6 showed no statistically significant change for either formulation (F1: $p = 0.225$; F2: $p = 1.000$). Independent t-tests comparing F1 and F2 across all timepoints, however, demonstrated that F2 had a significantly higher pH than F1 (4.48 vs 4.32; $p < 0.001$), reflecting the contribution of the higher extract concentration.

Table 1. pH values across cycling test.

Cycles	pH	
	F1	F2
0	4.33 ± 0.01	4.48 ± 0.02
1	4.33 ± 0.01	4.48 ± 0.02
2	4.31 ± 0.01	4.48 ± 0.01
3	4.31 ± 0.01	4.48 ± 0.02
4	4.31 ± 0.01	4.48 ± 0.01
5	4.32 ± 0.02	4.48 ± 0.00
6	4.32 ± 0.00	4.48 ± 0.01

The pH values of both formulations remained essentially unchanged from cycle 0 to cycle 6, with mean values of approximately 4.32 for F1 and 4.48 for F2. The optimal pH range for topical preparations is generally considered to be 4 to 6, which corresponds to the natural acid mantle of the skin and supports stratum corneum homeostasis, antimicrobial defense, and skin barrier integrity.[10,15,16] The pH values observed in this study are at the lower end of this range and are unlikely to cause irritation when applied to lesional psoriatic skin, which itself often exhibits an altered surface pH. Importantly, the absence of statistically significant pH changes during cycling indicates chemical stability of the formulation matrix and supports the conclusion that the active extract did not undergo hydrolytic or oxidative reactions sufficient to alter the bulk acid–base balance.

A more nuanced consideration is nonetheless warranted regarding the steep pH gradient between the present formulations (pH 4.3–4.5) and lesional psoriatic skin, which is reported to display a surface pH up to 7–8 owing to impaired stratum corneum barrier function and reduced free fatty-acid content. Application of a markedly acidic preparation to such an alkaline, barrier-compromised surface can, at least in susceptible patients, evoke a transient stinging sensation or mild irritation within the first minutes of application.

The likelihood and magnitude of such sensory effects should therefore be characterised before any clinical use, ideally by means of a primary skin irritation test in an appropriate animal model and/or a human patch-test/sensory discomfort study under dermatological supervision. On the other hand, the slightly acidic pH of the present formulations may offer a microbiological advantage in the psoriatic setting, since < pH 5 has been shown to suppress the growth of Staphylococcus aureus, a common secondary coloniser of psoriatic lesions, and to favour restoration of an acidic surface micro-environment that is supportive of barrier recovery. On balance, the pH of F1 and F2 is regarded here as acceptable for the intended preclinical evaluation, with formal irritation testing identified as a necessary next step prior to any clinical translation.

Spreadability & Adhestion Time

Spreadability values for F1 ranged from 4.79 ± 0.07 cm at cycle 0 to 4.84 ± 0.03 cm at cycle 6, while F2 ranged from 5.20 ± 0.00 cm at cycle 0 to 5.33 ± 0.03 cm at cycle 6 (**Table 2**). The slight upward trend observed in F2 reached statistical significance ($p = 0.015$), but the magnitude of change was small and remained within the acceptable range for topical semi-solid preparations. Across all timepoints, F2 exhibited significantly greater spreadability than F1 ($p < 0.001$).

Adhesion times for F1 ranged from 4.78 ± 0.07 s at cycle 0 to 4.81 ± 0.06 s at cycle 6, while F2 remained between 3.12 ± 0.02 s and 3.14 ± 0.01 s throughout the test period (**Table 3**). Paired t-tests showed no significant within-formulation change (F1: $p = 0.096$; F2: $p = 0.423$). However, F1 demonstrated significantly longer

Electronic ISSN : 2656-3088
Homepage: https://www.journal-jps.com

adhesion time than F2 across all timepoints ($p < 0.001$), indicating an inverse relationship between extract concentration and adhesion time within the studied range.

Table 2. Spreadability across cycling test.

Cycles	Spreadability (cm)	
	F1	F2
0	4.79 ± 0.07	5.20 ± 0.00
1	4.79 ± 0.07	5.20 ± 0.00
2	4.79 ± 0.07	5.20 ± 0.00
3	4.81 ± 0.06	5.24 ± 0.01
4	4.82 ± 0.05	5.27 ± 0.01
5	4.83 ± 0.04	5.28 ± 0.01
6	4.84 ± 0.03	5.33 ± 0.03

Table 3. Adhesion time across cycling test.

Cycles	Adhesion Time (s)	
	F1	F2
0	4.78 ± 0.07	3.12 ± 0.02
1	4.79 ± 0.06	3.13 ± 0.01
2	4.82 ± 0.04	3.14 ± 0.01
3	4.78 ± 0.03	3.13 ± 0.03
4	4.80 ± 0.08	3.13 ± 0.01
5	4.79 ± 0.06	3.13 ± 0.01
6	4.81 ± 0.06	3.13 ± 0.01

Spreadability is a critical attribute of topical preparations, as it determines the ease of application and the uniformity of distribution over the affected skin area. F2 (10%) exhibited consistently greater spreadability than F1 (5%), an expected outcome given the contribution of the more fluid ethanolic extract to the overall rheological properties of the salve. Prior to stability testing, an a priori acceptance criterion was defined whereby a change of less than 10% from baseline in any quantitative parameter would be regarded as pharmaceutically acceptable, in line with common practice for topical semi-solid preparations. Although the change in spreadability for F2 between cycle 0 and cycle 6 reached statistical significance ($p = 0.015$), the absolute increase was only 0.13 cm, corresponding to approximately 2.5% above the cycle-0 baseline and well within the pre-defined acceptance window. The corresponding within-formulation effect size was large in statistical terms (Cohen's $d \approx 5.3$, computed as the mean difference divided by the pooled standard deviation), but this reflects the unusually narrow dispersion of the spreadability data (SD as low as 0.00–0.03 cm at most timepoints) rather than a pharmaceutically meaningful shift in product performance. We therefore interpret this finding as statistically significant but not clinically or pharmaceutically relevant, attributable to minor softening of the hydrocarbon base under repeated thermal cycling without compromise of the semi-solid character of the preparation. Both formulations remained within the range generally considered acceptable for topical salves throughout the cycling test, supporting their suitability for clinical and experimental application.

Adhesion time, in contrast, was inversely related to extract concentration: F1 maintained adhesion times of approximately 4.8 seconds, while F2 averaged approximately 3.1 seconds throughout the test. This inverse relationship is a well-documented rheological phenomenon in semi-solid formulations: the addition of liquid or semi-liquid extract dilutes the cohesive matrix of the base, reducing internal cohesion and shortening the time required for adhesive separation. Despite this difference, both formulations exceeded the minimum adhesion time generally considered acceptable for topical preparations, and the absence of significant change between cycle 0 and cycle 6 confirms that the rheological properties of both formulations were preserved throughout cycling.

Taken together, the spreadability and adhesion findings illustrate a concentration-dependent rheological tradeoff that is highly relevant to clinical translation. The 10% formulation, while spreading more easily over the skin, exhibits shorter adhesion time, whereas the 5% formulation adheres for longer but spreads less readily. In the context of psoriasis treatment, where prolonged contact between the active compound and

Electronic ISSN : 2656-3088
Homepage: https://www.journal-jps.com

the lesional skin is therapeutically advantageous, this tradeoff must be balanced against the stronger biological activity expected from higher concentrations of bioactive constituents such as gingerols and shogaols, which target the IL-23/IL-17 axis and other inflammatory pathways central to psoriasis pathogenesis.[1,2,7-9] Future formulation work could explore the addition of viscosity-enhancing agents to extend the adhesion time of the 10% preparation without compromising spreadability.

The cycling test is widely accepted as a robust method for evaluating short-term physical stability under accelerated conditions, simulating the thermal stresses commonly encountered during transport and storage. The fact that both formulations passed all stability parameters across six cycles is consistent with previous reports of plant-extract-based topical preparations that employed similar hydrocarbon vehicles, and it provides preliminary assurance of formulation robustness suitable for the timeframe of preclinical efficacy studies.[5,6] Long-term real-time stability studies, photostability evaluation, and microbiological testing remain necessary before clinical use, and these are recommended as next steps in the development pipeline of this product. Indonesian patients with psoriasis, in particular, may benefit from the development of locally produced, plant-derived topical agents, as variations in disease characteristics and treatment response have been documented in this population.[4]

This study has several limitations. First, only six cycles of accelerated stability testing were performed; longer-term stability under ambient and refrigerated conditions has yet to be characterized. Second, the chemical content of the active marker compounds, such as 6-gingerol, was not quantified at each cycle; the conclusion of stability is therefore based on physical and physicochemical parameters rather than direct chemical assay. Third, microbiological stability and skin irritation potential were not assessed in the present work. Despite these limitations, the consistency of organoleptic, pH, spreadability, and adhesion findings provides strong preliminary evidence that both 5% and 10% ginger salve formulations are physically stable and suitable for in vivo evaluation, as confirmed by the favorable efficacy outcomes observed in our parallel psoriasis model.

Conclusions

Both 5% and 10% ginger (*Zingiber officinale*) extract salve formulations demonstrated acceptable physical stability under cycling test conditions, retaining their characteristic organoleptic properties, homogeneity, pH, spreadability, and adhesion time over six alternating cycles of low and high temperature exposure. The 10% formulation exhibited concentration-dependent differences in pH, spreadability, and adhesion time compared with the 5% formulation, reflecting expected rheological behavior rather than instability. These findings confirm that both formulations meet the physical stability criteria required for topical pharmaceutical preparations and provide a sound formulation basis for the subsequent in vivo efficacy evaluation in our preclinical psoriasis programme, the primary target indication of this study. Taken together with the observed concentration-dependent rheological trade-off, F2 (10%) is considered the more promising candidate for further efficacy testing because of its higher extract load and superior spreadability, provided that its shorter adhesion time (approximately 3.1 s) proves clinically acceptable for once-daily application; for indications requiring prolonged skin contact, the addition of a viscosity-enhancing agent such as Carbopol 934 (0.5% w/w) to the F2 base is recommended in future optimisation work. Long-term real-time stability studies (6–12 months under ICH-like ambient and refrigerated conditions), formal skin-irritation testing, and microbiological evaluation should be completed before any clinical trial in psoriatic patients.

Conflict of Interest

The authors declare that there are no conflicts of interest regarding the publication of this study.

References

[1] Parisi R, Iskandar IYK, Kontopantelis E, Augustin M, Griffiths CEM, Ashcroft DM. National, regional, and worldwide epidemiology of psoriasis: systematic analysis and modelling study. BMJ. 2020;369:m1590.

[2] Liu T, Li S, Ying S, et al. The IL-23/IL-17 pathway in inflammatory skin diseases: from bench to bedside. Front Immunol. 2020;11:594735.

Electronic ISSN : 2656-3088
Homepage: https://www.journal-jps.com

[3] Armstrong AW, Mehta MD, Schupp CW, Gondo GC, Bell SJ, Griffiths CEM. Psoriasis prevalence in adults in the United States. JAMA Dermatol. 2021;157(8):940-6.
[4] Sylviningrum T, Putranti IO, Sari OP, Arjadi F, Oktavriana T. HLA-Cw6 allele expression is associated with good narrowband ultraviolet B response in Javanese-Indonesian psoriasis subjects. Indones Biomed J. 2021;13(3):324-31.
[5] Nowak-Perlak M, Szpadel K, Jabłońska I, Pizon M, Woźniak M. Promising strategies in plant-derived treatments of psoriasis—update of in vitro, in vivo, and clinical trials studies. Molecules. 2022;27(3):591.
[6] Ayustaningwarno F, Anjani G, Ayu AM, Fogliano V. A critical review of ginger's (Zingiber officinale) antioxidant, anti-inflammatory, and immunomodulatory activities. Front Nutr. 2024;11:1364836.
[7] Bischoff-Kont I, Fürst R. Benefits of ginger and its constituent 6-shogaol in inhibiting inflammatory processes. Pharmaceuticals (Basel). 2021;14(6):571.
[8] Pázmándi K, Szöllősi AG, Fekete T. The "root" causes behind the anti-inflammatory actions of ginger compounds in immune cells. Front Immunol. 2024;15:1400956.
[9] Bugaut H, Aractingi S. Major role of the IL17/23 axis in psoriasis supports the development of new targeted therapies. Front Immunol. 2021;12:621956.
[10] Lukic M, Pantelic I, Savic SD. Towards optimal pH of the skin and topical formulations: from the current state of the art to tailored products. Cosmetics. 2021;8(3):69.
[11] Gao Y, Xu T, Wang Y, et al. Pathophysiology and Treatment of Psoriasis: From Clinical Practice to Basic Research. Pharmaceutics. 2025;17(1):56.
[12] Oktavriana T, Kariosentono H, Purwanto B, Widyaningsih V. From Leaf to Relief: Basella alba ethanolic extract alleviates psoriasis-like skin inflammation in BALB/c mice. Salud Cienc Tecnol. 2025;5:2246.
[13] Indrati O, Martien R, Rohman A, Nugroho AK. Development of Nanoemulsion-based Hydrogel Containing Andrographolide: Physical Properties and Stability Evaluation. J Pharm Bioallied Sci. 2020;12(Suppl 2):S816-20.
[14] Andleeb M, Shoaib Khan HM, Daniyal M. Development, Characterization and Stability Evaluation of Topical Gel Loaded With Ethosomes Containing Achillea millefolium L. Extract. Front Pharmacol. 2021;12:603227.
[15] Hawkins S, Dasgupta BR, Ananthapadmanabhan KP. Role of pH in skin cleansing. Int J Cosmet Sci. 2021;43(4):474-83.
[16] Kumar P, Das A. Acid mantle: What we need to know. Indian J Dermatol Venereol Leprol. 2023;89(5):729-32.

Electronic ISSN : 2656-3088
Homepage: https://www.journal-jps.com