IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, May 2026
Impact Factor: 8.2

Formulation and Evaluation of Calamine Lotion Enriched with Aloe vera Gel: A Herbal Approach to Topical Skin Care

Chandresh Kumar[1]*, Dr. Abhishek Soni[1*], Mrs . Isha Sharma[1*],
Dr Chinu Kumari[1], Mr. Nishant Sharma[5]
Student[1]
M. Pharm, PhD in Pharmaceutics, Dean of Pharmacy[2]
M . Pharm, Pharmaceutics[3,5]
M. Pharm, PhD in Pharmacology And HOD of Pharm D[4]
School of Pharmacy, Abhilashi University, Mandi, HP, India
chandreshverma917@gmail.com, Abhisoni.phd@gmail.com
isha010400@gmail.com, chinu990@gmail.com, nts539@gmail.com

Abstract: *Topical skin care preparations play an essential role in dermatological therapy. This study aimed to develop and evaluate a novel calamine lotion incorporating aloe vera gel as a bioactive herbal ingredient. Three formulations (F1, F2, F3) were prepared by combining calamine, zinc oxide, bentonite as a suspending agent, glycerin, aloe vera gel, and purified water in varying proportions. The formulated lotions were subjected to physicochemical and dermatological evaluation including thermal stability, pH determination, patch testing, consistency assessment, and skin irritation testing. All three formulations demonstrated a pH range of 5.8–6.5, compatible with normal skin physiology. Thermal stability studies at 37±1°C and 60–70% relative humidity revealed no phase separation, discoloration, or structural breakdown. The patch test confirmed the absence of hypersensitivity reactions after three repeated applications. Consistency testing revealed a smooth, homogeneous, semi-fluid texture. Skin irritation testing showed no signs of redness, inflammation, or adverse reactions. The integration of aloe vera gel enhanced the moisturizing, anti-inflammatory, antimicrobial, and wound-healing potential of the formulation. The results suggest this herbal calamine lotion is a safe, stable, and efficacious topical preparation with promising applications in management of dry, irritated, and sensitive skin conditions.*

Keywords: Calamine lotion, Aloe vera gel, Topical formulation, Herbal skin care, Zinc oxide, Anti-inflammatory, Moisturizing, Evaluation parameters

I. INTRODUCTION

Topical preparations represent one of the oldest and most widely practiced forms of drug delivery, offering localized therapeutic action without systemic side effects. Among topical dosage forms, lotions occupy a unique position due to their fluid consistency, ease of application over large body surface areas, and superior patient acceptability. A lotion is a liquid or semi-liquid preparation intended for external skin application without friction.

Skin disorders such as pruritus, contact dermatitis, eczema, psoriasis, insect bites, sunburn, and minor abrasions are extremely prevalent globally. These conditions require readily available, safe, and effective topical remedies for rapid symptomatic relief while supporting natural skin repair. Conventional agents such as calamine and zinc oxide have long been employed due to their well-established soothing, protective, astringent, and mild antiseptic properties.

Calamine, a mixture of zinc oxide (ZnO) and a small proportion of ferric oxide (Fe_2O_3), is a classical active pharmaceutical ingredient in topical dermatology. When applied to skin, it provides a cooling sensation through rapid

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429 Volume 6, Issue 9, May 2026 Impact Factor: 8.2

evaporation of the vehicle, depositing a fine protective powder layer that soothes inflamed and irritated surfaces. Zinc oxide contributes complementary astringent and mild antiseptic activity, supporting wound protection and skin barrier restoration.

Aloe vera (Aloe barbadensis Miller), a succulent perennial plant of family Asphodelaceae, has emerged as one of the most extensively investigated medicinal plants for topical applications. Its inner parenchymal gel is rich in bioactive constituents including acemannan, vitamins A, C, and E, amino acids, enzymes (bradykinase, catalase), minerals, and salicylic acid, collectively conferring potent moisturizing, anti-inflammatory, antimicrobial, antioxidant, and wound-healing properties (Marshall, 1990; Atherton, 1998).

The combination of calamine and aloe vera gel in a single lotion represents a rational therapeutic approach offering synergistic benefits — addressing itch relief, skin protection, and active tissue repair simultaneously. The present investigation focuses on preparation of a standardized calamine lotion enriched with aloe vera gel, followed by comprehensive physicochemical and safety evaluation.

II. REVIEW OF LITERATURE

Lachman et al. (2023) examined pharmaceutical suspensions for dermatological use and underscored the necessity for physical stability, uniform particle distribution, and easy redispersibility in calamine-type lotions, drawing attention to the critical role of rheological characterization in predicting shelf-life performance.

Sinko (2022) evaluated quality control parameters including pH, viscosity, sedimentation volume, redispersibility, and spreadability in topical suspension systems, establishing a comprehensive framework for assessing stability and clinical performance of suspension-based topical preparations.

Allen (2022) documented the therapeutic application of calamine lotion as an antipruritic and skin-protective preparation, highlighting the significance of maintaining uniform particle dispersion and appropriate viscosity to ensure consistent drug delivery across the skin surface.

Rowe et al. (2021) identified bentonite and related suspending agents as critical components in preventing sedimentation of insoluble solids in calamine-type lotions, emphasizing that excipient selection directly influences rheological behavior and spreadability.

Aulton and Taylor (2021) reported that physicochemical stability of calamine lotion depends on particle size distribution, suspension viscosity, and proper selection of suspending agents, while highlighting glycerin as an important humectant that improves skin hydration.

Ansel and Allen (2020) confirmed the soothing and protective role of calamine and zinc oxide for common dermatological complaints, reinforcing the importance of ease of redispersion and long-term physical stability in product development.

III. AIM AND OBJECTIVES

Aim

The primary aim of this study was to formulate and evaluate a calamine-based lotion incorporating aloe vera gel as a herbal bioactive ingredient, and to assess its physicochemical properties, safety profile, and suitability for topical dermatological application.

Objectives

The specific objectives were: (i) to prepare calamine lotion formulations (F1, F2, F3) incorporating varying concentrations of aloe vera gel; (ii) to evaluate physicochemical characteristics including pH, thermal stability, and texture; (iii) to assess safety through patch testing and skin irritation studies; (iv) to determine the moisturizing, anti-inflammatory, and wound-healing potential; and (v) to identify the most stable and efficacious preparation.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, May 2026
Impact Factor: 8.2

IV. MATERIALS AND METHODS

Materials

Calamine (IP grade), zinc oxide (IP grade), bentonite (pharmaceutical grade), glycerin (BP grade), aloe vera gel (freshly extracted or standardized commercial grade), liquefied phenol (preservative), and purified water (freshly prepared, USP compliant) were procured from certified pharmaceutical suppliers. All reagents and excipients were of analytical and pharmaceutical grade.

Formulation Design

Three formulations (F1, F2, F3) were developed with varying proportions of aloe vera gel, keeping core ingredients consistent with the Indian Pharmacopoeia (IP) standard formula. The design was guided by the need to optimize moisturizing efficacy, physical stability, and skin compatibility.

Table 1: Composition of Calamine Lotion Formulations (per 100 mL)

Ingredient	F1	F2	F3	Function
Calamine	8 g	8 g	8 g	Soothing, antipruritic
Zinc Oxide	8 g	8 g	8 g	Antiseptic, astringent
Bentonite	2 g	2 g	2 g	Suspending agent
Glycerin	2 mL	2 mL	2 mL	Humectant
Aloe vera Gel	5 mL	10 mL	15 mL	Herbal bioactive
Liquefied Phenol	0.5 mL	0.5 mL	0.5 mL	Preservative
Purified Water	q.s. 100	q.s. 100	q.s. 100	Vehicle

Preparation Method

Calamine, zinc oxide, and bentonite were accurately weighed and passed through sieve No. 80 to ensure particle size uniformity. The sifted powders were thoroughly triturated in a porcelain mortar to produce a homogeneous dry blend. Glycerin was gradually added with continuous trituration to produce a smooth, lump-free paste, facilitating effective wetting of hydrophobic particle surfaces.

Purified water was added in portions with continuous stirring to produce a uniform suspension. Aloe vera gel was incorporated at this stage by gentle but thorough mixing to preserve the integrity of its bioactive polysaccharides. Phenol was dissolved in a small quantity of water and added last. Final volume was adjusted to 100 mL with purified water. The lotion was transferred into amber glass bottles and labeled: Shake well before use.

Evaluation Parameters

Thermal Stability Testing

Thermal stability was assessed by storing formulations in a humidity chamber at 37±1°C and 60–70% RH, periodically examining for phase separation, color change, liquefaction, sedimentation, or surface cracking.

pH Determination

pH was measured at 27°C using a calibrated digital pH meter (standardized with pH 4.0 and 7.0 buffers). An accurately weighed portion (5±0.01 g) of each lotion was dispersed in 45 mL purified water and pH was measured in triplicate.

Patch Test

Approximately 1–3 g of each formulation was applied to fabric patches placed on retroauricular skin of healthy adult volunteers. Test sites were inspected at 24, 48, and 72 hours for erythema, edema, pruritus, or allergic manifestation.

Consistency and Texture Assessment

Physical consistency was assessed by visual inspection and tactile evaluation, examining homogeneity, smoothness, spreadability, presence of lumps or grittiness, and overall texture.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, May 2026
Impact Factor: 8.2

Skin Irritation Test

A measured quantity of lotion was applied to a defined forearm area of healthy volunteers and observed at 24 hours for erythema, swelling, pruritus, or inflammation, in accordance with ethical guidelines for cosmetic safety evaluation.

V. RESULTS AND DISCUSSION

Thermal Stability

All three formulations maintained physical integrity under accelerated conditions (37±1°C, 60–70% RH), with no observable phase separation, color alteration, or textural degradation (Table 2). This is attributed to the thixotropic gel network formed by bentonite and the additional colloidal stability contributed by aloe vera polysaccharides (Shelton, 1991; Atherton, 1998).

Table 2: Thermal Stability Results

Formulation	Temp. (°C)	Phase Sep.	Color Change	Result
F1	37±1	None	None	Stable
F2	35±1	None	None	Stable
F3	36±1	None	None	Stable

pH Determination

pH values for all formulations (Table 3) fell within the acceptable physiological range (4.5–6.5), critical for maintaining the protective acid mantle. The incorporation of aloe vera gel, which naturally exhibits a pH of approximately 6.0, did not adversely shift formulation pH outside the acceptable range.

Table 3: pH Values of Formulations

Formulation	pH Range	Mean pH	Compatible
F1	5.9 – 6.3	6.1	Yes
F2	5.1 – 6.4	5.8	Yes
F3	5.8 – 6.5	6.2	Yes

Patch Test

No hypersensitivity reactions erythema, pruritus, edema, or vesicle formation were observed in any test application (Table 4), confirming the non-sensitizing nature of all formulations. This aligns with the well-established safety profile of both calamine and aloe vera in topical use (Marshall, 1990; Davis, 1997).

Table 4: Patch Test Results

Form.	24 hrs	48 hrs	72 hrs	Result
F1	No reaction	No reaction	No reaction	Passed
F2	No reaction	No reaction	No reaction	Passed
F3	No reaction	No reaction	No reaction	Passed

Consistency and Texture

All formulations exhibited a smooth, homogeneous, semi-fluid texture with no lumps or gritty particles (Table 5). F3, containing the highest aloe vera concentration (15 mL/100 mL), demonstrated the best spreadability, likely due to the lubricating and film-forming properties of aloe vera's mucilaginous polysaccharide fraction.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, May 2026
Impact Factor: 8.2

Table 5: Consistency and Texture Assessment

Form.	Texture	Homogeneity	Spreadability
F1	Smooth, uniform	Excellent	Good
F2	No lumps	Excellent	Very Good
F3	Semi-fluid	Excellent	Excellent

Skin Irritation Test

No signs of cutaneous irritation were observed for any formulation (Table 6). These results confirm dermal safety and are consistent with the known anti-inflammatory activity of aloe vera, attributed to C-glucosyl chromone, bradykinase, and salicylic acid (Hutter et al., 1996).

Table 6: Skin Irritation Test Results

Form.	Erythema	Pruritus	Edema	Result
F1	Absent	Absent	Absent	Safe
F2	Absent	Absent	Absent	Safe
F3	Absent	Absent	Absent	Safe

VI. DISCUSSION

The present study demonstrates that calamine lotion enriched with aloe vera gel can be successfully formulated as a stable, safe, and efficacious topical preparation. Calamine and zinc oxide provide passive skin protection, mild astringency, cooling sensation, and antipruritic relief through formation of a fine powder deposit upon evaporation of the aqueous vehicle.

In contrast, aloe vera contributes active biological interactions: acemannan stimulates fibroblast activity and accelerates collagen synthesis for wound healing (Chithra et al., 1998), while vitamins C and E and the enzyme catalase collectively reduce oxidative stress. The antimicrobial constituents of aloe vera anthraquinones and saponins complement the antiseptic action of zinc oxide, collectively reducing the risk of secondary infection in compromised skin.

Among the three formulations, F3 demonstrated superior spreadability and texture, suggesting that a higher aloe vera concentration improves application characteristics. However, all three formulations satisfied the defined evaluation criteria, indicating a broad acceptable range for aloe vera incorporation without compromising stability or safety. The pH stability within 5.8-6.5 ensures the acid mantle is preserved upon application.

VII. CONCLUSION

This study successfully developed and evaluated three formulations of calamine lotion enriched with varying concentrations of aloe vera gel. All formulations demonstrated satisfactory thermal stability, appropriate physiological pH (5.8–6.5), excellent consistency, negative patch test outcomes, and absence of skin irritation collectively confirming their suitability as topical dermatological preparations.

The incorporation of aloe vera gel imparted enhanced moisturizing, anti-inflammatory, antimicrobial, and wound-healing potential. Formulation F3 exhibited the best spreadability and texture, while all formulations were safe and non-sensitizing. This herbal calamine lotion represents a promising, patient-friendly, and scientifically validated topical preparation for management of dry, irritated, and sensitive skin conditions. Further studies including long-term stability testing, in vitro drug release profiling, and clinical trials are warranted.

IJARSCT
International Journal of Advanced Research in Science, Communication and Technology
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
ISSN: 2581-9429
Volume 6, Issue 9, May 2026
Impact Factor: 8.2

ACKNOWLEDGEMENTS

The authors express sincere gratitude to the Department of Pharmacy, Abhilashi University, for providing laboratory infrastructure and technical support. The authors also acknowledge the willing participation of volunteer subjects in safety evaluation studies.

CONFLICT OF INTEREST

The authors declare no conflict of interest with respect to the research, authorship, and publication of this article.

REFERENCES

1. Allen LV. Compounding topical preparations: Calamine lotion and suspension systems. J Pharm Compounding. 2022;26(3):210-218.
2. Ansel HC, Allen LV. Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems. 12th ed. Wolters Kluwer; 2020.
3. Atherton P. Aloe vera revisited. Br J Phytother. 1998;4:76-83.
4. Aulton ME, Taylor KMG. Aulton's Pharmaceutics: The Design and Manufacture of Medicines. 6th ed. Elsevier; 2021.
5. Byeon S, Pelley R, Ullrich SE. Aloe barbadensis extracts reduce interleukin-10 production following UV radiation. J Invest Dermatol. 1988;110:811-817.
6. Chithra P, Sajithlal GB, Chandrakasan G. Influence of aloe vera on collagen characteristics in healing dermal wounds in rats. Mol Cell Biochem. 1998;181:71-76.
7. Davis RH. Aloe Vera: A Scientific Approach. Vantage Press; 1997.
8. Hart LA, Nibbering PH, van Dijk H. Effects of low molecular constituents from aloe vera gel on oxidative metabolism and bactericidal activities of human neutrophils. Int J Immunopharmacol. 1990;12:427-434.
9. Hutter JA, Salmon M, Stavinoha WB. Anti-inflammatory C-glucosyl chromone from Aloe barbadensis. J Nat Prod. 1996;59:541-543.
10. Indian Pharmacopoeia Commission. Indian Pharmacopoeia. Ministry of Health and Family Welfare, Govt. of India; 2007.
11. Kim HS, Lee BM. Inhibition of benzo[a]pyrene-DNA adduct formation by Aloe barbadensis Miller. Carcinogenesis. 1997;18:771-776.
12. Lachman L, Lieberman HA, Kanig JL. Theory and Practice of Industrial Pharmacy. 4th ed. CBS Publishers; 2023.
13. Marshall JM. Aloe vera gel: What is the evidence? Pharm J. 1990;24:360-362.
14. Peng SY, Norman J, Corrier D. Decreased mortality of Norman murine sarcoma in mice treated with acemannan. Mol Biother. 1991;3:79-87.
15. Ro JY, Lee B, Kim JY. Inhibitory mechanism of aloe single component (Alprogen) on mediator release in guinea pig lung mast cells. J Pharmacol Exp Ther. 2000;292:114-121.
16. Roberts DB, Travis EL. Acemannan-containing wound dressing gel reduces radiation-induced skin reactions. Int J Radiat Oncol Biol Phys. 1995;32:1047-1052.
17. Rowe RC, Sheskey PJ, Quinn ME. Handbook of Pharmaceutical Excipients. 9th ed. Pharmaceutical Press; 2021.
18. Shelton M. Aloe vera: Its chemical and therapeutic properties. Int J Dermatol. 1991;30:679–683.
19. Sinko PJ. Martin's Physical Pharmacy and Pharmaceutical Sciences. 8th ed. Wolters Kluwer; 2022.
20. Solanki H, Verma VS, Sharma G. Natural humectants in the formulation of calamine lotion. Res J Top Cosmet Sci. 2016;7:41-45.
21. Sydiskis RJ, Owen DG, Blomster RN. Inactivation of enveloped viruses by anthraquinones extracted from plants. Antimicrob Agents Chemother. 1991;35:2463-2466.
22. West DP, Zhu YF. Evaluation of aloe vera gel gloves in treatment of dry skin associated with occupational exposure. Am J Infect Control. 2003;31:40-42.