

FORMULATION, DEVELOPMENT AND EVALUATION OF HERBAL ANTI-ACNE GEL USING GUAVA LEAF AND LICORICE ROOT EXTRACT

Kulbhushan M. Lalwani¹, Prachi K. Gavhane^{*2}, Snehal S. Mundfan³, Vaishnavi M. Baykar⁴, Sanika S. Gund⁵, Yashanjali S. Thorve⁶, Sanika D. Dhobale⁷

Shri Amolak Jain Vidya Prasarak Mandal's R.M.D. College of Pharmacy, Kada, India.

Article Received on 15 July 2026,
Article Revised on 05 August 2026,
Article Published on 16 August 2026,

<https://doi.org/10.5281/zenodo.21990182>

*Corresponding Author

Prachi K. Gavhane

Shri Amolak Jain Vidya Prasarak
Mandal's R.M.D. College of
Pharmacy, Kada, India.



How to cite this Article: Kulbhushan M. Lalwani¹, Prachi K. Gavhane^{*2}, Snehal S. Mundfan³, Vaishnavi M. Baykar⁴, Sanika S. Gund⁵, Yashanjali S. Thorve⁶, Sanika D. Dhobale⁷. (2026). Formulation, Development And Evaluation Of Herbal Anti-Acne Gel Using Guava Leaf And Licorice Root Extract. World Journal of Pharmaceutical Research, 15(16), 1687-1698.

This work is licensed under Creative Commons Attribution 4.0 International license.

ABSTRACT

Acne vulgaris is one of the most common skin disorders affecting adolescents and adults, primarily caused by bacterial infection, excessive sebum production, inflammation, and oxidative stress. Herbal formulations have gained considerable attention due to their safety, effectiveness, and minimal side effects compared to synthetic anti-acne products. The present study aimed to formulate, develop, and evaluate a herbal anti-acne gel containing Guava (*Psidium guajava*) leaf extract and Licorice (*Glycyrrhiza glabra*) root extract. Two formulations (F1 and F2) were prepared using Carbopol 940 as the gelling agent, along with Aloe vera extract, Neem extract, Propylene glycol, Glycerin, Methyl paraben, Propyl paraben, Triethanolamine, and distilled water. The prepared gels were evaluated for their physicochemical properties, including appearance, pH, viscosity, spreadability, homogeneity, extrudability, washability, and stability. The herbal extracts

provided antibacterial, anti-inflammatory, antioxidant, and wound-healing properties, making the formulation suitable for acne management. Among the prepared formulations, the optimized formulation exhibited acceptable physicochemical characteristics, good stability, smooth texture, and satisfactory spreadability. The findings suggest that the developed herbal anti-acne gel has the potential to serve as a safe, effective, and economical topical formulation for the management of acne vulgaris. However, further antimicrobial and clinical studies are recommended to confirm its therapeutic efficacy

KEYWORDS: Herbal Anti-Acne Gel, Guava Leaf Extract, Licorice Root Extract, Acne Vulgaris, Topical Gel Antimicrobial Activity.

INTRODUCTION

Skin diseases are becoming increasingly common worldwide, and a large proportion of the population prefers herbal remedies due to their safety and minimal side effects. Herbal cosmetics and herbal topical formulations have gained significant importance because of their natural origin, better patient compliance, and therapeutic efficacy. Recent advances in herbal formulation development have focused on providing effective and safer alternatives for the management of chronic skin disorders, including acne vulgaris. Acne is one of the most prevalent inflammatory skin diseases, affecting nearly 85% of adolescents, and it is observed more frequently in females than in males. It is characterized by comedones, inflammatory papules, pustules, nodules, and cysts, which may lead to permanent scarring and pigmentation changes. Hormonal fluctuations during puberty also play a major role in the development of acne.^[1]

Acne vulgaris is a multifactorial disorder involving increased sebum production, abnormal follicular keratinization, colonization by *Cutibacterium acnes* (formerly *Propionibacterium acnes*), and inflammatory responses. During puberty, androgen-induced stimulation of sebaceous glands increases sebum secretion. Excess sebum, together with dead skin cells, blocks hair follicles, creating a favorable environment for bacterial proliferation and inflammation, ultimately resulting in acne lesions.^[2,3]

Conventional anti-acne therapies, including topical and oral antibiotics, benzoyl peroxide, and retinoids, are widely prescribed and are effective in controlling acne. However, prolonged use of these medications is frequently associated with adverse effects such as skin irritation, dryness, erythema, photosensitivity, and the emergence of antibiotic-resistant bacterial strains. Consequently, there is growing interest in the development of herbal alternatives that are safer and suitable for long-term use.^[4,5]

Herbal formulations have emerged as promising therapeutic options because of their natural origin, lower incidence of adverse effects, and multiple pharmacological activities. Medicinal plants contain bioactive constituents possessing antimicrobial, anti-inflammatory, antioxidant, and wound-healing properties that are highly beneficial in acne management. Among various topical dosage forms, herbal gels are particularly preferred due to their non-

greasy nature, ease of application, enhanced drug release, better patient compliance, and improved cosmetic acceptability.^[6]

Guava (*Psidium guajava* L.) leaves are rich in flavonoids, tannins, quercetin, and other phenolic compounds that exhibit potent antibacterial, antioxidant, and anti-inflammatory activities. Several studies have demonstrated that guava leaf extract effectively inhibits the growth of acne-causing microorganisms while reducing inflammation, making it a valuable herbal ingredient for anti-acne formulations.^[7]

Licorice (*Glycyrrhiza glabra* L.) root contains glycyrrhizin, glabridin, liquiritin, and other flavonoids with significant antimicrobial, anti-inflammatory, antioxidant, and skin-soothing activities. In addition, licorice extract has been reported to reduce erythema, post-inflammatory hyperpigmentation, and inflammatory acne lesions, thereby improving overall skin health.^[8]

The combination of guava leaf extract and licorice root extract is expected to provide synergistic therapeutic benefits by targeting multiple factors involved in acne pathogenesis, including microbial infection, inflammation, oxidative stress, and skin repair. Therefore, the development of a herbal anti-acne gel containing these extracts may offer an effective, safe, and patient-friendly alternative for the topical management of acne vulgaris.^[9]

AIM

To formulate, develop, and evaluate a herbal anti-acne gel containing Guava Leaf Extract, Licorice Root Extract, Aloe Vera Extract, and Neem Extract for the effective management of acne vulgaris with improved safety, stability, and patient acceptability.

OBJECTIVES

1. To formulate a herbal anti-acne gel using Guava Leaf Extract, Licorice Root Extract, Aloe Vera Extract, and Neem Extract.
2. To optimize different formulations (F1 and F2) by varying the concentration of herbal extracts.
3. To evaluate the prepared gel for physicochemical parameters such as appearance, colour, odour, pH, viscosity, spreadability, homogeneity, and extrudability.
4. To assess the stability of the optimized formulation under suitable storage conditions.
5. To evaluate the antimicrobial (anti-acne) activity of the developed gel against acne-

causing microorganisms (if performed).

6. To compare the prepared formulations and select the optimized formulation based on the evaluation results.



Fig. No. 01.

1) Plant Name: Guava Leaf

Biological Name: *Psidium guajava* L. Family: Myrtaceae

Uses: *Psidium guajava* leaves possess antimicrobial, antioxidant, anti-inflammatory, and wound-healing properties. They are effective against acne-causing microorganisms and help reduce skin inflammation, making them suitable for topical anti-acne formulations.^[10,11]

2). Liquorice (Yashtimadhu)



Fig. No: 02.

Biological Name: *Glycyrrhiza glabra* L. Family: Fabaceae

Chemical Constituents:

1. Glycyrrhizin (Glycyrrhizic acid)
2. Glycyrrhetic acid
3. Glabridin
4. Liquiritin
5. Isoliquiritin

Uses

1. Used as an expectorant to relieve cough and sore throat. Possesses anti-inflammatory and antioxidant properties.
2. Helps in the treatment of gastric ulcers and acidity. Exhibits antimicrobial and antiviral activities.
3. Used in cosmetic formulations as a skin-soothing and anti-aging agent.^[12]

3. Aloe vera



Fig. No: 03

Biological Name: Aloe vera (L.) Burm.f. Chemical Constituents:

Aloin (Barbaloin), Aloe-emodin, Acemannan, Aloesin, Anthraquinones, Polysaccharides, Saponins, Sterols (β -sitosterol, Campesterol), Vitamins (A, C, E), Amino Acids, Minerals.

Uses

Aloe vera is widely used for wound healing, burn management, skin moisturizing, anti-inflammatory, antioxidant, antimicrobial, and immunomodulatory activities. It promotes skin regeneration and is extensively used in pharmaceutical, cosmetic, and herbal formulations.^[13]

4) Neem Extract

Biological Name: *Azadirachta indica* A. Juss. Major

Chemical Constituents:

Azadirachtin, Nimbin, Nimbidin, Nimbolide, Quercetin, Gedunin.

Use

Neem extract possesses antibacterial, antifungal, anti-inflammatory, and antioxidant properties. It inhibits *Cutibacterium acnes* and helps reduce acne and skin inflammation.^[14]

5) Carbopol 940

Biological Name: Not applicable (Synthetic polymer; cross-linked polyacrylic acid)

Major Chemical Constituents:

Cross-linked poly(acrylic acid), acrylic acid polymer, allyl sucrose/allyl pentaerythritol cross-linker.

Use

Carbopol 940 is a high-performance gelling agent widely used in topical formulations. It provides suitable viscosity, excellent spreadability, stability, and controlled release of active ingredients in gel preparations.^[15]

6) Propylene Glycol

Biological Name: Not applicable (Chemical compound) Major Chemical Constituents:

Propane-1,2-diol ($C_3H_8O_2$).

Use:

Propylene glycol acts as a humectant, solvent, and penetration enhancer. It improves skin hydration and enhances the permeation of active ingredients through the skin.^[16]

7) Glycerin

Biological Name: Not applicable (Chemical compound)

Major Chemical Constituents:

Glycerol ($C_3H_8O_3$).

Use

Glycerin is an effective humectant and skin moisturizer. It helps retain moisture, improves skin hydration, and protects the skin barrier, making it suitable for topical gel formulations.^[17]

8) Methyl Paraben

Biological Name: Not applicable (Chemical preservative) Major Chemical Constituents:

Methyl 4-hydroxybenzoate ($C_8H_8O_3$).

Use

Methyl paraben is a broad-spectrum antimicrobial preservative used to prevent microbial contamination and improve the stability and shelf life of pharmaceutical and cosmetic formulations.^[18]

9) Propyl Paraben

Biological Name: Not applicable (Chemical preservative) Major Chemical Constituents:

Propyl 4-hydroxybenzoate ($C_{10}H_{12}O_3$).

Use

Propyl paraben is an antimicrobial preservative effective mainly against fungi and molds. It is commonly used with methyl paraben to extend the shelf life of topical formulations.^[19]

10) Triethanolamine

Biological Name: Not applicable (Chemical compound) Major Chemical Constituents:

Triethanolamine ($C_6H_{15}NO_3$).

Use

Triethanolamine is used as a pH adjuster and neutralizing agent. It neutralizes Carbopol to form a clear, stable gel and maintains the desired pH of the formulation.^[20]

11) Distilled Water

Biological Name: Not applicable Major Chemical Constituents

Purified Water (H₂O).

Use

Distilled water serves as the vehicle and solvent in topical formulations. It dissolves water-soluble ingredients and provides the required volume while ensuring formulation purity and stability.^[21]

MATERIALS

The herbal anti-acne gel was formulated using Guava Leaf Extract (*Psidium guajava*), Licorice Root Extract (*Glycyrrhiza glabra*), Aloe Vera Extract (*Aloe barbadensis* Miller), and Neem Extract (*Azadirachta indica*) as the active herbal ingredients.

Carbopol 940 was used as the gelling agent, Propylene Glycol as the penetration enhancer and co-solvent, Glycerin as the humectant, Methyl Paraben and Propyl Paraben as preservatives, Triethanolamine as the pH-adjusting agent, and Distilled Water as the vehicle.

Two formulations (F1 and F2) were prepared by varying the concentration of the herbal extracts while maintaining the remaining excipients at constant levels. The detailed composition of both formulations is presented in Table 1.

MATERIALS AND METHODS

1.1 Preparation of Herbal Extract Solution

The required quantities of Guava Leaf Extract, Licorice Root Extract, Aloe Vera Extract, and Neem Extract were accurately weighed according to the formulation design. The extracts were dissolved in a small quantity of Propylene Glycol and mixed thoroughly until a clear and homogeneous herbal solution was obtained.

1.2 Preparation of Gel Base

Carbopol 940 was slowly dispersed into distilled water under continuous stirring to prevent lump formation. The dispersion was allowed to hydrate for approximately 30–45 minutes until a uniform gel base was formed.

1.3 Addition of Humectant and Preservatives

Glycerin was added slowly into the hydrated Carbopol gel with continuous stirring. Methyl Paraben and Propyl Paraben were dissolved separately in a small quantity of warm Propylene Glycol and incorporated into the gel base while stirring continuously.

1.4 Incorporation of Herbal Extracts

The prepared herbal extract solution containing Guava Leaf, Licorice Root, Aloe Vera, and Neem Extracts was gradually incorporated into the Carbopol gel base under continuous stirring. Mixing was continued until a smooth and homogeneous gel was obtained.

1.5 pH Adjustment

Triethanolamine was added dropwise with gentle stirring until the pH of the gel reached 5.5–6.5, which is considered suitable for topical skin application. Neutralization of Carbopol resulted in the formation of a transparent and stable gel.

1.6 Final Volume Adjustment

Distilled Water was added to make the final weight up to 100 g. The prepared gel was mixed thoroughly to ensure complete uniformity and the absence of air bubbles.

1.7 Packaging and Storage

The prepared herbal anti-acne gel was transferred into clean, sterilized, airtight laminated tubes and stored at room temperature ($25 \pm 2^\circ\text{C}$) until further evaluation.

Evaluation of Herbal Anti-Acne Gel

The prepared formulations (F1 and F2) were evaluated for the following parameters:

- Physical Appearance

The prepared gels were visually examined for colour, odour, homogeneity, smoothness, and phase separation.

- pH Determination

The pH of each formulation was measured using a calibrated digital pH meter at room temperature.

- Homogeneity

The gel was visually inspected for the uniform distribution of ingredients and the absence of lumps.

- Spreadability

Spreadability was determined using the slide method by measuring the time required for two glass slides to separate under a specified weight.

- Viscosity

The viscosity of the gel was measured using a Brookfield Viscometer.

- Washability

Washability was evaluated by applying the gel onto the skin and washing it with tap water.

- Extrudability

Extrudability was determined by measuring the ease with which the gel was extruded from the collapsible tube.

- Stability Study

The prepared formulations were stored at room temperature and observed periodically for changes in colour, odour, pH, consistency, and phase separation.

CONCLUSION

The present study successfully formulated and evaluated a herbal anti-acne gel containing Guava Leaf Extract, Licorice Root Extract, Aloe Vera Extract, and Neem Extract using Carbopol 940 as the gelling agent. Both formulations demonstrated acceptable physicochemical properties, including suitable pH, good homogeneity, satisfactory viscosity, spreadability, and stability.

Among the developed formulations, F2 exhibited superior overall performance due to its higher herbal extract content and better physical characteristics. The formulated herbal gel has the potential to serve as a safe, effective, and economical topical anti-acne preparation. Further studies, including antimicrobial activity, skin irritation testing, and clinical evaluation, are recommended to confirm its therapeutic Efficacy.

RESULTS AND DISCUSSION

Both formulations (F1 and F2) were successfully prepared as smooth, homogeneous herbal gels without any visible phase separation. The gels exhibited a good appearance, pleasant odour, acceptable consistency, and satisfactory spreadability. The pH values of both formulations were found to be within the acceptable range (5.5–6.5), indicating their suitability for topical skin application. The viscosity and extrudability of the gels were satisfactory, allowing easy application to the affected skin surface.

Among the prepared formulations, F2 showed comparatively better consistency, spreadability, and overall physical stability because of the higher concentration of herbal extracts. The formulation remained stable during the storage period without significant changes in colour, odour, pH, or homogeneity. The combined presence of Guava Leaf Extract, Licorice Root Extract, Aloe Vera Extract, and Neem Extract is expected to provide antibacterial, anti-inflammatory, antioxidant, soothing, moisturizing, and wound-healing activities, making the formulation suitable for acne management.

REFERENCES

1. Dawson AL, Dellavalle RP. Acne vulgaris. *BMJ.*, 2013; 346: f2634.
2. Priyadarsini KI. The Chemistry of Curcumin: From Extraction to Therapeutic Agent. *Molecules*, 2014; 19(12): 20091–20112.
3. Rosenberg AL, Shah M, Del Rosso JQ, Baldwin H, Harper JC, et al. Optimal Use Recommendations and Stewardship Principles with Oral Antibiotics in Acne Vulgaris Management: An Expert Consensus Panel. *Journal of Clinical and Aesthetic Dermatology*, 2025; 18(12): 21–29.
4. O'Neill AM, Gallo RL. Host-Microbiome Interactions and Recent Progress into Understanding the Biology of Acne Vulgaris. *Microbiome*, 2018; 6(1): 177.
5. Zaenglein AL, Pathy AL, Schlosser BJ, et al. Guidelines of Care for the Management of Acne Vulgaris. *Journal of the American Academy of Dermatology*, 2016; 74(5): 945–973.
6. Mukherjee PK. Quality Control and Evaluation of Herbal Drugs. 2nd ed. Elsevier, 2019.
7. Gutiérrez RMP, Mitchell S, Solis RV. *Psidium guajava*: A Review of Its Traditional Uses, Phytochemistry and Pharmacology. *Journal of Ethnopharmacology*, 2008; 117(1): 1–27.
8. Pastorino G, Cornara L, Soares S, Rodrigues F, Oliveira MBPP. Liquorice (*Glycyrrhiza glabra*): A Phytochemical and Pharmacological Review. *Phytotherapy Research*, 2018; 32(12): 2323–2339.
9. Thring TSA, Hili P, Naughton DP. Anti-Collagenase, Anti-Elastase and Antimicrobial Activities of Herbal Extracts Used in Skin Care. *BMC Complementary and Alternative Medicine*, 2009; 9: 27.
10. Díaz-de-Cerio E, Verardo V, Gómez-Caravaca AM, Segura-Carretero A. Guava (*Psidium guajava* L.) Leaves: Nutritional Composition, Phytochemical Profile and Health-Promoting Bioactivities. *Antioxidants*, 2020; 9(8): 752.

11. Kokate CK, Purohit AP, Gokhale SB. Pharmacognosy. 58th ed. Pune: Nirali Prakashan; 2022; 6.1–6.8.
12. Hamman JH. Composition and Applications of Aloe vera Leaf Gel. *Molecules*, 2008; 13(8): 1599–1616. doi: 10.3390/molecules13081599.
13. Biswas K, Chattopadhyay I, Banerjee RK, Bandyopadhyay U. Biological Activities and Medicinal Properties of Neem (*Azadirachta indica*). *Current Science*, 2002; 82(11): 1336–1345.
14. Rowe RC, Sheskey PJ, Quinn ME, editors. Handbook of Pharmaceutical Excipients. 8th ed. London: Pharmaceutical Press, 2017.
15. Fluhr JW, Darlenski R, Surber C. Glycerol and the Skin: Holistic Approach to Its Origin and Functions. *British Journal of Dermatology*, 2008; 159(1): 23–34.
16. Soni MG, Carabin IG, Burdock GA. Safety Assessment of Esters of p-Hydroxybenzoic Acid (Parabens). *Food and Chemical Toxicology*, 2005; 43(7): 985–1015.
17. Indian Pharmacopoeia Commission. Indian Pharmacopoeia. 2022 ed. Ghaziabad: Indian Pharmacopoeia Commission, 2022.