



## Formulation and Evaluation of Herbal Antifungal Skin Gel with Antimicrobial Activity

Renuka D. Waghmare, Anjali S. Barsing, Gautami S. Kharge, Pratiksha P. Chavan, Manali D. Pandit, Pratibha S. Dabane, Atul R. Chopade

Rajarambapu College of Pharmacy, Kasegaon, Tal-Walwa, Dist-Sangali, Maharashtra, India

Received: 27 March 2026

Revised: 22 April 2026

Accepted: 28 April 2026

### ABSTRACT:-

Fungal skin infections are common and often require prolonged treatment, which may lead to adverse effects when synthetic drugs are used. The present study was undertaken to develop and evaluate a polyherbal antifungal skin gel using extract of bitter melon as a natural active component due to its known antimicrobial and anti-inflammatory properties. The extract was prepared by an appropriate method and incorporated into a suitable gel base formulated with selected gelling agents and excipients to obtain a smooth, stable, and easily spreadable preparation. The developed gel was evaluated for key physicochemical parameters such as pH, viscosity, homogeneity, spreadability, and extrudability to ensure its quality and usability. Antifungal efficacy was determined using standard microbiological methods against common fungal strains, and the formulation showed appreciable inhibitory activity. Stability studies further confirmed that the gel maintained its physical and functional characteristics under different storage conditions. Overall, the formulated polyherbal gel demonstrates potential as a safe, effective, and economical topical option for the management of fungal skin infections.

**Keywords:-** Polyherbal gel, Antifungal activity, Skin infections, bitter melon extract, Topical formulation

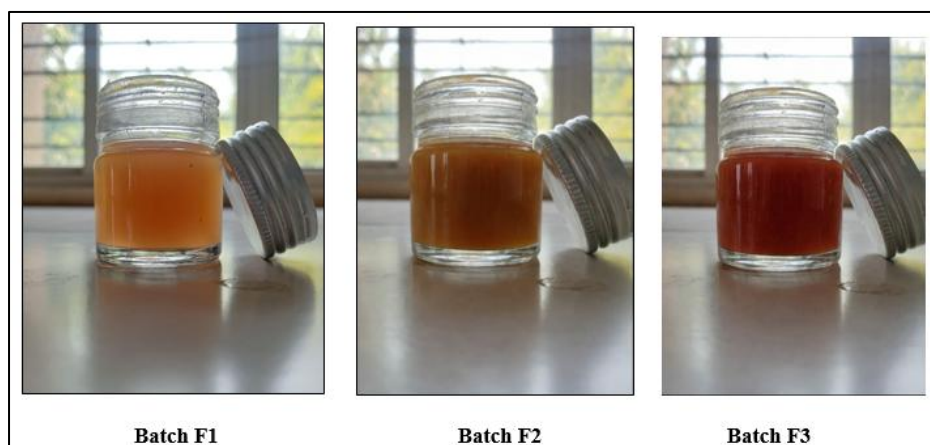
### 1.INTRODUCTION:-

Fungal infections of the skin are among the most frequently encountered dermatological conditions worldwide, affecting individuals of all age groups. These infections are commonly caused by dermatophytes, yeasts, and molds, leading to conditions such as ringworm, athlete's foot, and candidiasis. Factors like poor hygiene, humid climate, excessive sweating, and weakened immunity contribute significantly to their occurrence and recurrence. Although conventional antifungal therapies are effective, their prolonged use may result in side effects, resistance development, and increased treatment cost, highlighting the need for safer and more affordable alternatives.

In recent years, there has been growing interest in herbal and polyherbal formulations due to their natural origin, reduced toxicity, and therapeutic potential. Medicinal plants contain a wide range of bioactive compounds such as alkaloids, flavonoids, tannins, and glycosides that exhibit antimicrobial and antifungal activities. Among these, bitter melon has gained attention for its significant medicinal properties, including antifungal, antibacterial, and anti-inflammatory effects, making it a promising candidate for topical formulations.

Topical drug delivery systems, particularly gels, offer several advantages such as ease of application, non-greasy nature, better patient compliance, and enhanced drug release at the site of infection. Gels provide a suitable medium for incorporating herbal extracts and ensuring uniform distribution of active constituents. Therefore, the formulation of an antifungal skin gel using bitter melon extract can serve as an effective approach for localized treatment of fungal infections.

The present study aims to formulate and evaluate a polyherbal antifungal skin gel using bitter melon extract. The formulation is assessed for its physicochemical properties, stability, and antifungal activity to establish its potential as a safe, effective, and economical alternative to conventional antifungal therapies.



**Fig. 1 Antifungal skin Gel**



**Fig. 2 Cutaneous fungal Infection**

**Advantages of Pharmaceutical Gel:-**

- Stay away from the first pass metabolism.
- Convenient, acceptable, and simple to implement
- Ability to more precisely distribute medications to a specific location.
- Allowing for the use of medicines with a short biological half-life.
- Improving the drugs physiological and pharmacological response.

**Disadvantages of Pharmaceutical Gel :-**

- The medication and/or excipients can cause skin irritation in people with contact dermatitis.
- Some medication have a low permeability through the skin or mucous membrane, which might lead to allergic responses.
- Drugs with bigger particle size are more difficult to absorb via skin.
- Drugs may be denatured by an enzyme in the epidermis.



## **2. Literature Review**

### **2.1 Background and Rationale**

Fungal skin infections are widespread and often persistent, requiring long-term treatment that may lead to side effects, resistance, or reduced patient compliance when synthetic antifungal drugs are used. In recent years, there has been growing interest in herbal-based formulations due to their safety, affordability, and therapeutic potential. Natural plant extracts, such as those derived from bitter melon, possess notable antifungal and antimicrobial properties that can be effectively utilized in topical drug delivery systems. A polyherbal antifungal gel offers the advantage of combining multiple bioactive compounds, which may enhance efficacy through synergistic action while minimizing adverse effects. Therefore, the development of a herbal antifungal skin gel is a promising approach to provide a safer, effective, and patient-friendly alternative for the management of fungal infections.

### **2.2 Herbs and actives comenly used :-**

- Bitter melon – *Momordica charantia*
- Aloe vera – *Aloe barbadensis* Miller
- Clove oil – *Syzygium aromaticum*

### **2.3 Typical formulation approaches:-**

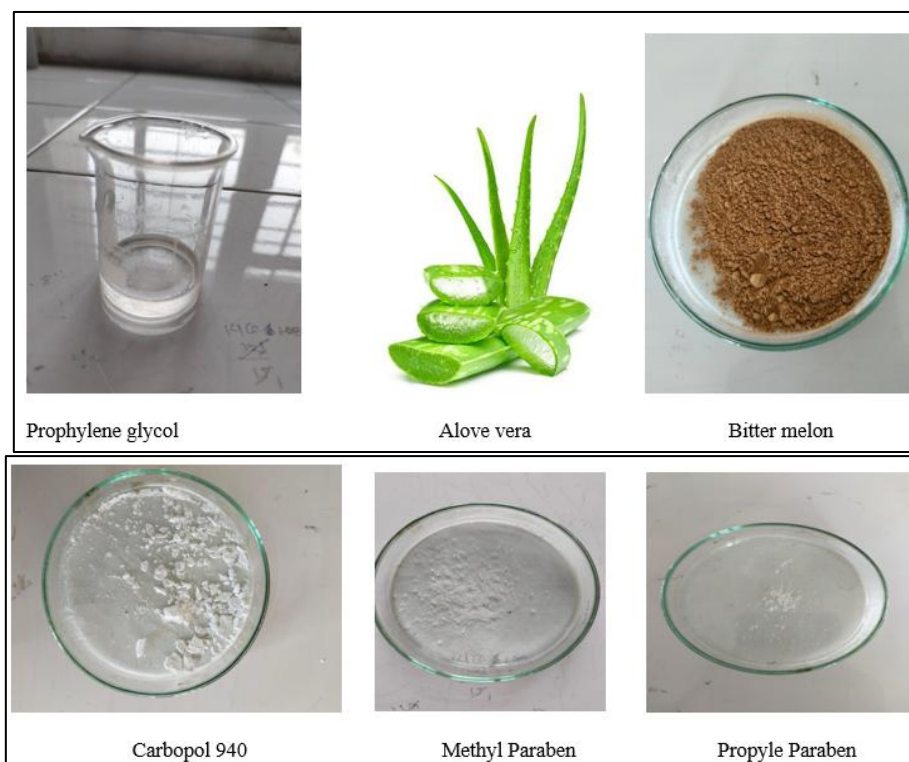
Typical formulation approaches for antifungal skin gels focus on selecting a suitable gel base, incorporating effective antifungal agents, and ensuring stability and patient acceptability. Natural or synthetic polymers such as carbopol, hydroxypropyl methylcellulose (HPMC), or sodium alginate are commonly used as gelling agents to provide the desired consistency. The active antifungal ingredient—either herbal extracts (like bitter melon or aloe vera) or synthetic drugs—is dissolved or dispersed in a suitable solvent system, often supported by penetration enhancers to improve skin absorption. Other excipients such as preservatives, stabilizers, and humectants are added to maintain product quality and shelf life.

### **2.4 Standard evaluation test:-**

- Appearance
- Homogenicity
- Spreadability
- Measurement of PH
- Viscosity
- Antimicrobial activity
- Skin irritation

## **3. Materials and methods:-**

Bitter melon, aloe vera, clove oil, propylene glycol, methyl paraben, Propyl paraben and Carbopol 940 all those ingredients are collected from ayurvedic as well as chemical store.



**Fig. 3 Herbs and Chemicals used in this Formulation**

**4. Formulation Table :-**

<b>Ingredients</b>	<b>Quantity</b>	<b>Category</b>
Bitter melon	2 ml	Active ingredient
Aloe vera	1ml	Antifungal agent
Carbopol 940	2gm	Gelling agent
Methyl paraben	1gm	Preservative
Propyl paraben	1gm	Preservative
Propylene glycol	1ml	Humectant
Clove oil	1ml	Antimicrobial agent

**5. Preparation of antifungal herbal gel:-**

Step1: Carbopol 940 mixed in demineralized water

Step2: Take 5 ml distilled water + methyl paraben and propyl paraben

Step3: Warm it in a water bath.

Step4: Then add different concentration of different types of powdered herbs or extracts

Step5: Mixed all ingredients and add carbopol 940.

Step6: With continuous stirring, gradually add triethanolamine to adjust pH to the desired level [21]

**6. Storage:-**

It is recommended to keep the gel at a controlled room temperature (approximately 20–25°C) and protect it from excessive heat, direct sunlight, and humidity, as these factors may affect its stability and efficacy.

## 7. Evaluation Parameter :-

**1. Appearance:-** The antifungal skin gel shows a pale yellow color with a mild, pleasant herbal odour. It has a smooth, uniform, and semi-solid consistency, free from lumps and easily spreadable on the skin.

**2. Measurement of PH:** The pH of antifungal skin gel is measured by dispersing a small quantity of gel in distilled water and recording it using a calibrated pH meter. An ideal pH range of 5.0–7.0 is maintained to match skin conditions and prevent irritation.

**3. Homogeneity:** All prepared USTG formulations were evaluated for uniformity by visually examining the gels after allowing them to settle in appropriate containers. They were assessed for appearance, presence of lumps, smear characteristics, after-feel, and ease of removal.

**4. Spreadability :** Spreadability is expressed in term of time in seconds taken by two slides to slip off from gel that is placed in between the slides under the direction of certain load. If the time taken for separation of two slides is less then better the spreadability is calculated by using formula.

$$S = M \times L / T$$

Where M= Weight tied to upper slide

L = length of glass slides

T = time taken to separate the slide

**5. Viscosity:** The viscosity of individual and polyherbal gels was measured by Brookfield viscometer (Model RVTDV II) at 100 rpm using spindle no. 6[25].

**6. Skin Irritation:** A well-formulated antifungal gel should show no significant signs of irritation, indicating good compatibility with the skin. In most cases, the irritation score is expected to be zero or within an acceptable minimal range, confirming that the formulation does not cause adverse dermatological reactions. In studies involving antifungal activity, the formulation may additionally show **reduction in symptoms associated with fungal infection**, such as itching and inflammation, further supporting its therapeutic effectiveness.

**7. Antimicrobial activity :** The antimicrobial activity of the formulated herbal gel was evaluated against *Staphylococcus aureus* using the agar well diffusion method. Sterile nutrient agar plates were prepared and inoculated uniformly with a fresh bacterial culture using a sterile swab to form a consistent lawn. Wells of appropriate diameter were made in the solidified agar using a sterile borer. Measured amounts of different gel formulations were carefully placed into the wells, and the plates were allowed to stand briefly to enable diffusion. The plates were then incubated at 37°C for 24 hours, after which the clear zones around the wells were measured in millimetres to determine the antibacterial activity.

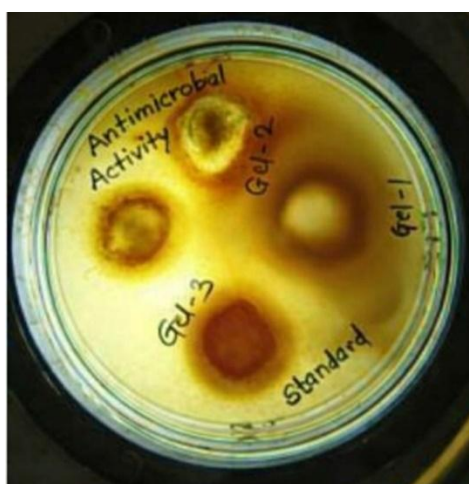


Fig. 4 Antimicrobial activity



## 8. Result and Discussion:

**1.Appearance :** All prepared formulations were evaluated for appearance. Color, Odour, Consistency of all three formulation was examined physically.

Parameter	F1	F2	F3
Color	Light orange	Orange-Brownish	reddish brown
Odour	Mild pleasant	Mild pleasant	Mild pleasant
Consistency	Thick	Moderately viscous	Semi –fluid

**2.Measurement of PH:** The antifungal gel showed uniform consistency, suitable pH for skin application, and good drug distribution. It provided sustained drug release, with higher polymer concentration slowing the release rate. The formulation demonstrated effective antifungal activity against common fungi and remained stable under storage conditions. Overall, the optimized gel offers controlled release, good stability, and promising efficacy for topical treatment of fungal infections.

Parameter	F1	F2	F3
PH	5.2	4.4	5.4

**3.Homogeneity:** The prepared antifungal gel formulations (F1, F2, and F3) were assessed for homogeneity by visual inspection. All batches showed a smooth and uniform appearance with no visible lumps, phase separation, or grittiness.

Parameter	F1	F2	F3
Homogeneity	Homogeneous	Homogeneous	Homogeneous

**4.Spreadability:** The prepared antifungal gel formulations (F1, F2, and F3) showed satisfactory physical and biological characteristics. All batches were smooth, homogeneous, and free from any visible aggregates, indicating proper formulation.

Parameter	F1	F2	F3
Spreadability	Good	Fair	Excellent

**5.Viscosity :** The rheological behaviours of gels formulation studied with Brookfield viscometer which indicated that the viscosity of gel formulation was consistent neither too thick nor too thin.

Parameter	F1	F2	F3
Viscosity(CP)	38.4	31.5	27.3

**6.Skin Irritation:** All three batches of the antifungal gel showed no signs of redness, swelling, itching, or burning sensation after application. This indicates that the formulation is non-irritant and safe for topical use.

Parameter	F1	F2	F3
Irritancy	Nil	Nil	Nil

**7.Antimicrobial activity :** The antimicrobial activity of the formulated antifungal gel was tested against *Staphylococcus aureus* and showed effective inhibition in all batches. The zone of inhibition increased from F1 to F3, indicating better activity with higher concentration of active ingredients, especially clove oil. This effect may be due to the presence of bioactive compounds like eugenol along with aloe vera and bitter melon extracts. Overall, the results suggest that the gel possesses good antimicrobial potential for topical use.

Parameter	F1	F2	F3
Zone of Inhibition	11 -0.5 mm	14 -0.7 mm	17-0.6mm
Observation	Moderate	Good	Strong

**9. Summary and Conclusion :** The antifungal skin gel was successfully formulated using appropriate herbal extracts, gelling agents, and excipients to obtain an effective and stable topical preparation. The formulation exhibited a smooth texture, good homogeneity, and acceptable physicochemical properties such as suitable pH, consistency, and spreadability, making it compatible with skin application. Evaluation studies confirmed that the gel was non-irritating and maintained stability during testing.



Furthermore, antimicrobial activity results demonstrated that the formulation possessed significant antifungal efficacy against selected microorganisms. Overall, the developed gel can be considered a safe, stable, and effective topical formulation, showing promising potential for the treatment of fungal skin infections and future pharmaceutical applications.

## 10. REFERENCES:

1. Parekar PB, Shivpuje SS, Navghare VV, Savale MM, Surwase VB, Mane-Kolpe PS, Kale PS. Polyherbal Gel Development And Evaluation For Antifungal Activity. *European Journal of Molecular & Clinical Medicine*. 2022;9(03):5409-18.
2. Bhingde SD, Bhutkar MA, Randive DS, Wadkar GH, Todkar SS, Kakade PM, Kadam PM. Formulation development and evaluation of antimicrobial polyherbal gel. In *Annales pharmaceutiques francaises* 2017 Sep 1 (Vol. 75, No. 5, pp. 349-358). Elsevier Masson
3. Veeraswamy SD, Raju I, Mohan S. An approach to antifungal efficacy through well diffusion analysis and molecular interaction profile of polyherbal formulation. *Biomedical and Pharmacology Journal*. 2022 Dec 20;15(4):2069-84
4. Islam M. Topical Drug Delivery of Polyherbal Drugs Entrapped Gel with Design and Validation.
5. Anuroop UP, KB AH, Kallatra AF, Yasmin F. FORMULATION AND EVALUATION OF POLYHERBAL ANTIFUNGAL MEDICATED SOAP FOR SKIN DISEASES.
6. DA D. Fungal infection in surgical patients. *Am J Surg*. 1996;171:371-82.
7. Rezabek GH, Friedman AD. Superficial fungal infections of the skin: Diagnosis and current treatment recommendations. *Drugs*. 1992 May;43(5):674-82.
8. Santiago TM, Pritt B, Gibson LE, Comfere NI. Diagnosis of deep cutaneous fungal infections: correlation between skin tissue culture and histopathology. *Journal of the American Academy of Dermatology*. 2014 Aug 1;71(2):293-301.
9. <https://my.clevelandclinic.org/health/diseases/24401-fungal-infections-mycosis>.
10. <https://www.medicinenet.com/script/main/art.asp?articlekey=255623>
11. Sharma S, Sharma S. Development, Standardization of Polyherbal Formulation of Anti-Fungal Cream of Plant *Curcuma longa*, *Eugenia aromatica*, *Foeniculum vulgare*. *International Journal of Pharmaceutical Research and Innovation*. 2020 May 8;13:65-87.
12. Kokate CK, Purohit AP, Gokhale SB. *Text book of Pharmacognosy*. Pune: Nirali Prakashan. 2003;8(66):1624
13. Win HY, Myo KK, Win NN. Phytochemicals Screening, Minerals, Antimicrobial and Antioxidant Activities of Bitter Melon Seed Extracts and Characterization of Isolated Momordicin I.
14. Ma X, Jia S, Wang G, Liang M, Guo T, Du H, Li S, Li X, Huangfu L, Guo J, Xing X. TRIM28 promotes the escape of gastric cancer cells from immune surveillance by increasing PD-L1 abundance. *Signal transduction and targeted therapy*. 2023 Jun 26;8(1):246.
15. Farhan Saeed FS, Muhammad Afzaal MA, Bushra Niaz BN, Arshad MU, Tabussam Tufail TT, Hussain MB, Ahsan Javed AJ. Bitter melon (*Momordica charantia*): a natural healthy vegetable.
16. Joseph B, Raj SJ. Pharmacognostic and phytochemical properties of *Aloe vera* linn an overview. *Int J Pharm Sci Rev Res*. 2010 Jan 1;4(2):106-10.
17. Sahu PK, Giri DD, Singh R, Pandey P, Gupta S, Shrivastava AK, Kumar A, Pandey KD. Therapeutic and medicinal uses of *Aloe vera*: a review. *Pharmacology & Pharmacy*. 2013 Nov 8;4(08):599.
18. Utami CS, Balqis U, Athaillah F, Hanafiah M, Iskandar CD. Characterization Evaluation of Clove Flower Oil (*Syzygium aromaticum* (L.) Meer) And Pharmacological Properties Of Anthelmintic. *The International Journal of Tropical Veterinary and Biomedical Research*. 2019 Nov 1;4(2).
19. Bhattacharya S, Chakraborty S, Pal R, Roy A, Bhattacharjee A. Tannins Containing Medicinal Plants and It's Significance: An Overview.
20. Tan SP, Stathopoulos C, Parks S, Roach P. An optimised aqueous extract of phenolic compounds from bitter melon with high antioxidant capacity. *Antioxidants*. 2014 Dec 2;3(4):814-29.
21. Parekar PB, Shivpuje SS, Navghare VV, Savale MM, Surwase VB, Mane-Kolpe PS, Kale PS. Polyherbal Gel Development And Evaluation For Antifungal Activity. *European Journal of Molecular & Clinical Medicine*. 2022;9(03):5409-18.
22. Sudipta Das SD, Haldar PK, Goutam Pramanik GP. Formulation and evaluation of herbal gel containing *Clerodendron infortunatum* leaves extract.
23. Sitepu NB, Ningsih SW, Harahap MA. Formulation and Physical Evaluation of Green Tea Leaf Extract (*Camellia Sinensis* L.) As a Gel Peel Off Mask. *Contagion: Scientific Periodical Journal of Public Health and Coastal Health*. 2023 Mar 30;5(1):154-67.
24. Al-Nima AM, Al-Kotaji MY, Al-Iraqi OS, Ali ZH. Preparation and evaluation of ultrasound transmission gel. *Asian J Pharm Clin Res*. 2019 Jan 7;12(1):422-7.
25. Ganesh Misal GM, Gouri Dixit GD, Vijay Gulkari VG. Formulation and evaluation of herbal gel.
26. Sohail T, Khan RA, Imran H, Fareed G, Yasmeen S. Development and Evaluation of Antimicrobial Polyherbal Gel Formulation for the Treatment of Various Skin Infections. *RADS Journal of Pharmacy and Pharmaceutical Sciences*. 2022 Oct 31;10(3):92-9.
27. Edula V, Nagulu M, Reddy PP. Formulation And Evaluation Of Wound Healing Activity Of Polyherbal Gel. *Int J Pharm Biol Sci*. 2017;7(3):158-67.



28. Santanu R, Hussan SD, Rajesh G, Daljit M. A review on pharmaceutical gel. The International Journal of Pharmaceutical Research and Bio-Science. 2012;1(5).

29. Pandey, A., Jagtap, J. V., Polshettiwar, S. A., & Kuchekar, B. S. (2011). Formulation and Evaluation of Antibacterial and Antifungal Activity of Herbal Gel Containing Aloe vera, Azadirachta indica And Lycopersicon esculentum Seed Extract. Research Journal of Pharmacy and Technology, 4(4), 552-554

How to cite this article:

Renuka D. Waghmare et al. Ijppr.Human, 2026; Vol. 32 (5): 138-145.

Conflict of Interest Statement: All authors have nothing else to disclose.

This is an open access article under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs License, which permits use and distribution in any medium, provided the original work is properly cited, the use is non-commercial and no modifications or adaptations are made.