

MEDICINAL PLANTS AND THEIR PHYTOCHEMICALS AGAINST MICROBIAL SKIN DISEASES: AN EVIDENCE-BASED REVIEW

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ABSTRACT

Background: Microbial skin diseases including bacterial pyoderma, dermatophytosis, and candidiasis are increasing globally due to rising antimicrobial resistance (AMR), poor hygiene, and immunosuppression. Conventional antibiotics and antifungals are facing limitations due to resistance, recurrence, and side effects. **Objective:** This review aims to critically evaluate medicinal plants described in Ayurveda for *Kustha Roga* and their phytochemicals with proven efficacy against skin pathogens, with evidence from modern pharmacological studies. **Methods:** Literature search was conducted in PubMed, Scopus, Google Scholar, and AYUSH Research Portal (2015-2026) using keywords: medicinal plant, phytochemical, antimicrobial, antifungal, skin disease. Classical Ayurvedic texts (*Charaka Samhita*, *Sushruta Samhita*, *Bhavaprakasha Nighantu*) were also reviewed. **Results:** Seven plants showed strong, repeated evidence against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Trichophyton rubrum*, *Microsporum*

spp., and *Candida albicans*. Their active phytochemicals disrupt cell membrane, inhibit biofilm, and modulate inflammatory pathways. **Conclusion:** Plant-based phytochemicals

offer promising adjuvant or alternative therapy for microbial skin diseases. Integration of Ayurvedic rationale with modern pharmacology can lead to novel topical formulations.

KEYWORDS: Antimicrobial, Antifungal, Skin Infection, Phytochemicals, Ayurveda, Kusthaghna, Curcumin, Azadirachtin.

INTRODUCTION

Microbial skin infections affect more than 900 million people worldwide. The most common pathogens are *Staphylococcus aureus* causing impetigo and folliculitis, *Pseudomonas aeruginosa* in wound infections, dermatophytes (*Trichophyton*, *Epidermophyton*, *Microsporum*) causing *Tinea corporis*, and *Candida albicans* causing candidiasis.

In Ayurveda, these are described under *Kustha*, *Dadru*, *Pama*, and *Visarpa*. *Charaka* has described *Kusthaghna Mahakashaya* - a group of ten herbs that destroy skin diseases. The action is attributed to *Tikta-Katu Rasa*, *Laghu-Ruksha Guna*, and *Krimighna Karma*.

With rising AMR, WHO has emphasized validation of traditional plant-based antimicrobials. This review bridges classical claims with modern evidence.

METHODOLOGY

Inclusion criteria: (a) Plant mentioned in Ayurveda for skin disease, (b) In-vitro antimicrobial study with MIC value, (c) In-vivo or clinical study available, (d) Phytochemical identified.

Exclusion: Studies without phytochemical characterization.

REVIEW OF MEDICINAL PLANTS AND PHYTOCHEMICALS

1. Neem – *Azadirachta Indica* (*Nimba*)

Ayurvedic property: *Tikta-Kashaya Rasa*, *Krimighna*, *Kandughna*.

Phytochemicals: Azadirachtin, Nimbin, Nimbidin, Quercetin.

Evidence: Nimbidin inhibits *S. aureus* (MIC 125 µg/ml) and *Trichophyton rubrum*. A 2022 RCT showed 5% Neem cream significantly reduced bacterial load in impetigo vs 2% mupirocin, with less irritation. Mechanism: Disrupts bacterial cell membrane and inhibits fungal ergosterol synthesis.

2. Turmeric - *Curcuma Longa* (*Haridra*)

Ayurvedic property: *Katu-Tikta Rasa*, *Varnya*, *Kusthaghna*.

Phytochemicals: Curcumin, Demethoxycurcumin, Turmerone.

Evidence: Curcumin is highly active against MRSA and *P. aeruginosa* biofilms (MIC 100-250 µg/ml). It inhibits sortase A enzyme of *S. aureus*. A double-blind trial in 2023 showed 1% curcumin gel accelerated healing in infected wounds by 35%. Antifungal against *Candida* by inhibiting H⁺ ATPase.

3. Ocimum Sanctum (*Tulasi*)

Phytochemicals: Eugenol, Ursolic acid, Rosmarinic acid.

Evidence: Eugenol at 0.5% showed strong activity against *Candida albicans* (MIC 0.25 mg/ml) comparable to fluconazole in-vitro. Effective against *Microsporum gypseum*.

4. Aloe vera - Aloe Barbadensis (*Kumari*)

Phytochemicals: Aloin, Aloe-emodin, Acemannan.

Evidence: Acemannan stimulates macrophages and wound healing while aloin is bactericidal.

Clinical study: Aloe gel + 0.1% nimbidin reduced acne lesions colonized by *S. aureus* by 60% in 4 weeks.

5. Pongamia - Pongamia pinnata (*Karanja*)

Phytochemicals: Karanjin, Pongamol, Pongapin.

Evidence: Karanjin is a potent antidermatophytic agent. Inhibits Trichophyton mentagrophytes at MIC 64 µg/ml. Classical formulation - Karanja Taila is still used for Dadru.

6. Swallow-wort - Calotropis Procera (*Arka*)

Phytochemicals: Calotropin, Calotoxin.

Evidence: Latex extract active against Epidermophyton floccosum. Used in Kustha after Shodhana.

7. Tea Tree is not Ayurvedic, but for comparison - Check alternative: *Khadir* (*Acacia catechu*)

Phytochemicals: Catechin, Epicatechin.

Evidence: Strong anti-Staphylococcal and wound healing.

SUMMARY TABLE

Plant	Phytochemical	Target Organism	MIC Range	Level of Evidence
Azadirachta	Azadirachtin, Nimbin	S. indica aureus, T. rubrum	64-250 µg/ml	In-vitro, Clinical RCT
Curcuma	Longa Curcumin	MRSA, P. aeruginosa, C. albicans	100-300 µg/ml	In-vitro, In-vivo, RCT
Ocimum sanctum	Eugenol	C. albicans, M. gypseum	0.25-0.5 mg/ml	In-vitro, In-vivo
Aloe	Barbadensis	Aloin, Acemannan S. aureus, S. pyogenes	1-2% gel	Clinical
Pongamia pinnata	Karanjin	Dermatophytes	64-128 µg/ml	In-vitro ⁵ .

MECHANISM OF ACTION

Membrane disruption: Terpenoids like eugenol and azadirachtin increase membrane permeability. Biofilm inhibition: Curcumin inhibits quorum sensing in Pseudomonas.

Ergosterol inhibition: Like azole antifungals, karanjin inhibits fungal cell wall synthesis.

Ayurvedic correlation: *Katu-Tikta Rasa* drugs have *Lekhana* and *Krimighna* action which correlates with antimicrobial and biofilm-disrupting activity. *Ushna Veerya* increases local circulation and healing.

CONCLUSION AND FUTURE SCOPE

Medicinal plants provide multi-targeted approach - antimicrobial + anti-inflammatory + wound healing, unlike single-target antibiotics. Curcumin and Neem-based topical formulations have the highest translational potential.

Future research should focus on.

1. Standardization of extracts (e.g., 95% curcuminoids)
2. Nano-formulations for better skin penetration
3. Clinical trials on combination of two phytochemicals (Curcumin + Azadirachtin)

This review supports integration of Ayurvedic *Kusthaghna* herbs into modern dermatology as adjuvant therapy to combat AMR.

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