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Review Article

Topical Herbal Therapy as an Alternative Treatment for Acne: Role of Neem and Tea Tree Oil – A Review

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ABSTRACT

Acne vulgaris is a chronic inflammatory skin disorder commonly affecting adolescents and young adults. It is characterized by comedones, papules, pustules, nodules, and possible scarring. The pathogenesis of acne involves excessive sebum production, follicular hyperkeratinization, microbial colonization, particularly by *Cutibacterium acnes*, and inflammation. Conventional therapies such as antibiotics, retinoids, and benzoyl peroxide are effective but often associated with adverse effects including skin irritation, dryness, peeling, and antibiotic resistance. Herbal therapy has recently gained attention as a safer and more sustainable alternative for acne management. Medicinal plants such as neem (*Azadirachta indica*) and tea tree oil (*Melaleuca alternifolia*) possess significant antimicrobial, anti-inflammatory, antioxidant, and wound-healing properties. Neem contains bioactive compounds such as nimbidin and azadirachtin that help control microbial growth and reduce inflammation. Tea tree oil, rich in terpinen-4-ol, demonstrates potent antibacterial activity against acne-causing microorganisms and reduces inflammatory lesions. This review discusses the pathophysiology of acne vulgaris, therapeutic mechanisms of neem and tea tree oil, topical formulations, clinical applications, advantages, limitations, and future prospects of herbal therapy in acne treatment.

INTRODUCTION

Acne vulgaris is one of the most common chronic inflammatory skin disorders affecting the pilosebaceous units of the skin (Thiboutot et al., 2009). It commonly occurs during adolescence because of hormonal changes associated with puberty and affects approximately 80–100% of

teenagers worldwide (Zaenglein et al., 2016). Although acne is often considered a temporary condition, it may persist into adulthood and result in complications such as hyperpigmentation and scarring. Acne also has a significant psychological impact, contributing to anxiety, reduced self-esteem, and social withdrawal.

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The etiology of acne vulgaris is multifactorial and involves excessive sebum production, follicular hyperkeratinization, microbial colonization, and inflammation (Thiboutot et al., 2009). Increased androgen levels stimulate sebaceous glands to produce excessive sebum, which blocks hair follicles and promotes comedone formation. The lipid-rich environment favors the growth of *Cutibacterium acnes*, which contributes to inflammation through the release of enzymes and inflammatory mediators.

Conventional treatments such as topical retinoids, antibiotics, benzoyl peroxide, and hormonal therapy are commonly used for acne management. However, these therapies may cause adverse effects including dryness, peeling, skin irritation, photosensitivity, and antibiotic resistance (Bassett et al., 1990). These limitations have encouraged the development of safer and more effective alternatives.

Herbal therapy has emerged as a promising approach because medicinal plants contain bioactive compounds with antimicrobial, anti-inflammatory, antioxidant, and healing properties (Kaur et al., 2018). Neem (*Azadirachta indica*) and tea tree oil (*Melaleuca alternifolia*) are widely studied herbal agents used in dermatology for acne treatment because of their strong therapeutic potential and improved safety profile.

2. METHODOLOGY / LITERATURE SEARCH STRATEGY

A comprehensive literature search was conducted using electronic databases including PubMed, Google Scholar, ScienceDirect, Scopus, and ResearchGate. Articles published between 2000 and 2025 related to acne vulgaris, herbal therapy, neem, tea tree oil, antimicrobial activity, and topical formulations were reviewed. Keywords used during the search included “acne vulgaris,”

“herbal anti-acne therapy,” “*Azadirachta indica*,” “*Melaleuca alternifolia*,” “tea tree oil,” and “topical herbal formulations.” Both review articles and original research studies were included to obtain updated scientific information.

3. ACNE PATHOPHYSIOLOGY

Acne vulgaris is a multifactorial inflammatory disorder involving sebaceous glands, hair follicles, and microbial flora (Thiboutot et al., 2009).

3.1 Sebum Overproduction

Increased androgen levels stimulate sebaceous glands to produce excessive sebum, creating an oily environment favorable for acne development.

3.2 Follicular Hyperkeratinization

Dead keratinocytes accumulate within hair follicles, causing obstruction and formation of comedones (blackheads and whiteheads).

3.3 Microbial Colonization

Cutibacterium acnes proliferates within clogged follicles and produces inflammatory mediators and enzymes that aggravate acne lesions.

3.4 Inflammation

Inflammatory mediators such as cytokines and chemokines cause redness, swelling, pain, papules, pustules, nodules, and cyst formation.

4. INTRODUCTION TO HERBAL THERAPY

Herbal therapy, also known as phytotherapy, involves the use of medicinal plants for the treatment and prevention of diseases. Herbal medicines are widely used in dermatology because of their safety, effectiveness, and reduced adverse effects (Kaur et al., 2018).



4.1 Natural and Safe Therapy

Herbal remedies contain bioactive compounds such as flavonoids, tannins, alkaloids, and essential oils with therapeutic properties and comparatively lower toxicity.

4.2 Use in Dermatology

Herbal therapy is commonly used for acne, eczema, psoriasis, wound healing, and inflammatory skin disorders because of its antimicrobial and anti-inflammatory properties.

4.3 Important Herbal Agents

Medicinal plants commonly used in dermatological therapy include neem (*Azadirachta indica*), tea tree oil (*Melaleuca alternifolia*), and *Aloe vera*.

5. NEEM (AZADIRACHTA INDICA)

Neem (*Azadirachta indica*) belongs to the family Meliaceae and is widely used in Ayurveda for the treatment of skin diseases (Biswas et al., 2002).

Neem contains bioactive compounds including nimbidin, azadirachtin, nimbolide, quercetin, and flavonoids responsible for its therapeutic activity. Neem exhibits potent antibacterial, anti-inflammatory, antioxidant, and wound-healing properties.

Neem inhibits the growth of acne-causing microorganisms such as *Cutibacterium acnes* and reduces inflammation associated with acne lesions (Pandey et al., 2014). It also promotes tissue regeneration and reduces oxidative stress.

Table 1. Neem Profile

Parameter	Details
Botanical Name	<i>Azadirachta indica</i>
Family	Meliaceae
Active Compounds	Nimbidin, Azadirachtin

Properties	Antibacterial, Anti-inflammatory
Uses	Acne, eczema, wound healing

6. TEA TREE OIL (MELALEUCA ALTERNIFOLIA)

Tea tree oil is an essential oil extracted from the leaves of *Melaleuca alternifolia* and is extensively used in dermatology because of its strong antimicrobial and anti-inflammatory activity (Carson et al., 2006).

The major active constituent of tea tree oil is terpinen-4-ol, which possesses antibacterial, antifungal, and antioxidant properties. Tea tree oil effectively inhibits acne-causing bacteria and reduces inflammation and lesion severity (Bassett et al., 1990).

Compared with benzoyl peroxide, tea tree oil produces fewer adverse effects such as dryness and irritation while improving acne lesions and overall skin appearance.

Table 2. Tea Tree Oil Profile

Parameter	Details
Source	Leaves of <i>Melaleuca alternifolia</i>
Active Component	Terpinen-4-ol
Properties	Antimicrobial, Anti-inflammatory, Antioxidant
Use	Topical acne treatment

7. MECHANISM OF ACTION

Neem and tea tree oil exert anti-acne activity through multiple mechanisms targeting the major causes of acne vulgaris.

7.1 Antibacterial Activity

Active compounds such as terpinen-4-ol, nimbidin, and azadirachtin inhibit the growth of *Cutibacterium acnes* and reduce bacterial



colonization within hair follicles (Hammer et al., 2003).

7.2 Anti-inflammatory Activity

Neem and tea tree oil suppress inflammatory mediators such as cytokines and prostaglandins, reducing redness, swelling, and irritation.

7.3 Antioxidant Activity

These herbal agents protect skin cells from oxidative stress and support tissue healing and regeneration.

Table 3. Comparative Activity of Neem and Tea Tree Oil

Activity	Neem	Tea Tree Oil
Antibacterial	Strong	Strong
Anti-inflammatory	Moderate	Strong
Antioxidant	Present	Present
Acne Reduction	Effective	Highly Effective

8. CLINICAL APPLICATIONS

Neem and tea tree oil are incorporated into several topical formulations used for acne treatment.

8.1 Creams

Herbal creams provide moisturization and deliver active ingredients to inflamed skin lesions.

8.2 Gels

Gels are suitable for oily and acne-prone skin because of their non-greasy nature and rapid absorption.

8.3 Face Washes

Neem and tea tree oil-based face washes remove excess oil, dirt, and microorganisms from the skin surface.

8.4 Spot Treatments

Concentrated formulations are directly applied to pimples and pustules to reduce inflammation and accelerate healing.

Topical herbal formulations are generally applied twice daily for effective acne management.

9. DISCUSSION

The reviewed literature indicates that neem and tea tree oil possess considerable therapeutic potential in acne management because of their antibacterial, anti-inflammatory, antioxidant, and healing properties. These herbal agents effectively target multiple stages of acne pathogenesis while producing fewer adverse effects compared with conventional therapies. Their compatibility with different topical formulations improves patient acceptance and long-term compliance. However, variability in herbal preparations, lack of standardization, and limited clinical trials remain major limitations requiring further scientific investigation.

10. ADVANTAGES AND LIMITATIONS ADVANTAGES

Advantages

- Natural and safe
- Fewer side effects
- Antimicrobial and anti-inflammatory activity
- Affordable and easily available
- Suitable for long-term use

Limitations

- Slower action compared with synthetic drugs
- Possible irritation in sensitive individuals



- Variability in herbal formulations
- Limited clinical evidence
- Need for dilution before application

Table 4. Advantages and Limitations of Herbal Therapy

Advantages	Limitations
Natural and safe	Slow action
Less side effects	Possible irritation
Affordable	Requires dilution

11. FUTURE PROSPECTS AND RESEARCH GAPS

Future research should focus on:

- Development of standardized herbal formulations
- Nanotechnology-based delivery systems
- Long-term clinical safety studies
- Comparative studies with conventional anti-acne therapies
- Commercialization of advanced herbal skincare products

12. CONCLUSION

Herbal therapy represents a promising and effective alternative approach for acne management. Neem (*Azadirachta indica*) and tea tree oil (*Melaleuca alternifolia*) possess potent antimicrobial, anti-inflammatory, antioxidant, and wound-healing properties that effectively reduce acne lesions and improve skin health. Compared with conventional therapies, these herbal remedies demonstrate better safety profiles and fewer adverse effects. However, further clinical studies and formulation standardization are necessary to establish long-term safety and therapeutic efficacy. Herbal formulations containing neem and

tea tree oil may play an important role in future dermatological and cosmetic practice.

13. SUMMARY

Neem and tea tree oil are valuable herbal agents used in topical acne therapy because of their antimicrobial and anti-inflammatory activities. Their natural origin, safety, and effectiveness make them promising alternatives to synthetic anti-acne medications. Continued scientific validation and advanced formulation approaches may improve their clinical acceptance and therapeutic potential.

14. ABBREVIATIONS

UV: Ultraviolet;

C. acnes: Cutibacterium acnes.

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16. CONFLICT OF INTEREST

The authors declare no conflict of interest.

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18. AUTHOR CONTRIBUTIONS

Both authors contributed equally to literature review, manuscript drafting, editing, and final approval of the manuscript.



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