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**Review Article**

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## **The Study and Formulation of Herbal Anti-Acne Gel**

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### **ABSTRACT**

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**ABSTRACT:** Acne vulgaris affects up to an estimated majority of adolescents and a sizable portion of adults, contributing to reduced quality of life and long-term skin sequelae. Topical conventional treatments are effective but may be limited by local irritation, adherence issues, and the risk of antibiotic resistance. Plant-derived extracts—many with demonstrated antimicrobial, anti-inflammatory and antioxidant properties—are being formulated into gels to maximise topical delivery while maintaining cosmetic appeal. We performed a systematic search for publications describing topical gels containing plant extracts intended for acne treatment, including formulation development studies, in vitro antimicrobial/inflammatory assays, animal models, and human clinical trials. Data extraction emphasised botanical identification, extraction and standardisation methods, gel composition (gelling agents, penetration enhancers, preservatives), evaluation protocols (stability, irritation, microbial testing) and clinical endpoints (lesion counts, severity scales, patient-reported outcomes). Quality assessment was performed with recognised tools appropriate to each study type.

### **KEYWORDS**

**KEYWORDS:** topical gel, phytotherapy, acne, formulation, tea tree oil, neem, curcumin

## INTRODUCTION

**INTRODUCTION:** Acne vulgaris is a chronic inflammatory disease of the pilosebaceous unit that affects nearly 80% of adolescents and a significant proportion of adults worldwide.<sup>1</sup> The pathogenesis involves increased sebum production, follicular hyperkeratinisation, colonisation by *Cutibacterium acnes*, and inflammation.<sup>2</sup> While current therapies such as topical retinoids, benzoyl peroxide, and antibiotics—remain the cornerstone of management, their frequent side effects, including dryness, peeling, erythema, and potential antibiotic resistance, have led to growing interest in natural and herbal alternatives.<sup>3</sup>

Herbal medicines are known to possess a wide range of bioactive compounds with antimicrobial, antioxidant, and anti-inflammatory effects. These properties make them suitable candidates for acne management.<sup>4</sup> Plant-based ingredients such as tea tree oil, neem, turmeric, green tea, and aloe vera have shown promising results in both preclinical and limited clinical settings.<sup>5</sup> When incorporated into gel formulations, herbal extracts demonstrate enhanced spreadability, patient compliance, and sustained release compared to traditional creams or ointments.<sup>6</sup> Gels also provide better penetration of active ingredients into the skin and reduce the greasiness often associated with oil-based formulations.<sup>7</sup>

Several studies have reported that gels containing *Melaleuca alternifolia* exhibit potent antibacterial action, while *Azadirachta indica* and *Curcuma longa* possess anti-inflammatory and antioxidant effects that reduce acne lesion severity.<sup>8</sup> Furthermore, aloe vera and green tea-based gels contribute to soothing and hydrating effects, reducing post-acne irritation.<sup>9</sup> Despite these encouraging results, variability in extraction methods, lack of phytochemical standardisation, and insufficient long-term clinical data pose challenges for consistent therapeutic outcomes.<sup>10</sup>

This review aims to critically summarise the literature on herbal anti-acne gels, focusing on their formulation approaches, mechanisms of action, evaluation parameters, and clinical findings. It highlights current research gaps, standardisation issues, and future directions for developing effective, safe, and scientifically validated herbal gels for acne management.





## **MATERIALS AND METHODS**

### **METHODOLOGY FOR HERBAL ANTI-ACNE GELS**

A comprehensive search was carried out

across scientific databases including PubMed, Google Scholar, ScienceDirect, chatgpt and Scopus

and journals like: Innovative journal of medical sciences, World journal of pharmaceutical research,

European journal of biomedical and pharmaceutical sciences.

A Deep Study was conducted on journals and review papers were downloaded from above websites

and information was collected regarding to herbal anti-acne gel.





## RESULTS

### PATHOPHYSIOLOGY OF ACNE

Acne vulgaris is a multifactorial skin disorder primarily affecting the pilosebaceous unit, which consists of a hair follicle, sebaceous gland, and associated duct. The pathogenesis of acne involves a complex interplay of hormonal, microbial, immunological, and environmental factors, leading to the formation of comedones, inflammatory papules, pustules, and sometimes nodules or cysts.<sup>11,12</sup>

**Table 1. Classification of Acne types by Severity and Characteristics** <sup>1,2,3</sup>

| Category         | Acne types                    | Appearance                                       | Primary cause                                  | Clinical notes                      |
|------------------|-------------------------------|--------------------------------------------------|------------------------------------------------|-------------------------------------|
| Non-Inflammatory | Closed comedones (whiteheads) | Small coloured bumps, not visible on the surface | Clogged pores due to excess sebum & dead cells | Often appear on forehead and cheeks |
|                  | Open comedones (Blackheads)   | Dark-tipped small bumps; open pores              | Oxidation of sebum and melanin                 | Common in T-zone (nose, chin)       |
| Inflammatory     | Papules                       | Red, tender, raised bumps                        | Mild follicular inflammation                   | Early inflammatory lesion           |
|                  | Pustules                      | White or yellow pus-filled bumps with redness    | Immune response to C. acnes                    | Painful, may ooze fluid             |
|                  | nodules                       | Large, firm, deep-seated lumps                   | Deep follicular infections and inflammation    | Can result in scarring              |
|                  | cysts                         | Deep, soft or firm pus-filled lesion             | Severe infection & inflammation                | Often requires medical intervention |



|                       |                        |                                                                    |                                           |                                           |
|-----------------------|------------------------|--------------------------------------------------------------------|-------------------------------------------|-------------------------------------------|
| Sever / special forms | Acne conglobata        | Large interconnected nodules & cysts with abscesses                | Chronic, severe inflammation              | High risk of scarring                     |
|                       | Acne fulminans         | Sudden, ulcerative acne with systemic symptoms (fever, Joint pain) | Extreme immune response                   | Rare; needs urgent treatment              |
|                       | Acne Mechanica         | Small to moderate bumps triggered by friction, pressure, or heat   | Mechanica irritation                      | Common in athletes or with tight clothing |
|                       | Cosmetic/ contact acne | Mild comedones or pustules after product use                       | Reaction to comedogenic cosmetics or oils | Usually reversible once trigger removed   |

**Table 2: Types of Herbal Anti Acne Gels:**

| Types Of Gels         | Herbal Examples                                                                   | Mechanism Of Action                                                                        | Therapeutic Effect                                       | References |
|-----------------------|-----------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------|----------------------------------------------------------|------------|
| Single-Herb Gel       | Neem (Azadirachta indica), Aloe vera (Aloe barbadensis), Turmeric (Curcuma longa) | Target Specific acne mechanism such as bacterial growth, inflammation, or sebum regulation | Antimicrobial, Anti-inflammatory, Healing                | 15,16      |
| <b>Polyherbal Gel</b> | Neem + Turmeric, Aloe Vera + Green Tea, Neem + Tea Tree + Aloe                    | Combines multiple mechanisms for synergistic effect                                        | Antimicrobial, Anti-inflammatory, Sebum control, Healing | 16,17      |



|                     |                                               |                                                                                  |                                                     |       |
|---------------------|-----------------------------------------------|----------------------------------------------------------------------------------|-----------------------------------------------------|-------|
| Hydrogel-Based Gel  | Aloe Vera, Green Tea, Licorice                | Water-based gel matrix enhances absorption of herbal actives; controlled release | Anti-inflammatory, Sebum control, Soothing effect   | 17    |
| Organogel-Based Gel | Tea Tree Oil, Neem Oil, Sesame Oil Extracts   | Oil-based gel carries lipophilic herbal compounds                                | Antimicrobial, Anti-inflammatory, Moisturizing      | 17    |
| Nano-Herbal Gel     | Green Tea polyphenols, Curcumin nanoparticles | Nano-carriers enhance skin penetration, bioavailability, and stability           | Anti-inflammatory, Antimicrobial, Enhanced efficacy | 16,17 |

## BENEFITS OF GELS IN ACNE MANAGEMENT

Gel-based formulations are increasingly recognized as ideal topical vehicles for acne therapy due to their physicochemical versatility, non-greasy texture, and enhanced patient compliance. In herbal anti-acne treatments, gels improve the stability, penetration, and therapeutic performance of bioactive compounds. <sup>18,19</sup>

- 1. Non-Greasy and Lightweight Formulation**
- 2. Enhanced Penetration and Rapid Absorption**
- 3. Controlled Release of Active Compounds**
- 4. Cooling and Soothing Effect**
- 5. Ease of Application and Patient Compliance**
- 6. Versatility in Formulation**



## 7. Localized Delivery with Reduced Systemic Exposure

### INGREDIENTS USED IN HERBAL ANTI-ACNE GELS

Herbal anti-acne gels are formulated using a combination of **active herbal extracts, gel bases, stabilizers, and enhancers**. The choice of ingredients is aimed at **targeting the multifactorial pathophysiology of acne**, including bacterial growth, inflammation, oxidative stress, and sebum overproduction.

#### 1. Active Herbal Extracts

The main component in herbal anti-acne gels is the **herbal extract** itself, which provides therapeutic action:

**Table 4:**

| Herb / Extract                        | Active Compounds                  | Primary Action                                           | References |
|---------------------------------------|-----------------------------------|----------------------------------------------------------|------------|
| Neem (Azadirachta indica)             | Nimbidin, Azadirachtin            | Antibacterial, anti-inflammatory, reduces sebum          | 20,21      |
| Tea Tree (Melaleuca alternifolia) Oil | Terpinen-4-ol                     | Antimicrobial against C. acnes, anti-inflammatory        | 21         |
| Aloe Vera (Aloe barbadensis)          | Aloin, Aloesin, Polysaccharides   | Soothing, anti-inflammatory, healing                     | 20         |
| Turmeric (Curcuma longa)              | Curcumin                          | Anti-inflammatory, antioxidant, reduces redness          | 20,21      |
| Green Tea (Camellia sinensis)         | EGCG (Epigallocatechin-3-gallate) | Reduces sebum production, antioxidant, anti-inflammatory | 21,22      |



|                                       |                         |                                                          |    |
|---------------------------------------|-------------------------|----------------------------------------------------------|----|
| Licorice (Glycyrrhiza glabra)         | Glycyrrhizin, Glabridin | Anti-inflammatory, antioxidant, reduces oxidative stress | 22 |
| Fenugreek (Trigonella foenum-graecum) | Saponins, Flavonoids    | Hormonal modulation, reduces sebum                       | 22 |

## 2. Gel Bases

The gel base provides the matrix for active ingredients, ensuring stability, spreadability, and skin absorption:

Carbopol: A synthetic polymer commonly used for its gelling and thickening properties.

Hydroxypropyl Methylcellulose (HPMC): Biocompatible polymer, provides smooth texture and controlled release.

Guar Gum / Xanthan Gum: Natural polysaccharides used as stabilizers and thickening agents.

The base type influences skin feel drug release, and patient compliance. <sup>21,22</sup>

## 3. Humectants and Moisturizers

These ingredients help maintain skin hydration and prevent dryness, which can be exacerbated by acne treatments:

Glycerin: Draws moisture into the skin and improves gel texture.

Propylene Glycol: Enhances penetration of herbal actives and retains moisture.

Humectants improve gel tolerability and reduce irritation during prolonged use. <sup>21</sup>

#### 4. Preservatives

Preservatives ensure microbial safety and shelf life of herbal gels:

Phenoxyethanol, Sodium Benzoate, Methylparaben: Common preservatives in topical gels.

Even though herbal gels are natural, preservatives are necessary to prevent contamination during storage.<sup>21</sup>

#### 5. Penetration Enhancers

These ingredients improve the delivery of herbal actives into the skin:

Ethanol, Propylene Glycol: Facilitate deeper skin absorption of hydrophilic and lipophilic compounds.

Essential Oils (like Lavender, Rosemary): Can also act as natural penetration enhancers while providing additional antimicrobial benefits.

Enhanced delivery ensures that active herbal compounds reach the target sites within the pilosebaceous unit.<sup>22</sup>

### EVALUATION PARAMETERS OF HERBAL ANTI-ACNE GELS

Evaluating herbal anti-acne gels is critical to ensure **safety, efficacy, stability, and patient acceptability**. The parameters are broadly categorized into **physical, chemical, microbiological, and therapeutic evaluations**.

#### 1. Physical Evaluation



**Appearance and Colour**

**2. Texture and Homogeneity**

**3. pH Measurement**

**4. Viscosity and Spreadability**

**2. Chemical Evaluation**

**1. Active Compound Content**

**2. Stability Studies**

**3. Microbiological Evaluation**

**1. Sterility and Microbial Load**

**2. Preservative Efficacy Test**

**4. In Vitro Evaluation:**

**1. Drug Release and Permeation Studies**

**2. Antimicrobial Activity**

**5. In Vivo Evaluation**

**1. Skin Irritation Test**

**2. Clinical Efficacy Studies**

**6. Organoleptic and Consumer Acceptability**

**1. Odour and Feel**

**2. Spreadability and Absorption**

**USES OF GELS IN PHARMACEUTICAL AND COSMECEUTICAL APPLICATIONS**

3. Gels are semi-solid dosage forms characterized by a three-dimensional polymeric network capable of retaining large amounts of water or other liquids. Their distinct rheological behavior, high spreadability, and cooling effect make them particularly valuable in pharmaceutical, dermatological, and cosmetic formulations. Due to their ease of application, patient acceptability, and ability to provide localized and controlled drug delivery, gels have gained extensive utility across therapeutic and cosmetic domains. <sup>23,24</sup>

**1. Topical Drug Delivery**

**2. Cosmetic and Dermatological Uses**



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### **3. Controlled and Sustained Drug Release**

### **4. Oral, Vaginal, and Rectal Applications**



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## DISCUSSION

The findings from the published literature indicate that herbal anti-acne gels can

effectively target multiple pathways involved in acne pathogenesis. Most plant-

based ingredients used in these gels demonstrate antibacterial, anti-

inflammatory, antioxidant, and sebum-regulating actions, which collectively help

reduce acne severity. Extracts such as *Azadirachta indica* (Neem), *Aloe*

*barbadensis* (*Aloe vera*), *Camellia sinensis* (Green tea), *Melaleuca alternifolia*

(Tea tree oil), *Curcuma longa* (Turmeric), and *Ocimum sanctum* (Tulsi) are

consistently reported as beneficial due to their rich phytochemical content

including flavonoids, terpenoids, phenolic compounds, and essential oils.

One major advantage of herbal anti-acne gels is their low side-effect profile.

Unlike synthetic treatments, herbal gels rarely cause skin peeling, burning, or

extreme dryness. Their gel base provides moisturization, faster absorption, and

comfortable use on oily or combination skin—making them suitable for

adolescents and young adults.



Overall, herbal anti-acne gels appear to be a promising and safer alternative to conventional topical medications. Their multi-mechanistic action and minimal irritation make them suitable for long-term acne management. Future research should focus on improving extract standardization, enhancing formulation stability, and conducting randomized clinical trials to create stronger evidence for their therapeutic use.

## **CONCLUSION**

Acne Vulgaris is a common disorder affects the individual among youngsters usually 18-28 years age. Herbal medicines are more softer than allopathic medicines. Natural medicines are more acceptable in the belief that they are softer with fewer side effects than the synthetic drugs. Herbal formulations have growing demand in the world market. It is very good attempt to formed the Herbal Gel containing Tea-Tree Oil.

## **ABBREVIATIONS**

No Abbreviations Used.



## **FUNDING**

self Funding.

## **CONFLICT OF INTERESTS**

Author Declares no Conflict of Interest.



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