

An Overview on Formulation and Development of Herbal Creams for Treatment of Acne/Pimple

Mohd. Wasiullah¹, Piyush Yadav^{2*}, Gurudayal Yadav³

Abstract

The increasing demand for natural skincare products has spurred the development of herbal creams for the treatment of common dermatological conditions, particularly acne and pimples. Acne is a complex skin condition that predominantly affects teenagers but can continue into adulthood. Traditional treatments for acne often have undesirable side effects, leading to a growing interest in herbal remedies. Plant-based creams are becoming increasingly popular because they are considered safer and more effective. This article seeks to offer an in-depth analysis of the creation and advancement of herbal creams designed for acne management. It explores the path physiology of acne, the role of herbal ingredients in its treatment, key formulation principles, and the safety and efficacy of various herbal compounds. Additionally, the review discusses challenges in herbal cream development, such as standardization, regulatory concerns, and consumer preferences.

Keywords: Herbal creams, acne treatment, pimple treatment, herbal formulations, green tea extract in skincare

INTRODUCTION

The condition is characterized by the blockage of hair follicles by excess sebum (skin oil) and dead skin cells, creating an environment conducive to the proliferation of (*P. acnes*) bacteria, which further aggravates the inflammatory response. Although acne is frequently regarded as a cosmetic issue, it can profoundly impact mental health, leading to reduced self-confidence, anxiety, and even depression, particularly in more severe cases. Consequently, managing acne effectively is crucial for both physical and emotional well-being. Historically, acne has been addressed through various medical treatments, including oral antibiotics and topical applications like benzoyl peroxide salicylic acid, and retinoids. However, these conventional treatments come with limitations, such as skin irritation, dryness, and the potential for antibiotic resistance with prolonged use. As a result, there has been growing interest in exploring alternative and more natural treatment options, particularly herbal formulations, which are perceived to offer a gentler, safer alternative with fewer side effects [1, 2].

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These creams often combine multiple bioactive plant compounds that work synergistically to address the underlying causes of acne, such as inflammation, excessive. The use of herbal remedies in skincare has been a cornerstone of traditional medical practices for centuries, including Ayurveda, Traditional Chinese Medicine (TCM), and Indigenous healing systems sebum production, and bacterial overgrowth. Herbs, like tea tree oil, neem, turmeric, aloe vera, and witch hazel, have long been prized for their antimicrobial, anti-inflammatory, and soothing properties, which are crucial in acne management. In addition, herbal treatments are often considered less harsh than their synthetic counterparts, providing a more natural

and holistic approach to skincare. The demand for natural, sustainable, and chemical-free cosmetic products has grown substantially. Consumers are increasingly seeking products that not only provide efficacy but also align with their values, including safety, environmental sustainability, and ethical sourcing. This shift in consumer preferences has driven the development of herbal creams specifically targeted for acne treatment. These creams promise to offer an alternative to the harsh synthetic ingredients change in other words to commonly found in over-the-counter acne products, while still providing effective results [3, 4].

The formulation of herbal creams involves a careful balance of active herbal ingredients with base ingredients, such as emulsifiers, stabilizers, and preservatives to ensure both the efficacy and safety of the product. Key formulation factors, such as the choice of emulsifiers, the stability of active ingredients, and the delivery systems used for skin penetration, play a crucial role in the final effectiveness of the product. Furthermore, challenges, such as the standardization of herbal extracts, ensuring the quality and consistency of ingredients, and overcoming regulatory hurdles are critical the development of successful herbal acne treatments.

This review article offers an in-depth analysis of the formulation and development of herbal creams for treating acne.

It explores the path physiology of acne, the role of herbal ingredients in managing acne symptoms, the principles behind the development of herbal creams, and the challenges and opportunities in this area. Additionally, the review examines the clinical evidence supporting the efficacy and safety of herbal creams, offering insight into the growing role of herbal alternatives in modern dermatology [5, 6].

ACNE PATHOPHYSIOLOGY

Acne vulgaris is a multifactorial skin disorder primarily of acne is crucial for developing effective treatments, including herbal creams. This review article offers an in-depth analysis of the formulation and development of herbal creams for treating acne.

Below is an in-depth look acting the pilosebaceous units, which are structures consisting of hair follicles and their associated sebaceous (oil) glands (Figure 1).

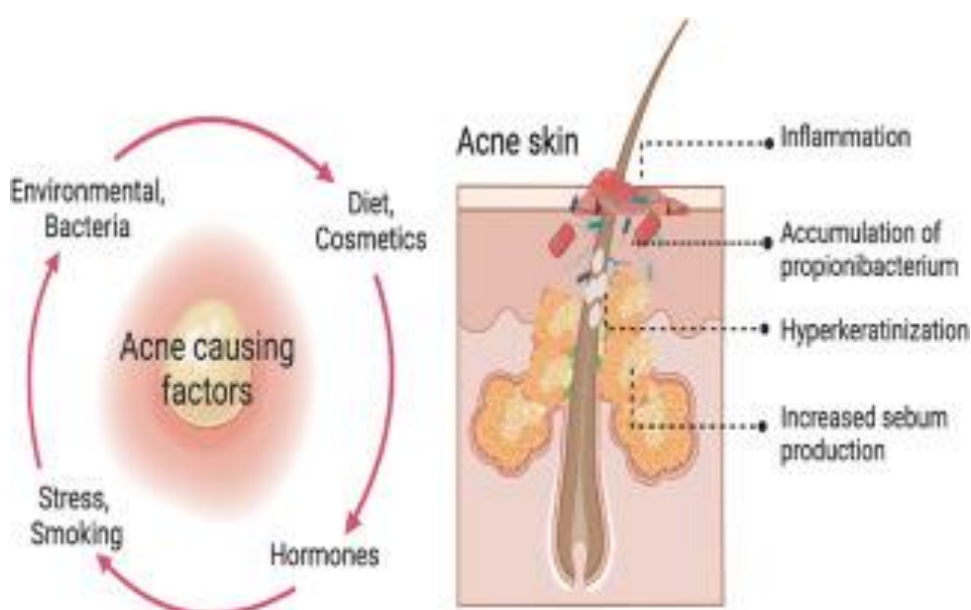


Figure 1. Understanding the pathophysiology: The various factors contributing to the development of acne.

Excess Sebum Production (Seborrhea)

One of the primary factors in acne development is the overproduction of sebum, an oily substance secreted by the sebaceous glands. Sebum plays an important role in lubricating and protecting the skin, but when produced in excess, it can lead to clogged pores. Sebum production is regulated by hormonal influences, particularly androgens (male hormones), which are elevated during puberty [6].

Increased sebum production is also observed in adult females due to fluctuations in hormones related to menstruation, pregnancy, and the use of oral contraceptives. In individuals with acne, the sebaceous glands are often hyper-responsive to androgens, leading to excessive oil production. This surplus sebum can combine with dead skin cells and create a sticky plug in the hair follicle, setting the stage for acne formation.

Follicular Hyperkeratinization

Follicular hyperkeratinization refers to the abnormal shedding of skin cells (keratinocytes) inside the hair follicle, which, when not properly exfoliated, can accumulate and combine with sebum. Discusses the key early stages in the development of acne. Under normal conditions, skin cells are off and replaced at a steady rate, but in individuals with acne, this shedding process is disrupted.

The excess keratinocytes contribute to the formation of a hard plug within the follicle, a condition referred to as a “comedone.” A comedone is the initial lesion in acne and can either be open (blackhead) or closed (whitehead). An open comedone occurs when the follicle is partially blocked, allowing the sebum to oxidize and turn dark, whereas a closed comedone results from a complete blockage of the follicle, trapping sebum and keratin inside.

Bacterial Colonization

Under normal conditions, these bacteria live harmlessly on the skins. However, when the hair follicle becomes clogged with excess sebum and dead skin cells, the anaerobic (low oxygen) environment within the follicle creates the perfect conditions for the proliferation of *P. acnes*.

The bacteria feed on the sebum, producing free fatty acids and other metabolic byproducts that can contribute to inflammation. As the population of *P. acnes* increases, the immune system is triggered, leading to an inflammatory response that manifests as the painful, red, swollen lesions typically seen in inflammatory acne. This leads to the development of papules, pustules, and in more severe instances, nodules and cysts [7].

Inflammation and Immune Response

Inflammation is a critical component of acne pathophysiology and is largely responsible for the progression from comedones to more severe forms of acne. When *P. acnes* proliferate within the clogged follicles, they produce various substances that trigger an immune response. These include lipases, which break down sebum, and other bacterial components that activate immune cells. The immune system's response to these bacteria involves the release of pro-inflammatory cytokines, chemokines, and other immune mediators that recruit white blood cells (such as neutrophils) to the site of infections that recruit white blood cells (such as neutrophils) to the site of infection. This inflammatory response leads to the characteristic redness, swelling, and tenderness associated with acne lesion change in other words The inflammation can damage surrounding tissue, resulting in scarring, which is a common complication of severe acne.

ROLE OF HORMONES IN ACNE DEVELOPMENT

Hormonal fluctuations are one of the most significant contributors to the development of acne, particularly during puberty when androgen levels increase. Hormones are a major factor in the development of acne, especially during puberty when androgen levels rise.

Androgens trigger the sebaceous glands to produce excess sebum, which can clog pores. These hormonal fluctuations help explain why acne is common during this period. These hormonal changes explain why acne is common in adolescents and why it may also persist or recur in adult women, particularly around the time of menstruation, pregnancy, or the use of hormonal contraceptives.

Polycystic ovary syndrome (PCOS) is another condition that is frequently associated with acne due to elevated levels of androgens, which stimulate excessive sebum production. Hormonal treatments, like oral contraceptives, which help control androgen levels, are commonly prescribed to treat acne in women [8].

- *Genetic Predisposition:* Genetic factors are a key determinant in a person's likelihood of developing acne. Research has indicated. Studies have shown that if one or both parents have had acne, their children are more likely to develop the condition. Certain genetic traits, such as an overactive sebaceous gland response to androgens or an inherent tendency for poor keratinocyte shedding, may predispose individuals to acne.
- *Environmental Factors and Lifestyle Influences:* External factors can also influence the development of acne. These include Diet can also play a role in the development of acne. Consuming foods rich in refined sugars, dairy, and those with a high glycemic index has been linked to a higher likelihood of developing acne. Foods that cause spikes in insulin levels can lead to increased sebum production. Foods that cause insulin spikes can increase sebum production and exacerbate acne.
- *Stress:* Stress is another key trigger for acne flare-ups. Hormones, like cortisol can stimulate sebum production and trigger inflammation, which can lead to the formation of acne lesions.
- *Cosmetic Product:* Oils, thick creams, and certain makeup products can contribute to the formation of comedones by clogging pores.
- *Environmental Pollution:* Pollutants in the air, such as dirt, smoke, and other chemicals, can contribute to skin inflammation and clog pores, potentially worsening acne [9].

FORMULATION PRINCIPLES OF HERBAL CREAMS

Formulating herbal creams for acne treatment involves combining plant-based active ingredients with appropriate Excipient to create an effective, safe, and cosmetically acceptable product. The primary goal is to deliver the therapeutic benefits of herbal ingredients while ensuring that the formulation is stable, non-irritating, and capable of penetrating the skin. Below are the key principles and factors to consider when formulating herbal creams for acne treatment:

Choice of Active Herbal Ingredients

The selection of active herbal ingredients is central to the formulation of a herbal cream. These ingredients must have proven therapeutic effects on acne and should be chosen based on their ability to address specific pathophysiological factors of acne, such as inflammation, bacterial growth, and excessive sebum production. Commonly used herbal ingredients in acne treatments include:

- *Antimicrobial Agents:* Tea tree oil, neem, witch hazel, and lavender have natural antimicrobial properties that help inhibit the growth of bacteria, a key trigger in acne.
- *Anti-inflammatory Agents:* Ingredients, like aloe vera, chamomile, turmeric, and green tea extract, possess anti-inflammatory properties that can soothe irritated skin and reduce redness and swelling in acne lesions.
- *Sebum-Regulating Agents:* Witch hazel, cinnamon, and zinc oxide help control excessive sebum production, preventing clogged pores that contribute to acne formation.
- *Antioxidants and Skin Repair Agents:* Green tea, vitamin E, and aloe vera can promote skin healing and reduce scarring by combating oxidative stress caused by inflammation [10].

Base and Excipient

Herbal creams typically consist of a water-based or oil-based formulation, with a variety of Excipient added to support the stability, texture, and effectiveness of the product. These excipients include

emulsifiers, stabilizers, preservatives, and moisturizers. The following components are essential in formulating an effective herbal cream:

- *Emulsifiers*: These are critical for creating a stable emulsion between water and oil phases in the cream. Emulsifiers ensure that the oil-soluble herbal extracts (such as essential oils or plant oils) and water-soluble ingredients (such as aloe vera or glycerin) mix well and remain stable throughout the product's shelf life. Common emulsifiers include cetearyl alcohol, glyceryl stearate, and lecithin.
- *Emollients*: Emollients soften and moisturize the skin. Ingredients, such as glycerin, fatty alcohols (e.g., cetyl alcohol), and plant oils (such as jojoba or olive oil) help form a barrier that locks in moisture and prevents transepidermal water loss. In acne treatment, emollients should be non-comedogenic (won't clog pores) to avoid aggravating the condition.
- *Humectants*: Glycerin and hyaluronic acid draw water into the skin, helping to maintain hydration. Maintaining hydration is important for acne-prone skin, which may become dry or irritated due to acne treatments.
- *Thickeners*: Thickeners or stabilizers help adjust the viscosity and consistency of the cream, ensuring it has an aesthetically pleasing texture. Ingredients, like xanthan gum, carbomer, or guar gum, are commonly used to thicken herbal creams.
- *Preservatives*: Since herbal creams often contain water-based components, they are prone to microbial contamination. Preservatives are needed to protect the formulation from bacteria, fungi, and mold. Natural preservatives, such as phenoxyethanol, ethylhexylglycerin, or potassium sorbate can be used to maintain product safety and integrity [11].

Stability and Shelf-Life

Stability is a critical factor in the formulation of herbal creams. Ensuring that the active herbal ingredients retain their potency over time requires careful attention to factors, such as pH, temperature, and light exposure. Herbal ingredients are often sensitive to light and heat, which can degrade their effectiveness. To ensure the cream remains effective throughout its shelf life, formulators must:

- *Optimize pH Levels*: The pH of the cream must be adjusted to match the skin's natural pH, which is typically between 4.5 and 5.5. A pH that is too high or low can irritate the skin or reduce the effectiveness of herbal ingredients.
- *Use Antioxidants*: Many herbal ingredients, particularly those rich in polyphenols (like green tea), are susceptible to oxidation. Antioxidants, like vitamin E or ascorbic acid, can be included in the formulation to prevent the degradation of active compounds.
- *Test for Microbial Stability*: Herbal creams are susceptible to microbial growth due to their water content. A preservative system must be carefully selected to prevent contamination without causing irritation or sensitization [12].

Skin Penetration and Delivery Systems

For herbal creams to be effective, the active ingredients must be able to penetrate the skin barrier and reach the deeper layers of the dermis, where acne lesions form. To enhance the bioavailability and effectiveness of herbal ingredients, various delivery systems may be employed:

- *Nanotechnology*: Nanoparticles or liposomes can encapsulate active ingredients, allowing for enhanced penetration and controlled release over time. Enhance the stability and bioavailability of ingredients, such as tea tree oil or turmeric, which might otherwise degrade or lose effectiveness.
- *Microemulsions*: A microemulsion is a system that contains small droplets of oil and water, creating a stable, transparent formulation. These emulsions can enhance the solubility and penetration of both water-soluble and oil-soluble herbal ingredients.
- *Liposomes and Niosomes*: These vesicular structures can encapsulate active herbal ingredients, protecting them from degradation while facilitating deeper skin penetration. Liposomes and niosomes are often used in formulations targeting acne scars or deeper inflammation [13].

Non-Comedogenicity

For acne treatment products, it is crucial to ensure that the cream is non-comedogenic, meaning it won't clog pores. Comedogenic ingredients can worsen acne by trapping sebum and bacteria inside hair follicles. Formulators should carefully choose oils and emollients that are non-comedogenic and avoid heavy or greasy substances.

Lightweight oils, such as jojoba oil, tea tree oil, and argan oil are often preferred in acne creams due to their non-comedogenic properties. Additionally, certain silicones, like dimethicone, may be used in moderation to create a smooth texture without promoting pore blockage [14].

Regulatory and Safety Considerations

Herbal creams must comply with the relevant cosmetic or pharmaceutical regulations depending on the region. In Europe, cosmetics are regulated by the EU Cosmetics Regulation, whereas in the United States, they are governed by the FDA (Food and Drug Administration).

Claims and Labelling

When marketing herbal creams for acne, formulators must ensure that any claims made about the product (e.g., "reduces acne in 7 days") are substantiated by clinical evidence. Products must also be labeled with proper ingredient listings, usage instructions, and potential allergens. Potential allergens can cause allergic reactions, which is particularly crucial for acne-prone skin.

DEVELOPMENT PROCESS AND CHALLENGES IN HERBAL CREAMS FOR ACNE TREATMENT

Identifying Therapeutic Needs

- *Target Audience:* Understand whether the cream is for teenagers with hormonal acne, adults dealing with persistent acne, or people with sensitive or acne-scarred skin.
- *Customized Formulations:* For example, a more soothing formulation may be needed for sensitive skin, while a more potent antimicrobial formulation may be required for acne with severe bacterial involvement [15].

Selection of Active Herbal Ingredients

- *Anti-inflammatory Herbs:* Aloe vera, calendula, chamomile, and turmeric are commonly used to reduce inflammation and soothe the skin.
- *Antimicrobial and Antibacterial Herbs:* are effective against the bacteria responsible for many acne lesions.
- *Sebum Regulation:* Plant extracts, such as Burdock Root, Cinnamon, and Witch Hazel help balance oil production in the skin, preventing clogged pores.
- *Skin Healing and Antioxidants:* Vitamin E, Rosehip Oil, Green Tea, and Gotu Kola promote healing, repair skin tissue, and may prevent scarring.

Formulation Development

- *Water-based vs. Oil-based:* Water-based creams are lighter and less greasy, suitable for oily, acne-prone skin. Oil-based creams may be more hydrating but must be chosen carefully to ensure non-comedogenicity.
- *Choosing Emulsifiers:* Natural emulsifiers, like Beeswax, Cetearyl Alcohol, and Lecithin, help blend herbal oils and water-based ingredients into a stable cream.
- *Optimal pH Level:* The cream must be formulated with a pH of 4.5–5.5, which is compatible with the skin's natural acidity and prevents irritation while maintaining the efficacy of active ingredients.

Testing for Efficacy and Safety

- *Patch Testing:* This ensures that the cream does not cause irritation or allergic reactions, especially in acne-prone skin, which is often sensitive.

- *Clinical Trials*: These trials help demonstrate the product's effectiveness in reducing acne, controlling oil production, or healing acne scars.
- *Microbial Testing*: Herbal creams are more susceptible to contamination than their synthetic counterparts due to their natural ingredients, so testing for bacteria, fungi, and Mold growth is essential to ensure the product's safety [16].

Consumer Experience and Sensory Testing

- *Texture*: A smooth, non-greasy, and easily absorbed texture is crucial for consumer acceptance. Thick, greasy creams can exacerbate acne and create a poor user experience.
- *Fragrance*: While herbal products are often associated with natural scents (e.g., lavender or tea tree), fragrances should not be too strong, as they can irritate sensitive acne-prone skin.
- *Color and Aesthetics*: Ensuring the cream is visually appealing, with a pleasant color and appearance, can influence consumer preference [17].

Challenges in the Development of Herbal Creams for Acne

Ingredient Stability and Standardization

- *Degradation of Active Ingredients*: Natural compounds in herbal ingredients, such as polyphenols in green tea or essential oils in tea tree oil, are susceptible to oxidation and degradation. Proper formulation techniques must preserve these active compounds.
- *Variation in Herbal Extracts*: The concentration of active compounds can vary based on factors like plant species, harvesting conditions, and extraction methods. This can lead to inconsistency in potency and effectiveness.
- *Solution*: Using standardized extracts ensures consistent concentrations of active ingredients, and antioxidants, like Vitamin E or Ascorbic Acid, can protect the product from oxidative damage.

Improving Skin Penetration

- *Limited Bioavailability*: Many herbal ingredients have low skin penetration due to their molecular size, polarity, or lipophilic nature.
- *Solution*: Advanced drug delivery systems, such as liposomes, nanoparticles, and microemulsions, can improve the bioavailability of herbal ingredients by encapsulating them for controlled release and enhancing their absorption through the skin [18].

Non-Comedogenicity (Pore Blockage)

- *Preventing Clogged Pores*: Certain oils and butters used in herbal creams (e.g., coconut oil, cocoa butter) can be comedogenic (pore-clogging) and exacerbate acne.
- *Solution*: Carefully selecting non-comedogenic oils, such as Jojoba Oil, Argan Oil, Grapeseed Oil, or Squalane, ensures that the product hydrates without causing breakouts. Furthermore, ensuring the cream has a lightweight, matte finish can prevent pore blockages.

Preservative Systems

- *Microbial Contamination*: Herbal creams are prone to microbial contamination due to the presence of water and natural ingredients.
- *Solution*: Natural preservatives, such as Phenoxyethanol, Ethylhexylglycerin, and plant-based antimicrobial ingredients, like Tea Tree Oil, Rosemary Extract, and Echinacea, can help preserve the product without compromising the natural formulation. Avoiding Harsh Preservatives: Many consumers prefer products without parabens or synthetic preservatives, so finding effective, gentle alternatives that maintain product safety is critical [19].

Regulatory Compliance

- *Differences in Regulations*: Herbal creams may be classified differently across regions (cosmetic vs. pharmaceutical). In the EU and U.S., regulations governing natural or herbal products can be complex.

- *Solution:* Formulators must work with regulatory experts to ensure the product adheres to local regulations, which may require clinical data, safety testing, and claims substantiation.
- *Labeling and Claims:* Claims, such as “anti-acne” or “heals acne scars” must be substantiated by scientific evidence to comply with advertising and health regulations.

Consumer Education and Expectations

- *Effectiveness vs. Time:* Many consumers expect quick results from acne treatments. However, herbal treatments tend to work more gradually, as they target the root causes of acne, such as inflammation, bacteria, and sebum production.
- *Solution:* Educating consumers about the expected timeline for results and how herbal ingredients work can help manage expectations and improve customer satisfaction.

Cost and Sustainability

- *Cost of High-Quality Ingredients:* Some herbal ingredients can be expensive to source, particularly if they require organic farming practices or specialized extraction methods.
- *Sustainability Concerns:* Ethical sourcing and environmental sustainability are increasingly important to consumers. Ensuring that ingredients are sustainably harvested, and that packaging is eco-friendly can be a challenge in cost management.
- *Solution:* Balancing cost with the need for high-quality, sustainably sourced herbal ingredients is essential. Using renewable resources, eco-friendly packaging, and transparency in sourcing practices can improve product appeal [20].

ENVIRONMENTAL FACTORS AND LIFESTYLE INFLUENCES ON ACNE

Several environmental and lifestyle factors can trigger or worsen acne. While genetics play a role, these external influences are significant contributors to the condition (Figure 2):

- *Diet and Nutrition:* High-glycemic foods (sugary snacks, refined carbs) and dairy may worsen acne by increasing sebum production and inflammation. Acids and antioxidants can aid in reducing inflammation and promoting better skin health.
- *Hormonal Changes:* Puberty, menstruation, pregnancy, and conditions, like PCOS (polycystic ovary syndrome), can trigger acne by increasing androgen levels and sebaceous gland activity, leading to more oil production.
- *Stress:* Stress raises cortisol levels, which can result in increased sebum production and inflammation, exacerbating acne. Stress behaviors (like touching the face) also contribute.
- *Pollution and Air Quality:* Environmental pollutants and high humidity can clog pores and trigger acne. UV radiation from sun exposure can also damage the skin and increase acne scarring.
- *Skincare and Cosmetics:* Use of comedogenic products (those that clog pores) and harsh skincare routines can aggravate acne. It's important to use non-comedogenic, gentle skincare products.
- *Smoking:* Smoking can damage the skin, increase inflammation, and impair healing, leading to worsened acne and scarring.
- *Medications:* Medications, such as steroids and certain antidepressants can either trigger acne or worsen pre-existing acne.
- *Sleep Patterns:* Poor sleep increases cortisol levels and disrupts skin repair, leading to more breakouts.
- *Physical Activity:* Exercise can promote healthy skin but may cause acne in areas, like the back or chest, due to sweat and friction from tight clothing. Hygiene after exercise is key.
- *Occupational and Environmental Factors:* Exposure to oils, chemicals, and grease in the workplace can lead to occupational acne. Additionally, weather conditions, such as hot, humid, or cold, dry environments can impact the skin's oil production and moisture balance [21–23].

Clinical Efficacy and Safety of Herbal Creams for Acne Treatment

Herbal creams for acne treatment show promising clinical efficacy, particularly in their ability to reduce inflammation, control sebum production, and offer antibacterial properties, making them useful

adjuncts or alternatives to traditional acne treatments. Ingredients, like tea tree oil, green tea extract, turmeric, and aloe vera, have demonstrated effectiveness in reducing acne lesions, improving skin texture, and minimizing scarring.

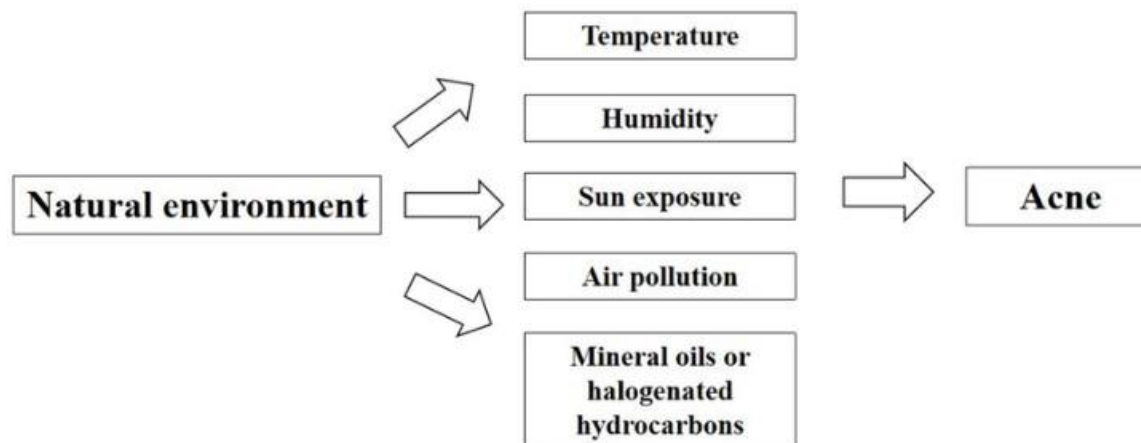


Figure 2. Environmental and lifestyle factors that trigger acne.

Herbal creams are typically well-tolerated and have a lower risk of severe side effects compared to conventional treatments. However, mild irritation, allergic reactions, or photosensitivity can occur, especially with certain active ingredients. Therefore, it is important to conduct patch testing and ensure product quality [24].

In conclusion, herbal creams represent a safe and effective option for managing acne, particularly for individuals seeking natural alternatives to pharmaceutical treatment for ever, as with any treatment, individual responses may vary, and users should choose products from reputable sources that adhere to high manufacturing standards.

- *Clinical Efficacy:* Herbal creams are gaining popularity for acne treatment due to their natural ingredients, which provide several therapeutic benefits:
- *Anti-inflammatory:* Herbs, like turmeric and green tea extract, help reduce inflammation, easing redness and swelling in acne lesions.
- *Sebum Regulation:* Witch hazel and licorice help regulate oil production, preventing clogged pores and acne formation.
- *Skin Healing:* Aloe vera and calendula promote skin healing and help reduce scarring, making them useful in post-acne care.
- *Safety:* Herbal creams are generally considered safe, with fewer side effects than pharmaceutical treatments, but there are potential concerns:
- *Irritation:* Some ingredients (like tea tree oil) may cause mild irritation or a burning sensation, especially on sensitive skin.
- *Allergic Reactions:* Some individuals may have an allergy to specific plant extracts, like chamomile or lavender.
- *Photosensitivity:* Ingredients, like turmeric and bergamot, can increase sun sensitivity, requiring users to apply sunscreen.
- *Product Quality:* The effectiveness and safety of herbal creams depend on the quality and concentration of the active ingredients, so choosing reputable products is important.

FUTURE DIRECTIONS IN THE DEVELOPMENT OF HERBAL CREAMS FOR ACNE TREATMENT

- *Enhanced Understanding of Herbal Mechanisms:* Deeper research into how active compounds in herbs (e.g., curcumin in turmeric, EGCG in green tea) interact with acne-related factors, like sebum production, inflammation, and bacterial growth, will improve product efficacy.

- *Novel Formulation Technologies:* Nanotechnology and liposomal formulations can enhance the delivery and stability of herbal ingredients, increasing their effectiveness. Microneedles could help target deeper acne lesions more directly.
- *Personalized Acne Treatments:* Customizing treatments based on genetic profiling and the skin microbiome can create more targeted and effective herbal solutions, addressing individual acne triggers like inflammation or oil production.
- *Long-Term Safety and Efficacy:* Long-term clinical studies are needed to confirm the effectiveness and safety of herbal creams, especially for chronic acne. Monitoring allergic reactions and assessing the impact on sensitive skin populations will ensure broad safety.
- *Combination Therapies:* Combining herbal creams with conventional acne treatments or advanced therapies (like blue light or laser) could offer enhanced results and faster recovery for more severe acne cases.
- *Sustainable and Eco-Friendly Formulations:* As consumers demand more eco-conscious products, future herbal creams should focus on sustainable sourcing, biodegradable packaging, and environmentally friendly manufacturing.
- *Holistic Skincare Integration:* Herbal creams could become part of a broader skincare regimen that includes dietary changes, stress management, and overall lifestyle improvements, offering a more comprehensive approach to acne care.
- *Clinical Trials and Standardization:* Rigorous clinical trials and the standardization of active herbal ingredients will help ensure the consistency, safety, and efficacy of herbal acne treatments, making them more widely accepted in medical practice [25, 26].

CONCLUSIONS

The formulation and development of herbal creams for acne treatment represent a promising approach to managing acne in a more natural and holistic way. Herbal ingredients, such as tea tree oil, turmeric, green tea, aloe vera, and neem have demonstrated significant therapeutic properties, including anti-inflammatory, antibacterial, and sebum-regulating effects, all of which are crucial in the treatment of acne and pimples. These natural compounds, when incorporated into well-designed topical creams, offer an alternative to conventional treatments, often with fewer side effects and better skin compatibility.

Despite their growing popularity, the development of effective herbal acne treatments faces challenges, including the need for better understanding of the precise mechanisms of action of these herbs, standardization of active ingredients, and ensuring the stability and delivery of these compounds to the skin. The incorporation of advanced formulation technologies, like nanotechnology and liposomal encapsulation, can enhance the efficacy of herbal creams by improving the penetration and bioavailability of active ingredients.

Looking ahead, the future of herbal creams for acne treatment lies in further research and development focused on personalized skincare, combination therapies, and sustainable practices. By integrating herbal remedies into holistic treatment regimens that also address lifestyle factors, like diet, stress, and sleep, these creams can provide more comprehensive care for acne sufferers. The push for eco-friendly formulations and sustainable practices will likely align with consumer demand for products that are not only effective but also ethically sourced and environmentally responsible.

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