



Review Article

Formulation and Evaluation of a Polyherbal Anti-Acne Emulgel Containing Tea Tree Oil, Neem Oil and Aloe Vera

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Abstract:

Topical therapy remains central to acne management, yet many conventional creams, ointments and gels can aggravate dryness and irritation in already compromised skin, which reduces comfort and adherence. Emulgels, produced by gelling an oil in water emulsion, offer a non-greasy, washable and physically stable vehicle that can solubilize lipophilic actives and improve their penetration into pilosebaceous units. Polyherbal emulgels further combine multiple plant derived actives in a single carrier, allowing complementary antimicrobial, anti-inflammatory, antioxidant and soothing actions that are attractive for long term use in acne prone skin. The proposed work will focus on a tri herbal emulgel incorporating tea tree oil, neem oil and Aloe vera in a Carbopol based emulgel system, designed through a structured formulation strategy including selection of surfactant system and viscosity optimization. The formulation will be evaluated for appearance, pH, spreadability, viscosity, drug content, in vitro antimicrobial activity and stability under accelerated conditions.

Keywords: Polyherbal emulgel; Anti acne topical formulation; Tea tree oil; Neem oil; Aloe vera.

Introduction

Polyherbal Emulgel

Topical therapy and limitations of conventional bases

Topical treatment is a mainstay in acne and many superficial skin disorders because the drug is placed directly on the lesion site, reducing systemic exposure and first-pass metabolism.

Conventional creams, ointments, and basic gels often worsen dryness, burning, and peeling in skin that already has a disturbed barrier, which lowers patient comfort and adherence. [1]

Concept of emulgel as a carrier

To overcome these problems, newer vehicles have been developed that combine better cosmetic feel with efficient drug delivery. Emulgels belong to this group and can be described as emulsions transformed into gels. An oil-in-water or water-in-oil emulsion is prepared first and then thickened with a gelling agent, giving a smooth, non-greasy semisolid that spreads easily, washes off with water, and remains physically more stable than a simple emulsion. [2]

Polyherbal approach in emulgel

When more than one herbal active is incorporated into such an emulgel, the system is termed a polyherbal emulgel. In acne and related conditions, this approach is attractive because different herbs can contribute antimicrobial, anti-inflammatory, antioxidant, and soothing actions in a single formulation. A vehicle that is comfortable on the skin combined with multiple plant-based constituents offers a modern way to bring traditional phytotherapy into scientifically designed topical products. [3]

Need for this study

Gaps with current anti-acne therapies

Synthetic anti-acne agents such as benzoyl peroxide, topical retinoids, and antibiotics are effective but frequently cause irritation, erythema, and further barrier damage. Long-term use of topical and systemic antibiotics also raises concern about resistance. Many patients prefer safer, better-tolerated alternatives that can be used for long durations without severe side effects. [4]

Limitations of simple herbal formulations

Herbal creams and gels are already present in the market, but they often show problems such as poor solubility of lipophilic components, uneven distribution of essential oils, and limited penetration into pilosebaceous units. As a result, their activity may be inconsistent, and instability like phase separation or loss of volatile components can occur during storage. [5]

Rationale for polyherbal emulgel system

An emulgel base can hold essential oils such as tea tree and neem in the oil droplets while the gel network increases residence time and spreadability on the skin.

Combining tea tree oil, neem oil, and Aloe vera in such a system is a logical strategy: tea tree and neem provide broad antimicrobial and anti-inflammatory activity, whereas Aloe vera supports hydration, soothing, and healing. There is therefore a clear rationale to design and evaluate a stable polyherbal emulgel as a more

acceptable and potentially effective anti-acne topical preparation. [6]

Key features of this study

Tri-herbal combination

The core feature of this work is the use of three well-known medicinal plants in a single topical carrier. Tea tree oil contributes strong antimicrobial and anti-inflammatory effects; neem oil adds additional antibacterial, antifungal, and wound-modulating actions; and Aloe vera mainly offers moisturizing, soothing, and barriersupporting properties. [7]

Modern formulation design

The formulation will not be prepared in a trial-and-error manner alone. A structured formulation strategy is planned that includes pre-formulation studies, selection of a suitable gelling agent (such as Carbopol 940) and surfactant system, and use of factorial design to optimize concentrations for desired viscosity, spreadability, and stability. [8]

Comprehensive quality evaluation

Another key aspect is that the emulgel will be evaluated thoroughly. Planned tests include pH, appearance, homogeneity, spreadability, viscosity and flow behavior, drug content uniformity, microbiological activity, and stability under accelerated conditions. This combination of herbal science and pharmaceutical development gives the study practical relevance for future product development. [9]

Mechanism of work of emulgel

Physicochemical behavior of the emulgel

base: In an emulgel, lipophilic components such as essential oils are dispersed as fine droplets within a gelled continuous phase. The gel gives the system a shear-thinning nature: viscosity decreases during rubbing, which helps spreading, and increases again when the product is at rest, helping it remain at the site of application. The increased surface area of the oil droplets facilitates closer contact with the stratum corneum and follicular openings, while

the hydrated gel environment maintains local moisture and can assist diffusion of actives into the upper skin layers. [10]

Biological actions of the herbal components

Tea tree oil contains terpenes such as terpinen-4-ol that disturb microbial cell membranes, leading to leakage of intracellular material and death of acne-related bacteria. Neem oil provides additional antimicrobial and antifungal action and also reduces inflammation and oxidative damage through its diverse phytoconstituents. Aloe vera forms a hydrating film on the skin, reduces transepidermal water loss, modulates inflammatory mediators, and supports re-epithelialization and collagen synthesis. Acting together in an emulgel base, these herbs can simultaneously reduce microbial load, calm inflammation, counter oxidative stress, and support barrier repair. [11]

Application of polyherbal emulgel

Therapeutic uses in dermatology

The primary intended use of the polyherbal emulgel is in mild to moderate acne vulgaris, either as a main treatment in early disease or as an add-on in maintenance regimens. Because of its light, non-greasy character, it is suitable for facial use in young, cosmetically conscious patients. With appropriate safety evaluation, similar formulations may also be explored in other minor superficial infections and inflammatory dermatoses where broad antimicrobial and soothing effects are desirable.

Cosmeceutical and routine-care potential

Polyherbal emulgels containing tea tree, neem, and Aloe vera can also be developed as over-the-counter cosmeceutical products, such as anti-blemish gels, spot-treatment preparations, or daily care gels for oily and acne-prone skin. Their washability, pleasant skin feel, and “natural” image can improve patient acceptance and long-term adherence compared with traditional greasy ointments. [12]

Limitation

Variability and standardization issues

Plant-based raw materials can show wide variation in active content depending on species, growing conditions, and extraction method. Without careful standardization of tea tree oil, neem oil, and Aloe vera, the potency and safety of the final emulgel may vary from batch to batch. This demands strict control over sourcing, processing, and quality testing of the herbal ingredients.

Stability and interaction challenges

Many essential oil components are volatile and prone to oxidation, while Aloe-derived polysaccharides may degrade or support microbial growth if not properly preserved. The presence of multiple actives also increases the chance of interactions with each other and with excipients, which may influence emulsion stability, gel rheology, and release behavior.

Appropriate antioxidants, preservatives, and protective packaging are therefore necessary. [13]

Limited clinical documentation

Although individual herbs like tea tree, neem, and Aloe vera have supporting data, robust clinical trials on complex polyherbal emulgels are still limited. Before such products can be recommended as complete alternatives to standard anti-acne drugs, more controlled studies are required to establish their comparative efficacy, safety, and long-term tolerability. [14]

Formulation and evaluation

Formulation plan and components

The polyherbal emulgel will be prepared by three main steps:

1. Preparing the gel base using a suitable gelling agent (Carbopol 940) dispersed in water and neutralized to obtain a clear gel at skin-compatible pH.
2. Preparing an oil phase containing neem oil, tea tree oil, a suitable carrier oil, and a low-irritancy emulsifier such as Span 80.

3. Preparing an aqueous phase containing Aloe vera gel or standardized extract, Tween 80 as a hydrophilic emulsifier, humectants such as propylene glycol, preservatives, and water.

Both phases will be warmed to similar temperature, emulsified with proper stirring to form an oil-in-water emulsion, and then incorporated into the gel base under gentle mixing to give a uniform emulgel. [15]

Evaluation tests: The prepared polyherbal emulgel formulations will be evaluated using the following tests:

1. Physical appearance

Observe color, odor, consistency, homogeneity, and any signs of phase separation or grittiness.

2. pH measurement

Measure pH of a suitable dispersion of the emulgel using a calibrated digital pH meter to ensure compatibility with skin (approximately pH 5–6.5).

3. Spreadability

Determine spreadability by placing a known quantity of emulgel between two glass slides and measuring the area or distance spread under a standard weight, which reflects ease of application.

4. Viscosity and rheology

Measure viscosity at different spindle speeds using a Brookfield or similar viscometer to confirm pseudoplastic (shear-thinning) behavior suitable for topical use.

5. Drug content / active content uniformity

Take a specified quantity of emulgel, suitably dilute and extract the herbal actives, and analyze using UV–visible spectrophotometry or other validated methods to confirm uniform distribution of actives across the batch.

6. In-vitro antimicrobial activity

Evaluate antimicrobial activity of the optimized formulation by agar well diffusion (or related) method against selected test organisms relevant

to acne, measuring zones of inhibition in comparison with base and standard.

7. Stability studies

Subject the chosen batch to accelerated stability conditions (for example, 40 ± 2 °C / $75 \pm 5\%$ RH) and periodically evaluate appearance, pH, viscosity, Spreadability, and drug content to detect any significant changes during storage. [16]

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