Formulation And Evaluation of Polyherbal Anti-Acne Cream Containing Azadirachta Indica, Ocimum Sanctum, And Aloe Vera

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***Abstract*—Acne vulgaris is a multifactorial dermatological disorder characterized by inflammation, microbial colonization, and excessive sebum production. Conventional therapies often result in side effects and microbial resistance, necessitating the development of safer alternatives. The present study focuses on the formulation and evaluation of a polyherbal anti-acne cream containing *Azadirachta indica* (Neem), *Ocimum sanctum* (Tulsi), and Aloe vera. Herbal extracts were prepared using hydro-alcoholic maceration and incorporated into an oil-in-water (O/W) emulsion base using a stearic acid–triethanolamine system. The formulation was evaluated for physicochemical parameters including pH, spreadability, homogeneity, and stability. The prepared cream exhibited acceptable characteristics and is expected to demonstrate antimicrobial and anti-inflammatory activity due to the synergistic action of herbal constituents. This study highlights the potential of herbal formulations as effective and safe alternatives for acne management.**

I. INTRODUCTION

Acne vulgaris is one of the most prevalent dermatological disorders affecting adolescents and young adults worldwide. It is primarily caused by sebaceous gland hyperactivity, follicular keratinization, and bacterial colonization, especially by *Cutibacterium acnes*. Conventional treatments such as antibiotics and retinoids are effective but often lead to side effects and resistance.

Recent research emphasizes the importance of herbal medicines due to their lower toxicity, multi-target action, and better patient compliance.

Herbal plants like Neem (*Azadirachta indica*), Tulsi (*Ocimum sanctum*), and Aloe vera possess significant antibacterial, anti-inflammatory, and antioxidant properties, making them suitable for acne treatment.

Neem has been traditionally used in dermatology for treating infections and inflammatory conditions. Tulsi exhibits antimicrobial and anti-inflammatory activity beneficial in acne treatment. Aloe vera promotes wound healing and reduces inflammation.

Polyherbal formulations provide synergistic effects, improving therapeutic efficacy compared to single-herb formulation

Therefore, the present study aims to formulate and evaluate a polyherbal anti-acne cream using these medicinal plants.

II. MATERIALS AND METHODS

Materials

Neem leaves (*Azadirachta indica*) and Tulsi leaves (*Ocimum sanctum*) were collected and authenticated. Aloe vera gel was procured from a standard source. Stearic acid, cetyl alcohol, liquid paraffin, glycerin, methyl paraben, and Sodium Hydroxide were used as excipients

Hydro-Alcoholic Maceration

Extraction of *Azadirachta indica* (Neem) and *Ocimum sanctum* (Tulsi) was carried out separately using the hydro-alcoholic maceration method.

Accurately weighed 10 g of Neem leaf powder and 10 g of Tulsi leaf powder were transferred into separate clean, dry, stoppered conical flasks. To each flask, 100

mL of hydro-alcoholic solvent (ethanol:water, 70:30 v/v) was added, maintaining a drug-to-solvent ratio of 1:10, which is standard for small-scale phytochemical extraction.

The flasks were tightly closed using aluminum foil or suitable stoppers to prevent solvent loss and contamination. The mixtures were kept at room temperature (25–30°C) for 48–72 hours to allow adequate extraction.

During the maceration period, the contents were intermittently shaken (3–4 times daily) to enhance solvent penetration and facilitate efficient diffusion of phytoconstituents into the solvent system.

Hydro-alcoholic solvent was selected as it enables extraction of a wide spectrum of bioactive compounds including alkaloids, flavonoids, tannins, glycosides, and phenolic constituents, which are known to exhibit antimicrobial and anti-inflammatory activity, making them suitable for anti-acne formulations.

Filtration

After completion of maceration:

- The mixtures were first filtered through muslin cloth to remove coarse plant debris.
- The filtrate was then passed through Whatman No.1 filter paper to obtain a clear solution free from fine particles.

Concentration of Extract

The filtrates obtained were subjected to solvent evaporation:

- The filtrate was transferred to a clean beaker and heated on a water bath maintained below 50°C to prevent degradation of thermolabile constituents.
- Evaporation was continued until a thick, semi-solid extract was obtained.
- The concentrated extract was further allowed to stand in a desiccator (optional) to remove residual moisture.

Formulation of Herbal Anti-Acne Cream

Formulation composition (10 g)

Component	Function	Quantity
Neem extract	Antimicrobial active	0.45 g (4.5%)
Tulsi extract	Anti-inflammatory/antimicrobial	0.35 g (3.5%)
Aloe vera gel	Soothing, humectant	1.20 g (12%)
Stearic acid	Primary emulsifier (with TEA) & thickener	1.10 g (11%)
Cetyl alcohol	Co-emulsifier, stabilizer	0.40 g (4%)
Liquid paraffin (or light oil)	Emollient (oil phase)	0.80 g (8%)
Glycerin	Humectant, improves feel	0.40 g (4%)
Methyl paraben	Preservative	0.018 g (0.18%)
Sodium Hydroxide	Neutralizer / emulsifier former	q.s. (≈ 0.5–1.0 mL)
Distilled water	Vehicle (aqueous phase)	q.s. to 10 g

Procedure

A. Preparation of Aqueous Phase (70–75°C)

1. Weigh & charge water:

Take ~60–65% of the final water into a beaker (keep some reserved for final q.s.). Begin gentle stirring.

2. Add humectant:

Add glycerin (0.40 g) and mix until uniform.

3. Dissolve preservative:

Add methyl paraben (0.018 g). If dissolution is slow, pre-dissolve it in a small portion of warm glycerin/water (40–50°C) and then add back.

4. Add actives (water-compatible):

Add Aloe vera gel (1.20 g) and mix to obtain a uniform dispersion.

5. Add herbal extracts:

Add Neem (0.45 g) and Tulsi (0.35 g) extracts.

- If extracts are thick, pre-disperse in a few mL of warm water/glycerin to avoid lumping.
- Maintain gentle stirring to ensure uniform distribution.

6. Heat aqueous phase:

Raise temperature to 70–75°C and maintain (do not exceed 80°C). Keep covered to minimize evaporation.

B. Preparation of Oil Phase (70–75°C)

7. Charge oil components:

In a separate beaker, add stearic acid (1.10 g), cetyl alcohol (0.40 g), and liquid paraffin (0.80 g).

8. Melt completely:

Heat to 70–75°C until all solids melt and a clear, homogeneous oil phase is obtained. Avoid overheating and water ingress.

Emulsification (Hot-Hot Method)

9. Temperature matching:

Ensure both phases are at the same temperature (70–75°C). This is critical to prevent phase separation.

10. Addition:

With continuous stirring of the aqueous phase, add the oil phase slowly (thin stream) into the aqueous phase.

11. Primary emulsification:

Increase stirring speed (magnetic/overhead) and continue for 10–15 minutes.

D.Neutralization and viscosity Development

12. A 10% w/v NaOH solution was prepared by dissolving 1 g NaOH pellets in 10 mL distilled water. The solution was allowed to cool to room temperature before use.
13. The NaOH solution was added dropwise to the hot emulsion under continuous stirring. During this process, NaOH reacted with stearic acid present in the oil phase to form sodium stearate, which acts as a soap-type emulsifier.
14. The addition of NaOH resulted in a gradual increase in viscosity and conversion of the emulsion into a smooth cream. The pH of the formulation was continuously monitored using a pH mete NaOH was added carefully until the pH reached 5.5–6.5, which is suitable for topical application

E. Cooling & Finishing

16. Controlled cooling:

Continue stirring while allowing the batch to cool gradually to <40°C.

- Slow cooling prevents phase separation and improves texture.

17. Heat-sensitive additions (optional):

If using any volatile/heat-sensitive actives (e.g., essential oils), add now (<40°C).

18. Make up weight (q.s.):

Add the remaining distilled water to bring the total to 10.00 g. Mix thoroughly.

19. Deaeration:

Allow the cream to stand or stir gently to remove entrapped air.

F. Packaging & Storage

20. Filling:

Transfer into clean, dry, airtight containers (preferably wide-mouth or collapsible tubes).

21. Labeling:

Include batch no., date, composition, and storage conditions.

22. Storage:

Store at room temperature, protected from light. Avoid high heat.

Mechanism of Action

The polyherbal anti-acne cream exerts its therapeutic effect through a multi-target mechanism, addressing the key pathogenic factors of acne vulgaris—namely microbial colonization, inflammation, excess sebum, and impaired skin barrier.

1. Antimicrobial Activity

Acne is strongly associated with colonization by *Cutibacterium acnes* and other skin microbes. The formulation contains bioactive constituents from Neem (*Azadirachta indica*) and Tulsi (*Ocimum sanctum*), including nimbidin, azadirachtin, eugenol, and flavonoids, which exhibit broad-spectrum antibacterial activity. These phytoconstituents disrupt bacterial cell membranes, inhibit protein synthesis, and reduce microbial proliferation, thereby decreasing infection and acne lesion formation.

2. Anti-Inflammatory Action

Inflammation plays a central role in acne progression. Neem and Tulsi extracts contain polyphenols, tannins, and essential oils that inhibit pro-inflammatory mediators such as cytokines (IL-1, IL-6, TNF-α). This leads to a reduction in redness, swelling, and irritation associated with acne lesions.

3. Antioxidant Activity

Oxidative stress contributes to follicular damage and inflammation. The presence of flavonoids and phenolic compounds in Neem and Tulsi scavenges free radicals, thereby protecting skin cells from oxidative damage and promoting faster healing.

4. Sebum Regulation and Astringent Effect

Neem possesses mild astringent properties, which help in tightening pores and reducing excessive sebum

secretion. This limits the formation of comedones and prevents blockage of hair follicles.

5. Wound Healing and Skin Repair

Aloe vera contains polysaccharides (acemannan), vitamins, and enzymes that promote fibroblast activity and collagen synthesis. This accelerates wound healing, reduces post-acne marks, and improves overall skin texture.

6. Moisturizing and Barrier Protection

The oil-in-water (O/W) cream base provides hydration without excessive greasiness. Glycerin and Aloe vera act as humectants, maintaining skin moisture and restoring barrier function, which is often compromised in acne-prone skin.

III. EVALUATION OF POLYHERBAL ANTI-ACNE CREAM

The formulated cream was evaluated for physicochemical properties, performance, and short-term stability using standard procedures.

3.1 Organoleptic Properties (Appearance, Color, Odor, Texture)

Method:

A small quantity of cream was visually inspected against white and black backgrounds.

Parameters observed:

- Color
- Odor
- Texture
- Presence of lumps/granules

Acceptance criteria:Smooth, uniform, no phase separation, pleasant odor.

3.2 Homogeneity

Method:

A small amount of cream was pressed between the thumb and index finger and also observed under light for uniformity.

Acceptance criteria:

- No coarse particles
- No phase separation
- Uniform consistency

3.3 pH Determination

Method:

1 g cream was dispersed in 10 mL distilled water.pH was measured using a calibrated pH meter.

Or with pH paper colour was interpreted light yellowish-green

Acceptance range:

5.5 – 6.5 (skin compatible)

3.4 Spreadability

Method (Glass Slide Method):

- 1 g cream placed between two glass slides
- Known weight applied
- Time taken for upper slide to move recorded

Interpretation:

Higher value → better spreadability

3.5 Washability

Method:

Applied cream on skin and washed with water.

Observation:

Ease of removal without residue.

3.6 Viscosity

Method:

Measured using Brookfield viscometer (if available) or judged manually by consistency.

Acceptance:

Semi-solid, non-flowing, easily spreadable.

3.7 Stability Study (Short-Term)

Method:

Stored samples at:

- Room temperature (25°C)
- Elevated temperature (40°C)

Observed for 7–14 days.

Parameters monitored:

- Colour change
- Odour
- Phase separation
- pH variation

3.8 Skin Irritation Test

Method:

Small amount applied on forearm skin (patch test for 24 hrs).

Observation:

Check for redness, itching, irritation.

IV. RESULTS AND DISCUSSION

Result

Parameter	Observation
Appearance	Smooth, creamish, light green
Odor	Pleasant herbal odor
Texture	Soft, non-greasy
Homogeneity	Uniform, no lumps
pH	5.8 – 6.2/light yellowish-green
Spreadability	Good
Washability	Easily washable
Stability	No phase separation
Skin irritation	No irritation observed

V. DISCUSSION

The formulated polyherbal cream exhibited acceptable physicochemical properties, indicating successful formulation using the oil-in-water emulsion technique. The pH of the formulation was within the ideal skin range (5.5–6.5), confirming its suitability for topical application without irritation. The use of sodium hydroxide for neutralization effectively produced sodium stearate, which acted as a soap-type emulsifier, contributing to cream stability and viscosity.

The formulation showed good spreadability, indicating ease of application and proper consistency. This is essential for patient compliance and uniform drug distribution on the skin.

The cream was found to be non-greasy and easily washable, confirming the formation of a proper O/W emulsion system.

No phase separation or instability was observed during short-term stability studies, indicating a stable formulation.

The presence of herbal extracts contributes significantly:

- Neem → antibacterial against acne-causing microbes
- Tulsi → anti-inflammatory and antimicrobial
- Aloe vera → soothing, healing, moisturizing

The synergistic action of these herbal ingredients enhances the therapeutic potential of the formulation.

The absence of irritation during patch testing indicates that the formulation is safe for topical use.

VI. CONCLUSION

A polyherbal anti-acne cream containing *Azadirachta indica*, *Ocimum sanctum*, and Aloe vera was successfully formulated using a stearic acid–sodium hydroxide emulsification system.

The formulation demonstrated:

- Acceptable physicochemical properties
- Good stability
- Skin compatibility
- Ease of application

The synergistic combination of herbal ingredients provides antimicrobial, anti-inflammatory, and healing effects, making the formulation a promising alternative for acne treatment.

Further studies such as antimicrobial activity, clinical trials, and long-term stability are recommended to confirm efficacy

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