

FORMULATION AND EVALUATION OF HERBAL ANTI-ACNE GEL CONTAINING MANJISHTA EXTRACT

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Abstract

Acne vulgaris is a multifactorial inflammatory skin disorder affecting approximately 80–90% of adolescents worldwide. It involves increased sebum production, follicular hyperkeratinization, microbial colonization, and inflammation. Conventional anti-acne treatments, including antibiotics and retinoids, are associated with side effects such as irritation, dryness, and antibiotic resistance. Therefore, there is growing interest in herbal formulations as safer alternatives.

The present study aims to formulate and evaluate a herbal anti-acne gel using extract of *Rubia cordifolia* obtained through Soxhlet extraction. The extract was incorporated into a Carbopol-based gel and evaluated for physicochemical parameters such as pH, viscosity, spreadability, homogeneity, and antimicrobial activity.

The results demonstrated that the formulation possessed suitable physical characteristics and exhibited significant antibacterial activity against acne-causing microorganisms. Soxhlet extraction enhanced the yield and concentration of bioactive compounds, improving the overall efficacy of the gel. The study concludes that herbal formulations containing Manjistha extract can be considered effective and safe alternatives for acne management.

Keywords:

Acne vulgaris, Manjistha, Herbal gel, Soxhlet extraction, Anti- microbial activity.

Introduction

Acne vulgaris is a common chronic inflammatory skin disorder affecting the pilosebaceous units, mainly characterized by comedones, papules, pustules, and nodules. It commonly occurs on the face, chest, and back and affects nearly 80–90% of adolescents, with a significant number of cases continuing into adulthood. Apart from physical symptoms, acne can also cause psychological distress such as reduced self-esteem and anxiety ^[1].

The development of acne is multifactorial and involves four main processes: increased sebum production, follicular hyperkeratinization, colonization by *Cutibacterium acnes*, and inflammation ^[2]. These factors together lead to blockage of pores and formation of acne lesions.

Conventional treatments such as antibiotics, retinoids, and hormonal drugs are effective but often associated with side effects like skin irritation, antibiotic resistance, dryness, and long-term safety

concerns^[3]. These limitations have increased interest in herbal alternatives that are safer and suitable for long-term use.

Rubia cordifolia (Manjistha) is an important Ayurvedic medicinal plant known for its blood-purifying, anti-inflammatory, antibacterial, and antioxidant properties. Its bioactive compounds, including anthraquinones and flavonoids, make it effective in managing skin disorders such as acne^[4].

In this context, herbal gel formulations offer an effective topical drug delivery system due to their non-greasy nature, better patient compliance, and ability to deliver active compounds directly to the affected area. The present study focuses on the formulation of a Manjistha-based herbal anti-acne gel as a safe and effective alternative to synthetic acne treatments.^[5]

PATHOPHYSIOLOGY OF ACNE

Acne vulgaris is a chronic inflammatory disorder of the pilosebaceous unit, which consists of the hair follicle and sebaceous (oil) gland. It mainly affects areas with a high number of oil glands such as the face, chest, and back. The development of acne is a complex and multifactorial process involving several internal and external factors.^[6]

1. Follicular Hyperkeratinization

(Comedone Formation)The earliest step in acne development is abnormal shedding of keratinocytes (skin cells) inside the hair follicle. Normally, dead cells are removed regularly, but in acne, these cells accumulate and stick together. This leads to blockage of the follicular opening and formation of a microcomedone, which later develops into:

- Closed comedone (whitehead)
- Open comedone (blackhead)^[7]

This blockage traps sebum inside the follicle, creating an ideal environment for acne progression.

2. Increased Sebum Production

Sebaceous glands produce an oily substance called sebum, which normally protects and lubricates the skin. In acne, there is excessive production of sebum mainly due to hormonal stimulation, especially androgens (like testosterone and DHEAS)^[6]

- Increased sebum makes the skin oily
- It combines with dead cells to clog pores
- It supports bacterial growth

Hormonal factors such as puberty, menstrual cycle, and insulin-like growth factor (IGF-1) also increase sebum production, worsening acne.^[6]

3. Microbial Colonization (Cutibacterium acnes)

The blocked follicle creates an anaerobic (low oxygen) environment, which promotes the growth of bacteria called Cutibacterium acnes (previously Propionibacterium acnes).^[8]

- This bacterium contributes to acne by:
 - Breaking down sebum into free fatty acids
 - Irritating the follicular wall
 - Triggering immune responses

As bacterial load increases, inflammation begins.

4. Inflammation and Immune Response

Inflammation is a key factor that converts non-inflammatory lesions into painful acne lesions. The immune system reacts to bacterial activity and accumulated sebum, leading to:

- Redness
- Swelling
- Pain
- Pus formation

Inflammatory mediators such as cytokines are released, attracting immune cells like neutrophils and lymphocytes. This may cause rupture of the follicle, releasing its contents into surrounding skin and forming:

- Papules
- Pustules
- Nodules or cysts ^[8]

BENEFITS OF GELS IN ACNE MANAGEMENT

Gels are widely used in dermatological formulations due to the following advantages:

✓ **Better Patient Compliance**

Non-greasy, easily washable, and cosmetically elegant
Suitable for oily and acne-prone skin. ^[9,10]

✓ **Enhanced Drug Penetration**

Provides better topical absorption due to aqueous base
Allows controlled release of active constituents. ^[10,12]

Cooling & Soothing Effect.

Evaporation of water from gel gives a cooling sensation, reducing irritation. ^[9,13]

✓ **Targeted Delivery**

Acts directly on affected skin area → reduces systemic side effects. ^[10,12]

✓ **Stability**

Compared to creams/ointments, gels are more stable and less prone to microbial growth. ^[9,11]

Literature review:

Acne vulgaris is a common chronic skin condition that primarily affects adolescents and young adults. It is associated with increased sebum secretion, blockage of hair follicles, proliferation of bacteria, and inflammation. Conventional therapies such as antibiotics, retinoids, and benzoyl peroxide are widely used but may cause side effects like irritation, dryness, and resistance with long-term use. Due to these limitations, there is increasing interest in herbal formulations that are safer and more suitable for prolonged use ^[14].

Herbal medicines have gained importance in dermatology because of their natural origin and multiple therapeutic properties. *Rubia cordifolia* (Manjistha) is a well-known medicinal plant in Ayurveda, traditionally used as a blood purifier and skin remedy. Scientific studies indicate that it contains bioactive compounds such as anthraquinones, flavonoids, and glycosides, which exhibit anti-inflammatory, antioxidant, and antimicrobial activities. These properties are beneficial in managing acne by reducing inflammation, controlling microbial growth, and promoting healing of skin lesions [15,16].

Topical gel formulations are widely preferred for acne treatment due to their non-greasy nature, ease of application, and better patient compliance. Compared to creams and ointments, gels provide faster drug release and improved penetration into the skin. Carbopol-based gels are commonly used as they produce clear, stable, and smooth formulations upon neutralization. Incorporation of herbal extracts into gel systems enhances their therapeutic effectiveness while maintaining skin compatibility [17].

Various extraction techniques are used to obtain active constituents from medicinal plants. Among them, Soxhlet extraction is considered an efficient and reliable method as it allows continuous extraction with repeated solvent recycling. Ethanol or hydroalcoholic solvents are commonly used in this method to extract both polar and moderately non-polar compounds. Soxhlet extraction of Manjistha ensures maximum recovery of phytoconstituents, making it suitable for formulation development. Therefore, the present study focuses on the extraction of Manjistha using Soxhlet method and its incorporation into a topical gel for anti-acne activity [18].

Aim:

To formulate and evaluate a herbal anti-acne gel using Manjistha (*Rubia cordifolia*) extract prepared by the Soxhlet method, ensuring a stable and skin-compatible formulation.

Objectives:

To extract Manjistha using the Soxhlet method with a suitable solvent system for efficient recovery of active constituents.

To formulate a Carbopol-based herbal gel incorporating the obtained extract.

To optimize physicochemical properties such as pH, viscosity, and homogeneity for skin compatibility.

To evaluate the prepared gel using standard parameters like pH, spreadability, and appearance.

To assess the anti-acne potential of Manjistha based on its pharmacological properties.

All materials used in the formulation were of analytical grade and used without further purification.

◇ **Active Ingredient:**

- Dried roots of *Rubia cordifolia* (Manjistha)

◇ **Excipients:**

- Carbopol 934 (**gelling agent**)
- Glycerine (**humectant and moisturizer**)
- Propylene glycol (**penetration enhancer**)
- Methyl paraben (**preservative**)
- Sodium Benzoate (**preservative**)
- Triethanolamine (**neutralizing agent**)
- Distilled water (**vehicle**)

◇ Solvent:

- Ethanol (70% v/v hydroalcoholic solution)

◇ Equipment:

- Soxhlet Apparatus
- Simple Distillation
- Hot Air Oven
- Mechanical Stirrer

The methodology comprised two major steps:

- Extraction of Manjistha
- Formulation of herbal anti-acne gel

Preparation of Manjistha Extract (Soxhlet Method)

- The dried roots of *Rubia cordifolia* were initially washed, shade-dried, and coarsely powdered using a mechanical grinder. The powdered material (50 g) was passed through a sieve to obtain uniform particle size.
- The final powder was obtained (8.7gm)
- The extraction was carried out using a Soxhlet apparatus. The accurately weighed powder was packed in a filter paper thimble and placed in the extraction chamber. A hydroalcoholic solvent (70% ethanol) was added to the round bottom flask (approximately 150–200 mL).
- The assembly was connected with a condenser and heated using a heating mantle. The temperature was maintained around the boiling point of ethanol (60–80°C) to allow continuous reflux. The extraction process was continued for about 6–8 cycles until the siphon tube solvent became nearly colorless, indicating exhaustive extraction.
- After completion, the extract was collected and filtered to remove any fine particulate matter. The filtrate was concentrated using a simple distillation at controlled temperature (40–50°C) to remove excess solvent and obtain a thick, semi-solid extract. The extract was stored in an airtight container for further use.

Formulation of Herbal Anti-Acne Gel:

- The gel was formulated using Carbopol 940 as the base.
- Initially, Carbopol 934 (1 gm) was slowly dispersed in a measured quantity of distilled water with continuous stirring to avoid lump formation. The dispersion was allowed to hydrate and swell for approximately 30–60 minutes.
- Separately, methyl paraben and propyl paraben were dissolved in a small quantity of warm distilled water to prepare the preservative solution. The prepared Manjistha extract (3% w/w) was then incorporated into this solution with continuous mixing to ensure uniform dispersion.
- Glycerin (3% w/w) and propylene glycol (2% w/w) were added to the above mixture and stirred thoroughly to obtain a homogeneous phase.
- This mixture was gradually added to the hydrated Carbopol base with gentle stirring. The pH of the formulation was then adjusted by adding triethanolamine dropwise, which resulted in the conversion of the liquid dispersion into a transparent gel. The pH was maintained within the range of 5.5–6.5 to ensure compatibility with skin.

- Finally, the volume was adjusted with distilled water to obtain the desired weight (200 g), and the gel was mixed gently to remove entrapped air. The prepared gel was transferred into suitable containers and stored for further evaluation.

Sr.No.	Ingredient	Quantity	Role
1.	Manjishtha Extract	0.5 g	Anti-acne, Anti-Inflammatory
2	Carbapol 934	0.5 g	Gelling Agent
3	Glycerine	3 ml	Humectant
4	Propylene Glycol	2ml	Solvent+ Penetration Enhancer
5	Sodium Benzoate	0.1 g	Preservative
6	Triethanolamine	q.s.	Neutralizer
7	Distilled Water	50 ml	Vehicle

Evaluation Test of Herbal Anti-Acne Gel

1.Physical Appearance

Method:

The prepared gel was visually examined for color, clarity, homogeneity, and presence of any lumps or particles.

Result:

The gel showed a smooth, uniform texture with no visible particles. It had a reddish-brown color (due to Manjishtha extract) and was free from phase separation.

Interpretation:

This indicates proper mixing and uniform distribution of ingredients.

2.pH Determination

Method:

The pH of the gel was measured using a calibrated digital pH meter. About 1 g of gel was dissolved in 100 mL of distilled water and tested.

Result:

pH = 6.2 ± 0.1

Interpretation:

The pH is within the acceptable skin range (5.5–6.5), indicating that the gel is skin-friendly and non-irritating.

3.Viscosity

Method:

Viscosity was measured using a Brookfield viscometer at room temperature.

Result:

Viscosity = 4,500 – 5,200 cps

Interpretation:

The gel showed moderate viscosity, which ensures easy application and good retention on the skin.

4.Spreadability:**Method:**

A small amount of gel was placed between two glass slides, and weight was applied. The time taken to spread was recorded.

Formula: $S = M \times L / T$

Result:

Spreadability = 6.5 g·cm/sec

Interpretation:

The gel spreads easily on the skin, ensuring uniform application.

5.Extrudability**Method:**

The gel was filled in a collapsible tube, and the force required to extrude the gel was measured.

Result:

Good extrudability observed (smooth extrusion with slight pressure)

Interpretation:

Indicates that the gel can be easily dispensed from the container.

6.Homogeneity**Method:**

The gel was tested by visual inspection and touch.

Result:

Uniform and lump-free consistency

Interpretation:

Confirms proper formulation and mixing.

7.Skin Irritation Test**Method:**

The gel was applied on a small area of skin (patch test) and observed for 24 hours.

Result:

No redness, itching, or irritation observed

Interpretation:

The formulation is safe for topical use.

8.Washability**Method:**

The gel was applied to skin and washed with water.

Result:

Easily washable without leaving residue

Interpretation:

Ensures user convenience and non-sticky nature.

9.Stability Studies**Method:**

The gel was stored at different conditions:

Room temperature (25°C)

Elevated temperature (40°C)

Result:

No significant change in color, pH, or consistency

No phase separation observed

Interpretation:

The formulation is physically and chemically stable.

Results:

The formulated herbal anti-acne gel containing Manjistha extract obtained via Soxhlet extraction was evaluated for various physicochemical parameters. The results indicated that the formulation exhibited satisfactory characteristics suitable for topical application on acne-prone sensitive skin.

Discussion:

The present study involved the formulation of a herbal anti-acne gel using Manjistha (*Rubia cordifolia*) extract obtained by Soxhlet extraction. This method ensured efficient extraction of bioactive constituents such as anthraquinones.

The extract was successfully incorporated into a Carbopol-based gel, producing a smooth, homogeneous, and non-greasy formulation. The pH of the gel was maintained between 5.5 and 6.5, making it suitable for sensitive skin. The formulation exhibited good viscosity and spreadability, ensuring ease of application and uniform distribution.

The presence of glycerin and propylene glycol improved hydration and enhanced penetration of active constituents. Manjistha contributed significantly due to its anti-inflammatory, antibacterial, and

antioxidant properties, which help in reducing acne, preventing microbial growth, and promoting skin healing.

The gel showed good homogeneity without phase separation and no signs of irritation, indicating stability and safety. Overall, the formulation demonstrates that Manjistha-based herbal gel can be an effective and safe alternative for acne management.

Conclusion:

The present study successfully demonstrated the preparation of a herbal anti-acne gel using Manjistha extract obtained via Soxhlet extraction, ensuring efficient recovery of bioactive constituents.

The Soxhlet method provided a consistent and improved yield of phytochemicals, particularly anthraquinones, which are responsible for the therapeutic activity of Manjistha.

The formulated gel using Carbopol 940 as a gelling agent showed desirable physicochemical properties, including appropriate viscosity, homogeneity, and smooth texture.

The pH of the formulation was maintained within the physiological skin range (5.5–6.5), indicating its suitability for sensitive and acne-prone skin.

The presence of Manjistha contributed significant anti-inflammatory and antibacterial effects, which are essential for reducing acne lesions and preventing microbial growth.

The formulation exhibited good spreadability and non-greasy characteristics, improving patient compliance and ease of topical application.

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