



Formulation And Evaluation Of Herbal Analgesic Gel For Management Of Joint And Muscle Pain Relief.

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ABSTRACT

The increasing demand for safer, natural alternatives to synthetic pain relievers has led to the development of herbal-based topical formulations. This study focuses on the formulation and evaluation of a herbal analgesic gel incorporating plant-derived ingredients known for their anti-inflammatory and analgesic properties—namely menthol, ginger extract, curcumin, capsicum extract, neem extract, and lavender oil. Three gel formulations (F1, F2, and F3) were prepared with varying concentrations and evaluated for parameters such as pH, appearance, spreadability, washability, and user acceptability. Among them, Formulation F2 demonstrated optimal properties, including smooth texture, excellent spreadability, and ease of washing. The gel showed pH values within the skin-friendly range (5.5–6.2) and exhibited no signs of skin irritation, making it suitable for topical application. The findings highlight the therapeutic potential of herbal ingredients in delivering effective pain relief with minimal side effects and support the ongoing shift toward plant-based, sustainable healthcare solutions.

KEYWORDS

Herbal analgesic gel, pain relief, menthol, ginger extract, curcumin, capsicum extract, anti-inflammatory, topical formulation, natural medicine, joint and muscle pain.

INTRODUCTION

Pain management is a crucial aspect of healthcare, particularly for individuals suffering from muscle and joint pain caused by conditions such as arthritis, sprains, strains, and muscle fatigue. Conventional pain relief formulations often include non-steroidal anti-inflammatory drugs (NSAIDs), corticosteroids, and synthetic analgesics, which may have adverse side effects with long-term use. Pain, particularly in joints and muscles, is a common issue that affects people of all ages. While there are various treatments available, many synthetic analgesics and anti-inflammatory drugs come with side effects, leading to a growing interest in herbal remedies. Herbal analgesic gels are an effective alternative, combining natural ingredients that provide localized pain relief without significant side effects.

Herbal analgesic gel that uses a combination of menthol, ginger extract, curcumin extract, capsicum extract, neem extract, and lavender oil. These ingredients are known for their anti-inflammatory, analgesic, and soothing properties. The gel aims to offer an effective, safe, and easily applicable solution for joint and muscle pain relief. The formulation was created in three different batches, each with varying concentrations, to evaluate their effectiveness and stability.

Joint and muscle pain is a common issue affecting individuals of all age groups due to factors such as aging, physical exertion, injury, and chronic inflammatory conditions. Conventional pain relief methods often involve the use of synthetic drugs, which may cause adverse effects with long-term use. Therefore, there is growing interest in developing herbal-based topical formulations that are safer, effective, and user-friendly.

The topical application of herbal gels allows for targeted pain relief without affecting internal organs, as seen with oral medications. This makes them particularly effective in managing localized pain due to arthritis, sprains, strains, and muscle fatigue. In addition to pain relief, many herbal ingredients also offer skin-calming and moisturizing benefits, promoting overall skin health alongside pain management. Furthermore, modern research supports the effectiveness of herbal formulations, with several studies indicating that combinations of ingredients like capsicum extract, curcumin, and ginger significantly reduce inflammation and discomfort.

MATERIALS AND EQUIPMENT'S:**➤ Materials:**

Sr. No.	Name of Material	Type	Purpose/Function in Gel
1	Menthol	Active Ingredients	Provides cooling sensation and reduces pain
2	Ginger Extract	Active Ingredients	Anti-inflammatory and improves blood circulation
3	Curcumin Extract	Active Ingredients	Antioxidant and anti-inflammatory agent
4	Capsicum Extract	Active Ingredients	Provides Warmth Relives Muscles and Joint Pain
5	Neem extract	Active Ingredients	Antiseptic, anti-inflammatory, and skin healing
6	Lavender oil	Active Ingredients	Soothing aroma and mild analgesic property
7	Glycerine	Excipients	Acts as humectant and softens the skin
8	Carbopol	Excipients	Gelling agent that gives structure to the formulation
9	Sodium Benzoate	Excipients	Preservative to prevent microbial growth
10	Purified Water	Vehicle	Solvent and base for gel preparation

➤ **Equipments:**

S. No.	Equipment Name	Purpose/Use
1	Digital Weighing Balance	To accurately weigh solid and semi-solid ingredients.
2	Measuring Cylinders (10 mL–100 mL)	For measuring liquid extracts, oils, and water.
3	Beakers (100 mL, 250 mL, 500 mL)	For mixing and preparing gel batches.
4	Glass Stirring Rod	Manual mixing of components in the beaker.
5	Magnetic Stirrer with Hot Plate	For uniform mixing and mild heating of gel ingredients.
6	Mortar and Pestle	To triturate solid ingredients like menthol if needed.
7	pH Meter or pH Strips	To measure the pH of the gel formulation.
8	Thermometer	To check temperature during heating of ingredients.
9	Spatula	For transferring and mixing semisolid components.
10	Clean Glass Jars or Tubes	For packaging and storing the gel formulations.
11	Water Bath	For gentle heating if required during formulation.
12	Stop Watch	For timing spreadability and other evaluation tests.
13	Microscope (optional)	To check homogeneity or particle size if needed.

METHOD**Methodology:****Step 1: Selection of Herbal Ingredients**

Menthol: Known for its counterirritant and cooling effect.

Ginger Extract: Contains gingerol, which has potent anti-inflammatory and circulation-enhancing properties.

Curcumin Extract: A powerful antioxidant and anti-inflammatory compound found in turmeric.

Capsicum Extract: Contains capsaicin, which induces a warming effect and helps relieve pain.

Neem Extract: Has anti-inflammatory, antibacterial, and wound-healing activities.

Lavender Oil: Provides a calming aroma and mild analgesic effect.

Excipient selection was made to ensure optimal gel texture, stability, and patient acceptability:

Carbopol: Gelling agent.

Glycerin: Humectant and skin softener.

Sodium Benzoate: Preservative.

Purified Water: Vehicle.

Step 2: Preparation of Herbal Extracts

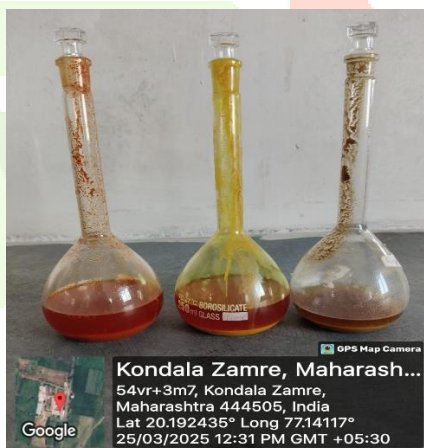
Drying and Grinding: Plant materials were cleaned, shade-dried, and powdered.

Extraction Method: Cold maceration or Soxhlet extraction using ethanol/water as solvents.

Filtration: The extracts were filtered using Whatman filter paper.

Concentration: Solvent was evaporated using a rotary evaporator or water bath.

Storage: Extracts were stored in airtight containers in a cool, dry place.



Extraction Process

Step 3: Formulation of herbal Gel

a. Dispersion of Carbopol: Carbopol 940 was slowly added to purified water with gentle stirring and allowed to hydrate for 2 hours.

b. Addition of Glycerin: Glycerin was added to the hydrated Carbopol to improve consistency and hydration.

c. Incorporation of Extracts: Pre-weighed quantities of herbal extracts (menthol, ginger, curcumin, capsicum, neem, and lavender oil) were added gradually with continuous stirring.

- d. Neutralization: The pH of the gel was adjusted to 6.0–6.5 using triethanolamine to obtain a clear gel.
- e. Addition of Preservative: Sodium benzoate was dissolved in a small amount of water and added to the formulation.
- f. Final Mixing: The mixture was stirred until a uniform gel consistency was achieved.



Formulation of Gel

FORMULATION TABLE

S. No.	Ingredients	Function/uses	F1	F2	F3
1	Menthol	Cooling agent, analgesic	0.3 g	0.5 g	0.7 g
2	Ginger Extract	Anti-inflammatory	0.8 mL	1.0 mL	1.2 mL
3	Curcumin Extract	Anti-inflammatory	1.0 mL	0.8 mL	1.0 mL
4	Capsicum Extract	Analgesic (capsaicin)	0.4 mL	0.5 mL	0.6 mL
5	Neem Extract	Anti-inflammatory, healer	1.2 mL	1.0 mL	1.5 mL
6	Lavender Oil	Calming agent, fragrance	0.2 mL	0.2 mL	0.3 mL
7	Glycerin	Humectant, moisturizer	2.0 mL	2.5 mL	3.0 mL
8	Carbopol 940	Gelling agent	0.5 g	0.6 g	0.4 g
9	Sodium Benzoate	Preservative	0.1 g	0.1 g	0.1 g

EVALUATION

1. Appearance Test

The appearance of the herbal analgesic gel is one of the primary evaluation parameters as it reflects the physical quality and acceptability of the formulation. This test involves a visual inspection of the gel to assess:

Color: uniform and appropriate based on the ingredients used. Herbal gels often exhibit greenish, yellowish, or light brown hues depending on the plant extracts.

Clarity/Opacity: formulation, the gel can be transparent, translucent, or opaque, but it should be consistent throughout the sample.

Homogeneity: The gel is appear smooth, without any visible lumps, phase separation, or air bubbles.

Texture: When observed or touched, it feel smooth and non-gritty.

2.Odour Test

The odour test is a sensory evaluation performed to assess the smell or fragrance of the gel. This characteristic plays a vital role in patient compliance, especially for topical products like herbal analgesic gels that are used multiple times a day.

Purpose:

To ensure the gel has a pleasant or acceptable smell.

To check for any unpleasant, strong, or irritating odours that might discourage use.

To verify the consistency of fragrance in all batches.

Procedure:

1. A small amount of gel is taken on a clean spatula or directly from the container.
2. The odour is gently inhaled by evaluators (usually 2–3 individuals).
3. Evaluators record whether the smell is:

Pleasant / Acceptable Strong / Irritating Medicinal / Herbal / Aromatic

Formulation	Odour	Result
F1	Herbal, Menthol	Pleasant
F2	Lavender, mild	Pleasant

F3	Herbal, Slightly Strong	acceptable
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3. pH Determination:

The pH of a topical gel is a critical parameter that ensures the product is compatible with the skin and does not cause irritation. Human skin typically has a pH around 5.5, so the pH of the herbal analgesic gel should ideally be in the range of 5.0 to 6.5.

Procedure:

A small amount of gel (about 1 gram) is dispersed in 10 mL of distilled water.

The mixture is stirred thoroughly to form a uniform dispersion.

The pH is measured using a digital pH meter that has been calibrated with standard buffer solutions (usually pH 4 and pH 7).



pH Test

Importance:

Skin compatibility: A gel with appropriate pH prevents skin irritation or allergic reactions.

Stability: pH can influence the chemical stability of herbal extracts and other ingredients.

Preservative effectiveness: Many preservatives (like sodium benzoate) are only effective within a certain pH range

4. Spreadability Test

Spreadability is an important evaluation test that determines how easily the gel can be spread on the skin. It reflects the application comfort and uniformity of dosing, both of which affect user satisfaction and therapeutic effectiveness.

Purpose:

To ensure the gel can be smoothly and evenly applied over the affected area without requiring excessive effort.

Better spreadability promotes better absorption and coverage.



Spreadability Test

Procedure (Slip and Drag Method):

1. A fixed amount of gel (usually 1 gram) is placed between two glass slides.
2. A weight (commonly 500 g) is placed on the top slide for 5 minutes to compress the gel into a thin layer.
3. The weight is then removed and the distance the top slide moves under its own weight or with a light force is measured.

M = mass tied to upper slide

L = length of glass slide

T = time in seconds

5. Washability Test

Washability refers to how easily the gel can be removed from the skin using water. This is important for user convenience and hygiene, especially for products used multiple times a day or over large skin areas.

Purpose:

To ensure that the gel does not leave a sticky or greasy residue after use.

To confirm that it can be easily cleaned from the skin without requiring soap or vigorous scrubbing.

**Before Wash****After wash**

Procedure:

1. A small quantity of the gel is applied to a marked area on the skin.
2. It is allowed to sit for a few minutes (usually 5–10 minutes).
3. The area is then rinsed with plain water.

RESULTS AND DISCUSSION

➤ Results

1. Physical Appearance

The appearance of all three gel formulations (F1, F2, and F3) was found to be aesthetically acceptable upon visual examination. Each gel displayed a smooth and semi-solid consistency, with no visible lumps, grittiness, or phase separation, indicating proper mixing and formulation techniques. The color of the gels varied slightly due to the natural tint of herbal extracts—F1 appeared pale yellow, F2 had a light brown hue, and F3 showed a yellowish-brown shade. All formulations-maintained uniformity and clarity, enhancing their appeal for topical application. Overall, the physical appearance confirmed the stability and consumer acceptability of the herbal analgesic gels.

2. Ph of the Gel

The pH of all three herbal analgesic gel formulations (F1, F2, and F3) was measured to ensure skin compatibility and product stability. The pH values were found to be within the ideal range of 5.5 to 6.2, which closely matches the natural pH of human skin. Specifically, formulation F1 showed a pH of 5.8, F2 had a pH of 6.0, and F3 recorded a pH of 5.6. These results indicate that the gels are safe for topical use, are unlikely to cause skin irritation, and will support the stability and efficacy of the active herbal ingredients.

3. Separability Test

The spreadability of all three gel formulations was evaluated to determine how easily they can be applied on the skin. Formulation F2 demonstrated the best spreadability, spreading smoothly with very little effort and forming a uniform layer. Formulation F1 also showed good spreadability, requiring a moderate amount of effort for even application. Formulation F3 had relatively lower spreadability compared to the others, indicating it was slightly thicker and needed more effort to apply. Overall, all formulations were acceptable, with F2 showing the most desirable characteristics for user comfort and effectiveness.

4. Washability test:

All three formulations were washable with plain water. F2 showed excellent washability, leaving no residue. F1 was good, with minimal residue and no stickiness. F3 had moderate washability, requiring more rinsing and leaving a slight oily feel. Overall, F2 was the most user-friendly in terms of ease of removal.

➤ Discussion

The development of a herbal analgesic gel aims to combine the benefits of traditional plant-based medicine with modern topical delivery systems. The formulation incorporated well-known herbal ingredients such as menthol, ginger extract, curcumin, capsicum extract, neem extract, and lavender oil, each chosen for their scientifically recognized analgesic, anti-inflammatory, or soothing properties.

The gel was evaluated for various pharmaceutical and cosmetic parameters. The pH of the formulation was found to be within the acceptable range for skin application, indicating minimal risk of irritation. Spreadability and consistency results suggested that the gel can be easily applied and evenly distributed over the skin surface, enhancing patient compliance. The washability test confirmed that the gel could be easily removed with water, indicating user convenience and cleanliness. Odour and appearance were pleasant and acceptable, supporting the aesthetic and sensory attributes required for topical use. The evaluation showed that the combination of herbal extracts in a gel base provided a stable, effective, and skin-friendly product for managing muscle and joint pain. The study reinforces the value of herbal alternatives in pain management and supports further exploration into plant-based topical formulations.

SUMMARY AND CONCLUSION

This project aimed to develop and evaluate a Herbal Analgesic Gel intended for the relief of joint and muscle pain using natural plant-based ingredients. The formulation incorporates multiple herbal extracts known for their anti-inflammatory and pain-relieving properties—namely menthol, ginger, curcumin, capsicum, neem, and lavender oil—along with essential excipients like glycerin, Carbopol, sodium benzoate, and purified water.

Three formulations (F1, F2, and F3) were prepared with varying concentrations of active ingredients and subjected to detailed evaluation tests. These included pH, appearance, spreadability, viscosity, washability and stability assessments. The results indicated that all three batches met acceptable standards, with

Formulation F2 emerging as the most suitable due to its excellent spreadability, smooth texture, ease of washing, and ideal consistency.

The findings support the growing interest in herbal and natural remedies as safer alternatives to synthetic pain relief options. This project lays a foundation for the future development of commercially viable herbal topical formulations that can provide effective relief with fewer side effects.

The present research focused on the formulation and evaluation of a herbal analgesic gel designed for the relief of joint and muscle pain using natural plant-based ingredients. The study successfully combined various medicinal herbal extracts known for their analgesic, anti-inflammatory, and soothing properties, resulting in a safe and effective topical preparation.

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