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"Formulation and Evaluation of Herbal Pain Relief Gel"

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ABSTRACT: Herbal pain relief gels have gained prominence as natural alternatives to synthetic analgesics due to their therapeutic benefits and minimal side effects. This study focuses on the formulation and evaluation of a herbal pain relief gel using a blend of medicinal plant extracts known for their analgesic and anti-inflammatory properties. The objective is to develop a stable, effective, and safe gel that provides quick pain relief and enhances muscle relaxation. The research involves selecting key herbal ingredients based on their traditional and pharmacological benefits. The prepared herbal gel is subjected to various physicochemical evaluations, such as pH, spreadability, homogeneity etc. Results indicate that the formulated herbal pain relief gel exhibits promising characteristics, including rapid pain alleviation, improved absorption, and prolonged relief. The study concludes that herbal pain relief gels, formulated with scientifically validated ingredients, offer a natural and effective alternative to conventional pain management solutions. This research contributes to the field of herbal pharmacology by providing a formulation that aligns with consumer preferences for natural, safe, and effective pain relief products.

KEYWORDS: Introduction to Herbal pain relief gel, Parijat, Acacia Nilotica, Formulation of herbal pain relief gel, & Evaluation.

I. INTRODUCTION

1.1 INTRODUCTION TO HERBAL PAIN RELIEF GEL:

Gels that relieve pain provide a sensible and practical solution to managing suffering and inconvenience. These gels are suggested to be directly related to the challenging area, providing targeted assistance. They provide comfort where it's needed while lowering the risk of adverse effects on the rest of the body by combining gel-shaped pain-soothing, anti-inflammatory, and relieving ingredients.[1]

The introduction of herbal gels represents a significant advancement in the field of topical treatments, leveraging the therapeutic properties of natural ingredients. These gels are formulated to provide effective alternatives to conventional medications, often with fewer side effects and enhanced safety profiles. The development of herbal gels has gained traction due to their multifunctional benefits, including analgesic, antimicrobial, anti-inflammatory, and wound-healing properties, making them suitable for various applications such as oral health, pain relief, and skin care.[2]

The herbal pain relief gel is formulated using herbal extracts known for analgesic and anti-inflammatory properties. This gel serves as a potential alternative to conventional analgesics, aiming to provide effective pain management while minimizing side effects associated with traditional medications.[3]

Key Components of Herbal Gels:

Parijat (Nyctanthesarbor-tristis): Traditionally used in Ayurveda medicine, it exhibits analgesic and anti-inflammatory properties, making it effective for pain relief.

Acacia Nilotica: Known for its analgesic and anti-inflammatory effects, this plant's extracts can enhance the overall efficacy of the gel.[4]

1.2 INTRODUCTION TO PARIJAT:

Synonyms:

Night-flowering Jasmine, Coral Jasmine, Tree of Sorrow

Biological source:

The biological source of Parijat is the dried leaves, flowers, seeds, and bark obtained from the plant Nyctanthesarbor-tristis Linn., belonging to the family Oleaceae.[5]

International Journal of Pharmaceutical Research and Applications
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Figure 2. parijat (Nyctanthesarbor-tristis)

Chemical constituents:

The leaves of Parijat contain benzoic acid, fructose, glucose, carotene, amorphous resins, ascorbic acid, methyl salicylate, tannic acid, oleanolic acid, and flavonol glycoside. The flowers are composed of apigenin, anthocyanin, D-mannitol, tannins, glucose, carotenoid, essential oils, kaempferol, nyctanthes, glycosides, quercetin, and rengylone. [6]

Medicinal Properties:

Anti-inflammatory and Analgesic: Extracts from Parijat have demonstrated significant anti-inflammatory effects, making them useful in treating conditions like arthritis and respiratory issues.

Antibacterial and Anti-inflammatory: The leaves of Parijat exhibit broad-spectrum antibacterial effects, making them useful in treating infections.

Antipyretic and Anti-helminthic: The plant is also noted for its ability to reduce fever and combat parasitic infections.[7]

1.3 INTRODUCTION TO ACACIA NILOTICA:

Synonyms:

Gum Arabic tree, Egyptian thorn, Babul, Prickly Acacia, Babul, Kikar, Baval, Babool, Baboola.

Biological source:

The biological source of Acacia nilotica (now Vachellia Nilotica) is the dried gum, bark, leaves, pods, and seeds obtained from the plant Acacia nilotica Linn. (Fam: Fabaceae/Mimosaceae).

Figure: Acacia Nilotica

Chemical constituents:

Quercetin, rutin, kaempferol, and naringenin are prominent, known for their antioxidant and anti-inflammatory effects. Other constituents is Gallic acid, ellagic acid, catechin, and epicatechin contribute to the plant's antimicrobial and anticancer properties.[8]

Medicinal properties:

Pain Relief: The aerial parts of the plant exhibit significant analgesic properties, demonstrating dose-dependent pain relief in experimental models.

Herbal Medicine: Acacia nilotica has been utilized for respiratory, gastrointestinal, and urogenital issues, often prepared as teas, oils, or poultices.

Antiulcer Activity: The seedpods of Acacia nilotica have demonstrated gastroprotective effects, potentially through mechanisms involving nitric oxide synthesis.[9]

II. MATERIALS AND METHODS

Selected ingredients for the formulation of herbal pain relief gel:

Acacia nilotica seed oil:

Acacia nilotica recognized for their pain-relieving properties, with Acacia nilotica being extensively studied for its analgesic effects. Acacia nilotica, a plant from the Fabaceae family, has been traditionally used to treat various ailments, including pain. It is particularly beneficial for conditions like arthritis, muscle pain, joint pain, and neuralgia (nerve pain).

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 2 Mar–Apr 2025, pp: 1194-1205 www.ijprajournal.com ISSN: 2456-4494

Parijat (Nyctanthesarbor-tristis) flowers oil:

Studies suggest that Parijat oil possesses analgesic properties that can help relieve various types of pain, including headaches, back pain, and nerve pain. The essential oils present in Parijat work by inhibiting pain pathways and reducing the perception of pain.

Hydroxypropyl Methylcellulose (HPMC):

Acts as a thickening agent and gelling agent. Provides viscosity and consistency to the herbal gel.

Carbopol:

Serves as a primary gelling agent, forming a transparent gel. Provides a smooth texture and good viscosity. Improves the bioavailability of herbal extracts in the gel.

Gum Guar:

Functions as a natural thickener and stabilizer. Enhances the gel's viscosity and water retention properties. Improves the adhesion of the gel to the skin for prolonged action.

Glycerine:

Acts as a humectant, drawing moisture to the skin and preventing dryness. Provides a smooth and soft texture to the gel. Enhances the absorption of herbal ingredients into the skin.

Propylene Glycol:

Functions as a penetration enhancer, improving the delivery of active herbal compounds. Works as a solvent for herbal extracts and other ingredients. Adds moisturizing properties to the gel.

Distilled Water:

Serves as a solvent for dissolving and mixing the ingredients. Provides hydration and maintains the gel's consistency.

- **Oil Extraction process of acacia nilotica Seeds:**

1. **Seed Collection and Preparation:** Collect mature Acacia nilotica seeds from pods. Remove any debris and unwanted materials. Wash the seeds thoroughly to remove dust and dirt. Dry the seeds under the sun.

Figure 4. Acacia Nilotica seeds

2. **Grinding and Size Reduction:** Use a mechanical grinder to crush the dried seeds into a fine powder or coarse particles. This increases the surface area for efficient oil extraction. The powder is sieved to 60 mesh size.

Figure 4.1 Acacia Nilotica Seed Powder

3. Solvent Extraction (Soxhlet Method):

Place the 25 gm of powdered seeds in a Soxhlet extractor.

The process is done with the help of solvent (hexane) to dissolve the oil.

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 2 Mar–Apr 2025, pp: 1194-1205 www.ijprajournal.com ISSN: 2456-4494

Heat the solvent to extract oil over multiple cycles.

After extraction, evaporate the solvent by leaving it undisturbed overnight.

The residual solvent is recovered, leaving behind pure seed oil.

Figure 4.2 oil extraction process of acacia nilotica seed

- **Oil Extraction process of Parijat (Nyctanthesarbor-tristis) flowers:**

Harvest fresh Parijat flowers early in the morning when the aromatic compounds are at their peak.

Clean the flowers by removing any dirt or insects without washing them. The dried flowers converted into fine powder with the help of grinder.

Air-dry the flowers for a few hours to remove excess moisture

Place the fresh flowers in an extraction flask. Pour the solvent (e.g., ethanol) over the flowers until they are fully submerged.

Allow the mixture to soak for 6-24 hours.

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 2 Mar–Apr 2025, pp: 1194-1205 www.ijprajournal.com ISSN: 2456-4494

After soaking, the solvent-oil mixture is filtered to separate the solid plant material. The solvent is gently heated under reduced pressure.

The solvent evaporates, leaving behind a semi-solid waxy extract called concrete.

The concrete is dissolved in a small amount of ethanol.

Where ethanol is evaporated, leaving behind pure Parijat oil.

Figure 5. Parijat flower collection & preparation

Method of Preparation of Herbal Gel:

Active Ingredients:

- Parijat (Nyctanthesarbor-tristis) flower oil
- Acacia nilotica seed oil

Gelling Agents:

- Hydroxypropyl Methylcellulose (HPMC)
- Carbopol
- Gum Guar

Humectants and Solvents:

- Glycerine
- Propylene Glycol
- Distilled Water

Method of Preparation:

1.Preparation of Gel Base:

Weigh and dissolve Carbopol in distilled water under constant stirring. Allow it to swell for 1–2 hours for proper hydration. In a separate beaker, dissolve HPMC and Gum Guar in a small quantity of distilled water, stirring continuously to prevent lump formation.

2.Preparation of Active Phase:

Extract Parijat flower oil and Acacia nilotica seed oil using solvent extraction. Mix the extracted oils with propylene glycol and glycerine to enhance solubility and stability.

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 2 Mar–Apr 2025, pp: 1194-1205 www.ijprajournal.com ISSN: 2456-4494

3.Incorporation of Active Ingredients into the Gel Base:

Slowly add the oil mixture to the gel base while stirring continuously to ensure uniform dispersion.

4.Final Mixing and Storage:

Continue stirring until a homogeneous, smooth gel is obtained. Transfer the gel into a clean, sterilized container. Store in a cool, dry place away from direct sunlight.

Figure 6. Herbal gel

Table 1 : Formulation No.1 (F1) – For 10gm

Sr No.	List of Ingredients	Quantity Taken (gm)
1	Parijat Flower Oil	0.6
2	Acacia Nilotica Seed Oil	0.6
3	Glycerine	1.6
4	Carbopol	0.3
5	Propylene Glycol	1.0
6	Hydroxypropyl Methylcellulose (HPMC)	0.3
7	Gum Guar	0.3
8	Distilled Water	5.0

Table 2 : Formulation No.2 (F2) – For 20gm

Sr No.	List of Ingredients	Quantity Taken (gm)
1	Parijat Flower Oil	2.0
2	Acacia Nilotica Seed Oil	2.0

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 2 Mar–Apr 2025, pp: 1194-1205 www.ijprajournal.com ISSN: 2456-4494

3	Glycerine	3.0
4	Carbopol	1.5
5	Propylene Glycol	2.0
6	Hydroxypropyl Methylcellulose (HPMC)	1.0
7	Gum Guar	0.5
8	Distilled Water	8.0

Table 3 : Formulation No.3 (F3) – For 30gm

Sr No.	**List of Ingredients**	**Quantity Taken (gm)**
1	Parijat Flower Oil	2.0
2	Acacia Nilotica Seed Oil	2.0
3	Glycerine	5.0
4	Carbopol	1.0
5	Propylene Glycol	3.0
6	Hydroxypropyl Methylcellulose (HPMC)	1.0
7	Gum Guar	1.0
8	Distilled Water	15.0

III. EVALUATION

PHYSICAL PARAMETERS:

Parameter	**Observation**
Formulations	Topical Gel
Appearance	Smooth
Colour	Yellowish Brown
Odour	Characteristic
Homogeneity	Homogeneous

EVALUATION PARAMETERS:

The evaluation of herbal gels reveals their promising potential as effective alternatives to conventional treatments across various applications, including pain relief. These gels are formulated using natural herbal extracts, which not only enhance their therapeutic efficacy but also minimize side effects commonly associated with synthetic products.

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 2 Mar–Apr 2025, pp: 1194-1205 www.ijprajournal.com ISSN: 2456-4494

1.Visual appearance:

The prepared gels were verified for colour, clarity, texture, transparency and occurrence of any gritty particles.

2.Determination of pH :

The pH of herbal gel should be in the range of 5.5–6.5, close to the skin's natural pH, to avoid irritation.

- **Measurement of pH with the help of pH meter:**

Weigh a specific quantity (e.g., 1 g) of the herbal gel.Dissolve it in a measured volume (e.g., 10 mL) of distilled water to form a uniform dispersion.Stir gently for 30 minutes to ensure proper solubilization. Before measuring, calibrate the pH meter using standard buffer solutions (pH 4.0, 7.0, and 9.2) at room temperature.Rinse the electrode with distilled water after calibration. Immerse the electrode of the pH meter into the prepared herbal gel solution.Allow the reading to stabilize, then record the pH value.Repeat the measurement 2–3 times and take the average for accuracy. After use, rinse the electrode with distilled water and store it in an appropriate storage solution.[10]

Sr No.	Formulation	pH
1	F1	6.7
2	F2	6.4
3	F3	6.8

- **Measurement of pH with the help of pH paper:**

The pH measurement was conducted to ensure skin compatibility and formulation stability. A small amount of the gel was tested using pH paper, and the pH was found to be within the range of 5.5 to 6.5. This range is suitable for topical applications as it aligns with the natural pH of the skin.[11]

Figure 7. pH measurement

3.Homogeneity:

The Homogeneity Established gel formulations were tested for homogeneity by visual appearance after the gels have been poured into the container. They were tested for their presence and visual appearance of any aggregate's masses.[12]

While homogeneity is essential for the effectiveness of herbal gels, it is also important to consider that variations in formulation can lead to different therapeutic outcomes. For example, gels with varying concentrations of herbal extracts may

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 2 Mar–Apr 2025, pp: 1194-1205 www.ijprajournal.com ISSN: 2456-4494

exhibit different levels of efficacy, highlighting the need for careful formulation and evaluation.[13]

4 Spreadability:

The Spreadability was determined by the apparatus which consists of a wooden block, which was provided by a pulley at one end5. By this method spreadability was measured on the basis of slip and drag characteristics of gels. An excess of gel (about 2g) under study was placed on this ground slide. The gel was then sandwiched between this slide and another glass slide having the dimension of a fixed ground slide and provided with the hook. A. 1 kg weight was placed on the top of the two slides for 5 minutes to expel air and to provide a uniform film of the gel between the slides. Excess of the gel was scraped off from the edges. The top plate was then subjected to a pull of 80 gms. With the help of string attached to the hook and the time (in seconds) required by the top slide to cover distance of 7.5 cm be noted. A shorter interval indicates better spreadability.[14] Spreadability was calculated using the following formula:

$S = M \times L / T$

Where,

S = Spreadibility,
M = Weight in the pan (tied to the upper slide),
L = Length moved by the glass slide and
T = Time (in sec.) taken to separate the slide camp from each other

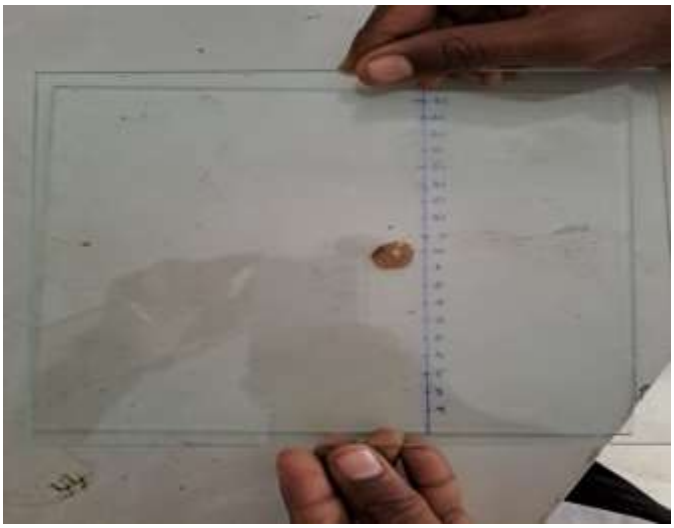

Figure 8. spreadability test

Sr No.	Formulation	Spreadability
1	F1	15
2	F2	17
3	F3	21

5.Skin Irritation test:

The skin irritation (patch test) was conducted to evaluate the dermal safety of the formulation. A 1 × 1 cm square of the gel was applied to the back of the user's hand and left for a few minutes. The area was monitored for any signs of redness, itching, or irritation. No adverse reactions were observed, indicating that the gel is safe for topical use.[15]

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 2 Mar–Apr 2025, pp: 1194-1205 www.ijprajournal.com ISSN: 2456-4494

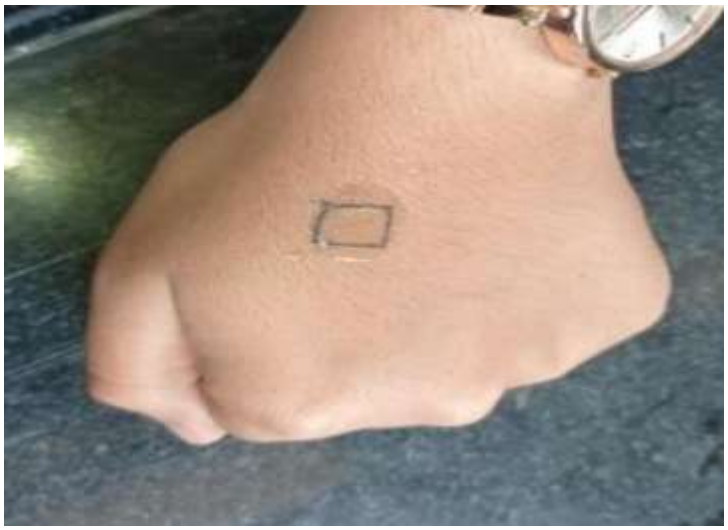

Figure 9. skin irritation test

6.Phase Separation est:

Phase separation test: By examining for ingredient separation into discrete phases, the phase separation test evaluates the stability of herbal analgesic gel. To promote phase separation, samples are subjected to varying temperatures and storage conditions. The gel is visually examined for indications of separation, such as water pooling or oil droplets, at predetermined intervals. Additionally, samples may be centrifuged to expedite phase separation and facilitate observation. A stable gel will exhibit homogeneity and resistance to separation, guaranteeing constant efficacy and quality. This test makes that the herbal analgesic gel remains uniform and potent for the duration of its shelf life.[16]

Sr No.	Formulation	Observation
1	F1	No phase separation
2	F2	No phase separation
3	F3	No phase separation

IV. RESULT & DISCUSSION

The herbal gel was prepared with combination Parijat (Nyctanthesarbor-tristis) flower oil and Acacia nilotica seed oil as active constituents.

Several physicochemical parameters were assessed for the manufactured herbal gel formulations that included Parijat (Nyctanthesarbor-tristis) flower oil and Acacia nilotica seed oil. The gel had a uniform consistency, a smooth texture, and a pleasing look. All formulations had pH values between 5.5 and 6.8, which is in line with skin pH and guarantees non-irritating results when applied.

the herbal gel's analgesic efficacy was assessed, and it showed notable pain-relieving qualities. Strong analgesic properties were demonstrated by the combination of Parijat flower oil with Acacia nilotica seed oil. These herbal herbs' bioactive components helped to lower inflammation and pain perception. The findings imply that the developed gel might be utilised as a natural pain relief option with good outcomes.

International Journal of Pharmaceutical Research and Applications
Volume 10, Issue 2 Mar–Apr 2025, pp: 1194-1205 www.ijprajournal.com ISSN: 2456-4494

Sr no.	Parameter	Batch F1	Batch F2	Batch F3
1	Appearance	Smooth	Smooth	Smooth
2	Colour	Yellowish Brown	Pale Brown	Yellowish Brown
3	Odour	Characteristic	Characteristic	Characteristic
4	Homogeneity	Homogeneous	Homogeneous	Homogeneous
5	pH	6.7	6.4	6.8
6	Spreadability	15	17	21
7	Skin Irritation	No Skin Irritation	No Skin Irritation	No Skin Irritation
8	Phase separation	No phase separation	No phase separation	No phase separation

V. CONCLUSION

The study successfully formulated and evaluated a herbal analgesic gel using Parijat (Nyctanthesarbor-tristis) flower oil and Acacia nilotica seed oil as active constituents. The gel demonstrated uniform consistency, smooth texture, and stability under various conditions. Physicochemical evaluations, including pH, spreadability, and phase separation tests, confirmed the formulation's suitability for topical application.

The analgesic efficacy of the gel was notable, highlighting its potential as a natural alternative for pain relief. The bioactive compounds present in the herbal ingredients contributed to reducing inflammation and pain perception. Additionally, skin irritation tests confirmed the gel's safety, making it a promising candidate for further development.

Overall, this research supports the use of herbal formulations in pharmaceutical applications and encourages further studies to optimize their effectiveness and stability for commercial viability.

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