WWW.IJRPR.COM

**International Journal of Research Publication and Reviews**

Journal homepage: www.ijrpr.com ISSN 2582-7421

# Herbal Gel for Managing Skin-Related Problems of PCOS: A Research

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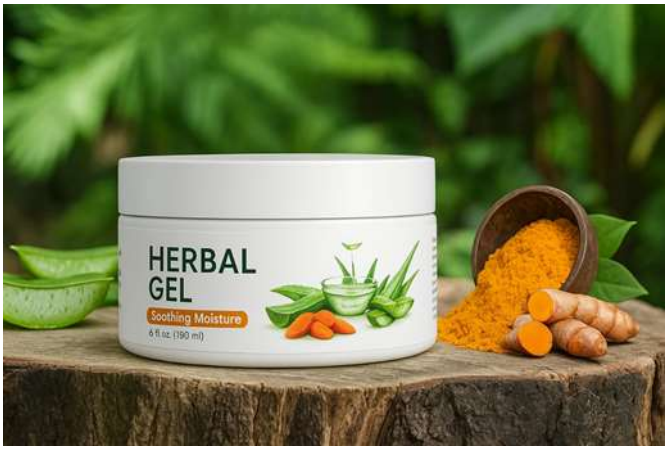
**A B S T R A C T:**

Polycystic Ovary Syndrome (PCOS) is a multifaceted endocrine disorder affecting women of reproductive age, often manifesting through dermatological issues such as acne, seborrhea, hirsutism, and hyperpigmentation. Conventional treatments, including hormonal therapy and antibiotics, may have undesirable side effects, prompting a shift toward herbal alternatives. This study aims to formulate and evaluate an herbal gel incorporating bioactive plant extracts known for their anti-inflammatory, antimicrobial, and skin-brightening properties. The gel was assessed for physicochemical characteristics, antimicrobial efficacy, stability, and user safety. Results indicate that the herbal gel exhibits favorable skin compatibility, significant antimicrobial activity, and potential efficacy in addressing PCOS-related skin concerns. The results suggested that various herbs, including fennel, licorice, spearmint, saw palmetto, green tea, Turmeric and neem, curcumin have the potential as herbal remedies for hirsutism and other complications of pcos [1]

**Keywords:** Polycystic Ovary Syndrome, Herbal gel, Skin disorders, Acne, Formulation, Evaluation, Natural skincare.

## OBJECTIVE:

1. To make a herbal gel using natural ingredients that help with common PCOS skin problems.
2. To check the basic properties of the gel like how thick it is, how easily it spreads, and its pH.
3. To test if the gel can fight germs and protect the skin with antioxidant effects.
4. To see if the gel works well in reducing acne, dark spots, and oily skin in PCOS.
5. To compare the herbal gel with other regular creams or gels used for PCOS skin issues.




**(Fig 1: Herbal gel)**

## INTRODUCTION:

Polycystic Ovarian Syndrome (PCOS) is one of the most prevalent endocrine disorders, affecting approximately 5–10% of women of reproductive age worldwide. It is characterized by hormonal imbalances, irregular ovulation, and metabolic dysfunction.

Among its various symptoms, dermatological manifestations are particularly distressing, with acne, excessive sebum production, hyperpigmentation, and hirsutism being common issues. These skin conditions are primarily driven by androgen excess and insulin resistance, leading to increased sebum secretion, inflammation, and abnormal melanogenesis [2]

Conventional treatments, such as hormonal contraceptives, retinoids, and antibiotics, can help manage symptoms but often come with side effects like skin irritation, dryness, and potential long-term health risks. The growing interest in herbal remedies stems from their natural composition, lower risk of adverse effects, and long-standing use in traditional medicine. Herbal extracts such as Neem (*Azadirachta indica*), Aloe Vera (*Aloe barbadensis*), Green Tea (*Camellia sinensis*), and Turmeric (*Curcuma longa*) have demonstrated antimicrobial, anti-inflammatory, and sebum-regulating properties, making them ideal candidates for PCOS skincare formulations.

This study focuses on the formulation of an herbal gel incorporating selected plant extracts to address skin-related symptoms of PCOS. The gel's physicochemical properties, antimicrobial efficacy, stability, and skin compatibility were evaluated to determine its potential as a safe and effective skincare alternative [3]

## HOW PCOS AFFECT THE SKIN

Polycystic Ovarian Syndrome (PCOS) is a hormonal disorder that can affect various aspects of health, including the skin. Common skin-related problems experienced by individuals with PCOS are often due to the hormonal imbalances, particularly elevated levels of androgens (male hormones like testosterone). Here are some of the most common skin issues:[4]

**Common skin problems**

**1]** **Acne**: One of the most common skin problems in PCOS due to increased androgen levels.Acne typically appears on the face, chest, and back and can range from mild to severe. It often develops around puberty and can continue into adulthood.

**2]** **Hirsutism:** This refers to excessive hair growth in areas where men typically grow hair, such as the upper lip, chin, chest, and abdomen. The excess hair growth is primarily due to elevated androgen levels

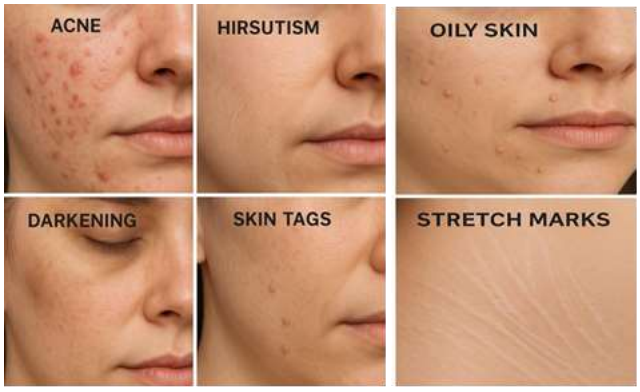
**3]** **Darkening of Skin (Acanthosis Nigricans)**: This condition causes dark, velvety patches of skin to develop, often in areas where skin folds, such as the neck, armpits, groin, or under the breasts. It is associated with insulin resistance, which is common in people with PCOS.

**4]** **Oily Skin**: Higher androgen levels can lead to increased sebum (skin oil) production, which can result in shiny, greasy skin, particularly on the face.

**5]** **Scalp Hair Thinning (Androgenic Alopecia)**: Some individuals with PCOS experience thinning or loss of hair o. n the scalp. This is due to elevated androgen levels, which can shorten the hair growth phase and lead to finer, shorter hair.

**6]** **Stretch Marks**: Rapid weight gain, which is common in PCOS due to insulin resistance and hormonal imbalances, can result in stretch marks, particularly on the abdomen,thighs, and hips.

**Skin Tags**: Small, benign growths of skin, often found in areas like the neck, armpits, and groin.




**(Fig 2: Skin related problems in PCOS)**

**GEL** [5]

As semisolid systems consisting of dispersions made up of either small inorganic particles or large organic molecules enclosing and interpenetrated by a liquid

- A high degree of physical or chemical cross- linking may be involved.
- The increased viscosity caused by the internal friction is responsible for the semisolid State.

**1) Advantages of gels formulation [6] [7]**

1. Easy to apply and spread
2. Non-greasy and non-sticky
3. Quick drying and FAST absorption
4. Can be formulated for various skin types
5. Stable and consistent texture
6. Cooling and Soothing
7. Easy to remove
8. Suitable for topical and transdermal applications.

**Why Gel?**

Topical gels are semisolid dosage forms in which a liquid phase is constrained within a three-dimensional polymeric matrix derived from natural or semi-synthetic sources with high physical or chemical cross-linking. Because of their intermediate behavior between solid and liquid materials, topical gels are an excellent candidate for transdermal drug delivery. Clinical evidence indicates that topical gel is a safe and effective treatment choice for the management of skin-related diseases, especially when used for local action to avoid the side effects of other conventional dosage forms. Gels, cream, ointment, and paste are the most commonly used semi-solid formulations for topical drug delivery. Gels are colloids in which the liquid medium has thickened to the extent that it behaves like a solid. Since topical gel formulations are less greasy and can be quickly removed from the skin, they offer better drug delivery. In comparison to cream, ointment, and paste, gel formulations have improved application properties and consistency.

## 1.PLAN OF WORK

**a) Literature Review**

Polycystic Ovary Syndrome (PCOS) is frequently associated with dermatological manifestations such as acne, hyperpigmentation, and skin inflammation. Herbal gels, due to their biocompatibility and natural therapeutic potential, offer promising alternatives for managing these issues.

**1) Sharma et al. (2021)** demonstrated the successful formulation and evaluation of an herbal gel targeting acne management, emphasizing the anti-inflammatory and antimicrobial properties of plant-based ingredients. [8]

**2) Khan and Patel (2020)** explored the use of herbal gel for hyperpigmentation and highlighted its effectiveness as a natural skin-lightening approach, incorporating ingredients known for their melanin-suppressing activity.[9]

**3) Mehta et al. (2022)** developed a polyherbal gel focused on alleviating skin inflammation and redness, confirming its efficacy through experimental formulation and irritation studies. These studies underscore the relevance of herbal formulations in dermatological applications and support the development of a multi-targeted herbal gel specifically designed to address the diverse skin issues commonly observed in individuals with PCOS.

**4) Gupta and Saini (2019)** contributed to this field by creating a natural gel aimed at sebum control—an important factor in managing acne and oily skin, both prevalent among PCOS patients. Most recently.[10]

**5) Nair and Thomas (2023)** emphasized the formulation of an antiandrogenic herbal gel for skin disorders, aligning closely with the hormonal basis of PCOS-related skin concerns. Collectively, these studies underscore the therapeutic potential of herbal gels in addressing multifaceted dermatological symptoms of PCOS, providing a strong foundation for the formulation and evaluation of a comprehensive herbal gel tailored to this condition.[11]

**Herbal drugs for skin problems of pcos**

Topical herbal gel for skin diseases are a natural treatment option applied directly to the skin.

These gels contain herbal extracts that help in soothing, healing, and treating various skin conditions like acne, eczema, psoriasis, or rashes. [12]

**b) herbal ingredients:**

1. ALOE VERA
2. GREEN TEA

3. LICORICE
4. TURMERIC
5. NEEM
6. SPEARMINT
7. ROSE WATER

**Aloe Vera**

- **Botanical name** - *Aloe barbadensis*
- **Common name** – *Korphad*
- **Family** – *Aloeceae*
- **Parts used**- Leaves

**(Fig 3: Aloe Vera)**

**Uses:** Aloe vera is good for irritated or inflamed skin. It helps repair skin from the most tender wounds. It helps speed up the process of healing to burns & other wounds. It is hydrating, rejuvenating and toning for skin. It moisturizes and softens skin. Known for its cooling and healing properties, it helps soothe burns, rashes, and dry skin.[13] [14]

**Green Tea**

- **Botanical name –** *camellia sinensis*
- **Common name -** *Tea plant, Tea shrub*
- **Family** - *Theaceae*
- **Parts used**- Leaves

**(Fig 4: Green tea)**

- **Uses**: Green Tea (Camellia sinensis) is rich in polyphenols, catechins, and antioxidants, which offer anti-inflammatory, antimicrobial, sebum-regulating,

and skin-brightening properties. Incorporating Green Tea into an herbal

- formulation can provide a natural, non-irritating treatment for managing PCOS-related dermatological conditions.

**Licorice**

- **Botanical name** - *Glycyrrhiza glabra*
- **Common name** - *Licorice, liquorice, sweetwood, Mulaithi*
- **Family** –*Fabaceae (also known as Leguminosae)*
- **Parts used**- Root

**(Fig 5: licorice root powder)**

**Uses**: Women with PCOS often experience acne, hyperpigmentation, oily skin, and hirsutism due to elevated androgen levels. Liquorice contains bioactive compounds that help regulate sebum production, reduce post-inflammatory hyperpigmentation, and inhibit 5-alpha reductase, which plays a role in excessive hair growth.[15].

**Turmeric**

- **Botanical origin** -*Curcuma longa*
- **Family**- *zingiberaceae*
- **Common name**- *Turmeric*
- **Urdu name**- *Haldi*

**Part used**- Dried rhizomes

**(Fig 6: Turmeric powder)**

- **Uses**: Has anti-inflammatory and antibacterial effects, useful for treating acne and skin irritation. [16] [17].

**Neem**

- **Botanical origin** -*Azadirachta Indica*
- **Family**- *Meliaceae*
- **Common name**- *Neem*
- **Part used**- leaves

**Uses**: Antibacterial: Neem can help fight acne-causing bacteria.

**(Fig 7: Neem powder)**

Anti-inflammatory: Neem can relieve inflamed skin and soothe redness and itchiness.

Hydrating: Neem can help heal dry skin and avoid further dryness and itchiness.

Anti-aging: Neem has anti-aging properties that rejuvenate the skin and make it healthy.

Rich in vitamin E: Neem is a rich source of vitamin E which helps repair damaged skin cells. Known for its antibacterial and antifungal properties, helps treat infections and inflammation.[18].

**Spearmint**

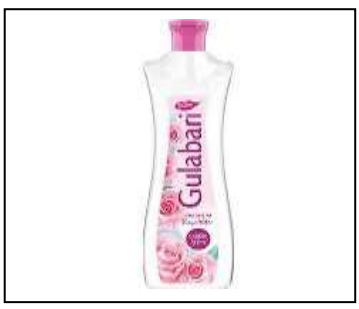
- **Botanical origin** - *Mentha spicata*
- **Family**- *Lamiaceae*
- **Common name**- *Garden mint, Common mint, Lamb mint, Mackerel mint*
- **Part used**- leaves

**(Fig 8: Spearmint leaves)**

- **Active Constituents**: Rosmarinic Acid, Carvone, Menthol.

- **Uses:** Women with PCOS often experience acne, oily skin, hirsutism (excess hair growth), and inflammation due to high androgen levels. Spearmint has been scientifically studied for its ability to reduce androgen levels, which can help control acne and excessive oil production. Its antioxidant compounds also support skin healing and rejuvenation, making it a valuable ingredient in an herbal gel formulation for PCOS-related skin issues.

**Rose water**




**(Fig 9: Rose water)**

**Rose water can have many benefits for your skin, including**

- **Hydration**: Rose water is a natural hydrator that can help maintain your skin's moisture balance. It's rich in natural oils and sugars, which can help prevent dryness and promote a dewy complexion.
- **Anti-inflammatory properties**: Rose water can soothe irritated skin and reduce redness. This makes it a good choice for people with sensitive or acne-prone skin.
- **Anti-aging properties**: Rose water is rich in antioxidants, which can help diminish the appearance of fine lines and wrinkles.
- **Toning and tightening**: Rose water can act as a natural astringent, which can help tone and tighten the skin. This can minimize the appearance of pores.
- **Acne control:** Rose water has antimicrobial properties that can help control and prevent acne breakouts.

**C) Excipients, herbal ingredients and their uses:**

**(Table 1: Excipients, herbal ingredients and their uses)**

| **Ingredient** | **Role** |
|---|---|
| Aloe Vera | Hydrates, soothe, Base |
| Green Tea | Antioxidant, reduces oil, calms skin irritation |
| Licorice | Brightens skin, reduces pigmentation, anti-inflammatory, manage hirsutism |
| Turmeric | Anti-inflammatory, reduces scars and pigmentation |
| Neem | Antibacterial, treats acne, purifies skin |
| Spearmint | Anti-androgenic, reduces acne, refreshes skin, manage hirsutism |
| Phenoxyethanol | Preservative |
| Xanthan Gum | Thickener and stabilizer in cosmetic formulations |
| Rose Water | Tones skin, reduces redness, mild astringent |

## 2. METHODOLOGY

**a) Process of extraction** [19] [20] [21]

**a] Preparation of herbal extract**

1. **Aloe Vera:**

**(Fig 10: Aloe Vera pulp)**

- Fresh Aloe Vera Leaf: Cut a mature aloe vera leaf. Wash and peel off the outer layer to extract the gel inside.

- Preparation: Scrape the clear gel from the leaf and blend it to create a smooth consistency.
- Optional Preservation: Mix with a few drops of Vitamin E capsule.

**2. Neem Extraction:**

- Neem Powder: Fresh neem powder used for extraction.
- Infusion: Boil 1 tablespoon of neem powder in 100 ml of distilled water for about 30 minutes, then strain it to get a neem infusion.

**(Fig 11: Neem Extract)**

**3. Turmeric Extraction:**

**(Fig 12: Turmeric extract)**

- Turmeric Powder: Use fresh turmeric powder.
- Method: Boil it in ethanol (about 100 ml) for 120 minutes. Strain and use the yellow turmeric infusion with Soxhlet apparatus.

**4. Green Tea Extraction**:

**(Fig 13: Green tea extract)**

- Green Tea Bags: Use commercial tea bags.
- Method: Boil water (100 ml) and steep the green tea bag or leaves for 90 minutes.

Strain the residue to get the infusion. Let it cool down.

**5. Spearmint Extraction:**

**(Fig 14: Spearmint extract)**

- Spearmint Leaves: Fresh spearmint leaves work best.
- Method: Crush fresh spearmint leaves. Separate them in 100 ml of distilled water by distillation process for 120 minutes. Strain and allow it to cool.

**6. Licorice Extraction:**

**(Fig 15: Licorice extract)**

- Licorice Root: Use dried licorice root powder.
- Method: Infuse 1 tablespoon of licorice powder in 100 ml of distilled water with 5ml of Ethanol. Boil for 120 minutes, then filter it. Again, boil it for concentrated Extract.

**B] Formulation Table:**

| Sr NO. | Constituents | F1 (g) | **F2 (g)** | F3 (g) | F4 (g) | Role |
|---|---|---|---|---|---|---|
| 1 | ALOE VERA | 8 | **7** | 6 | 7 | Used as base |
| 2 | GREEN TEA | 1 | **1.20** | 1.40 | 1 | Strong antioxidant, sebum regulation, calm redness |
| 3 | LICORICE | 1 | **1** | 1.40 | 1 | Reduce pigmentation, calm hormonal irritation |
| 4 | TURMERIC | 1 | **1.20** | 1 | 1 | Helps with acne, pigmentation |
| 5 | NEEM | 2 | **2** | 2.40 | 02 | Antibacterial, control acne causing bacteria |
| 6 | SPEARMINT | 0.40 | **0.60** | 0.40 | 0.60 | Reduce hirsutism |
| 7 | ROSE WATER | 2 | **2** | 2 | 0.2 | Calming and toning |
| 8 | Xanthan gum | 0.20 | **0.20** | 0.20 | 0.20 | Gelling agent |
| 9 | Phenoxyethanol | 0.10 | **0.12** | 0.10 | 0.10 | Preservative |
| 10 | Glycerin | 0.20 | **0.20** | 0.20 | 0.20 | Gel Smoothing Agent |

| | | | | | | |
|---|---|---|---|---|---|---|
| 11 | Water | Q.S. 20 | **Q.S.20** | Q.S.20 | Q.S 20 | Vehicle |

**(Table 2: Formula of topical herbal gel.)**

**b) Herbal Gel Formulation Process: [22], [23]**

**Step 1: Preparing Herbal Extracts**

1. Prepare all the herbal extracts as outlined above (aloe vera gel, neem infusion, turmeric infusion, green tea infusion, spearmint infusion, licorice infusion).
2. Allow all the extracts to cool down to room temperature if heated.

**Step 2: Prepare Xanthan Gum Gel Base**

1. Mix xanthan gum (1g) with glycerin (3g) in a small bowl to prevent lumps.
2. Slowly add distilled water (80g) while stirring continuously until the mixture begins to thicken.
3. Let it sit for 30–60 minutes to fully hydrate into a smooth gel.

**Step 3: Combine Phases**

1. Slowly add the herbal extract mixture into the hydrated xanthan gel base.
2. Stir gently and thoroughly until a uniform and homogenous gel is formed.

**Step 4: Add Preservative**

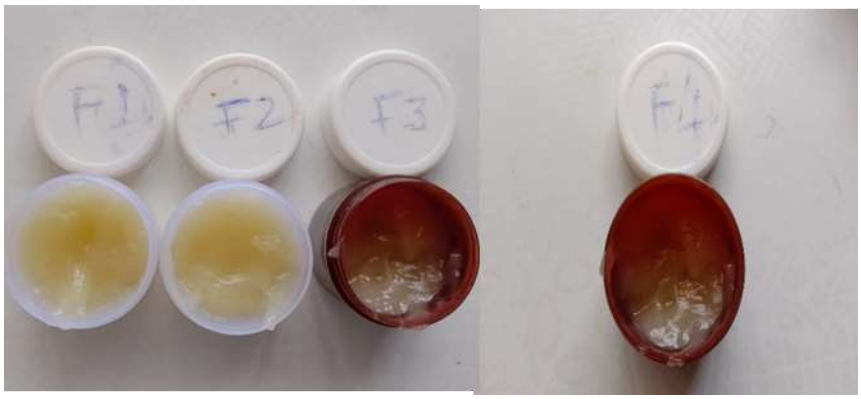
1. Add 1g of preservative (according to recommended dose) and mix well.
2. Check the pH using pH strips or meter (ideal range: 5.0–5.5). Adjust with citric acid or NaOH if needed.

**Step 5: Packaging**

1. Transfer the gel into sterilized, airtight containers.
2. Label with date, ingredients, and usage instructions.

**Storage**: Store at room temperature for 9- 11 months.

**Usage:** Apply a thin layer to clean skin, once or twice daily, focusing on hirsutism acne-prone or oily areas. Suitable for daily use.




**(Fig 16: Herbal gel)**

**EVALUATION PARAMETER** [24] [25] [26] [27]

**1.Appearance and Homogeneity**:

The developed gel was evaluated for physical appearance and homogeneity by visual observation.

**2.pH measurement**:

pH Test: The pH of the herbal gel was measured to ensure its compatibility with the skin. About 1 gram of the gel was dispersed in 100 mL of distilled water and allowed to stand for 2 hours at room temperature to achieve equilibrium. The pH was then determined using a digital pH meter, which was previously calibrated with standard buffer solutions (pH 4.0 and 7.0). The pH of topical formulations should ideally fall between 4.5 and 6.5 to match the skin's natural pH and avoid irritation. The obtained pH values confirmed the formulation's suitability for topical application (Shivhare et al., 2009).

**3.Viscosity**: The viscosity of the herbal gel was determined using a Brookfield Viscometer to assess its flow behavior and consistency. The test was done by placing the gel sample in a beaker and measuring the viscosity at 25°C using spindle number 64 at varying speeds (e.g., 10, 20, and 50 rpm) to observe shear-thinning behavior. The readings were recorded in centipoise (cP) after the spindle was rotated in the gel for about 5 minutes to ensure uniformity. Viscosity is a crucial parameter affecting the gel's spreadability, stability, and patient compliance. The results indicated that the gel exhibited pseudoplastic behavior, which is desirable for topical formulations.

Formula:

Viscosity (cPs) = Torque **x** Calibration factor

(Calibration factor): A constant that depends on the spindle number and speed (RPM).

**4.Spreadability:**

The spreadability of the gel formulations was determined by measuring the

spreading diameter of 1 g of gel between two horizontal plates (20 cm x 20 cm) after one min.

Formula:

Spreadability (S) = ( M **x** L ) / T

Where,

S = Spredability

M = Weight tied to the upper slide (g)

L = Length the slide moves (cm)

T = Time taken to move that length (sec)

**5.Extrudability**:

A closed collapsible tube containing about 20 g of gel was pressed firmly at the crimped end and a clamp was applied to prevent any roll back. The cap was removed and the gel was extruded. The amount of the extruded gel was collected and weighed. The percentage of the extruded gel was calculated.

## RESULT AND DISCUSSION:

The herbal gel formulations (F1–F4) were successfully prepared using xanthan gum as the gelling agent along with selected herbal extracts known for their skin benefits in managing PCOS-related issues such as acne, inflammation, and excess sebum. Among all, Formulation F2 was found to be the most suitable based on the following evaluation parameters: pH: Maintained within the skin-friendly range (4.5–6.5)

**1.Appearance and Homogeneity**:

| **Parameters** | **Ideal Value** | **Observed Value** |
|---|---|---|
| Colour | Light green | Whitish green |
| Odour | Mild herbal | Slightly herbal |
| Texture | Smooth non-sticky | Smooth with slight granules |
| Appearance | Homogeneous uniform gel | Slight lump formation |

**(Table 3: for Appearance and Homogeneity)**

**2.pH measurement**:

| **Formulation** | **F1** | **F2** | **F3** | **F4** |
|---|---|---|---|---|
| pH | 5.6 | **5.3** | 5.1 | 5.4 |
| Suitability with Skin | Less suitable | **Good suitable** | Moderate suitable | Well suitable |

**(Table 4: for pH test)**

**(Fig 17: pH test)**

**3.Viscosity**: Ideal consistency for smooth application.

| **Formulation** | **F1** | **F2** | **F3** | **F4** |
|---|---|---|---|---|
| Viscosity | 8200 cPs | **10000 cPs** | 11500 cPs | 9800 cPs |
| Status | Slightly Low | **Ideal** | Slightly High | Acceptable |

**(Table 5: for viscosity test)**

**4.Spreadability:** Excellent, allowing easy and even skin coverage.

| **Formulation** | **F1** | **F2** | **F3** | **F4** |
|---|---|---|---|---|
| Flow behavior | Medium | **Medium-Smooth** | Lower (Thick Flow) | Medium |
| Spreadability (g.cm) | 12.5 | **14.8** | 16.2 | 14.2 |
| Observation | Slightly low | **Excellent** | Slightly High | Acceptable |

**(Table 6: for spreadability test)**

**(Fig 18: Spreadability test)**

**5.Extrudability**: Smooth dispensing without clogging.

| **Formulation** | **Extrudability (g/30sec)** | **Ease of Squeez** | **Observation** |
|---|---|---|---|
| F1 | 4.8-5.2g | Easy | Good |
| F2 | 4.5-5.0g | Very Easy | Excellent |
| F3 | 3.5-4.2g | Moderate | Poor |
| F4 | 4.6-5.0g | Easy | Moderate |

**(Table 7: for extrudability test)**

## CONCLUSION:

Formulation F2 is a successfully developed herbal gel designed to improve skin conditions associated with PCOS, such as acne and hirsutism-related conditions. It maintains a skin-friendly pH of 4.5–6.5, preserving the skin's natural barrier while ensuring gentle, safe topical use. The gel's ideal viscosity offers a smooth, non-sticky, and cosmetically elegant application. Enriched with potent anti-inflammatory and antimicrobial herbal extracts, it helps

reduce acne lesions, soothe follicular inflammation, and prevent post-inflammatory pigmentation. This stable, effective formulation supports clear, healthy skin and provides a natural, soothing solution for women dealing with PCOS-related skin concerns.

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