Formulation and Evaluation Anti-Acne Cream on Pomegranate Peel

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***Abstract*—Acne vulgaris is a common chronic inflammatory skin disorder caused by excessive sebum production, follicular blockage, bacterial proliferation, and inflammation. Conventional anti-acne therapies may produce adverse effects such as skin irritation, dryness, and antimicrobial resistance, creating a need for safer and more effective alternatives. The present study focuses on the formulation and evaluation of a herbal anti-acne cream containing pomegranate peel extract (Punica granatum), a natural source rich in polyphenols, flavonoids, tannins, and antioxidants. These bioactive constituents possess significant antimicrobial, anti-inflammatory, antioxidant, and skin-protective properties that may help in the management of acne and related skin disorders.**

The cream was formulated using suitable excipients and evaluated for various physicochemical parameters including appearance, pH, viscosity, spread ability, homogeneity, washability, and stability. The formulation demonstrated acceptable physical characteristics, good stability, and skin compatibility. The presence of pomegranate peel extract contributed to the antimicrobial and anti-inflammatory potential of the formulation, making it suitable for acne-prone skin. The study concludes that the developed herbal anti-acne cream is a promising, economical, and safe topical preparation that may serve as an effective alternative to synthetic anti-acne products.

***Index Terms*—Acne vulgaris, Herbal cream, Pomegranate peel extract, Punica granatum, Anti-microbial activity, Antioxidant activity, Anti-inflammatory activity, Herbal cosmetics.**

I. INTRODUCTION

Punica granatum, commonly known as pomegranate, is cultivated on a large scale because of its nutritional value and long-recognized medicinal importance. While the edible arils and juice are generally consumed, the outer peel is commonly discarded as a processing or agricultural by-product. Current research indicates that this peel contains several bioactive groups, including polyphenols, flavonoids, antioxidant constituents and alkaloid-like compounds, which together provide notable therapeutic relevance. Owing to its antimicrobial, anti-inflammatory, antioxidant and skin protective actions, pomegranate peel can be considered a promising natural material for cosmetic and medicinal preparations.

Pomegranate (Punica granatum) is a plant of the Punicaceae family. Its name is derived from the Latin expression Malum granatum, meaning granular apple. The peel represents the firm, non-edible outer fraction of the fruit and is mainly composed of two anatomical portions, namely the pericarp and the mesocarp.

Botanically, Punica granatum is placed in the family Punicaceae, and the traditional Latin name Malum granatum denotes a fruit filled with granular seeds. The non-edible external covering, commonly called the peel, includes the pericarp and mesocarp. These tissues are rich in naturally occurring pigments and phytochemicals that contribute to the colour of the peel and to several biological effects. Reported activities of pomegranate peel include anti-inflammatory, antimicrobial, anticancer, detoxifying and cardioprotective effects.

II. FRUITS AND VEGETABLES SUPPORT HEALTH LARGELY BECAUSE THEY SUPPLY ESSENTIAL NUTRIENTS AND PROTECTIVE PHYTOCHEMICALS

1. Skin:

Skin is the biggest organ of the body and serving as the first protective interface against microorganisms, ultraviolet radiation, environmental pollutants and chemical irritants. Among different dermatological problems, acne vulgaris is one of the most frequently

encountered chronic inflammatory conditions. It develops through excess sebum production, follicular blockage, microbial proliferation and inflammation around sebaceous glands. Lesions commonly appear on the face, neck, chest, shoulders and back as comedones, papules, pustules, pimples and, in severe cases, scars. Along with visible skin changes, acne may reduce self-confidence and create psychological stress.

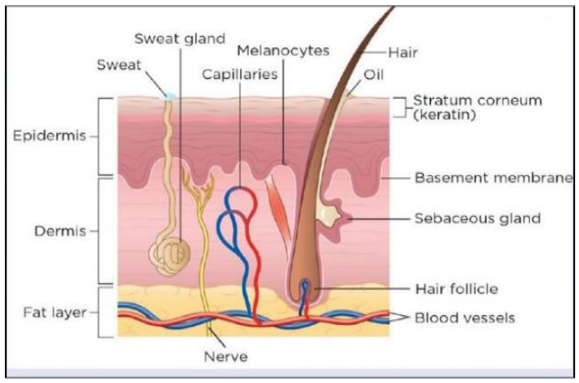

Fig no 1: Structure of skin

2. Acne:

Acne is a long-lasting inflammatory skin disorder produced when follicles are obstructed by sebum, shed keratinocytes and bacteria. It mainly affects sebaceous gland-rich regions such as the face, chest, neck, shoulders and back. Although it is common during adolescence because of hormonal changes, it may occur at any age.

The clinical picture may include pimples, blackheads, whiteheads, papules, pustules, nodules or cysts. Severe disease may leave scars and may also influence self-image and emotional well-being.

Fig no 2: Acne

Human skin is continuously exposed to ultraviolet radiation, dust, pollution and chemical agents, which can contribute to several skin concerns such as acne, pimples, hyperpigmentation and sunburn. Acne vulgaris is a common follicular disorder involving the pilosebaceous unit, mainly over the face, head, neck and trunk. Its pathogenesis includes androgen-driven sebaceous enlargement, disturbed follicular keratinisation, hormonal imbalance, immune reactivity and bacterial colonisation.

Common anti-acne treatments include retinoids, benzoyl peroxide, antibiotics and hormonal therapy. Long-term or inappropriate use of these synthetic agents may cause irritation, dryness, allergic reactions or microbial resistance. Hence, attention has shifted toward herbal formulations that are economical, better tolerated and potentially associated with fewer adverse effects. Herbal cosmetics and medicinal products are gaining acceptance because they are naturally derived, patient-friendly and therapeutically multifunctional.

Causes of Acne:

a) Excess Sebum Production Excessive activity of sebaceous glands increases sebum output, which can obstruct pores and favour acne development.

b) Hormonal Changes in hormones during puberty, menstruation, pregnancy or PCOS can raise androgenic stimulation of sebaceous glands and worsen acne.

c) Bacterial Growth Multiplication of Cuti bacterium acnes inside blocked follicles promotes inflammation, redness and pus formation.

d) Accumulation of Dead Skin Cells Accumulated dead keratinocytes can plug the follicular opening and produce comedowns such as blackheads and whiteheads.

e) Dietary Factors In some individuals, oily foods, high-sugar intake, junk food and dairy products may aggravate acne.

f) Stress may disturb hormonal balance and increase cortisol, thereby worsening acne in susceptible individuals.

g) Use of Certain Medications Medicines such as corticosteroids, lithium, testosterone and other hormonal preparations may trigger or aggravate acne.

h) Cosmetic Products Oily or comedogenic cosmetic products may block pores and increase

i) Poor Skin Hygiene and Pollution Dust, sweat, pollution and inadequate cleansing can irritate the skin and contribute to acne formation.

Symptoms of Acne:

- Pimples and red inflamed lesions may develop.

- Blackheads and whiteheads may be present.
- The skin may appear oily or greasy.
- Papules and pustules may occur on the surface.
- Severe cases may show painful nodules or cysts.
- Affected areas may show redness, swelling and irritation.
- Healing may leave scars or dark marks.
- Altered appearance may cause stress, anxiety and reduced self-confidence.

III. HERBAL COSMETICS

Herbal cosmetics are preparations made from botanically derived materials such as herbs, flowers, fruits, plant extracts and natural oils. They are used to maintain skin and hair health, improve appearance and protect against environmental stress.

Compared with highly synthetic cosmetics, they usually contain fewer harsh chemicals and are often preferred for long-term use because of their perceived safety and natural origin. Such products may include plant extracts, essential oils, natural colours and active phytochemicals with antimicrobial, antioxidant, anti-inflammatory, moisturising or protective effects. These ingredients are used in creams, lotions, shampoos, soaps, face packs, sunscreens and anti-acne products.

Advantages of Herbal Cosmetics

- Prepared from natural plant-based ingredients.
- Generates fewer adverse effects in comparison to synthetic preparations.
- Possesses antimicrobial and anti-inflammatory activities.
- Helps reduce redness, irritation, and acne lesions.
- Provides antioxidant protection to the skin.
- Suitable for long-term use.
- Economical and eco-friendly.
- Improves overall skin health and appearance.

Plant Profile:

1. Pomegranate:

A) Synonym

Hindi: Anar

Sanskrit: Dadimah,

English: Pomegranate,

B) Botanical Classification

Botanical name- Punica granatum Kingdom: Plantae (Angiosperms)

Order: Myrtales

Family: Lythraceaes

Genus: Punica S

pecies: P. granatum

C) Chemical Constituents: Punicalagin, Punicalin, Ellagic acid, Gallic acid, Catechin, Epicatechin, Tannins.

Fig no3: Pomegranate

Health advantages of pomegranate

a. Antioxidant capacity:

The peel is commonly considered the richest pomegranate fraction in total polyphenols and antioxidant constituents. Ellagitannin-rich phenolics provide strong radical-scavenging and reducing effects, which explains the high antioxidant performance of peel extracts.

b. Significance of anti-inflammatory properties:

Traditional use of pomegranate in inflammatory conditions is supported by studies showing that peel and leaf extracts may suppress inflammatory pathways. Ellagitannins and ellagic-acid-related metabolites are repeatedly suggested to modulate inflammatory signalling.

c. Antimicrobial Efficacy:

Leaf, peel and seed fractions of pomegranate contain several bioactive classes that have been examined for antibacterial action.

d. Antifungal Efficacy:

Non-edible fractions of pomegranate, especially peel and seeds, are also considered potential antifungal sources.

e. Anti-obesity and metabolic assistance:

Pomegranate has been studied for metabolic support, with attention given to seed oil and peel polyphenols. into anti-obesity and related metabolic effects.

f. Antiviral Efficacy of Pomegranate:

A considerable portion of pomegranate fruit mass is inedible, particularly the peel, which is rich in tannins and other bioactive.

g. Significance of pomegranate in diabetes management:

Pomegranate arils, peel and seeds have been investigated for metabolic health because they contain flavonoids, tannins, ellagic-acid derivatives, catechin-type molecules and other polyphenols.

h. Potential for anti-hypertensive and cardioprotective effects:

Dietary approaches are often considered in cardiovascular risk reduction. Pomegranate peel, seed and leaf fractions have been studied as supportive components within lifestyle and medical management.

Benefits of Pomegranate for skin:

1. Anti-acne Activity Pomegranate possesses antimicrobial and anti-inflammatory properties that help reduce acne, pimples, redness, and skin irritation.
2. Powerful Antioxidant Effect The polyphenols and flavonoids present in pomegranate protect the skin from free radical damage and oxidative stress.
3. Anti-aging Property Pomegranate helps reduce wrinkles, fine lines, and signs of premature aging by promoting collagen production and improving skin elasticity.
4. Skin Hydration Pomegranate seed oil contains essential fatty acids that help moisturize and nourish the skin, keeping it soft and smooth.
5. Reduces Inflammation Its anti-inflammatory compounds help soothe irritated skin and reduce swelling and redness.

2. Tulsi

Scientific Classification of Tulsi:

Kingdom: plantae
Phylum: spermatophyte
Subphylum: Angiosperm
Order: Lamiales
Family: Lamiaceae
Genus: Ocimum
Species: ocimum. Tenuiflorum, ocimum sanctum

2.1 Synonyms:

- Indian Languages:

1. Hindi: Tulsi, Krishna Tulsi
2. Tamil: Thulasi, Nalla Thulasi, Karun Tulasi
3. Telugu: Tulasi, Krishna Tulsi

Fig no 4: Tulsi

Chemical Constituents: Eugenol, Methyl eugenol, Caryophyllene, Linalool, Cineole, Camphor, Rosmarinic acid, Caffeic acid, Gallic acid, Chlorogenic acid.

Medicinal Uses

1. Tulsi is employed in the management of cough, cold, and bronchitis due to its expectorant action.
2. It has antimicrobial activity and helps in fighting bacterial, viral, and fungal infections.
3. Tulsi acts as an anti-inflammatory agent and is useful in reducing pain and swelling.
4. It is used as an antipyretic to reduce fever, especially in malaria and viral fevers.
5. Tulsi helps in boosting immunity by enhancing the body's defense mechanisms.
6. It is beneficial in respiratory disorders such as asthma and allergic conditions.
7. Tulsi is used in the treatment of diabetes mellitus as it helps in lowering blood glucose levels.
8. It acts as an antioxidant, protecting the body from oxidative stress.

Detoxification and Protection agent:

Tulsi is traditionally described as a protective or detoxifying herb because it may help the body resist toxin-induced damage and maintain internal balance. This effect is related to its phenolic and antioxidant content. Experimental studies suggest that Tulsi can strengthen antioxidant defence and reduce tissue damage caused by toxic exposure.

3. Aloe vera

2. Scientific Classification of Aloe vera

- Kingdom: Plantae
- Division: Angiosperms (Tracheophyta)
- Class: Liliopsida (Monocotyledons)
- Order: Asparagales

- Family: Asphodelaceae
- Genus: Aloe L.
- Species: Aloe vera (L.) Burm.f.

Fig no 5: Aloe vera

Chemical Constituents: Aloin, Aloe-emodin, Barbaloin, Acemannan, Glucomannan, Mannose-rich polysaccharides, Amylase, Lipase, Catalase.

Aloe Vera for Healthy Skin:

Apart from its internal benefits, Aloe vera also has a positive impact on the skin.

1) It contains antioxidants that neutralize harmful free radicals. This helps prevent the appearance of wrinkles and other signs of aging.

2) It nourishes the skin by promoting better blood circulation.

3) Aloe vera is effective in treating skin conditions like dermatitis and psoriasis.

4) It aids in healing cuts, wounds, blisters, burns, including sunburns, and even minor second-degree burns.

5) Aloe vera helps clear acne, skin allergies, dark spots, and blemishes, making the skin look clearer. It is also beneficial for the hair and scalp.

IV. METHOD AND MATERIAL

Table No 7 - Role of Ingredients

Ingredients	Part	Use
Pomegranate peel.	Peel	Fighting acne
Aloe Vera gel	Gel	Anti-aging, anti-inflammatory, moisturiser, and acne and pimple reduction.
Tulsi.	Leaf	Antibacterial, adds glow to the face.

Table no 8 Role of Excipients

Excipient	Activity
Borax	Emulsifying agent, stabiliser, and thickening agent to the cream.
Methyl paraben	Preservative
Rose oil	Fragrance
Bees wax:	Emulsifying agent, stabiliser, and thickening agent.
Liquid paraffin	Lubricating agent
Water	Vehicle

1. Bee Wax:

Biological Name- Apis mellifera

Biological Source Beeswax is a natural wax produced by worker honey bees of the species Western honey bee from the honeycomb.

Chemical Constituent: Myricyl palmitate, Cerotic acid, Palmitic acid, Hydrocarbons.

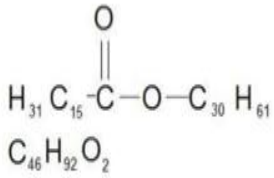

Fig no 6: Bee wax

Uses of Beeswax

- Used as a thickening agent in creams and ointments.
- Provides smooth texture and stability to cosmetic formulations.
- Acts as an emollient and moisturizer.
- Used in lip balms, lotions, creams, and herbal preparations.

2. Borax

Scientific Name- Sodium tetraborate decahydrate

Chemical Formula- $NaBO \cdot 10HO$

Common Names: Borax, Sodium borate, Tincal

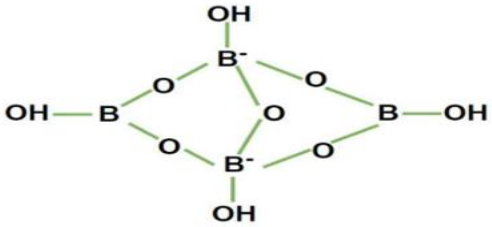

Fig no 7: Borax

Uses of Borax

- Used as an emulsifying agent in creams and cosmetics
- Acts as a buffering and stabilizing agent
- Used in pharmaceutical and topical preparations
- Helps improve texture and consistency of creams and ointments
- Used in cleansing and antiseptic formulations

Extraction Processes

i) Preparation of Aloe vera gel

Mature Aloe vera leaves were collected and washed thoroughly with distilled water to remove adhering impurities. After removal of excess surface moisture, the leaves were cut lengthwise with a sterile knife and the inner gel was carefully separated. The gel was collected in a clean container, homogenised to obtain a uniform mass and stored under appropriate conditions until use.

ii) Preparation of extract from Tulsi leaves

Tulsi leaves were collected, washed with distilled water and dried in a hot-air oven until a constant dry state was reached. The dried leaves were powdered finely. Accurately weighed Tulsi powder (0.5 g) was transferred to a Beaker , treated with 10 mL heated at 75 °C in water bath.

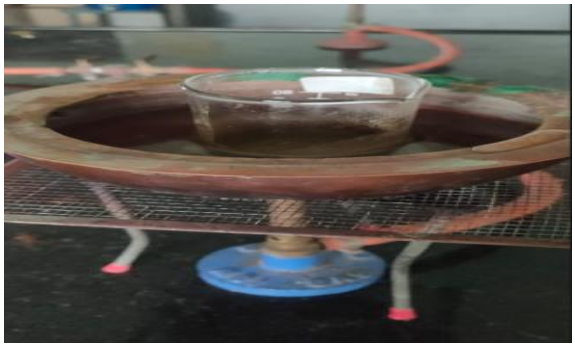

Fig no 8: Extraction of tulsi

iii) Extraction Of Pomegranate Peel

Pomegranate peels were collected, washed carefully with distilled water to remove dirt and dried in a hot-air oven until moisture was completely removed. The dried peel was powdered finely. Accurately weighed peel powder (2.5 g) was placed in a suitable Beaker and filtered to obtain heated at 75 °C in water bath.

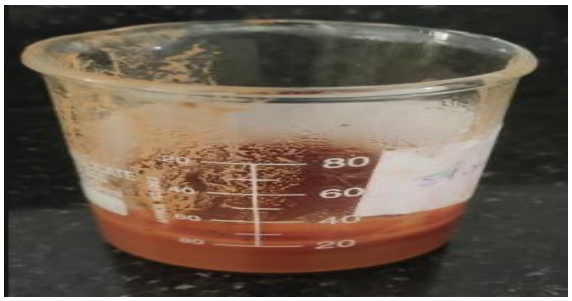

Fig no 9: Extraction of pomegranate peel

Formulation of Anti Acne Face Cream:

1) Liquid paraffin and beeswax were heated together in a borosilicate glass beaker and maintained at 75 °C to prepare the oil phase.

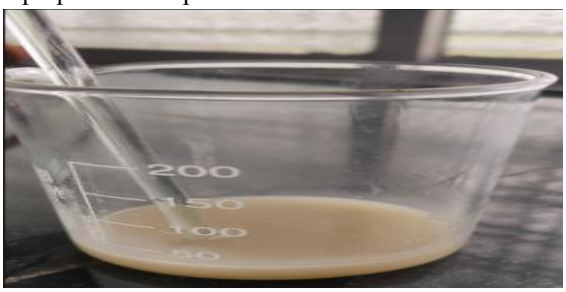

Fig no 10: Oil Phase

2) Borax and methylparaben were dissolved in purified water in a separate beaker and heated to 75 °C until a clear aqueous phase was obtained.

Fig no 11: Aqueous Phase

3) Required quantities of Aloe vera gel, pomegranate peel extract and Tulsi extract were incorporated into the base and stirred continuously until a homogeneous cream formed.

Fig no 12: stir cream

4) A few drops of rose water were added to give the cream a pleasant fragrance.
5) The cream was transferred onto a slab, and small quantities of distilled water were added as required. The mass was blended geometrically to achieve a smooth texture and uniform distribution of ingredients; this process is known as slab technique.

Fig no 13: Cream

6) Add Colouring agent

Fig no 14: Pomegranate Peel Cream

Evaluation of Cream:
Evaluation of Anti Acne Pomegranate peel cream was following: -
Physical evaluation formulate cream was further evaluated by using the following parameters such as physical parameter, colour, Odour, consistency, state of the preparation.
1. Colour: - The colour of anti-acne cream was recorded by visual inspection. The colour of cream is faint Pink.
2. Odor: - The Odor of cream was pleasant.
3. State: - State of cream was examined visually. The cream was solid in state.
4. Texture: - The texture of the cream was smooth.
5. Washability: - A small amount of cream was applied to a hand, and then it was washed with tap water to test how easily it could be removed.

Fig 15: Washability

6. pH: The pH of the cream was determined with a digital pH meter. Before measurement, the instrument was calibrated using standard buffer solutions. A small portion of cream was placed in a clean beaker, the electrode was immersed in the sample and the displayed pH was recorded.

Fig no 16: Ph of cream

V. RESULT AND DISCUSSION

The formulated herbal anti-acne cream containing pomegranate peel extract was successfully prepared and evaluated for its physicochemical properties, stability, and therapeutic potential. The results obtained from various evaluation parameters demonstrated that the formulation possessed acceptable characteristics suitable for topical application.

Table No 1: Organoleptic Properties of Cream Formulations (F1–F4)

Sr. no	Parameter	F1	F2	F3	F4
1	Colour	Light Pink	Light Pink	Light Pink	Light Pink
2	Odour	Pleasant smell	Pleasant smell	Pleasant smell	Pleasant smell

3	Texture	Uneven	Smooth	Smooth	Non grecy
4	State	Semisolid in nature	Semisolid in nature	Semisolid in nature	Semisolid in nature
5	Consistency	Non-Uniform	Uniform	Uniform	Highly Uniform

Organoleptic assessment of formulations F1-F4 was performed to judge appearance and user acceptability. All batches showed a light pink colour and pleasant odour, which supported their cosmetic acceptability for topical application.

F1 showed uneven texture and non-uniform consistency, probably because of inadequate mixing or an imbalance between the oil and aqueous phases. This batch therefore appeared less stable and less suitable for smooth application.

F2 and F3 showed semisolid consistency with smooth texture and uniform appearance, indicating proper emulsification and acceptable formulation quality. Their appearance and ease of use made them more appropriate for topical application than F1.

F4 produced a highly uniform, non-greasy cream, suggesting improved spreadability and better user acceptance. This non-greasy character is important for acne-prone skin because oily preparations can occlude pores and aggravate lesions.

On the basis of organoleptic properties, F4 was selected as the optimized formulation because it showed uniform consistency, pleasant appearance, semisolid nature and non-greasy texture, which are desirable in an herbal anti-acne cream.

2. pH Determination:

Table No 2: pH of Cream Formulations

Formulation	pH Value
F1	4.9
F2	5.2
F3	5.6
F4	5.9

The pH of each herbal anti-acne cream was determined using a digital pH meter. All formulations showed pH values within the acceptable range for topical skin preparations, namely 4.5-6.0.

The pH results were close to the normal skin range, suggesting suitability for topical use. F1 recorded the lowest pH value of 4.9, which may cause mild irritation or dryness in sensitive skin after prolonged application.

F2 and F3 showed pH values of 5.2 and 5.6, respectively. These values indicate better skin compatibility and a lower possibility of irritation while helping maintain the natural acidic environment of skin.

F4 showed a pH of 5.9, which was nearest to physiological skin pH and therefore most suitable for anti-acne topical use. Such a pH supports barrier function, reduces irritation risk and improves acceptability.

The pH evaluation indicated that all formulations were appropriate for topical use; however, F4 was considered the optimized batch because of its more skin-compatible pH

3. Viscosity:

Table No 3: Viscosity of Cream Formulations

Formulation	Viscosity (cP)
F1	1215
F2	1235
F3	1305
F4	1325

Viscosity of the formulated creams was determined using a Brookfield viscometer.

Viscosity increased progressively from F1 to F4. F1 had the lowest viscosity, indicating a thinner consistency that may reduce residence time on the skin. Although low-viscosity creams may spread easily, they can show comparatively lower physical stability.

F2 and F3 showed intermediate viscosity, improved consistency and suitable semisolid character. Their smoothness and ease of application are favourable for topical cream use.

F4 showed the highest viscosity, 1325 cP, indicating stronger consistency and improved stability. This viscosity may help the cream remain longer on the skin and thereby support anti-acne action. Its smooth, non-greasy texture further improves acceptability.

Overall, viscosity findings showed that all formulations had acceptable semisolid properties. F4 was considered optimized because it provided appropriate viscosity, better consistency and improved stability.

4. Spread ability:

Table No 4: Spread ability of Cream Formulations

Formulation	Spread ability (g/cm/sec)
F1	4.2
F2	4.8
F3	5.3
F4	6.1

Spread ability increased from F1 to F4. F1 showed the lowest value, indicating comparatively poor spreading and less smooth application, probably due to uneven texture and lower uniformity.

F2 and F3 exhibited moderate spread ability with satisfactory application behaviour. They spread more uniformly than F1, which may improve patient compliance and distribution of active constituents.

F4 showed the maximum spread ability value of 6.1 g.cm/sec, demonstrating excellent spreading and smooth application. Good spread ability allows the cream to be applied with minimal friction and enables uniform delivery of active constituents to the affected area. The non-greasy texture and high uniformity of F4 probably contributed to this result.

The spread ability study showed that all formulations could be used topically, but F4 was preferred because it gave the best spreading behaviour, smooth texture and patient acceptability.

VI. CONCLUSION

Pomegranate peel extract has important cosmetic and medicinal potential because it contains several phytochemicals with therapeutic activity. A herbal anti-acne cream prepared with this extract may help manage acne vulgaris through antimicrobial, antioxidant and anti-inflammatory mechanisms. Such herbal formulations may offer a safer and more economical alternative to synthetic anti-acne products, with fewer adverse effects and better patient compliance.

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