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## Research Article

# Formulation & Evaluation of *Aegle marmelos* Cream Scrub

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## ABSTRACT

A scrub is a topical formulation primarily utilized for exfoliation and skin cleansing, contributing to improved skin texture and appearance. These products are designed to enhance skin aesthetics and address specific dermatological concerns, including photoprotection, anti-acne effects, anti-aging properties, and reinforcement of the skin barrier. While synthetic ingredients provide notable therapeutic benefits, their potential environmental impact has driven increasing interest in herbal and naturally derived cosmetic formulations. Natural cosmetics are currently in high demand due to their dual functionality as both therapeutic agents and beauty enhancers. This study focused on the formulation and evaluation of a cream-based scrub incorporating *Aegle marmelos* (Bael) fruit extract and poppy seeds as key active ingredients. The primary objectives were to harness the antioxidant properties of *Aegle marmelos*, enhance exfoliation through the inclusion of poppy seeds, and develop a formulation with desirable physical and sensory attributes. The cream scrub was prepared using fresh *Aegle marmelos* extract and poppy seeds, along with excipients such as stearic acid, cetyl alcohol, coco glucoside, shea butter, coconut oil, ascorbic acid, essential oils, methylparaben, and distilled water. The final formulation was subjected to a series of physicochemical evaluations, including organoleptic characteristics (appearance and texture), pH determination, spreadability, and foamability. The results indicated that the developed cream scrub exhibited acceptable stability, favorable sensory properties, and met all the evaluated parameters. Thus, the formulated herbal cream scrub may serve as an effective skincare product, offering exfoliation, antioxidant activity, and potential cosmetic benefits for maintaining healthy and radiant skin.

## INTRODUCTION

The skin, the body's largest organ, plays a crucial role in providing a physical barrier against harmful environmental agents, regulating water loss, and

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maintaining immunological and homeostatic functions. For optimal physiological performance, particularly in the stratum corneum—the outermost layer—the skin requires adequate hydration, generally maintained at a minimum of 10% water content. This hydration is essential for preserving skin elasticity, structural integrity, and barrier function<sup>[1]</sup>

In addition to its physiological roles, skin health significantly influences an individual's aesthetic appearance and psychosocial well-being. Skin conditions such as dryness, rough texture, dullness, and premature aging are often manifestations of oxidative stress induced by reactive oxygen species (ROS). These free radicals can result from ultraviolet (UV) radiation, pollution, and other environmental stressors, leading to damage of cellular proteins, lipids, and DNA. Antioxidants play a pivotal role in counteracting oxidative damage by neutralizing ROS and supporting cellular repair mechanisms<sup>[2]</sup>

Although the human body produces endogenous antioxidants, their quantity is often insufficient to combat prolonged or excessive oxidative stress. Hence, exogenous supplementation through topical applications has gained attention as a supportive strategy for skin protection and rejuvenation. Among the various topical formulations, body scrubs serve a dual function: mechanical exfoliation of dead skin cells and enhancement of microcirculation, both of which contribute to improved skin texture and appearance

In recent years, there has been a paradigm shift in consumer preference toward natural and plant-based skincare products. This transition is fueled by growing concerns about the environmental and health impacts of synthetic ingredients. Consequently, research and development in the cosmetic and dermatological industries have

focused on botanical alternatives that offer bioactivity with minimal side effects and ecological footprint<sup>[3]</sup>

*Aegle marmelos* (Bael), a medicinal plant extensively used in Ayurvedic formulations, exhibits potent antioxidant properties attributed to its rich content of flavonoids, phenolic compounds, and vitamins. These constituents are known to protect against UV-induced oxidative stress, reduce inflammation, and support dermal regeneration. Despite its well-documented pharmacological potential, the application of *Aegle marmelos* in topical cosmetic formulations remains underexplored<sup>[4]</sup>

*Papaver somniferum* (poppy) seeds, on the other hand, are recognized for their gentle exfoliating capability and moisturizing benefits due to their natural oil content and fine granularity. These characteristics make them an ideal physical exfoliant for inclusion in body scrub formulations, particularly for sensitive or dry skin types

Given the synergistic potential of combining the antioxidant-rich *Aegle marmelos* with the exfoliating and emollient properties of poppy seeds, the present study aims to develop and evaluate a novel herbal cream scrub formulation. The formulation is designed to deliver enhanced antioxidant defence, effective exfoliation, and skin moisturization, while ensuring formulation stability and consumer acceptability. This investigation further aligns with the global trend of promoting sustainable, plant-based skincare solutions with reduced ecological impact<sup>[5]</sup>

## MATERIALS AND METHODS

### Plant Materials

The careful selection of plant-derived raw materials is a fundamental step in the development



of herbal cosmetic formulations, as the therapeutic and cosmetic efficacy of the final product depends largely on the bioactive phytoconstituents present. In the present study, two botanicals of high pharmacological and cosmetic relevance were employed: *Aegle marmelos* (commonly known as Bael) and *Papaver somniferum* (poppy seeds). Both species have a long history of use in traditional medicine systems and have been scientifically reported to possess skin-beneficial properties, making them suitable for incorporation into exfoliating and antioxidant-rich cosmetic products.

### 1. *Aegle marmelos* (Bael)

*Aegle marmelos* (L.), commonly known as Bael, is a culturally revered and medicinally significant plant belonging to the family Rutaceae. Native to the Indian subcontinent, it is a medium-sized, deciduous tree characterized by aromatic trifoliate leaves and greenish-yellow fruits. It thrives in dry forests, plains, and cultivated areas across India and other tropical regions of South and Southeast Asia. Ethnopharmacological records indicate that almost all parts of the plant—including the roots, bark, leaves, fruit, and seeds—are extensively used in Ayurvedic, Unani, and Siddha formulations for their diverse therapeutic applications.

In the context of skincare, *Aegle marmelos* leaves are particularly valued for their high content of bioactive phytoconstituents, such as flavonoids, tannins, saponins, alkaloids, and coumarins. These compounds have been scientifically reported to exhibit antioxidant, anti-inflammatory, antimicrobial, and wound-healing activities. Flavonoids, in particular, play a critical role in combating oxidative stress by neutralizing free radicals, thereby protecting skin cells from premature aging. Tannins provide astringent effects that help tighten skin pores, while alkaloids

and coumarins contribute to antimicrobial and photoprotective benefits<sup>[6]</sup>

Topical application of *Aegle marmelos* leaf extract has been associated with:

- Reduction of UV-induced oxidative damage and prevention of photoaging
- Soothing of skin irritation and reduction of erythema
- Acceleration of healing in minor cuts, abrasions, and infections
- Inhibition of microbial growth, making it beneficial for acne-prone skin
- Protection against environmental pollutants through antioxidant defense mechanisms

For the present formulation, *Aegle marmelos* leaf extract was obtained via ethanolic maceration to ensure efficient extraction of both polar and non-polar phytoconstituents. Ethanol was selected as the extraction solvent due to its broad-spectrum solubility, ability to preserve thermolabile compounds, and compatibility with cosmetic formulations. This extraction process enhances the bioactivity and stability of the final herbal cream scrub, ensuring its efficacy in delivering antioxidant protection, anti-inflammatory effects, and overall skin rejuvenation.

### 2. *Papaver somniferum* (Poppy Seeds)

*Papaver somniferum* L., a member of the family Papaveraceae, is an annual herbaceous plant cultivated globally for its seeds and medicinally relevant alkaloids<sup>[7,8]</sup>. The seeds are small, kidney-shaped, and oil-rich, with a long history of use in both culinary and therapeutic applications<sup>[7,9]</sup>. In topical cosmetic formulations, poppy seeds are recognized for their gentle exfoliating capability, owing to their fine granular texture, which facilitates the removal of dead skin cells without causing mechanical irritation or microtears<sup>[8,10]</sup>.



Poppy seeds are a valuable source of essential fatty acids, notably linoleic acid and oleic acid, which play a critical role in maintaining the skin barrier function and reducing transepidermal water loss (TEWL)<sup>[9,10]</sup>. They also provide micronutrients such as zinc, calcium, and magnesium, which are important for enzymatic processes involved in skin regeneration and repair<sup>[8,10]</sup>. Furthermore, the seeds contain natural antioxidants, including phenolic compounds and tocopherols, which help mitigate oxidative stress induced by ultraviolet radiation and environmental pollutants, thereby slowing the onset of premature skin aging<sup>[9,11]</sup>.

Due to their mild abrasive nature and nutrient profile, poppy seeds are particularly suitable for sensitive and dry skin types, offering effective exfoliation while simultaneously nourishing and softening the skin<sup>[10]</sup>. When incorporated into an herbal cream scrub alongside *Aegle marmelos* leaf extract, they contribute synergistically to a multifunctional cosmetic product that delivers exfoliation, hydration, antioxidant protection, and skin rejuvenation<sup>[8,9]</sup>.

For the present study, poppy seeds were sourced from authenticated suppliers, thoroughly cleaned, and gently processed to preserve their nutrient integrity<sup>[7]</sup>. The combination of *Aegle marmelos* and poppy seeds in the cream scrub reflects a targeted approach to herbal cosmetic formulation, emphasizing safety, efficacy, and alignment with clean and green cosmetic trends<sup>[8,10]</sup>.

### Preparation of *Aegle marmelos* Extract<sup>[12]</sup>

10 grams of market-purchased *Aegle marmelos* leaf powder was soaked in 100 mL of 70% ethanol in a sealed glass container. The mixture was stored at room temperature for 7 days, with occasional shaking during the maceration process. After the extraction period, the mixture was filtered first through muslin cloth and then through Whatman filter paper. The filtrate was concentrated using a water bath at 40–50 °C, followed by drying to obtain a semi-solid ethanolic extract. The extract was stored in an airtight container under refrigeration until use.

### Formulation and Development of Body Scrub

**Table I: Master formula of Cream Scrub**

Ingredients	F1	F2	F3	F4	F5
<i>Aegle marmelos</i> extract	3 gm	3 gm	2 gm	2 gm	2 gm
Poppy seeds	1.5 gm	1 gm	1 gm	1 gm	1 gm
Stearic acid	0.3 gm	0.3 gm	0.3 gm	0.3 gm	0.3 gm
Cetyl alcohol	0.3 gm	0.3 gm	0.3 gm	0.3 gm	0.3 gm
Shea butter	0.5 gm	0.4 gm	0.4 gm	0.4 gm	0.4 gm
Coco glucoside	1 ml	1 ml	1.5 ml	1 ml	1 ml
Coconut oil	1.5 ml	1 ml	1.5 ml	1 ml	1 ml
Emulsifying wax	0.5 gm	0.5 gm	0.6 gm	0.7 gm	0.7 gm
Ascorbic acid	-	-	-	0.5 gm	0.6 gm
Methyl paraben	0.1 gm	0.1 gm	0.1 gm	0.1 gm	0.1 gm
Essential oil	Q.S.	Q.S.	Q.S.	Q.S.	Q.S.
Distilled water	Upto 10ml	Upto 10 ml	Upto 10ml	Upto 10ml	Upto 10ml

### Preparation of Cream Scrub<sup>[13]</sup>

All ingredients were accurately weighed prior to the initiation of the formulation process. The

components were divided into two primary phases: oil phase and aqueous phase.



- **Oil Phase:** Stearic acid, cetyl alcohol, shea butter, coconut oil, emulsifying wax, and coco glucoside were transferred into a clean beaker and heated in a water bath to 70–75 °C. Continuous stirring was performed until complete melting and uniform blending of all constituents was achieved.
- **Aqueous Phase:** Distilled water was heated separately to 70–75 °C in another beaker. Aegle marmelos extract and ascorbic acid were dissolved into the heated distilled water with gentle stirring.

Once both phases reached the target temperature, the aqueous phase was slowly incorporated into the oil phase with continuous homogenization to obtain a stable emulsion. The mixture was allowed to cool to 45–50 °C, at which stage poppy seeds were incorporated to impart exfoliating properties. On further cooling to below 40 °C, methyl paraben (as a preservative) and essential oil (as a fragrance

agent) were added. The formulation was mixed until a uniform, smooth, and creamy texture was achieved. The finished cream scrub was then transferred into pre-sterilized containers and stored at ambient conditions for further evaluation.

### Evaluation Parameters

The prepared cream scrub was subjected to evaluation based on its physical and sensory attributes. The following parameters were assessed:

The organoleptic evaluation was conducted to assess the physical appearance of the formulation, including colour, odour, and consistency. The colour and consistency were examined visually under adequate lighting conditions, while the odour was assessed by olfactory perception to determine its acceptability.



Fig 1: Organoleptic properties

### pH Determination<sup>[14]</sup>

The pH of the formulated cream scrub was determined to assess its compatibility with the skin's natural pH range. A small quantity of the formulation was applied to pH indicator paper, and the value was recorded. The observed pH range of 5.0–6.0 falls within the acceptable limit for dermal preparations, ensuring minimal risk of irritation and optimal product stability.

### Spreadability Test<sup>[14]</sup>

Spreadability was evaluated to determine the ease of topical application and uniform distribution over the skin surface. Approximately 1 g of the formulation was placed at the center of a clean glass plate. Another glass plate was gently positioned over the sample and left undisturbed for 1 minute, after which the spread diameter was measured. Subsequently, a 50 g weight was applied to the upper plate, and the final spread diameter was recorded.



The spreadability coefficient (S) was calculated using the formula:

$$S = m \times l/t$$

As per cosmetic formulation standards, an ideal spreadability diameter of 5–7 cm indicates an optimal consistency that facilitates ease of application and consumer acceptability.

#### **Washability Test<sup>[15]</sup>**

Washability was assessed by applying a small amount of the scrub to the skin, followed by rinsing with water at ambient temperature. The ease and completeness of removal were qualitatively evaluated, which is essential for ensuring consumer satisfaction and practical usability.

#### **Skin Irritation Test<sup>[15]</sup>**

Dermal irritation potential was evaluated using the open patch test method. A defined quantity of the formulation was applied to a demarcated forearm area (2.5 × 2.5 cm) and allowed to dry. The test site was examined for erythema, edema, or other signs of irritation at 0, 24, 48, and 72 hours post-application. The absence of visible dermal reactions indicated good skin tolerance of the formulation.

#### **Foamability Test<sup>[16]</sup>**

Foamability was assessed to evaluate the product's ability to generate foam upon contact with water. A measured quantity of the scrub was mixed with water in a measuring cylinder and gently shaken. The height and stability of foam formation were recorded, providing an indication of surfactant efficiency and consumer perception attributes.

#### **Homogeneity Test<sup>[16]</sup>**

The homogeneity of the cream scrub was evaluated by applying 0.1 g of the formulation onto a clean glass slide and observing it visually under adequate illumination. A homogeneous preparation was characterized by the absence of aggregates, lumps, or phase separation, ensuring uniform texture and consistency throughout the batch.

#### **Acid Value Determination<sup>[17]</sup>**

The acid value, indicative of the free fatty acid content and formulation stability, was determined according to standard titrimetric procedures. A 10 g sample of the formulation was dissolved in 50 ml of a pre-neutralized (0.1 M KOH) 1:1 ethanol (95%):ether mixture. After complete dissolution, 1 ml of phenolphthalein indicator was added, and the mixture was titrated against 0.1 M KOH until a persistent faint pink endpoint was achieved.

The acid value was calculated using the equation:

$$\text{Acid Value} = 5.61 \times (n / w).$$

### **RESULT AND DISCUSSION:**

A cream scrub was successfully formulated using *Aegle marmelos* leaf extract and poppy seeds as natural exfoliants. The extract was prepared by macerating 10 g of leaf powder in 100 ml ethanol. The cream base of emulsifying wax, shea butter, coco glucoside, and coconut oil was blended with the extract and exfoliant to produce a smooth, stable formulation with uniform texture, even particle dispersion, and a pleasant herbal aroma. The product showed desirable cosmetic attributes and potential as a plant-based exfoliating skincare formulation.





Fig 2: Body scrub Cream Preparation

Table 2: Comparative Results of Evaluation Parameters of Different Batches of *Aegle marmelos* Scrub

Parameters	F1	F2	F3	F4	F5
Color	Brownish	Brown	Light brown	Dark Yellow	Yellow
Odor	Rancid	Rancid	Pungent	Floral	Floral
pH	6	4	6	5	5
Consistency	Hard	Oily	Runny	Thick	Smooth
Appearance	Dull	Dull	Faded	Glossy	Lustrous
Spreadability	6.34 g.cm/sec	6.50 g.cm/sec	6.50 g.cm/sec	6.66 g.cm/sec	6.66 g.cm/sec
Washability	Easily washable	Easily washable	Easily washable	Easily washable	Easily washable
Irritation	No irritation	No irritation	No irritation	No irritation	No irritation
Foamability	No foam	No foam	Slight foam	No foam	No foam
Homogeneity	Homogenous	Homogenous	Homogenous	Homogenous	Homogenous
Acid value	9.56 mg KOH/gm	9.67 mg KOH/gm	8.48 mg KOH/gm	7.91 mg KOH/gm	7.80 mg KOH/gm

The cream scrub formulations (F1–F5) were evaluated for various physicochemical parameters to identify the most suitable batch. All formulations exhibited a brown color, floral odor, and semi-solid consistency, indicating uniformity in base composition. Among them, formulation F5 demonstrated optimal characteristics in terms of safety, stability, aesthetics, and performance, and was therefore selected as the optimized formulation.

### STABILITY STUDY:

The stability of the formulated cream scrub was evaluated by storing the samples at different temperature conditions, namely low temperature (8 °C), Room temperature (25 °C), and High temperature (45 °C), for a specified period. The

formulations were monitored for changes in physical appearance, color, odor, texture, phase separation, and other physicochemical parameters to assess product stability under varying storage conditions<sup>[18]</sup>

Table 3: Stability Study of *Aegle marmelos* Cream Scrub at Low Temperature (8 °C)

Day	Color	Odor	Consistency
1	No change	No change	No change
15	No change	No change	No change
30	No change	No change	No change

Table 4: Stability Study of *Aegle marmelos* Cream Scrub at Room Temperature (25 °C)

Day	Color	Odor	Consistency
1	No change	No change	No change
15	No change	No change	No change
30	No change	No change	No change

**Table 5: Stability Study of *Aegle marmelos* Cream Scrub at High Temperature (45 °C)**

Day	Color	Odor	Consistency
1	No change	No change	No change
15	No change	No change	No change
30	No change	No change	No change

**DISCUSSION:**

In this study, five batches of *Aegle marmelos* cream scrub were formulated and evaluated. Among them, Batch F5 showed the most desirable results in terms of texture, spreadability, pH, grittiness, and washability. It had a smooth, creamy consistency and was gentle yet effective as an exfoliant.

The stability study of Batch F5 revealed no significant changes in physical appearance, pH, or texture over time, confirming its stability and shelf-life suitability. Thus, Batch F5 was identified as the optimized and stable formulation for herbal cream scrub development.

**FUTURE SCOPE:**

This formulation presents a strong foundation for further development. Future studies can include in vivo dermatological testing and long-term consumer satisfaction studies. The incorporation of additional herbal extracts like aloe vera, neem, or turmeric may enhance therapeutic value. There is also potential to develop a range of products using the same base, such as face scrubs, hand creams, and cleansing balms. Clinical testing and dermatological certifications would further strengthen its marketability.

**CONCLUSION:**

The formulated *Aegle marmelos* cream scrub demonstrated effective exfoliating, cleansing, and skin-conditioning properties, highlighting the potential of *Aegle marmelos* (bael) as a valuable herbal ingredient in natural cosmetic formulations.

The inclusion of *Aegle marmelos* leaf extract provided antioxidant and antimicrobial benefits, while natural exfoliants such as poppy seeds promoted gentle yet effective removal of dead skin cells. The cream base was optimized to ensure stability, desirable texture, and ease of application. Evaluation parameters, including pH, spreadability, and stability, confirmed the product's safety and suitability for topical use. Overall, the scrub offers a sustainable and skin-friendly alternative to synthetic exfoliants and aligns with current consumer preferences for clean and herbal skincare solutions.

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