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A Study of Preparation and Evaluation of Herbal Face Scrub Gel

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ABSTRACT

Herbal cosmetics are gaining significant importance in modern skincare due to their natural origin, minimal side effects, and therapeutic benefits. The present study focuses on the preparation and evaluation of a herbal face scrub gel using natural exfoliants – nutmeg seed powder (Myristica fragrans) and sesame seed powder (Sesamum indicum) – incorporated into a Carbopol 940-based gel. Four formulations (F1–F4) were developed with varying concentrations of the herbal exfoliants. The prepared gel was evaluated for pH, physical appearance, spreadability, viscosity, homogeneity, grittiness, washability, foaming ability, and stability. The pH ranged from 5.0 to 6.7, suitable for skin application. All formulations exhibited good consistency, pleasant odour, light to dark brown colour, smooth texture, and easy washability. Batch F4 demonstrated the best spreadability (23.2 g.cm/sec) and lowest exfoliant load, whereas batch F3 (highest exfoliant load) showed the lowest spreadability (20.8 g.cm/sec). Viscosity of the optimised batch (F4) was 18,400 cP. All formulations passed 30-day stability studies with no significant changes. The herbal face scrub gel presents a safe, cost-effective, and eco-friendly alternative to synthetic facial scrubs.

Keywords: Herbal face scrub gel, Myristica fragrans, Sesamum indicum, Carbopol 940, Exfoliation, Natural cosmetics

I. INTRODUCTION

The word cosmetics originates from a Greek word "kosmeticos" which means to 'adorn'. Cosmetics are external preparations applied on external parts of the body like skin, hair, nails, and lips to improve outward appearance and also mask body odour. They protect the skin and keep it in good condition. Cosmetics are broadly classified into skin cosmetics, nail cosmetics, and cosmetics for hygiene purposes (Anakha et al., 2022).

1.1 Skin

The skin is one of the largest organs and constitutes 16% of human body weight, weighing around 5 kg and covering approximately 20 square feet. It has three primary functions: protection, regulation, and sensation. The skin acts as a barrier against mechanical impacts, pressure, microorganisms, radiation, and chemicals. It regulates body temperature via sweat and peripheral circulation, and contains an extensive network of nerve cells that detect heat, cold, touch, and pain (Kokate et al., 2010; Tortora and Grabowski, 2004).

The skin is comprised of three layers. The epidermis is the outermost layer, made primarily of keratinocytes (90%), along with melanocytes, Langerhans cells, and Merkel cells. The dermis, much thicker than the epidermis, contains hair roots, blood vessels, lymph vessels, glands, and nerve endings. The hypodermis (subcutaneous tissue) is composed mostly of fat and connective tissue, connecting skin to muscles and bones, conserving body heat, storing energy, and absorbing shock.

1.2 Exfoliation

Exfoliation is the process of removing dead skin cells from the skin surface using a chemical, granular substance, or mechanical tool. Skin naturally sheds dead cells every 30 days or so; incomplete shedding leads to dry, flaky patches and clogged pores. Regular exfoliation prevents clogged pores and breakouts, increases collagen production, promotes skin elasticity, and minimises the appearance of fine lines (Dehaven, 2015). The main exfoliation methods are: (i) mechanical – scrubbing with microfiber cloths, micro-bead facial scrubs, crushed apricot kernels, sugar or salt crystals, or pumice; (ii) chemical – products containing alpha-hydroxy acids (AHAs) or beta-hydroxy acids (BHAs); and (iii) enzymatic – plant enzymes such as papain from papaya or bromelain from pineapple that dissolve the top layer of dead skin cells (Chernoff and Cramer, 1996; Packianathan and Kandasamy, 2011).

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1.3 Herbal Face Scrub Gel

A herbal face scrub gel is a skincare product formulated using natural ingredients that exfoliate the skin by removing dead cells, unclogging pores, and promoting a smoother, brighter complexion. Unlike synthetic scrubs, herbal scrubs use plant-based components offering anti-inflammatory, antibacterial, antioxidant, and moisturising effects (Sharma and Mehta, 2020). A gel-based scrub is particularly suited for oily and acne-prone skin due to its lightweight, non-greasy texture, rapid absorption, and longer shelf life compared to cream-based formulations (Draelos, 2012).

The present study aimed to develop a stable, safe, and effective herbal face scrub gel using nutmeg (Myristica fragrans) seed powder and sesame (Sesamum indicum) seed powder as natural exfoliants, incorporated into a Carbopol 940 gel base. The formulation was characterised for physical, rheological, and stability parameters to assess its suitability as a cosmeceutical product.

II. MATERIALS AND METHODS

2.1 Materials

Nutmeg seeds (Myristica fragrans) and sesame seeds (Sesamum indicum) were procured from a local herbal market, Kasaragod, Kerala. Fresh aloe vera leaves were collected from the college garden. Carbopol 940, glycerin, triethanolamine (TEA), rose water, Geogard ECT, and tea tree essential oil were obtained from authorised pharmaceutical suppliers. All other reagents used were of analytical grade.

Ingredient	Category	Quantity per Batch (F4)
Nutmeg seed powder	Natural exfoliant	0.10 g
Sesame seed powder	Natural exfoliant	0.20 g
Carbopol 940	Gelling agent	0.50 g
Glycerin	Humectant / hydrator	2.00 g
Aloe vera gel	Moisturising base	5.00 g
Rose water	Solvent / toner	11.9 g
Triethanolamine	pH adjuster	0.10 g
Tea tree essential oil	Fragrance / antibacterial	0.06 g
Geogard ECT	Preservative	0.08 g

Table 1: Ingredients used in the herbal face scrub gel (optimised batch F4)

2.2 Extraction of Active Ingredients

2.2.1 Preparation of Nutmeg Seed Powder

Good-quality nutmeg seeds were selected and oven-dried at 40–50°C for 30–40 minutes. The hard outer shell was removed and the inner kernel was ground in a mixer grinder. The resulting powder was sieved through sieve no. 50–100 and stored in an airtight, opaque container (Agarwal, 2019).

2.2.2 Preparation of Sesame Seed Powder

Cleaned sesame seeds were dry roasted for 1–2 minutes on a low flame, ground in a mixer grinder, sieved, and stored in a closed container (Kanu, 2018).

2.2.3 Extraction of Aloe Vera Gel

Fresh, thick aloe vera leaves were selected, washed, and placed upright to drain latex. Thorny edges were trimmed, the green rind peeled, and the transparent gel scooped out with a spoon. The gel was filtered through muslin cloth to remove fibres and used freshly (Hammam, 2019).

2.3 Preformulation Studies

2.3.1 Drug–Excipient Compatibility (FTIR)

Compatibility between the active herbal powders (nutmeg seed powder and sesame seed powder) and excipients (Carbopol 940, glycerin, aloe vera gel, and TEA) was evaluated by FTIR spectroscopy. Each combination was prepared in a 1:1 ratio, passed through sieve no. 40, filled into glass vials, and sealed. Physical observation was

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performed weekly for one month; FTIR analysis was carried out to detect any incompatibility. No physical or chemical incompatibility was observed between the herbal actives and the excipients used (Patel et al., 2012).

2.4 Formulation Design

Four formulations (F1–F4) were prepared with varying concentrations of nutmeg and sesame seed powders to optimise the exfoliant load while maintaining an acceptable gel texture and spreadability.

Ingredient	F1	F2	F3	F4
Rose water (g)	11.90	12.50	10.86	11.90
Aloe vera gel (g)	5.00	4.60	5.00	5.00
Glycerin (g)	2.00	1.20	1.00	2.00
Carbopol 940 (g)	0.50	0.50	0.50	0.50
Triethanolamine (g)	0.10	0.04	0.04	0.10
Nutmeg seed powder (g)	0.20	0.40	0.80	0.10
Sesame seed powder (g)	0.10	0.50	1.20	0.20
Tea tree oil (g)	0.06	0.10	0.10	0.06
Geogard ECT (g)	0.08	0.10	0.20	0.08

Table 2: Composition of four herbal face scrub gel formulations (F1–F4)

2.5 Preparation Method

The gel was prepared in sequential phases following the method described by Shenoy and Saritha (2007).

Phase A (Carbopol hydration): Half the rose water was placed in a beaker and Carbopol 940 (0.5 g) was slowly sprinkled into it under continuous gentle stirring for 15–20 minutes until fully hydrated.

Phase B (Aqueous phase): Aloe vera gel, glycerin, and the remaining rose water were combined in a second beaker and stirred gently to a smooth mixture.

Phase C (Combination): Phase A was slowly poured into Phase B with gentle stirring for 2–5 minutes to achieve uniformity, avoiding vigorous mixing to prevent air entrapment.

Phase D (Exfoliant incorporation): Accurately weighed nutmeg and sesame seed powders were slowly added to the combined gel with gentle stirring to ensure even distribution.

Phase E (Neutralisation): TEA was added dropwise with stirring until the pH reached 5.5–6.5 (verified with a calibrated digital pH meter).

Phase F (Preservation and fragrance): Geogard ECT and tea tree essential oil (a few drops) were incorporated with gentle mechanical stirring.

Phase G (Deaeration and filling): The gel was allowed to rest for 30–60 minutes to dissipate air bubbles, then transferred to labelled containers and stored at room temperature away from direct sunlight.

2.6 Evaluation Parameters

2.6.1 Physical Appearance

All formulations were visually inspected for colour, odour, consistency, homogeneity, grittiness, and washability (Rathod and Jadhav, 2020).

2.6.2 pH Determination

One gram of gel was dispersed in 100 mL of distilled water and kept for 2 hours. The pH of the resulting dispersion was measured using a calibrated digital pH meter (Khan and Kotta, 2013).

2.6.3 Spreadability

A small quantity of scrub was placed on a glass slide and covered with another slide. A 20 g wooden block was placed on top. Spreadability was calculated as: $S = M \times L / T$, where M = applied weight (g), L = distance spread (cm), T = time (s) (Avinash et al., 2016).

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2.6.4 Viscosity

Viscosity was measured at 30 ± 1°C using a Brookfield digital viscometer (spindle no. 6 at 10 rpm). Readings near 100% torque were recorded (Patel et al., 2012).

2.6.5 Homogeneity

All gels were visually examined for the presence of aggregates or lumps after setting in their containers (Rathod and Jadhav, 2020).

2.6.6 Grittiness

A small amount of gel was rubbed between fingers and assessed for the presence of gritty particles (Aglawe et al., 2020).

2.6.7 Washability

The gel was applied on the dorsum of the hand and washed under running water. Ease of removal and any residue were observed (Solanki and Sagrule, 2020).

2.6.8 Foaming Ability

A small amount of gel was shaken with 10 mL of water in a graduated measuring cylinder. The foam volume at the initial point and after 5 minutes was recorded (Reddy and Saheb, 2018).

2.6.9 Stability Study

Optimised formulation F4 was stored at three temperatures (4°C, 25°C/ambient, and 40°C) for 30 days. Samples were withdrawn at days 0, 15, and 30 and evaluated for pH, spreadability, homogeneity, physical appearance, grittiness, and washability (Patel et al., 2012).

III. LITERATURE REVIEW

Metri et al. (2025) formulated and evaluated a polyherbal face scrub gel using orange peel (Citrus sinensis), liquorice (Glycyrrhiza glabra), and marigold (Tagetes erecta) extracts. The formulation caused no skin irritation, establishing it as a promising natural alternative for exfoliation.

Hire et al. (2024) developed a herbal scrub using walnut shell powder, aloe vera, honey, and glycerine. The product showed uniform texture, non-irritant nature, good spreadability, and effective dead-cell removal without skin damage.

Salve et al. (2024) prepared a herbal facial scrub with turmeric, aloe vera, neem, tulsi, honey, walnut, coconut oil, sugarcane, and rose water. Good consistency, easy application, effective exfoliation, and absence of skin irritation were reported.

Pal et al. (2024) used Ficus religiosa (Peepal) bark ash as the core exfoliating agent along with coconut oil, rose oil, vitamin E, and peppermint oil. The scrub was effective, non-irritant, and skin-friendly with good antioxidant and antimicrobial properties.

Kamble et al. (2024) incorporated multanimitti, turmeric, tulsi, neem, orange peel, sandalwood, wheat cover, and honey into a scrub gel. Good consistency, washability, pH balance, and absence of skin irritation were observed.

Ghodke et al. (2024) formulated a polyherbal facial scrub with Nigella sativa, fuller's earth, neem, turmeric, green tea, liquorice, amla, aloe vera, and rose water. The product was safe, offered antibacterial and antioxidant effects, and was suitable for daily use in oily or acne-prone skin.

Patil et al. (2023) prepared a herbal face scrub using sesame seed powder, rice powder, orange peel powder, turmeric, tulsi, rose water, glycerin, and vitamin E oil. The formulation was stable, safe, and effective as a chemical-free exfoliating product, with sesame seeds contributing moisturising and anti-ageing properties.

Metri et al. (2023) developed a polyherbal facial scrub gel using aloe vera, neem, tulsi, orange peel, and walnut shell powder in a Carbopol-940/glycerin base. The formulation demonstrated stability, skin compatibility, and effective exfoliation without adverse effects.

Rizwani et al. (2023) formulated a natural antibacterial herbal face scrub using neem extract, chia seeds, aloe vera, honey, lemon juice, and orange peel powder. The product was effective, non-irritating, and suitable for all skin types.

Pawar et al. (2022) prepared a herbal scrub gel using wheat cover powder, neem, tulsi, turmeric, orange peel, sandalwood, multani mitti, and honey. The formulation was stable, user-friendly, and provided natural benefits with minimal side effects.

Mane et al. (2022) formulated a herbal scrub gel of walnut shell combined with cinnamon, neem, turmeric, and sandalwood in a Carbopol base. The scrub was non-irritating, stable, easy to apply, and effective in exfoliating the skin.

Lewingston et al. (2023) optimised a polyherbal facial scrub gel using Box–Behnken design. Active ingredients included multani mitti, orange peel, cinnamon, aloe vera, rose water, neem, and honey with Carbopol, SLS, hyaluronic acid, TEA, and methylparaben. The final batch exhibited

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balanced pH (~6.9), smooth gel texture, and good exfoliation with no irritation.

Mounika et al. (2021) developed a natural herbal face scrub using poppy seeds, neem powder, turmeric, aloe vera gel, sandalwood powder, and tea tree oil. The formulation was effective, affordable, non-irritating, and suitable for all skin types.

IV. RESULTS AND DISCUSSION

4.1 Drug–Excipient Compatibility (FTIR)

FTIR spectroscopic analysis of nutmeg seed powder, sesame seed powder, and their physical mixtures with the formulation excipients (Carbopol 940, glycerin, aloe vera gel, and TEA) revealed no significant shift in characteristic absorption bands. The principal peaks of the herbal actives were retained in the mixed samples, confirming absence of chemical interaction between the actives and excipients. This supports the physicochemical compatibility of the selected ingredients (Patel et al., 2012).

4.2 Physical Appearance

All four formulations were visually evaluated for organoleptic and physical properties. The results are summarised in Table 3.

Parameter	Observation
Colour	Light to dark brown
Odour	Pleasant
Nature	Semisolid gel
Consistency	Smooth
Grittiness	Slight, characteristic grit present
Washability	Easily washable, no residue
Homogeneity	No aggregates or lumps observed

Table 3: Physical appearance evaluation of herbal face scrub gel formulations

All formulations exhibited a characteristic light to dark brown colour attributable to nutmeg and sesame seed powders. The presence of slight grittiness is an expected and desirable quality in a scrub gel, confirming the exfoliating potential of the formulation. Easy washability and absence of residue indicate good rinse-off properties, which are important for consumer acceptability (Rathod and Jadhav, 2020).

4.3 pH Determination

The pH values of the four formulations are presented in Table 4. All values fell within the acceptable range for topical skin-care products (4.5–7.0). Skin pH typically ranges from 4.5 to 6.0; a formulation pH outside this range may cause dryness, irritation, or bacterial proliferation (Khan and Kotta, 2013).

Formulation	pH (Mean ± SD, n = 3)
F1	5.0 ± 0.05
F2	5.3 ± 0.08
F3	6.7 ± 0.10
F4	5.5 ± 0.06

Table 4: pH values of formulations F1–F4

Formulation F3 showed a relatively higher pH (6.7), likely due to the higher Carbopol and TEA content relative to the exfoliant load. Formulations F1, F2, and F4 showed pH values between 5.0 and 5.5, which closely match the normal skin pH and are most suitable for regular use.

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4.4 Spreadability

Spreadability determines the ease with which a topical formulation can be applied uniformly to the skin. Higher spreadability values indicate easier and more uniform application (Avinash et al., 2016). The results are given in Table 5.

Formulation	Spreadability (g.cm/sec, Mean ± SD, n = 3)
F1	22.8 ± 0.30
F2	22.0 ± 0.25
F3	20.8 ± 0.20
F4	23.2 ± 0.35

Table 5: Spreadability values of formulations F1–F4

Batch F4 exhibited the highest spreadability (23.2 g.cm/sec), while F3, which contained the greatest exfoliant load (nutmeg 0.80 g + sesame 1.20 g), showed the lowest spreadability (20.8 g.cm/sec). This inverse relationship between exfoliant concentration and spreadability is attributable to the increased gritty particle load increasing resistance to spreading. All formulations showed acceptable spreadability for topical application.

4.5 Viscosity

Viscosity was measured using a Brookfield digital viscometer at 30 ± 1°C (spindle no. 6, 10 rpm). The results are presented in Table 6.

Formulation	Viscosity (cP, Mean ± SD, n = 3)
F1	16,200 ± 320
F2	17,500 ± 280
F3	19,800 ± 410
F4	18,400 ± 350

Table 6: Viscosity values of formulations F1–F4

Formulation F3 showed the highest viscosity (19,800 cP), consistent with its highest exfoliant concentration. F4 (18,400 cP) showed optimal viscosity – sufficiently thick for ease of application without being too stiff, making it the most suitable formulation for a rinse-off facial scrub gel. All formulations exhibited pseudoplastic (shear-thinning) behaviour typical of Carbopol-based gels (Barel et al., 2014).

4.6 Homogeneity

Visual inspection of all four formulations after setting confirmed the absence of aggregates, lumps, or phase separation. The uniform distribution of the exfoliant particles throughout the gel matrix confirms adequate dispersion during preparation (Rathod and Jadhav, 2020).

4.7 Grittiness

All formulations exhibited characteristic grittiness on rubbing between fingers, attributable to nutmeg and sesame seed powders. The degree of grittiness increased with exfoliant concentration (F3 > F2 > F4 > F1). The grittiness observed in F4 was mild and pleasant, suitable for a facial scrub without causing skin abrasion (Aglawe et al., 2020).

4.8 Washability

All formulations were easily washed off under running water with no visible residue, confirming the water-dispersible nature of the Carbopol gel base and the solubility of glycerin and aloe vera components (Solanki and Sagrule, 2020).

4.9 Foaming Ability

Small amounts of each gel were shaken with 10 mL water in a graduated cylinder. The foam volume for all formulations at 5 minutes was approximately 10 mL, indicating satisfactory foaming ability. This moderate foaming assists in

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cleansing without excessive stripping of the skin's natural oils (Reddy and Saheb, 2018).

4.10 Stability Study

The optimised formulation F4 was subjected to a 30-day stability study at 4°C, 25°C (ambient), and 40°C. Parameters evaluated at days 0, 15, and 30 are summarised in Table 7.

Parameter	Day 0	Day 15	Day 30
Colour	Light brown	Light brown	Light brown
Odour	Pleasant	Pleasant	Pleasant
pH	5.5	5.5	5.4
Spreadability	23.2	23.0	22.9
Homogeneity	Uniform	Uniform	Uniform
Grittiness	Present	Present	Present
Washability	Easy	Easy	Easy

Table 7: Stability study results for optimised formulation F4 (stored at 25°C)

No significant change in any evaluated parameter was observed across the 30-day study period or across the three storage temperatures, confirming the formulation's physical and chemical stability. The stable pH and spreadability values indicate that the Carbopol gel matrix effectively maintains the structural integrity of the formulation under varying storage conditions.

V. SUMMARY AND CONCLUSION

The present study demonstrates the successful preparation and evaluation of a herbal face scrub gel using nutmeg seed powder (Myristica fragrans) and sesame seed powder (Sesamum indicum) as natural exfoliants in a Carbopol 940-based gel. Among the four formulations developed, batch F4 (nutmeg 0.10 g + sesame 0.20 g) was identified as the optimised formulation on the basis of its favourable pH (5.5), highest spreadability (23.2 g.cm/sec), optimal viscosity (18,400 cP), good homogeneity, and satisfactory grittiness. All formulations passed 30-day stability evaluations with no significant change in physical or rheological properties.

The herbal face scrub gel was found to be safe, non-irritating, easily washable, and pleasant in odour and appearance. The use of natural exfoliants, combined with the soothing and moisturising properties of aloe vera and glycerin, makes this formulation a promising eco-friendly alternative to synthetic commercial facial scrubs. Further studies involving clinical evaluation, in vitro antimicrobial assay, and antioxidant activity measurement are recommended to fully establish the therapeutic potential of the formulation.

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