



Research Article

Formulation and Evaluation of Cosmetic Herbal Face Pack for Glowing Skin

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The escalating demand for natural, safe, and efficacious skincare formulations has driven extensive research into herbal cosmetics as viable alternatives to synthetic products. This comprehensive study presents the formulation and multi-parameter evaluation of a polyherbal face pack designed to promote skin radiance, cleansing, and rejuvenation. The formulation was meticulously developed using seven carefully selected herbal ingredients: Multani Mitti (Fullers Earth), Curcuma longa (Turmeric), Aloe barbadensis (Aloe Vera), Trigonella foenum-graecum (Fenugreek/Methi), Coffea arabica (Coffee Powder), Hibiscus rosa-sinensis (Hibiscus), and Rosa indica (Rose Powder). These ingredients were incorporated in specific proportions to achieve synergistic therapeutic benefits encompassing cleansing, antioxidant, anti-inflammatory, and moisturizing properties. The prepared formulations (F1, F2, F3) underwent rigorous physicochemical, organoleptic, and dermatological evaluation. Assessment parameters included pH measurement, loss on drying (LOD), ash content determination, bulk and tapped density, angle of repose and spreadability analysis. Results demonstrated that F2 formulations exhibited pH values within the skin-compatible range (6.5-6.8), excellent physical appearance with free-flowing properties, smooth texture, and superior spreadability. Significantly, no irritation, erythema, or edema was observed in any formulation during safety testing, confirming excellent dermatological tolerance. Stability studies conducted at $37 \pm 2^\circ\text{C}$ over 30 days revealed no significant degradation in organoleptic or physicochemical properties. This research validates the potential of polyherbal formulations as effective, economical, and environmentally sustainable topical drug delivery systems that can provide comprehensive skin benefits without synthetic additives, supporting their commercial viability and broader adoption in the natural cosmetics industry.

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INTRODUCTION

The human skin, serving as the body's largest organ and primary interface with the external environment, plays multifaceted roles encompassing protection, thermoregulation, and sensory perception. Beyond its physiological functions, the skin profoundly influences aesthetic perception and psychological well-being, making skincare an integral component of personal hygiene and self-care practices globally. Historically, the pursuit of youthful, radiant, and blemish-free skin has transcended cultural boundaries, representing a universal aspiration across diverse civilizations and temporal periods [1].

The contemporary cosmetics industry reflects an exponential surge in consumer demand for skincare products, particularly those derived from natural or herbal sources. This paradigm shift represents a fundamental departure from the dominance of synthetic cosmetics that, despite their efficacy in addressing specific dermatological concerns, often carry significant drawbacks including potential allergic reactions, skin irritation, organ-level toxicity, and cumulative adverse effects from prolonged exposure to synthetic preservatives and chemical dyes.

Limitations of Synthetic Cosmetics

Synthetic cosmetics, while engineered to deliver rapid visible results through potent chemical actives, present considerable safety concerns:

- Potential sensitization and allergic contact dermatitis

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- Long-term accumulation of chemical residues in bodily tissues
- Environmental persistence and bioaccumulation
- Endocrine disruption from certain chemical constituents
- Inadequate long-term safety data for emerging synthetic compounds

Emergence of Herbal Cosmetics

In response to these limitations, there has been a remarkable resurgence of interest in herbal and plant-derived cosmetics. These formulations leverage naturally occurring bioactive compounds that have demonstrated safety through centuries of traditional use while offering modern scientific validation. The transition toward herbal cosmetics represents not merely a trend but a fundamental recognition of nature's therapeutic potential when integrated with contemporary pharmaceutical science [2, 3].

Ayurvedic Perspective on Skin Health

Ancient Indian medicine systems, particularly Ayurveda, present a sophisticated understanding of skin health integrated within holistic frameworks of wellness. Ayurveda attributes most cutaneous disorders to blood impurities (raktadushti) resulting from inappropriate dietary choices and lifestyle practices [4]. The classical Ayurvedic preparation known as "Mukha Lepa" or facial mask exemplifies this therapeutic philosophy. Mukhalepana—the Ayurvedic equivalent of modern facial treatments—involves applying finely powdered herbal pastes mixed with natural vehicles (milk, rose water, honey) to the facial skin to purify, detoxify, and restore natural luminosity while harmonizing the three doshas (biological energies).

Natural Herbal Ingredients: Mechanism and Rationale

The fundamental advantage of herbal cosmetics resides in their multifaceted mechanism of action, wherein various plant-derived constituents work synergistically through complementary pathways:

Cleansing and Pore Unclogging: Natural mineral-rich clays absorb excess sebum, dead epithelial cells, and environmental contaminants while gently exfoliating the skin surface [5].

Anti-inflammatory and Antioxidant Action: Polyphenolic compounds and alkaloids in herbal ingredients neutralize reactive oxygen species, reduce pro-inflammatory cytokine production, and modulate inflammatory responses at the cellular level.

Wound Healing and Tissue Regeneration: Growth-promoting compounds enhance fibroblast activity, collagen synthesis, and epithelialization of damaged tissue.

Hydration and Moisturization: Natural humectants and emollients maintain the stratum corneum hydration, preventing transepidermal water loss and preserving skin barrier integrity.

Antimicrobial Protection: Essential oils and phenolic compounds suppress pathogenic microorganism growth, particularly acne-causing bacteria like *Cutibacterium acnes* (formerly *Propionibacterium acnes*) [6].

Mechanism of Action

Multi-Mechanism Therapeutic Model

When applied to the facial skin surface, herbal face packs operate through multiple complementary mechanisms, each contributing to overall efficacy:

Sebum Absorption and Pore Cleansing

Mineral-based clays, particularly montmorillonite minerals present in Multani Mitti, possess exceptional absorptive capacity based on their crystalline lattice structure. These materials absorb excess sebum, sweat, and hydrophobic toxins accumulated on the skin surface and within pilosebaceous units. The absorption mechanism occurs through van der Waals interactions and electrostatic attraction between the negatively charged clay minerals and positively charged organic compounds, effectively unclogging pores and reducing comedone formation [7].

Anti-inflammatory and Antioxidant Effects

Herbal constituents including curcumin (from turmeric) and anthocyanins (from hibiscus) penetrate upper epidermal layers where they scavenge reactive oxygen species (ROS) and inhibit pro-inflammatory signaling pathways. These polyphenolic compounds downregulate nuclear factor-kappa B (NF-κB) activation, thereby suppressing production of inflammatory cytokines (IL-6, TNF-α, IL-8) responsible for erythema, edema, and acne pathogenesis [8].

Exfoliation and Cell Renewal

Physical exfoliants such as coffee powder and rose petals gently remove desquamating stratum corneum cells (keratin debris), promoting the natural cellular turnover process (approximately 28-40 days in healthy skin). This mechanical exfoliation prevents accumulation of dead cells that would otherwise dull complexion and promote bacterial growth within occluded follicles. Stimulated cell turnover simultaneously enhances dermal microcirculation, increasing oxygen and nutrient delivery to viable skin layers [9].

Hydration and Moisture Retention

Hydrating ingredients including aloe vera gel (rich in polysaccharides and mucopolysaccharides) and rose water function as natural humectants, drawing moisture from deeper dermal layers into the stratum corneum. These substances form a temporary occlusive layer that reduces transepidermal water loss

(TEWL), maintaining optimal skin hydration and promoting a smooth, supple appearance [10].

Wound Healing and Tissue Regeneration

Amino acids, vitamins, and bioactive polysaccharides present in aloe vera and methi stimulate fibroblast proliferation and collagen synthesis, accelerating wound healing processes and reducing scar appearance. These compounds also upregulate expression of growth factors including transforming growth factor-beta (TGF- β) and vascular endothelial growth factor (VEGF) [11-13].

Antimicrobial and Antifungal Protection

Essential oil components and phenolic compounds exert bacteriostatic and fungistatic effects through multiple mechanisms including cellular membrane disruption, enzyme inhibition, and nucleic acid damage. These properties are particularly important for acne management, wherein they suppress *Cutibacterium acnes* proliferation [14].

MATERIALS AND METHODS

Materials and Botanical Sources

Table 1: Botanical Sources and Chemical Composition of Herbal Ingredients

S.No	Ingredient	Botanical Source	Chemical Composition	Role in Formulation
1.	Multani Mitti	Fullers Earth (Hydrated Aluminium Silicate)	Montmorillonite, Kaolinite	Base, Oil Absorber, Cooling
2.	Turmeric	<i>Curcuma longa</i> Rhizome	Curcumin, Demethoxycurcumin	Antiseptic, Anti-inflammatory
3.	Aloe Vera Powder	<i>Aloe barbadensis</i> Leaf Gel	Anthracene, Isobabolin, Aloe Glycosides	Moisturizer, Anti-aging Agent
4.	Coffee Powder	<i>Coffea arabica</i> Seeds	Caffeine, Tannins, Chlorogenic Acids	Natural Exfoliant, Anti-cellulite
5.	Methi (Fenugreek)	<i>Trigonella foenum-graecum</i> Seeds	Diosgenin, Proteins, Fiber	Anti-acne, Anti-aging
6.	Hibiscus Powder	<i>Hibiscus rosa-sinensis</i> Flowers	Anthocyanins, Citric Acid, Ascorbic Acid	Antioxidant, Moisturizing
7.	Rose Powder	<i>Rosa indica</i> Petals	Anthocyanins, Essential Oils	Aroma, Cooling, Anti-aging

Equipment Utilized

The following equipment and apparatus were employed for formulation preparation, evaluation, and testing:

- Analytical balance (accurate to ± 0.001 g) for precise ingredient quantification
- pH meter (digital, calibrated to ± 0.05 pH units) for pH determination
- Stability chamber ($37 \pm 2^\circ\text{C}$) for shelf-life and stability studies
- Oven (100°C - 105°C) for loss-on-drying determinations

Preparation Method:

All herbal ingredients were procured from authenticated Ayurvedic suppliers with certified quality documentation. Ingredients underwent thorough washing and shade-drying for 7-14 days to achieve standardized moisture content. Each ingredient was individually pulverized using mortar and pestle, then sequentially passed through mesh 120 sieve to achieve uniform particle size (150 micrometers or smaller).

Geometric mixing protocol was employed to ensure homogeneous distribution of ingredients: First, ingredients comprising 50% or more of total weight were mixed for 5 minutes. Subsequently, remaining ingredients were added incrementally in geometric progression, with thorough mixing after each addition. The final homogeneous powder was transferred to air-tight, light-protected containers (amber glass bottles) and stored at room temperature ($25\pm 2^\circ\text{C}$) until evaluation [15-17].

Formulation Composition and Preparation

Table 2: Formulation Composition of Three Herbal Face Pack Batches

Ingredient	Formulations		
	F1 (g)	F2 (g)	F3 (g)
Multani Mitti	20	18	18
Turmeric Powder	10	10	11
Aloe Vera Powder	3	3	3
Methi Powder	5	5	5
Coffee Powder	5	5	5
Hibiscus Powder	4	4	4
Rose Powder	3	5	4
Total Weight	50	50	50

Evaluation Parameters and Methodologies

Organoleptic Evaluation

Appearance: Visual assessment of formulation character (powder, solid, semi-solid) and physical integrity.

Color: Descriptive determination of color characteristics and any color changes during storage.

Odor: Olfactory assessment of characteristic aroma and any unpleasant or rancid odors.

Texture: Tactile evaluation of formulation texture (fine, grainy, smooth) when rubbed between fingers.

Smoothness: Assessment of formulation smoothness when applied to skin [18-20].

Physicochemical Evaluation

pH Determination: One percent (w/v) aqueous dispersion of formulation was prepared, and pH was measured using calibrated pH meter at room temperature. Skin-compatible pH range is 6.5 ± 0.2 .

Loss on Drying (LOD): An Approximately 3 gram of powdered formulation was accurately weighed into a pre-weighed porcelain dish. The sample was dried in an oven at $100-105^\circ\text{C}$ until constant weight was achieved (consecutive weighings differing by ≤ 0.5 mg). Moisture content was calculated as percentage weight loss.

Ash Value Determination: Two to four grams of dried, powdered material was accurately weighed into a platinum or silica crucible. Material was ignited gradually at $500-600^\circ\text{C}$ until complete carbon elimination (white residue) was achieved. Residue was cooled in desiccator and weighed. Total ash content was calculated in mg per gram of dried material.

Acid Insoluble Ash: Total ash was treated with 25 mL distilled water and boiled for 5 minutes. Insoluble matter was collected on sintered glass crucible, washed with hot water, and ignited for 15 minutes at $\leq 450^\circ\text{C}$. Acid insoluble ash content was calculated as difference between total ash and water-soluble residue.

Bulk Density: Required powder quantity was dried and filled in 50 mL measuring cylinder to 50 mL mark. Cylinder was dropped onto hardwood surface from 1-inch height at 2-second intervals until constant volume was achieved. Powder was weighed and bulk density calculated as mass/volume ratio.

Tapped Density: Measuring cylinder containing powder was mechanically tapped for 1 minute until negligible volume change was observed. Tapped density was calculated as mass/final volume ratio and expressed as g/cm^3 .

Angle of Repose: Dried powder was placed in cylindrical tube (open at both ends) positioned on horizontal surface. Funnel was raised to form heap, and height and radius were measured. Angle of repose was calculated using formula:

$$\tan^{-1}(h/r), \quad (1)$$

Where h = heap height, r = heap radius base.

Spreadability Evaluation

A precision-controlled quantity of formulation (1 gram) was placed on center of glass plate ($10\text{ cm} \times 10\text{ cm}$). Formulation was allowed to spread naturally at room temperature for 1 minute. Spread diameter was measured in millimeters. Maximum spread diameter indicates optimal

spreadability characteristics for ease of application.

Stability Studies

Prepared formulations were stored in amber glass bottles at $37\pm 2^\circ\text{C}$ and $75\pm 5\%$ relative

humidity for 30 days. Organoleptic properties (color, odor, texture) and physicochemical parameters (pH, appearance) were assessed on days 0, 10, 20, and 30 to evaluate stability and shelf-life [21, 22].

RESULTS

Organoleptic Evaluation Results

Table 3: Organoleptic Properties of Formulations

Parameter	Formulations		
	F1	F2	F3
Appearance	Free-flowing Powder	Free-flowing Powder	Free-flowing Powder
Color	Slightly Brown	Creamish Brown	Slight Creamish
Odor	Slight, Pleasant	Slight, Pleasant	Slight, Pleasant
Texture	Fine	Fine	Fine
Smoothness	Smooth	Smooth	Smooth
Consistency	Homogeneous	Homogeneous	Homogeneous

All three formulations demonstrated excellent Organoleptic characteristics including free-flowing powder appearance, uniform color, pleasant aroma, and fine particle texture. Formulation F2 exhibited superior color consistency described as "Creamish brown," suggesting optimal ingredient proportioning for balanced visual appeal.

Physicochemical Evaluation Results

Table 4: Physicochemical Properties of Three Formulations

Parameter	Formulations		
	F1	F2	F3
pH (1% w/v dispersion)	6.5	6.8	6.6
Loss on Drying (%)	0.33	0.29	0.31
Total Ash Content (mg/g)	29.6	30.0	26.0
Bulk Density (g/mL)	0.62	0.59	0.58
Tapped Density (g/mL)	0.74	0.70	0.68
Angle of Repose (degrees)	30.5	33.8	36.8
Spreadability (cm)	5.5	5.8	5.6

pH Results: All formulations exhibited pH values within the optimal skin-compatible range (6.5-6.8), indicating non-irritant nature and compatibility with normal skin physiology. F2 demonstrated slightly alkaline character (pH 6.8), while F1 and F3 were precisely neutral (pH 6.5-6.6).

Moisture Content: Loss-on-drying values ranged from 0.29-0.33%, indicating low residual moisture and excellent formulation stability

during storage. Low moisture content prevents microbial proliferation and premature degradation of active constituents.

Ash Content: Total ash values ranged from 26-30 mg/g, reflecting high mineral content from clay-based and botanical ingredients, which contributes to the formulation's cleansing and skin-purifying properties.

Bulk and Tapped Density: F1 demonstrated highest bulk density (0.62 g/mL) and tapped density (0.74 g/mL), indicating optimal packing characteristics and flow properties. F2 and F3 showed proportionally lower densities, suggesting more porous particle packing.

Angle of Repose: F1 exhibited optimal angle of repose (30.5°), indicating excellent flow characteristics. F2 (33.8°) and F3 (36.8°) demonstrated acceptable but slightly reduced flowability, with angles remaining within acceptable ranges for powder formulations.

Spreadability: F2 demonstrated superior spreadability (5.8 cm spread diameter), indicating optimal ease of application on facial skin. F1 (5.5 cm) and F3 (5.6 cm) also demonstrated acceptable spreadability.

Stability Study Results

Formulations stored at $37\pm 2^\circ\text{C}$ and $75\pm 5\%$ relative humidity were assessed over 30-day period:

- **Day 0:** Baseline Organoleptic and physicochemical parameters established
- **Day 10:** No significant changes observed in color, odor, texture, or pH
- **Day 20:** Minimal changes in Organoleptic characteristics; pH remained stable
- **Day 30:** All formulations maintained their original properties with negligible degradation

Conclusion: All three formulations demonstrated excellent stability characteristics during 30-day accelerated storage conditions, indicating adequate shelf-life potential when stored in appropriate light-protected, air-tight containers.

DISCUSSION

Interpretation of Results

The research successfully developed three polyherbal cosmetic formulations exhibiting superior organoleptic characteristics, optimal physicochemical properties, excellent dermatological safety, and satisfactory stability profiles. Results align with published literature and previous investigations of herbal face packs, validating the consistency and reproducibility of the formulation approach.

Ingredient Synergy and Therapeutic Benefits

The polyherbal approach employed in this study represents deliberate ingredient selection to achieve complementary therapeutic effects:

Cleansing and Purification: Multani Mitti provides the primary cleansing base through its exceptional sebum and toxin absorption capacity. This mineral-rich clay constituent comprises approximately 36-40% of each formulation, establishing the foundational pore-cleansing action.

Anti-inflammatory Effects: Turmeric (20% formulation weight) contributes potent anti-inflammatory effects through curcumin, which inhibits inflammatory mediator production and oxidative stress.

Moisturization and Hydration: Aloe Vera (6% formulation weight) provides essential moisturizing properties through its polysaccharide content, preventing excessive drying that would compromise skin barrier function.

Natural Exfoliation: Coffee Powder (10% formulation weight) provides gentle mechanical exfoliation, removing dead stratum corneum cells while promoting circulation enhancement.

Anti-aging and Antioxidant Protection:

Hibiscus and Rose Powder (8-14% combined) deliver rich anthocyanins and phenolic compounds offering antioxidant protection and age-defying benefits.

Formulation Optimization Rationale

Formulation F2 demonstrated optimal performance across multiple parameters:

- Superior spreadability (5.8 cm) indicating enhanced ease of application
- Balanced color profile (Creamish brown) suggesting optimal ingredient proportioning
- Excellent aesthetic appeal without sacrificing efficacy
- Stable pH within optimal skin-compatible range

The optimization of ingredient ratios in F2—particularly the 18g Multani Mitti, 10g Turmeric, and 5g Rose Powder combination—suggests that balanced constituent proportions enhance overall formulation performance.

Physiological Compatibility and Safety

All formulations exhibited pH values within the critical 6.5 ± 0.2 range, indicating excellent compatibility with normal skin physiology. The slightly acidic to neutral pH maintains the skin's natural acid mantle, which protects against pathogenic microorganism colonization and preserves beneficial commensal flora. Crucially, the absence of irritation, erythema, and edema across all formulations in human volunteers demonstrates that this naturally-derived cosmetic represents a safe alternative to synthetic formulations.

Stability and Shelf-Life Considerations

Stability studies indicating minimal changes over 30-day storage at elevated temperature ($37 \pm 2^\circ\text{C}$) suggest substantially extended shelf-life under normal room temperature storage. The low loss-on-drying values (0.29-0.33%) ensure minimal moisture content and reduced risk of microbial proliferation or oxidative degradation of active constituents.

Commercial and Sustainability Implications

This research demonstrates that economically viable, environmentally sustainable cosmetic formulations can be developed using locally-sourced herbal ingredients without sacrificing quality or efficacy. The simple mixing methodology requires minimal specialized equipment, making this formulation appropriate for small-scale artisanal production or large-scale commercial manufacture.

CONCLUSION

This comprehensive research successfully developed and rigorously evaluated a polyherbal cosmetic face pack designed to promote skin radiance, purification, and rejuvenation. The formulation integrates seven scientifically-validated botanical ingredients selected based on traditional Ayurvedic knowledge and modern pharmacological evidence, demonstrating that ancient wisdom and contemporary pharmaceutical science are complementary rather than contradictory. The formulated herbal face pack represents a safe, effective, economical, and environmentally sustainable alternative to synthetic cosmetics. It provides multifaceted dermatological benefits—cleansing, detoxification, moisturization, antioxidant protection, and age-defying effects—without synthetic additives, harmful chemicals, or environmental toxicity.

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