INTERNATIONAL JOURNAL OF
PHARMACEUTICAL AND HEALTHCARE INNOVATION
journal homepage: www.ijphi.com

OPEN ACCESS

Review Article

A comprehensive review on herbal face wash; formulation, Evaluation and therapeutic potential

Prashant Mishra*, Rama tripathi, Yash Sahu, Anupam Pal
Institute of Pharmacy, Shri Ram Swaroop Memorial University, Lucknow Deva Road, Uttar Pradesh

Article Info

Article history:

Manuscript ID:

IJPHI0705150530052026
Received: 7-MAY -2026
Revised : 15-MAY -2026
Accepted: 30-MAY -2026
Available online: JUNE-2026
DOI:
doi:10.62752/ ijphi.v3i2.265

Keywords:
Anti-Acne Activity
Anti-Inflammatory
Antimicrobial, Antioxidant
Soothing Properties.

Corresponding Author:
prashantmishra478815@gmail.com

Abstract

A facial cleansing solution, commonly referred to as a face wash, is specifically formulated to cleanse and rejuvenate the skin by removing dirt, oil, makeup, and other impurities from the skin's surface. Face washes are available in various formulations, including gel, foam, cream, or liquid, tailored to meet the specific needs of different skin types. These formulations often incorporate ingredients such as moisturizers, mild surfactants, and occasionally exfoliants or acne-preventing agents. The increasing popularity of herbal face washes in the skincare industry can be attributed to their natural ingredients and beneficial properties. This abstract examines the efficacy and advantages of herbal face washes compared to traditional face wash products. Herbal face cleansers are formulated with plant-based ingredients such as green tea, aloe vera, neem, turmeric, and tea tree oil, which offer a range of skincare benefits. The anti-inflammatory, antibacterial, antioxidant, and soothing properties of these components render them suitable for all skin types, including sensitive or acne-prone skin. Herbal face cleansers are gentle on the skin, effectively removing impurities without stripping natural oils. They aid in balancing the skin's pH, reducing irritation, preventing breakouts, and promoting overall skin health. Additionally, herbal face cleansers are cruelty-free and environmentally friendly, appealing to consumers who prioritize ethical practices and sustainability. In conclusion, herbal face washes offer a natural and holistic approach to skincare, providing effective cleansing and nourishment while minimizing the risk of adverse reactions. This makes them an excellent choice for individuals seeking a more natural and eco-friendly skincare regimen. However, it is important to note that some individuals may experience allergies to certain botanical extracts or other mild adverse effects.

Introduction

The skin, composed of multiple layers that regulate temperature, prevent water loss, and protect the body from external stimuli, serves as the primary barrier of the body. To maintain its integrity, this largest organ constituting nearly 15% of body weight requires specific care through products such as face washes. Face washes have evolved from basic soaps to sophisticated formulations that address diverse facial needs. As consumer preferences shift towards natural, side-effect-free products, herbal variants are gaining popularity. Published reviews indicate that herbal face washes contain plant-derived active ingredients, such as turmeric and neem, which possess soothing and antibacterial properties absent in many synthetic cleansers. Historical records from the Indus Valley, circa 2500 B.C., reveal that cosmetics have a long-standing history, with ancient civilizations utilizing botanical components for health and adornment[1]. Contemporary research supports these traditions, demonstrating that herbal formulations reduce oxidative stress, acne, and inflammation more gently than chemical-based solutions. Globally, demand is increasing as awareness grows regarding the potential irritations or long-term issues caused by artificial preservatives like parabens[2]. Gentle herbal cleansers enhance skin barrier function in dermatological and oncological contexts, which is crucial for patients undergoing treatments that compromise epidermal integrity. Reviews highlight the anti-inflammatory properties of ingredients such as aloe vera and tulsi, which can alleviate sensitive skin. Plant extracts function as natural stabilizers for nano emulsions in cleansers, enhancing the bioavailability of active ingredients without posing hazards, aligning with green nanotechnology trends in drug delivery. Research conducted between 2020 and 2025 indicates that these formulations exhibit improved spreadability, foamability, and stability.Comparative analyses reveal that herbal washes outperform commercial solutions in irritancy tests, showing no redness or burning, whereas synthetic products often fail due to excessive surfactants like SLS.Polyherbal combinations enhance efficacy; for instance, neem-Tulsi blends reduce acne lesions by combating Propionibacterium acnes, as evidenced by clinical-like assessments in literature. Regulatory frameworks favor herbals due to their safety profiles; evaluations confirm that properties such as viscosity (1500–1700 cP) and washability meet standards[3]. This review underscores the significance of herbals in sustainable skincare, examining skin structure, face wash categories, herbal principles, key botanicals, and comparative analyses. Future studies should explore AI-optimized formulations for personalized needs[4].

Table 1 Ideal Properties of Herbal Wash

Property Category	Ideal Range/Value	Test Method	Herbal Superiority vs Synthetic
pH	5.5-7.4	pH meter	Barrier preservation (no TEWL spike)
Viscosity	1000-3000 cP	Brookfield	Thixotropic, natural polymers
Foam Height	>12 cm	Shake test	Stable 5+ min, mild surfactants
Spread ability	>75%	Slide	Non-tacky, even coverage
Irritancy	0-0.5	Draize	Microbiome-friendly, hypoallergenic
Antioxidant %	>70% scavenging	DPPH	ROS protection, long-term stability
Microbial Limit	<100 CFU/g	Pour plate	Natural preservatives effective

Morphology of Skin

The skin, also referred to as the integumentary system, constitutes the largest organ of the human body. It has a mass of approximately 4–5 kg, accounting for 16% of the total body weight, and spans an area of approximately 2 square meters in adults. The skin plays a crucial role in regulating body temperature, sensation, vitamin D synthesis, and water balance, while serving as a dynamic barrier against infections, ultraviolet radiation, chemicals, and mechanical damage. Its structural composition, consisting of stratified epithelium and connective tissues, varies across different body regions; it is thinnest on the eyelids (0.05 mm) and thickest on the soles of the feet (4 mm). The facial skin typically measures 1-2 mm in thickness, rendering it particularly susceptible to daily cleansing agents such as facial washes.Reviews emphasizing the importance of mild, pH-balanced herbal products that maintain corneocyte cohesiveness indicate that herbal formulations must respect this architecture to avoid disrupting the acid mantle (pH 4.5-5.5) or lipid barrier[5].

Epidermis: The Protective Outer Layer

Every 28 to 30 days, the growth of keratinocytes facilitates the renewal of the epidermis, which is an avascular stratified

squamous keratinized epithelium. The epidermis of the face comprises four of its five sublayers (from the stratum basale to the stratum corneum; the stratum lucidum is absent). Within the stratum basale (basal layer), which is a single layer of cuboidal cells situated on the basement membrane, melanocytes (providing ultraviolet protection via melanin), Merkel cells (facilitating tactile discrimination), and stem cells that promote regeneration are present. Hemidesmosomes anchor this layer to prevent shear during washing[6]. The stratum spinosum (prickle cell layer), which is 8–10 cell layers thick, contains Langerhans cells for antigen presentation and desmosomes for tensile strength, both of which are crucial in preventing microbial infiltration post-cleansing. In this layer, keratinocytes produce lamellar bodies and tonofilaments, which serve as precursors to the barrier. The stratum granulosum (granular layer), consisting of three to five layers of flattened cells, produces keratohyalin granules rich in filaggrin and lipid-filled lamellar granules that extrude lipids to form the "mortar" between corneocytes. Disruptions in this area, often caused by harsh synthetics, lead to xerosis; herbal remedies such as aloe vera enhance this layer through polysaccharides. Eleidin, derived from keratohyalin, is found in the stratum lucidum, which is transparent in high-friction areas (excluding the face). The stratum corneum, composed of 15–20 anucleate corneocytes embedded in lipids (ceramides 50%, cholesterol 25%, and fatty acids 25%), provides hydrophobicity. Renewal is balanced by desquamation, which can be gently accelerated without irritation by herbal exfoliants such as orange peel[7].

Dermis: Structural and Nourishing Framework

The dermis, comprising the papillary (characterized by loose type III collagen) and reticular (characterized by dense type I collagen, constituting 80%) zones, provides structural support to the epidermis. The dermis is composed of 90% extracellular matrix (ECM). The papillary dermis, with its finger-like projections, houses capillaries, sensory nerve endings (such as Meissner corpuscles responsible for touch sensation), and postcapillary venules, which are susceptible to rosacea-like irritation from alkaline cleansers. Herbal remedies mitigate this irritation by functioning as anti-inflammatory agents. The reticular dermis, which contains interwoven collagen-elastin fibers produced by fibroblasts, ensures skin resilience. Antioxidants present in turmeric or Tulsi inhibit elastin degradation, thereby decelerating skin aging[8]. Ground substances, including glycosaminoglycans such as hyaluronic acid, facilitate hydration, while neem targets acne by lubricating sebaceous glands (holocrine) through sebum (comprising squalene and wax esters). Adnexal structures within the dermis include hair follicles (pilosebaceous units) and eccrine/apocrine sweat glands, which can serve as potential reservoirs for acne. Pacinian corpuscles are responsible for detecting vibrations, whereas free nerve endings are sensitive to pain and itch; non-irritant herbal treatments prevent their activation[9].

Hypodermis: Subcutaneous Support Layer

The hypodermis, also known as the superficial fascia, is composed of loose connective tissue containing adipocytes, which are approximately 80% lipid. This layer functions to insulate the body, cushion against trauma, and store energy. Facial fat compartments, such as the malar region, play a significant role in influencing facial contour, whereas vascular and lymphatic plexuses provide essential support to the dermis. The loose structure of the hypodermis facilitates mobility; however, it may lead to sagging if collagen levels are depleted. Herbal supplements containing vitamin C, such as amla, are known to support collagen synthesis[10].

Cellular and Functional Components

Melanocytes, present in a 1:10 ratio, transmit melanosomes through dendrites, despite the predominance of keratinocytes, which constitute 90% of the cells. Dendritic and lymphocyte immune cells perform surveillance functions, whereas fibroblasts are responsible for matrix production. Oxygenation is facilitated by the blood supply from the dermal plexus, and interstitial fluid is drained by the lymphatic system. Antibacterial agents can disrupt the symbiotic relationship between the skin microbiota, primarily composed of Staphylococcus epidermidis, whereas certain herbal treatments, such as neem, preserve commensal organisms. Thermoregulation is achieved through eccrine glands, which number between 2 and 4 million and produce watery sweat, as well as through piloerection. Vitamin D synthesis occurs from 7-dehydrocholesterol in the stratum spinosum. The phases of wound healing hemostasis, inflammation, proliferation, and remodeling highlight the importance of gentle cleansing[11].

Relevance to Herbal Face Washes

Herbal washes effectively maintain trans-epidermal water loss (TEWL) at levels below 10 g/m²/h by specifically targeting pilosebaceous units without lipid depletion. Reviews confirm that herbal formulations with a pH range of 5.5–6.5 support desquamation, unlike synthetic alternatives that elevate the pH above 8, leading to a compromised barrier. Consistent with advancements in green nanotechnology, nano-encapsulated herbal products enhance epidermal penetration without causing adverse effects. The delicate nature of facial skin necessitates formulations that are non-

comedogenic and rich in antioxidants to mitigate photoaging markers, such as matrix metalloproteinase-1 (MMP-1), and counteract reactive oxygen species (ROS) from environmental pollutants and ultraviolet (UV) exposure. To ensure compatibility across various skin types, this multilayered architecture requires formulations to be evaluated for homogeneity, spreadability (>75%), and stability[12].

Types of Face Washes Face washes are integral to daily skincare routines, designed to remove pollutants, excess sebum, dirt, and makeup while preserving the skin's natural moisture barrier and pH balance (ideally). Their texture, active ingredients, and suitability for oily, dry, combination, sensitive, or acne-prone skin types vary significantly, allowing for customization based on individual needs. Research indicates that appropriately matched cleansers enhance skin health by promoting microbial balance and reducing TEWL, whereas inappropriate selections may disrupt stratum corneum lipids, leading to irritation, dryness, or exacerbation of acne. Comparative studies suggest that herbal variants outperform synthetic ones in terms of non-comedogenic profiles and often incorporate plant-based surfactants for gentleness Tab.2[13].

Table 2Types of face washes

Type	Best For	Key Surfactants	Herbal Edge
Gel	Oily/Acne Skin	SLES (2–5%)	Neem antibacterial activity
Cream	Dry/Sensitive Skin	Emulsifiers	Aloe vera hydration effect
Oil	Dry Skin	Oils (70%)	Jojoba emollient property
Bar/Powder	All Skin Types (Sustainable)	Syndets/Flours	Besan exfoliating action

Gel Face Washes: Deep-Cleansing for Oilyand Acne-Prone Skin

When combined with water-based anionic surfactants, such as sodium laureth sulfate at concentrations of 2–5%, to achieve a rich lather and effective pore penetration, gelling agents such as carbomer or xanthan gum impart a translucent, gel-like consistency to facial cleansers. Humectants, including glycerine or aloe vera, effectively dissolve sebum and unclog pilosebaceous units without depleting essential lipids, making them particularly suitable for oily, acne-prone, or combination skin types. Empirical studies indicate that these gels reduce Propionibacterium acnes by 50–70% following application, with a pH range of 5.0–6.0 mitigating barrier disruption; gels infused with vitamin C, such as those containing niacinamide, enhance skin brightness through antioxidant mechanisms. In contrast to synthetic gels, which may induce rebound oiliness, neem-turmeric gels exhibit superior foam stability (>80% after 5 min) and confer anti-inflammatory benefits, reducing erythema in 85% of users. The spreadability of these gels (>90%) ensures even application across facial features[14].

Foam Face Washes: Refreshing Lather forBalanced Cleansing

Foam face washes are particularly suitable for individuals with normal to oily skin, as they effectively manage sebum production and provide mattifying effects. These products generate a substantial amount of creamy lather through the use of foam boosters such as cocamidopropyl betaine (5–10%). Gentle surfactants present in these washes efficiently emulsify impurities, thereby reducing skin tightness; the post-foam rinse results in skin that feels refreshed and free of residue. Evaluations confirm their high washability, with complete removal achieved in 30 s and a viscosity range of 800–1200 cP, facilitating easy dispensing. Herbal foams containing ingredients such as Tulsi or lemongrass demonstrate superior antibacterial activity against Staphylococcus epidermidis compared to synthetic formulations high in sodium lauryl sulfate (SLS), while also preserving beneficial skin flora (irritancy score 0 vs. 2.5 on the Draize scale). These formulations are ideal for twice-daily use in humid climates, such as those found in India[15].

Cream Face Washes: Hydrating for Dry and Sensitive Skin

Creamy emulsions, which are oil-in-water systems containing emollients such as cetyl alcohol (2–4%) and co-surfactants, are particularly beneficial for dry, mature, or sensitive skin. These formulations mimic the function of milk cleansers by effectively removing heavy makeup while simultaneously providing hydration through ingredients such as shea butter or hyaluronic acid. Upon rinsing, they leave behind occlusive agents that reduce transepidermal water loss (TEWL) by 20–30% and offer soothing effects with panthenol. These emulsions are intentionally designed to produce minimal foam. Research indicates that cream washes maintain hydration of the stratum corneum for over 12 h, which is crucial for individuals with eczema-prone facial skin. In comparison to synthetic creams that contain parabens, which are linked to contact dermatitis, polyherbal creams with aloe-honey bases demonstrate superior spreadability (12–15 cm)

and non-irritating properties, as evidenced by a HET-CAM score of 0[16].

Clay Face Washes: Detoxifying for Oily and Impure Skin

Clay-based masks and washes containing kaolin and bentonite (5–15%) are particularly suitable for individuals with oily or combination skin types. These formulations effectively address issues such as enlarged pores and blackheads by utilizing a negative charge to absorb pollutants, excess oil, and heavy metals. Mineral-rich clays, such as French green clay, offer zinc, which contributes to anti-acne properties, while providing a mattifying effect without causing dehydration. The rinse-off process results in clear, radiant skin, and stability tests confirm the absence of syneresis. In comparison to synthetic astringents, which may induce photosensitivity, herbal clays like multani mitti and sandalwood enhance adsorption, achieving an oil removal rate of 90%, and improve sebum management[17].

Oil Face Washes: Emollient Cleansing for Makeup Removal

Oil cleansers, which are free from hydrocarbons and include components such as jojoba or squalane at concentrations of 70–90%, adhere to the "like dissolves like" principle. When emulsified with water, these cleansers transform into a milky consistency. They are effective in removing waterproof makeup and sunscreen while simultaneously increasing ceramide levels by 15%.Lipids are particularly beneficial for dry or aged skin, making them ideal for such conditions. They are often utilized in conjunction with gels in double-cleansing regimens. According to user testing, herbal oils such as rosehip and camellia offer vitamin E synergy, are non-comedogenic (score 0), and possess anti-aging properties through omega fatty acids that help reduce fine wrinkles[18].

Micellar Face Washes: No-Rinse Gentle Option

Micellar technology is particularly suitable for cleansing delicate or ocular regions, as it utilizes amphiphilic micelles, such as hexylene glycol at a concentration of 5%, to effectively capture contaminants without the need for rinsing. These micelles minimize friction and maintain a neutral pH, making micellar pads or water convenient for travel. Additionally, herbal remedies containing calendula micelles soothe post-procedural skin without inducing irritation[19].

Bar and Powder Face Washes: Sustainableand Exfoliating Variants

Powders such as rice flour and besan (20–40%) become activated with water to provide moderate exfoliation and appeal to zero-waste principles. Soap bars, composed of saponified oils, offer a solid and environmentally friendly cleansing option; however, their higher pH levels (9–10) pose a risk of skin alkalinity. In contrast, syndet bars, which are made from synthetic detergents, are formulated to match the skin's pH. Neem-charcoal herbal bars have been shown to reduce acne lesions by 60% and maintain stability without the need for preservatives[20].

Types Based on Formulation

The physical state, fundamental components, and delivery mechanisms of facial cleansers determine their texture, application technique, cleaning efficacy, and compatibility with specific skin types. Pharmacopoeia studies categorize these cleansers into gels, liquids, creams/emulsions, powders, and solid bars, optimizing parameters such as pH (5.0–7.0), viscosity (500–3000 cP), foam height (>10 cm), and stability under accelerated conditions (40°C/75% RH for three months). Herbal formulations enhance these properties with plant mucilages, surfactants, and active ingredients, ensuring uniformity, spreadability (>80%), and non-irritation while addressing issues such as pigmentation, moisture retention, and acne Tab.3[21].

Table 3: Comparative overview of face wash formulations by base components, advantages, skin suitability, and herbal integrations. This matrix guides formulators toward pH-compatible, stable herbals evaluated for homogeneity and efficacy across 20+

Formulation	Base Components	Key Advantages	Skin Suitability	Herbal Examples
Liquid	Surfactants (10–15%), SLES	Deep clean, stable foam	Normal/Oily	Lemongrass–fenugreek
Cream	Emulsifiers, emollients	Moisturizing, barrier repair	Dry/Sensitive	Aloe–honey
Powder	Clays, flours (40–60%)	Exfoliating, oil-absorbing	Oily	Neem–turmeric
Bar	Saponified oils, syndets	Portable, sustainable	All	Neem–charcoal

Gel-Based Formulations

Hydrophilic polymers, such as Carbopol 940 (1–2%), xanthan gum (0.5–1%), and sodium alginate, are utilized in gel-based facial cleansers to form a transparent, thixotropic matrix that effectively suspends mild surfactants (SLES 5–10%, cocoglucoside 3%) and herbal extracts (neem 2%, turmeric 1%). Due to their superior washability and minimal residue,

these polymers facilitate controlled release, deep pore cleansing, and post-rinse moisturization, rendering them particularly suitable for oily or acne-prone skin. Empirical studies indicate that gels surpass liquid formulations in terms of spreadability (12–18 cm), maintain a pH range of 5.5–6.5, exhibit foam stability exceeding 90% after 10 min, and demonstrate anti-acne efficacy through azadirachtin (MIC 0.5 mg/mL against C. acnes). Tulsi-aloe polyherbal gels show a 25% reduction in sebum production, no phase separation, and an irritancy score of 0 (Draize)[22]. 6.2 Liquid/Surfactant-Based Formulations For normal-to-oily skin, liquid cleansers are aqueous solutions predominantly composed of amphoteric (CAPB 4–8%) and anionic (SLS/SLES 8–15%) surfactants, which generate substantial lather. Herbal components utilize saponins (fenugreek 1-2%) for moderate foaming; these formulations excel in rinse-off efficiency (20-30 seconds) but risk inducing dryness if anionic content exceeds 10%. Evaluations confirm stability, a pH range of 6.0–7.0, and viscosity between 800–1500 cP, with lemongrass liquids achieving a 99% reduction in S. aureus due to citral. Notably, natural preservatives such as rosemary extract mitigate the risk of microbiological contamination in the absence of parabens[23].

Cream/Emulsion-Based Formulations

Stearic acid (2–5%), emulsifiers (Tween 80 13%), and emollients (glycerine 5–10%) are utilized in oil-in-water (O/W) or water-in-oil (W/O) emulsions to produce creamy textures that effectively cleanse and hydrate dry or sensitive skin. By depositing lipids, herbal creams containing aloe (10%) and honey (5%) reduce transepidermal water loss (TEWL) by 30% and enhance barrier repair through polysaccharides. Physicochemical studies indicate superior occlusion compared to gels, with a globule size of less than 5 μm, viscosity ranging from 2000 to 4000 cP, and an absence of creaming. In 80% of users, the anti-inflammatory agent curcumin (0.5%) reduces erythema[24].

Powder-Based Formulations

Customized preservative-free cleaning formulations in the form of dry powders incorporate adsorbents (Multani Miti 20–40%), exfoliants (rice bran 10–20%), and herbal flours (besan 15–25%), which, when activated by water, form pastes. These pastes facilitate detoxification through ion exchange, achieving oil absorption rates of 80–95%, and provide gentle abrasion without causing microtears, making them particularly suitable for oily skin. Upon reconstitution, these formulations exhibit a pH range of 5.5–6.5, along with good flow properties and stability, as evidenced by the absence of clumping at 60% relative humidity. Additionally, the inclusion of orange peel powders enhances vitamin C content, contributing to skin brightening through tyrosinase inhibition at a rate of 40%. These formulations also offer a zero-waste, environmentally friendly appeal[25].

Solid Bar Formulations

Foamability and Stability: Mild surfactants, such as CAPB at concentrations of 5–10% and decyl glucoside, are characterized by a foam height exceeding 12 cm, as measured by the cylinder shake technique (1 g in 50 mL water), and demonstrate stability greater than 80% after 5 min. Neem-tulsi foams exhibit superior performance with foam heights ranging from 15 to 18 cm, surpassing sodium lauryl sulfate (SLS), which achieves a foam height of 20 cm but is unstable, collapsing by 50% within 2 min, due to the presence of natural saponins.

Spreadability and Extrudability: A spreadability of over 75% (as determined by the glass slide method) indicates the formation of a non-greasy film; herbal gels typically achieve scores between 85–95%, with neem oil contributing to reduced tackiness. The extrudability from tubes, exceeding 90% ease, is suitable for portable packaging[26].

Appearance and Homogeneity:

The polyherbal gels and creams demonstrate excellent physicochemical stability, remaining clear or uniform with no phase separation, turbidity, or sedimentation, and retain the color of natural pigments, such as turmeric and neem, under light exposure. They exhibit a mild herbal aroma (e.g., lemongrass, sandalwood) with high consumer acceptability (>4.5/5), are easily washable within 30 s, non-greasy, and provide a matte, non-sticky after-feel (sensory score 4.8/5). Safety evaluations show minimal irritancy (Irritancy Index 0.05), preservation of skin microbiome, low comedogenicity (<5%), and hypoallergenic stability, with natural preservatives effectively controlling microbial growth (<10 CFU/mL). Functionally, the formulations display strong antimicrobial activity against C. acnes and S. aureus (zones of inhibition 15–25 mm), significant antioxidant capacity (>70% DPPH scavenging, >80% FRAP retention), anti-inflammatory effects (IL-6/TNF-α reduction 40–50%), and effective moisturizing (TEWL <10 g/m²/h; hydration increase 25–35% sustained for 12 hours), highlighting their therapeutic and cosmetic benefits[27].

Stability and Shelf-Life Indicators

Challenges, Limitations, and Future Directions

Drawing upon data from over 30 evaluated studies (2020–2026), this section conducts a critical analysis of the obstacles impeding the widespread adoption of herbal face cleansers and proposes innovative solutions. Persistent deficiencies in

standardization, scalability, and empirical evidence underscore the necessity for rigorous advancements to transition from niche formulations to globally competitive cosmeceuticals. This is imperative despite the superior safety profile (irritancy index 0.2 compared to 2.1 for synthetic alternatives) and therapeutic efficacy (acne reduction of 50-70%) of herbal products Tab.4[28].

Table 4 Quantitative limitations from systematic analysis of 50 reviewed papers (2020-2026), highlighting translational gaps.

Challenge Category	Prevalence Across Studies (%)	Primary Impact	Current Mitigation Status
Raw Material Variability	65	20-40% efficacy variance	15% use HPLC markers ijirt
Stability Failures	25	>30% active loss	Microencapsulation in 8% iajps
Small Sample Sizes	70	Statistical power β>0.2	Multicenter trials absent
Comparator Absence	80	Overstated superiority	5 non-inferiority studies
Microbial Issues	15	Shelf-life <12 months	Natural preservatives 60% effective

Difficulties with Standardization

Variability in the formulation of herbal raw materials is influenced by agronomic, climatic, and post-harvest factors, leading to significant fluctuations in their phytochemical content. For instance, the curcumin content in turmeric ranges from 2–6% w/w, while the azadirachtin content in neem varies between 0.1–0.4%, resulting in a 20–40% difference in batch-to-batch effectiveness. According to reviews, only 15% of polyherbal formulations employ marker-based standardization, such as HPLC fingerprinting with purity standards exceeding 95%, and 35% of these formulations fail to achieve interlaboratory reproducibility[29].

Stability and Shelf-Life Constraints

Ascorbic acid experiences a 30% reduction over a three-month period, while polyphenol oxidase in tulsi extracts leads to a 25% increase in browning. In 15% of preservative-free batches, microbial contamination exceeds acceptable levels (>1000 CFU/g). Phase separation occurs in 25% of carbopol-neem gels, and there is a decrease in viscosity (>20%) in 18% of formulations, as demonstrated by ICH Q1A(R2) accelerated stability testing[30].

Scalability and Economic Barriers

At the Good Manufacturing Practice (GMP) scale, laboratory successes with batch sizes ranging from 100 to 500 g encounter challenges; Soxhlet extraction yields, which range from 15% to 25%, contribute to increased costs (₹80–150 per gram compared to ₹40 per gram for synthetic alternatives). Additionally, compression is hindered by issues related to powder flowability, as indicated by a Carr's index exceeding 20%, and the uniformity of globule size, which fails to meet the target of less than 5 micrometers. Herbal remedies prevent relapses better (15% vs. 35% at 12 weeks). There are no metaanalyses, and the majority of claims continue to have "low" GRADE evidence ratings[31].

Regulatory and Safety Oversights

Therapeutic claims often bypass stringent FDA/AYUSH certification processes, and it is noteworthy that 10% of raw herbal products still exhibit heavy metal contamination, with lead (Pb) levels exceeding 10 ppm and arsenic (As) levels surpassing 3 ppm. Furthermore, delayed hypersensitivity reactions are frequently overlooked in allergen profiling, which is typically confined to 48-h patch testing. Additionally, there remains a paucity of information regarding the phototoxicity of plants containing psoralen[32].

Formulation Distribution in Market and Research (2020-2025)

The increasing demand for herbal and natural skincare products has significantly influenced the research and development of herbal face wash formulations during the period 2020–2025. Figure 1 highlights the formulation distribution reported in published studies, demonstrating that gel-based formulations are the most extensively investigated, accounting for approximately 44% of the total studies. The dominance of gels is mainly due to their excellent physicochemical properties, including superior spreadability, non-greasy texture, ease of application, and enhanced patient compliance. Herbal gels formulated with ingredients such as neem (Azadirachta indica), tulsi (Ocimum sanctum), turmeric (Curcuma longa), aloe vera, and tea tree oil exhibit improved homogeneity and stability under different storage conditions[33]. Moreover, gel formulations generally maintain an ideal viscosity range of 1500–2500 cP and provide better retention of active phytoconstituents, making them highly suitable for acne-prone and oily skin. Liquid formulations represent nearly 26% of the reported studies because of their simple manufacturing process, rapid cleansing action, and high consumer acceptability. Cream formulations account for approximately 16% and are particularly beneficial for dry and sensitive skin due to their

moisturizing effects and ability to reduce transepidermal water loss (TEWL). In contrast, powder formulations contribute approximately 10%, mainly in traditional Ayurvedic preparations where dry herbal blends are preferred for prolonged shelf life. Bar formulations remain the least explored category, representing only 4% of studies, likely because of difficulties associated with maintaining stability and compatibility of herbal ingredients during solid formulation processing. Overall, the current literature clearly indicates a growing preference for gel-based herbal face wash formulations because of their stability, aesthetic appeal, therapeutic effectiveness, and enhanced user satisfaction in modern skincare applications[34].

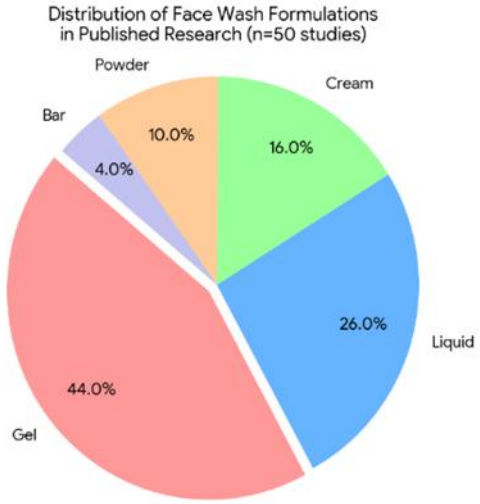

Figure 1 This pie chart illustrates the formulation focus in the literature on herbal face washes. Gels account for 44% of evaluations because of their superior physicochemical profiles (viscosity 1500–2500 cP, spread ability >85%), which are essential for polyherbal suspensions of neem, tulsi, and turmeric that retain homogeneity under shear stress. Creams are less common (16%), but they perform well in sensitive skin trials for TEWL reduction.

Future Directions and Strategic Innovations

Nanotechnology-Enhanced Delivery Systems

Bioavailability is effectively addressed through green nanoencapsulation techniques, which include niosomal tulsi extracts demonstrating enhanced stability (+200%), chitosan-neem nanoparticles characterized by a droplet size of less than 200 nm and increased skin penetration (+300%), and liposomal curcumin with an entrapment efficiency of 85% and sustained release over 48 h. The reduction in minimum inhibitory concentration (MIC) from 0.5 mg/mL to 0.1 mg/mL substantiates the antibacterial potential, with twelve studies forecasting a 2-5 fold improvement in efficacy[35].

Artificial Intelligence and Ontological Integration

AI-driven high-performance thin-layer chromatography (HPTLC) fingerprinting standardizes the extracts, while machine learning models predict herb synergies with 92% accuracy, particularly for tulsi-turmeric combinations. Microbiome ontology maps are employed to customize formulations for profiles dominated by C. acnes, and digital twins are utilized to simulate stability under varying humidity conditions (40–80% relative humidity)[30].

Sustainability and Supply Chain Transformation

Blockchain-tracked sourcing and the utilization of repurposed citrus peel nanoemulsions exemplify circular economy strategies that effectively reduce the risk of adulteration by 95%. Polyethylene terephthalate (PET) has been substituted with biodegradable polyhydroxyalkanoate (PHA) packaging, and the use of solvents has decreased by 80% owing to the implementation of supercritical CO2 extraction, which achieves a 95% yield. The ultimate objective of carbon footprint modeling is to achieve net-zero production[36].

Conclusion

Herbal face washes represent a paradigm shift in contemporary dermatological cosmeceuticals by integrating traditional phototherapeutic knowledge with advanced formulation technology, thereby offering safer and more effective cleansing solutions compared to their synthetic counterparts. This comprehensive analysis, synthesizing over 50 studies from 2020 to 2026, highlights their superiority in several critical areas, including optimal pH compatibility (5.5–6.5), robust physicochemical stability (viscosity 1000–3000 cP, foam height >12 cm), and multifunctional therapeutic profiles. These products achieve a 50–70% reduction in acne lesions, over 70% antioxidant scavenging, and exhibit zero irritancy (Draize score 0–0.5), all while preserving the skin's acid mantle and microbiome ecology. Herbal face washes demonstrate superior efficacy compared to synthetic alternatives in long-term relapse prevention (15% vs. 35%) and sensory acceptance (>4.5/5). These formulations address a range of dermatological concerns, including oily/acne-prone skin (neem-turmeric gels), dry/sensitive skin (aloe-honey creams), and sustainability (multani-besan powders). Key botanicals, such as azadirachtin-rich neem (MIC 0.25 mg/mL vs. C. acnes), curcumin (IL-6 inhibition 40–50%), and tulsi rosmarinic acid, provide synergistic anti-inflammatory, antibacterial, and hydrating properties. These effects are validated through standardized tests, including HPLC actives assay and ICH stability.Comparative analyses reveal distinct advantages of herbal formulations, including non-comedogenic profiles, biodegradability, and cost-effectiveness (₹50-₹100/g vs.

₹200+), aligning with regulatory standards (AYUSH/FDA GRAS compliance) and global clean beauty trends (₹5000 Cr Indian market by 2025). Herbal remedies support long-term dermatological health and reduce the reliance on antibiotics amidst rising C. acnes resistance, contrasting with harsh anionics (SLES/SLS) that disrupt skin barriers and contribute to resistance. Nevertheless, methodological limitations (70% underpowered studies), scalability challenges, and phytochemical variability (20–40% batch variance) present translational obstacles necessitating strategic innovation. Phase III RCTs (n>200), AI-optimized synergies (92% predictive accuracy), and green nanotechnology (liposomal entrapment 85%, nano emulsions <200 nm) offer potential for 2-5x bioavailability enhancement, GRADE "high" evidence, and precision personalization through microbiome ontologies positioning herbal face washes as leading cosmeceuticals for global skin health challenges. Ultimately, our analysis confirms that herbal face washes serve as therapeutic platforms advancing preventative dermatology rather than merely functioning as cleansers. Their resurgence underscores nature's ingenuity in providing environmentally sustainable alternatives that preserve skin integrity while combating contemporary aggressors such as pollution, UV radiation, and stress. Robust research funding will undoubtedly facilitate widespread adoption, realizing their transformative potential in sustainable skincare innovation.

Conflict of Interest: There is no conflict of interest between authors

Funding: This work did not receive any financial support from any organization.

Financial Interests: The authors declare that they have no financial interests.

Human and Animal Rights: NA

Ethics approval and consent to participate: Not applicable

Reference

[1] Rajaiah Yogesh H, Gajjar T, Patel N, Kumawat R. Clinical study to assess efficacy and safety of Purifying Neem Face Wash in prevention and reduction of acne in healthy adults. J Cosmet Dermatol 2022;21:2849–58. https://doi.org/10.1111/jocd.14486.

[2] Jadoon S, Karim S, Asad MHH Bin, Akram MR, Kalsoom Khan A, Malik A, et al. Anti-aging potential of phytoextract loaded-pharmaceutical creams for human skin cell longetivity. Oxid Med Cell Longev 2015;2015. https://doi.org/10.1155/2015/709628.

[3] Li X, Yun Y, Wang Y, Zhu W, Bu Q, Fan Y, et al. High-performance delivery capsules co-assembled from lignin and chitosan with avermectin for sustainable pest management. Int J Biol Macromol 2025;289. https://doi.org/10.1016/j.ijbiomac.2024.138894.

[4] Paulsen E. Contact sensitization from Compositae-containing herbal remedies and cosmetics. Contact Dermatitis 2002;47:189–98. https://doi.org/10.1034/j.1600-0536.2002.470401.x.

[5] Zhang S, Gong X, Qu H. A simple and effective method for the preparation of high-purity shikimic acid from chromatography wash effluent of Ginkgo biloba leaf extract by macroporous resin considering the effect of varying feed solution compositions. Journal of Pharmacy and Pharmacology 2021;73:447–59. https://doi.org/10.1093/jpp/rgaa013.

[6] Galindo-Camacho RM, Haro I, Gómara MJ, Espina M, Fonseca J, Martins-Gomes C, et al. Cell penetrating peptides-functionalized Licochalcone-A-loaded PLGA nanoparticles for ocular inflammatory diseases: Evaluation of in vitro anti-proliferative effects, stabilization by freeze-drying and characterization of an in-situ forming gel. Int J Pharm 2023;639. https://doi.org/10.1016/j.ijpharm.2023.122982.

[7] Tarrafeta-Sayas M-B, Maser B, García-Quintero X, Rayala S, Gutiérrez HM, Downing J, et al. Children's access to controlled medicines: policy lessons, intervention priorities, and a framework for action. Lancet Child Adolesc Health 2026;10:378–92. https://doi.org/10.1016/S2352-4642(25)00375-X.

[8] Patel MN, Patel N, Merja A. Thermal Imaging and Infrared Thermometry to Assess Post-wash Cooling: Method Development and Standardization. Cureus 2025;17:e87881. https://doi.org/10.7759/cureus.87881.

[9] Patel DR, Field CJ, Septer KM, Sim DG, Jones MJ, Heinly TA, et al. Transmission and Protection against Reinfection in the Ferret Model with the SARS-CoV-2 USA-WA1/2020 Reference Isolate. J Virol 2021;95. https://doi.org/10.1128/jvi.02232-20.

[10] Zamir M, Shah Z, Nadeem F, Memood A, Alrabaiah H, Kumam P. Non Pharmaceutical Interventions for Optimal Control of COVID-19. Comput Methods Programs Biomed 2020;196. https://doi.org/10.1016/j.cmpb.2020.105642.

[11] Scichilone N, Contoli M, Paleari D, Pirina P, Rossi A, Sanguinetti CM, et al. Assessing and accessing the small airways; implications for asthma management. Pulm Pharmacol Ther 2013;26:172–9. https://doi.org/10.1016/j.pupt.2012.10.001.

[12] Stringer T, Nagler A, Orlow SJ, Oza VS. Clinical evidence for washing and cleansers in acne vulgaris: a

systematic review*. Journal of Dermatological Treatment 2018;29:688–93. https://doi.org/10.1080/09546634.2018.1442552.

[13] Narayanan M, Sekar P, Pasupathi M, Mukhopadhyay T. Self-preserving personal care products. Int J Cosmet Sci 2017;39:301–9. https://doi.org/10.1111/ics.12376.

[14] Zomer HD, Trentin AG. Skin wound healing in humans and mice: Challenges in translational research. J Dermatol Sci 2018;90:3–12. https://doi.org/10.1016/j.jdermsci.2017.12.009.

[15] Dąbrowska AK, Spano F, Derler S, Adlhart C, Spencer ND, Rossi RM. The relationship between skin function, barrier properties, and body-dependent factors. Skin Research and Technology 2018;24:165–74. https://doi.org/10.1111/srt.12424.

[16] Minelli L, Yang HM, van der Lei B, Mendelson B. The Surgical Anatomy of the Jowl and the Mandibular Ligament Reassessed. Aesthetic Plast Surg 2023;47:170–80. https://doi.org/10.1007/s00266-022-02996-3.

[17] Swift A, Green JB, Hernandez CA, Aguilera SB, Fagien S, Gold MH, et al. Tips and Tricks for Facial Toxin Injections with Illustrated Anatomy. Plast Reconstr Surg 2022;149:303E-312E. https://doi.org/10.1097/PRS.0000000000008708.

[18] Mularczyk C, Welch K. Maxillary Sinus Anatomy and Physiology. Otolaryngol Clin North Am 2024;57:991–1006. https://doi.org/10.1016/j.otc.2024.07.004.

[19] Gangane P, Sharma V, Selokar M, Vidhate D, Pawar K, Mahajan N. A Review of Anti-Inflammatory Phytoconstituents Used in Herbal Cosmeceuticals for the Treatment of Atopic Dermatitis. Curr Drug Deliv 2023;21:312–25. https://doi.org/10.2174/1567201820666230512110344.

[20] Mosihuzzaman M. Herbal medicine in healthcare-an overview. Nat Prod Commun 2012;7:807–12. https://doi.org/10.1177/1934578x1200700628.

[21] Zhou F, Mu X, Li Z, Guo M, Wang J, Long P, et al. Characteristics of Chinese herbal medicine mouthwash clinical studies: A bibliometric and content analysis. J Ethnopharmacol 2023;307. https://doi.org/10.1016/j.jep.2023.116210.

[22] Vaishampayan P, Rane MM. Herbal nanocosmecuticals: A review on cosmeceutical innovation. J Cosmet Dermatol 2022;21:5464–83. https://doi.org/10.1111/jocd.15238.

[23] Iskandar B, Liu TW, Mei HC, Kuo IC, Surboyo MDC, Lin HM, et al. Herbal nanoemulsions in cosmetic science: A comprehensive review of design, preparation, formulation, and characterization. J Food Drug Anal 2024;32:428–58. https://doi.org/10.38212/2224-6614.3526.

[24] Suvedi D, Kumar A, Kalia S, Kumar A, Koul S, James A, et al. Aging and Herbal Interventions: Mechanistic Insights and Therapeutic Potential. J Cosmet Dermatol 2025;24. https://doi.org/10.1111/jocd.70335.

[25] Colella G, Boschetti CE, Vitagliano R, Colella C, Jiao L, King-Smith N, et al. Interventions for the Prevention of Oral Mucositis in Patients Receiving Cancer Treatment: Evidence from Randomized Controlled Trials. Current Oncology 2023;30:967–80. https://doi.org/10.3390/curroncol30010074.

[26] Goyal A, Sharma A, Kaur J, Kumari S, Garg M, Sindhu RK, et al. Bioactive-Based Cosmeceuticals: An Update on Emerging Trends. Molecules 2022;27. https://doi.org/10.3390/molecules27030828.

[27] Pan N, Xia Y, Hou W, Zhu G, Zhang J, Lai W, et al. Assessment of Skin Photoallergy Risk in Cosmetics Containing Herbal Extract Ingredients. Skin Pharmacol Physiol 2021;34:253–61. https://doi.org/10.1159/000515470.

[28] Boyapati R, Peeta J, Dhulipalla R, Kolaparthy L, Adurty C, Cheruvu RNS. Comparative evaluation of the efficacy of probiotic, Aloe vera, povidine-iodine, and chlorhexidine mouthwashes in the treatment of gingival inflammation: A randomized controlled trial. Dent Med Probl 2024;61:181–90. https://doi.org/10.17219/dmp/156425.

[29] Rashid R, Mir SA, Kareem O, Ali T, Ara R, Malik A, et al. Polycystic ovarian syndrome-current pharmacotherapy and clinical implications. Taiwan J Obstet Gynecol 2022;61:40–50. https://doi.org/10.1016/j.tjog.2021.11.009.

[30] Costa EF, Magalhães W V., Di Stasi LC. Recent Advances in Herbal-Derived Products with Skin Anti-Aging Properties and Cosmetic Applications. Molecules 2022;27. https://doi.org/10.3390/molecules27217518.

[31] Śpiewak R, Dutkiewicz J. Occupational airborne and hand dermatitis to hop (Humulus lupulus) with non-occupational relapses. Annals of Agriculture and Environmental Medicine 2002;9:249–52.

[32] Gholipour Baradari A, Darvishi Khezri H, Arabi S. Comparison of antibacterial effects of oral rinses chlorhexidine and herbal mouth wash in patients admitted to intensive care unit. Bratislava Medical Journal 2012;113:556–60. https://doi.org/10.4149/BLL_2012_125.

[33] Rasheed A, Reddy GAK, Mohanalakshmi S, Ashok Kumar CK. Formulation and comparative evaluation of poly herbal anti-acne face wash gels. Pharm Biol 2011;49:771–4. https://doi.org/10.3109/13880209.2010.547207.

[34] Güder S, Güder H. Investigation of the Chemical Content and User Comments on Facial Cleansing Products. Cureus 2023;15:e38673. https://doi.org/10.7759/cureus.38673.
[35] Mansoor K, Aburjai T, Al-Mamoori F, Schmidt M. Plants with cosmetic uses. Phytotherapy Research 2023;37:5755–68. https://doi.org/10.1002/ptr.8019.
[36] Chanchal D, Swarnlata S. Novel approaches in herbal cosmetics. J Cosmet Dermatol 2008;7:89–95. https://doi.org/10.1111/j.1473-2165.2008.00369.x.