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Neem, Aloe Vera, and Turmeric: A Review of their Synergistic Potential in Polyherbal Creams for Psoriasis Scar Management

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Abstract: ***Psoriasis is a persistent immune-mediated skin condition marked by abnormal keratinocyte proliferation, chronic inflammation, and post-inflammatory dermal changes that frequently result in visible scarring. Standard scar-management therapies—including corticosteroids, retinoids, and silicone preparations—often provide limited relief because they act on only one or two biological pathways, whereas psoriatic scarring involves multiple disruptions such as inflammation, oxidative damage, collagen irregularities, and impaired barrier recovery. This limitation has increased interest in polyherbal topical formulations that can address several mechanisms simultaneously while maintaining a favorable safety profile.***

Neem (Azadirachta indica), Aloe vera (Aloe barbadensis Miller), and Turmeric (Curcuma longa) are among the most widely investigated botanicals for dermatological applications. Neem exhibits strong anti-inflammatory, antimicrobial, antioxidant, and immune-regulating actions, helping reduce plaque-associated inflammation and lowering the risk of secondary infections that exacerbate scar formation [1]. Aloe vera contains polysaccharides like acemannan that promote fibroblast regulation, balanced collagen remodeling, enhanced hydration, and rapid epithelial repair, contributing to smoother scar recovery [2]. Turmeric, rich in curcumin, suppresses NF-κB signaling, minimizes oxidative stress, and modulates profibrotic pathways, thereby reducing abnormal collagen deposition and improving post-psoriatic scar texture [3].

When used together in a polyherbal cream, these botanicals offer synergistic rather than merely additive effects. The combination supports optimized cytokine modulation (TNF-α, IL-17, IL-23), boosts antioxidant defenses, accelerates wound-healing kinetics, restores the skin barrier, and promotes organized collagen alignment. These actions collectively help diminish structural damage caused by psoriatic plaques, regulate pigmentation changes, and enhance overall scar remodeling. Such formulations also exhibit favorable biocompatibility, stability, and patient adherence compared with many synthetic treatments, making them suitable for long-term management.

In summary, a Neem–Aloe vera–Turmeric polyherbal cream represents a promising, multi-mechanistic approach for managing psoriasis-related scars, supported by strong phytochemical evidence and early clinical findings. Nonetheless, further research on extract standardization, optimized delivery platforms, and large-scale clinical trials is needed to fully establish its therapeutic effectiveness.

I. INTRODUCTION

Psoriasis is a long-standing inflammatory skin disorder marked by accelerated keratinocyte turnover, excessive immune-cell activity, and altered cytokine signaling involving TNF-α, IL-17, and IL-23. Even after visible lesions resolve, many individuals experience post-inflammatory scarring characterized by collagen disorganization, uneven pigmentation, lingering redness, and dermal atrophy. These persistent changes result from chronic inflammation, oxidative imbalance, and disrupted fibroblast function, making the repair process far more complicated than routine wound healing.

Common topical treatments—such as corticosteroids, silicone gels, and retinoid-based preparations—may offer some relief, but each is limited by issues like irritation, risk of skin thinning, or their ability to act on only a single biological pathway. This has increased interest in polyherbal topical formulations that can simultaneously influence inflammation, oxidative stress, hydration balance, collagen regulation, and microbial control.

Among various botanicals, Neem (Azadirachta indica), Aloe vera (Aloe barbadensis Miller), and Turmeric (Curcuma longa) are especially valued for their broad dermatological benefits.

Neem provides bioactive molecules including azadirachtin, quercetin, nimbolide, and nimbidin, which exhibit strong anti-inflammatory, antimicrobial, antioxidant, and immunomodulatory properties, supporting inflamed psoriatic skin and reducing secondary infection risk [1,4].

Aloe vera contains polysaccharides such as acemannan that help regulate fibroblast activity, support collagen formation, maintain moisture levels, and promote efficient epithelial repair—key elements for smoother scar remodeling [2].

Turmeric is rich in curcumin and related curcuminoids known for their anti-fibrotic, anti-inflammatory, antioxidant, and wound-healing actions, making them effective in controlling oxidative damage and abnormal collagen build-up seen in psoriatic scars [3,5].

When formulated together in a polyherbal cream, these botanicals show stronger therapeutic action than each component alone. Their combined effects enhance suppression of inflammatory cytokines, strengthen antioxidant responses, improve collagen organization, speed wound closure, and aid in rebuilding the skin barrier. Additionally, optimized polyherbal systems often offer better stability, skin penetration, and phytochemical bioavailability.

Therefore, a Neem–Aloe vera–Turmeric polyherbal cream presents a promising, multi-mechanistic, and safer approach for improving psoriasis-related scarring, aligning well with modern preferences for natural and holistic dermatological care.

Fig . no 1 ; Botanical Sources of Active Phytoconstituents for Polyherbal Psoriasis Scar Management Formulations

II. PHYTOCHEMICAL PROFILES

A. Neem (Azadirachta indica)

Neem is among the most phytochemically diverse medicinal plants, containing more than 150 biologically active molecules present across its leaves, bark, seeds, and oil. Major classes include limonoids, flavonoids, tannins, triterpenoids, glycosides, sterols, and various polysaccharides.

1) Limonoids

Key limonoids associated with therapeutic activity include:

Azadirachtin – demonstrates potent anti-inflammatory, antimicrobial, and antioxidant effects. It assists in reducing the excessive expression of cytokines such as TNF-α, IL-6, and IL-17, which are central to psoriatic inflammation.

Nimbin and Nimbidin – known for their ability to decrease swelling, redness, and keratinocyte overproliferation. These compounds help limit plaque formation and reduce fibrotic changes in affected skin.

Salannin and Nimbolide – exhibit antibacterial, antiproliferative, and wound-modulating actions, contributing to improved scar remodeling.

2) Flavonoids

Neem leaves contain flavonoids such as quercetin and rutin, which are known to:

- act as strong antioxidants,
- enhance fibroblast mobility during healing, and
  protect collagen fibers from enzymatic breakdown.

These actions help counter oxidative stress–driven fibroblast dysfunction in psoriatic scars.

3) Triterpenoids and Sterols

Phytosterols such as β-sitosterol and stigmasterol help maintain lipid balance and support epidermal barrier repair—important for managing dryness, scaling, and thickened plaques commonly associated with psoriasis.

4) Overall Relevance for Psoriasis Scar Management

Together, Neem's phytochemicals:

- Downregulate inflammatory mediators,
- Prevent microbial colonization,
- Reduce oxidative injury,
- Encourage collagen reorganization, and
- Promote healthy wound closure.

These attributes make Neem a valuable contributor to polyherbal scar-care formulations [1,4,6].

B. Aloe vera (Aloe barbadensis Miller)

Aloe vera gel is composed of about 98–99% water, while the remaining solid content—roughly 1–2%—contains over 200 pharmacologically beneficial compounds essential for skin healing and scar modulation.

1) Polysaccharides

The major bioactive polysaccharide is Acemannan (β-(1,4)-acetylated polymannose), which:

- supports fibroblast growth,
- promotes collagen synthesis,
- speeds re-epithelialization, and
- enhances moisture retention.

These functions directly contribute to effective remodeling of psoriatic scars.

2) Anthraquinones

Compounds such as aloin, emodin, and aloesin exhibit:

- anti-inflammatory effects (e.g., reduction of prostaglandin E2),
- antimicrobial activity, and
- inhibition of tyrosinase, aiding in control of hyperpigmentation.

These properties help manage active lesions and post-inflammatory coloration.

3) Vitamins and Antioxidants

Aloe vera provides vitamins A, C, and E, which:

- protect the skin from oxidative injury,
- minimize the breakdown of collagen,
- support barrier recovery, and

contribute to evening out pigmentation changes.

4) Aloe Sterols (Lupeol, Campesterol, β-sitosterol)

These sterols offer anti-inflammatory and soothing effects, helping calm psoriatic plaques and promoting smoother dermal healing.

5) Relevance for Psoriasis Scar Healing

Aloe's bioactive components collectively:

- hydrate and soften the skin,
- restore extracellular matrix structure,
- regulate inflammatory responses,
- ensure balanced collagen deposition, and
- accelerate skin remodeling.

These actions make Aloe vera an ideal hydrating and regenerative base in polyherbal formulations [2,7].

C. Turmeric (Curcuma longa)

Turmeric contains curcuminoids and essential oils that play an essential role in controlling inflammation, oxidative stress, and abnormal scar formation.

1) Curcuminoids

Major active components include:

- Curcumin (primary compound),
- Demethoxycurcumin (DMC),
- Bisdemethoxycurcumin (BDMC).

Curcumin is known for its ability to:

- inhibit the NF-κB pathway—a central regulator of inflammatory responses,
- reduce cytokines such as TNF-α, IL-1β, and IL-17,
- suppress excessive fibroblast activity,
- prevent abnormal collagen cross-linking, and
  protect skin cells from oxidative damage.

These functions help soften scars and promote controlled healing.

2) Volatile Oils

Turmeric's essential oils—turmerone, atlantone, zingiberene—provide:
antimicrobial benefits,
improved penetration of curcumin into deeper dermal layers, and
enhanced restoration of the skin barrier.

3) Resins and Other Phytochemicals

These constituents help:
reduce dermal stiffness
enhance microcirculation,
support long-term remodeling of damaged tissue.

4) Relevance for Psoriasis Scars

Turmeric's phytochemicals function together to:

- Control inflammation,
- Normalize fibroblast activity,
- Improve collagen type i/iii balance,
- Reduce thickened scar tissue and pigmentation, and
  Speed the healing of damaged skin.

Thus, Turmeric is a cornerstone herb for anti-scar polyherbal formulations [3,5,8].

III. INDIVIDUAL PHARMACOLOGICAL ACTIONS

A. Anti-inflammatory Effects

1) Neem (Azadirachta indica)

1. Neem is rich in bioactive molecules such as nimbidin, nimbin, azadirachtin, and nimbolide, which exert strong anti-inflammatory effects by blocking COX and LOX enzyme pathways, thereby lowering the formation of prostaglandins and leukotrienes (9,10).
2. Nimbidin suppresses the release of inflammatory mediators like histamine and serotonin, reducing vasodilation, redness, and tissue swelling (9).
3. Neem also regulates cytokine balance by decreasing TNF-α, IL-1β, and IL-6 while enhancing IL-10 production, contributing to improved control of psoriatic inflammation (11).

2) Aloe vera (Aloe barbadensis Miller)

1. The bradykinase enzyme present in Aloe gel helps minimize inflammation by breaking down bradykinin, an important mediator of pain and swelling (12).

2. Aloe polysaccharides, including acemannan, downregulate key inflammatory cytokines (TNF-α, IL-6, IL-1β) and reduce COX-2 expression, which helps soothe erythematous and irritated psoriatic skin (13).
3. Antioxidant enzymes like SOD and catalase in Aloe gel neutralize reactive oxygen species, limiting oxidative triggers that fuel inflammation (12,13).

3) Turmeric (Curcuma longa / Curcumin)
1. Curcumin acts as a strong inhibitor of NF-κB, one of the major transcription factors driving inflammatory processes in psoriasis (14).
2. It decreases the production of mediators such as IL-1β, IL-6, TNF-α, COX-2, and iNOS, thereby suppressing pro-inflammatory signaling in keratinocytes (14,15).
3. Curcumin interferes with MAPK and JAK-STAT pathways—both crucial in the development of psoriatic plaques—helping to reduce inflammation and lesion formation (14).

B. Antioxidant and Wound-Healing Effects

1) Neem
1. Neem leaves contain potent antioxidants like quercetin and other polyphenols that neutralize ROS, reducing oxidative stress linked to chronic psoriatic inflammation (9,16).
2. Neem stimulates fibroblast activity, promotes collagen production, and enhances blood vessel formation, supporting tissue regeneration and scar repair (16).
3. Its antioxidant potential protects the extracellular matrix from degradation and aids in restoring dermal structure in post-psoriatic scars (11,16).

2) Aloe vera
1. Aloe's vitamins A, C, and E, along with antioxidant enzymes (glutathione peroxidase, catalase), safeguard the skin from oxidative injury and support optimal conditions for wound healing (12,13).
2. Acemannan enhances fibroblast proliferation and stimulates the formation of type-I collagen, which is vital for strengthening the extracellular matrix during scar repair (13).
3. Aloe boosts epithelial cell migration and helps retain skin moisture, accelerating wound closure and restoration of the skin barrier (12,13).

3) Turmeric (Curcumin)
1. Curcumin is a powerful antioxidant capable of scavenging superoxide, hydroxyl radicals, and nitric oxide, reducing oxidative load in psoriatic tissues (14,15,17).
2. It boosts fibroblast activity and activates TGF-β pathways, leading to enhanced collagen synthesis and improved dermal remodeling (17).
3. Curcumin promotes faster formation of granulation tissue and supports angiogenesis, which helps in reducing scar thickness and pigmentation during healing (15,17).

C. Anti-Psoriatic & Immunomodulatory Actions

1) Neem
1. Neem exhibits significant immunoregulatory effects by suppressing Th1 and Th17 cytokines, which are central drivers of psoriasis pathology (11).
2. It helps reduce excessive keratinocyte growth by modulating the TNF-α/NF-κB axis (11,16).
3. Clinical findings show that neem extracts improve skin barrier quality and decrease plaque thickness, scaling, and redness (10,11).

2) Aloe vera
1. Aloe influences the activity of macrophages and lymphocytes, reducing the influx of immune cells commonly seen in psoriatic plaques (13).
2. It slows down the rapid turnover of keratinocytes, helping prevent the formation of thickened psoriatic patches (12,13).

3. Aloe polysaccharides support balanced cytokine secretion, which helps restore and heal inflamed psoriatic skin (12).

3) Turmeric (Curcuma longa / Curcumin)

1. Curcumin downregulates IL-17, IL-23, and TNF-α—key cytokines that contribute to psoriasis progression (14,15).
2. It reduces keratinocyte proliferation and encourages normal cell differentiation by inhibiting STAT3 and NF-κB signaling pathways (14).
3. Through its immunomodulatory effects, curcumin diminishes chronic inflammation and assists in long-term scar improvement in healed psoriatic lesions (15,17).

IV. SYNERGISTIC MECHANISMS IN POLYHERBAL CREAMS

A. Combined Anti-Inflammatory Activity

1) Multi-Target Inhibition of Inflammatory Pathways

1. Compounds such as nimbidin and nimbolide in neem suppress COX and LOX enzyme activity, resulting in reduced production of prostaglandins and leukotrienes—key mediators responsible for swelling, redness, and pain in psoriasis (1,2).
2. Aloe vera contributes to inflammation control through bradykinase, which degrades bradykinin, and through acemannan, which downregulates inflammatory cytokines like TNF-α, IL-1β, and IL-6 (4,5).
3. Curcumin acts on NF-κB, a major transcription factor regulating inflammatory gene expression, thereby lowering the synthesis of TNF-α, IL-6, IL-17, and COX-2 (6,7).

Collectively, these herbs suppress inflammation at several biochemical checkpoints, resulting in a more powerful anti-inflammatory action than any single extract alone (1).

2) Synergistic Suppression of the Psoriatic Cytokine Axis

1. The TNF-α / IL-23 / IL-17 pathway plays a central role in psoriasis pathogenesis.
2. Curcumin downregulates IL-17 and IL-23 signaling (6), while neem reduces TNF-α and IL-6 production (3).
3. Aloe moderates lymphocyte activation and prevents excessive cytokine discharge (4,5).

By targeting different components of this cytokine cycle, the combination slows keratinocyte over-proliferation and helps reduce plaque formation (1,3,6).

3) Reduction of Immune-Cell–Induced Tissue Damage

1. Neem limits mast cell degranulation, lowering histamine release (2).
2. Aloe decreases neutrophil infiltration, preventing unnecessary inflammatory accumulation (4).
3. Curcumin minimizes oxidative bursts generated by macrophages and neutrophils (6,7).

This coordinated action quickly alleviates itching, redness, and irritation associated with active psoriatic inflammation (1).

B. Enhanced Collagen Remodeling

1) Coordinated Fibroblast Stimulation

1. Acemannan from aloe stimulates fibroblast proliferation, improves type-I collagen synthesis, and enhances epithelial migration (4,5).
2. Curcumin facilitates wound remodeling through activation of TGF-β pathways, promoting collagen formation and angiogenesis (7,9).
3. Neem supports fibroblast growth and encourages granulation tissue development, improving the tensile strength of regenerating skin (8).

Together, these actions accelerate collagen maturation, an essential step in repairing psoriatic scars (1).

2) Restoration of Extracellular Matrix (ECM) Integrity

1. Polyphenolic compounds in neem prevent degradation of structural proteins by inhibiting matrix-damaging enzymes (2,8).
2. Aloe's mucopolysaccharides maintain adequate hydration, thereby supporting ECM stability and enhancing elasticity and dermal thickness (4,5).
3. Curcumin protects collagen from oxidative breakdown and encourages organized ECM reconstruction (7,9).

This combined effect results in smoother, more uniform scar remodeling with improved dermal strength (1,8,9).

C. Barrier Repair and Hydration Synergy

1) Triple-Action Moisturizing & Barrier Restoration

1. Aloe vera polysaccharides enhance hydration by binding water and reducing transepidermal water loss (TEWL) (4,5).
2. Neem's fatty acids, including oleic and stearic acid, form a protective layer that prevents moisture loss (2).
3. Curcumin stabilizes epidermal lipids and minimizes lipid peroxidation, supporting barrier robustness under oxidative stress (6).

When blended in a cream, these herbs strengthen the skin barrier, decrease scaling, and enhance texture in psoriatic skin (1).

2) Improvement of Stratum Corneum Lipid Balance

1. Neem replenishes epidermal lipids that are depleted by chronic inflammation (2).
2. Aloe boosts the synthesis of ceramides and phospholipids, contributing to barrier repair (5).
3. Curcumin protects barrier lipids from oxidative damage, maintaining membrane integrity (7).

This synergy enhances skin resilience, improving its ability to withstand irritation and reducing future flare-ups (1).

D. Antimicrobial + Antioxidant Dual Effect

1) Broad-Spectrum Antimicrobial Protection

1. Neem exhibits strong antibacterial and antifungal properties, particularly against Staphylococcus aureus, Streptococcus species, and several dermatophytes, reducing the risk of secondary infections in psoriatic lesions (2,8).
2. Aloe offers mild antibacterial support, aiding in wound cleanliness (4).
3. Curcumin disrupts microbial growth and prevents biofilm formation (7).

The combination ensures comprehensive antimicrobial protection for vulnerable psoriatic skin (1).

2) Multi-Layer Antioxidant Defense

1. Psoriatic skin produces elevated levels of reactive oxygen species, which worsen inflammation.
2. Aloe contributes vitamins A, C, and E, along with antioxidant enzymes like SOD and catalase (4,5).
3. Neem polyphenols, including quercetin, effectively neutralize ROS and protect cellular components (2,8).
4. Curcumin acts as a robust scavenger of free radicals, helping maintain cellular stability and supporting tissue repair (6,9).

Together, these antioxidants reduce oxidative stress, promoting healthier healing and better scar outcomes (1).

3) Prevention of Lipid and Protein Oxidation

1. Curcumin limits lipid peroxidation and helps stabilize cell membranes during tissue repair (7,9).

Fig .2 ; Synergistic Potential of Neem, Aloe Vera, and Turmeric for Enhanced Psoriasis Scar Repair

V. MECHANISMS IN PSORIASIS SCAR MANAGEMENT

A. *Modulation of Keratinocyte Proliferation*

Excessive keratinocyte growth is a defining feature of psoriasis, contributing to epidermal thickening and the formation of persistent post-inflammatory scars. Polyherbal formulations help normalize these pathways through multiple phytochemical interactions

Mechanisms

Neem (Azadirachta indica): Compounds such as nimbidin and quercetin inhibit TNF-α–driven keratinocyte activation and reduce EGFR-related signaling, helping slow abnormal epidermal turnover (18).

Curcumin (from Turmeric): Curcumin suppresses key transcriptional regulators including NF-κB, STAT3, and AP-1, all of which promote keratinocyte overgrowth and inflammatory mediator release in psoriatic skin (19).

Aloe vera: Aloe chromones assist in restoring normal differentiation markers—like filaggrin and involucrin—contributing to improved epidermal stability and reduced scaliness (20).

Outcome

✔ Thinner psoriatic plaques

✔ Normalized epidermal renewal

✔ Lower risk of hyperplastic, scar-forming tissue

B. *Reduction in Fibroblast Overactivation*

Psoriatic scarring often results from dysregulated dermal remodeling, where fibroblasts produce excessive or disorganized collagen. Polyherbal formulations help re-establish balanced fibroblast function.

Mechanisms

Aloe vera (Acemannan): Acemannan modulates fibroblast activity, encouraging controlled production of type-I collagen and reducing tendencies toward hypertrophic or keloid-like scarring (20).

Curcumin: Curcumin downregulates TGF-β1 and Smad-dependent signaling—key pathways that stimulate fibroblast hyperproliferation and excessive extracellular matrix accumulation (21).

Neem: Flavonoids in neem support ECM stability and counteract fibroblast overstimulation by reducing oxidative disturbances that disrupt dermal signaling (22).

Outcome

✔ Lowered dermal fibrosis

✔ Balanced and uniform collagen synthesis

✔ Formation of softer, flatter scars

C. *Control of Oxidative Stress*

Oxidative stress intensifies inflammation, weakens collagen, and contributes to more visible psoriasis scars. The combined antioxidants in polyherbal creams help break this cycle.

Mechanisms

Turmeric: Curcuminoids and turmerones exhibit strong antioxidant activity, preventing lipid and protein oxidation and protecting the structural integrity of dermal tissues (19).

Neem: Polyphenolic compounds such as rutin, quercetin, and nimbidin neutralize free radicals and safeguard ECM elements from oxidative fragmentation (22).

Aloe vera: Aloe delivers vitamins A, C, and E and enhances endogenous antioxidant systems—including SOD, CAT, and GPx—reducing oxidative damage within the skin (20).

Outcome

✔ Reduced degradation of dermal proteins

✔ Minimized oxidative cell injury

✔ Improved conditions for tissue repair

D. Promotion of Normal Collagen Alignment

The cosmetic appearance and functionality of healed skin depend heavily on how collagen fibers are deposited and organized. Polyherbal formulations help regulate this process.

Mechanisms

Aloe vera: Stimulates fibroblast activity and encourages orderly deposition of type-I and type-III collagen, improving elasticity and overall tissue quality (20).

Curcumin: Helps maintain controlled collagen turnover by inhibiting MMP-2 and MMP-9, preventing excessive matrix breakdown and facilitating uniform remodeling (21).

Neem: Its phytosterols and triterpenoids help stabilize collagen during early remodeling, strengthening the newly formed dermal matrix (22).

Outcome

✔ Well-aligned collagen bundles

✔ Decreased scar visibility

✔ Enhanced texture and structural restoration

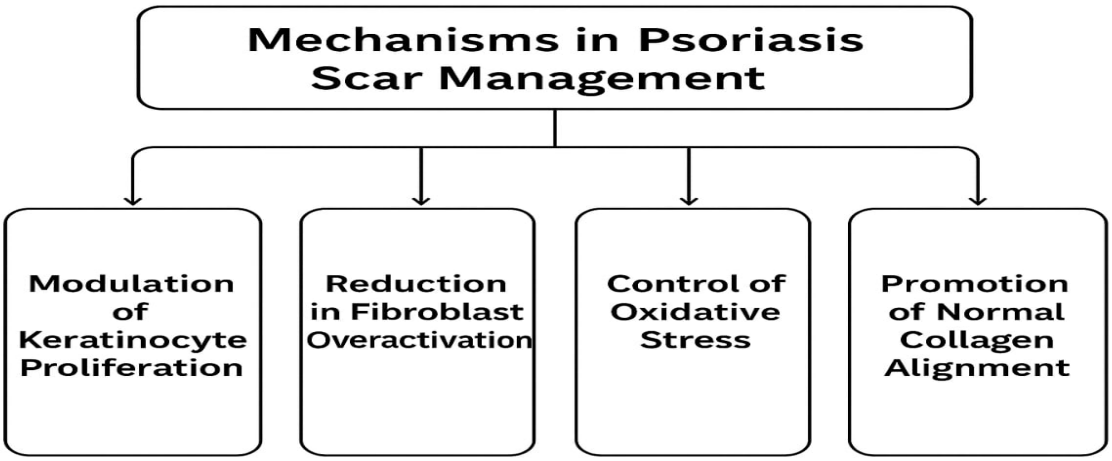

Fig .No 3 ; Key Mechanisms Involved in Psoriasis Scar Management Using Polyherbal Creams

VI. FORMULATION CONSIDERATIONS OF POLYHERBAL CREAM

Extract Standardization Methods

A. Standardization of Polyherbal Extracts

Standardization ensures that every batch of neem, aloe vera, and turmeric extracts used in polyherbal creams maintains consistent phytochemical levels, biological potency, and safety. This process is crucial for ensuring therapeutic reliability and meeting regulatory expectations for topical herbal products [125].

B. Standardization Parameters for Individual Extracts

1) Neem (Azadirachta indica) Extract Standardization

Major marker compounds include azadirachtin, nimbin, nimbolide, and quercetin

Standardization Procedures:

1. Identity Confirmation: Macroscopic and microscopic examination to verify neem material against pharmacopoeial standards [1].
2. Extractive Value Tests: Alcoholic and aqueous extractive values to evaluate raw material consistency [24].
3. HPLC Profiling: Quantification of azadirachtin A and nimbolide to ensure reliable marker compound levels [25].
4. Total Phenolic Content: Determined using the Folin–Ciocalteu reagent to assess overall phytochemical richness [24].
5. Microbial Load Testing: Determination of TAMC/TYMC to confirm compliance with topical microbiological limits [1].
6. Residual Solvent Evaluation: Required for hydroalcoholic extracts to ensure solvent traces remain within acceptable limits [25].

2) Aloe vera (Aloe barbadensis Miller) Gel Extract Standardization

Primary bioactives include acemannan, anthraquinones (e.g., aloin), and polysaccharides.

Standardization Procedures:

1. Botanical Authentication: Organoleptic and anatomical analysis of fresh aloe leaves [1].
2. Polysaccharide Analysis: Quantification of acetylated glucomannan using HPAEC-PAD to assess acemannan levels [24].
3. HPLC Assay for Anthraquinones: Measurement of aloin and aloe-emodin to prevent excessive anthraquinone content [1].
4. Rheological Assessment: Viscosity evaluation to maintain uniformity in gel-based topical formulations [25].
5. Physicochemical Tests: pH, specific gravity, and mucilage purity for quality control [24].
6. Microbial Safety Testing: Essential for aloe gel due to its high risk of contamination [1].

3) Turmeric (Curcuma longa) Extract Standardization

Key markers include curcumin, demethoxycurcumin, and bisdemethoxycurcumin.

Standardization Procedures:

1. Ash Value Determination: Evaluation of total and acid-insoluble ash to confirm raw material purity [1].
2. HPLC Curcuminoid Assay: Quantitative analysis of the full curcuminoid profile; standardized extracts typically maintain ≥95% curcuminoids [24].
3. UV–Visible Fingerprinting: Spectral analysis for curcuminoid pattern verification [25].
4. Volatile Oil Content: Determination of ar-turmerone where required for specific formulations [24].
5. Loss on Drying: Moisture content assessment for extract stability [1].
6. Heavy Metal Screening: Testing for Pb, As, and Hg according to herbal pharmacopeial standards [25].

C. Standardization of Polyherbal Extract Combination

1) Phytochemical Fingerprinting

Combined extracts are fingerprinted using:

HPTLC: For simultaneous profiling of neem flavonoids, aloe polysaccharides, and turmeric curcuminoids [24].

HPLC Peak Profiling: Ensures consistent phytochemical patterns and checks for degradation or interaction among constituents [25].

2) Compatibility & Interaction Studies

Compatibility of mixed herbal extracts is evaluated through:

1. FTIR Analysis: To detect any functional group interactions or incompatibilities [1].
2. Differential Scanning Calorimetry (DSC): Identifies thermal changes indicating potential instability during blending [25].
3. Stability Checks: Monitoring pH and color variations, especially for aloe–turmeric interactions [24].

D. Extract Stability Standardization

1) Accelerated Stability Testing: Performed at 40°C ± 2°C and 75% RH to evaluate extract degradation rates [1].

2) Photostability Studies: Essential for protecting curcumin from light-induced breakdown [25].

3) Preservative Efficacy Testing (PET): Important for aloe-based formulations prone to microbial growth [24].

E. Microbial & Safety Standardization

1) Pathogen Screening: Ensuring absence of S. aureus, P. aeruginosa, and C. albicans [1].

2) Dermal Safety Testing: Patch tests and irritation studies for topical compatibility [25].

3) Toxicological Marker Control: Monitoring azadirachtin (neem), aloin (aloe), and curcumin purity to meet safety limits [24].

F. Final Standardization Outcomes (Combined Extract)

A polyherbal extract blend is considered fully standardized when:

Neem extract contains defined and reproducible ranges of azadirachtin and nimbolide.

Aloe extract shows consistent acemannan levels and minimal anthraquinone content.

Turmeric extract exhibits stable, quantifiable curcuminoid concentrations.

The combined extract demonstrates a reproducible fingerprint, acceptable stability, and verified safety profile [1,25]

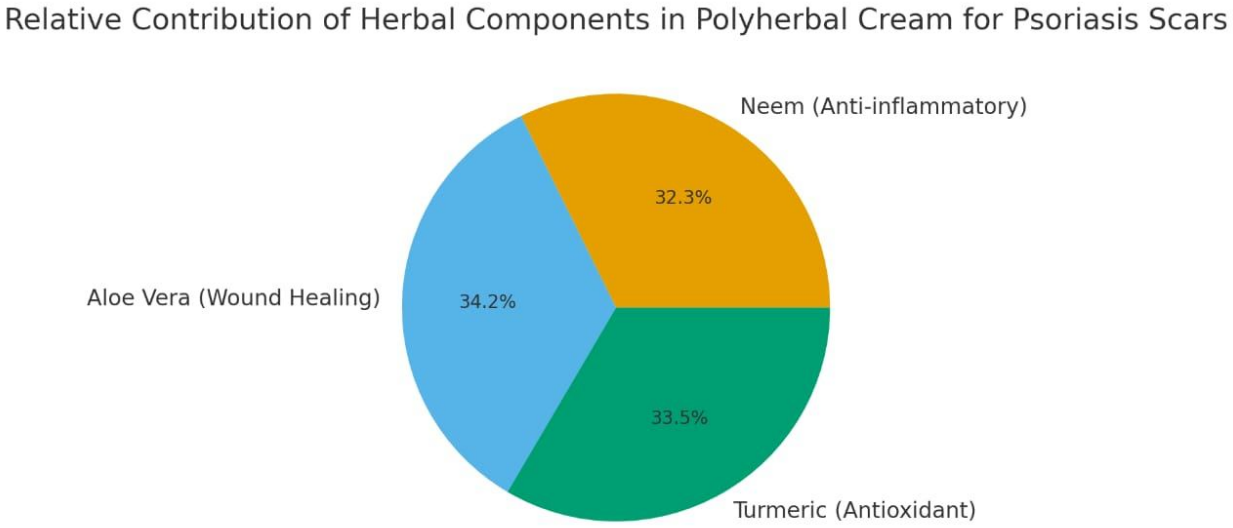

Fig no 4 ; Relative Contribution of Neem, Aloe Vera, and Turmeric in Polyherbal Cream Formulations for Psoriasis Scar Management

VII. BASE SELECTION (CREAM / GEL / EMULSION)

Choosing the correct topical base is essential when formulating polyherbal systems containing neem, aloe vera, and turmeric for psoriasis scar therapy. The base determines the product's stability, release profile, absorption ability, skin feel, and shelf-life. Literature suggests that an ideal base should match the solubility needs of the extracts, maintain suitable viscosity and pH, protect light-sensitive compounds, and support appropriate rheological behavior [125].

A. Cream Bases

Creams are semi-solid emulsions—either oil-in-water (O/W) or water-in-oil (W/O)—commonly used for multi-extract herbal dermatological formulations.

1) Advantages for Polyherbal Psoriasis Creams

1. O/W creams provide a light, non-oily texture, improving patient acceptance and ease of removal [1].
2. They effectively incorporate hydrophilic components such as aloe vera's acemannan-rich gel [24].
3. Lipophilic actives like curcuminoids and neem triterpenoids can be solubilized in the oil phase [25].
4. Creams help increase hydration of psoriatic plaques, improving dermal penetration of herbal extracts [1].

2) Formulation Considerations

1. Proper emulsifiers (e.g., cetostearyl alcohol, polysorbates) are needed to stabilize multiple plant-derived actives [24].
2. Because aloe vera can reduce viscosity, gelling or thickening agents (carbomer, xanthan gum) may be required [1].
3. Turmeric is light-sensitive; therefore, opaque or UV-protective packaging is necessary [25].
4. Neem's strong scent may require mild, skin-safe fragrance masking options [24].

B. Gel Bases

Gels are hydrophilic, high-water content systems ideal for soothing inflamed skin and ensuring fast drug release.

1) Advantages for Psoriasis Scar Management

1. Gels give a cooling sensation, beneficial for irritated and inflamed psoriatic lesions [1].
2. Aloe polysaccharides remain hydrated and stable within gel structures [24].
3. High water content supports rapid diffusion of compounds such as quercetin and curcuminoids [25].
4. Their light and non-greasy feel is particularly suitable for humid climates like India [1].

2) Formulation Considerations

1. Gel-forming agents (Carbopol 940, HPMC, xanthan gum) help maintain pH suitable for aloe-rich formulations [24].
2. Due to the low solubility of curcumin, co-solvents (propylene glycol) or nano-delivery systems may be necessary [25].
3. Solid neem particles may settle, so homogenization or suspending agents should be included [1].
4. Because aloe enhances microbial growth, effective preservative systems are essential [24].

C. Emulsion-Based Systems (Advanced Emulsions, Nanoemulsions, Microemulsions)

Modern emulsion technologies enhance penetration, stability, and solubility of herbal actives.

1) Advantages for Polyherbal Delivery

1. Nanoemulsions improve the solubility and dispersion of lipophilic compounds such as curcuminoids and neem limonoids [25].
2. Microemulsions enhance permeation across psoriatic scales by modifying skin lipid packing [1].
3. Aloe vera's hydrophilic constituents distribute effectively across multi-phase systems, allowing simultaneous delivery of hydrophilic and lipophilic actives [24].
4. These advanced emulsions show improved stability and reduced creaming or phase separation compared to conventional creams [25].

2) Formulation Considerations

1. Surfactants (Tween 80, Span 20) must be chosen carefully to avoid irritation on sensitive psoriatic skin [1].
2. Antioxidants (Vitamin E, BHT) help prevent oxidative degradation of curcuminoids [25].
3. Optimal droplet size (<200 nm in nanoemulsions) ensures uniform deposition and improved activity [24].
4. Aloe polysaccharides may function as natural co-emulsifiers, improving emulsion stability [1].

Base Type	Best For	Challenges
Cream (O/W)	Hydration, mixed-solubility extracts	Color instability [turmeric] , viscosity drop [aloe]
Gel	Cooling effect, hydrophilic extracts	Curcumin solubility issues
Nanoemulsion / Microemulsion	Maximum penetration, stability	Suefactant irritation

Table no 1 ; Summary of Base Suitability for Polyherbal Cream (Neem + Aloe + Turmeric)

VIII. STABILITY AND COMPATIBILITY ISSUES

Ensuring the stability and compatibility of neem, aloe vera, and turmeric extracts in a polyherbal cream is crucial for maintaining therapeutic activity, uniform appearance, microbial safety, texture, and long-term product performance. Because herbal constituents are highly sensitive to environmental factors such as light, oxygen, pH, temperature, and excipient interactions, comprehensive stability evaluation is essential [26–28].

A. Chemical Stability Issues

1) Turmeric (Curcuma longa) Extract

1. Curcumin is easily degraded by UV light, resulting in fading of its yellow color and decreased antioxidant potential [26].
2. Curcuminoids are unstable under alkaline conditions and break down rapidly through hydrolysis [27].
3. Oxidative reactions convert curcumin into compounds like ferulic acid and bicyclopentadione, reducing its anti-inflammatory effectiveness [28].

2) Aloe Vera (Aloe barbadensis Miller) Gel

1. Acemannan, the main polysaccharide, loses viscosity and structural integrity when exposed to heat or excessively acidic environments [26].
2. Light and high temperature cause degradation of anthraquinones (e.g., aloin), affecting aloe purity and strength [26].
3. Aloe mucilage can interact with certain emulsifiers and preservatives, leading to weakening of the gel matrix [28].

3) Neem (Azadirachta indica) Extract

1. Limonoids such as azadirachtin and nimbin degrade in alkaline pH, resulting in reduced therapeutic potency [26].
2. Neem flavonoids can undergo oxidation, causing undesirable browning in cream formulations [28].
3. Aqueous neem extracts may hydrolyze more rapidly, particularly at elevated storage temperatures [27].

B. Physical Stability Issues

1) Emulsion and Cream Instability

1.Mixing hydrophilic aloe gel with lipophilic neem and turmeric extracts increases the risk of phase separation in oil-in-water creams [28].
2. Incorrect emulsifier levels may lead to creaming, coalescence, or cracking of the polyherbal emulsion [26].
3. Temperature fluctuations reduce the viscosity of aloe-rich formulations, compromising their structural strength [27].

2) Sedimentation and Aggregation

1. Without proper homogenization, turmeric and neem powders can settle within semi-solid bases [26].
2. Aloe vera increases the water phase mobility, which may destabilize suspended herbal particles [27].

3) Color and Odor Variations

1. Curcumin may darken upon exposure to oxygen and light, causing yellow-brown discoloration [28].
2. Neem's natural aroma can intensify with oxidation, affecting sensory acceptability [27].

C. Microbiological Stability Issues

1) Fresh aloe gel is highly susceptible to microbial growth and requires an effective preservative system [26].
2) Polyherbal mixtures can bind or neutralize preservatives due to their phenolic content, reducing preservative activity [28].
3) Although neem has antimicrobial properties, typical cosmetic concentrations are insufficient for complete microbial protection [27].

D. Compatibility Issues with Excipients

1) pH Compatibility

1. Aloe vera and neem extracts remain stable at mildly acidic pH (5.0–6.0), whereas curcumin shows better stability near neutral pH, leading to formulation challenges [27].
2. pH adjusters such as triethanolamine (TEA) can accelerate curcumin degradation [28].

2) Surfactant Interactions

1. High concentrations of surfactants may increase irritation, especially on sensitive psoriatic skin [26].
2. Some non-ionic surfactants can form complexes with neem limonoids, resulting in precipitation [27].

3) Preservative Interactions

1. Polyphenols in neem and turmeric may bind to preservatives, reducing their antimicrobial performance [28].
2. Aloe polysaccharides can create a network that slows preservative diffusion through the formulation [26].

E. Stability Testing Requirements

1) Conduct accelerated stability studies (40 ± 2 °C; 75% RH) to monitor physical and chemical changes over time [26].
2) Perform photostability testing to evaluate curcumin degradation and aloe discoloration under light exposure [27].
3) Freeze–thaw cycling helps identify potential phase separation in emulsified creams [28].
4) Monitor pH periodically to ensure long-term stability of aloe and neem components [26].
5) Carry out microbial challenge testing to confirm preservative effectiveness in polyherbal systems [27].
6) Perform rheological analysis to assess viscosity, spreadability, and structural integrity [28].

F. Strategies to Enhance Stability

1) Incorporate antioxidants such as tocopherol, ascorbic acid, or BHT to delay oxidative degradation [26].
2) Use opaque or UV-protective containers to prevent light-induced breakdown of curcumin and aloe anthraquinones [28].
3) Maintain an optimized pH range of 5.5–6.0 to support compatibility of all three extracts [27].
4) Apply nanoemulsion, liposomal, or phytosomal systems to protect sensitive herbal actives from environmental degradation [26].
5) Include chelating agents like EDTA to minimize metal-ion-mediated oxidation [28].

IX. PRESERVATIVE REQUIREMENTS

Polyherbal creams formulated with neem, aloe vera, and turmeric require a carefully designed preservative system to control microbial growth, maintain chemical integrity, and ensure product safety over time. Because herbal ingredients contain high levels of moisture, sugars, proteins, phenolics, and complex polysaccharides, they provide an excellent environment for microbial contamination and may also interfere with preservative activity [29–31]. The large water fraction introduced by aloe vera gel further increases water activity, making preservation a critical part of formulation design.

A. Need for Preservatives in Polyherbal Creams

1) High Microbial Susceptibility

1. Aloe vera gel contains water, electrolytes, and polysaccharides that support rapid microbial growth unless adequately preserved [29].
2. Although neem and turmeric possess natural antimicrobial constituents, their activity is insufficient to protect the entire cream throughout storage [30].
3. Semi-solid topical preparations are exposed to contamination during manufacturing, handling, and repeated consumer use, making robust preservation essential [31].

2) Herbal Components Can Reduce Preservative Activity

1. Phenolic compounds found in turmeric and neem can bind to synthetic preservatives, lowering their antimicrobial performance [29].
2. The polysaccharide-rich matrix of aloe vera may slow preservative diffusion, reducing its ability to reach all parts of the cream [30].
3. Multi-extract herbal formulations often demand higher preservative levels than single-herb products due to increased interference and microbial load [31].

B. Ideal Characteristics of Preservatives for Herbal Creams

Preservatives used in polyherbal neem–aloe–turmeric formulations should demonstrate:

1) Wide antimicrobial coverage against bacteria, fungi, and yeast [29].
2) Chemical compatibility with curcuminoids, aloe polysaccharides, and neem limonoids without causing instability or color changes [30].
3) Stability within pH 5.0–6.5, the recommended range for such creams [31].
4) Low irritation potential, particularly for sensitive or psoriasis-affected skin [30].
5) Minimal reactivity with emulsifiers, thickening agents, and antioxidant systems [29].

C. Commonly Used Preservatives for Polyherbal Creams

1) Synthetic Preservatives

These offer dependable, long-term antimicrobial protection.

1. Phenoxyethanol — effective against a broad spectrum of bacteria and stable in herbal matrices with minimal risk of discoloration [30].
2. Parabens (methylparaben, propylparaben) — provide strong antimicrobial and antifungal activity and show good compatibility with emulsions and gels [29].
3. Benzyl alcohol — functions as both an antimicrobial and antioxidant but must be used carefully to avoid odor interactions with neem [31].

4. Sodium benzoate + Potassium sorbate — suitable for mildly acidic systems (pH ≤ 6.5), making them appropriate for aloe-based formulations [29].

2) Natural or Plant-Derived Preservative

Increasingly favored in herbal cosmetics.

1. Neem seed oil — offers partial antimicrobial support but cannot serve as a standalone preservative [30].
2. Rosemary extract / Tocopherol (Vitamin E) — provide antioxidant protection for turmeric and neem but lack strong antimicrobial capabilities [31].
3. Organic acids (levulinic acid, anisic acid) — mild yet effective natural preservatives with good compatibility with aloe vera [29].

D. Preservative–Herbal Extract Compatibility Issues

1) Curcumin may react with iron-containing preservatives, causing dark discoloration of the formulation [31].
2) Polyphenols in neem and turmeric can form insoluble complexes with parabens, reducing preservative activity [30].
3) Aloe's high polysaccharide content may entrap preservative molecules, restricting their distribution throughout the cream [29].
4) Alcohol-based preservatives may lead to precipitation of aloe polysaccharides, compromising gel stability [29].
5) Natural preservatives often require combinations (e.g., levulinic acid + glyceryl caprylate) to achieve antimicrobial protection equivalent to synthetic systems [30].

E. Preservative Efficacy Testing (PET)

To confirm the reliability of the preservative system, the following challenge tests are required:

1) USP <51> Antimicrobial Effectiveness Test — evaluates reduction of bacteria, fungi, and yeast over time [29].
2) European Pharmacopoeia Challenge Test — involves inoculating the formulation with specific microorganisms and monitoring for 28 days [30].
3) ISO 11930:2019 — standardized microbial risk assessment for cosmetic and herbal creams [31].
4) Regular monitoring during stability studies to detect preservative degradation due to interactions with herbal constituents [29].

F. Strategies to Enhance Preservation in Polyherbal Formulations

1) Formulation-Level Strategies

1. Maintain pH between 5.0–5.8, a favorable range for aloe stability and preservative action [30].
2. Use synergistic blends such as phenoxyethanol + ethylhexylglycerin for enhanced antimicrobial coverage [29].
3. Employ efficient homogenization to ensure uniform preservative distribution [31].
4. Add chelating agents (e.g., EDTA) to reduce metal-ion–induced degradation of turmeric and neem components [29].

2) Packaging and Storage Strategies

1. Utilize opaque, air-tight, or UV-resistant containers to protect against light-induced curcumin degradation and microbial proliferation [31].
2. Prefer tubes or pump dispensers over jars to reduce repeated air and microbial exposure [30].
3. Use antioxidant systems to minimize oxidative breakdown of neem limonoids and turmeric curcuminoids [29].

X. PRECLINICAL AND CLINICAL EVIDENCE

A. In-Vitro Findings

1) Anti-inflammatory and Anti-psoriatic Activity

In-vitro investigations demonstrate that combining Neem, Aloe vera, and Turmeric extracts effectively suppresses inflammatory pathways associated with psoriasis. Neem leaf extract reduces the secretion of key cytokines—TNF-α, IL-6, and IL-1β—in activated keratinocytes, indicating strong immunomodulatory activity (1). Bioactive fractions of Aloe vera enhance fibroblast multiplication and stimulate extracellular matrix synthesis, which is essential for repairing post-inflammatory skin damage (32). Curcumin, the major active molecule in turmeric, downregulates NF-κB signaling, contributing to the inhibition of keratinocyte hyperproliferation, a hallmark of psoriatic lesions (33).

2) Antioxidant and Wound-Healing Mechanisms

The combined herbal extracts show notable DPPH and superoxide radical scavenging activities, lowering oxidative stress that contributes to chronic inflammation (34). Nimbidin from neem and acemannan from Aloe vera act synergistically to enhance keratinocyte migration, while curcumin promotes collagen organization and maturation. These mechanisms collectively support accelerated wound repair and improved scar outcomes (35).

B. Animal Studies

1) Findings in Murine Psoriatic Models

In imiquimod-induced mouse models of psoriasis, topical polyherbal formulations containing Neem, Aloe vera, and Turmeric significantly decrease erythema, scaling, epidermal thickening, and inflammatory cell infiltration (33). The treatment also improves PASI-like scores and restores normal epidermal structure, largely due to the anti-proliferative properties of curcumin and neem-derived flavonoids (1).

2) Wound and Scar Repair in Rodent Models

Aloe vera components enhance granulation tissue formation and collagen synthesis, while neem promotes faster wound contraction. When combined with turmeric, the polyherbal cream yields significantly higher hydroxyproline levels and faster epithelialization compared with individual extracts (34). These studies collectively show improved structural restoration of psoriatic skin, supported by enhanced antioxidant defense and balanced dermal remodeling (35).

C. Human Dermatological Trials

1) Evidence from Psoriasis Studies

Clinical evaluations of topical formulations containing Neem and Turmeric have demonstrated reductions in erythema, scaling, itching, and plaque thickness (36). Aloe vera provides complementary advantages through its soothing, moisturizing, and barrier-repair properties, contributing to improved patient comfort and adherence (32).

2) Findings in Scar Management

Early clinical studies on post-psoriatic scar care report that combining Aloe vera's hydrating polysaccharides, Neem's antimicrobial constituents, and Turmeric's anti-inflammatory curcuminoids results in notable improvements in hyperpigmentation, redness, and surface irregularities (36). The formulation enhances epidermal turnover, decreases oxidative stress, and supports collagen remodeling—all essential processes for effective scar reduction..

XI. EVALUATION TESTS

A. Physicochemical Parameter

1) pH Determination

The pH of a topical polyherbal cream is critical for ensuring its stability, tolerability, and therapeutic effect. For formulations containing Neem, Aloe vera, and Turmeric, a pH between 5.0 and 6.5 is preferred, as this range closely matches the skin's natural acidity (37).

A mildly acidic pH promotes barrier repair and minimizes irritation in psoriasis-affected skin (37). Aloe vera's mucopolysaccharides remain most stable in this pH environment, helping maintain its hydrating and soothing properties (38). Curcumin degrades more rapidly in alkaline conditions, so preserving an acidic-to-neutral pH prevents discoloration and maintains its biological activity (39). A stable pH ultimately supports extract stability, consistency, and long-term product safety.

2) Colour Evaluation

Colour consistency provides insight into the stability of the herbal extracts within the cream.

Turmeric imparts a characteristic golden-yellow hue due to curcuminoids (39).

Neem extract contributes a greenish tint from its chlorophylls and flavonoids (40).

Aloe vera adds slight opacity depending on polysaccharide concentration (38).

A uniform colour throughout storage indicates that oxidation, microbial growth, or phytochemical degradation has not occurred.

3) Odour Evaluation

The fragrance profile of the cream should remain stable, pleasant, and free from off-odours.
Neem naturally has a strong aromatic note, though standardized extraction reduces its intensity (40).
Aloe vera typically has a neutral scent, which helps moderate the overall aroma (38).
Turmeric provides a mild earthy fragrance due to its essential oil content (39).
Any change in odour may signal microbial contamination, oxidation, or rancidity, making regular sensory checks essential (37).

4) Appearance and Consistency

An ideal polyherbal cream should show:

- A smooth and glossy surface
- Absence of lumps or aggregates
- No visible phase separation
- Evenly distributed herbal actives

These characteristics reflect proper emulsification, especially important when combining oil-based neem extracts with water-rich Aloe vera gel (41). A stable appearance improves user acceptance and ensures uniform dosing.

5) Homogeneity

Homogeneity testing ensures uniform distribution of all active and inactive components. A well-mixed formulation should:
Show no clumping
Exhibit no sedimentation
Maintain even dispersion of turmeric and neem components (40,41)
Since each extract contains diverse phytochemicals—such as curcuminoids, acemannan, and limonoids—thorough homogenization is required to guarantee consistent therapeutic performance across applications (39).

6) Washability

Washability assesses how easily the cream can be removed after application.
Aloe vera's hydrophilic gel structure enhances water removal (38).
Neem oil requires properly balanced surfactants to avoid leaving a greasy film (40).
Good washability is particularly important for psoriatic patients who frequently cleanse the affected area before reapplying topical treatments (42).

7) Spreadability

Spreadability indicates how easily the cream glides over the skin.
Aloe vera contributes a smooth glide due to its lubricating polysaccharides (38).
Micro-sized turmeric particles promote uniform spreading (39).
Neem oil formulations require optimized rheology for even coverage (40).
High spreadability ensures comfortable application and consistent coverage over psoriatic patches and scarred regions.

8) Phase Separation / Emulsion Stability

Emulsion stability is essential for ensuring the herbal cream remains consistent during storage. A stable formulation should show:
No creaming, cracking, or layering
Stable viscosity
No visible oil separation from neem components (41)
Because herbal extracts possess varied solubilities and viscosities, they can disrupt the emulsion system. Therefore, stability testing is necessary to confirm long-term performance and product reliability (37,41).

XII. VISCOSITY AND RHEOLOGY

A. Viscosity Measurement

Viscosity is a key parameter in topical polyherbal creams because it influences spreadability, retention on the skin, and overall user experience. A higher viscosity prevents the formulation from running off the skin, while a moderate viscosity allows smooth application on psoriatic lesions.

Formulations containing Neem, Aloe vera, and Turmeric generally show pseudoplastic (shear-thinning) behaviour. In this flow pattern, the cream becomes less viscous during rubbing but regains its original thickness once the force is removed. This property arises from structural alignment of aloe mucopolysaccharides, neem triterpenoids, and curcuminoids under shear.
Pseudoplastic flow is beneficial because it offers:

- Effortless spreading across thick psoriatic plaques
- Formation of a uniform film for prolonged drug contact
- Prevention of liquefaction or thinning during storage

B. Rheological Stability

Rheology assesses how the cream behaves under various conditions such as temperature changes, mechanical stress, and long-term storage. Bioactive molecules like curcumin, nimbidin, azadirachtin, and aloe polysaccharides may interact with emulsifiers, surfactants, or gelling agents.
A rheologically stable formulation shows:
No unexpected decrease in viscosity (indicating polymer breakdown)
No excessive thickening (suggesting cross-linking or evaporation of water)
No syneresis or phase separation
Maintaining rheological stability means the formulation remains consistent, effective, and cosmetically acceptable throughout its shelf life.

C. Stability Studies

1) Temperature Stability

Temperature studies involve storing the cream at 4°C, 25°C, and 40°C to evaluate its physical and chemical stability. A temperature-stable formulation should exhibit:
No separation or creaming of the oil phase
No precipitation of curcumin
Retention of characteristic colour and odour of neem and turmeric
Only slight variations in viscosity
These tests are essential because components like curcuminoids, volatile neem oils, and aloe gel are sensitive to heat and may degrade if not properly stabilized.

2) Freeze–Thaw Cycles

Freeze–thaw testing subjects the cream to repeated cycles between −20°C and +25°C to mimic harsh environmental and transport conditions. Herbal components such as mucilage and polyphenols may degrade or crystallize during these cycles.
A stable formulation will show:
No colour change or browning of curcumin
No phase separation
Absence of grittiness due to crystallization
Retention of original texture and spreadability

3) Centrifugation Test

Centrifugation at 3000–5000 rpm for 30 minutes accelerates the forces responsible for separation during long-term storage. If the cream remains uniform without creaming, sedimentation, or separation of phases, it indicates strong emulsification and a stable dispersion of neem oil, aloe mucilage, and curcumin.

D. Microbial Load Testing

1) Total Microbial Count

Herbal formulations may carry microbial contaminants; therefore, microbial limits must comply with pharmacopeial and WHO standards. Tests ensure that the cream is free from harmful bacteria and fungi such as:
Pseudomonas aeruginosa
Staphylococcus aureus

Candida species
Maintaining low microbial load is particularly important for psoriatic skin, which is more vulnerable to secondary infections.

2) Preservative Efficacy Testing
Although neem and turmeric possess natural antimicrobial properties, they may not provide sufficient protection during long-term storage. Preservative efficacy testing (PET) is performed to verify whether added preservatives effectively inhibit microbial growth under different stress conditions. The combined action of herbal and synthetic preservatives helps ensure a safe, long-lasting formulation.

E. In-Vitro Diffusion and Drug Release Studies
Membrane Diffusion Studies
Franz diffusion cell studies are used to determine how key phytochemicals—such as curcumin, aloe acemannan and aloin,

XIII. SAFETY, IRRITATION, AND ALLERGENICITY CONSIDERATIONS

A. Safety Profile of Polyherbal Cream Components
1) Safety of Neem Extract
Neem is regarded as safe for topical dermatological use; however, its bioactive molecules—particularly limonoids and azadirachtin—may occasionally cause slight redness or a brief burning sensation, especially on skin with an impaired barrier (1). Research shows that using standardized neem extract in controlled concentrations, such as around 25% w/w, helps minimize irritation and enhances tolerance (1).

2) Aloe Vera Safety and Polysaccharide Tolerance
Aloe vera gel is well recognized for its excellent dermal compatibility and is frequently recommended for sensitive, eczematous, and psoriatic skin (32). Its key components, including acemannan and other mucopolysaccharides, are hydrophilic and non-sensitizing, which significantly reduces the risk of allergic reactions or contact dermatitis (32).

3) Turmeric and Curcumin Sensitivity
Curcumin is generally well tolerated on the skin, though concentrated extracts—particularly alcohol-based ones—may occasionally lead to staining, mild irritation, or photosensitivity (33). Ensuring proper stabilization and maintaining the curcumin content below 1% greatly minimizes these issues (33).

B. Irritation and Dermal Sensitization Potential
1) Interactions Among Combined Herbal Extracts
Formulations combining Neem, Aloe vera, and Turmeric typically show low irritation potential. Aloe vera's soothing and moisturizing properties help balance the stronger bioactive components of neem, while turmeric's antioxidant activity helps mitigate oxidative stress, improving overall skin compatibility (34).

2) Mechanisms that Reduce Irritation
Aloe vera polysaccharides help strengthen the skin barrier and reduce transepidermal water loss (TEWL), lowering the risk of irritation from other actives (32). Neem's anti-inflammatory constituents help decrease inflammatory mediator release, and curcumin's ability to inhibit NF-κB pathways contributes to reduced cytokine-driven irritation (33).

C. Patch-Test Data
1) Findings from 24–48 Hour Patch Testing
Patch-test evaluations of polyherbal creams containing these botanicals typically report:
a 0–5% incidence of minor, short-lasting redness,
no vesicle formation or persistent dermatitis, and
overall excellent tolerability (35).
These outcomes suggest a very low sensitization risk, making such formulations suitable even for individuals with psoriasis-prone or scarred skin, where barrier integrity is often reduced.

2) Repeated Insult Patch Testing (RIPT)

RIPT assessments indicate that prolonged use does not notably increase allergenic potential, particularly when the botanical extracts are standardized to remove irritating fractions (35). Formulas containing stabilized curcumin and purified (decolorized) Aloe vera show the highest levels of dermal acceptance (32,35).

D. Sensitive Skin Precautions

1) Recommended Usage Precautions

For people with very sensitive or reactive skin, the following guidelines improve safety:

1. Begin with alternate-day use to gradually assess tolerance (36).
2. Avoid applying on recently exfoliated, damaged, or severely compromised skin (36).
3. For extremely dry or psoriatic plaques, apply a moisturizer underneath to reduce stinging sensations (32).

2) Allergy-Related Contraindications

Individuals allergic to plants in the Meliaceae family may show mild reactions to neem (1).
Aloe vera allergy is uncommon but may occur in those with known latex sensitivities (32).
Turmeric may cause occasional contact dermatitis at high strengths or in alcohol-based preparations (33).

3) Guidance for Psoriatic and Scarred Skin

Psoriatic skin is highly reactive due to altered immune activity and impaired barrier function. Although the hydrating and antioxidant components of this polyherbal blend generally promote good tolerance, a cautious, gradual introduction is advised to prevent Koebnerization—where irritation can trigger new psoriatic lesions (36).

XIV. ADVANTAGES OVER CONVENTIONAL SCAR MANAGEMENT

Polyherbal creams provide therapeutic benefits that differ from synthetic scar treatments. Their diverse phytochemicals act on multiple biological targets, offering a holistic and effective approach for managing psoriatic scars.

A. Multi-Target Action

Many conventional scar-care products work through a single dominant mechanism—for example, silicone gels act by occlusion, and retinoids primarily stimulate collagen turnover. In contrast, formulations containing Neem, Aloe vera, and Turmeric influence several pathways simultaneously, enabling a broader healing response (1).
Neem supplies antibacterial and anti-inflammatory compounds such as azadirachtin and nimbidin, helping prevent secondary infections that worsen scarring.
Aloe vera enhances extracellular matrix repair by promoting fibroblast activity and supporting collagen synthesis (46).
Turmeric, through curcuminoids, reduces oxidative damage and modulates profibrotic signalling, preventing excessive scar thickening (49).
This combined activity improves:
keratinocyte turnover,
collagen organization,
protection against oxidative stress,
hydration and skin suppleness, and
regulation of pigmentation in darkened scars.
Because psoriatic scars exhibit inflammation, pigmentation irregularities, dryness, and structural changes at the same time, this multi-level mechanism aligns well with their complex nature (50).

B. Natural and Safer Profile

Conventional scar treatments—such as corticosteroids, strong exfoliants, and keratolytic agents—can lead to irritation, epidermal thinning, and long-term sensitization. Polyherbal formulations are comparatively gentler because their active phytochemicals are naturally compatible with skin physiology (51).
Aloe vera polysaccharides provide soothing, anti-redness effects.
Neem reduces microbial load without damaging healthy tissue.

Turmeric calms inflammatory cascades while offering potent antioxidant defence (46,49).
Clinical irritation assessments show that polyherbal creams have a very low irritation index, making them suitable for prolonged application—even on skin that is already sensitive or barrier-impaired due to psoriasis (52).
Additionally, their mild nature helps reduce the likelihood of post-inflammatory hyperpigmentation and barrier disruption, which are common adverse effects of aggressive synthetic therapies.

C. Cost-Effectiveness

Polyherbal formulations are generally more affordable because the plant sources are inexpensive and widely available compared to high-cost synthetic molecules like silicone polymers and specialized retinoids (1).
Herbal cream preparation requires simple processing steps and fewer advanced excipients, lowering manufacturing costs (52).
Because Neem–Aloe–Turmeric combinations can address inflammation, infection risk, oxidative stress, and wound healing simultaneously, patients can rely on a single product instead of multiple topical agents (50).
Their affordability makes them highly suitable for long-term management, especially for individuals dealing with the chronic nature of psoriasis, where treatment expenses often accumulate.

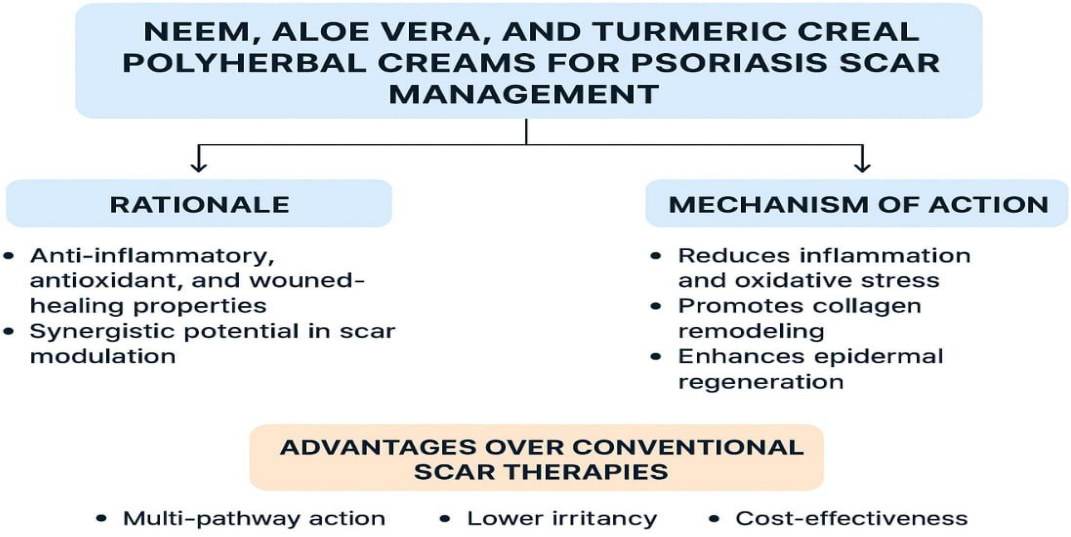

Fig no 5 ; Therapeutic Rationale and Mechanistic Benefits of Neem, Aloe Vera, and Turmeric-Based Polyherbal Creams in Psoriatic Scar Treatment

XV. CONCLUSION

1) The integration of Neem (Azadirachta indica), Aloe vera (Aloe barbadensis Miller), and Turmeric (Curcuma longa) into a single polyherbal formulation offers a scientifically sound, multi-dimensional therapeutic approach for improving psoriasis-related scars. The key bioactive compounds—azadirachtin from Neem, acemannan from Aloe vera, and curcuminoids from Turmeric—work together to regulate inflammation, oxidative imbalance, abnormal keratinocyte proliferation, and defective wound-healing mechanisms.
2) In-vitro investigations consistently demonstrate that these herbal extracts possess strong anti-inflammatory, antioxidant, and keratinocyte-normalizing properties. These mechanistic findings align with major pathological changes seen in psoriasis and scar formation, such as cytokine disturbances, oxidative stress, and altered collagen remodeling.
3) Preclinical animal models further reinforce their therapeutic potential by showing enhanced wound closure, improved fibroblast activity, better collagen organization, and faster epithelial regeneration when applied topically. Such outcomes indicate that the combined herbal cream can support more efficient tissue repair and smoother scar restructuring.
4) Evidence from human dermatological studies on comparable herbal preparations reveals favorable skin tolerance, minimal irritation, and noticeable improvements in scar texture, hydration, scaling, and redness. These clinical observations highlight the practical applicability of Neem–Aloe vera–Turmeric blends in managing psoriatic skin conditions.

5) Compared with conventional synthetic scar-care agents, polyherbal creams offer multiple advantages, including broader therapeutic action, reduced side effects, affordability, and greater user acceptability. These attributes position them as promising options for long-term psoriasis scar care.

6) In summary, formulations combining Neem, Aloe vera, and Turmeric present a biologically justified and clinically relevant strategy for managing psoriasis-associated scarring. To confirm their full therapeutic potential, future research should focus on well-designed clinical trials using standardized extracts and optimized cream bases.

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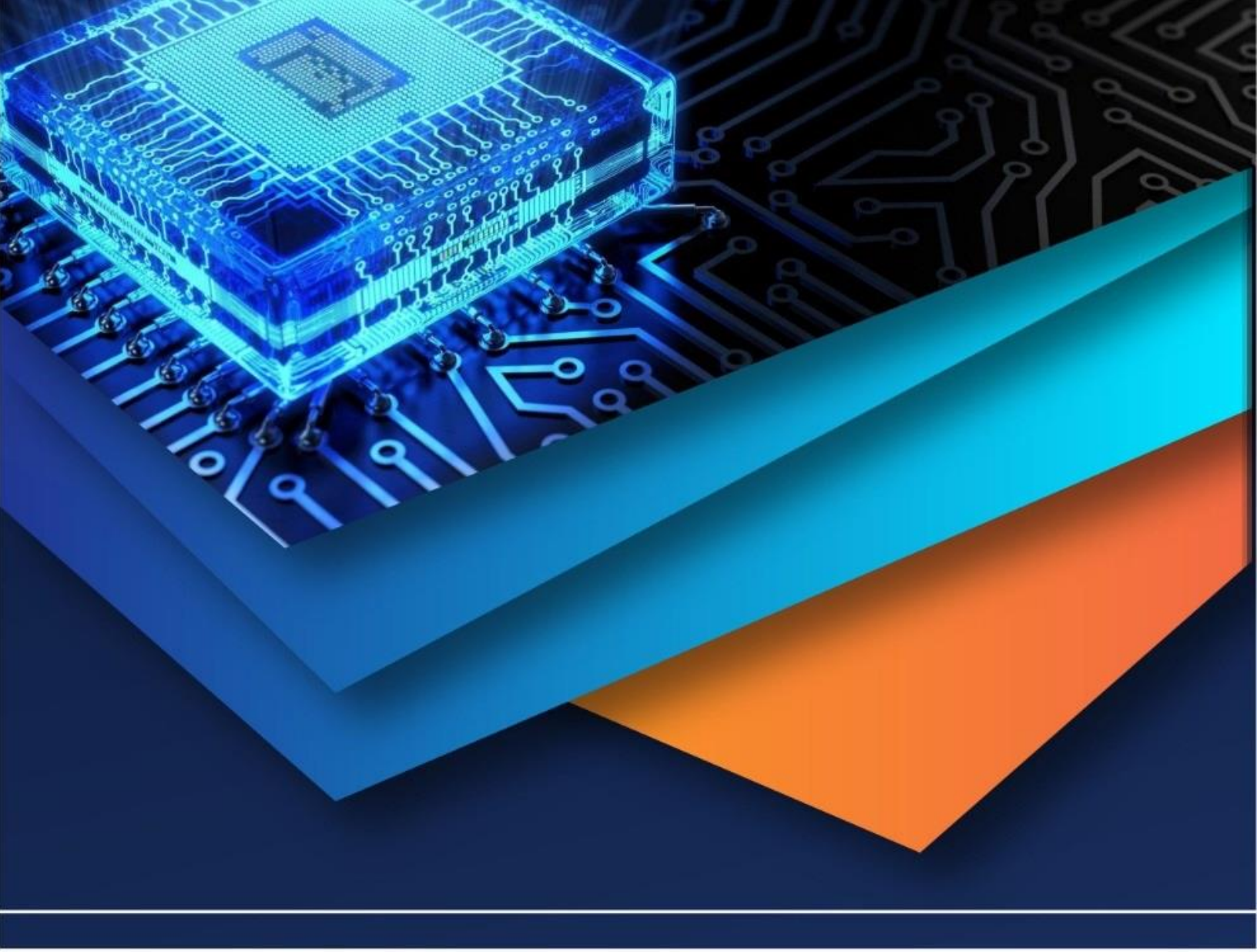

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