



Review Article

Healing from the Desert: Southwestern U.S. Indigenous Botanicals for Inflammatory Skin Conditions

Andres Parga, M.D.¹, Hannah Coven, R.D.N., M.S.²

¹ HCA Florida Oak Hill Hospital/University of South Florida Morsani College of Medicine, ² College of Health Solutions, Arizona State University

Keywords: Ethnobotany, Inflammatory skin disease, Indigenous medicine, *Larrea tridentata*, *Yucca*, *Juniperus monosperma*, *Aloe vera*, Southwestern United States, Integrative dermatology

Journal of Integrative Dermatology

Relevance

For millennia, Indigenous communities of the American Southwest have used native plants to treat skin inflammation, wounds, and infections. Despite this rich ethnobotanical knowledge, many of these therapies remain underrepresented in dermatologic literature and practice.

Objective

This review bridges traditional Indigenous use and modern scientific validation of four Southwestern botanicals, *Larrea tridentata* (chaparral), *Yucca* spp., *Juniperus monosperma* (desert cedar), and *Aloe vera*, with established or emerging applications in inflammatory skin conditions.

Methods

A structured literature search was conducted across biomedical and ethnobotanical databases (PubMed, Scopus, ScienceDirect, Google Scholar, AnthroSource). Inclusion criteria prioritized topical use, Indigenous documentation, Southwestern U.S. origin, and relevance to dermatology. Extracted data were organized into four categories: traditional use, phytochemistry, mechanisms of action, and safety.

Results

All four botanicals demonstrated convergent support between traditional applications and biomedical findings. *Larrea tridentata* exhibits potent antioxidant and anti-inflammatory activity via nordihydroguaiaretic acid, though systemic toxicity limits internal use. *Yucca* spp. deliver saponins and flavonoids that suppress NF- κ B and MAPK pathways, reduce cytokines, and combat microbial infections. *Juniperus monosperma*, rich in thujone, α -pinene, and bornyl acetate, demonstrates antimicrobial and anti-inflammatory activity, with caution warranted due to potential neurotoxicity in high concentrations. Of the four botanicals studied, *Aloe vera* shows the most robust clinical evidence for wound healing, eczema, and psoriasis, with key compounds like acemannan and aloin supporting epithelial regeneration and cytokine modulation.

Conclusion

Southwestern Indigenous botanical therapies for skin inflammation are increasingly supported by molecular and clinical evidence. Integrating these therapies into modern dermatology requires both scientific rigor and cultural respect. Future research should emphasize culturally contextualized formulations, safety assessments, and collaborative efforts with Indigenous communities to ethically preserve and apply ancestral knowledge.

INTRODUCTION

Indigenous peoples of the Southwestern United States have long relied on botanical medicine for dermatologic care, using native plants to treat wounds, rashes, burns, and inflammatory conditions in arid and sun-exposed environments (Table 1). This knowledge, interwoven with

ceremony, ecological stewardship, and oral tradition, pre-dates and underlies many ingredients now found in commercial skin care.^{1,2} However, despite growing biomedical interest in phytomedicine, the dermatologic traditions of Native American communities remain underrepresented in clinical literature and commercial dermatology.

Table 1. Ethnobotanical Use and Dermatologic Applications of Key Southwestern Plants

Plant	Indigenous Use	Dermatologic Indications	Application Form	Region	Tribe
<i>Larrea tridentata</i> (Chaparral)	Poultices, tea	Wounds, infection, inflammation	Poultice, wash	AZ, NM	Cahuilla, Pima
<i>Yucca spp.</i>	Root soap, scalp/hair wash	Eczema, scalp irritation	Root extract	NM, AZ	Navajo, Pueblo
<i>Juniperus monosperma</i> (Desert Cedar)	Steam bath, salves	Swelling, purification	Essential oil, steam	Southwest US	Apache, Hopi
<i>Aloe vera</i>	Burn/wound remedy	Burns, psoriasis, eczema	Gel	Southwest US	Yoeme, Xicana

This gap is particularly pressing given the disproportionate burden of inflammatory skin conditions in rural and Indigenous populations, including atopic dermatitis, xerosis, and bacterial or fungal infections secondary to environmental stressors such as sun exposure, dust, and limited water access.^{3,4} Limited access to dermatologic care further exacerbates these conditions, reinforcing health inequities that disproportionately affect Native and underserved communities.

This review aims to respectfully bridge traditional ethnobotanical wisdom with modern scientific findings, focusing on four botanicals commonly used by Southwestern tribes: *Larrea tridentata* (chaparral), *Yucca spp.*, *Juniperus monosperma* (desert cedar), and *Aloe vera*. Each plant is explored for its phytochemical constituents, clinical relevance, anti-inflammatory and wound-healing mechanisms, and safety considerations. We frame this exploration not only as a scientific endeavor but as a step toward ethical inclusion and preservation of Indigenous dermatologic knowledge.

By highlighting the convergence of ancestral healing and recent contemporary scientific research, this review supports the integration of culturally contextualized botanicals into evidence-based dermatology, particularly in settings where conventional therapies may be inaccessible, unaffordable, or culturally incongruent.⁵⁻⁷

MATERIALS AND METHODS

A structured literature review was conducted between January and April 2025 using databases including PubMed, Scopus, Google Scholar, ScienceDirect, and AnthroSource. Search terms combined plant names (eg, *Aloe vera*, *Yucca spp.*, *Larrea tridentata*, *Juniperus spp.*) with keywords such as “Indigenous,” “Southwest,” “dermatology,” and “topical use.” Inclusion criteria required sources to document topical application, Southwestern U.S. botanical species, Indigenous ethnobotanical relevance, and dermatologic utility. Studies limited to systemic use or lacking phytochemical or pharmacologic evidence were excluded. Each plant was analyzed using a four-part framework: (1) traditional Indigenous use, including preparation and cultural context; (2) phytochemistry, emphasizing active compounds like saponins, flavonoids, and lignans; (3) mechanisms of action, such as cytokine inhibition or antioxidant

activity; and (4) safety, drawing from both traditional practices and modern toxicology. This approach allowed cross-validation of ancestral knowledge with biomedical evidence to assess relevance for modern integrative dermatology.

RESULTS

1. KEY BOTANICALS (FIGURE 1)

1.1. CHAPARRAL (*LARREA TRIDENTATA*)

TRADITIONAL USE

Chaparral (*Larrea tridentata*), or creosote bush, is one of the most widely utilized plants in Indigenous Southwestern medicine. Tribes including the Cahuilla, Pima, and Apache have long applied poultices of its leaves and stems to treat skin infections, wounds, fungal eruptions, and rheumatic pain.^{4,8} Preparations such as “chaparral tea” or resinous compresses were also used ceremonially and for purifying the skin after environmental exposure.

PHYTOCHEMISTRY

The primary bioactive compound in *L. tridentata* is nordihydroguaiaretic acid (NDGA), a potent lignan that can comprise up to 50% of the leaf resin.⁷ Other constituents include quercetin, catechins, flavonolignans, saponins, and essential oils. NDGA and its derivatives possess powerful antioxidant, anti-inflammatory, and antimicrobial properties, making them pharmacologically promising yet controversial due to toxicity concerns (Table 2).^{7,8}

MECHANISMS OF ACTION

NDGA exhibits dual lipoxygenase and cyclooxygenase inhibition, reducing leukotrienes and prostaglandins central to cutaneous inflammation. In vitro assays show superoxide scavenging capacity surpassing vitamin C, and significant reductions in TNF- α , IL-1 β , and COX-2 activity.^{7,9} NDGA also activates the NRF2 antioxidant pathway while simultaneously downregulating redox-sensitive inflammatory genes like Sp1 and NF- κ B.⁹ Recent hydrogel-based formulations using *Larrea* extract enhanced fibroblast adhesion and promoted wound healing in vivo without cytotoxicity.¹⁰



2

Figure 1. Mechanistic pathways of Southwestern U.S. botanicals in dermatologic inflammation and skin repair.

Illustrated mechanisms of action for four traditional medicinal plants: *Larrea tridentata* (Chaparral) inhibits lipoxygenase (LOX) and cyclooxygenase (COX) enzymes and activates the NRF2 antioxidant response pathway. *Yucca spp.* suppress nuclear factor-kappa B (NF- κ B) and mitogen-activated protein kinase (MAPK) signaling while supporting epidermal barrier restoration. *Juniperus monosperma* (Desert Cedar) downregulates pro-inflammatory cytokines and disrupts microbial membranes through monoterpene action. *Aloe vera* enhances type I collagen synthesis, modulates cytokines, and upregulates aquaporin-3 (AQP3), supporting hydration and epithelial repair. Parga, A. (2025). Southwestern Botanicals Mechanisms. Zenodo. <https://doi.org/10.5281/zenodo.15547979>

ANTIMICROBIAL EFFECTS

Modern studies affirm the plant's broad-spectrum antimicrobial activity, with ethanol extracts showing >99.9% inhibition against *Staphylococcus aureus*, *Pseudomonas aeruginosa*, and *Malassezia spp.*¹¹ The mechanisms likely involve

phenolic disruption of microbial membranes and fungal β -1,3-glucanase inhibition.⁴

MODERN SAFETY CONSIDERATIONS

Although *L. tridentata* is non-cytotoxic in vitro at topical concentrations, its use is limited by the systemic hepatotoxicity of NDGA. High-dose ingestion has been associated with nephropathy and bile duct injury, leading to its removal from the Food and Drug Administration (FDA) food additive lists.^{8,9} However, as of late, newer methylated derivatives (eg, M4N) and nanocarrier formulations are being developed to retain bioactivity while mitigating systemic toxicity.¹² For dermatologic use, topical application of controlled-extract preparations remains the safest and most effective route.

SUMMARY

L. tridentata exemplifies the intersection of ancestral Indigenous knowledge and modern phytomedicine. Its NDGA-rich profile offers compelling anti-inflammatory, antioxidant, and antimicrobial potential for skin conditions such as eczema, infected wounds, and fungal dermatoses. While internal use carries toxicity risk, topical formulations rooted in traditional poultice methods offer a culturally grounded and scientifically supported therapeutic avenue.

1.2. YUCCA (*YUCCA SPP.*)

TRADITIONAL USE

Yucca, known as the "soap root" or "desert cleanser," holds deep ethnobotanical significance for Indigenous communities across the Southwest, including the Navajo, Apache, and Pueblo peoples. Traditionally, yucca roots were pulverized to create foamy skin washes used to cleanse wounds, soothe eczema, and reduce joint swelling.^{1,13} Yucca was also ritually used to purify the scalp, promote hair growth, and relieve inflammation of the skin, scalp, and joints, particularly through intergenerational ceremonial practice among the Yoeme and Hopi.¹⁴

PHYTOCHEMISTRY

Yucca is pharmacologically rich in steroidal saponins, which confer both its foaming and medicinal properties.

Table 2. Antioxidant and Anti-inflammatory Activities (In Vitro Assays)

Plant	DPPH (IC ₅₀ μ g/mL)	ABTS	Scavenging Activity	Suppression of Inflammatory Markers
<i>Larrea tridentata</i> (Chaparral)	8.49	Strong	\downarrow NO	\downarrow IL-6, TNF- α
<i>Yucca spp.</i>	29.18	Moderate	\downarrow NO, COX-2	\downarrow IL-1 β , TNF- α
<i>Juniperus monosperma</i> (Desert Cedar)	Not reported	High (via α -thujone)	\downarrow iNOS	\downarrow TNF- α , IL-1 β
<i>Aloe vera</i>	Varies by extract	Moderate	\downarrow ROS, \downarrow NO	\downarrow JAK/STAT, NF- κ B

Abbreviations: DPPH: 2,2-diphenyl-1-picrylhydrazyl; IC₅₀: Half-maximal inhibitory concentration; ABTS: 2,2'-azino-bis(3-ethylbenzothiazoline-6-sulfonic acid); NO: Nitric oxide; iNOS: Inducible nitric oxide synthase; COX-2: Cyclooxygenase-2; ROS: Reactive oxygen species; IL: Interleukin; TNF- α : Tumor necrosis factor-alpha; JAK/STAT: Janus kinase / Signal transducer and activator of transcription; NF- κ B: Nuclear factor kappa B

Table 3. Dermatologic Use of Yucca-Derived Bioactives

Compound	Dermatologic Use	Current Status in Skincare
Quercetin	Anti-inflammatory, antioxidant, reduces UV damage and hyperpigmentation	Widely used in serums and creams
Resveratrol	Antioxidant, combats photoaging and oxidative stress	Popular in anti-aging and rejuvenation products
Caffeic Acid	Antioxidant, tyrosinase inhibitor (skin brightening, anti-aging)	Present in formulations for melasma/photodamage
Gallic Acid	Antioxidant, anti-inflammatory, skin tone improvement	Used in skin-brightening and anti-aging products
Luteolin	Anti-inflammatory, soothing, potential for rosacea and sensitive skin	Emerging in plant-based calming formulations
Apigenin	Anti-inflammatory, used for irritated and sensitive skin	Niche use in botanical formulations
Shikimic Acid	Mild exfoliant (AHA-like), promotes skin renewal	Used in Asian cosmeceuticals and peels
Steroidal Saponins	Foaming, antimicrobial, enhances penetration	Recognized potential; limited use in natural cleansers
Trans-4,4'-Dihydroxystilbene	Anti-inflammatory, anti-cancer potential	Preclinical; not yet used in commercial skincare
Yuccaloesides / Gloriosaols	Saponins with antioxidant and anti-inflammatory effects	Not commercialized; potential area for exploration

Studies have identified over 100 saponins from various *Yucca* species, with prominent spirostane structures such as yuccaloeside A–E and gloriosaol A–E, as well as flavonoids like quercetin, luteolin, apigenin, and resveratrol.^{15–17} Other key constituents include phenolic acids (caffeic acid, gallic acid), shikimic acid, and anti-inflammatory stilbenes such as trans-4,4'-dihydroxystilbene.¹⁸ (Table 3).

MECHANISMS OF ACTION

Yucca's anti-inflammatory activity is driven by the suppression of multiple cytokines and signaling pathways. *Yucca* root and leaf extracts downregulate TNF- α , IL-1 β , IL-6, and COX-2 expression, while also inhibiting the NF- κ B, JAK/STAT, and MAPK (p38, ERK1/2, JNK) pathways.^{16,17} The saponins and stilbenes act in synergy to inhibit nitric oxide production via iNOS and reduce reactive oxygen species through Nrf2 activation.¹⁵ Notably, yuccaol A and C have been shown to inhibit β -glucuronidase and NO in macrophages, suggesting a role in chronic inflammatory dermatoses. In a carrageenan-induced rat paw model, *Yucca gigantea* extract significantly lowered TNF- α and COX-2, improved histologic skin structure, and restored GSH levels.¹⁶

ANTIMICROBIAL AND BARRIER-SUPPORTIVE EFFECTS

Yucca's saponin-rich butanolic extracts inhibit both Gram-positive (*Staphylococcus aureus*) and Gram-negative (*E. coli*, *P. aeruginosa*) bacterial growth, as well as *Candida albicans* and other fungi.¹⁵ The amphipathic nature of saponins allows membrane disruption and antimicrobial penetration, while the plant's high antioxidant capacity, measured via DPPH, ORAC, and FRAP assays, supports its ability to mitigate oxidative barrier damage.¹⁷

MODERN APPLICATIONS

Yucca's traditional cleansing function translates well into modern dermatology as a gentle topical adjunct for inflammatory conditions like eczema, especially when compounded into soaps, hydrosols, or foaming gels. Clinical formulations that harness its saponins and flavonoids show promise in restoring the skin barrier, scavenging free radicals, and reducing microbial colonization, all without the steroid-associated side effects. As a bonus, topical preparations avoid the hepatotoxicity observed in oral saponin overdoses and maintain favorable safety profiles in vivo.^{8,15}

SUMMARY

Yucca exemplifies a desert-adapted botanical whose intergenerational use for skin inflammation has been mechanistically validated by contemporary science. Its rich content of steroidal saponins, anti-inflammatory flavonoids, and barrier-protective antioxidants supports its continued exploration in integrative dermatology, especially for conditions like eczema, contact dermatitis, and infected wounds. With minimal toxicity and deep cultural roots, *Yucca* spp. stand as a symbol of the harmony between Indigenous plant wisdom and biomedical innovation.

1.3. CEDAR (*JUNIPERUS MONOSPERMA*)

TRADITIONAL USE

Known to many Indigenous Southwestern tribes as a sacred purifying agent, *Juniperus monosperma* (commonly referred to as desert cedar) has long been used in ceremonial steam baths, smoke cleansing rituals, and topical poultices. Among the Diné (Navajo), Pueblo, and Apache peoples, crushed needles and berries were applied to swollen joints and inflamed skin, while aromatic steam infusions were

used to treat respiratory conditions and cleanse the spirit.^{1, 14} Juniper smoke, in particular, played a dual medicinal and spiritual role, believed to detoxify both the skin and the mind.

PHYTOCHEMISTRY

The resin-rich needles and berries of *J. monosperma* are high in monoterpenes such as α -pinene, sabinene, limonene, and particularly α -thujone, an oxygenated monoterpenoid also present in Eastern white cedar (*Thuja occidentalis*).^{19,20} Other constituents include β -thujone, camphene, and terpineol derivatives, all contributing to its distinctive aroma and potent biological activity. These volatile oils act as both antimicrobial agents and skin stimulants.

MECHANISMS OF ACTION

Essential oils from various *Juniperus* species, including *J. monosperma* analogs such as *J. communis* and *J. chinensis*, exhibit robust antimicrobial and anti-inflammatory activity. In vitro studies show that α -pinene and β -thujone inhibit the production of pro-inflammatory cytokines like TNF- α , IL-1 β , and IFN- γ via suppression of NF- κ B and iNOS pathways.¹⁹ Lipid peroxidation markers such as MDA are also reduced, indicating antioxidant capacity. Antimicrobial assays reveal that *J. communis* oil possesses MIC values as low as 4.75 μ g/mL against *S. aureus*, with comparable activity against *E. coli* and various fungal strains including *Aspergillus* and *Trichophyton*.^{19,20} These results, though derived from close relatives, are likely translatable to *J. monosperma*, given the shared chemical profile and traditional usage overlap.

MODERN DERMATOLOGIC APPLICATIONS

Cedar essential oils are increasingly incorporated into topical formulations aimed at treating acne, contact dermatitis, and oily skin conditions due to their astringent and purifying properties. In integrative dermatology, hydrosols and diluted essential oil preparations derived from this species are used for wound cleansing, fungal skin infections, and even scalp conditions such as seborrheic dermatitis.¹ Its vasodilatory and circulation-enhancing actions also make it a candidate for post-inflammatory hyperpigmentation care. However, due to thujone's known neurotoxicity at high doses, formulation safety requires precise dilution, especially for application on compromised skin or in pediatric populations.²¹

RISKS AND SAFETY CONSIDERATIONS

Thujone is a known neurotoxin at high concentrations and may provoke seizures through GABA receptor antagonism. Regulatory agencies, including the European Medicines Agency, limit thujone content in topical formulations to prevent systemic absorption.²² Contact dermatitis has also been reported with undiluted or oxidized oils. Therefore, clinical use of *J. monosperma* must rely on low-dose, well-characterized extracts with known chemotypes. Topical application of diluted cedar oil in carrier bases (eg, jojoba,

glycerin) is generally well tolerated when used intermittently.

SUMMARY

Cedar, specifically *Juniperus monosperma*, embodies the integrative potential of plant-based medicine rooted in ceremony, tradition, and science. Its volatile oils, rich in thujone and α -pinene, provide antimicrobial and anti-inflammatory effects validated by modern pharmacology. When formulated responsibly, cedar offers a culturally resonant botanical for treating inflammatory and infectious skin conditions, especially in underserved communities where traditional plant knowledge remains an untapped resource for sustainable dermatologic care.

1.4. ALOE (ALOE VERA)

TRADITIONAL USE

While not endemic to the American Southwest, *Aloe vera* has been embraced by Indigenous desert-dwelling communities such as the Yoeme and Xicana peoples as a "hero plant" for treating sunburns, insect bites, and dry, inflamed skin.¹ Traditionally, the fresh inner gel was applied directly to burns and wounds, hydrating and cooling the skin while simultaneously aiding healing. These practices reflect deep environmental adaptation, with aloe serving both medicinal and survival purposes in arid climates.

PHYTOCHEMISTRY

Aloe vera gel contains over 200 bioactive constituents, including polysaccharides (especially acemannan), glycoproteins, sterols (β -sitosterol), anthraquinones (aloin, aloe-emodin), flavonoids, trace minerals (zinc, magnesium), and salicylic acid.^{23,24} Acemannan, a mannose-rich polysaccharide, is considered the principal compound responsible for aloe's wound healing and immunomodulatory effects.

MECHANISMS OF ACTION

Aloe's healing properties are driven by its capacity to reduce inflammation, enhance fibroblast activity, and stimulate collagen synthesis. Acemannan activates macrophages, increases cytokine signaling (IL-6, IL-8, IL-10), and promotes type I collagen production via Smad and MAPK pathways.^{23,25} Anthraquinones like aloin inhibit JAK1-STAT1/3 and ROS production, reducing TNF- α , IL-1 β , and IL-6 levels.²⁶ Aloe also restores tight junction proteins (eg, claudin-1, ZO-1) and reduces Th2/Th17-driven inflammation in atopic dermatitis models.²⁷ Extracellular vesicles derived from Aloe gel have recently been shown to shift macrophages from pro-inflammatory (M1) to regulatory (M2) phenotypes, offering a novel mechanism of immune modulation.²⁸

EVIDENCE-BASED DERMATOLOGIC APPLICATIONS

Aloe's traditional uses have been strongly validated by modern clinical trials. A systematic review of 23 human trials found that Aloe significantly accelerated healing in burns, ulcers, cesarean wounds, cracked nipples, and pres-

sure sores, often outperforming standard treatments like silver sulfadiazine and lanolin.²⁹ One randomized trial reported a 29% faster wound healing time and complete closure by day 15 with Aloe hydrogel.³ Another RCT involving 2,248 psoriasis patients showed that an Aloe-propolis ointment led to complete lesion clearance in 64.4% of participants.³⁰ In vitro studies also demonstrate Aloe's ability to upregulate aquaporin-3 (AQP3), a key protein in skin hydration, by over 380% when combined with betaine.³¹

CONDITIONS TREATED

Aloe is clinically beneficial in:

- Burns and radiation dermatitis
- Psoriasis and atopic dermatitis (eczema)
- Wound healing post-biopsy, graft, or surgery
- Xerosis and transepidermal water loss

SAFETY AND FORMULATION CONSIDERATIONS

Aloe is generally well tolerated in topical applications, especially when derived from the inner leaf gel. Rare adverse effects include mild dryness or irritation in sensitive individuals.⁵ Toxicity concerns related to anthraquinones like aloin and alo-emodin apply mainly to oral preparations or whole leaf extracts; thus, dermatologic formulations adhere to International Aloe Science Council (IASC) guidelines, limiting aloin to <10 ppm.²⁴ Traditional usage of fresh aloe gel aligns with safe, effective application, though commercial dilution often reduces therapeutic potency.

SUMMARY

Aloe vera bridges ancient desert knowledge and contemporary skin science, making it a standout example of ethnobotanical convergence. Its polysaccharide- and anthraquinone-rich composition supports epithelial regeneration, collagen synthesis, cytokine modulation, and hydration, properties corroborated by robust clinical and molecular data. For Indigenous and integrative dermatology alike, Aloe vera remains a culturally meaningful and biologically powerful ally in the treatment of inflammatory skin conditions.

2.0 CULTURAL CONSIDERATIONS AND ETHICAL INTEGRATION

2.1. AVOIDING CULTURAL APPROPRIATION

While many plant-based skincare ingredients have become mainstream in modern dermatology, it is crucial to recognize and credit their cultural origins. Botanicals such as *Larrea tridentata* (chaparral), *Yucca spp.*, and *Aloe vera* were not only medicinal remedies but sacred tools passed through generations by Indigenous peoples of the Southwestern United States, including the Pima, Cahuilla, Hopi, Navajo, and Yoeme communities.^{1,32} The incorporation of these plants into commercial dermatology products often occurs without proper acknowledgment or reciprocity. Cece Meadows, a Xicana and Yoeme skincare advocate, notes that many Indigenous practices are “appropriated and watered down for profit without understanding the intergen-

erational knowledge behind them.”¹ In integrative dermatology, it is imperative to resist cultural erasure by ensuring that Indigenous origins are not only cited but honored.

2.2. IMPORTANCE OF TRIBAL CONSULTATION AND CO-AUTHORSHIP

Ethnobotanical research carries a responsibility to include Native voices as partners, not subjects. Historical extraction of plant knowledge without consent or benefit-sharing has fostered deep mistrust. Therefore, tribal consultation should be a foundational step in study design, ideally including tribal IRB approval, local elder input, and co-authorship by Indigenous scholars or knowledge keepers. Ethical models include Community-Based Participatory Research (CBPR), which re-centers research priorities around community-defined goals. This is particularly important for plants like *Yucca baccata* and *Juniperus monosperma*, which are tied not only to medicinal use but to language, ceremony, and ecological identity.¹⁴

2.3. PROTECTING PLANT SOVEREIGNTY AND SUSTAINABILITY

The rise of “green beauty” and demand for botanical actives threatens the sustainability of many desert plants. *Larrea tridentata*, once used in small batches for poultices or tea, is now at risk of overharvesting for NDGA-based extracts marketed for anti-aging and skin inflammation.³³ Plant sovereignty refers to the right of Indigenous communities to control access, use, and stewardship of flora within their territories. Ethical sourcing must include sustainable wildcrafting guidelines and, ideally, formal agreements that ensure financial or educational return to Native communities. Furthermore, the inclusion of non-native plants like *Aloe vera* in Indigenous skincare traditions exemplifies adaptability but should not be mistaken for erasure of native species. True decolonization of dermatologic botanicals involves both environmental and cultural protection.

2.4. INCORPORATING INDIGENOUS VOICES IN RESEARCH AND EDUCATION

Modern dermatologic education often omits the cultural context behind widely used botanicals. Integrating Indigenous voices into medical training, whether through guest lectures, required readings, or co-authored papers, can foster a more respectful and holistic approach to skin health. Curricula should not only discuss mechanisms of action but the ecological, spiritual, and ceremonial meanings of these plants. For instance, desert cedar is used in both dermatologic care and ceremonial smoke cleansing, often simultaneously, symbolizing purification in multiple realms.^{2,14} As we pursue evidence-based medicine, we must also protect and elevate evidence grounded in oral tradition and place-based knowledge.

Table 4. Key Bioactive Compounds and Mechanisms of Dermatologic Action

Plant	Major Compounds	Molecular Pathways	Dermatologic Effects
<i>Larrea tridentata</i> (Chaparral)	NDGA, flavonoids	↓ COX/LOX, ↑ NRF2	Antioxidant, anti-inflammatory
<i>Yucca spp.</i>	Saponins, flavonoids	↓ TNF-α, ↓ NF-κB, ↑ Nrf2	Barrier support, antimicrobial
<i>Juniperus monosperma</i> (Desert Cedar)	α-/β-thujone, α-pinene	↓ IL-1β, ↓ COX-2, antimicrobial	Anti-inflammatory, antifungal
<i>Aloe vera</i>	Acemannan, aloin, aloesin	↓ JAK-STAT, ↓ MAPK, ↑ AQP3	Wound healing, hydration, cytokine modulation

Abbreviations: AQP3: Aquaporin-3; COX: Cyclooxygenase; COX-2: Cyclooxygenase-2; IL-1β: Interleukin-1 beta; JAK-STAT: Janus kinase / Signal transducer and activator of transcription; LOX: Lipoxygenase; MAPK: Mitogen-activated protein kinase; NF-κB: Nuclear factor kappa B; NDGA: Nordihydroguaiaretic acid; NRF2: Nuclear factor erythroid 2-related factor 2; TNF-α: Tumor necrosis factor-alpha

DISCUSSION

CROSS-VALIDATING TRADITIONAL AND MODERN UNDERSTANDINGS

The convergence of Indigenous knowledge and biomedical science offers a powerful validation of traditional desert botanicals. *Aloe vera*, used for generations to treat burns and dry skin, is now clinically shown to accelerate wound healing by up to 29% and promote fibroblast proliferation, angiogenesis, and collagen synthesis.^{3,29} Similarly, *Yucca spp.*, historically applied as poultices and shampoos, have demonstrated anti-inflammatory and antimicrobial efficacy through saponins, flavonoids, and NF-κB suppression.^{16,17} *Larrea tridentata* (chaparral), revered for wound care, exhibits NDGA-driven antioxidant and COX/LOX inhibition.⁷ ⁸ *Juniperus monosperma*, though under-studied compared to its eastern relatives, shares phytochemical parallels such as α-pinene and bornyl acetate with *Thuja occidentalis*, which reduces TNF-α and IL-6 in murine models.^{19,21} These findings affirm that traditional uses are not merely anecdotal, they align with immunologic and pharmacologic mechanisms recognized in modern dermatology (Table 4).

GAPS IN CLINICAL TRIALS AND DERMATOLOGIC FORMULATIONS

Despite robust *in vitro* and animal-model support, translational research remains limited. Of the four botanicals reviewed, only *Aloe vera* has undergone substantial human testing for dermatologic conditions such as psoriasis, eczema, and burns, with numerous clinical trials confirming efficacy. In contrast, *Yucca spp.*, *Larrea tridentata*, and *Juniperus monosperma*, lack formal trials in skin disease populations. Additionally, most over-the-counter formulations dilute active ingredients below therapeutic thresholds, and rarely include culturally grounded application methods.¹ This disconnect underscores the need for dermatologic products that not only incorporate traditional actives but also reflect their historical context and effective delivery systems.

RECOMMENDATIONS FOR FUTURE INTEGRATIVE DERMATOLOGY STUDIES

To responsibly bridge ethnobotany and evidence-based medicine, future research should include:

Culturally Co-designed Trials: Collaborative trials with Indigenous stakeholders to assess safety, efficacy, and formulation preferences.

Biochemical Standardization: Quantification of active compounds such as NDGA, acemannan, and steroidal saponins in both traditional and commercial preparations.

Novel Delivery Platforms: Exploration of hydrogels, emulsions, or nanocarriers (eg, Aloe-derived extracellular vesicles) to optimize penetration and reduce toxicity.^{12,28}

Safety Surveillance: Ongoing toxicologic studies to define dermal safety windows for compounds like thujone and NDGA, especially in pediatric or immunocompromised populations.

INTEGRATIVE AND EQUITABLE CARE FOR UNDERSERVED REGIONS

Many rural and reservation-based communities suffer from underdiagnosed and undertreated inflammatory skin conditions due to limited dermatologic access. Botanicals with dual anti-inflammatory and antimicrobial properties, such as *Yucca spp.* or *Larrea tridentata*, may offer low-cost, culturally acceptable adjuncts. Incorporating these therapies into teledermatology, community clinics, and mobile care platforms could help reduce access disparities while honoring traditional knowledge. The respectful integration of Indigenous botanicals, grounded in both community voice and scientific rigor, may enhance treatment options for eczema, psoriasis, and wound healing in marginalized populations across the arid Southwest.

ACKNOWLEDGMENT

We extend our deepest gratitude to the Indigenous peoples of the Southwestern United States for their willingness to open their world of science and healing with us. Their traditions, knowledge systems, and practices reflect generations of cultural preservation and environmental understanding

that continue to inspire and inform modern medicine. Our mission is to help the medical community and the broader public grow in awareness, respect, and advocacy for these populations and their beautiful cultures. We recognize the importance of preserving and honoring this knowledge with integrity, humility, and collaboration.

DISCLOSURES

The authors received no financial support, editorial assistance, or third-party editing services in the preparation of this manuscript.

CONFLICTS OF INTEREST

The authors declare no financial or personal conflicts of interest related to the content of this review.

FUNDING

This work received no external funding or financial support.

Submitted: May 29, 2025 PST. Accepted: January 19, 2026 PST.



This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC0). View this license's legal deed at <https://creativecommons.org/publicdomain/zero/1.0> and legal code at <https://creativecommons.org/publicdomain/zero/1.0/legalcode> for more information.

REFERENCES

- Fields J. These Beloved Skin Care Ingredients Are Rooted In Indigenous Cultures. TZR. November 16, 2023. Accessed May 12, 2025. <https://www.thezoereport.com/beauty/indigenous-skin-care-ingredients>
- Native American Heritage Month – Native American Beauty Tips. Avari Beauty. November 16, 2020. <https://avaribeauty.com/blogs/blog/native-american-heritage-month?srsId=AfmBOooZabi6BfPR69AI5gb5xLkqHLSAuQkDr7sx1FUINX4KNVYOMQoy>
- Albahri G, Badran A, Hijazi A, et al. The Therapeutic Wound Healing Bioactivities of Various Medicinal Plants. *Life*. 2023;13(2):317. doi:[10.3390/life13020317](https://doi.org/10.3390/life13020317)
- Herrera-Medina RE, Álvarez-Fuentes G, Contreras-Servín C, García-López JC. Creosote Bush (*Larrea tridentata*) Phytochemical Traits and its Different uses: A Review. *JALSI*. Published online April 24, 2021:34-45. doi:[10.9734/jalsi/2021/v24i230221](https://doi.org/10.9734/jalsi/2021/v24i230221)
- Anheyer M, Cramer H, Ostermann T, Längler A, Anheyer D. Herbal medicine for treating psoriasis: A systematic review. *Complementary Therapies in Medicine*. 2025;90:103173. doi:[10.1016/j.ctim.2025.103173](https://doi.org/10.1016/j.ctim.2025.103173)
- Sánchez M, González-Burgos E, Iglesias I, Gómez-Serranillos MP. Pharmacological Update Properties of Aloe Vera and its Major Active Constituents. *Molecules*. 2020;25(6):1324. doi:[10.3390/molecules25061324](https://doi.org/10.3390/molecules25061324)
- Skouta R, Morán-Santibañez K, Valenzuela CA, Vasquez AH, Fenelon K. Assessing the Antioxidant Properties of *Larrea tridentata* Extract as a Potential Molecular Therapy against Oxidative Stress. *Molecules*. 2018;23(7):1826. doi:[10.3390/molecules23071826](https://doi.org/10.3390/molecules23071826)
- Morales-Ubaldo AL, Rivero-Perez N, Valladares-Carranza B, et al. Phytochemical Compounds and Pharmacological Properties of *Larrea tridentata*. *Molecules*. 2022;27(17):5393. doi:[10.3390/molecules27175393](https://doi.org/10.3390/molecules27175393)
- Manda G, Rojo AI, Martínez-Klimova E, Pedraza-Chaverri J, Cuadrado A. Nordihydroguaiaretic Acid: From Herbal Medicine to Clinical Development for Cancer and Chronic Diseases. *Front Pharmacol*. 2020;11:151. doi:[10.3389/fphar.2020.00151](https://doi.org/10.3389/fphar.2020.00151)
- Tovar-Carrillo KL, Saucedo-Acuña RA, Ríos-Arana J, et al. Synthesis, Characterization, and In Vitro and In Vivo Evaluations of Cellulose Hydrogels Enriched with *Larrea tridentata* for Regenerative Applications. Dastjerdi R, ed. *BioMed Research International*. 2020;2020(1):1425402. doi:[10.1155/2020/1425402](https://doi.org/10.1155/2020/1425402)
- Detering M, Langland A, Terry A, Langland J. In vitro characterization of potential botanicals to reduce infection and improve the rate of wound healing in humans and canines. *BMC Complement Med Ther*. 2025;25(1):55. doi:[10.1186/s12906-025-04777-2](https://doi.org/10.1186/s12906-025-04777-2)
- John GSM, Vuttaradhi VK, Takeuchi S, Pitani RS, Venkatraman G, Rayala SK. Facile synthesis and nanoscale features of a nanostructured nordihydroguaiaretic acid analog for therapeutic applications. *J Nanobiotechnol*. 2020;18(1):74. doi:[10.1186/s12951-020-00628-z](https://doi.org/10.1186/s12951-020-00628-z)
- Morales-Figueroa GG, Pereo-Vega GD, Reyna-Murrieta ME, et al. Antibacterial and Antioxidant Properties of Extracts of *Yucca Baccata*, a Plant of Northwestern Mexico, against Pathogenic Bacteria. Snoussi M, ed. *BioMed Research International*. 2022;2022(1):9158836. doi:[10.1155/2022/9158836](https://doi.org/10.1155/2022/9158836)
- Lucero A. Southwest Region Indigenous and Wild Plants. Accessed May 12, 2025. <https://www.usda.gov/sites/default/files/documents/southwest-region-indigenous-wild-plant-list.pdf>
- Jiménez GG, Durán AG, Macías FA, Simonet AM. Structure, Bioactivity and Analytical Methods for the Determination of *Yucca* Saponins. *Molecules*. 2021;26(17):5251. doi:[10.3390/molecules26175251](https://doi.org/10.3390/molecules26175251)
- Attallah NGM, El-Sherbeni SA, El-Kadem AH, et al. Elucidation of the Metabolite Profile of *Yucca gigantea* and Assessment of Its Cytotoxic, Antimicrobial, and Anti-Inflammatory Activities. *Molecules*. 2022;27(4):1329. doi:[10.3390/molecules27041329](https://doi.org/10.3390/molecules27041329)
- Culhuac EB, Maggiolino A, Elghandour MMY, De Palo P, Salem AZM. Antioxidant and Anti-Inflammatory Properties of Phytochemicals Found in the *Yucca* Genus. *Antioxidants*. 2023;12(3):574. doi:[10.3390/antiox12030574](https://doi.org/10.3390/antiox12030574)
- Saha B, Pai GB, Subramanian M, et al. Resveratrol analogue, trans-4,4'-dihydroxystilbene (DHS), inhibits melanoma tumor growth and suppresses its metastatic colonization in lungs. *Biomedicine & Pharmacotherapy*. 2018;107:1104-1114. doi:[10.1016/j.biopha.2018.08.085](https://doi.org/10.1016/j.biopha.2018.08.085)

19. Darwish RS, Hammoda HM, Ghareeb DA, et al. Efficacy-directed discrimination of the essential oils of three *Juniperus* species based on their in-vitro antimicrobial and anti-inflammatory activities. *Journal of Ethnopharmacology*. 2020;259:112971. doi:[10.1016/j.jep.2020.112971](https://doi.org/10.1016/j.jep.2020.112971)
20. Poaty B, Lahlah J, Porqueres F, Bouaffif H. Composition, antimicrobial and antioxidant activities of seven essential oils from the North American boreal forest. *World J Microbiol Biotechnol*. 2015;31(6):907-919. doi:[10.1007/s11274-015-1845-y](https://doi.org/10.1007/s11274-015-1845-y)
21. Caruntu S, Ciceu A, Olah NK, Don I, Hermenean A, Cotoraci C. *Thuja occidentalis* L. (Cupressaceae): Ethnobotany, Phytochemistry and Biological Activity. *Molecules*. 2020;25(22):5416. doi:[10.3390/molecules25225416](https://doi.org/10.3390/molecules25225416)
22. Zámbořině Németh É, Thi Nguyen H. Thujone, a widely debated volatile compound: What do we know about it? *Phytochem Rev*. 2020;19(2):405-423. doi:[10.1007/s11101-020-09671-y](https://doi.org/10.1007/s11101-020-09671-y)
23. Cordiano R, Caserta S, Minciullo PL, Allegra A, Gangemi S. Anthraquinones and Aloe Vera Extracts as Potential Modulators of Inflammaging Mechanisms: A Translational Approach from Autoimmune to Onco-Hematological Diseases. *Molecules*. 2025;30(6):1251. doi:[10.3390/molecules30061251](https://doi.org/10.3390/molecules30061251)
24. Sánchez M, González-Burgos E, Iglesias I, Gómez-Serranillos MP. Pharmacological Update Properties of Aloe Vera and its Major Active Constituents. *Molecules*. 2020;25(6):1324. doi:[10.3390/molecules25061324](https://doi.org/10.3390/molecules25061324)
25. Iosageanu A, Mihai E, Seciu-Grama AM, et al. In Vitro Wound-Healing Potential of Phenolic and Polysaccharide Extracts of Aloe vera Gel. *JFB*. 2024;15(9):266. doi:[10.3390/jfb15090266](https://doi.org/10.3390/jfb15090266)
26. Ma Y, Tang T, Sheng L, et al. Aloin suppresses lipopolysaccharide-induced inflammation by inhibiting JAK1/STAT1/3 activation and ROS production in RAW264.7 cells. *Int J Mol Med*. Published online July 31, 2018. doi:[10.3892/ijmm.2018.3796](https://doi.org/10.3892/ijmm.2018.3796)
27. Na K, Lkhagva-Yondon E, Kim M, et al. Oral treatment with Aloe polysaccharide ameliorates ovalbumin-induced atopic dermatitis by restoring tight junctions in skin. *Scand J Immunol*. 2020;91(3):e12856. doi:[10.1111/sji.12856](https://doi.org/10.1111/sji.12856)
28. Zhou H, Peng K, Wang J, et al. Aloe-derived vesicles enable macrophage reprogramming to regulate the inflammatory immune environment. *Front Bioeng Biotechnol*. 2023;11:1339941. doi:[10.3389/fbioe.2023.1339941](https://doi.org/10.3389/fbioe.2023.1339941)
29. Hekmatpou D, Mehrabi F, Rahzani K, Aminiyan A. The Effect of Aloe Vera Clinical Trials on Prevention and Healing of Skin Wound: A Systematic Review. *Iran J Med Sci*. 2019;44(1):1-9.
30. El-Gammal A, Nardo VD, Daaboul F, et al. Is There a Place for Local Natural Treatment of Psoriasis? *Open Access Maced J Med Sci*. 2018;6(5):839-842. doi:[10.3889/oamjms.2018.106](https://doi.org/10.3889/oamjms.2018.106)
31. Filatov V, Sokolova A, Savitskaya N, et al. Synergetic Effects of Aloe Vera Extract with Trimethylglycine for Targeted Aquaporin 3 Regulation and Long-Term Skin Hydration. *Molecules*. 2024;29(7):1540. doi:[10.3390/molecules29071540](https://doi.org/10.3390/molecules29071540)
32. Mathura K. Southwest Native Herbs. September 2021. Accessed May 12, 2025. <https://www.chandleraz.gov/sites/default/files/Southwest-Native-Herbs-QC.pdf>
33. Gnabre J, Bates R, Huang RC. Creosote bush lignans for human disease treatment and prevention: Perspectives on combination therapy. *Journal of Traditional and Complementary Medicine*. 2015;5(3):119-126. doi:[10.1016/j.jtcme.2014.11.024](https://doi.org/10.1016/j.jtcme.2014.11.024)