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Dermatology Benefits of Licorice (Glycyrrhiza glabra L.): A Review of its Potential in Skin and Hair Disorders

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ABSTRACT

The anti-inflammatory, antimicrobial, and immune-modulatory properties of licorice have been used in traditional medicine for centuries. This review examines its effectiveness in treating skin ailments. From 2000 to 2025, PubMed, ScienceDirect, and Cochrane databases were searched for clinical trials, in vitro, or in vivo studies. Data were synthesized thematically. Licorice extract demonstrates promising efficacy in treating acne vulgaris, rosacea, and atopic dermatitis. Glycyrrhizin, licochalcone A, and glabridin are among the main active compounds. Despite the need for higher-quality RCTs, licorice extract is a safe and effective adjunct for treating skin disorders

INTRODUCTION

The Glycyrrhiza plants have 30 species and are mainly found in the Mediterranean and parts of Asia. The root is valuable, while the leaves are often considered waste (Ding *et al.*, 2022). Leaf compounds are similar to root compounds but less concentrated (Pastorino *et al.*, 2018). Technological advancements enable detailed chemical analysis that identifies important compounds in licorice,

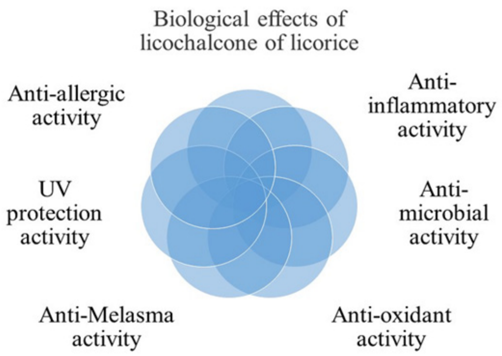

Figure 1. Multiple pharmacotherapeutics of chalcones.

such as glycyrrhizin, chalcone, and glabridin, showcasing its medicinal value (Tuli *et al.*, 2024). Chalcones are important flavonoids known for their various biological activities (Salehi *et al.*, 2021). Forty-two chalcones have been found in licorice, showing various biological activities like anti-inflammatory, antimicrobial, and antioxidant effects (D. Wang *et al.*, 2020).

Glycyrrhizin, a compound 60 times sweeter than cane sugar, has been employed for its medicinal properties since antiquity (Colak *et al.*, 2021). Beneficial pharmaceutical actions demonstrated in studies include anticancer, antiviral, immunomodulatory, and detoxifying effects, as well as efficacy in treating various conditions such as digestive, hepatic, cardiovascular, and atherosclerotic diseases (Leite *et al.*, 2022). Licorice was documented in 'The Code of Hammurabi' around 2000 BC, and the Assyrians formulated it into pills. Ancient Egyptians used it for sweet drinks and recognized its healing properties. Soldiers drank licorice extract during battles. Theophrastus documented its use for skin lesions, and Ibn Al-Bitar and Dioscorides noted its treatment for gastroesophageal reflux and foot ulcers (Fiore *et al.*, 2005; Thangavelu & Geetha, 2011). Licorice has been used for medicinal purposes since 500 BC; Hippocrates acknowledged its effectiveness for treating wounds and reducing thirst. Theophratus noted licorice root's benefits for cough, asthma, and breathing issues in "Historia Plantarum." Pliny the Great discussed its medical use for voice clarity, cough suppression, and digestive problems in "Naturalis Historia." Carl Linnaeus identified three species of licorice: G. glabra, G. echinata, and G. hirsuta. The first mention of licorice culture was by Peter de Crescenzi in "Liber ruralium commodorum" (Husain *et al.*, 2022). The Roman physician Pedanius Dioscorides (AD 40-90), author of the Pharmacopoeia of Materia Medica, classified plants according to their nutritional and medicinal functions (Chen *et al.*, 2023; Mohammadifar, 2018). Avicenna (c. 980-c. 1037) was a notable Persian physician and polymath known for his works, the Canon of Medicine and the Book of Healing. He discussed licorice as a treatment for gastrointestinal and respiratory issues (Abbasi & Pouyan, 2019). Ibn Sina's canon of medicine cites licorice for treating wounds and ulcers (Mahdizadeh *et al.*, 2015). This study aims to explore its medicinal effectiveness in dermatology to aid future clinical research and complementary medicine

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development.

LITERATURE REVIEW

Pharmacognosy

Licorice (Glycyrrhiza spp.) is a perennial herb reaching up to 2.5 meters in height. Its leaves are compound, consisting of 4 to 7 pairs of leaflets along with a terminal leaf. The flowers are irregular in shape and can be found in yellow, purple, or violet colors (Bayati Zadeh *et al.*, 2013). The fruit is two to three centimeters long and brownish-red. The genus Glycyrrhiza can fix nitrogen through symbiosis with rhizobium on the root surface and is suitable for sandy and clay soils, though it prefers moist soils (Kusaba *et al.*, 2021).

Phytochemistry

Over 400 phytochemicals—including flavonoids, chromenes, coumarins, and triterpenoid saponins—have been identified in plants of the Glycyrrhiza genus. The majority of glycyrrhizin is found in the roots and rhizomes of licorice. These structures constitute approximately 50% of the plant's total dry weight. Their composition includes roughly 5–15% water-soluble metabolites and sugars, around 25% starch, 10–16% glycyrrhizin, and 1–2% amines, along with asparagine, betaine, choline, and sterols such as stigmasterol and beta-sitosterol (Cerulli *et al.*, 2022). Glycyrrhizin constitutes 10–25% of licorice root extract (Isbrucker & Burdock, 2006). The primary bioactive constituents are glycyrrhizin and its aglycone, glycyrrhetinic acid (also known as enoxolone). Glycyrrhizin is a saponin formed from glycyrrhetinic acid and glucuronic acid, and it exists in two stereoisomeric forms: 18α- and 18β-glycyrrhizin (Ni *et al.*, 2022). The dried roots of G. glabra contain several flavonoids, such as liquiritin and isoliquiritin. Similar compounds are found in the leaves, albeit at lower concentrations. Analyses indicate the absence of detectable alkaloids or tannins. The presence of flavonoids and saponins with cosmetic potential has attracted considerable research interest (Sharifi-Rad *et al.*, 2021).

Flavonoids

Approximately 300 flavonoid compounds have been identified across various licorice species. These encompass subclasses such as flavanones, flavonols, flavones, isoflavones, and chalcones, all of which are investigated for their cosmetic applications. Liquiritin, a key flavonoid, exhibits beneficial properties including antioxidant and anti-aging effects (Alrushaid *et al.*, 2016; Liga *et al.*, 2023; Panche *et al.*, 2016; Wang *et al.*, 2021). Representative flavonols and flavanones include pinocembrin, liquiritin-apioside, kaempferol, protensin, and chrysoriol. Certain key compounds constitute approximately 11% of the total flavonoid content. Notably, isoliquiritigenin, liquiritigenin, licochalcone A, and glabridin exhibit properties with significant potential for cosmeceutical application (Lan *et al.*, 2016). Furthermore, isoliquiritigenin, liquiritigenin, licochalcone A, and glabridin have been investigated for their cosmeceutical potential (Wahab *et al.*, 2021).

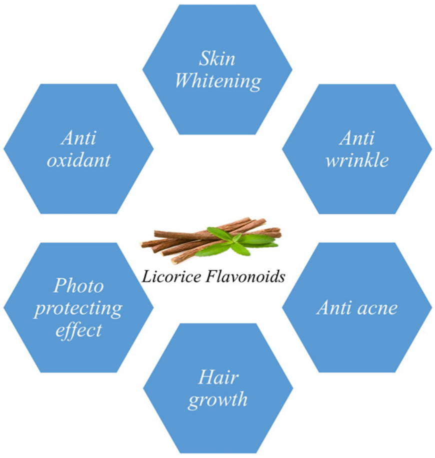

Figure 2: Cosmetic applications of licorice isoflavones.

Saponins

A study identified over 70 saponins in licorice root, with glycyrrhizin (glycyrrhizic acid) being the most abundant and biologically significant. The primary bioactive saponins are glycyrrhizin and its aglycone, glycyrrhetinic acid. Glycyrrhizin, which is significantly sweeter than sucrose, is a glycoside categorized based on the composition of its sugar moieties (Mousavi *et al.*, 2022; Sabbioni *et al.*, 2005; Shinu *et al.*, 2023).

Polysaccharides

Glycyrrhiza plants contain significant polysaccharides, notably heteropolysaccharides composed of various sugars linked by diverse glycosidic bonds. These polysaccharides exhibit superior moisturizing efficacy compared to glycerol and have been shown to promote aquaporin expression (Dang *et al.*, 2024; Wu *et al.*, 2022).

Licorice in skin and hair diseases

Acne Vulgaris

Acne vulgaris is a multifactorial inflammatory condition affecting the skin's pilosebaceous unit. The face, neck, upper chest, shoulders, and back contain a high density of pilosebaceous units, which are typically affected by this disease. Other features that may be present include seborrhea, non-inflammatory lesions such as blackheads or whiteheads, inflammatory lesions such as papules and pustules, and varying degrees of scarring. Acne is caused by excess sebum production, changes in sebum composition, follicle hyperkeratinization, and colonization by Cutibacterium acnes. Inflammatory mediators are released in response to C. acnes, but Staphylococcus epidermidis helps limit C. acnes colonization and inflammation (Cavallo *et al.*, 2022; Fournière *et al.*, 2020; Huang *et al.*, 2023; Vasam *et al.*, 2023). Antioxidants neutralize reactive oxygen species, which are key mediators of inflammatory pathways. Patients with acne vulgaris frequently exhibit reduced antioxidant levels, a factor that may contribute to the pathogenesis of the condition (Md Jaffri, 2023; Mills *et al.*, 2016). Licorice extract possesses beneficial properties including anti-androgenic, antimicrobial, and antioxidant activities, which contribute to its efficacy in treating acne and reducing inflammation. The safety profile and underlying molecular mechanisms of licorice extract have been characterized in preclinical and clinical investigations. Licochalcone A and E exhibit antibacterial activity against key acne-related pathogens, including C. acnes, S. aureus, S. epidermidis, and S. pyogenes (Ruan *et al.*, 2022; Raoufinejad *et al.*, 2020). Extensive research has investigated the safety profile and elucidated the molecular mechanisms of action of licorice extract. Studies demonstrate that Licochalcone A and Licochalcone E exhibit potent antibacterial activity against acne-associated bacteria. Glycyrrhizic acid, the primary active constituent, is metabolized in vivo to its active aglycone, glycyrrhetinic acid. Given the escalating challenge of antibiotic resistance, bioactive plant metabolites like these represent important candidates for the development of safe and effective antibacterial therapies (Dessinioti & Katsambas, 2022; Graebin, 2018). The active methanolic extract of G. glabra demonstrated potent antibacterial activity against S. aureus, S. epidermidis, and C. acnes. For this extract, the minimum inhibitory concentration was 200 μg/mL for C. acnes strain ATCC 6919 and 100 μg/mL for strain ATCC 11827S. Furthermore, licorice extract demonstrated an MIC of 0.25 mg/mL against Staphylococcus aureus and 2.5 mg/mL against methicillin-resistant S. aureus (Nam *et al.*, 2003; Semenescu *et al.*, 2024). In vitro studies indicate that licorice extracts inhibit the growth of S. aureus and S. pyogenes, producing zones of inhibition up to 10-15 mm in diameter. Supporting this, Gupta *et al.* (2013) reported broad-spectrum antibacterial activity for G. glabra extracts against various Gram-positive and Gram-negative organisms (Gupta *et al.*, 2013; Wu *et al.*, 2019). A study with 25 participants tested cosmetic products containing glycolic acid, salicylic acid, gluconolactone, and licochalcone A for treating mild to moderate acne over 28 days. Participants used two products: one with 0.1% adapalene and one with only adapalene. Results indicated no difference in inflammatory lesions by day seven, but the combined product notably improved acne scores. Previous studies have shown that Isoliquiritigenin inhibits MRSA activity (Kantikosum *et al.*, 2019). Licochalcone A, a key antimicrobial active constituent in licorice extract, exhibits potent antifungal and antibacterial activity. Notably, licochalcone A has been shown to exhibit bactericidal activity against S. aureus biofilms (Liu *et al.*, 2022). C. acnes isolates have shown 73% resistance to erythromycin and 59% resistance to clindamycin. Multidrug resistance has been observed in isolates of C. acnes, S. aureus, and S. epidermidis (Alkhawaja *et al.*, 2020). The anti-acne activity of licochalcone A inhibits the leucine-rich, pyrin-3 domain-containing inflammasome, which is crucial for inducing inflammation and worsening acne lesions (Liu *et al.*, 2025; Yang *et al.*, 2018). A review by Reuter *et al.* (2010) examined the potential of plant extracts, including those from Glycyrrhiza, for managing acne, skin infections, and photodamage. The authors suggested that Glycyrrhiza extracts represent promising candidates that could complement existing topical therapies. Dall'Oglio *et al.* (2019) evaluated a cosmetic regimen for mild facial acne in adults in a study involving 91 patients. The regimen consisted of a morning solution containing licochalcone A, salicylic acid, and L-carnitine, and a night cream with licochalcone A and hydroxy acids, applied over an eight-week period. After four weeks, there was a significant reduction in acne severity, with 41% fewer comedones, 45% fewer papules, and 47% less sebum. By week 8, there was a 64% decline in comedones, a 71% decrease in papules, and a 52% reduction in sebum, showing the regimen's effectiveness. Furthermore, a regimen combining 0.1% adapalene gel with a moisturizer containing licochalcone A, L-carnitine, and 1,2-decanediol significantly reduced inflammatory lesions (Chularojanamontri *et al.*, 2016). Supportively, a separate 9-week study confirmed that this combination of active ingredients (licochalcone A, L-carnitine, and 1,2-decanediol) effectively reduced both acne severity and sebum production (Kulthanan *et al.*, 2020).

Anti-androgenic Activities

Increased androgen activity in sebaceous glands stimulates sebum production, contributing to acne pathogenesis. Key licorice constituents—glycyrrhizin, licochalcone A, and licorice root extract—exhibit anti-androgenic properties. Licochalcone A acts by inhibiting 5-alpha-reductase, while glycyrrhizin reduces testosterone levels. These mechanisms support the safe and effective use of licorice-derived compounds for managing post-adolescent acne (Hasan *et al.*, 2021; Del Rosso & Kircik, 2024).

Rosacea

Rosacea is a multifactorial chronic inflammatory disorder characterized by flushing, persistent centrofacial erythema, papules and pustules, telangiectasia, and phymatous changes (Maden, 2023; Paiva-Santos *et al.*, 2023). There are four types of rosacea: erythematotelangiectatic, papulopustular, phymatous, and ocular (Hilbring *et al.*, 2022). Rosacea is a complex skin condition caused by genetic factors, environmental triggers, immune responses, blood vessel issues, inflammation, and a weakened skin barrier (Galluccio *et al.*, 2024). Hesperidin methylchalcone, licochalcone A, and tetracarboxymethylnaringenin chalcone have shown significant effects in improving rosacea, relieving inflammation, and reducing redness (Martinez *et al.*, 2016). Studies have shown that topical formulations containing hesperidin methyl chalcone can improve rosacea by reducing vasodilation, total vessel surface, and IL-8 secretion (Bussmann *et al.*, 2022). Furthermore, hesperidin methyl chalcone possesses anti-inflammatory and analgesic properties, exerting dual therapeutic effects in rosacea. Its mechanism involves the inhibition of the vanilloid receptor type 1 (TRPV1), reduction of oxidative stress, and suppression of pro-inflammatory mediators such as TNF-α, IL-1β, IL-6, IL-10, and NF-κB activity (Felipe *et al.*, 2015). Licochalcone A protects against UVA/UVB rays, hydrates the skin, and soothes redness, making it good for rosacea. It suits sensitive skin and can be used with metronidazole or other treatments, while reducing water loss (Jumina *et al.*, 2021; Weber *et al.*, 2006). Tetracarboxymethyl naringenin chalcone is utilized in rosacea treatment, demonstrating efficacy in reducing erythema in clinical trials (Gafner *et al.*, 2013; Weber *et al.*, 2006). In a related study, Frattaruolo *et al.* (2019) reported that Glycyrrhiza leaf extract exhibits potent antioxidant and anti-inflammatory properties. Specifically, the extract downregulates the expression of pro-inflammatory cytokines, including TNF-α, IL-1β, and IL-6. The researchers identified three major compounds, among which licoflavone demonstrated the highest antioxidant capacity. This property makes licoflavone a promising ingredient for skincare formulations targeting sensitive and rosacea-prone skin (Frattaruolo *et al.*, 2019; Bisht *et al.*, 2022).

Herpes Simplex Virus and Varicella-Zoster

Herpesviruses are large viruses with double-stranded DNA and an envelope. Types include HSV 1 and 2, Epstein-Barr virus, varicella-zoster virus, human cytomegalovirus, human herpesvirus-6 and -7, and Kaposi's sarcoma-associated herpesvirus (Connolly *et al.*, 2021; Levinson *et al.*, 2020). The herpes simplex virus causes recurrent painful vesicular eruptions, most commonly in the orofacial (HSV-1) or anogenital (HSV-2) regions. Although effective antiviral drugs exist, issues such as side effects, the emergence of resistant strains, and the desire for preventive or complementary therapies drive the ongoing search for improved treatment options. Herbal plants, particularly licorice extract and Boswellia serrata oleo gum, have shown promising antiviral properties against the virus (Lautenschlager, 2022; Sabouri Ghannad *et al.*, 2014). Topical gel formulations containing licorice (G. glabra, G. uralensis) can alleviate symptoms of herpes zoster and postherpetic neuralgia. This effect is supported by in vitro evidence demonstrating that glycyrrhizin inhibits the replication and proliferation of varicella-zoster virus (Shenefelt, 2011). Licorice extract has also demonstrated broad antiviral activity, inhibiting the replication of various viruses including varicella-zoster virus, Japanese encephalitis virus, influenza virus, and vesicular stomatitis virus (Diomede *et al.*, 2021). Glycyrrhizin exerts its antiviral effect by inhibiting the attachment of viral particles to host cells. Licorice extract inhibits herpes simplex virus type 1 through dual mechanisms: it can directly inactivate viral particles and prevent their adherence to host cells, such as Vero cells, as demonstrated in in vitro studies. Glycyrrhizin also inhibits virus replication in in-vitro tests (Huan *et al.*, 2021). Research suggests glycyrrhizin has efficacy against herpesviruses. Studies indicate it may aid immunocompromised hosts by enhancing immune parameters, such as CD4+ T cell counts, thereby potentially improving resistance to infections. In animal models, glycyrrhizin reduces mortality in mice exposed to herpes simplex virus and decreases viral load and mortality in models of HSV encephalitis. Furthermore, GL modulates infection-related pathways by reducing cellular stress markers and adhesion molecule expression, thereby attenuating the inflammatory response. GL demonstrates greater efficacy in inhibiting HSV-1 proliferation in vivo than in vitro. Against HSV-1, glycyrrhetinic acid exhibits approximately tenfold greater potency than its precursor, glycyrrhizin. This suggests that the antiviral activity of GL may be mediated by its biotransformation into GA, potentially by gut microbiota.

Table1: Summary of Key Active Compounds for Rosacea

Compound / Extract	**Mechanism of Action & Key Benefits**	**References**
Hesperidin Methyl Chalcone	▪ Improves rosacea by reducing vasodilation, total vessel surface, and IL-8 secretion. ▪ Has anti-inflammatory and analgesic activity. ▪ Inhibits TRPV1, oxidative stress, TNF-α, IL1β, IL-6, IL-10, and NF-κB activity.	(Bussmann, *et al.*, 2022; Pinho-Ribeiro *et al.*, 2015)
Licochalcone A	▪ Protects against UVA/UVB rays, hydrates the skin, and soothes redness. ▪ Suitable for sensitive skin and can be used with metronidazole. ▪ Reduces transepidermal water loss (TEWL).	(Jumina, *et al.*, 2020; Weber, *et al.*, 2006)
Tetracarboxymethyl Naringenin Chalcone (TNC)	▪ TNC is used to treat rosacea, significantly reducing erythema in affected skin, per clinical trial findings.	(Gafner, *et al.*, 2013; Weber, *et al.*, 2006)
Glycyrrhiza Leaf Extract	▪ Has strong antioxidant and anti-inflammatory qualities. ▪ Reduces the expression of TNF-α, IL-1, and IL-6. ▪ Licoflavone (a constituent) has high antioxidant potential, making it suitable for sensitive skin and rosacea.	(Bisht *et al.*, 2022; Frattaruolo *et al.*, 2019)

GA activates autophagy, aiding resistance to HSV1 and preventing its spread in infected cells (Zuo *et al.*, 2023). Glycyrrhizin may act as a broad-spectrum antiviral agent, with activity reported against numerous viruses including herpes simplex virus, human immunodeficiency virus, human respiratory syncytial virus, arboviruses, and SARS-related coronavirus. Separately, polysaccharides derived from Glycyrrhiza glabra have been shown to inhibit the adhesion of Helicobacter pylori to the gastric mucosa (García-Salazar *et al.*, 2023; Perera *et al.*, 2021; Wittschier *et al.*, 2009). Compounds in licorice, notably glycyrrhizin, can inhibit the replication and cytopathic effects of herpes simplex virus type 1, certain hepatitis viruses, and SARS-CoV-2 (Van de Sand *et al.*, 2021). Separately, the varicella-zoster virus, which causes chickenpox, is transmitted through contact with infected respiratory droplets or direct contact with lesions on damaged skin (Gershon *et al.*, 2015). Research demonstrates that glycyrrhizin can deactivate over 99% of VZV particles at a concentration of 2.4 mM within 37 minutes. Furthermore, GL acts synergistically with standard antiviral agents such as acyclovir, enhancing their efficacy against VZV. Although its precise mechanism requires further elucidation, GL is known to inhibit VZV replication, at least in part, by blocking the release of viral particles from infected cells (Baba & Shigeta, 1987; Gomaa & Abdel-Wadood, 2021).

Oxidative Damage

Licorice extract exhibits potent antioxidant activity, effectively scavenging free radicals and neutralizing reactive oxygen species. Key bioactive compounds in licorice, such as glycyrrhizin, glabridin, licochalcone A, licochalcone B, and licochalcone D, contribute to its antioxidant profile. They act by inhibiting the generation of reactive oxygen species, elevating glutathione levels, and conferring protection against oxidative damage. Antioxidants are crucial for maintaining health, as an excess of free radicals accelerates aging and contributes to the development of various diseases. Among these protective compounds, chalcones such as isoliquiritigenin have demonstrated specific efficacy in protecting against atherosclerosis (Semenescu *et al.*, 2024; Wu *et al.*, 2022). Several chalcones, including isoliquiritigenin, licochalcones A, B, and D, and isobavachalcone, inhibit microsomal lipid peroxidation. Notably, isobavachalcone also suppresses lipid peroxidation induced by ascorbate and tert-butyl hydroperoxide. The compound 5-(1,1-dimethylallyl)-3,4,4'-trihydroxy-2-methoxychalcone has been reported to share this inhibitory activity. Licochalcones B and D show strong activity against superoxide anions and DPPH radicals (Fu *et al.*, 2013). Licochalcone A helps protect skin cells from oxidative stress by activating the Nrf2 signaling pathway, which boosts the expression of protective enzymes and reduces harmful reactive oxygen species. In a clinical study involving 22 volunteers, topical application of licochalcone A twice daily for two weeks significantly decreased UVA-induced photon emissions compared to a placebo. The treatment also elevated levels of antioxidant enzymes and glutathione while reducing markers of oxidative damage in the skin (Kühnl *et al.*, 2015).

Atopic Dermatitis

Atopic dermatitis, or atopic eczema, is an inflammatory skin disease that causes dry skin and severe itching, typically starting in youth or childhood. Its development involves genetic and immune issues that affect the skin's barriers, leading to overactive immune responses due to pollutants and pathogens. Environmental factors also play a role in worsening the condition. Licochalcone A has shown promise in treating AD, with research indicating that a moisturizer containing it is as effective as hydrocortisone lotion for children (Sroka-Tomaszewska & Trzeciak, 2021; Wollenberg *et al.*, 2023). A recent report indicates that a moisturizer with licochalcone A may be less effective than hydrocortisone lotion for treating mild to moderate atopic dermatitis. Non-steroidal anti-inflammatory agents like licochalcone A and vitamin B12 are being studied for their soothing and anti-inflammatory benefits in skin care (Udompataikul & Srisatwaja, 2011). 4-t-Butylcyclohexanol and Licochalcone A cream worked better than Triamcinolone Acetonide 0.02% cream for reducing redness and boosting skin hydration, although it had a lower recovery rate. A conditioner with licochalcone A and other ingredients can prevent atopic dermatitis even after treatment. Licochalcone A helps reduce inflammation and strengthen the skin barrier. Isoliquiritigenin significantly improved skin issues and decreased several pro-inflammatory parameters, e.g. Immunoglobulin E, cytokine Th2, TNF-α, IL-6, and IL-4 in atopic dermatitis-like lesions in mice. Other potent compounds like the flavonoid isoliquiritigenin and the chalcone licochalcone A also demonstrated anti-inflammatory properties (Boonchai *et al.*, 2018; Angelova-Fischer *et al.*, 2018; Yu *et al.*, 2017). Licorice extract may help treat skin rashes like dermatitis and eczema. A 2% licorice gel is more effective than a 1% gel in reducing redness, swelling, and itching, making it a potential treatment for atopic dermatitis. Research with 281 adults showed that a 2% glycyrrhetinic acid ointment decreased swelling by 80% in those with mild to moderate atopic dermatitis, compared to only 10% with a placebo. Additionally, Licochalcone A cream has strong anti-inflammatory effects, and an herbal mix of gentian root, licorice root, and willow bark showed anti-inflammatory benefits in a UV test study (Saeedi *et al.*, 2003; Hoffmann *et al.*, 2020). Licorice cream has been found to effectively reduce inflammation like 1% hydrocortisone, especially for atopic dermatitis, indicating the need for more research. Glycyrrhizic acid reduces inflammation by blocking cyclooxygenase and prostaglandin formation (Richard, 2021; Seiwerth *et al.*, 2019). Glycyrrhizin lowers reactive oxygen species in neutrophils, as shown by Akamatsu *et al.* (1991), which indicated a dose-dependent decrease in certain ROS levels. However, it did not affect ROS in a cell-free system or neutrophil functions such as chemotaxis and phagocytosis. Barone *et al.* (2020) demonstrated that ammonium glycyrrhizin-loaded transfersomes effectively reduced skin inflammation, showing better drug transport than ethosomes (Akamatsu *et al.*, 1991; Barone *et al.*, 2020). Wrinkles and visible signs of aging are shaped by a combination of internal and external factors. On the inside, genetics and hormone level changes naturally affect skin ages. Everyday exposures like sunlight, air pollution, smoking, and diet can accelerate the aging process. Ultraviolet radiation, smoke, and environmental toxins are particularly damaging. They trigger oxidative stress and degrade collagen and elastin. Fortunately, simple habits such as using sunscreen, avoiding smoking, staying hydrated, and following a balanced, nutrient-rich diet can protect the skin and slow the visible effects of aging (Cao *et al.*, 2020; He *et al.*, 2023; Marrot, 2018; Shanbhag *et al.*, 2019). There is an increasing inclination toward natural herbal skincare as a safe alternative to invasive procedures like plastic surgery and laser therapy. Herbal treatments nourish the skin and support its physiological functions. Plant-derived phytochemicals offer numerous dermatological benefits, including UV protection, antioxidant effects, hydration, and the reduction of inflammation and oxidative stress. Notably, ingredients such as glabridin, punicalagin, and licorice extracts indicate efficacy in alleviating skin irritation, preventing hyperpigmentation, and supporting the skin's structural integrity. These herbs present a safer and more holistic option compared to synthetic chemicals in dermatological care (Cetin Aluc *et al.*, 2022; Jurel *et al.*, 2024). A study found that GA-Poly nanoparticles achieved 80% encapsulation efficiency and showed sustained release over 48 hours, enhancing skin delivery. Additionally, they reduced oxidative stress and MMP-1 activity, proving effective for anti-aging skincare (Cetin Aluc *et al.*, 2022). Topical application fades dark spots and evens skin tone. Glabridin inhibits the enzymes of melanin production, lightening the skin and reducing excess melanin. It promotes collagen synthesis, reduces irritation, and improves the appearance of dark spots (Yokota *et al.*, 1998). Liquiritigenin exhibits various pharmaceutical properties, including antioxidant, anti-inflammatory, antibacterial and anti-aging effects (Ramalingam *et al.*, 2018; Sajeev *et al.*, 2025).

Photo-aging

Photoaging, caused by continuous sun exposure, results in both macroscopic and microscopic changes in the skin. Factors that contribute to skin aging include pro-inflammatory cytokines, reactive oxygen species and molecules like matrix metalloproteinase-1, which are upregulated by NF-kappa B due to UV exposure (Chen *et al.*, 2021; Tanveer *et al.*, 2023). Environmental factors like sunlight, smoking, and pollution generate ROS, causing oxidative stress that disrupts cellular signaling, activates transcription factors linked to collagen degradation, and promotes aging. Antioxidants and chelators can mitigate this damage (Dunaway *et al.*, 2018; Farris & Valacchi, 2022; Maharajan *et al.*, 2021; Papaccio *et al.*, 2022).

Afnan *et al.* (2012) showed that UVB radiation is associated with levels of ROS and NF-kappa B. GA is a potent ROS scavenger and an inhibitor of NF-kappa B. However, the study indicates that the inhibitory effects of GA on NF-kappa B and ROS are independent. Licoricedin, another compound, has been shown to reduce UV-induced aging, as a reactive oxygen species scavenger and to modulate matrix metalloproteinase 1 activity (Kim *et al.*, 2017). Mann *et al.* (2020) investigated the photo-protection mechanism of licochalcone A against reactive oxygen species induced by visible light.

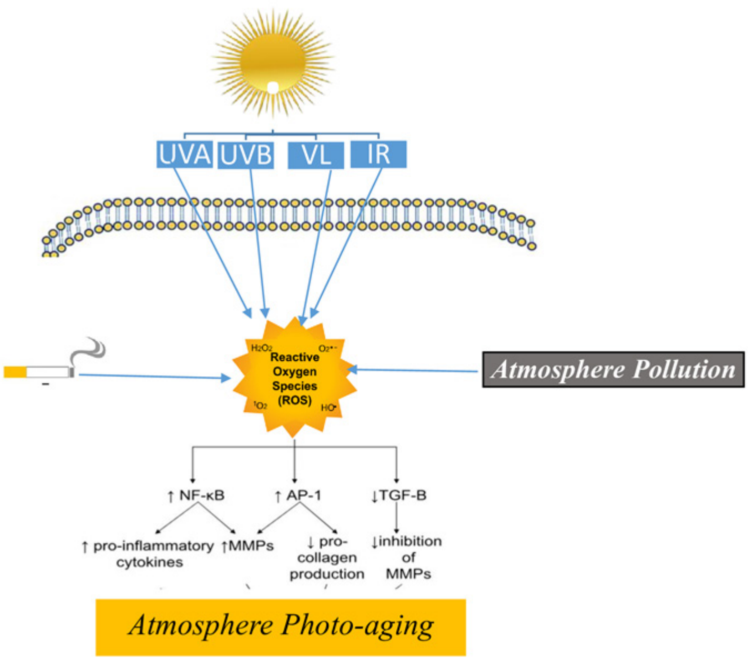

Figure 3: Paths of aging caused by the atmosphere from environmental aggravating factors.

Their research found that licochalcone A induces Nrf2/ARE signaling for photo-protection. Clinical trials have shown that licochalcone A formulations effectively reduce erythema, inhibit pro-inflammatory responses, and help combat UV-B-induced erythema in rosacea patients. In addition, a moisturizing cream containing Beta vulgaris and G. glabra extracts protect against UV-A/UV-B rays after laser therapy; they contribute to re-pigmentation, the proliferation of melanocytes and the reduction of scars and wrinkles (Mann *et al.*, 2019). Plant antioxidants in cosmetics protect the skin from oxidative damage caused by free radicals and UV rays. Ingredients like licorice have important antioxidant properties in skin care formulas. Phytochemicals from plants such as pomegranate and licorice also protect against UV rays and other environmental factors (Garg *et al.*, 2020; Michalak, 2022). The phenolic compounds in licorice, such as flavonoids, isoflavones and chalcones, show strong antioxidant potential, protecting against oxidative stress and skin damage. Glabridin, licochalcones B and D, and other components of licorice have been shown to inhibit lipid peroxidation and provide photo-protection. Licorice extract, especially at 0.5% and 1% concentration, is effective in preserving cosmetic formulations sensitive to oxidation, making it a valuable natural antioxidant for skin care products. In addition, licorice saponins and polysaccharides contribute to its antioxidant activity, suggesting its potential use in anti-aging and skin protection formulations (Hoang *et al.*, 2021; Mapoung *et al.*, 2021).

Psoriasis

Glycyrrhizin, commonly used to treat allergies, can help manage psoriasis by modulating immune cells and IFN-γ. Topical application of glycyrrhizinic acid can relieve psoriasis lesions. The anti-inflammatory and immunomodulatory properties of glycyrrhizin show promise in the management of psoriasis symptoms (Qiong *et al.*, 2021). A study by Zhang *et al.* (2023) developed an ointment with glycyrrhetinic acid as the main ingredient, along with other plant monomers known for their antipsoriatic properties. The researchers created a psoriasis-like mouse model using imiquimod and tested the ointment's effects on the damaged skin, spleen index, and inflammatory factors. The glycyrrhizic acid combination ointment proved more effective than calcipotriol ointment, reducing TNF-α, IL-12, IL-17, and IL-23 secretion, improving psoriasis in mice. Calcipotriol ointment had little effect on splenomegaly, IL-17, and IL-23 expressions. The glycyrrhetinic acid combination ointment demonstrated dose-dependent efficacy in treating imiquimod-induced psoriatic dermatitis. Chen *et al.* (2020) found that glycyrrhetinic acid effectively improved psoriasis lesions and reduced the severity index. It also decreased the levels of interleukins IL-6, TNF-α, IL-17, IL-23 and IL-1β in the skin, indicating its anti-inflammatory and immunomodulatory properties. This may be due to its ability to inhibit STAT3 and mTOR signaling. Overall, glycyrrhetinic acid has shown promise in alleviating psoriasis symptoms by suppressing inflammatory cytokines and activating Tregs in lymph nodes and spleen, making it a possible treatment and prevention option. Emollient creams are essential for the management of psoriasis in patients (Cassano *et al.*, 2010). Cassano *et al.* (2010) studied the effect of a new emollient cream containing milk proteins and Glycyrrhiza glabra extract in patients with palmar or plantar psoriasis receiving topical corticosteroid therapy. Research highlights the positive complementary role of specific emollients in the treatment of psoriasis. A 2015 study on the treatment of psoriasis found that the combination of glycyrrhizin and acitretin significantly improved outcomes compared to acitretin alone, reducing Th17 cells and blood levels of IL-6, IL-17, IL-22 and TGF-β (Wu & Zhang, 2015). Chalcones can help treat psoriasis by reducing pro-inflammatory cytokines. Mice treated with licorice compounds showed reduced levels of IL-6 and IL-8 by inhibiting NF-kB. Glycyrrhiza glabra containing licochalcone B and echinatin compounds effectively reduces psoriasis-like inflammation caused by various agents (Wang *et al.*, 2022).

Table 2: Summary of Studies on Psoriasis Treatments

Study	Treatment	Findings	Reference
Zhang *et al.* (2023)	Glycyrrhetinic acid ointment (vs. calcipotriol)	Reduced TNF-α, IL-12, IL-17, and IL-23; improved symptoms better than calcipotriol. Showed dose-dependent efficacy in psoriatic dermatitis. Calcipotriol had minimal effect on splenomegaly and IL-17/IL-23.	(Zhang *et al.*, 2023)
Chen *et al.* (2020)	Glycyrrhetinic acid	Improved lesions, reduced severity index, and decreased IL-6, TNF-α, IL-17, IL-23, and IL-1β. Anti-inflammatory effects via STAT3/mTOR inhibition. Activated Tregs, suggesting therapeutic potential.	(Chen *et al.*, 2020)
Cassano *et al.* (2010)	Emollient cream (milk proteins + G.glabra)	Complementary role in palmar/plantar psoriasis when used with corticosteroids. Supported skin barrier repair and symptom relief.	(Cassano *et al.*, 2010)

Wu *et al.* (2015)	Glycyrrhizin + acitretin (vs. acitretin alone)	Combination therapy outperformed acitretin alone, reducing Th17 cells and IL-6, IL-17, IL-22, and TGF-β levels.	(Wu & Zhang, 2015)
Fatima *et al.* (2024)	Licorice compounds (licochalcone B, echinatin)	Reduced psoriasis-like inflammation by suppressing IL-6 and IL-8 via NF-κB inhibition. Effective against multiple psoriasis-inducing agents.	(Wang *et al.*, 2022)

Hyperpigmentation Disorder

Melanocytes are responsible for synthesizing and then transporting melanin to keratinocytes. Melanin production will be differentially impacted by keratinocyte and fibroblast signaling when exposed to UVB rays. In melasma lesions, endothelin-1 produced by the endothelial cells brings about localized angiogenesis that upregulates melanogenesis. In addition to the newly formed blood vessels, both the activity of sebocytes and the alteration of the basement membrane also modulate melanocytic activity. Sunlight is a well-known driver of melanocyte activity, especially UVB, UVA, and visible light. Those with specific overt or silent susceptibility can demonstrate an exacerbated production of non-facial melasma following both acute and chronic exposures (Espósito *et al.*, 2022; Passeron & Picardo, 2018). Flavonoids are common natural phenolic compounds for skin lightening, used in treatment of various hyperpigmented skin disorders. Melanogenesis, or the production of melanin in the skin, is controlled by tyrosinase, a copper-dependent enzyme. It serves as the enzyme responsible for conversion of L-tyrosine to L-DOPA and subsequently dopachrome in melanin synthesis. Flavonoids generate a lot of curiosity for their role in inhibition of tyrosinase activity which has beneficial effects on the management of melanogenesis and skin discoloration (El-Nashar *et al.*, 2021). Glycyrrhiza extract and its components reduce melanin production for improving skin hyperpigmentation. Hyperpigmentary conditions include increased melanin concentrations with hyperpigmentation, which can result from an increase in the total levels of melanin and/or changes in distribution producing abnormal melanin deposition (as demonstrated by solar lentigines and melasma), as well as hypopigmented disorders such as vitiligo (Kang *et al.*, 2021). Licorice extract has active ingredients, such as glabridin and isoliquiritigenin, that lower tyrosinase activity and melanin production. Glabridin and isoliquiritigenin reduced melanin as the dosage increased. A study of 44 women showed that licorice extract can treat melasma and has minimal side effects. Liquiritin probably impacts tyrosinase through other processes (Chen *et al.*, 2016; Shamsi Meymandi *et al.*, 2016). A study by Lin *et al.* (2017) examined the effectiveness of licorice extract cream in three different concentrations in women aged 30 to 50 years. For a period of four weeks, the creams were applied twice a day to the arms and the results showed an improvement in the brightness of the skin. Surprisingly, the 10% concentration showed the best skin lightening effects compared to the 20% and 40% concentrations. The study concluded that 10% licorice extract cream was more effective. Glabridin inhibits melanogenesis, mainly due to hydroxyl groups at positions 2 and 4 (Wang *et al.*, 2020). G. glabra's pinocembrin, licoisoflavone B, and glabridin from Glycyrrhiza uralensis root inhibit fungal tyrosinase. Glycyrrhiza uralensis extract also inhibits tyrosinase and melanin production. Glyasperin C and glycyrrhisoflavone may help in skin-lightening cosmetics (Kim *et al.*, 2005; Hong *et al.*, 2018). Licochalcones A, B, C, and E derived from G. inflata roots have potent inhibitory effects on tyrosine phosphatase 1B. Licochalcone A inhibits melanogenesis via the MAPK/ERK pathway, which activates ERK. A 20% liquiritin cream formulation applied at 1 gr daily for four weeks exhibited a therapeutic benefit in melasma (Amer & Metwalli, 2000; Nerya *et al.*, 2003). Nerya *et al.* (2003) found that licorice extract, particularly glabridin and isoliquiritigenin, reduces melanin production.

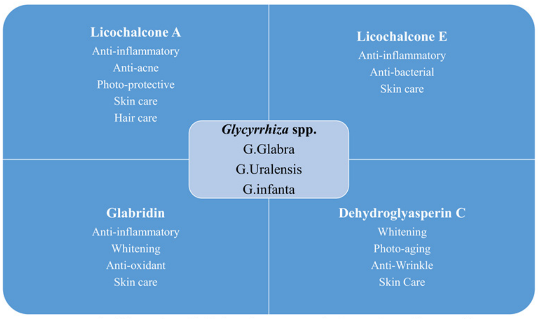

Figure 4: Cosmetic effects of studied bioactive compounds from Glycyrrhiza species.

A study compared Kligman's modified diet with a treatment of 4-n-butyl resorcinol, alpha-arbutin, and licorice extract for melasma. Both treatments improved symptoms, with 34.7% satisfaction in Group A and 30.2% in Group B, and the combination had fewer side effects (Sreeja *et al.*, 2020). A clinical trial tested hydroquinone and licorice extract creams for melasma in 38 female patients. Hydroquinone was more effective, showing a higher reduction rate than licorice cream after eight weeks (Matoorian pour *et al.*, 2010; Parviz *et al.*, 2013).

Leishmaniasis

Cutaneous leishmaniasis is a disease caused by a parasite from sand-fly bites, leading to skin lesions. It affects tropical regions and has treatment challenges. New oral medications are being developed, and preventing bites is essential (Elmahallawy *et al.*, 2021). 18 β-glycyrrhetinic acid and various licorice components exhibit anti-ulcer and anti-toxic effects. However, the focus has been on 18 β-glycyrrhetinic acid, glycyrrhizin, and licochalcone A for their antileishmanial properties, with licochalcone A effectively inhibiting Leishmania proliferation and showing promise as a safe treatment for leishmaniasis. Chalcone-type flavonoids are also noted for their potential safety and effectiveness as alternatives to current drugs (Souza *et al.*, 2020). Sheikhi *et al.* (2020) studied licorice root extract and glycyrrhizic acid's effects on Leishmania major, finding cytotoxic effects on promastigotes and amastigotes.

Genital Warts

Genital warts, caused by HPV, occur at a rate of 160 to 289 cases per 100,000 people worldwide. Herbal remedies are becoming popular as effective, affordable treatments alongside traditional methods, especially for those with HIV (Gylling *et al.*, 2023). Domínguez Gómez *et al.* (2012) studied 100 patients with anogenital warts, dividing them into two groups. The first group used a 0.1% GL spray, while the second received 25% podophyllin. After eight weeks, the spray had an efficacy rate of 87.5%, which was slightly higher than podophyllin. Studies indicate that 0.1% GL spray effectively treats anogenital warts, even in HIV-positive patients, over eight weeks. Limited improvement was noted after twelve weeks. The poor response in HIV patients may be due to reduced T helper lymphocytes. Dermoscopy helps assess treatment progress (Aji Achdiat *et al.*, 2021; Bravo *et al.*, 2023). There has been an increase in human papillomavirus infections among HIV patients, with host immunity significantly impacting disease development. Immunocompromised patients experience more severe and longer-lasting HPV symptoms. Genital warts, caused by HPV, are benign skin growths. HPV strains are categorized into high-risk and low-risk groups for cancer. The virus can infect various mucosal areas, leading to cervical cancer. Previously, no specific treatment existed, but new drugs, including glycyrrhizinic acid, show promise with fewer side effects (Hewavisenti *et al.*, 2023). A study of the clinical response to GL in vaginal infection caused by human papillomavirus and low-grade squamous intraepithelial lesion indicated that after four weeks of treatment, all patients had resolved, with 74% demonstrating improvement after 12 weeks. However, 27.7% of patients had chronic low-grade squamous intraepithelial lesions, and only one developed grade II cervical intraepithelial neoplasia. Glycyrrhizinic acid efficiently resolves clinical lesions, although long-term treatment and one-year monitoring are suggested depending on disease development (Valencia *et al.*, 2011).

Wound healing

Researchers have studied herbal remedies for their wound-healing properties. As the body's largest organ, the skin protects against external damage and infections. When skin is damaged, the body initiates a complex healing process involving molecular and cellular mechanisms to restore skin integrity. Disruption in this process can result in abnormal scarring and chronic conditions, impacting the quality of life (Kolimi *et al.*, 2022). Oloumi *et al.* (2007) explored the healing properties of licorice root extract on skin wounds in male white rats. They made 90 wounds on the rats' backs and evaluated the extract's effect on wound closure, inflammation, and overall healing process. This study highlights the aqueous extract of licorice root as an effective herbal medicine for wound healing. A study used rabbits with wounds on their backs and sides. Licorice cream with 5%, 10%, and 15% concentrations was applied twice daily, showing 10% cream as the best healer compared to dexpanthenol cream (Zaki *et al.*, 2005). Assar *et al.* (2021) explored how licorice extracts affect rats and found an increase in leukocyte counts, more vigorous phagocytosis by neutrophils, higher levels of certain antioxidants, and lower levels of oxidative stress. Their analysis of the histopathological data indicated re-epithelialization and more collagen production. Immunohistochemistry revealed higher levels of α-SMA, PDGFR-α, FGFR1, and cytokeratin-14 in the licorice groups. The licorice diet accelerated the rate of healing by increasing collagen and blood vessel formation, governed by the up-regulation of bFGF, VEGF, and TGF-β genes. Leite *et al.* (2023) focused on using in vivo models to assess the effects of topically applied dipotassium glycyrrhizinate on the inflammation associated with skin wounds. This therapy significantly decreased inflammatory exudates and improved the formation of granulation tissue, epithelial tissue, and collagen. Pro-inflammatory cytokines (e.g. TNF-α, Cox-2, Il-8, Irak-2, Nf-kB, and Il-1) also decreased and Il-10 increased, demonstrating its anti-inflammatory action. Its action is based on the control of cytokines and the supportive formation of granulation tissue, angiogenesis, and tissue re-epithelialization that are essential for tissue repair, particularly for difficult to heal diabetic wounds. The HMGB1 protein, involved in recombination, transcription regulation, and inflammation, is released during wounding, impairing skin regeneration. Glycyrrhizin, an HMGB1 inhibitor, forms hydrogels with beneficial properties. These hydrogels (5% or 10% glycyrrhizic acid) expedite skin wound closure in diabetic rats by promoting keratinocyte migration and enhance wound healing effectively (Zhang *et al.*, 2012). According to a study on rabbits, licorice root extract has shown the potential to heal oral wounds. Hydrogels derived from licorice are also effective in accelerating wound healing (Mees *et al.*, 2022; Moussa *et al.*, 2023). Ahmadi *et al.* (2017) found that a combination of aloe vera and licorice extract improves wound healing. Aloe vera and licorice gels' potential for wound healing requires additional preclinical investigation due to their recognized wound healing, antibacterial, and anti-inflammatory properties. Kazemi *et al.* (2018) demonstrated that a lavender oil and licorice extract nanoemulsion cream reduced wound size in mice, enhanced gene expression for healing, decreased lipid peroxidation, and increased antioxidant activity. Zabihi *et* *al.* (2023) found that licorice extract in hydrogel helped heal second-degree burns faster in 50 patients compared to a control group. The extract showed anti-inflammatory, burning, and wound improvement effects. Aly *et al.* (2023) studied a topical cream containing flavonoids from licorice root and Sophora japonica leaves, finding it may improve wound healing due to strong antioxidant properties. They identified 32 compounds in licorice and 23 in Sophora japonica, supporting enhanced wound care strategies with these extracts.

Seborrheic Dermatitis

Seborrheic dermatitis is a skin condition affecting areas with high sebaceous gland activity, characterized by scaling and redness. The mildest form is dandruff or pityriasis capitis, which only affects the scalp. SD typically affects adolescents and adults, but there is also an infantile form. The disease's cause is unknown, but it is likely due to an imbalance of hormonal and environmental factors, as well as the presence of certain bacteria. These bacteria stimulate the production of anti-inflammatory and pro-inflammatory substances (Jackson *et al.*, 2024; Schweiger *et al.*, 2013). Shivakant *et al.* (2020) studied a licorice-based scalp tonic for dandruff treatment involving 102 participants. The formulation, containing piroctone olamine and licochalcone A, showed significant reduction in scalp inflammation and antifungal effects against Malassezia furfur. Licochalcone A effectively decreased inflammation, while silver nanoparticles from licorice extract demonstrated activity against the fungus. Elements like urea, lactate, polidocanol, and certain herbal extracts improved scalp symptoms. The licorice-based shampoo led to lower dandruff incidences, reduced inflammation, and decreased cytokine levels versus a placebo. A research study compared 0.025% licochalcone and 1% hydrocortisone for treating SD in children. Seventy-five children aged two weeks to one year with neonatal SD were treated twice daily with a licochalcone or hydrocortisone moisturizer. Licochalcone showed a higher healing rate initially, but both treatments were similarly effective after two weeks. This shows the importance of assessing both short-term and long-term results in pediatric skin disorders, suggesting licochalcone A may be included in treatment plans (Wananukul *et al.*, 2012). Facial dermatitis can be a challenging condition with various treatment options. In a study comparing an experimental facial moisturizer containing 4-t-butylcyclohexanol and licochalcone A with 0.02% triamcinolone acetonide for treating facial dermatitis, 80 volunteers with mild to moderate dermatitis were randomized. Results showed that the experimental moisturizer provided better skin moisturizing than triamcinolone, with comparable amelioration in TEWL after four weeks than two weeks of triamcinolone use. While triamcinolone improved sensitivity more rapidly, the experimental moisturizer was slower in improving dermatitis but more effective in controlling erythema and skin hydration (Boonchai *et al.*, 2023). One study found that licorice was not significantly different from placebo in reducing the severity of dandruff, and neither treatment had anti-inflammatory properties; however, licorice and selenium sulfide showed a remarkable antipruritic effect. More research is needed to confirm licorice's potential for reducing hair loss. A 7% licorice shampoo caused high eye irritation, making it unsuitable for anti-dandruff use. Further studies on licorice's effectiveness in preventing hair loss and itching are necessary (Rahmatollah *et al.*, 2012).

Hair growth

Hair follicles grow in cycles, including anagen (growth), catagen (transition), and telogen (rest) phases. Hair falls out during exogen, followed by new hair growth. Hair care is crucial for physical attractiveness and health. Shampoos are vital in hair and scalp treatment, as well as maintaining health and beauty. Green tea, red clover, safflower, ginseng, and jujube stimulate hair growth and treat androgenetic alopecia (Akbarnejad, 2023; Feng & Lai, 2023; Kumar *et al.*, 2012; Liu *et al.*, 2014). Licorice extract has been extensively researched for its ability to promote hair growth. Recent studies have found that licorice ethanol extract, used in herbal hair tonics, can stimulate hair growth as effectively as minoxidil. Additionally, an oriental herbal supplement containing licorice and other ingredients showed positive effects on hair count, diameter, scalp moisture, sebum levels, and overall scalp conditions in women. Various formulations with licorice have successfully treated hair loss, with research showing that these formulations can increase the proliferation of dermal papilla cells, which is crucial for hair growth. Utami *et al.* (2017) researched the effects of licorice extract tonic on hair growth. Hair tonics containing 2.5%, 5%, and 10% licorice extract were tested. Results showed the 5% and 10% tonics had hair growth activity comparable to 2% minoxidil. The tonics also demonstrated good stability and no skin irritation. Roy *et al.* (2014) found that licorice hydroalcoholic extract effectively promotes hair growth. Compared to minoxidil, a 2% concentration of licorice extract showed superior activity in stimulating hair growth. The study concluded that licorice extract has significant potential for hair growth and can safely be used in herbal formulations for different types of hair loss. Preliminary phytochemical evaluations identified coumarins, saponins, phytosterols, flavonoids, carbohydrates, starch, and fixed oils in licorice extract.

Alopecia Areata

Xue (2018) analyzed the effects of glycyrrhizin on treating alopecia areata and its impact on immune indicators, including interferon-γ and interleukin-10. One hundred fifty patients were randomly divided into a study group and a control group. The control group received LingDan tablets, while the study group received combined glycyrrhizin tablets and LingDan tablets for three months. The study group had a significantly higher effectiveness of 93.3% than the control group's 77.3%.

The severity of alopecia decreased in both groups but was lower in the study group. In the study group, interferon-γ levels decreased while interleukin-10 levels increased compared to the control group. Other immunological indicators also showed improvement in the study group. Combining glycyrrhizin, LingDan tablets, and minoxidil tincture significantly improves alopecia areata outcomes and strengthens immune response. Overall, glycyrrhizin combined with LingDan tablets shows promise for alopecia areata, but larger trials are needed.

Hirsutism

Excessive growth of terminal hair in androgen-sensitive body parts is known as hirsutism. With a prevalence of almost 10%, it is also one of the most prevalent health issues among women and can have a severe and detrimental impact on their quality of life (Mihailidis *et al.*, 2017). Hydrolysis of glycyrrhizic acid produces d-glucuronic acid and the aglycone of 18-beta-glycyrrhetinic acid, which is responsible for the estrogenic effects of licorice and is a potential herbal antiandrogen. Faghihi *et al.* (2015) compared the efficacy of 755 nm alexandrite hair removal laser alone and with topical licorice to treat idiopathic hirsutism. Ivosevic-Zaper *et al.* (2014) found that applying a solution containing glycyrrhizic acid, urea, and ethanol to the neck area of rats resulted in significant hair loss. After three days, 20-30% of treated areas were hairless, and after 6–12 days, 90-95% of hair was lost. Long-term therapy reduced hair regrowth by 20% without inducing irritation. The result suggests glycyrrhizic acid may treat excessive hair growth in humans.

Vitiligo

Chrysoeriol stimulates melanogenesis by increasing MITF expression and activating key signaling pathways (ERK, AKT, PKA, Wnt/β-catenin). Chrysoeriol could be a potential treatment for vitiligo and other hypopigmentation skin conditions (Han & Hyun, 2023; Oh & Hyun, 2022).

MATERIALS AND METHODS

A literature search was conducted using electronic databases including PubMed, ScienceDirect, Cochrane Library, SpringerLink, and Google Scholar. The search covered the period from 2000 to 2025, and employed keywords related to Glycyrrhiza species, their phytoconstituents (such as glycyrrhizin, licochalcone A, and glabridin), and dermatological applications (including acne, rosacea, atopic dermatitis, psoriasis, hyperpigmentation, wound healing, and alopecia). Studies were selected based on predefined inclusion criteria. Original research articles including clinical trials, randomized controlled trials, open-label studies, in vitro experiments, and in vivo animal studies were included. Only English-language publications evaluating the efficacy, safety, or mechanism of action of licorice root extract, fractions, or isolated compounds on skin or hair disorders were considered. Exclusion criteria comprised studies focusing exclusively on non-dermatological conditions, review articles without original data, conference abstracts, and publications investigating other herbal extracts without a specific licorice component.

The screening process involved an initial review of titles and abstracts by the author, followed by full-text assessment of potentially relevant articles. From each eligible study, data were extracted on study characteristics (author, year, design), intervention (type of licorice preparation, concentration, formulation, duration), population (human subjects, animal models, or cell lines), outcome measures (efficacy parameters and mechanistic data), and reported adverse effects. Due to heterogeneity in study designs, interventions, and outcome measures, a meta-analysis was not feasible. Instead, extracted data were analyzed and synthesized thematically by the author. Findings were organized into thematic categories based on the dermatological disorder, allowing for comparison of clinical, in vitro, and in vivo evidence to evaluate the overall efficacy and safety profile of licorice in treating skin and hair disorders. Key findings were summarized in tabular format to facilitate comparison across studies.

RESULTS AND DISCUSSIONS

This review highlights licorice's dermatological efficacy, informing future research and complementary medicine development. The Chinese Food and Drug Administration has authorized 554 licorice-containing medications. Theophrastus is the first source for employing and utilizing licorice to remedy skin lesions. In the current century, according to Ibn al-Bithaar and Dioscorides, its use helps treat granulomas at the base of fingernails and toenails and foot ulcers. In his canon book, Ibn Sina considered licorice a medicine for wounds and ulcers. The key active components in licorice are GL and GA. Glycyrrhizin is a saponin of glycyrrhetic acid (glycyrrhetinic acid, enoxolone) and glucuronic acid, existing in 18α and 18β stereoisomers. The dried roots contain flavonoids like liquiritin, isoliquiritin, liquiritigenin, rhamnoliquiritin, glucoliquiritin, liquiritin apioside, prenyllicoflavone A, shinflavanone, shinpterocarpin, and 1-methoxyphaseolin. Chalcones are one of the principal classes of flavonoids, which have various biological activities and are widely present in nature. Licochalcone A and Licochalcone E have antimicrobial properties against bacterial strains of acne. In vitro tests have indicated the remarkable antibacterial function of licorice extract against C. acnes, S. aureus, S. epidermidis, and S. pyogenes. The inhibitory activity of licochalcone A in vitro was due to its ability to inhibit 5-alpha-reductase and antagonize androgen receptors. Also, glycyrrhizin and glycyrrhetinic acid reduced testosterone production through β-HSD 17 inhibition. In a clinical setting, glycyrrhizin lowered serum testosterone levels, which is safe and effective for post-adolescent acne treatment. Hesperidin methylchalcone, licochalcone A, and tetracarboxymethylnaringenin chalcone all had significant effects in improving rosacea, relieving inflammation, and reducing redness. Topical formulations containing hesperidin methyl chalcone can improve rosacea by reducing vasodilation, total vessel surface area, and IL8 production. Topical gel preparations made from licorice (Glycyrrhiza glabra, G. uralensis) can help relieve symptoms of herpes zoster and postherpetic neuralgia. Glycyrrhizin inhibits the replication and proliferation of varicella-zoster virus in vitro. It also showed a decrease in the death rate of specific pathological mice exposed to herpes simplex virus. Glycyrrhizic acid activates autophagy and provides resistance to HSV1. It has antiviral effects on Vero cells infected with HSV1 and prevents its proliferation and cytopathic activity. GL and its derivatives reduce viral activity and mortality caused by herpes simplex virus encephalitis in animal studies. It has also been shown to reduce the stress and adhesion between cells during herpes simplex virus infection, thereby reducing the inflammatory responses. Chalcones, specifically isoliquiritigenin, are powerful antioxidants that can reduce atherosclerosis by preventing low-density lipoprotein oxidation. Isoliquiritigenin and paratocarpin B are the most potent antioxidant agents using a validated peroxynitrite antioxidant assay method. Licochalcones A, B, D, and isobavachalcone inhibited microsomal lipid peroxidation induced by nicotinamide adenine dinucleotide phosphate. Iso-bavachalcone suppresses lipid peroxidation induced by ascorbate, tert-butyl hydroperoxide, carbon tetrachloride, and mitochondrial NADPH. Licochalcones A and C increase antioxidant enzymes, protecting against oxidative damage. Licorice extract has a high amount of phenolic ingredients. The phenolic ingredients are potent antioxidants that inhibit free radicals, chelate metal ions, and reduce anti-lipid peroxidation. Clinical trials have demonstrated that formulations containing licochalcone A have different properties, including protection against UVA/UVB rays, effective skin moisturization, and the ability to relieve erythema, thereby improving rosacea symptoms. Licochalcone A formulas suit sensitive skin and can be prescribed with metronidazole or other topical treatments. The moisturizing formula containing licochalcone A also increases skin moisturization and reduces transepidermal water loss. Current research indicates that moisturizers containing licochalcone A are compared to hydrocortisone lotion in treating childhood AD. A recent report suggests that a moisturizer containing licochalcone A may have been less effective than hydrocortisone lotion in treating mild to moderate AD in children. Licorice root extract has antioxidant properties that combat free radicals, slowing skin aging. It contains glabridin, known for its antioxidant, anti-inflammatory, and skin-whitening benefits. This extract reduces wrinkles, improves elasticity, firms skin, and heals damaged cells. It also addresses various signs of aging. The topical application eliminates dark spots and evens skin tones. Glabridin inhibits enzymes involved in melanin production, brightening the skin and reducing excess melanin. A study shows that an anti-aging skin care product containing glycyrrhizic acid nanoformulation has the potential to be a local anti-aging alternative. The data of the current research show that different types of licorice have effective compounds and have therapeutic and protective effects on skin and hair diseases, including acne, herpes, shingles, rosacea, atopic dermatitis, skin aging, psoriasis, anti-cutaneous leishmaniasis, leprosy, vitiligo, seborrheic dermatitis, and dandruff, hair growth stimulating effects, baby seborrheic dermatitis or cradle cap, facial dermatitis, wound and burn repair, genital warts, hirsutism, etc. It also has the impact of preventing damage caused by sunlight, skin protection against the harmful consequences of the sun's rays, anti-aging effects of the skin caused by ultraviolet rays, protection against UV-B rays and visible rays, are among the properties of the active ingredients and root extract. This study is the first comprehensive research on the effects of licorice root on dermatology so far.

Evidence Strength and Limitations

Compelling evidence exists for licorice in acne vulgaris and rosacea. For acne, licochalcone A demonstrates dual action: direct antimicrobial effects against C. acnes and inhibition of the NLRP3 inflammasome to reduce inflammation (Liu *et al.*, 2025; Ruan *et al.*, 2022; Yang *et al.*, 2018). Clinically, formulations combining licochalcone A with salicylic acid or adapalene show significant reductions in both inflammatory and non-inflammatory lesions (Chularojanamontri *et al.*, 2016; Dall'Oglio *et al.*, 2019; Kulthanan *et al.*, 2020). For rosacea, ingredients like hesperidin methyl chalcone and licochalcone A reduce erythema and improve skin barrier function (Bussmann *et al.*, 2022; Weber *et al.*, 2006). However, evidence quality varies significantly. While preclinical data are robust, high-quality human RCTs remain limited for many conditions. Promising results in atopic dermatitis, wound healing, psoriasis, and cutaneous leishmaniasis often come from small studies, animal models, or open-label trials (Assar *et al.*, 2021; Boonchai *et al.*, 2018; Leite *et al.*, 2023; Saeedi *et al.*, 2003; Souza *et al.*, 2020; Udompataikul & Srisatwaja, 2011; Wang *et al.*, 2022; Zhang *et al.*, 2023). This gap between laboratory findings and clinical confirmation represents the primary challenge for licorice-based therapies

Safety Considerations

Despite its dermatological benefits, chronic or excessive use of licorice containing glycyrrhizin may lead to pseudoaldosteronism (hypertension, hypokalemia, and edema) due to inhibition of 11β-hydroxysteroid dehydrogenase type 2. Topical formulations are generally well-tolerated, but oral consumption should be avoided in pregnancy, hypertension, and renal disease. Deglycyrrhizinated licorice (DGL) extracts are safer for long-term use.

Table 3: Summary of Clinical Studies on Licorice in Dermatological Disorders

Disorder	Intervention	Population	Key Finding	Reference
Acne Vulgaris	Licochalcone A + adapalene vs. adapalene alone	25 participants	Combined product notably improved acne scores	(Kantikosum *et al.*, 2019)
Acne Vulgaris	Licochalcone A + salicylic acid + L-carnitine	91 patients	64% reduction in comedones, 71% reduction in papules at week 8	(Dall'Oglio *et al.*, 2019)
Atopic Dermatitis	2% glycyrrhetinic acid ointment vs. placebo	281 adults	80% reduction in swelling vs. 10% with placebo	(Saeedi *et al.*, 2003)
Melasma	Licorice extract cream (10%, 20%, and 40%)	44 women	10% concentration showed best skin lightening effects	(Shamsi Meymandi *et al.*, 2016)
Anogenital Warts	0.1% glycyrrhizinic acid spray vs. 25% podophyllin	100 patients	87.5% efficacy vs. podophyllin	(Domínguez Gómez *et al.*, 2012)
Alopecia Areata	Glycyrrhizin + LingDan tablets vs. LingDan alone	150 patients	93.3% efficacy vs. 77.3% in control	(Xue, 2018)
Infantile Seborrheic Dermatitis	0.025% licochalcone vs. 1% hydrocortisone	75 children	Similar efficacy after 2 weeks	(Wananukul *et al.*, 2012)

CONCLUSION

Licorice is more than just a sweet flavor in candies and teas—it is a powerful medicinal plant with real benefits for skin and hair. After reviewing the available research, it is clear that licorice works especially well for several common skin problems, including acne, rosacea, eczema, dark spots, and even slow-healing wounds. What makes this plant so effective is its unique mix of natural compounds—glycyrrhizin, licochalcone A, glabridin, and isoliquiritigenin—each playing a specific role. Together, they fight inflammation, kill acne-causing bacteria, protect skin from oxidative stress, and help calm overactive immune responses. Scientists have traced these effects to specific pathways in the body, such as reducing the inflammation that makes acne worse, activating the skin's own defense system against UV damage, slowing down the production of excess pigment, and speeding up tissue repair.

Of course, no remedy is perfect, and licorice is no exception. While the lab results are impressive, high-quality studies in humans are still relatively few. Many of the clinical trials conducted so far have been small or not tightly controlled, which means we cannot say with absolute certainty how well licorice works for every skin condition just yet. That is an important gap that future research needs to fill. On the safety front, using licorice on the skin is generally very safe and well tolerated by most people. However, taking it by mouth for long periods or in large amounts can sometimes cause issues like raised blood pressure or low potassium levels because of the way it affects certain hormones. People with high blood pressure, kidney disease, or those who are pregnant should be especially careful.

Looking forward, researchers need to run larger, more rigorous clinical trials using standardized licorice extracts. It would also be helpful to compare licorice head-to-head with conventional treatments and to figure out the best concentrations and delivery methods—like using tiny nanoparticles to help the active ingredients penetrate deeper into the skin. All things considered, licorice is a wonderful example of how ancient herbal wisdom can be backed up by modern science. It offers a safe, natural, and effective option for anyone looking to care for their skin the way nature intended.

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