REVIEW ON AYURVEDIC FORMULATION AND THERAPEUTIC EVALUATION OF *GLYCYRRHIZA GLABRA LINN*

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Abstract: *Glycyrrhiza glabra* Linn., commonly known as licorice or Yashtimadhu in Ayurveda, is a versatile medicinal herb extensively used for its rejuvenating and skin-restorative properties. This review consolidates the pharmacognostic, phytochemical, and therapeutic aspects of *G. glabra*, highlighting its significance in modern Ayurvedic formulations and cosmeceutical applications. The plant contains potent bioactive compounds such as glabridin, liquiritin, licochalcone A, and glycyrrhizin, which exhibit antioxidant, anti-inflammatory, antimicrobial, and tyrosinase-inhibiting properties. These attributes make licorice a promising natural candidate for managing hyperpigmentation, acne, eczema, and premature skin aging. This review also examines Ayurvedic formulations incorporating licorice and their evaluation through organoleptic, physicochemical, phytochemical, and stability parameters to ensure product safety and efficacy. Additionally, this review emphasizes the importance of quality control, compatibility testing, and stability studies to validate *G. glabra* as a reliable ingredient in therapeutic skincare and pharmaceutical preparations.

Indexterms **- Glycyrrhiza glabra,Yashtimadhu,Ayurvedic formulations, Cosmeceuticals,Phytochemical evaluation**

I. INTRODUCTION

Herbal formulations restore balance using plant-based compounds. They promote dermatological health and enhance appearance. Licorice is valued for its therapeutic applications in Ayurveda. It is known for its rejuvenating effects and medicinal use. Licorice is a Rasayana herb that supports vitality and longevity. Licorice contains bioactive phytochemicals with anti-inflammatory and antioxidant actions. Licorice extracts are widely used in modern cosmetic science for their skin-benefiting properties [1,5].

Recent studies show licorice extract inhibits melanin synthesis[6], alleviates irritation in conditions like eczema and dermatitis [7,8], and protects skin from oxidative and photochemical stress[9,10]. These findings support Ayurvedic claims and establish G. glabra as a key ingredient in the cosmeceutical industry. Compatibility with other active agents enhances its therapeutic potential [11,12]. Integrating Ayurvedic strategies with modern evaluation techniques ensures efficacy, safety, and stability of licorice-based products[13,14]. Parameters like organoleptic characteristics, pH, viscosity, and stability testing are now crucial for product standardization. This review examines Glycyrrhiza glabra Linn., including its features, constituents, mechanisms, strategies, and evaluation parameters. Correlating Ayurvedic wisdom with modern insights emphasizes the importance of G. glabra for dermatological and cosmetic applications[13,14,17].

II. PHARMACOGNOSTIC PROFILE OF *GLYCYRRHIZA GLABRA*

2.1 Botanical Source

Licorice is obtained from the dried roots, rhizomes, and stolons of *Glycyrrhiza glabra* Linn., belonging to the family Leguminosae (Fabaceae). Commercially, it is available as Spanish or Russian licorice, depending on the plant variety and geographic origin. The major varieties include *G. glabra* var. *violacea* (Persian licorice) characterized by violet flowers, G. *glabra* var. *glandulifera* (Russian licorice) known for its thick, elongated root and absence of stolons, and *G. glabra* var. *typica* (Spanish licorice) with purple-blue flowers and stoloniferous roots[1,2,3]

2.2 Geographical Distribution

Glycyrrhiza glabra thrives in subtropical and warm temperate regions with fertile, well-drained sandy or clay soils. *Glycyrrhiza glabra* is native to Western and Central Asia and is cultivated in India and other temperate regions.

2.3 Morphology and General Description

Figure 1. Whole plant of *glycyrrhiza glabra*

Licorice is a hardy perennial shrub that can reach a height of up to 2.5 meters. The plant has an extensive underground system consisting of a taproot that branches into multiple subsidiary roots, giving rise to stolons that may extend up to 8 meters. These stolons and roots are the main commercial sources of licorice. Externally, the root appears yellowish-brown to dark brown and exhibits a fibrous fracture with a characteristic sweet taste and pleasant odor. Internally, it is yellow in color and shows a smooth texture when cut longitudinally.[1,2,3]

Leaves: Measuring 7–15 cm in length, bearing 4–7 pairs of oblong or lanceolate leaflets.
Flowers: Usually pale whitish-blue to lavender in color.
Calyx: Short and campanulate with lanceolate lobes and glandular hairs.
Fruit: A compressed, glabrous pod about 1.5 cm long, containing 3–5 brown, kidney-shaped seeds.
Roots: Cylindrical, stoloniferous, and externally covered with a thin bark; the fractured surface appears fibrous and yellow.

2.4 Organoleptic Characteristics

Color: Yellowish-brown to dark brown externally; yellow internally.
Odor: Characteristic, pleasant, and slightly woody.
Taste: Distinctly sweet with a faint bitterness due to glycyrrhizin.
Texture: Hard and fibrous when dry, with a smooth fracture surface.[10]

2.5 Macroscopic and Microscopic Features

Under microscopic examination, licorice root displays a multilayered cork, secondary phloem with distinct sieve tubes, and lignified xylem elements. The presence of starch grains and calcium oxalate crystals is notable within parenchymal tissues. These histological characteristics aid in its pharmacognostic identification and authentication.

2.6 Habitat and Growth Conditions

Licorice prefers sunny locations and soils rich in organic matter with adequate moisture. It thrives best in loamy soils near water sources and requires mild winters and hot summers for optimal growth. In Ayurvedic pharmacognosy, the plant is classified as *madhura rasa* (sweet taste) and *sheeta virya* (cool in potency), aligning with its soothing and anti-inflammatory properties.

Licorice's well-established pharmacognostic profile supports its use as a standardized herbal drug. Understanding its morphology, origin, and identification parameters is essential for ensuring quality control in Ayurvedic, pharmaceutical, and cosmeceutical formulations.[11]

2.7 Active constituents and cosmetic formulations of *glycyrrhiza glabra*

Glycyrrhiza glabra root contains a wide range of biologically active phytoconstituents that contribute to its therapeutic and cosmetic applications. The major constituents include flavonoids, isoflavonoids, chalcones, and triterpenoid saponins, among which glabridin, liquiritin, licochalcone A, and **glycyrrhizin** are the most pharmacologically significant.[4,5,6] These compounds collectively exhibit antioxidant, anti-inflammatory, antimicrobial, depigmenting, and skin-soothing properties. **Glabridin** and **liquiritin** play a key role in regulating melanogenesis and improving skin tone, making licorice extracts effective in managing hyperpigmentation and melasma. **Licochalcone** A contributes to the reduction of inflammation and microbial growth, particularly in sensitive and acne-prone skin, while glycyrrhizin enhances anti-inflammatory activity and provides moisturizing and protective effects. The synergistic action of these constituents supports the use of licorice in Ayurvedic formulations and modern cosmeceuticals[6,7,8,9]

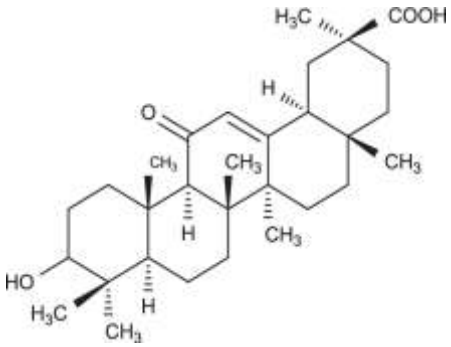

Figure 2. Chemical structure *of glycyrrhizin.*

2.8 Synergistic Cosmetic Ingredients

Modern skincare formulations often combine licorice extracts with other active compounds to enhance their effects:

Vitamin C (Ascorbic Acid): Enhances brightening by inhibiting tyrosinase activity and neutralizing free radicals.

Niacinamide (Vitamin B3): Reduces melanin transfer to keratinocytes, supporting an even skin tone.

Kojic Acid: Complements glabridin's depigmenting action by preventing melanin biosynthesis.

Hyaluronic Acid and Glycerin: Provide hydration and improve barrier function, promoting smoother and plumper skin.

Aloe Vera Extract and Green Tea Polyphenols: Offer additional soothing and antioxidant protection.

Vitamin E: Strengthens the skin's defense against oxidative stress and photoaging.

III. COSMETIC FORMULATIONS INVOLVING LICORICE

3.1 Creams and Lotions:

Widely used for brightening and anti-pigmentation purposes. Glabridin-rich creams help fade sunspots, age spots, and post-inflammatory hyperpigmentation. Night creams containing licorice extract aid in overnight repair and even skin tone development.[9]

3.2 Serums and Essences:

Concentrated formulas that allow better skin penetration. Licorice-based serums, often paired with niacinamide or vitamin C, effectively target dark spots and dullness while improving hydration and radiance.[10]

3.3 Masks and Face Packs:

It is used for intensive treatments. DIY and commercial licorice masks combine extracts or powders with honey, yogurt, or clay to calm and brighten the skin. Sheet and gel masks infused with dipotassium glycyrrhizinate offer convenient topical benefits.[11]

3.4 Toners and Mists:

Lightweight, hydrating products that deliver licorice derivatives for instant soothing and revitalization. Aqua-based mists containing glycyrrhizinate refresh the skin and maintain its pH balance.[12]

3.5 Cleansers:

Gentle foaming or gel-based formulations with licorice extract help purify the skin while reducing inflammation and bacterial growth, making them suitable for acne-prone and sensitive skin types.

3.6 Functional Role in Formulations

Licorice's bioactives serve as multifunctional agents—skin brighteners, anti-irritants, and antioxidants—making it an essential component in both Ayurvedic and contemporary cosmetic products. By combining ancient herbal wisdom with modern dermatological research, licorice-based formulations provide effective, natural alternatives for achieving balanced and radiant skin.

Figure 3. Ayurvedic and cosmeceutical formulations containing *licorice* extract.

IV. PHARMACOLOGICAL AND THERAPEUTIC ACTIONS OF *GLYCYRRHIZA GLABRA*

4.1 Ayurvedic Perspective

In Ayurveda, *Glycyrrhiza glabra* (Yashtimadhu or Mulethi) is classified as *madhura rasa* (sweet in taste), *guru guna* (heavy), and *sheeta virya* (cool in potency). It is known to balance the *Vata* and *Pitta* doshas, helping to maintain harmony between bodily

energies and thereby supporting skin health. Its R*asayana* (rejuvenating) properties enhance vitality, tissue regeneration, and skin resilience, while its soothing nature alleviates inflammation and irritation.[5,6,7,8]

4.1.1 Effect on Vata Skin:

Vata-type skin is typically dry, thin, and prone to dehydration. Licorice nourishes and moisturizes such skin through its unctuous and rejuvenating properties, helping to reduce dryness and fine lines. Its sweet taste (*madhura rasa*) provides a soothing, hydrating effect, restoring suppleness to the skin.

4.1.2 Effect on Pitta Skin:

Pitta-type skin is generally sensitive and susceptible to redness, inflammation, and acne. The herb's cooling and anti-inflammatory actions, largely due to glycyrrhizin and licochalcone A, help to reduce erythema, swelling, and irritation. Additionally, glabridin inhibits melanin production by blocking the tyrosinase enzyme, preventing hyperpigmentation common in Pitta imbalances.

4.1.3 Effect on Kapha Skin:

Kapha-type skin is often oily, thick, and prone to dullness or clogging. Licorice helps balance excess sebum production and promotes a brighter, clearer complexion. However, due to its inherently sweet nature, excessive internal use of licorice may aggravate Kapha and should be limited; topical application is preferred for this dosha.

4.2 Pharmacological Properties

4.2.1 Anti-Inflammatory Action

Glycyrrhizin and licochalcone A are well-documented anti-inflammatory agents. They inhibit cyclooxygenase and pro-inflammatory cytokines, reducing redness, swelling, and irritation in inflammatory dermatoses such as eczema, psoriasis, and rosacea.[7]

4.2.2 Antioxidant Activity

Flavonoids like glabridin and liquiritin scavenge free radicals and prevent oxidative stress, thereby protecting cellular integrity. This contributes to anti-aging benefits, as oxidative stress is a key factor in wrinkle formation and skin dullness.[8,9]

4.2.3 Antimicrobial Effects

Licorice extract exhibits antibacterial and antifungal activity against *Staphylococcus aureus*, *Candida albicans*, and *Propionibacterium acnes*. These properties make it effective in acne management and in preventing secondary infections in compromised skin. Licorice exhibits significant antimicrobial activity against bacterial and fungal pathogens.

4.2.4 Depigmenting and Skin-Brightening Effects:

Glabridin and liquiritin interfere with melanin synthesis and promote pigment dispersion, resulting in reduced hyperpigmentation and improved skin tone. Topical applications have shown significant improvement in melasma and post-inflammatory pigmentation.

4.2.5 Anti-Aging and Photoprotective Role:

The antioxidant and anti-inflammatory compounds in *G. glabra* protect against photoaging by neutralizing UV-induced reactive oxygen species. Glabridin also enhances collagen and elastin preservation, maintaining the skin's elasticity and firmness.

4.2.6 Wound-Healing and Soothing Properties:

Licorice accelerates wound closure by promoting re-epithelialization and collagen synthesis. Its soothing effects make it beneficial for burns, rashes, and irritation associated with eczema or dermatitis.

4.3 Common Therapeutic and Cosmetic Applications

4.3.1 Face Packs: Combining licorice powder with rose water or milk yields brightening and calming masks suitable for all skin types.[11]

4.3.2 Topical Oils and Creams: Licorice-infused oils or creams reduce itching, redness, and irritation associated with eczema and dermatitis.[12]

4.3.3 Internal Preparations: Consumed in powder or tea form, licorice helps correct internal imbalances that contribute to skin disorders. However, long-term or high-dose ingestion should be supervised, particularly in hypertensive individuals.[13]

4.3.4 Serums and Moisturizers: Regular topical use enhances hydration, luminosity, and overall skin texture, providing a natural and sustainable approach to skincare.

V. EVALUATION OF AYURVEDIC FORMULATIONS OF *GLYCYRRHIZA GLABRA*

The effectiveness and stability of Ayurvedic formulations containing *Glycyrrhiza glabra* depend on rigorous evaluation to ensure safety, quality, and reproducibility. Standardized testing parameters—covering physical, chemical, stability, and skin compatibility assessments—are essential to confirm that the final formulation maintains its therapeutic integrity throughout its shelf life.[12,14,17]

5.1 Physical Evaluation

5.1.1 Organoleptic Properties:

The formulation's color, odor, and appearance are assessed visually and manually. High-quality preparations should have a uniform color, pleasant odor, and consistent appearance representative of licorice-based products.

5.1.2 Homogeneity and Consistency:

A small portion of the formulation is rubbed between the thumb and index finger to test for smoothness and absence of coarse particles. The ideal formulation should exhibit even texture and appropriate spreadability when applied to the skin.

5.1.3 Washability:

For creams and ointments, ease of removal with water is tested to determine user comfort. Non-greasy, easily washable formulations are preferred for topical application.

5.1.4 pH Determination:

The pH is measured using a digital pH meter to ensure compatibility with skin physiology. A pH between 4.5 and 6.5 is generally considered optimal for maintaining skin health and minimizing irritation.

5.1.5 Viscosity and Spreadability:

Viscosity is measured using a Brookfield viscometer to assess the formulation's texture and application behavior. Spreadability tests evaluate the ease with which the product distributes across the skin, a critical factor for user compliance and absorption.

5.2 Chemical Evaluation

5.2.1 Phytochemical Screening:

Preliminary tests are performed to confirm the presence of active compounds such as flavonoids, saponins, triterpenoids, tannins, and phenolic compounds. These constituents are responsible for licorice's key pharmacological activities.

Flavonoids: Tested by the Shinoda or lead acetate test.
Saponins: Identified by the foam test.
Tannins: Detected using ferric chloride or gelatin reagents.
Triterpenoids: Confirmed by Liebermann–Burchard reaction.

5.2.2 Assay of Active Markers:

Advanced chromatographic techniques are employed to quantify major bioactive compounds

High-Performance Thin Layer Chromatography (HPTLC): Provides chemical fingerprints for identification and quantification of glycyrrhizin and other markers.

High-Performance Liquid Chromatography (HPLC): Offers precise separation and quantification of glabridin, liquiritin, and glycyrrhizin.

5.2.3 Stability Evaluation

Accelerated Stability Studies:

Formulations are subjected to stress conditions such as elevated temperature, humidity, and light exposure to predict long-term stability. Periodic analysis includes changes in color, odor, consistency, and pH.[14]

Freeze–Thaw Cycles:

Products are alternately exposed to low and high temperatures to assess emulsion stability and identify potential phase separation or precipitation issues.

Moisture Content:

Particularly for powdered or semi-solid formulations, moisture content is monitored to prevent microbial growth and ensure product longevity.

Light and Temperature Sensitivity:

The presence of sensitive compounds like glycyrrhizin and glabridin necessitates protection from direct light and extreme temperatures to prevent degradation and discoloration.

Microbial Stability:

Microbiological testing ensures that the product remains free of bacterial and fungal contamination. Standard plate count methods are used to confirm microbial safety during storage.

5.3 Skin Compatibility and Safety Assessment

5.3.1 In Silico Predictions:

Computational modeling tools predict the potential irritancy, sensitization, and cytotoxicity of the formulation's ingredients, providing an early indication of product safety.[14]

5.3.2 In Vitro Evaluation:

Skin irritation potential is tested using reconstructed human epidermis models such as EpiDerm™ or SkinEthic™. Parameters like cell viability (MTT assay) and inflammatory cytokine release are analyzed.[15]

5.3.3 In Vivo Studies:

Human patch tests are conducted to evaluate irritation or allergic reactions under dermatological supervision. The Human Repeated Insult Patch Test (HRIPT) helps assess cumulative irritation and sensitization risks. Products classified as non-irritating show no significant redness, swelling, or discomfort after repeated applications.[16,17]

5.4 Sensory Evaluation

Sensory analysis is performed by trained panelists who assess the product's appearance, texture, odor, and overall acceptability using hedonic scales. The sensory appeal of licorice-based formulations—such as their mild herbal aroma, smooth texture, and subtle color plays an important role in consumer satisfaction and compliance.

VI. STABILITY AND SENSORY EVALUATION OF LICORICE FORMULATIONS

6.1 Stability Evaluation

Stability testing is a critical component in developing and validating herbal formulations to ensure that their efficacy, safety, and physical integrity remain consistent throughout storage and usage. The natural components of *Glycyrrhiza glabra*—particularly glycyrrhizin, liquiritin, and glabridin—are sensitive to environmental factors such as pH, temperature, moisture, and light. Understanding these influences enables formulators to design stable, high-quality products for both therapeutic and cosmetic purposes.

6.2 pH Stability

The pH of a formulation directly affects the chemical stability of licorice-derived compounds. Glycyrrhizin, for instance, demonstrates reduced stability under strongly acidic conditions (pH < 5), which can lead to hydrolysis and loss of activity. Formulations are therefore optimized within a pH range of 5.0–6.5 to ensure ingredient preservation and skin compatibility.

6.3 Temperature Stability

Temperature fluctuations can accelerate degradation reactions and alter formulation consistency. Studies show that exposure to high temperatures (>60°C) or repeated freeze–thaw cycles can cause phase separation in emulsions, affecting their uniformity and performance. To counteract this, formulations are typically stored in cool, dry environments and packed in temperature-resistant containers.

6.4 Moisture Sensitivity

For powdered or microencapsulated formulations, moisture content is a key determinant of stability. Elevated humidity can promote caking, microbial growth, and reduced dispersibility. Controlled packaging conditions and desiccant use are recommended to maintain product integrity.

6.5 Light Exposure

Prolonged exposure to sunlight can initiate oxidative degradation of phenolic and flavonoid compounds, resulting in discoloration and reduced potency. Therefore, light-protective packaging such as amber or opaque containers is essential to preserve the visual and functional quality of licorice formulations.

6.6 Antioxidant Role

Licorice itself possesses inherent antioxidant compounds that protect against oxidative degradation. Phenolic constituents such as glabridin and liquiritin help stabilize other components within the formulation, enhancing the overall shelf life and functional performance of products containing ghee, oils, or emulsions.

6.7 Microbial Stability

Due to its natural composition, licorice formulations are susceptible to microbial contamination. Glycyrrhiza extracts, however, exhibit intrinsic antibacterial activity against *Staphylococcus aureus* and *Escherichia coli*, which contributes to microbial preservation. Nevertheless, preservatives and good manufacturing practices are essential to maintain long-term microbiological stability, particularly for aqueous formulations.

6.8 Appearance and Color

The color of licorice formulations varies from light yellow to dark brown depending on the concentration of extract and presence of additional ingredients. Uniform color and glossy appearance typically indicate proper emulsification and stability. Any change in color during storage may signify oxidation or phase separation.

6.9 Odor

Licorice root emits a pleasant, mild, and earthy aroma. In formulations such as serums and creams, the natural fragrance should remain consistent throughout the shelf life without developing rancidity or off-odors. Mild aromatic additives can be incorporated to complement its natural scent.

6.10 Taste (for oral or ingestible forms)

Licorice possesses a distinctly sweet flavor due to glycyrrhizin, which is approximately 50 times sweeter than sucrose. Longer extraction durations can intensify bitterness as polyphenols and tannins are released. For internal preparations, optimizing extraction time and concentration helps balance sweetness and palatability.

6.11 Texture and Consistency

The ideal texture depends on the formulation type—creams should feel smooth and non-greasy, serums should be viscous yet easily spreadable, and jellies should maintain a uniform gel structure. Consistency testing ensures the formulation is neither too fluid nor excessively thick, providing a comfortable sensory experience for the user.

CONCLUSION

Glycyrrhiza glabra Linn. (licorice) remains one of the most versatile and well-studied herbs in Ayurvedic and modern medicine. Its rich phytochemical composition—comprising glabridin, liquiritin, licochalcone A, and glycyrrhizin—confers a broad range of pharmacological and dermatological benefits, including antioxidant, anti-inflammatory, antimicrobial, and depigmenting effects. These properties make licorice a cornerstone ingredient in Ayurvedic formulations and an increasingly popular component in contemporary cosmeceutical products. The integration of traditional Ayurvedic principles with modern pharmacological validation has enhanced the credibility and acceptance of licorice-based formulations in global healthcare. Standardization through physicochemical, phytochemical, and stability testing ensures consistent quality, safety, and efficacy. Furthermore, skin compatibility and sensory evaluations contribute to optimizing user experience and compliance, thereby enhancing therapeutic

success.Overall, *Glycyrrhiza glabra* exemplifies how traditional herbal knowledge, when supported by modern analytical techniques, can yield high-value, evidence-based natural formulations. Continued research into its phytoconstituents, delivery systems, and synergistic combinations with other botanicals will further strengthen its role in dermatological therapy and holistic skincare.

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