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Glycyrrhiza glabra: Active Phytoconstituents and Medicinal Properties

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Abstract

Since ancient times, *Glycyrrhiza glabra* (liquorice) has been commonly used as a medicinal plant, which has a rich nutritional value including carbohydrates, proteins, essential amino acids, micronutrients, and bioactive phytochemicals. The roots and rhizomes of this plant are particularly valued due to the presence of glycyrrhizin, a triterpene saponin responsible for its characteristic sweetness and diverse pharmacological properties. Various phytoconstituents such as flavonoids, tannins, glycosides, essential oils, and polysaccharides contribute to its therapeutic potential.

Extensive studies have demonstrated that *G. glabra* exhibits a wide range of biological activities, including antibacterial, antifungal, antiviral, anti-inflammatory, anthelmintic, larvicidal, antioxidant, and anti-malarial effects. Root extracts have shown inhibitory activity against several pathogenic microorganisms such as *Streptococcus pyogenes*, *Staphylococcus aureus*, *Escherichia coli*, and *Candida albicans*. Additionally, bioactive compounds like glabridin and isoflavonoids play a significant role in antifungal activity, while glycyrrhizin exhibits antiviral properties against both DNA and RNA viruses, including herpes simplex virus and influenza virus. Its anti-inflammatory and anti-ulcerogenic effects further enhance its importance in traditional and modern medicine.

The current review focuses on highlighting the broad-spectrum pharmacological importance of *G. glabra* and related medicinal plants, emphasising their promising role in controlling parasitic infections and contributing to sustainable healthcare solutions.

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INTRODUCTION

The *Glycyrrhiza glabra* is a medicinal plant that belongs to the family Fabaceae. The name of the species clarifies the sweet root (Greek-*glukus* sweet; *rhiza*-root) because it contains glycyrrhizin, which has more than 30 to 50 times the sweetness of sugar. It is a native Mediterranean basin, the Southwest and Central region of Asian medicinal plants (Bell *et al.,* 2011; Grieve, 1971), which are found at low or high altitudes (Durak, 2014) and widely cultivated in the Himalaya tracts and Punjab (Dhuke *et al.,* 2002). This plant is commonly known as liquorice, liquorice (Zheng *et al.,* 2015), jothi-madh, mulethi in Hindi, and yashti-madhuh, madhuka in Sanskrit (Chopra *et al.,* 2002), which grows erect in 0.7 to 2.0-meter height (Fenwick et al., 1990). It contains a deep root system, which is present in more than 1 meter of depth (Grieve, 1971). The nutritional values of *G. glabra* are also very high due to the presence of carbohydrates, proteins, amino acids (threonine, glycine, isoleucine, valine, alanine, tyrosine, leucine, histidine, glutamic acid, phenylalanine, serine, arginine, aspartic acid, and lysine), micronutrients (sodium, potassium, calcium, iron, phosphorous, copper, and zinc), and fats (Kozhuharova and Stanilova, 2017). However, the more than three-year-old plant *G. glabra* is commonly used in traditional medicine for curing many diseases like psoriasis, renal calculus ulcer, asthma, and rheumatism (Kozhuharova and Stanilova, 2017). Its rhizome roots are widely used as herbal medicine and natural sweetener for the treatment of different diseases (Asl and Hosseinzadeh, 2008).

Phytochemicals of *G. glabra*

The root of *G. glabra* (Liquorice) has a large number of bioactive components such as pectin, starches, simple sugars, polysaccharides, mucilage, gums, amino acids, triterpene saponin, mineral salts, flavonoids, essential oil, bitters, fats, female hormone estrogen, asparagines, tannins, glycosides, resines, protein, sterols, and volatile oils (Hoffmann, 1990; Bradley, 1992). However, the major active component in the stolons and roots of *G. glabra* is glycyrrhizin, which is a triterpene saponin (Obolentseva *et al.,* 1999). The active component glycyrrhizin is a combination of glucuronic acid and glycyrrhetinic acid (Sheela and Sangam, 2017).

Biological activities of *G. glabra*

The rhizomes of *G. glabra* are used worldwide as an herbal medicine for the treatment of different diseases (Patil *et al.,* 2009). The main bio-active component is glycyrrhizic acids, which have a sweet taste and it has anti-ulcer, anti-inflammatory, anti-arthritic, diuretic, healing, and bacteriostatic properties (Asl and Hosseinzadeh, 2008). Several studies of *G. glabra* roots and rhizomes are focused on their widespread pharmacological properties, such as anti-viral, anti-inflammatory, and hepatoprotective (Kameri *et al.,* 2005). The bioactive components of glycyrrhizin, which are obtained from the root extract of *G. glabra,* are used in the treatment of liver cirrhosis and chronic hepatitis (Khare, 2004). Some biological properties of *G. glabra* are as follows-

Anti-inflammatory activity

The root extract of liquorice promotes the healing of mouth and stomach ulcers (Damle, 2014). However, the bioactive components of glycrrhetinic acid in liquorice extract have anti-inflammatory activity (Baker, 1994). Different preparation of *G. glabra* possesses a significant anti-ulcerogenic property, about 77.7 per cent after 17 days and 90 per cent after 30 days of the treatment (Nudrat *et al.,* 2008). Glycyrrhizin is an effective and established anti-inflammatory medicine (Kokate *et al.,* 2009). Liquorice extract has anti-inflammatory activity, which has a similar action to hydrocortisone (Der, 2001). The cabonoxolone is a derivative of glycyrrhizic acid, which is used as an anti-inflammatory component (Rao, 1993).

Anti-bacterial activity

The aqueous and ethanolic extract of *G. glabra* root *in vitro* inhibits the cultural activities of *Streptococcus pyogenes* and *S. aureus* (Alonso, 2004). The secondary metabolites like alkaloids, saponins, and flavonoids are also extracted from the root of *G. glabra,* which have potent antibacterial activity (Sharma *et al.,* 2013). A study of anti-bacterial activity against *Candida albicans* and *Staphylococcus aureus* of the root extract of liquorice is more effective. *In vitro,* the root extract has antibacterial activity against the growth of *E. coli, Salmonella paratyphi*, *S. typhi*, *Shigella flexneri*, and *S. sonnei* (Shirazi *et al.,* 2007). Their various preparations exhibited the growth of Gram-positive and Gram-negative bacteria (Gupta *et al.,* 2008).

Anti-viral activity

A triterpenoid bioactive component and glycyrrhiza polysaccharides isolated from *G. glabra* have anti-viral activities against DNA and RNA groups of viruses (Rao, 1993). *In vitro* studies of glycyrrhizin revealed anti-viral activity against vesicular stomatitis virus, vaccinia virus, arbovirus, respiratory syncytial virus, SARS-related coronavirus, and HIV-1 viruses (Sheela and Sangam, 2017). The extract of *G. glabra* inhibits the growth of viruses like Varicella-zoster virus, Japanese encephalitis virus, Herpes simplex virus, Influenza virus, and Stomatitis virus (Alonso, 2004; Adam, 1997; Pompei *et al.,* 1980).

Anti-fungal activity

The bioactive component glabridin is isolated from the root extract of *Glycyrrhiza*, which has anti-fungal properties against *Candida albicans* and *Mycobacterium smegmatis* (Fatima *et al.,* 2009). The methanolic root extract of *G. glabra* has fungicidal activity against *Chaetomium funicola*, and *Arthrinium sacchari* (Damle, 20014). However, the active component isoflavonoids like glabrol, glabridin, and their derivatives are effective in inhibiting the growth of *Candida albicans* and *Mycobacterium smegmatis* (Alonso, 2004).

Anthelmintic larvicidal activity

The ethanolic extract of dried root powder of *Glycyrrhiza* has potent anthemintic larvicidal activity against larva of *Fasciola gigantica* in *in vivo* (Vishwakarma and Kumar, 2021) and *in vitro* treatment (Vishwakarma and Kumar, 2023) may be due presence of one or more phytochemicals in ethanolic extract which might responsible for larvicidal activity.

Anti-malarial activity

A chalcone (licochalcone-A) is isolated from liquorice, which has a good anti-malarial capacity. This compound is found in the *Glycyrrhiza* species in different quantities, which studies against *Plasmodium yoelii* in mice and has eradicated the malaria parasite (Sianne and Fanie, 2002).

Anti-oxidant activity

Liquorice has significant anti-oxidant properties in both *in vivo* (Kuhnl *et al.,* 2016) and *in vitro* (Martins et al., 2015) studies, which include scavenging hydrogen-donation, metal ion chelating, and anti-lipid peroxidation (Visavadiya *et al.,* 2009). Flavonoids are extracted from *G. glabra,* which are the strongest natural antioxidants (Ju *et al.,* 1989). The various preparation of liquorice exhibits the best antioxidant potential and liver-protective effects, such as the strand drug silymarin (Kanimozhi and Karthikeyan, 2011). The ethanolic extract of liquorice also exhibits antioxidant activity in humans against lipoprotein oxidation (Visavadiya *et al.,* 2009).

DISCUSSION

G. glabra is a highly valuable medicinal plant with a long history of use in traditional medicine. Its sweet-tasting roots, primarily due to the bioactive compound glycyrrhizin, are not only used as natural sweeteners but also contribute to a wide range of therapeutic benefits. The plant's adaptability and broad geographical distribution further enhance its importance in both traditional and modern healthcare systems.

A major strength of *G. glabra* lies in its rich phytochemical composition. Its roots contain flavonoids, saponins, tannins, glycosides, and essential oils, along with amino acids and minerals. Among these, glycyrrhizin is the principal active compound, composed of glucuronic acid and glycyrrhetinic acid, which plays a major role in modulating inflammation and immune responses. This diverse composition makes liquorice a multifunctional medicinal plant with both nutritional and pharmacological value.

The plant exhibits a wide range of biological activities. Its antibacterial properties are effective against both Gram-positive and Gram-negative bacteria, including *Streptococcus pyogenes*, *Staphylococcus aureus*, and *Escherichia coli*. It also shows antifungal activity, particularly against *Candida albicans*, with compounds like glabridin contributing to these effects. Additionally, liquorice demonstrates promising antiviral activity against viruses such as herpes simplex, influenza, and SARS-related coronaviruses, although most evidence comes from laboratory studies.

Anti-inflammatory and anti-ulcer properties are among its most clinically relevant benefits. Compounds like glycyrrhetinic acid and carbenoxolone promote healing of gastric and oral ulcers and exhibit effects similar to hydrocortisone, supporting its traditional use in treating inflammatory and gastrointestinal disorders. Furthermore, its antioxidant activity helps neutralise free radicals, reduce oxidative stress, and protect against chronic diseases such as liver damage, cardiovascular disorders, and cancer.

Liquorice also shows potential antimalarial activity, particularly due to licochalcone-A, which has demonstrated inhibitory effects on *Plasmodium* species in experimental studies. Despite these promising findings, limitations remain. Many studies are based on in vitro or animal models, highlighting the need for well-designed clinical trials. Additionally, excessive consumption may lead to side effects such as hypertension and electrolyte imbalance.

Hence, *G. glabra* is a versatile medicinal plant with significant therapeutic potential. Its diverse pharmacological properties make it a valuable natural remedy, though further research is essential to confirm its safety and efficacy in clinical use.

CONCLUSION

G. glabra (liquorice) is an important medicinal plant known for its diverse pharmacological properties and rich phytochemical composition. The presence of glycyrrhizin, a major bioactive compound, contributes significantly to its sweetness as well as its therapeutic effects. Along with glycyrrhizin, the plant contains flavonoids, saponins, tannins, and essential nutrients, which enhance its medicinal value.

The plant exhibits a wide range of biological activities. Its antibacterial and antifungal properties make it effective against several pathogenic microorganisms such as *Staphylococcus aureus*, *Escherichia coli*, and *Candida albicans*. These properties suggest its potential as a natural alternative to synthetic antimicrobial agents. Additionally, *G. glabra* demonstrates strong antiviral activity against various DNA and RNA viruses, indicating its importance in managing viral infections.

The anti-inflammatory and anti-ulcer properties of liquorice are particularly significant. Compounds like glycyrrhetinic acid help reduce inflammation and promote healing of gastric and oral ulcers, with effects comparable to corticosteroids such as hydrocortisone. Furthermore, its antioxidant activity plays a crucial role in protecting cells from oxidative stress, thereby reducing the risk of chronic diseases.

The presence of licochalcone-A also highlights its antimalarial potential, offering promising prospects for future drug development. However, despite these benefits, excessive consumption may lead to side effects, emphasising the need for controlled usage.

Hence, liquorice is a potent medicinal plant with multiple therapeutic applications. Further clinical studies are necessary to validate its efficacy and ensure safe use in modern medicine.

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