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Lovneet KaurDepartment of Botany, Mata
Gujri College, Fatehgarh Sahib,
Punjab, India**Rajandeep Kaur**Department of Botany, Mata
Gujri College, Fatehgarh Sahib,
Punjab, India**Ajaypal Singh**Department of Botany, Mata
Gujri College, Fatehgarh Sahib,
Punjab, India**Navjeet Kaur**Department of Botany, Mata
Gujri College, Fatehgarh Sahib,
Punjab, India**Corresponding Author:****Ajaypal Singh**Department of Botany, Mata
Gujri College, Fatehgarh Sahib,
Punjab, India

A brief review on ethnobotanical, pharmaceutical and therapeutic uses of *Glycyrrhiza glabra*

Lovneet Kaur, Rajandeep Kaur, Ajaypal Singh and Navjeet Kaur

Abstract

Glycyrrhiza glabra is a perennial herb, belonging to family fabaceae. It is also known as Licorice, sweet wood, Liquorice. It is a popular ingredient and well known remedy for coughs, syrups and various medicines with its relieving properties. *Glycyrrhiza glabra* Linn. Is one of the most important herb which is used in Ayurvedic medication since thousands of years. Medicinal plants are often used for treating various diseases. Now a days, the demand various herbal medicines, pharmaceuticals & health related products is increasing widely. Herbal medicine, include fruit, vegetables, as dry material on the extract of *Glycyrrhiza* to cure different diseases and maintenance of health. *Glycyrrhiza* is used in herbal preparation which is obtained from licorice roots for the treatment of liver related diseases. The root can help to heal gastric ulceration. It is also used in traditional medicine for its ethnobotanical and pharmacological value. It possesses anti-oxidant, antibacterial, antifungal, anti-viral, anti-inflammatory, skin whitening, anti-diuretic agent. The present article on *Glycyrrhiza glabra* is an effort to compile with the medicinal uses, ethnobotanical, pharmaceuticals and therapeutic effects.

Keywords: *Glycyrrhiza glabra*, Mulethi, therapeutic uses, medicinal uses, pharmacological, ethnobotanical uses

1. Introduction

Incontestably catholic changes are seen in healthcare industry in the 3rd paradise. The system of ayurvedic medical care has acquired attention and is becoming prominent. It is an extensive network of medical care that has established in India. Variety of plants has been mentioned by execution of several diseases. Therefore the current study is enrapt on medicinal herb *Glycyrrhiza glabra* [1]. *Glycyrrhiza glabra* is a perennial herb belonging to family fabaceae. *Glycyrrhiza glabra* is arrived from the ancient greek term glykos, which means sweet root [2] and rhiza denoting root, the name given by Dioscorides [3].

Glycyrrhiza glabra also known as, sweet wood; cultivated for its rhizome that contains a compound "glycyrrhizin". It is native to the Mediterrian region, Southwest & Central Asia [4-9]. Mulathi is a prominent medicinal herb, that grows in Egypt and various parts of the world. It is considered as one of the venerable and commonly used herb from the ancient times of Ayurveda, both as flavoring and as a medicine, to impersonate the unpleasant flavor of some other pharmaceuticals [10].

Licorice is the name concerned to stolons of roots of few species of *Glycyrrhiza*, hence used by humans since 400 years [11]. Glycyrrhizic acid in *Glycyrrhiza* is a triterpene glucoside, is considered as principal component, that is 50 times more sweeter as compare to sugar [12]. This acid (a flavanoid) arrived from word Licorice, which includes anti *Helicobacter pylori* effect [13]. Licorice, commonly used as respiratory infections, tremor, gastritis, peptic ulcers etc in conventional Persian medication [14-16] and also as the global criterion in medieval age [17, 18]. It is advantageous for the increasing obstruction of the gastric and upper respiratory tract and ulcers too [19].

It plays an important role in memory enhancement also helps as antidepressant and decreases level of blood cholesterol [20-22]. The diabetes symptoms like frequent urination and polydipsia can be reduced by it, but cannot control blood glucose [23]. It also acts as a good antioxidant agent [24]. The compounds in root of licorice used to relief heart disease in post-menopausal in females [25]. Roots acts as antacid, anti-ulcer and demulcent [26] diuretic, anti-inflammatory, laxative, expectorant tonic, sedative properties [27, 28]. They also possess antimicrobial, anti-herpes [29], antipyretic [30], and anxiolytic [31] activities. This herb is also used as an antiviral agent by the Japanese [32]. It also shows free radical scavenging and antioxidant [33, 34] and anticonvulsant activities [35, 36].

The circulatory levels of testosterone in men can be minimized by the use of *Glycyrrhiza glabra* [37-39].

2. Botanical description

2.1 Classification [40]

Kingdom	Plantae
Division	Angiospermae
Class	Dicotyledoneae
Order	Rosales
Family	Leguminosae
Genus	<i>Glycyrrhiza</i>
Species	<i>glabra</i> Linn

2.2 Regional names [41]

Gujarati	Jethimadhu
Sanskrit	Yashti-madhuh, Madhuka
Hindi	Jothi-madh, Mulhatti
Bengali	Jastimadhu, Jaishbomodhu
Malayalam	Iratimadhuran
Oriya	Jatimadhu
Tamil	Atimadhuram
English	Licorice, Liquorice, Sweet Wood
Marathi	Jeshtamadhu
Telugu	Atimadhuranu,
Kannada	Yastimadhuka, atimaddhura
Persia	Ausareha mahaka
Parts used	Roots and Rhizomes

2.3 Morphology

Licorice is a perennial herb or shrub, which is erect basically rough at the top and further branched from the base [42] reaches height up to 2.5m [43].

a) Stem

The stem of *Glycyrrhiza* is about 50-150 cm tall, white hairy, glandular punctuate scaly dense, woody at the base [44].

b) Leaves

Leaves are alternate, compound pinnately odd and up to 10-20 cm long. 3-8 pair of leaflets with small and drooping stipules [45]. 11-17 foliate; linear, 1-2mm; yellow brown hairy glandular and piliferous, densely petiolated, caducous stipules, oblong lanceolate, ovate-oblong leaflets, elliptical, abaxially yellow-scaly pubescent and glandular punctuate on veins, rounded base, adaxially pilose. Grows erect upto 200 m height. Its purplish white flower clusters, flat pods and oval leaflets look very beautiful [6, 7].

Flower-May-June,

Fruit-July-September, 2n=16* [46, 47].

c) Flower

The flowers are narrow, with upright axillary inflorescences, spike like 10-15 cm long. They are typically papilionaceous, glandular, lavender to violet in colour, with short pedicel. The individual flowers are 1-1.5 cm long. The calyx is short, campanular, acuminate tips, possess glandular hairs [48]. Petals-Narrow petals and the carina petals are not fused, pointed but not beaked.

d) Fruit

They are reddish brown, or compressed oblong pod or

legume, 1.5-2.5 cm long, 4-6 mm wide. It is long, erect, glabrous, flat with thick sutures, glandular, reticulate-pitted, contains 3-5 brown coloured, containing smooth reniform seeds [49, 50].

e) Roots

The roots are long, cylindrical, thick multi branched. Roots and Rhizome are considered as the officinal part, nearly round cylindrical, up to 1m length and 50-20 mm in diameter. The bark is brownish grey, to dark brown, from outside, wrinkled longitudinally bearing small round or transverse rootlet-scars in roots or dark buds in rhizomes [51, 52]. The woody stolons may reach 8m, when dried and cut, along with the root, constitute the commercial drug, known as liquorice/licorice. It may be peeled or unpeeled [53].

The root pieces break with a fibrous fracture, exposing the yellowish interior, with distinctive sweet taste and odor [54].

3. Cultivation

Licorice performs best in well-drained soils with full sun, and harvested after 2-3 years from planting in autumn. Licorice producing countries are India, Iraq, Uzbekistan, Pakistan, The People's Republic of China, Turkey, Turkmenistan, Azerbaijan [55]. Licorice enjoys sandy, fertile or clayey soil along with a stream or river, where there is enough water for the plant's growth, or where it can be irrigated under cultivation [28].

3.1 Active components

a) Flavonoids

Some components, contains flavonoids and chalcones, as they are responsible for the yellow shade of licorice such as liquiritin, neoliquiritin, chalcones isoliquiritin, glabrolide, liquiritigenin and licoflavonol [56-59]. Previously, glychionide B, 5,8-dihydroxy-flavone-7-O-beta-D-glucuronide were extracted from *G. glabra* roots [60].

b) Isoflavones

The isoflavonoid derivatives found in licorice include glabrone, glyzarin, glabrene, glabridin, kumatakenin, licoisoflavones A & B [57]. The isoflavones hispaglabridins A & B along with the glabridin have antioxidant activity. Both glabrene, glabridin indicates estrogen-like activity [61].

c) Saponins

Roots of Licorice contains triterpenoid saponins glycyrrhizin which is also known as Glycyrrhizic acid, present as a mixture of calcium & potassium salts [57] which is 50 times sweeter than sugar [19]. Other triterpenes are glabrolide, isoglabrolide, liquiritic acid, glycyrrhetol, licorice acid [54]. The natural saponins include a molecule named glycyrrhizic acid, comprise of a hydrophilic part, molecules of 2 glucuronic acid, and fragment, glycyrrhetic acid [62].

4. Therapeutic/Traditional Uses

I. *Glycyrrhiza glabra* Linn. has been widely used in folk medicine. Traditionally the plant is recommended as a prophylaxis for duodenal ulcers and gastric and dyspepsia as well as an anti-inflammatory agent at the time of allergic reactions [63]. It has been used as a contraceptive, laxative, galactagogue, emmenagogue, anti-viral agent and anti-asthmatic drug in folk medication [64]. It is considered as an important ingredient in medicine oil for the paralysis, epilepsy, rheumatism, hemorrhagic

diseases, and also to cure fever with delirium, diarrhea, and anuria^[65]. The roots of *Glycyrrhiza* are used for its expectorant and demulcent property^[66].

II. The medicinal plants have been used in various diseases since hundred years ago^[67]. *Glycyrrhiza glabra* is proved to be one of the best remedies for relieving discomfort, pain and other stomach infections, as it help in removing the irritating effect of acids in much better way as compared to alkalies. Research shows that glycyrrhizin creates an anti-inflammatory action on being broken down in the gut which is similar to hydrocortisone and various corticosteroid hormones. It prevents the production of hormones by adrenal glands and limits the breakdown of steroids by kidneys and liver. It also

proved to be effective in treating the liver cirrhosis and chronic hepatitis^[68].

III. The extract of root produces estrogenic effects, and it has been proved to be useful in treating symptoms of menopause, regulating menstruation and reliefs menstrual cramps. There is a great use of *Glycyrrhiza glabra* in clinics for centuries to cure liver diseases and is considered as a major compound of polyherbal formulations for treating hepatotoxicity^[69]. It is also helpful in anemia, croackiness, sore throat, fever, indigestion, nausea, coughs, bleeding, sexual debility, skin related diseases, heartburns, tonsillitis, gout, jaundice, etc.^[70]

Table 1: Pharmaceutical preparations containing *Glycyrrhiza glabra* with their indications and therapeutic uses^[71].

SI. No.	Name of Drug	Manufacturer	Composition	Therapeutic Uses
1.	<i>Glycyrrhiza glabra</i> 1X	Dr. Willimar Schwabe	<i>Glycyrrhiza glabra</i> extract	Irritating cough without wheeze, antitussive, sore throat, Chronic inflammatory condition of air passage
2.	Gut Gard	Natural remedies	<i>Glycyrrhiza glabra</i> extract (>10% flavanoids content)	Supports gastro intestinal tract, helps maintain a normal and healthy body, soothers heartburn, gives antioxidant support.
3.	Licorice root	Pure Science Supplements	10% <i>Glycyrrhiza glabra</i> extract of root, deglycyrrhizinated Licorice	Supports digestive and respiratory function, expectorant and demulcent
4.	Health Aid Licorice (CG 50ml)	Health aid	Each 1ml Licorice Liquid contains (average): Licorice Extract 1:3	Dry cough and promotes clear and comfortable breathing
5.	Solaray Licorice 450mg 100 Capsules	Nutraceutical	Licorice (<i>Glycyrrhiza glabra</i>) (root), gelatin and magnesium stearate	Health supplement
6.	Nature's sunshine licorice roots	Nature's Sunshine	Licorice root 792 mg	Supports the glandular system, mainly the liver and adrenal glands
7.	Brefus <i>Glycyrrhiza glabra</i> L., 0.2ml/ml	Brefus	<i>Glycyrrhiza glabra</i> L. 0.2ml/ml	Expectorant in cases of pharyngitis, acute and chronic bronchitis, intense coughing or secretion
8.	Chewable DGL Liquorice tablets	Nature's Garden	Deglycyrrhizinated Licorice 380 mg (<i>Glycyrrhiza glabra</i>) (root), L-glycine 50mg	Health Supplement
9.	Himalaya pure herb-licorice	Himalaya herbal healthcare	Organic licorice root 250mg (Standardized extract 25% glycyrrhizin-62.5mg). Organic licorice root powder 350mg	Gastric support, soothes the mucous membranes, balances excess acidity in stomach lining, and supports comfortable digestion
10.	Banyan botanicals licorice root powder	Banyan botanicals	<i>Glycyrrhiza glabra</i> extract	Natural expectorant and demulcent, dry cough and promotes clear and comfortable breathing, reproductive system, balanced adrenals, and proper function of kidneys
11.	The Nature Republic Cotton Armpit Cream	Nature Republic	<i>Glycyrrhiza glabra</i> root extract as one of the component	Claims to whiten, brighten and deodorize your underarm areas with its calming, powdery scent
12.	Illuminate clean face cleanser	Younique	Made with Garden Aloe vera, chrysanthemum, and Licorice root	Used as cleanser for face for oily skin
13.	Himalaya clear complexion whitening face wash	Himalaya	Pomegranate, saffron, liqorice, white dammar	Removes dark spots, cleanses and clarifies Impurities
14.	Liqorice extract-resist barrier repair moisturizer with retinol	Seattle	Retinol, liqorice	Removes wrinkles and has Anti-aging properties.

IV. The extract Hydro-methanolic root of *Glycyrrhiza glabra*, include anti-bacterial activity, because various secondary metabolites like flavonoids, alkaloids, saponins are present. The extract of *Glycyrrhiza* is being used in treatment of ayurvedic dentistry, and in some oral infections^[72].

V. *Glycyrrhiza glabra*, may also be useful in treating diarrhea, which may be caused due to rotavirus infection

^[73]. The active compound known as glabridin is responsible for the antifungal activity of liquorice, that shows the modifying resistance activity against mutants of drug resistance, *Candida albicans* and *Aspergillus niger*^[74].

VI. The anti-malarial activity in, *in vitro* & *in vivo* of 18- β glycyrrhetic acid, which is an active compound of *Glycyrrhiza glabra*, has been found to be productive^[75].

The evaluation of the cytotoxicity of polyphenol has been done by researchers, obtained from *Glycyrrhiza glabra*, which has been used for curing the breast & prostate cancer [76], non malignant primary mucosal cell, head & neck cancer lines [77] and also against various cell lines of cancer like Lung Adenocarcinoma, 7 Liver Carcinoma cell lines [78].

VII. The ethanolic extract of *Glycyrrhiza glabra* on the anti-hyperglycemic and anti hyperlipidemic effects against *Streptozotocin* induces diabetic rats has been found. Different biochemical, physical and histo morphological guidelines were assigned to observe the anti hyperlipidemic effects [79]. It has been noticed that liquorice flavonoids contains 100 times stronger antioxidant property as compared to antioxidant property of Vitamin E [80].

VIII. *Glycyrrhiza glabra* also acts as memory enhancing agent on learning and memory animal models in case of rodents [49, 81]. It has been found in the research that *Glycyrrhiza glabra* extract is beneficial in co-morbidities & stress inducing psychopathologies, as like some other medications and herbal drugs [82, 83]. As, the neurotransmitter modulating anti-oxidant property justifies the cerebro protective potential effect of *Glycyrrhiza glabra* in case of hypoxic rats [84].

IX. The Scientists explored the anti nociceptive activity of of ethanolic extracts of *Glycyrrhiza glabra* by using various pain models such as acetic acid, which induces abdominal constrictions. Tail flick and hyperalgesia method, induced by formation in Swiss albino mice. *Glycyrrhiza* has the potential to suppress the inflammatory events, like apoptosis, edema, NF κ B, iNOS expression, was expressed & remarked in numerous studies [85, 86].

5. Pharmaceutical/medicinal uses

However, a number of pharmaceutical inspections has been carried out on the basis of the existence of ingredients but a lot can still be examined, analyzed and explored. The different plant species have been explored in the literature for its essential activities like anti-expectorant & anti-inflammatory, which helps in managing the hormonal effects and cough. It also helps in the protection and detoxification of liver. It is being used for Addison's disease, bronchitis, arthritis, allergies, Steroid therapies, peptic ulcers, internally in medication [87]. The summary of various activities is given below:-

1) Anti-tussive & expectorant Activity

The extract and powder of liquorice has found useful in the medication of cough, bronchial catarrh and sore throat. It also act as an expectorant and antitussive [88]. Liquorice is found to work effectively as codeine in sore throat, as it reduces irritability and causes expectorant effects. Carbenoxolone, enhances secretion of gastric mucus. The tracheal mucus secretions are stimulated by liquorice extract which generally produces expectorant & demulcent effects [89]. An active compound named, Liquirtin apioside, found in the extract of methanol, which prevent capsaicin induced cough [90, 91].

2) Antioxidant Activity

Glycyrrhiza glabra has an important free radical scavenging effect [92]. Flavonoids of liquorice have strong antioxidant property found in liquorice flavanoids, is considered to be

over 100 times more stronger than antioxidant activity in Vitamin E. It can also be used for protection against damage of oxidants in cosmetic products for skin and hair. It is also found that glabridin has antioxidant activity towards oxidative lipoproteins of low density [93].

3) Anti-malarial Activity

A compound named Licochalcone A (a chalcone) found in liquorice, which causes, antimalarial activity. *In vivo* studies, against *P. yoelii* in mice, have been noted to eliminate the parasite of malaria completely and no toxicity was found [94]. The *In vitro* growth of chloroquine-resistant (Ddz) and chloroquine-susceptible (3D7) strains of *Plasmodium falciparum* is inhibited by Licochalcone A.

4) Anti-inflammatory Activity

The activity of Glabridin is found to be efficient in inflammation & melanogenesis by preventing the tyrosinase property found in melanocytes [96, 97]. β -glycyrrhittinic acid, apprise anti-inflammatory property in different animal models by preventing the metabolism of glucocorticoid [98, 99, 100]. As β -glycyrrhittic acid is considered as one of the major metabolite of glycyrrhizin [101]. It also inhibits the activation pathway of classical complement and its activity depends on its configuration [102]. It will be useful in the treatment of inflammatory lung disease if its co-medication is done with hydrocortisone [103]. A derivative of glycyrrhizic acid, glyderinine, also shows the anti-inflammatory effect [104, 105]. It plays an important role in reducing inflammatory myocardial edema in myocardial damage [106].

5) Anti-fungal Activity

Glycyrrhiza glabra acquires excellent anti-fungal activity. The recent study on antifungal compounds, include licorice extract with 80% methanol, it acquires high fungicidal affect, against *Chaetomium funicola* M002 & *Arthrinium sacchari* M001, as well as glabridin is considered as its active compound [107]. The different cosmetic products & antiseptic properties has been, formulated by the extract of liquorice. The inhibitory effects of aqueous extract of licorice root, demonstrated on cultures of *Candida albicans*, got from 5-months old infant's mouth lesions. The use of licorice based mouthwash had supported to cure *Candida*-inducing lesions, in patients suffering from HIV [108].

6) Anti-ulcer Activity

One of the most important component of licorice, is Glycyrrhizinic acid that include antiulcer effect by increase in the level of concentration of prostaglandins, enhance cell proliferation in stomach and mucous secretions. Glycyrrhizic acid, includes the *In vitro* activity, which works against *H. pylori* & therefore show its profitable effect on peptic ulcers [109].

7) Anti-bacterial Activity

The hydro-methanolic extract of roots of *Glycyrrhiza glabra* includes some secondary metabolites like alkaloids, saponins 7 flavonoids, they shows antibacterial activity against *Staphylococcus aureus*. Ethanolic extracts of liquorice justifies, that the *Staphylococcus aureus* & *Staphylococcus pyogenes*, exhibits the inhibitory activity. It is considered as an important drug & is able to fight against bacterial infection, scavenging of hydroxyl radicals [110].

8) Anti-viral Activity

Glycyrrhizin, acquires an outstanding antiviral activity, as it prevent the binding of virus cell. Yellow Fever virus, HIV-1 & Japanese encephalitis virus have been reported. It is found that Glycyrrhizin is considered as most efficient to control viral replication and it has been used to treat HIV-1 & chronic hepatitis C virus suffering patients ^[111, 112].

9) Anticoagulant Activity

The first plant inhibitor of thrombin is Glycyrrhizin, which is already known as anti-inflammatory compound. The thrombin & fibrinogen clotting time and duration of increase in plasma recalcification is also prolonged by it. The aggregation induced by the plantlet of thrombin inhibited by glycyrrhizin action but callogen induced agreement was not overwhelmed by glycyrrhizin ^[113, 114].

10) Anti-diabetic Activity

Type 2 (non-insulin dependent) diabetes mellitus, which is a growing health concern issue in the modern technology. The activated receptors (PPAR's) of per-oxisome proliferation, are those transcriptional factors which are ligand dependent, helps in the regulation of expression of gene groups, therefore play a vital role in lipid metabolism & glucose. Traditionally, Licorice induces artificial sweetening agent and help in resisting syndrome in insulin ^[115].

11) Anti hyperglycemic Activity

The root extract of *Glycyrrhiza glabra* known for anti-hyperglycemic and anti-lipidemic activity, in low concentration. The liquorice extract on live enzymes and serum containing lipid profile was considered in albino mice ^[116].

12) Memory enhancing Activity

The *Glycyrrhiza glabra* effects on memory and learning was inspected in mice. Number of herbal plants are being used in ayurvedic medications for treating dementia which are showing the property of memory enhancement in current studies. The roots and rhizomes found in *Glycyrrhiza glabra* is considered as an effective brain tonic as it enhances the CNS system circulation and manage the level of sugar in blood ^[117]. The products of oxidative metabolism and oxygen free radicals found to be neurotoxin ^[118].

13) Skin lightening and skin tightening Activity

It has been reported that the extract of liquorice is included as an effective pigment lightening agent. It is one of the best and safest lightening agent which is known for its least effects. Glabridin is the only compound in liquorice extract that prevents tyrosinase activity in B16 murine melanoma cells. As liquiritin disperse melanin present in the extract of liquorice and therefore induces the property of skin lightening ^[119]. The presence of antioxidants in extract may lead in the

reduction of melanin content in skin ^[120]. The studies on *In vitro* tyrosinase enzyme resistance implies that methanolic extract of 21.2 ug/ml of liquorice caused 50% resistance of enzyme tyrosinase. The decrease in the activity of enzymes resistance of tyrosinase enzyme is caused by the alteration of active site of the enzyme. Liquorice extract could be utilized to create cosmetic management with depigmenting activity, due to good resistance activity of tyrosinase ^[121]. The liquorice include interactive effects of UV protective, anti-inflammatory & antioxidant activities which are responsible for providing useful effects on skin ^[122].

14) Anti cancer Activity

Composition of polyherbal medication is used for prostate cancer which is the extract of *Glycyrrhiza glabra* used in herbal management for inhibiting cancers like PC-SPEs. Bcl2 phosphorylation is induced by the extract of licorice, G2/M cycle retard in cell lines of tumor. The licorice acetone extract include, fraction of 70% methanol & which is found to cause apoptosis in human monoblastic leukaemia U937 cells. The compound which is responsible for antimicrobial & antioxidant activity is licocoumarone ^[123].

15) Anti-allergic Activity

Glycyrrhiza glabra L. (Glycyrrhizin, 18 β glycyrrhetic acid and Liquiritigenin) possess anti allergic activity, which are cooperative to relieve IgE -induced allergic diseases, like asthma and dermatitis that are critically vulnerable to sickness.

16) Hepatoprotective Activity

Chronic hepatitis is considered as the slow liver disease, which leads to cirrhosis along with its developing complexity of liver failure. *Glycyrrhiza*, has been used for more than 60 years, so as to treat chronic hepatitis, clinically as antihepatitis & anti-allergic agent in Japan under the name of stronger Neo-Minophagen C (SNMC) ^[125]. An aglycone of glycyrrhizin, which is 18 β -glycyrrhizin acid (GA), is found to reduce the P450 E1 expression, and therefore protect the liver ^[126]. GA contribute in the anti-carcinogenic activity of hepatotoxin by metabolic deactivation, and also inhibits the hepatic & oxidative damage caused due to a flatoxins by increase in the CYP1A1 and Glutathione-S-transferase (GST) activities ^[127].

17) Hair Growth Stimulating Activity

The liquorice extract of hydro-alcohol, exhibit good hair growth stimulatory activity. As comparing liquorice extract and the drug used (Minoxidil 2%) showed, licorice extract with 2% concentration shows better hair growth promoting activity than that to 2% Minoxidil. It has been proved that liquorice indicates a symbolic property of hair growth, as it can be used cautiously in herbal and ayurvedic medications in treating different types of Alopecia ^[128].

Table 2: Pharmacological Activities Reported From *Glycyrrhiza glabra*

Sr. No	Activity	Part/Extract	Animal models & cell lines
1.	Immunomodulatory activity	Aqueous extract	<i>In vivo</i> phagocytosis, determination of cellular immune response haemagglutination antibody titre & plaque forming cell assay using sheep RBCs ^[129] .
2.	Antitussive activity	Ethanol extract	SO ₂ gas induced cough in experimental animals. An inhibition of 35.62 % was seen in mice for cough treatment with <i>G. glabra</i> extract ^[130] .
3.	Anti-inflammatory activity	Hydroalcoholic extract	Carrageenan induced rat paw oedema at dose levels of 100, 200, 300 mg/kg. The extract showed a maximum of 46.86% inhibitory action ^[131] .
4.	Chronic fatigue stress	Hydroalcoholic extract	The extract showed the protective effect on mice on exposure to chronic fatigue stress

			[132].
5.	Antinociceptive activity	Ethanol extract	Different pain models in Swiss albino mice. Activity was evaluated at 50-200 mg/Kg ip in mice using various pain models like acetic acid induced abdominal constrictions, formalin induced hyperalgesia & tail flick method [133].
6.	Antiulcer activity	Aqueous, acetone, ethanolic extracts of leaves	Micro-organism used: <i>Helicobacter pylori</i> by agar well diffusion method [134].
7.	Hepatoprotective activity	Aqueous extract of roots	PCM induced rats hepatocytes damage <i>In vivo</i> . Rabbit models with acute liver injury induced by CCl ₄ [135].
8.	Memory enhancing activity	Aqueous extract of roots	Three month old Wistar albino rats. Elevated-plus maze and Morris water-maze test were conducted [136].
9.	Anticonvulsant activity	Hexane, ethanol, methanol, extract of leaves	Fractions were evaluated intraperitoneally in mice using maximal electroshock (MES) & pentylene tetrazol (PTZ) seizure tests [137].
10.	Antistress activity	Alcoholic & aqueous extract	Reduce stress in <i>Drosophila melanogaster</i> induced by Methotrixate at different conc [138].
11.	Antioxidant activity	Methanol extract	The method based on scavenging activity & reduction capability of 1,1-diphenyl-2-picrylhydrazyl radical; Also against nitric oxide & superoxide radicals [139].
12.	Testicular toxicity	Aqueous extract	Carbendazim induced testicular toxicity in albino rats [140].
13.	Cytotoxic activity	CHCl ₃ , methanol & aqueous extract	<i>In vitro</i> cytotoxic activity using two different cell lines MCFT-cancerous & Vero-normal cell line [141].
14.	Enzyme inhibiting activity	Methanolic extract	<i>In vitro</i> inhibition of tyrosinase enzyme [95]
15.	Antihyperglycemic activity	-----	Male albino rats of Wistar strain [142].
16.	Antimalarial activity	Alcoholic extract	Micro-organism used: <i>Plasmodium falciparum</i> ; <i>Plasmodium yoelii</i> [94]
17.	Antiviral activity	Aqueous extract	Herpes simplex 1 & vesicular stomatitis virus [143]
18.	Anticancer activity	Licorice extract	Ames test, Trp-p-1, Trp-p-2, in <i>S.typhimurium</i> TA 98 revertants [144]
19.	Estrogenic activity	Alcoholic extract	Mouse
20.	Antimycobacterial activity	Methanolic extract	Micro-organisms used: <i>Mycobacterium tuberculosis</i> H37Ra & H37Rv strain
21.	Antidyslipidaemic activity	Ethanol extract	Fractions significantly brought down LDL and VLDL in the HFD fed hamsters to various degrees
22.	Antimicrobial activity	Ether, Chloroform, acetone	Micro-organisms used: <i>E. coli</i> , <i>B. subtilis</i> , <i>P. aerogenosa</i> , <i>S. aureus</i> [145]

6. Ethnobotanical uses

Ethnobotanical knowledge is one of the oldest and best aspect in Indian history. It basically holds the cooperation between man and his surroundings which includes plant wealth [146]. The plant based remedies consider ethno-medications, that are being used by local people for medication purposes. The folk and traditional medicine system is still being exercised in various parts of the world. The medicines are easily available, cost effective and affordable too. The plant is known for its medicinal and healing properties and it has been proved scientifically [147]. Number of diseases like cough, asthma, cold and fever can be cured by this herb. Licorice roots were collected by men, in September to November (tehsil Mustuj) and about 1kg roots were made to boil in 2L water for about 45 min. As a result, there is the formation of yellowish white and sweet extract which later on cooled down and used as cathartic for animals like goat, cow and sheep. *Glycyrrhiza glabra* locally known As Khawasdar, which is used to cure cough, sore throat and considered as major energetic tonic in Baluchistan. The bark of the plant must be removed before chewing it. Kalat and Nushki are the best places where, wild species have been found commonly. It is found that other drugs are mixed for the derangements of the blood in Baluchistan [148].

7. Conclusion

Glycyrrhiza glabra also known as sweet wood, native to Mediterranean & certain areas of Asia. Glycyrrhizin, is a pentacyclic triterpenoid β -amyrin compound, responsible for providing sweet taste of root of licorice, hence used by humans since 400 years. This compound, is present as a

mixture of calcium & potassium salts of glycyrrhizin acid. It has been reported that root of *Glycyrrhiza glabra* include anti-bacterial activity, because various secondary metabolites like alkaloids, saponins & flavonoids are present. This herb has been widely used in folk medicine, & traditionally it is considered as a demulcent, contraceptive, and also to soothe gastrointestinal along with respiratory problems. The parts of the herb *Glycyrrhiza glabra* has been recommended as a prophylaxis, dyspepsia, as well as anti-inflammatory agent. The different species of plant are known for its essential activities like anti-inflammatory, anti-expectorant, anti-malarial, anti-oxidant, anti-viral properties to cure various diseases. Pharmaceutically, it is used as Addison's disease, also for the treatment of peptic ulcers & bronchitis too. Whereas, ethnobotanical, knowledge is one of the oldest & essential aspect in Indian history. It is used to treat sore throat, also acts as cough suppressent The present review is mainly focused on the pharmaceutical and therapeutic activities of licorice. The review will be helpful in further studies and researches for exploring its potential in treating and preventing diseases.

8. References

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