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Review on medicinal properties of *Glycyrrhiza glabra* Linn. (Liquorice)

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Abstract

Glycyrrhiza glabra Linn. (Liquorice) is a plant used as a traditional medicine from the ancient time. The dried roots of the plant are mainly used in the treatment for its cooling, demulcent, expectorant, emollient, laxative, stimulant, anti-inflammatory, anti-allergic & antimicrobial properties. This review article is presented to compile all the updated information on its phytochemical and pharmacological activities, which were performed by widely different methods. Studies indicate *Glycyrrhiza glabra* Linn., possesses hepato-protective, anti-ulcer, anti-inflammatory, anti-microbial, antioxidant, anti-tussive and demulcent, Immunostimulatory, anti-diabetic, neuroprotective and anti-malarial activity. These results are very encouraging and indicate this herb should be studied more extensively to confirm these results and reveal other potential therapeutic effects. Clinical trials using *Glycyrrhiza glabra* Linn., for a variety of conditions should also be conducted.

Keywords: Antitussive, *Glycyrrhiza glabra*, Glycyrrhizic acid, Liquorice

Introduction

Herbs are very important resource for all major system of medicine, nutraceuticals and cosmetics. In the last few decades, a curious thing has happened to botanical medicine. Instead of being killed off by medical science and pharmaceutical chemistry, it has made a comeback. Botanical medicine has benefited from the objective analysis of medical science, while fanciful and emotional claims for herbal cures have been thrown out, herbal treatments and plant medicines that work have been acknowledged. And herbal medicine has been found to have some impressive credentials. No laboratory has yet produced a substitute for digitalis. The penicillin that replaced mercury in the treatment of syphilis and put an end to so many of the deadly epidemics comes from plant moulds; it was discovered accidentally as it destroyed a bacterial culture that Alexander Fleming was trying to grow in his laboratory. Belladonna still provides the chemicals used in ophthalmological preparations and in antispasmodics used to treat gastrointestinal disorders. In fact, plant substances remain the basis for a very large proportion of the medications used today for treating heart diseases, hypertension, depression, pain, cancer, aids, asthma, neurological disorder, and other ailments. Plants may offer a medical revolution for 5 billion inhabitants of the world who relies primarily on traditional medicine for their health care needs. Very recently herbal medicine has made a breakthrough in the history of medical science. During the last three decades its importance usage has increased dramatically all over the world.

Glycyrrhiza glabra Linn., has long been well-known in traditional medicine. It was considered first-class drugs in the old Chinese pharmacy and the rejuvenating quality was attributed to it when ingested for long periods. Liquorice was widely used in ancient Egypt, Greece and Rome. Theophrastus had alluded to this. The use from that time on, until now, proves the effectiveness. The Egyptian, Chinese, Greek, Indian, and Roman cultures also used the dried rhizome and root as expectorant and carminative. The Materia Medica referred to as bronchitis, emollient, emmenagogue, demulcent expectorant, diuretic, hemoptysis, laryngitis, laxative etc. Sore throat, soreness, cough, influenza, cold, bronchodilator, ophthalmia, anti-syphilitic is beneficial [13]. The ethno botanical studies regarding the *Glycyrrhiza glabra* Linn., also reported. The white and sweet yellowish decoction that was produced and used as purgative and for cough and this was sometimes used as a purgative for the pigs, goats and cows. It increased the production of milk in both cows and goats. *Glycyrrhiza glabra* Linn., uses as a cough suppressant, throat dryness and as a tonic as well [14].

Glycyrrhiza glabra Linn., plant can be used orally for gastric, duodenal, and esophageal ulceration, inflammation, cathartics, mouth ulcer, spasmolytic, anti-tussive, demulcent, expectorant and components making it a suitable herb for respiratory disorders. Apart from that Licorice helps improve memory, plays an antidepressant role and reduces cholesterol levels in the blood [8]. The main

objective is to provide a comprehensive overview of the medicinal properties of *Glycyrrhiza glabra* Linn. combining traditional knowledge with modern scientific evidence, to inform healthcare professionals, researchers, and policymakers about their potential roles in healthcare and pharmacotherapy.



Fig 1: *Glycyrrhiza glabra* Linn. Plant & Wood

Description

A perennial plant 50 cm to 1 m high or more, erect. Leaflets 4-7 pairs, oblong to elliptical-lanceolate, acute or obtuse; racemes loose, shorter than the leaves or a little longer. Flowers 1 cm long. Pods oblong to linear, 1-3 cm long flattened, straight, more or less densely echinate glandular, many seeded or abbreviated and 2-3 seeded. This universal drug consists of peeled pieces of underground stems mixed with a few pieces of roots, 13-19 cm or more in length. Unpeeled pieces are dark reddish or purplish brown in colour and longitudinally wrinkled [1].

Habitat

It occurs commonly and is cultivated in Pakistan, India, Afghanistan, Europe, Northern Asia. The plant thrives in a dry, sunny climate and in deep moist soil, particularly on the banks of rivers subject to periodical inundation¹. This plant is cultivated in Russia, UK, USA, Italy, France, Germany, Spain, China and Northern India (Punjab and Sub-Himalayan tracts). It is distributed in Southern Europe, Syria, Iran, Afghanistan, Russia, China, Pakistan and Northern India. Large scale commercial cultivation is seen in Spain, Sicily and England [8].

Vernacular name

Glycyrrhiza glabra has been known by various names according to regional languages and areas, which are as follows-Yashti-madhuh. Madhuka (Sanskrit), Jashtimadhu (Bengali), Jethimadhu (Gujarat), Jothi-madh, Mulhatti (Hindi), Yastimadhuka, atimaddhura (Kannada), Iratimadhuram (Malayalam), Jeshtamadha (Marathi), Jatimadhu (Oriya), Atimaduram (Tamil), Atimadthuranu, Yashtimadhukam (Telugu), Licorice, Liquorice, Sweet wood (English), Aslussiesa (Arab), Ausareha mahaka (Persia), Boisdoux (France) [28].

Classification

Kingdom: Plantae
Subkingdom: Tracheobionta-Vascular plants
Super division: Spermatophyta-Seed plants

Division: Magnoliophyta

Class: Magnoliopsida

Subclass: Rosidae

Order: Fabales

Family: Fabaceae-Pea family

Genus: *Glycyrrhiza licorice*

Species: *Glycyrrhiza glabra* Linn [21]

Chemical composition

A large number of components have been isolated from the liquorice roots. 40-50 percent of total dry material weight of *Glycyrrhiza glabra* Linn. is accounted by water-soluble, biologically active complex. Starches (30%), pectins, polysaccharides, simple sugars, gums, mucilage (Rhizome), amino acids, triterpene saponin, flavonoids, mineral salts, bitters, essential oil, fat, asparagines, female hormone estrogen, tannins, glycosides, protein, resins, sterols, volatile oils and various other substances are components of this complex [22]. The chief constituent of liquorice is glycyrrhizin, which is present in the drug in the form of the potassium and calcium salts of glycyrrhizic acid. Glycyrrhizic acid is not a glycoside since it yields on hydrolysis one molecule of glycyrrhetic acid and two molecules of glycuronic acid but no sugar. Glycuronic acid is, however, very closely related to the hexose sugars, and glycyrrhetic acid has a haemolytic action like that of the saponins. Liquorice also contains glucose (up to 3.8 per cent.), sucrose (2.4 to 6.5 per cent.), bitter principles, resins, mannite, asparagine (2 to 4 per cent.), and fat (0.8 per cent.). Glycyrrhizin is reported to be approximately 50 times as sweet as cane-sugar and its sweetness is detectable at a dilution of 1: 15,000 [23]. It contains vitamin C, iodine, manganese, essential oil (far-nesol), flavonoids (herperidin, quercetin, kaempferol, astralagin), mucilage, phenolic acids (chlorogenic, caffeic), tannins [24]. The primary active ingredient, Glycyrrhizin (glycyrrhizic acid; glycyrrhizinate) constitutes 10-25% of liquorice root extract. It is a saponin compound (60 times sweeter than cane sugar) comprised of a triterpenoid aglycone, glycyrrhetic acid (glycyrrhetic acid; enoxolone) conjugated to a disaccharide of glucuronic

acid. Glycyrrhizin and glycyrrhetic acid can exist in the 18 α and 18 β stereoisomer forms [22].

Glycyrrhizin, a triterpenoid compound, accounts for the sweet taste of licorice root. This compound represents a mixture of potassium-calcium-magnesium salts of glycyrrhizic acid that varies within a 2-25 percent range. Among the natural saponin, glycyrrhizic acid is a molecule composed of a hydrophilic part, two molecules of glucuronic acid, and a hydrophobic fragment, glycyrrhetic acid. The yellow color of licorice is due to the flavonoid content of the plant, which includes liquiritin, isoliquiritin (a chalcone), and other compounds [2].

Mechanism of action

The beneficial effect of *Glycyrrhiza glabra* can be attributed to a number of mechanisms, Glycyrrhizin and glycyrrhetic acid have been shown to inhibit growth and cytopathology of numerous RNA and DNA viruses, including hepatitis A [4] & C [5-6], herpes zoster, HIV, herpes simplex, and CMV. Glycyrrhizin and its metabolites inhibit hepatic metabolism of aldosterone and suppress 5-(beta)-reductase, properties responsible for the well-documented pseudo aldosterone syndrome. The similarity in structure of glycyrrhetic acid to the structure of hormones secreted by the adrenal cortex accounts for the mineral-corticoid and gluco-corticoid activity of glycyrrhizic acid [6]. *Glycyrrhiza glabra* constituents also exhibit steroid-like anti-inflammatory activity, similar to the action of hydrocortisone. This is due, in part, to inhibition of phospholipase A2 activity, an enzyme critical to numerous inflammatory processes. *In vitro* research has also demonstrated glycyrrhizic acid inhibits cyclooxygenase activity and prostaglandin formulation as well as indirectly inhibiting platelet aggregation, all factors in the inflammatory process. *Glycyrrhiza glabra* constituents possess significant antioxidant and hepatoprotective properties. Glycyrrhizin and glabridin inhibit the generation of reactive oxygen species (ROS) by neutrophils at the site of inflammation. *In vitro* studies have demonstrated licorice isoflavones, hispaglabridin A & B, inhibit (Fe.sup.3)-induced mitochondrial lipid per-oxidation in rat liver cells. Other research indicates glycyrrhizin lowers lipid peroxide values in animal models of liver injury caused by ischemia reperfusion. *Glycyrrhiza glabra* constituents also exhibit hepatoprotective activity by lowering serum liver enzyme levels and improving tissue pathology in hepatitis patients [2]. Glycyrrhizin and glycyrrhetic corrosive have been appeared to repress develop of various RNA and DNA infections, including hepatitis A and C, herpes zoster, HIV, Herpes simplex, and CMV. Glycyrrhizin and its metabolites repress hepatic digestion system of aldosterone and smother 5 [beta]-reductase, properties capable for the well-documented pseudo aldosterone disorder. The comparability in the structure of glycyrrhetic corrosive to the structure of hormones discharged by the adrenal cortex represents the mineralocorticoid and glucocorticoid action of glycyrrhizin corrosive [6].

Pharmacological actions

1. Hepato-protective activity

In Japan glycyrrhizin has been used for more than 60 years as treatment for chronic hepatitis under the name of Stronger Neo-Minophagen C (SNMC) clinically as an anti-allergic and anti-hepatitis agent [6]. Glycyrrhizin induced a

significant reduction in serum aminotransferases and improved the liver histology when compared with the placebo. It has also been implicated that long-term usage of glycyrrhizin prevents development of hepatocellular carcinoma in chronic hepatitis C. *In vitro* studies have indicated that glycyrrhizin modifies the intracellular transport and suppresses hepatitis B virus (HBV) surface antigen (HbsAg) [26-27]. It has been found that 18 β glycyrrhetic acid (GA), an aglycone of glycyrrhizin decreases the expression of P450 E1 thereby protecting the liver. GA also prevents the oxidative and hepatic damage caused by aflatoxins by increasing the CYP1A1 and Glutathione-S-transferase (GST) activities and may also contribute to anticarcinogenic activity by metabolic deactivation of the hepatotoxin. It has also been experimentally investigated that Glycyrrhizin and its analogues have a mitogenic effect via epidermal growth factor receptors subsequently stimulating the MAP (Mitogen Activated Protein) kinase pathway to induce hepatocyte DNA synthesis and proliferation². Oral liquorice preparations containing glycyrrhetic acid are used for the treatment of viral infections-viral hepatitis and common cold [8].

2. Anti-ulcer activity

The drug is also beneficial in the treatment of peptic ulcer and deglycyrrhizinated liquete while being substantially free from mineralocorticoid side effects of liquorice root is clinically effective for gastric and duodenal ulcers. It also indicates that in addition to glycyrrhetic acid, other unidentified constituents of the drug contribute to the antiulcer activity [28]. Licorice has been used as an antiulcer agent since early 1970's. The extracted glycyrrhizin, Deglycyrrhizinated licorice (DGL) is generally employed for the effective treatment of ulcers. Carbenoxolon from liquorice roots produce the anti-ulcerogenic effect by inhibiting the secretion of gastrin. Liquorice can raise the concentration of prostaglandins in the digestive system that promote mucus secretion from the stomach; it was also reported that liquorice prolongs the life span of surface cells in the stomach and has an anti-pepsin effect [2]. In a previous reported study activity of glycyrrhizic acid, glycyrrhetic acid and a novel lipophilic derivative of glycyrrhetic acid monoglucuronide (GAMG), acetylated GAMG (aGAMG), were active against *Helicobacter pylori* strains [21]. The peptic ulcer activity was reported in systematically study on licorice extract. In an unblended and uncontrolled study 45 patients with confirmed gastric ulcers were administered 10 g/day of powdered licorice extract. The ulcers were reported to disappear in 17 of the cases, were diminished in 22 cases and were unchanged in six of the cases. Patients with duodenal ulcers did not react as favorably. Approximately 20% of the patients were noted to develop edema, some with complications including violent headache, dizziness, upper right quadrant pain, compression in the chest, and hypertension. A reduction of the dosage to 3g/day reduced the occurrence of edema although not in all cases. Crude fractionation of the licorice extract revealed that glycyrrhizin was the probable agent responsible for the edematous effect and an unknown component was therefore considered to be the active antiulcerogenic agent. The potent *in vitro* activity of glycyrrhizic acid against *H. pylori* concludes its beneficial effect on peptic ulcers [8].

3. Anti-inflammatory activity

The drug possesses potent demulcent, expectorant, and anti-inflammatory properties and these are attributed to the presence of glycyrrhizin [27]. A controlled clinical trial was conducted on 92 randomly selected cases of post-operative traumatic inflammation following tonsillectomy with powdered *Glycyrrhiza glabra* (Mulethi), the anti-inflammatory response of *Glycyrrhiza glabra* was found to be equivalent to that of Oxyphenbutazone. It appears to possess a more potent antipyretic and antiexudative activity in comparison to Oxyphenbutazone [24]. According to studies, glycyrrhizic acid inhibits all factors responsible for inflammation. It inhibits Pandey *et al.* Universal Journal of Pharmaceutical Research ISSN: 2456-8058 9 CODEN (USA): UJPRA3 cyclooxygenase activity and prostaglandin formation. It is also responsible for indirectly inhibiting platelet aggregation [21]. It is reported that glycyrrhetic acid in liquorice extract gives anti-inflammatory effect similar to glucocorticoids and mineralocorticoids. Liquorice root (*Glycyrrhiza*) extract promotes the healing of ulcers of the stomach and mouth [8]. Compounds such as hispaglabridin B, 40-methylglabridin, glabridin, gabrin, 3-hydroxyglabrol and glabrene which were isolated from *G. glabra* have shown *in vitro* antimicrobial properties. Also *G. glabra* has used to treat cysts due to parasitic infestations of skin, pruritis and atopic dermatitis [12].

4. Anti-Microbial activity

Saponins, alkaloids, flavonoids in hydro-methanolic root extract of *Glycyrrhiza glabra*, the extract exhibits potent anti-bacterial activity. *In vitro* studies have proved that aqueous and ethanolic extracts of liquorice show inhibitory activity on cultures of *Staphylococcus aureus* and *Streptococcus pyogenes* [2]. Glycyrrhetic acid is known to inhibit Epstein-Barr virus activation by tumor promoters⁸. Because of the presence of secondary metabolites such as; saponins, alkaloids, flavonoids in hydro-methanolic root extract of *Glycyrrhiza glabra*, the extract exhibits potent antibacterial activity. *In vitro* studies have proved that aqueous and ethanolic extracts of liquorice show inhibitory activity on cultures of *Staphylococcus aureus* and *Streptococcus pyogenes* [22]. Secondary metabolites such as; saponins, alkaloids and flavonoids present in hydro-methanolic root extract of *Glycyrrhiza glabra*, possess potent antibacterial activity against *Staphylococcus aureus*. It also possess good anti-fungal activity. It is reported that liquorice extract inhibits the growth of viruses, including *herpes simplex*, *Varicella zoster*, *Japanese encephalitis*, *influenza virus*, *vesicular stomatitis virus* and type A influenza virus. Glycyrrhizin does not allow the virus cell binding. Thus, it is found to have a prominent antiviral activity [21].

5. Antioxidant activity

Glycyrrhiza have a significant free-radical quenching effect. Liquorice flavonoids have exceptionally strong antioxidant activity. Antioxidant activity of liquorice flavonoids was found to be over 100 times stronger than that of antioxidant activity of vitamin E. Thus, liquorice extract can be efficiently used to formulate cosmetic products for the protection of skin and hair against oxidative damage²¹. Hydro-methanolic root extract (crude) of *Glycyrrhiza glabra* showed presence of many useful secondary metabolites such as; saponins, alkaloids, flavonoids and so

on. Because of these components the extract exhibited potent anti-oxidant activities [2]. The antioxidant activity of *G. glabra* is one of the major reasons for its uses. The phenolic content is probably responsible for the powerful antioxidant activity observed 26 attributed this activity to flavonoids, isoflavones, such as glabridin, hispaglabridin A, and 30-hydroxy-4-O-methylglabridin, are the responsible compounds [8].

6. Anti-tussive and demulcent activity

Liquorice has been shown to work as efficiently as codeine in sore throat. It decreases irritation and produces expectorant effects. Carbenoxolone (a semi synthetic compound derived from *Glycyrrhiza*) stimulates gastric mucus secretion. Glycyrrhizin is responsible for demulcent action of liquorice. Liquiritin apioside, an active compound present in the methanolic extract of liquorice which inhibits capsaicin induced cough [8]. Liquorice extract may also be able to stimulate tracheal mucus secretions producing demulcent and expectorant effects [22].

7. Immunostimulatory activity

A studies proved that *Glycyrrhiza glabra* Linn. at 100µg/ml concentration, possess immunostimulatory effects. It increases production of TCD69 lymphocytes and macrophages from human granulocytes. In a previous reported study, liquorice root extract was found to prevent the rise in the amount of immune-complexes related to autoimmune diseases like systemic lupus erythematosus [21].

8. Anti-diabetic activity

In a previous study Kuroda M *et al.* reported that ethyl acetate extract of licorice exhibited a significant PPAR-γ (peroxisome proliferator-activated receptors) that function as transcription factors regulating the expression of genes involved in glucose and lipid metabolism binding activity. Finally reduces the blood glucose level in knockout diabetic mice [21]. Pioglitazone and Glycyrin were found to suppress the increased blood glucose level in mice after sucrose loading during Sharma *et al* Mintage journal of Pharmaceutical & Medical Sciences 15-20 Vol 2 Issue 3, July-Sep 2013 www.mintagejournals.com 18 the oral sucrose tolerance test. Pioglitazone, a potent PPAR-γ agonist ameliorated the insulin resistance and type-2 diabetes mellitus. Similarly glycyrin also exhibited a potent PPAR-γ ligand binding activity and therefore reduces the blood glucose level in knockout diabetic mice (KK-Ay). This finding is of much significance as licorice has also been traditionally used as an artificial sweetening agent and could be helpful in insulin resistance syndrome prevalent in the modern society [2]. The root of *Glycyrrhiza glabra* Linn. is known as liquorice. It has various medicinal uses. It is cited as belonging to plants that reduce blood sugar levels. Liquorice can help to treat diabetes. It possesses hypoglycaemic properties and its consumption helps in lowering glucose or sugar in blood [29].

9. Neuroprotective activity

The effects of *Glycyrrhiza glabra* Linn. on learning and memory were investigated in mice [9]. Administered the extract of *Glycyrrhiza glabra* Linn. orally to mice during 7 days at different concentrations (75-300 mg/kg). Studied the effects of *Glycyrrhiza glabra* Linn. root aqueous extract on the learning and memory of 1-month-old male Wistar

albino mice at doses between 75 and 300 mg/kg, orally administered during six successive weeks. Both studies demonstrated a significant improvement of learning and memory in mice, but the exact mechanism behind this action remains unknown^[10]. These findings suggest a possible neuroprotective role of licorice in the prevention of diseases such as Alzheimer. The basis of Alzheimer is the chronic inflammation of certain brain regions. Thus, the anti-inflammatory activity of licorice might contribute to the observed memory- enhancing effects. Also oxygen free radicals are implicated in the process of aging and could be responsible for the development of Alzheimer's disease in elderly persons. The protective role of licorice extract may be attributed to its antioxidant properties resulting in reduced brain damage & improvement of neuronal function and memory. The combination of anti-inflammatory and antioxidant activities with neuroprotective role could lead to memory enhancing effects^[8]. To summarize the present review, licorice extracts and flavonoids have been employed to reduce neuro-inflammatory processes after acute ischemia injury to brain cells, TBI, and neurodegenerative diseases. Licorice is safe for human intake at therapeutic doses that have been researched. These results can lead to the discovery and manufacture of novel medications for neurodegenerative illnesses and acute brain tissue injury^[18]. Licorice and its constituents have been shown to mediate several signalling pathways involved in acute and chronic neurodegeneration. Ischemic stroke, which causes a burst of infarctions in the center of a hypoperfusion zone, is an acute neurotoxic process. Neurodegenerative diseases like Parkinson's and Alzheimer's are examples of chronic neurotoxicity (AD)^[19]. Recent studies showed that plant based active ingredients are effective in neurodegenerative disease. Both active components and the entire extract of licorice have been shown to have neuroprotective properties^[18].

10. Anti-malarial activity

Licochalcone A (a chalcone) present in licorice has reported to possess very good antimalarial activity. All *Glycyrrhiza* species have this compound in different amounts and it can be isolated from them. *In vivo* studies against *P. yoelii* in mice with oral doses of 1000 mg kg⁻¹ have shown to eradicate malarial parasite completely. Also no toxicity was observed^[3]. Malaria is one of the most serious health problems in Asia, Africa, and Latin America^[16]. In 2012, the World Health Organization (WHO) estimated the 219 million global incidences of malaria and 660000 deaths due to this disease^[15]. *Glycyrrhiza glabra* Linn. is considered as a constituent that can reduce the risk of malaria. An *in vitro* study showed that 9.95 µg/ml water-methanol and 13 µg/ml ethyl acetate fractions isolated from the root extract of licorice possess good antiplasmodial activity against *P. falciparum* strain with low toxicity against HeLa cells whereas the *in vivo* study showed that administration of these fractions of licorice root extracts inhibits 72.2% and 65% growth of *P. berghei* in mice. Licorice contains licochalcone, which has antimalarial activity. An oral dose of 1000 mg/kg in mice has completely eradicated malarial parasites^[15].

11. Anti-asthmatic activity

Licorice is one of the commonly used herbs in the field of medicine due to its pharmacological activities. Among these

activities, the anti-inflammatory and anti-allergic activities that support its use in asthma^[33]. Glycyrrhizic acid and flavonoids, the *Glycyrrhiza glabra*'s significant components, have shown anti-asthmatic effects. A clinical trial was conducted to conclude in *Boswellia carterii* (Olibanum) and *Glycyrrhiza glabra* as broncho relaxants. Chronic bronchial asthma affected 54 patients who participated in this trial. Clinical examinations have been conducted such as serum electrolytes test: calcium, selenium, calcium, and potassium with pulmonary functions tests. *Glycyrrhiza glabra* has shown superiority over *Boswellia carterii* to manage chronic bronchial asthma. Glycyrrhizin assists in the inhibition of fibrosarcomas and lung cancer. Glycyrrhetic acid has exhibited inhibition of bile acid-induced necrosis and apoptosis^[34].

Side effects

One of the most common reported side effects with licorice supplementation is elevated blood pressure. This is thought to be due to the effect of licorice on the rennin-angiotensin-aldosterone system. It is suggested licorice saponins are capable of potentiating aldosterone action while binding to mineral-corticoid receptors in the kidneys. The phenomenon is known as pseudoaldosteronism. In addition to hypertension, patients may experience hypokalemia (potassium loss) and sodium retention, resulting in edema. All symptoms usually disappear with discontinuation of therapy. Many studies report no side effects during the course of treatment^[31-32]. Generally the onset and severity of symptoms depend on the dose and duration of licorice intake, as well as individual susceptibility. Patients with delayed gastrointestinal transit time may be more susceptible to these side effects, due to enterohepatic cycling and re-absorption of licorice metabolites. The amount of licorice ingested daily by patients with mineral-corticoid excess syndromes appears to vary over a wide range, from as little as 1.5 g daily to as much as 250 g daily^[2]. Licorice in large doses may cause sodium retention and potassium loss, leading to hypertension, water retention and severe electrolyte imbalance^[34]. Licorice in large doses may causes sodium retention and potassium loss, leading to hypertension, water retention and severe electrolyte imbalance^[17].

Conclusion

The literature survey revealed that *Glycyrrhiza glabra* Linn. has been widely studied for its phytochemical and pharmacological activities. It present in class of herbal drug with very strong conceptual or traditional base. *Glycyrrhiza glabra* Linn. is an important source of glycyrrhizin, glycyrrhizic acid, triterpene saponin, flavonoids, mineral salts, essential oil, tannins, glycosides and some other alkaloids. In this reviews some pharmacological studies has been concluded like Hepato-protective, Anti-Ulcer, Anti-inflammatory, Anti-Microbial, Antioxidant, Anti-tussive, demulcent, Immunostimulatory, Anti-diabetic, Neuroprotective & Anti-malarial activity and some more studies are done. These activities generally agree with traditional knowledge and folk medicine. Although the results from this review are quite promising for the use of *Glycyrrhiza glabra* Linn. as a multi-purpose medicinal agent. While *Glycyrrhiza glabra* Linn. has been used successfully in Alternative medicine for centuries, more clinical trials should be conducted to support its therapeutic

use.

Conflict of Interest:

Not available

Financial Support:

Not available

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