CGC International Journal of Contemporary Technology and Research
ISSN: 2582-0486 (online) Vol.-6, Issue-2; DOI: 10.46860/cgcijctr.2024.06.10.400

Innovative Formulations of Glycyrrhizaglabra Extract: a Comprehensive Review

Shaveta Sharma*, Mamik Verma, Payal Sharma
Department of Pharmacy
Chandigarh College of Pharmacy, Landran
*Email Id:shavetasharma022@gmail.com

***Abstract*: *Glycyrrhizaglabra* (Licorice) has been used for thousands of years to treat various diseases. It is used as traditional medicine to treat various diseases, including cancer, rheumatoid arthritis, ulcerative colitis, tuberculosis and asthma. This article highlights the wide range of pharmaceutical properties of licorice and its derivatives, opening up new avenues for studying and creating pharmaceutical treatments derived from this ancient plant. Glycyrrhetic acid, isoliquiritin, isoflavone, and other chemicals make up *Glycyrrhizaglabra* chemical composition. Their derivatives have been documented in a number of therapeutic uses, including expectorant, antidepressant, anti-inflammatory, and anti-diabetic. These phytochemicals hold great potential for the development of novel herbal medications, and their derivatives are being produced in order to assess their potential for application in pharmaceutical research in the future. Natural goods are frequently taken on a daily basis and are a major source of treatment for many disorders. They offer a significant defense against a range of conditions.**

***Indexed Terms*-*Glycyrrhizaglabra, Glycyrrhetic acid, Licorice, Phytochemicals, Tuberculosis, Ulcerative colitis.*

I. INTRODUCTION

In traditional Chinese medicine, *Glycyrrhizaglabra*, liquorice, or licorice has been used for generations. Licorice-derived compounds have anti-inflammatory, anticancer, antibacterial, antiviral, and antiallergic action [1,2,3,4,5] and no harmful toxic effect has been reported yet [6].

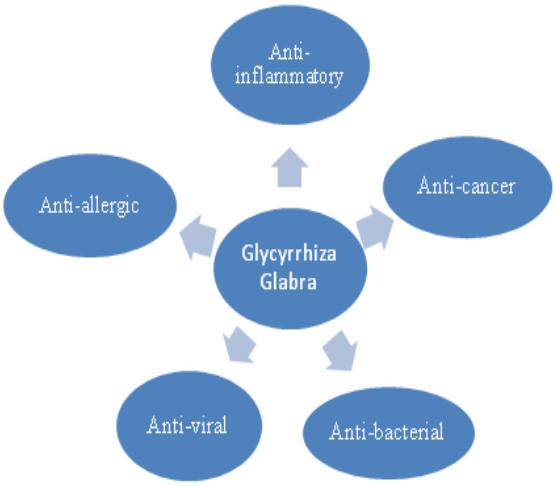

Fig. 1- Properties of *Glycyrrhiza Glabra*

The two main bioactive components that have been isolated from licorice are glycyrrhizin and glycyrrhetinic acid [7]. Glycyrrhizin, a bioactive triterpenoidsaponin having anti-inflammatory qualities that have been shown to decrease hepatotoxicity, eczema, urticaria, and other disorders, is the primary active component of the Chinese herbal remedy Gan-Cao (*Glycyrrhizaglabra*) [8,9,10]. Numerous studies indicate Compound Glycyrrhizin lowerstumor Necrosis Factor Alpha, Interleukin-6, And Interleukin-8 amounts, which can improve symptoms of illness including diarrhea and stomach discomfort. At this moment, mounting data suggests that compound GL has a positive impact on Ulcerative Colitis [11,12]. Because glycyrrhizin shares structural similarities with steroid hormones, it restricts phospholipase A2 in a way similar to that of steroids[13,14].

Glycyrrhizaglabra is a species of licorice that is commonly used in feed and meals, out of about thirty different types [15]. Glycyrrhizin makes up nearly about 25% of the extract extracted from licorice root[21].Glycyrrhetinic acid (one molecule) and glucuronic acid (two molecules) make up glycyrrhizin[22]. Proteins, amino acids, simple sugars, polysaccharides, mineral salts, pectin, starches, sterols, gums, and resins are among the compounds found in licorice[16].Herbs like*Glycyrrhizaglabra*are "essential medications." It is often believed that "9 out of 10 herbal formulations contain licorice," and that licorice is one of the finest herbal medicines for decreasing toxicity and enhancingthe effectiveness of other herb medicines when combined with them. As an herbal cure and a "medicine food homology," it may be considered a type of sugar substitute as well as a nutritional product [17].

Chemical analysis of licorice in its unprocessed form revealed the following composition: low-fat content (0.53%), protein (9.15%), fiber (24.48%), carbohydrates (47.11%), silica (3.56%) ash and moisture. In addition, it was discovered that the licorice root had ash (7.70%) and moisture (6.80%) amino acids like proline (1.02%), aspartic (0.88%), alanine (0.51%), and glutamic acid (0.50%), calcium (1720 mg/100 g) and phosphorus (78 mg/100 g) [23].One of the most important plants in the world for commerce is licorice, which finds extensive use in the food and beverage cosmetics, tobacco, and pharmaceutical sectors[18]. Western Asia, Central Africa, Middle East Europe, United States, Northern portion of India, England, Spain, Iraq, Turkey, and China are among the regions where licorice is commercially cultivated [19].

By the time of the end of the projection period, the global industry for licorice extract, which was estimated to be worth 1,978 million $ (US) in 2021, is projected to have grown at a compound annual growth rate (CAGR) of 6.81%. Licorice is made from the roots of the medicinal plant licorice. Compounds found in licorice have been

shown to reduce coughing, reduce swelling, and enhance the body's innate healing capacity for ulcers. Root extracts from the licorice plant are sweet and aromatic. The majority of the sweetness in licorice extracts comes from glycyrrhizin, which has a sweetness that is between 30 and 50 times greater than sugar. Heartburn, acid reflux, and upset stomach are common indigestion symptoms that are treated with licorice extract. Because licorice extract has anti-inflammatory and skin-lightening qualities, it has become a popular ingredient in cosmetic products. Using active licorice extracts in cosmetic formulations helps reduce skin inflammations such as flushing and redness by blocking the signaling channel [20].

Licorice has a yellow color as roots include flavonoid components like glabridin and hispaglabridins [24]. Licorice's dried aqueous extracts have a glycyrrhizinic acid content of 4% to 25% [25]. Glycyrrhizin, 18β-glycyrrhetinic acid, glabrin A and B, and isoflavones of *Glycyrrhizaglabra* Linn play a role in pharmacological activity [26].

II. BENEFICIAL ROLE OF LICORICE

A. *Immunomodulatory and Anti-viral Effects*

Licorice has shown strong antiviral and immunomodulatory properties [27]. Licorice extracts have a beneficial effect on immune systems. It can be applied to enhance their productive performance and optimize their immune response. Humoral immunity was enhanced by 0.1% LE food supplementation, which induced antibody titers against both specific and non-specific antigens [28].Research assessing the effects of extracted licorice root supplementation on the immunological profile found that laying chicken's cellular immunity was enhanced in specific ways when 50 µg/mL of licoriceextract was added to their feed [29].Glycyrrhiza polysaccharide is widely implicated in various aspects of immune regulation and has a strong immuno-boosting effect [30]. The development of T-cells, gamma interferon, and antibodies indicates its antiviral action. The broiler diet's addition of Licorice extracts did not affect the weights of the immune organs [31,32]. By stimulating T-cell proliferation, glycyrrhizin exhibits remarkable immunostimulant qualities and works in concert with the duck hepatitis virus (DHV) vaccination. Therefore, glycyrrhizin therapy, either by itself or in conjunction with the DHV vaccination, may stimulate the immune system or have an antiviral impact against DHV [38].

B. *Anti-inflammatory and Anti-oxidant Activities*

The three species of licorice that were initially found are *Glycyrrhizaglabra*, *Glycyrrhizainflata*, and *Glycyrrhizauralensis*. Among the several naturally occurring active substances they contain are 300 flavonoids and over 20 triterpenes. For this medicinal herb, 73 bioactive substances and 91 possible targets have been found [33,34]. Because of their anti-inflammatory, anti-sensitizing, and skin-whitening qualities, *glycyrrhizaglabra* extracts are utilized in cosmetic preparations. Glucoliquiritinapioside and glycyrrhizin were found to have the greatest antioxidant, anti-inflammatory, and dermatocosmeticactions based on molecular docking. Licorice extracts are one example of a potential antioxidant that may enhance dermal and epidermal characteristics while reducing the quantity of inflammatory agents and wrinkle-causing indicators[35]. This meta-analysis suggests that *Glycyrrhizaglabra* may upregulate Interleukin-10 expression while significantly lowering Tumor Necrosis Factor Alpha, Interleukin-6, Interleukin-8, and Interleukin -17 levels. This may demonstrate Compound GL's anti-inflammatory properties when applied to the management of UC [36]. Glycyrrhizin demonstrated weak antioxidant activity when assessed in its isolated form, unable to effectively offset the oxidative damage [37].

C. *Anti-allergic Activities*

The licorice family *Glycyrrhizaglabra*, which is used in traditional Chinese medicine, has an agreeable aroma and sweet taste. It also contains immunomodulatory and anti-allergic properties [39]. The studydemonstrated the anti-allergic properties of glycyrrhizic acid by giving mice oral administration of varying amounts [40]. Glycyrrhizin, 18beta-glycyrrhetinic acid, and liquiritigenin are the primary components of licorice that have antiallergic properties. These compounds assist with IgE-induced allergic conditions like dermatitis and asthma [41].

D. *Anti-bacterial Activities*

It was found that *Glycyrrhizaglabra* extracts exhibited strong antibacterial properties against each of the five bacteria: *Escherichia Coli*, *Bacillus Subtilis*, *EnterobacterAerogenes*, *Klebsiella Pneumonia*, and *Staphylococcus Aureus* [42]. When applied to *PorphyromonasGingivalis*, the licorice root extract exhibited strong antibacterial properties [43]. The antibacterial properties of *Glycyrrhizaglabra* extract towards Streptococcus mutans and Enterococcus faecalis bacteria were observed in infections of the mouth. Gallbridin, the plant's most important ingredient, has been demonstrated to have greater antibacterial action towards gram-positive bacteria compared to gram-negative ones [44].

E. *Anti-cancer Activities*

Researchers have studied the benefits of medicinal plants widely, and several studies have documented *Glycyrrhizaglabra*'s anticancer properties [50]. 18 β-glycyrrhetic acid, a hydrolyzed derivative of Glycyrrhizic acid derived from *Glycyrrhizaglabra*, is a great example of a naturally occurring anticancer compound [45,46]. The substance exhibited antitumor properties against A549 lung cancer [47]. The cytotoxic and anticancer activities of the extract may depend on other chemical constituents such isoliquiritigenin, formononetin, glabridin, licochalcone-A glycyrrhizinic acid, and 18b-glycyrrhetinic acid [48].*Glycyrrhizaglabra*'s aqueous extract has been shown to suppress the development of breast and colon cancer [49].

III. DIVERSE FORMULATION

TABLE1: DIVERSE FORMULATION OF *GLYCYRRHIZAGLABRA*

Sr. No	Formulation	Treatment	Outcome	Reference
1	Skin Whitening Cream	Tyrosinase Inhibition Activity	According to the study, Tyrosinase Activity was reduced by the licorice root ethanol extract. The viscosity and spreadability of the cream were impacted by the addition of licorice extract. After centrifugation, the cream did not exhibit any sedimentation, demonstrating its stability. The cream's pH was within the range of normal skin pH. More glycerylmonostearate concentrations produced a cream that was less spreadable, more viscous, and less soft. In addition to being a useful ingredient for skin whitening cream, licorice root extract also sheds light on the composition and physical properties of the product.	[51]
2	Herbal Syrup	COVID-19, Treatment of pulmonary disease, cough, and fever due to infection	According to the study's findings, hospitalized COVID-19 patients who get licorice syrup as an adjuvant treatment may have improvements in their oxygen saturation, length of stay, and inflammatory indicators. When compared to patients who got standard care alone, the period of hospitalization for patients who received licorice syrup was much shorter, according to the results. Furthermore, the group that was administered licorice syrup showed greater improvements in inflammatory markers like lymphocyte count and C-reactive protein, as well as an increase in oxygen saturation. Glycyrrhizaglabra syrup can be used as an adjuvant therapy in mild to moderate Covid-19 cases.	[52]
3	Phytosome	Skin disorders, skin aging and skin pigmentation and diseases	The study into the production of licoricephytosomes by the Rotary Evaporation Method has demonstrated positive results in terms of improving drug release, stability, and bioavailability. When the medication is in the form of a phytosome, its entrapment efficiency has grows dramatically along with the polymer concentration. Studies show the long-term stability of the phytosme. The evaluation experiments have shown that the licoricephytosome is appropriate for a range of formulations, including those involving release kinetics, drug content and in vitro drug release. Licoricephytosome has demonstrated efficacy and drug transport potential 1:5 ratio has been found to be most effective.	[53]
4	Shampoo	Clean scalp and hair	Using aqueous extracts of Glycyrrhizaglabra (licorice), which is recognized for its isoflavonoid, flavonoid, and triterpenoid glycoside components, the study aimed to produce a new herbal shampoo. The licorice shampoo showed good cleansing power, respectable viscosity, and acceptable clarity. The amount of foam generated and the duration of wetness were similar to those of a commercial shampoo. There was no evidence of microbial contamination. Users claimed that the licorice shampoo worked well to prevent issues with their hair and scalp. The licorice shampoo formulation demonstrated encouraging outcomes in terms of its capacity to cleanse, consumer satisfaction, and safety against microbiological contamination.	[54]
5	Nano-complexes	Anti-cancer and Anti-inflammatory Effects	To effectively transport curcumin, this study concentrated on creating nano-complexes with glycyrrhizic acid obtained from licorice root (Glycyrrhizaglabra). The formulation significantly increased CUR's solubility in aqueous solutions. Within 12 hours, the bulk of Curcumin was released from the Glycyrrhizic Acid/Curcuminnanocomplexes, indicating regulated release behavior. Promising outcomes were seen in the formation of nanocomplexes for the delivery of curcumin utilizing glycyrrhizic acid. Positive features of the nano-complexes included increased solubility, regulated release, and significant intracellular absorption. While in vivo research showed possible therapeutic benefits in a model of rheumatoid arthritis, in vitro studies suggested enhanced anti-inflammatory and anti-cancer properties. This work highlights the potential of Glycyrrhizic Acid/Curcuminnanocomplexes as a platform for specific drug delivery with applications in cancer and anti-inflammatory therapy.	[55]

6	Mix Oral Adhesive Pastes	Minor aphthous ulcers	The goal of this research is to create an adhesive paste, a novel and stable pharmaceutical formulation made of organic botanical extracts from Glycyrrhizaglabra L. and Acacia nilotica L. The composition is engineered to efficiently address oral ulcers while guaranteeing a high level of patient acceptance. The combination of both extracts has a synergistic impact, and the formulation shows therapeutic efficacy in lowering the size of oral ulcers. The paste's cost-effectiveness and prolonged efficacy add to its practical advantages. This study addresses both patient acceptance and efficacy in the treatment of oral ulcers, highlighting a viable and approachable option. It might be necessary to do more clinical research to confirm these results and evaluate the formulation's wider applicability.	[56]
7	PEG-Cy5-coated GANP (Glycyrrhizic acid nanoparticles)	Antiviral and Anti-inflammatory Agents for coronavirusTreatment	In the form of extremely biocompatible glycyrrhizic acid (GA) nanoparticles, this work offers a possible breakthrough. To address the uncontrollably high levels of inflammation caused by SARS-CoV-2, this study investigates the possible therapeutic use of glycyrrhizic acid nanoparticles to reduce viral replication and inflammation. glycyrrhizic acid nanoparticles showed evidence of suppressing the mouse coronavirus MHV-A59's ability to proliferate. It was shown that the N protein of SARS-CoV-2 or MHV-A59 reduced the generation of proinflammatory cytokines. The research not only demonstrates the technological progress made possible by hydrothermal synthesis, although it also validates the safety and effectiveness of glycyrrhizic acid nanoparticles in antiviral and anti-inflammatory settings. As evidenced by a surrogate mouse model of COVID-19, glycyrrhizic acid nanoparticles are capable of targeting sites of high inflammation, indicating a potentially useful and adaptive treatment strategy for pandemics and hyperinflammatory disorders in general.	[57]
8	Model of lipopolysaccharide-stimulated macrophages	Anti-Inflammation	The study targeted to evaluate the in vitro anti-inflammatory properties of glycyrrhizic acid and 18β-glycyrrhetinic acid, both produced from licorice. According to the results, both may have anti-inflammatory properties by reducing the production of too much nitric oxide, prostaglandin E2, and reactive oxygen species. Suppressing the expression of COX-2 and iNOS, two genes that promote inflammation. PI3K and NF-κB activity inhibition. The medicinal potential of these substances in the management of inflammatory disorders is highlighted by their proven capacity to alter important inflammatory pathways and mediators.	[58]
9	Injectable Micelles	DNA Topoisomerase I Inhibitor for Enhanced Antitumor Activity	The research effectively created injectable Glycyrrhizic acid-hydroxycamptothecin micelles as a novel hydroxycamptothecin drug delivery method, demonstrating an increase in the solubility and stability of hydroxycamptothecin. Increased intracellular accumulation in cancer cells of the liver. Greater anticancer efficacy against in vitro liver cancer cells. Efficient inhibition of in vivo tumor development. Reduction of cytotoxicity to healthy liver cells due to selective accumulation in the liver.Higher anticancer activity of hydroxycamptothecin and physical mixture of Glycyrrhizic acid-hydroxycamptothecin was detected against the liver cancer cells It is one of the cost-effective and accessible methods for building an intravenous medication delivery systems to use GL-HCPT micelles.	[59]
10	Herbal Cream	Whitening Effect	The study's objective was to create and examine an externally applied cream that has whitening properties using Glycyrrhizaglabra extract. Significant anti-tyrosinase activity was shown by licorice extract, suggesting that it may have whitening properties. By using a microscope, the created creams were recognized as oil-in-water emulsions. Furthermore, in accelerated stability testing, creams kept at a lower temperature (8°C) showed greater stability. The development of cosmetic creams that may whiten skin by utilizing Glycyrrhizaglabra extract's qualities.	[60]
11	Topical Gel	Anti-microbial Activity	The purpose of the study was to create a topical gel from licorice and investigate its antibacterial activity against a variety of pathogens, for example, Candida albicans, Pseudomonas aeruginosa, and Staphylococcus aureus. Carbopol 934 was used as the gelling agent in the formulation of licorice gel with success. The	[61]

			chosen mixture exhibited strong antibacterial properties against Candida albicans and Staphylococcus aureus. The antibacterial action against Pseudomonas aeruginosa was absent. The created licorice gel may be viewed as a useful substitute for popular topical antibacterial medications. The gel has good stability at room temperature and promise as a novel herbal antibacterial topical gel formulation.	
12	Traditional Syrup	Cough	The investigation's goal was to create a herbal syrup using fig, fennel, and licorice that followed ancient Iranian medical recipes. The prepared syrup tasted sweet and smelled like fennel. It was brown in shade. The syrup's physicochemical properties were appropriate, and the amount of glycyrrhizic acid was measured. To quantify the syrup, the verified HPLC method can also be utilized as a quality control measure. This study highlights the investigation's alignment with traditional methods of medicine and lays the groundwork for the development of herbal syrup with potential applications in respiratory health.	[62]
13	Nanocapsules	Antimicrobial Activity	The goal of the study was to create nanocapsules that contained a methanol extract of Glycyrrhizaglabra and turmeric oil. The study concentrated on examining Glycyrrhizaglabra's antibacterial properties in both extract and nanocapsuleform. Chitosan molecular weight affected the properties of nanocapsules. Some of the factors influencing the qualities of the nanocapsules include the kind and quantity of surfactant used the mass ratio of turmeric oil extract, and the molecular weight of chitosan. Under ideal circumstances, tiny nanocapsules with potential uses in antibacterial compositions were produced. Turmeric oil and Glycyrrhizaglabra extract nanocapsulesexhibit potential for antibacterial uses. In order to prepare nanocapsules, natural polymers, chitosan, and alginate are added. This gives the formulation a biopolymeric dimension that may improve its bioavailability and possible applications in therapeutic settings.	[63]
14	Hand Wash	Antimicrobial Activity	The goal of the study was to create and assess a herbal hand wash that included licorice root (Glycyrrhizaglabra) ethanolic extract. The aim was on developing an efficient hand wash composition by exploiting the antibacterial qualities of botanicals, particularly licorice root. The formulation containing licorice root was found to be more effective than the typical commercial hand wash at lowering the amounts of microorganisms on hands. Highlighted the possibility of using plant extracts in hand wash recipes to reduce or eliminate adverse effects. This study highlights the value and efficacy of herbal hand wash recipes and highlights licorice root extract's potential as a moreeffective and safe substitute for conventional store-bought hand washes.	[64]
15	Oral Combined Tablet	Childhood Asthma	The study aimedto examine the efficacy of an oral combination tablet containing GlycyrrhizaGlabra, Operculinaturpethum, and Viola odorata as an additional therapy for mild-to-moderate childhood asthma. When comparing the cases to the controls, respiratory test indices revealed improvement in the cases. There was a considerable decrease in the degree of activity restriction. The oral combination tablet showed promise as an adjuvant treatment for mild-to-moderate childhood asthma, reducing the severity of symptoms. The potential effectiveness of the Anti-Asthma oral formulations as an independent therapy for mild-to-moderate childhood asthma is provided by this study.	[65]
16	Floating Tablets	Helicobacter pylori and gastric ulcers	The goal of the research was to create floating tablets that would include an aqueous licorice extract and be used to treat stomach ulcers and Helicobacter pylori. The pills were made with extended gastric residence time, enhanced bioavailability, and easier localized distribution of medication to the stomach in mind. The direct compression method was used to make the tablets. Using psyllium husk, HPMC K100M, talc, sodium bicarbonate, and magnesium stearate, floating tablets containing licorice extract showed good floating behavior and regulated drug release. With better stomach residence duration and bioavailability than traditional dosage forms, floating pills containing licorice extract	[66]

			offer a viable replacement.	
17	Polyherbal Formulation	Anti-inflammatory Activity	Through the development of a polyherbal mixture, the purpose of this study is to look at the anti-inflammatory qualities of medicinal herbs, specifically Glycyrrhizaglabra and Calotropisgigantea. The anti-inflammatory effects of the polyherbal mixture peaked at 120 minutes and then gradually increased at 180 minutes. In both carrageenan-induced and formalin-induced inflammation models, the polyherbal formulation combining Calotropisgigantea and Glycyrrhizaglabra showed considerable anti-inflammatory action. This implies that these plants may be used therapeutically in conjunction to treat inflammatory disorders.	[67]
18	Mucoadhesive Dental Gel	Antimicrobial Activity	This study set out to create and assess an antimicrobial mucoadhesive dental gel that contained herbal remedies to treat and prevent periodontitis, dental caries, and tooth plaque. Extract from the roots of Glycyrrhizaglabra exhibited antibacterial properties and helped to hide the formulation's unpleasant taste. The batch that was optimized demonstrated stability, good mucoadhesive qualities, and good drug release characteristics. This dental gel has the potential to be an effective medication delivery method to stop periodontitis, dental cavities, and plaque development. The gel's mucoadhesive qualities make it a viable delivery method for long-lasting antibacterial activity in the oral cavity.	[68]
19	Transdermal microemulsions	Antioxidant Potential	The objective of this study was to produce an aqueous ethanolic extract of Glycyrrhizaglabra's roots and rhizomes for use in microemulsion carrier systems for transdermal administration of two different kinds of antioxidant actives: polyphenols and flavonoids. In terms of medication content (polyphenols and flavonoids), viscosity, pH, particle size, polydispersity index, zeta potential, and stability, the microemulsion system showed ideal characteristics. Because the suggested microemulsion is applied topically and avoids uncomfortable oral or parenteral administration, it is easy to dispense, affordable and offers great patient compliance and convenience. This formulation offers a potentially useful method of administering medicinally useful biologically active phytochemicals.	[69]
20	Inhalable liposomes	Tuberculosis	Licorice Extract dry powder for inhalation (LDPI) will be investigated as a potent anti-tubercular medication or as an addition to existing available anti-tubercular drugs. The LDPI's flow properties were within the acceptable range, suggesting qualities that might be advantageous for inhalation. Mice with tuberculosis (TB) showed a substantial decrease in the number of germs in their lungs and spleen when the LDPI was evaluated pharmacodynamically. The licorice extract-containing LDPI exhibits encouraging potential as a strong anti-tubercular medication.	[70]
21	Herbal Fairness Cream	Beautification	The study's objective was to develop and evaluateherbal fairness cream with extracts from Camellia sinensis, Glycyrrhizaglabra, and Pleurotusostreatus. Formulations for oil-in-water (O/W) bases were developed. The creams showed good homogeneity, spreadability, pH, appearance, and ease of removal. Formulation demonstrating no emulsion breakdown over an extended period of storage. It was discovered that herbal creams were safe for the skin, showing no symptoms of allergic sensitization or irritation. The basis for a skincare product with little adverse effects is provided by the antioxidant qualities of the herbal extracts, which help to suppress the synthesis of melanin.	[71]
22	Biscuits	Nutraceutical in Conditions Like Cough orSore Throat	In order to maximize the health advantages of nutraceutical biscuits, especially for problems like sore throats and coughs, the study set out to create them using extracts of Glycyrrhizaglabra (licorice) root, Ocimum sanctum, and Pimpinellaanisum. It was discovered that biscuits were an excellent source of nutritional fiber and protein. These nutraceutical biscuits had much higher dietary fiber content than regular wheat biscuits. The antimicrobial qualities, anti-inflammatory effects, bronchial irritation relief, cough and cold relief, DNA protection, and treatment from high acidity are all combined in nutraceutical biscuits.	[72]

23	Hydrotropic Cream	Skin Pigment	The objective of the research was to create a stable water-in-oil (W/O) cream with Glycyrrhizaglabra extract and evaluate the way it affected skin pigmentation. A stable W/O cream was created, and the reduction in skin erythema was facilitated by the inclusion of Glycyrrhizaglabra extract and emollient glycerin in the base and formulation. The formulation was well-tolerated by the skin and showed acceptability stability.	[73]
24	Hydrogels	Innovative Dressings	To speed up the processes of wound repair by lowering wound infection and inflammation, The goal of the study was to use licorice root extract and nanosilver to make hydrogel dressings. The created hydrogels showed stability, good sorption characteristics, and non-cytotoxic behavior after being altered with licorice root extract and nanosilver. The hydrogel surface was smoothed by licorice root extract filling the external voids. These characteristics point to their possible use as cutting-edge dressings that promote regenerative processes in wound healing. Licorice root extract and nanosilver work together to effectively treat wounds by reducing inflammation and infection.	[74]
25	Floating Beads	Extending Gastric Residence Period	The goal of the study was to create glycyrrhizin-containing floating calcium alginate beads that target stomach mucosa and extend the gastric residency period. Glycyrrhizin was suspended in a calcium alginate solution to create beads. These beads provide a potential remedy for gastrointestinal issues because they are designed to carry drugs specifically to the stomach. These beads increase gastric residence duration and controlled release may help treat illnesses related to the stomach more effectively.	[75]
26	Hair Tonic	Hair Growth	In order to create and test a hair tonic, aqueous extracts of licorice (Glycyrrhizaglabra) and aloe vera were combined. A number of criteria were assessed, including color, specific weight, viscosity, pH, and hair growth performance. Formulas for hair tonics were brown in hue and smelled like menthol. The aloe vera and licorice extracts in hair tonic showed promising properties in terms of color, odor, specific weight, viscosity, and pH. It is a desirable formulation for hair care because it also demonstrated a notable increase of hair growth.	[76]
27	Licorice-Based Gel	Periodontal Disease	The study's objective was to develop and assess a controlled-release gel containing licorice extract so that it could be applied topically in periodontal therapy. Licorices extract showed good physicochemical characteristics, mucoadhesiveness, and controlled drug release when incorporated into a polymeric gel foundation. The licorice gel may be utilized in localized medicine administration to try to enhance the therapeutic outcomes of scaling and root planing in dental treatment.	[77]
28	Herbal Sunscreen Cream	Protection From UV-Radiation	The goal of the investigation was to create and produce a sunscreen cream made of herbs that contains extracts from Glycyrrhizaglabra, Terminaliaarjuna, and Tinosporacordifolia. Studies on animal irritancy showed no signs of redness or discomfort, indicating the cream's safety. The cream's status as an oil-in-water type emulsion was verified by the dye test. Extracts were distributed evenly throughout the cream. The cream had a no oily appearance, was readily removed with tap water, and had good slickness and emolliency. The combined effects of the extracts together produced the observed high SPF value, good physical qualities, stability, and safety in animal experiments.	[78]
29	Fast Dissolving Oral Film Containing	Mouth Ulcer	The goal was to develop a fast-dissolving dose formulation for oral ulcer treatment that would enhance medication distribution, beginning of action, and patient compliance. The films looked excellent and had good homogeneity, uniformity, and spreading ability. The greatest SPF number attained indicates excellent emolliency, sufficient sun protection, a non-oily finish, and ease of removal with tap water. According to the study's findings, the extracts can be successfully combined to create oral films that dissolve quickly.	[79]
30	Chitosan-Katira Gum	Enhancement of anti-inflammatory	The purpose of this investigation was to enclose glycyrrhizic acid, a triterpenesaponin which were extracted from Glycyrrhizaglabra, in	[80]

	Nanoparticles	activity	safe biopolymeric nanoparticles in order to increase its bioavailability and efficiency. The encapsulation of glycyrrhizic acid in chitosan-katira gum nanoparticles overcame the restricted bioavailability of previous forms of glycyrrhizic acid and produced an improved anti-inflammatory potential. According to the study, glycyrrhizic acid's bioavailability and therapeutic efficacy may be enhanced by the created nanoparticles, especially when it comes to the treatment of inflammatory disorders.	
31	Ethanolic Extract	Anti-Tumor Activity	Swiss albino mice were used to assess the anticancer efficacy of Glycyrrhizaglabra extracts in response to Ehrlich ascites carcinoma. In terms of changes in hematology and biochemical markers, the combination of Glycyrrhizaglabra and the conventional medication cisplatin demonstrated greater effectiveness. The results demonstrate the potential of Glycyrrhizaglabra as an anticancer natural product and emphasize its importance in the creation of new cancer treatments.	[81]
32	Sustained release herbal Matrix tablet	Cough	The purpose of the investigation was to create controlled-release matrix tablets containing natural extracts from Glycyrrhizaglabra and Ocimum sanctum in order to solve the problems related to coughing medication. The research effectively addressed problems with traditional cough remedies by creating controlled-release matrix tablets for plant extracts. For weight variation, hardness, friability, drug content, and swelling index, satisfactory findings were obtained. The drug release from the formulation was sustained for almost 16 hours. The created matrix pills may provide a once-daily delivery option, enhancing patient adherence to cough therapy.	[82]
33	Microemulsion for transdermal delivery	Increase dissolvability and penetration	By creating a microemulsion, this study sought to improve the licorice flavonoids dissolvability and transdermal absorption. A prolonged release of licorice flavonoids was seen in the ideal microemulsion, which greatly enhanced dissolvability. The composition that was developed showed excellent distribution and retention of licorice flavonoids through the epidermal layer. Because the formulation had components that were acceptable from a cosmetic standard point, it may be used in cosmetic applications.	[83]

Liquisolid Technology can be used to increase solubility of poor water-soluble drugs. As it converts drug solution into dry free flowing powder at low production cost. Improves the drug release byusing certain hydrophobic carriers and surface-active agents thus enhance the dissolution profile. [84]. By using Liquisolid formulations, rapid release rates of drug are obtained. • Act as weapon to enhance the bioavailability of hydrophobic drugs..• They are used in probiotics.[85]

IV. CONCLUSION

A broad range of beneficial characteristics, including as anti-inflammatory, anti-cancer, anti-bacterial, anti-viral, and anti-allergic actions, have been demonstrated by licorice and its bioactive ingredients. The main active ingredient in licorice, glycyrrhizin, has demonstrated potential in several medicinal uses, such as the treatment of ulcers in the oral cavity, anti-inflammatory medication, wound healing, and sunscreen formulation. The potential uses of licorice in targeted delivery of drugs for particular medical conditions have increased with the introduction of new drug delivery methods like nanoparticles and micelles. This article's study highlights the wide range of pharmacological properties of licorice and its derivatives, opening up new avenues for investigation and the creation of pharmaceutical treatments derived from this old-age plant.

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