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Research Paper

Formulation and Evaluation of Liquorice Jellies for Cough

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ABSTRACT

Liquorice (Glycyrrhiza glabra) is widely known for its beneficial properties, such as acting as an expectorant, anti-inflammatory, and antibacterial agent. It plays a significant role in many herbal remedies for respiratory conditions. The focus of this study is to develop and evaluate liquorice jellies as an easy-to-use and enjoyable form of medication for treating respiratory issues. To achieve the best texture, stability, and therapeutic effects, several formulations were prepared using liquorice extract, gelling agents (like pectin and gelatin), sweeteners, and preservatives.The physicochemical properties of the jellies, such as pH, texture, moisture content, dissolution rate, and drug release were thoroughly tested. Additionally, sensory attributes like taste, color, and appearance were evaluated to ensure patient acceptance. Stability studies were conducted to check how well the jellies would last under different storage conditions.The findings indicated that the improved formulation of liquorice jelly has the potential to serve as a promising alternative to traditional liquid expectorants. It showed good mechanical strength, consistent drug distribution, and prolonged release of active ingredients. This study highlights the potential of liquorice jellies as a patient-friendly, easy-to-administer, and effective herbal formulation for respiratory treatments.

INTRODUCTION

Jellies are semisolid to thick viscous fluids that consists of sub microscopic particle in a somewhat rigid or plastic vehicle. Jellies are transparent, non-greasy semi solid gels. They are used for medication, lubrication and some miscellaneous application. But limited work has been done to formulate oral jelly candies. Jelly formulation is wide spread these days in the confectionaries as jelly candies that are being loved by children as they enjoy the taste and the chewing property of jellies. This makes them a dosage form with improved patient compliance. Medicated jelly today is gaining consideration as a “vehicle” or a “delivery system” to administer active principles that can improve health and nutrition but it’s potential as an “alternative drug delivery system”

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has not been yet fully discovered and exploited. The use of medicated jelly is feasible as all local treatment of diseases of the oral cavity as well as treatment of systemic conditions. In traditional medicine, liquorice has been recommended as a prophylactic agent for gastric and duodenal ulcers. It is employed in dyspepsia as an anti-inflammatory agent during allergenic reactions.*Glycyrrhiza* roots are useful for treating cough because of its demulcent and expectorant property. The liquorice powder and extract was found to be effective in treatment of sore throat, cough and bronchial catarrh. The specific mechanism of action is not known. 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. Likewise, liquorice extract may also be able to stimulate tracheal mucus secretions producing demulcent and expectorant effects. 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 [23]. Ethanolic extract of *G. glabra* was found to be responsible for inhibition of 35.62% SO2 gas induced cough in experimental animals (mice)

Physiology of the Respiratory Tract:

The **respiratory system** is essential for **gas exchange**, which allows oxygen to enter the blood and removes carbon dioxide. Additionally, it protects the body by filtering out harmful particles, dust, and pathogens from the air. The respiratory tract is divided into two parts:

- **Upper Respiratory Tract**: This includes the **nose**, **nasal cavity**, **pharynx** (throat), and **larynx** (voice box). It helps filter, warm, and humidify the air before it enters the lungs.
- **Lower Respiratory Tract**: This includes the **trachea** (windpipe), **bronchi**, **bronchioles**, and **lungs**. It plays a key role in the exchange of gases, specifically oxygen and carbon dioxide, within the **alveoli** (tiny air sacs in the lungs).

The inner lining of the respiratory tract is covered with **mucous membranes** and **ciliated cells** that trap and remove particles, bacteria, and viruses, helping to protect the lungs from infections. This process is called **mucociliary clearance**, which is an important defense against respiratory diseases.

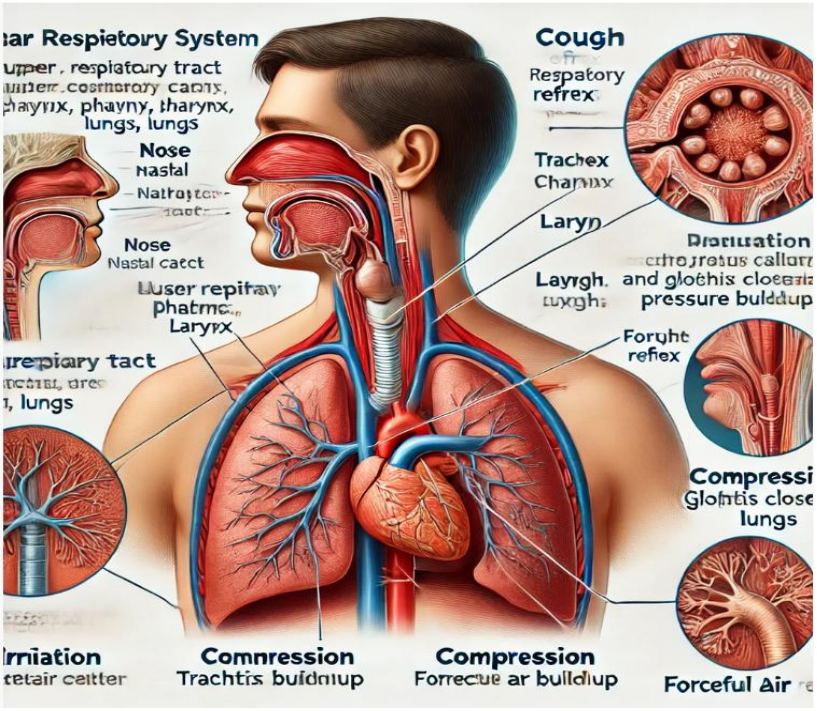


Fig.1 Respiratory Tract

Mechanism of Cough:

Coughing is a natural protective reflex that helps clear the airways of mucus, irritants, and pathogens. The process of coughing occurs in three main stages:

- **Irritation & Initiation**: **Sensory receptors** in the respiratory tract detect irritants such as dust, smoke, or excess mucus. These receptors send signals to the **cough center** in the **brainstem**, triggering the cough reflex.
- **Compression Phase**: The **vocal cords** (glottis) close, and pressure builds up in the lungs as the **diaphragm** and **chest muscles** contract.
- **Expulsion Phase**: The glottis suddenly opens, releasing air at high speed to expel mucus and irritants from the respiratory tract.

A persistent or excessive cough can cause throat irritation and inflammation. In such cases, soothing agents like **liquorice** can help by coating the throat, reducing inflammation, and loosening mucus, offering relief.

AIM & OBJECTIVES:

To develop and assess liquorice-infused jellies as a potent expectorant for alleviating cough and promoting respiratory wellness.

1) To collect the dried roots of liquorice.
2) Extensive review of literature of plant.
3) Extraction of the powdered liquorice root by soxhlation.
4) Preparation of the jellies.
5) Evaluation tests of jellies.

BENEFITS:

1. **Soothing Relief**: Liquorice has natural soothing properties that help calm throat irritation and reduce coughing.
2. **Effective Expectorant**: It helps loosen mucus in the respiratory tract, making it easier to clear the airways.

3. **Convenient and Palatable**: Jellies are easy to consume, portable, and more pleasant in taste compared to syrups or pills.
4. **Controlled Dosage**: Each jelly provides a consistent and precise dose of active ingredients, ensuring safe and effective treatment.
5. **Prolonged Action**: Jellies dissolve slowly, providing extended relief to the throat and respiratory system.
6. **Stability**: Jelly form helps preserve the therapeutic properties of Liquorice for longer shelf life.
7. **Complementary Ingredients**: Additional soothing agents like honey or lemon can be included for enhanced benefits.

1. Drug Profile:

Liquorice:

1. **Scientific Name**: *Glycyrrhiza glabra*
2. **Common Name**: Liquorice
3. **Family:** Fabaceae
4. **Part Used:** Roots



Fig.2 Liquorice (Glycyrrhiza glabra)

5. Biological source:

Liquorice is the dried peeled or unpeeled roots, rhizomes or stolon of Glycyrrhiza glabra Linn., invariably known in commerce as Spanish liquorice, or of glycyrrhiza glabra linne. Var Glandulifera Waldstein et Kitaibel, mostly known in commerce as Russian liquorice or of other varieties of Glycyrrhiza glabra linne; which produces a sweet and yellow wood belonging to family Leguminosae The word Glycyrrhiza has been derived from Greek origin that means sweet root and glabra means smooth and usually refers to the smooth, pod-like fruit of this particular species nevertheless the fruits of the glandulifera variety has a distinct gland like swellings. Geographical sources: Liquorice is grown in sub Himalayan tracts and Baluchistan. It is cultivated on a large scale in Spain, Sicily and Yorkshire (England) G. Glabra var violaceae is found in Iran; whereas G.glabra var glandulifera exclusively grows in Russia (the ‘Russian liquorice') .

The following are the three commonly grown varieties of Glycyrrhiza glabra, namely:

- G. glabra var. Violaceae (or Persian liquorice): this specific species bears violet flowers.
- G. glabra var. Gladulifera (are Russian liquorice): it has distinct big stock together with a number of elongated roots but it has not got any stolon.

- G. glabra var. typica (or Spanish liquorice): This specific plant bears only purplish- blue coloured papilionaceous flowers. it possesses a large number of a stolons.

6. Preparation:

The roots are usually harvested after 3 to 4 years from its plantation when they mostly display enough growth. The rhizomes and roots are normally harvested in the month of October, particularly from all such plants that have not yet born the fruits. Thereby ascertaining maximum sweetness of the sap. The rootlets and buds are removed manually and drug is washed with running water. The drug is first dried under the sun and subsequently under the shade till it loses almost 50% of its initial weight. The large thick roots of the Russian liquorice are usually peeled before drying. It is an usual practice in Turkey, Spain and Israel to extract a substantial quantity of a drug with water, the resulting liquid is filtered and evaporated under vacuo and the concentrated extract is molded either into sticks or other suitable forms.

7. Description:

Colour: Unpeeled liquorice externally, yellowish Brown or dark brown and internally yellowish colour.

Odour: faint and characteristic

Taste: sweet

Size: Length = 20 to 50 cm; Diameter= 2 cm

Shape: Unpeeled drug - Straight and nearly cylindrical

Peeled drug: mostly angular

Fracture: fibrous in bark and splintery in the wood

8. Cultivation:

It is cultivated by planting rhizomes or Stolons cutting in deep, rich, loamy, fertile soil in rows about 4 feet apart in March, addition of farmyard manure has favorable effect on the growth of the plant. Collection of the drug is carried out in autumn in the third or fourth year, by which time extensive development of subterranean part has taken place. Rhizomes stolons and roots are dug out, buds and rootlets removed, washed, cut into pieces of usually 20cm length and dried in sun in some cases drug is peeled before drying. Peeled drug is used for direct administration but in preparing tincture or liquid extracts unpeeled drug is used.

9. Chemical Test:

1. When sulphuric acid (80%) is added to a thick section of the drug or powder, it instantly produces a deep yellow colour.

2. Chemical constituents Glycyrrhiza (Liquorice):

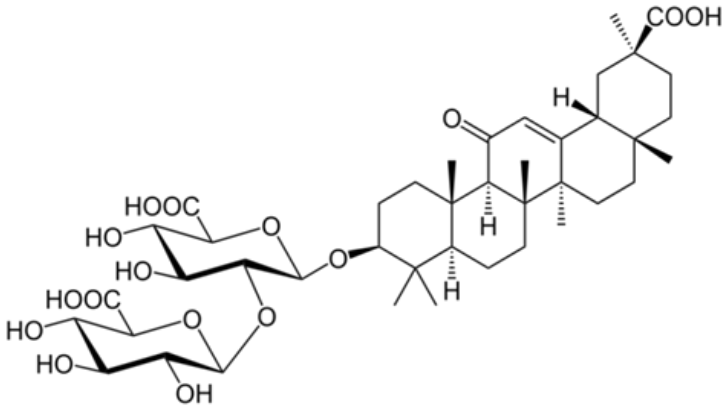


Fig.3 Chemical Structure of Glycyrrhiza

Glycyrrizin is found to be 50 times as sweet. Glycyrrhizin upon hydrolysis loses its sweet taste and gives rise to the aglycone glycyrrhetinic acid (glycyrrhetic acid) together with two moles of glucoronic acid. The former is a pentacyclic triterpene derivative of the β amyrin type. A host of other chemical constituents are namely; coumarin derivatives e.g., umbelliferone and herniarin; flavonoid glycoside e.g., liquiritoside; isoliquiritoside, liquiritin; isoliquiritin, rhanoliquiritin, and rhamnoisoliquiritin; asparagines; 22-33 dihydrostigmasterol; glucose; mannitol and about 20% of starch. Interestingly carbenoxolone, which is an oleandane derivative is prepared from glycyrrhiza and possesses considerable mineralocorticoid activity.it is used as an anti-ulcer.

2. Experimental Studies:

A) Methodology:

- **Material Required:**

1. Propylene glycol
2. Citric acid
3. Agar-agar
4. Sodium benzoate
5. Amaranth colour
6. Peppermint water
7. Distilled water
8. Extract of glycyrrhiza glabra (ethanolic) was prepared in laboratory

- **Method of Extraction:**

Glycyrrhiza glabra roots were used as plant material. The shade dried roots of glycyrrhiza glabra (Family: Leguminosae) were taken, cleaned and ground in an hand operated grinder to have a coarse powder. The powder was passed through sieve number 60 and stored in a well closed container at 25^0C. 25gm of liquorice coarse powder is packed in soxhlet column and refluxed with 100ml of ethanol for 6 hours. The concentrate of extraction was concentrated on electric water bath under reduced pressure at 45^0C and the extract is collected.

B) Preparation of Liquorice jellies:

- All the ingredients are weight accurately.
- In one beaker agar, propylene glycol, citric acid were taken and heated to dissolved agar and citric acid with constant stirring.
- In another beaker sugar syrup was prepared by adding 67 gm of sugar in a beaker and make up the volume up to 100 ml. Sugar syrup was added to agar solution and boiled for few minutes.
- Sodium benzoate, amaranth colour were dissolved in peppermint water.
- After boiling agar solution, the scum was removed and peppermint water was added to it and mixed thoroughly and uniformly.
- Herbal drug extract was weight accurately, dissolved in little amount of water and added before jelly is allowed to set, mix thoroughly.
- These whole solutions was transferred in to moulds and then allow it for cooling and settling undisturbed by proper covering the moulds to avoid exposure to outer environment.
- After the jelly is set it is wrapped in to the gelatin paper and store in dry place.

3. Formulation of Jellies

Ingredients	F1 (g/mL)	F2 (g/mL)	F3 (g/mL)	Uses
Liquorice Extract	5.0	6.0	7.0	Drug
Sugar Syrup	30.0	30.0	30.0	Bulking agent
Agar	2.5	3.0	3.5	Gelling agent
Citric Acid	0.5	0.5	0.5	Buffering agent
Sodium Benzoate	0.2	0.2	0.2	Preservative

Propylene glycol	5.0	6.0	7.0	Lubricant
Peppermint water	0.3	0.3	0.3	Flavouring agent
Amaranth colour	0.5	0.5	0.5	Colouring agent
Water (q.s. to 100 mL)	Up to 100	Up to 100	Up to 100	Vehicle

4. Evaluation of Jellies:

To evaluate the quality of the created formulation,several quality control tests were conducted,including visual inspection and physiochemical and conditioning performance testing.

- **Organoleptic Properties:**

Parameters	Glycyrrhiza glabra
Texture	Hard and fibrous in a root form; sticky and viscous in extract;fine and smooth in powder form.
Smell	Sweet,earthy,and slightly woody aroma.
Taste	Sweet with slight herbal bitterness
Colour	Light to dark brown in root and powder form;dark brown to black in liquid extract

- **Screening of Jelly Formulation Phytochemically:**

Phytoconstituent	Glycyrrhiza glabra
Tannins	Present
Protein	Present
Starch	Present
Alkaloids	Present

- **Procedure of Phytochemical Tests:**

Phytochemical test	Procedure	Observation
Flavonoids	Add magnesium turning and few drops of conc.HCL to the extract	Pink/Red colour.
Saponins	Shake the extract vigorously with water and let it stand.	Persistent froth formation
Phenols	Add 5% ferric choloride solution to the extract	Deep blue or green colour
Tannins	Add 5% ferric choloride solution to the extract	Blue-black, green colour
Alkolides	Add a few drops of Dragendorff's reagent to the extract.	Orange or reddish-brown ppt

5. Herbal Drug Extraction:

Soxhlet extraction is an effective technique for extracting bioactive compounds from medicinal plants. The process starts with drying and grinding the herbal material, such as liquorice root, into a coarse powder. This powdered material is then placed inside a thimble within the Soxhlet extractor. A suitable solvent, such as ethanol, methanol, or a water-alcohol mixture, is heated in a round-bottom flask, generating vapors that rise into the condenser. These vapors cool down and drip onto the plant material, allowing the solvent to dissolve the active compounds. Once the extraction chamber fills with the dissolved extract, the siphon mechanism automatically empties it back into the flask, leaving the plant residue

behind while fresh solvent continues the process. This continuous cycle runs for 6–8 hours, ensuring efficient extraction of bioactive constituents. After completion, the solvent is evaporated using a rotary evaporator or water bath, leaving a concentrated herbal extract. The final extract is stored in an airtight container at 4°C to preserve its stability and effectiveness. Soxhlet extraction is highly beneficial as it maximizes compound recovery, recycles solvent efficiently, and is ideal for heat-stable phytochemicals, making it a preferred method in herbal drug formulations.



Fig.4 Glycyrrhiza Glabra Extract

6. Beneficial Qualities Of "Powder of Drugs"

a. Alcohol-Soluble Extractive:

Weigh 5g of liquorice powder and place it in a 100mL conical flask. Add 100mL of alcohol (ethanol or methanol), shake well, and let it stand for 24 hours, shaking occasionally. After 24 hours, filter the solution and evaporate 25mL of the filtrate in a dish, dry at 105°C, and weigh the residue. The extractive value is calculated based on the weight of the residue.

b. Water-Soluble Extractive:

Weigh 5g of liquorice powder and soak it in 100mL of distilled water in a conical flask. Allow it to stand for 24 hours, with occasional shaking. Filter the extract and evaporate 25mL of the filtrate in a dish, dry at 105°C, and weigh the remaining solid. The extractive value is calculated from the final weight.

c. Total Ash:

Weigh 2g of liquorice powder in a silica crucible and incinerate it in a muffle furnace at 500–600°C until a constant weight is obtained. Cool it in a desiccator and weigh the ash. The total ash value represents the total mineral and inorganic content.

d. Acid-Insoluble Ash:

After obtaining the total ash, mix it with 25mL of dilute HCl (10%) and boil for 5 minutes. Filter the insoluble matter, wash it with hot water, dry it in an oven, and weigh it. This represents the amount of acid-insoluble impurities like silica and sand.
These tests help evaluate the purity, quality, and presence of active phytochemicals in liquorice powder.

Tests	Result (Glycyrrhiza glabra)	Inference
Total Ash Content	6.2 %	Moderate Ash Content
Acid Insoluable Ash Content	1.1%	Low Acid Insolubility
Alcohol Soluable Content	15.8%	Moderate Alcohol Solubility
Water Soluable Content	25.5%	High Water Solubility

7. Theraputic Use:

- **Liquorice (**Glycyrrhiza glabra)

1. Digestive Health:

Gastrointestinal Soothing: Liquorice has gastroprotective properties, which help alleviate symptoms of indigestion, heartburn, and acid reflux by promoting mucosal protection and reducing irritation in the gastrointestinal tract.

Peptic Ulcers: Liquorice contains bioactive compounds like glycyrrhizin and flavonoids, which may support ulcer healing by enhancing mucosal defense mechanisms and promoting gastric mucosal regeneration. Additionally, it has mild antimicrobial activity against Helicobacter pylori, a bacterium associated with ulcer formation.

2. Respiratory Health:

Cough and Sore Throat: Liquorice acts as an expectorant, facilitating mucus clearance by reducing viscosity and aiding in mucociliary transport. It is commonly used in herbal preparations to treat upper respiratory tract infections, including cough and sore throat.

Asthma and Bronchitis: Liquorice exhibits bronchodilator effects, potentially alleviating bronchoconstriction in asthma and improving airflow. It also demonstrates anti-inflammatory properties that may reduce inflammation in the airways, providing relief in conditions like bronchitis.

3. Anti-inflammatory Effects:

Liquorice demonstrates significant anti-inflammatory activity, which is beneficial in the management of inflammatory disorders such as rheumatoid arthritis and inflammatory bowel disease. Its compounds can modulate inflammatory pathways, reducing cytokine production and alleviating pain associated with inflammation.

RESULT

- **Evaluation studies of prepared formulations:**

The prepared three formulations were evaluated by observing the appearance and
consistency. Further formulations were evaluated by conducting pH measurement,
spreadability, viscosity.

1. Physical Appearance:

The formulated liquorice jellies was visually inspected for their colour, odour and
Consistency.

Formulation	Colour	Odour	Consistency
F1	Light Brown	Pleasant	Semi solid
F2	Dark Brown	Pleasant	Semi solid
F3	Yellowish Brown	Pleasant	Firm

2. Determination of pH:

The pH of prepared formulation was determined using pH paper and pH value are shown below:

Formulation	pH
F1	4.8
F2	5.0
F3	5.3

The pH of formulated jellies that is F1,F2 & F3 was found to be 4.8, 5.0 & 5.3 respectively. All formulations fall within an acceptable pH range for oral administration.

3. Determination of Spredability:

Determining the spreadability of products like licorice jellies is an important quality control test, especially if the product is designed to be spread or applied to surfaces, such as in pharmaceutical or cosmetic formulations.

Formulation	Spredability (gm.cm/sec)
F1	9.2
F2	8.4
F3	7.1

The spredability of the F1 formulation is 9.2 gm.cm/sec which is more than the other formulation. This shows that formulation F13 has better spredability than the other formulations.

4. Antimicrobial Studies:

Antimicrobial studies are essential for evaluating the effectiveness of licorice jellies in inhibiting the growth of microorganisms, which is particularly important for products that are used in pharmaceutical or cosmetic applications.

Formulation	Zone of inhibition (mm) Against Bacteria	Zone of inhibition (mm) Against Fungi
F1	12.5	10.2
F2	14.8	11.6
F3	13.2	9.8

5. Determination of Viscosity:

Viscosity is an important property for licorice jellies, particularly when considering their ease of application, texture, and stability.

Formulation	Viscosity (cP at 25°C)
F1	3200
F2	4100
F3	4800

CONCLUSION

The present study demonstrates the herbal extract of *glycyrrhiza glabra* was successfully formulated in the jelly formulation using Agar agar, was physically and chemically stable. The drugs extract, which is used in the dose range are safe for consumption and can be swallowed without any risk of systemic side effects.

G.glabra extract in the formulation is effectively used as expectorant and antitussive. And thus, it is used to treat throat infections. The prepared formulation will be a substitute over the other preparation available in the market in near future. The prepared jelly formulation showed good antitussive activity.

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