

Formulation And Evaluation of Herbal Lozenges by Using Liquorice Roots (*Glycyrrhiza Glabra*) For the Treatment of Sore Throat

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Abstract—Sore throat is a common upper respiratory condition often associated with inflammation, irritation, and Microbial infections. The present study aims to formulate and evaluate herbal lozenges using Liquorice root Powder (*Glycyrrhiza glabra*), Ginger (*Zingiber officinale*), Tulsi (*Ocimum sanctum*), Honey, Peppermint, and Clove (*Syzygium aromaticum*) for their combined soothing, anti-inflammatory, antimicrobial, and demulcent Properties. The ingredients were selected based on their traditional medicinal use and proven pharmacological Activities. Lozenges were prepared using a heating and congealing technique, incorporating sucrose and glucose Syrup as base materials. The formulated lozenges were evaluated for organoleptic properties, weight variation, hardness, friability, disintegration time, pH, and microbial load. Results indicated that the polyherbal lozenges Exhibited acceptable physical properties with uniformity in weight and hardness, optimal disintegration time, And pleasant taste and aroma. The presence of liquorice, honey, and tulsi contributed to soothing and demulcent Effects, while ginger, clove, and peppermint enhanced anti-inflammatory and antimicrobial activity. Overall, the Formulated polyherbal lozenges demonstrated promising potential as a natural, safe, and effective remedy for the symptomatic relief of sore throat.

Index Terms—Herbs, sore throat, liquorice roots, inflammation, soothing effect, sore throat.

I. INTRODUCTION

Sore Throat

Sore throat, medically referred to as pharyngitis, is one of the most common upper respiratory tract conditions encountered in clinical practice. It is characterized by

pain, irritation, or a scratchy sensation in the throat, often aggravated by swallowing or speaking. Sore throat can occur as an isolated symptom or as part of a broader infectious or inflammatory process. Although viral infections such as rhinovirus, influenza virus, adenovirus, and coronavirus account for the majority of cases, bacterial pathogens, particularly *Streptococcus pyogenes*, also contribute significantly, especially in acute pharyngitis among children and young adults.

Etiology of Sore Throat

The etiology of sore throat (pharyngitis) is multifactorial and encompasses infectious as well as non-infectious causes.

1. Infectious Causes

a. Viral Infections (70–90% of cases)

Viruses are the most common cause of acute sore throat. Common pathogens include:

Rhinovirus

Adenovirus

Influenza and Parainfluenza viruses

Coronavirus

Respiratory Syncytial Virus (RSV)

Epstein-Barr Virus (EBV) – causes infectious mononucleosis

Viral pharyngitis is often accompanied by cough, rhinorrhea, and hoarseness.

b. Bacterial Infections

The main bacterial pathogen is:

Streptococcus pyogenes (Group A β -hemolytic streptococcus – GABHS)

Other less common bacteria include:

Staphylococcus aureus

Mycoplasma pneumoniae

Corynebacterium diphtheriae (rare)

Bacterial infections typically present with high fever, tonsillar exudates, and tender lymph nodes.

2. Non-Infectious Causes

Allergies: Dust, pollen, animal dander leading to postnasal drip.

Environmental irritants: Pollution, tobacco smoke, chemical fumes.

Dry air: Causes mucosal dryness and irritation.

Gastroesophageal reflux (GERD): Acid reflux irritates pharyngeal mucosa.

Voice overuse/strain: Seen in teachers, singers, and public speakers.

Trauma: From instrumentation, intubation or ingestion of foreign bodies.

Pathophysiology of Sore Throat

The pathophysiology varies depending on the underlying cause but primarily involves inflammation of the pharyngeal mucosa.

1. Viral Pathophysiology

Viruses infect epithelial cells of the upper respiratory tract.

This leads to cell damage, mucosal irritation, and activation of the innate immune response.

Release of inflammatory mediators like prostaglandins, bradykinin, and cytokines stimulates pain receptors.

Result: Pain, burning, and scratchiness in the throat, often accompanied by cough and rhinitis

2. Bacterial Pathophysiology

Streptococcus pyogenes adheres to epithelial cells via M-protein.

The bacteria release exotoxins and enzymes (streptolysins, hyaluronidase), which cause:

Tissue inflammation

Neutrophil infiltration

Tonsillar swelling and exudate formation

Immune response results in fever, lymph node enlargement, and severe throat pain.

Untreated infections may lead to complications such as rheumatic fever or glomerulonephritis.

3. Non-Infectious Pathophysiology

Allergens activate mast cells causing histamine release → mucosal edema & irritation.

Chemical irritants induce oxidative stress and inflammatory cytokines.

GERD causes repeated acid exposure leading to chronic mucosal inflammation.

Mechanical overuse causes microtrauma to mucosal surfaces.

Lozenges:

Lozenges are solid, single-dose oral preparations designed to dissolve slowly in the mouth to provide localized Action in the oral cavity and throat. They are commonly used for the management of sore throat, cough, and Minor infections due to their ability to deliver therapeutic agents directly to the affected mucosal surfaces. Lozenges work by releasing active ingredients gradually, allowing prolonged contact time and improved Therapeutic efficacy. Traditionally, they are prepared using sugar-based bases such as sucrose and glucose syrup, or sugar-free bases like isomalt and sorbitol, which provide structure, taste, and stability to the formulation.

Herbal lozenges have gained increasing attention in recent years because of their safety, minimal side effects, Biocompatibility, and consumer preference for natural remedies. Several medicinal plants possess demulcent, Anti-inflammatory, antimicrobial, and soothing



properties that make them ideal for use in lozenge formulations intended for the treatment of sore throat. Liquorice (*Glycyrrhiza glabra*) is a well-known demulcent and anti-Inflammatory herb widely used to relieve throat irritation. Ginger (*Zingiber officinale*) exhibits potent anti-Inflammatory and antimicrobial activity, helping reduce throat pain and infection. Tulsi (*Ocimum sanctum*) is Recognized for its immunomodulatory, antiviral, and antibacterial effects. Honey acts as a natural soothing agent and

provides antimicrobial benefits, while Peppermint offers a cooling sensation and mild aesthetic effect. Clove (*Syzygium aromaticum*) contains eugenol, a compound known for its analgesic and antiseptic properties. Combining these herbal ingredients into a single polyherbal lozenge formulation offers a synergistic approach to relieving sore throat symptoms. The use of herbal actives not only enhances therapeutic benefits but also Improves palatability, patient acceptability, and market potential. Therefore, the present study focuses on the Formulation and evaluation of polyherbal lozenges containing liquorice root powder, ginger, tulsi, honey, Peppermint, and clove for effective and natural management of sore throat

Advantages of Lozenges:

1. Prolonged Local Action
2. Immediate Soothing Effect
3. Bypass First-Pass Metabolism
4. Easy to Administer
5. Improved Patient Compliance
6. Suitable for Heat-Sensitive Herbal Ingredients
7. Stable Dosage Form
8. Can Be Used for Both Local and Systemic Effects
9. Mask Unpleasant Taste
10. Dose Accuracy
11. Cost-Effective Formulation

Disadvantages of Lozenges:

1. Not Suitable for Heat-Sensitive Drugs
2. Risk of Dental Caries
3. Slow Onset of Action (for systemic effect)
4. Potential for Choking in Children
5. Limited Drug Dose Capacity.
6. Moisture Sensitivity
7. Taste Masking Challenges
8. Not Suitable for All Patients
9. Possible Irritation

Types of Lozenges

There are three main types of herbal lozenges: hard, soft, and chewable.

Hard Lozenges:

Hard lozenges are typically made from a combination of sugar, honey, and herbs and they are designed to Dissolve slowly in the mouth. They are often used to soothe sore throats, reduce coughing, or freshen breath.

Soft Lozenges:

Soft lozenges are similar to hard lozenges, but they have a softer, chewier texture. They are often made from a Combination of sugar, honey, herbs, and gelatine, and they are used to soothe

Chewable Lozenges:

Chewable lozenges are designed to be chewed, rather than slowly dissolved. They are typically made from a Combination of sugar, honey, herbs, and gum Arabic, and they are used to soothe sore throats, freshen breath, and provide other health benefits. When choosing an herbal lozenge, it is important to consider the specific Health benefits you are looking for and the texture that you prefer. It is also important to read the label carefully to make sure that you are getting a high-quality product that contains the herbs and active ingredients you are Looking for.

II. LITERATURE REVIEW

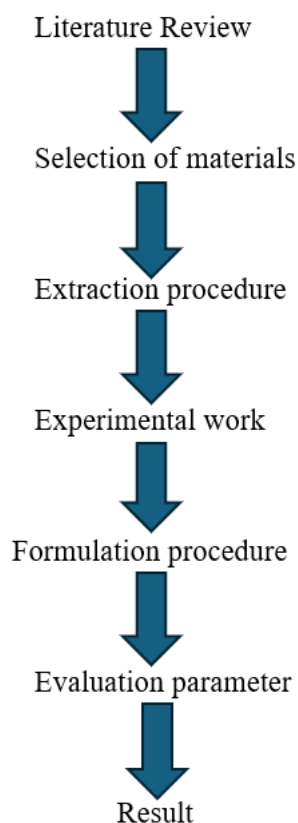
Polyherbal lozenges are natural throat-soothing formulations designed to deliver herbal actives through slow dissolution in the oral cavity. Studies show that herbs like liquorice, ginger, Tulsi, clove, peppermint, honey, and jaggery work synergistically to provide antimicrobial, anti-inflammatory, demulcent, and analgesic effects.

Research highlights improved symptomatic relief in sore throat and mild respiratory irritation compared to single-herb formulations. Standard evaluation parameters such as hardness, friability, dissolution, and stability confirm their quality and effectiveness. Overall, literature supports polyherbal lozenges as safe, effective, and patient-friendly alternatives to synthetic throat medications.

Literature review on Polyherbal lozenges (liquorice as a main ingredient)

Sr. No.	Author(s) & Year	Study Title / Focus	Main Findings
1.	Smith et al., 2018	Development and evaluation of liquorice based demulcent lozenges for sore throat	Liquorice + honey + peppermint Lozenges showed good hardness, 8-10 min dissolution and excellent Stability
2.	Kumar & Rao, 2019	Antimicrobial activity of polyherbal lozenges containing liquorice, clove and tulsi	Strong antimicrobial effect against Streptococcus pyogenes; synergistic action with clove and tulsi.
3.	Hernandez et al., 2020	Clinical pilot: liquorice-ginger lozenges in acute pharyngitis	Faster pain relief and reduced swallowing discomfort over 48-72 hrs compared to placebo.
4.	Patel et al. 2017	Comparative anti-inflammatory effect of Glycyrrhiza lozenge vs. Syrup	Lozenges provided sustained local anti-inflammatory effect with increased mucosal residence time.
5.	Zhang & Li, 2021	Mucoadhesive polyherbal lozenges using liquorice and mucilage polymers.	Enhanced mucoadhesion and prolonged release of glycyrrhizin.
6.	Oliveira et al., 2016	Sensory acceptability of herbal throat lozenges	Liquorice-based lozenge's preferred for soothing effect; taste masking improved acceptability.
7.	Ahmed et al., 2022	Antiviral properties of liquorice - containing Polyherbal lozenges	Lozenge extracts inhibited respiratory virus replication in vitro
8.	Gupta & Mehra, 2015	Safety and toxicity evaluation of prolonged liquorice lozenge use	High-dose long-term use showed electrolyte changes; short-term use considered safe.
9.	Fernandes et al., 2023	Taste masking of liquorice lozenges using microencapsulation	Reduced bitterness without affecting antimicrobial activity.
10.	Thompson & Roy, 2020	Systematic review of herbal lozenges focusing on liquorice	Moderate evidence for symptomatic relief, need for more clinical trials.

Plan of work:



Aim and objective

Aim: Formulation and evaluation of herbal lozenges by using liquorice roots for the treatment of sore throat.

Objectives:

- To formulate a safe and effective lozenge using multiple medicinal herbs.
- To provide relief from sore throat, cough, and throat irritation.
- To achieve synergistic therapeutic action through combined herbal ingredients.
- To develop a palatable and patient-friendly solid dosage form.
- To evaluate the lozenges for quality, stability, and therapeutic efficacy.

III. ESSENTIAL MATERIAL AND METHODS

1) Liquorice:

Synonyms-sweet root, yashtimadhu, Glycyrrhiza glabra, lakritz

Biological name- Glycyrrhiza glabra



Family- Fabaceae family (also known as Leguminosae)

Chemical constituent- Its main bioactive component that imparts a sweet flavor is glycyrrhizin, in addition, contains some volatile compounds, flavonoids, and saponins

Extraction process-Cut the liquorice roots into small pieces, soak them in cold water for 24 hours, and dry in the shade. To remove unwanted components, you can pretreat the dry powder with absolute ethanol.

Uses-

- Acts as expectorant, soothing agent, and anti-inflammatory herb.
- Highly effective in sore throat, cough, and upper respiratory tract irritation
- Reduces inflammation by forming a mucilaginous protective layer.
- Supports immunity and has mild antimicrobial activity.
- Traditionally used for digestive discomfort, acidity, and ulcers.

2)Tulsi:

Synonyms- Holy basil, Tulsi, Krishna Tulsi, Munjariki.

Biological name – *Ocimum sanctum* Lin

Family- Lamiaceae.



Chemical constituent-The most important antioxidant compounds of basil are caffeic, vanillic, rosmarinic acids, quercetin, rutin, apigenin, chlorogenic, and p hydroxybenzoic

Extraction process- Leaves were separated from the stem, washed in clear water and dried until they were adequately dry to be ground (dried for 7 days). Dried leaves

Were powdered separately in an electric grinder until a homogenous powder was obtained.

Uses-

1. Tulsi provides strong antimicrobial action to reduce throat infections.
2. It has anti-inflammatory properties that relieve sore throat and irritation.
3. Tulsi boosts immunity, helping the body fight respiratory infections.
4. It acts as a mild expectorant, aiding in clearing mucus and easing cough.

3)Honey:

Synonyms – Madhu, Shahad.

Biological name – *Apis mellifera* (source – honeybee).

Family – Apidae.



Chemical constituents – Honey contains natural sugars such as fructose, glucose, maltose, sucrose; organic acids; minerals like calcium, potassium, magnesium; vitamins (B-complex, vitamin C); amino acids; antioxidants (flavonoids, phenolic acids) and small amounts of enzymes such as invertase, amylase, and catalase.

Extraction process – Raw honey is collected from honeycombs, filtered to remove wax particles, bee

residues, and impurities. It is then warmed slightly (not overheated to preserve enzymes) and stored in airtight, sterilized containers for use in formulations.

Uses:

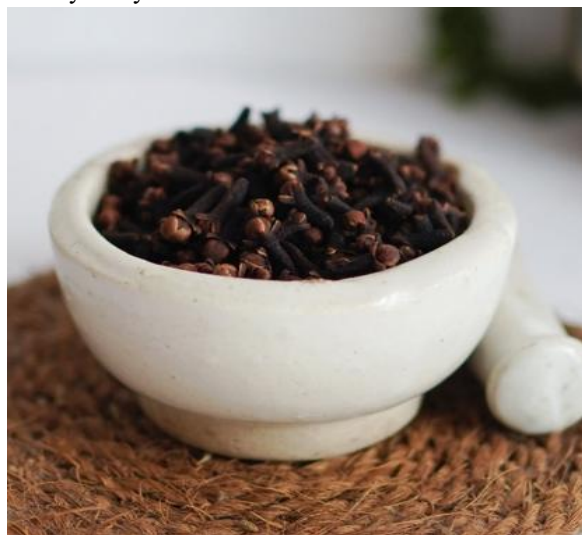
- Acts as antibacterial, anti-inflammatory, and wound-healing agent.
- Soothes irritated throat and reduces cough by forming a protective layer.
- Provides natural sweetness and enhances palatability in herbal lozenges.
- Contains antioxidants that boost immunity and promote healing.
- Helps moisturize and nourish tissues and is beneficial in respiratory disorders.

4)Clove:

Synonyms – Lavang, Laung, Clou, Caryophyllus.

Biological name – *Syzygium aromaticum*

Family – Myrtaceae



Chemical constituents-The main active compound of clove is eugenol, along with eugenol acetate, β -caryophyllene, gallic acid, tannins, flavonoids, and volatile oils responsible for aroma and medicinal properties.

Extraction process-Dried flower buds were cleaned, washed gently, and shade-dried for 5-7 days until they became completely moisture-free. The dried buds were then ground in an electric grinder to obtain a fine, homogenous powder suitable for formulation.

Uses:

- Acts as a strong antibacterial, antifungal, and antiseptic agent.
- Provides analgesic effect; commonly used for relief from toothache and sore throat.
- The antioxidant eugenol helps reduce oxidative stress and supports immune system function.
- Helps in reducing inflammation and irritation in throat like lozenges.
- Useful in digestive problem gas, nausea and indigestion

5)Ginger:

Synonyms – Sunthi, Shunthi, Adrak, Dry ginger.

Biological name – *Zingiber officinale*



Family – Zingiberaceae

Chemical constituents-Contains gingerols, shogaols, zingerone, essential oils (zingiberene, camphene), phenolic compounds, and antioxidants contributing to its pungency and medicinal actions.

Extraction process-Fresh rhizomes were washed thoroughly, peeled, cut into thin slices, and dried under shade for about 7 days. Once fully dried, the slices were finely powdered using an electric grinder to obtain uniform ginger powder for herbal formulations.

Uses:

- Possesses anti-inflammatory, antioxidant, and antimicrobial activities.
- Provides soothing relief in sore throat, cough, and cold.
- Gingerol helps reduce throat irritation and supports respiratory health.
- Enhances digestive function and relieves nausea, bloating, and indigestion.
- Helps boost immunity and provides warming effect.

6)Peppermint:

Synonyms – Pudina, Mentha mint, Brandy mint. *Mentha piperita*

Family – Lamiaceae

Biological source -*Mentha piperita*



Chemical constituents-Contains menthol, methane, menthyl acetate, limonene, cineole, and flavonoids which provide cooling, soothing, and medicinal properties.

Extraction process-Fresh peppermint leaves were washed, shade-dried for 5-6 days, and then crushed in an electric grinder to obtain fine herbal powder. Leaves were dried until crisp to preserve essential oils like menthol.

Uses:

- Provides cooling, analgesic, and mild anesthetic effect due to menthol.
- Helps relieve sore throat, coughing, and irritation in the respiratory tract.
- Shows antibacterial and antiviral activities beneficial in oral formulations.
- Useful for digestive problems such as indigestion and gas.
- Refreshes breath and opens nasal passages for easier breathing.

7)Jaggery

Synonyms-Gur, Bellam, Sarkara (Ayurveda), Panela (Latin America)

Family-Not applicable (processed natural sweetener obtained from *Saccharum officinarum* – family Poaceae)

Biological Source-Unrefined sugar product obtained from the concentrated juice of *Saccharum officinarum* L. (sugarcane).



Chemical Constituents-

Sucrose, Glucose and fructose

Minerals (iron, calcium, magnesium, potassium)

Phenolic antioxidants and Organic acids

Trace vitamins (B-complex)

Uses:

- Natural sweetener and binding agent
- Provides pleasant taste and smooth texture
- Acts as a base for herbal lozenges
- Provides mild demulcent effect for throat soothing

8)Amla (Indian Gooseberry)

Synonyms-Amalaki, Indian Gooseberry, Dhatri, Emblic myrobalan

Biological name-*Emblica officinalis*

Family-Phyllanthaceae

Biological Source-Dried or fresh fruits of *Phyllanthus emblica* Linn. (syn. *Emblica officinalis*).



Chemical Constituents

High Vitamin C (ascorbic acid)

Hydrolysable tannins (emblicanin A & B)

Gallic acid, Flavonoids, Pectin and amino acids

Uses:

- Provides antioxidant and immunomodulatory benefits

- Acts as a soothing agent for sore throat
- Adds mild astringent flavor
- Supports anti-inflammatory activity
- Enhances stability due to natural tannins

Experimental work:

Formulation table:

Sr. No.	Ingredients	Quantity (for 25 lozenges)	Role of ingredients
1	Jaggery	45gm	Natural base, binder, sweetener
2	Liquorice roots powder	5gm	Main herbal demulcent
3	Honey	6gm	Humectant, soothing agent
4	Ginger powder	2gm	Anti-inflammatory, warming
5	Tulsi powder	3gm	Antimicrobial
6	Peppermint leaf powder	1gm	Cooling effect
7	Clove powder	1gm	Analgesic, antiseptic
8	Amla powder	2gm	Antioxidant, hardening aid
9	Water	10-12ml	For herbal extract

Procedure:

1 Weigh all herbal powders accurately. Use 60-80 mesh powders.



2 Take liquorice (5 g), tulsi (3 g), ginger (1 g), clove (0.5 g), peppermint (0.5 g). For decoction.

3 Add these powders to 10-12 mL water. Use purified water.

4 Heat gently for 5-7 minutes; do not boil vigorously. To extract herbal actives.

5 Filter through muslin cloth to obtain decoction. Expected yield: ~6-7 mL.

6 Add jaggery (45 g) into a pan. Base material.

7 Add the herbal decoction to jaggery. Mix well.

8 Heat on low flame until jaggery melts completely. Stir gently.

9 Increase heat and cook until thick (hard-ball stage). Approx 130-135°C.

10 Add honey (6 g) and mix for 1-2 minutes. Do NOT overheat honey.

11 Reduce heat and add remaining herbal powders: ginger (1 g), clove (0.5 g), peppermint (0.5 g), amla (2 g). Add quickly.

12 Mix thoroughly to achieve uniform distribution. Work rapidly.

13 Pour hot mixture onto lightly greased steel plate. Use ghee/coconut oil thin layer.

14 Let it cool to semi-solid state. Avoid full hardening.

15 Cut into 25 equal pieces (≈3 g each). Maintain uniform size.

16 Shape into round/flat lozenges or put into molds. Optional molding.

17 Allow to cool fully for 30-40 minutes. No refrigeration needed.

18 Dust with fine sugar or ginger powder to prevent sticking. Optional.

19 Pack in airtight container. Prevent moisture uptake.

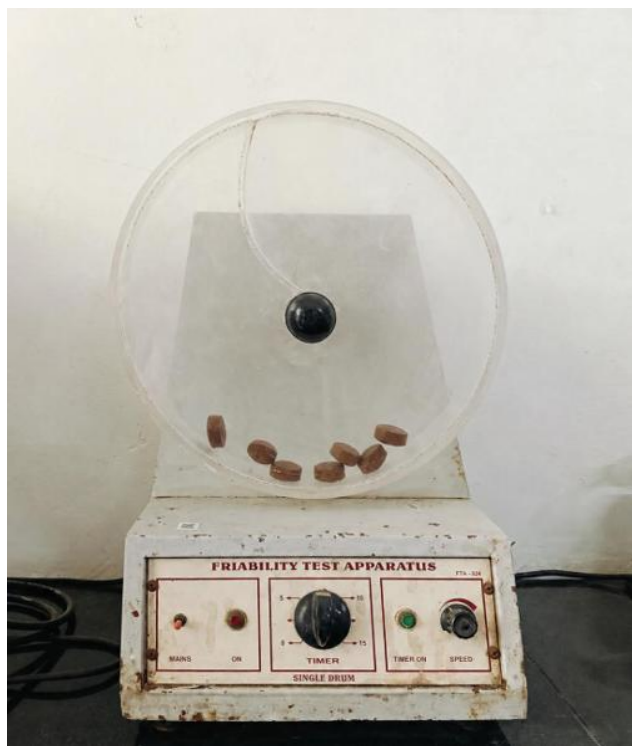


IV. EVALUATION PARAMETERS:

Evaluation Parameters for Herbal Lozenges

1. Organoleptic Evaluation: Assessment of colour, odour, taste, appearance, and surface texture to ensure patient acceptability.

2. Uniformity of Weight: Twenty lozenges are weighed individually and average weight with deviation is calculated to ensure dose uniformity.
3. Thickness and Diameter: Measured using Vernier calipers to maintain uniform size and shape.
4. Hardness Test: Determination of crushing strength ($5\text{-}10\text{ kg/cm}^2$) to ensure mechanical stability.
5. Friability: Evaluated using friabilator; weight loss should not exceed 1%.
6. pH Determination: Measured after dissolving in water; ideal pH range is 5-6.
7. In-vitro Dissolution Time: Determines time required for complete dissolution (10-30 minutes).
8. Stickiness/Brittleness: Evaluated manually to ensure proper texture and non-sticky nature.
9. Microbial Load Testing: Determines microbial contamination and ensures safety.
10. Stability Studies: Performed under ICH conditions to check physical and chemical stability.
11. Taste Masking and Mouthfeel: Sensory evaluation for sweetness, bitterness, cooling effect, and smoothness.



V. RESULTS AND DISCUSSION

The formulated polyherbal lozenges were evaluated for various physicochemical and organoleptic parameters. The lozenges showed acceptable colour, pleasant odour, and good taste with a smooth and glossy surface. The formulation was found to be non-gritty and suitable for oral use.

The weight variation was within acceptable limits, indicating uniform distribution of herbal ingredients. Hardness and friability values confirmed good mechanical strength of the lozenges. The disintegration time was appropriate, ensuring slow dissolution in the oral cavity for prolonged therapeutic action. The pH was found to be near neutral, indicating no irritation to the mucosal lining.

Overall, the formulation showed good stability, effectiveness, and patient acceptability, suggesting that polyherbal lozenges can be safely used for soothing throat irritation and providing antimicrobial action.

Evaluation parameter of herbal lozenges:

Sr. No.	Evaluation parameters	Result
1)	Colour	Brown
2)	Odour	Pleasant herbal
3)	Taste	Sweet and soothing
4)	Surface texture	Smooth
5)	Weight Variation	Within limits
6)	pH	6.5
7)	Disintegration time	15-20 minutes

Discussion

The present study focused on the development of polyherbal lozenges using natural ingredients with therapeutic benefits for sore throat. The use of jaggery as a base provided good binding properties and improved palatability.

The evaluation results confirmed that the formulation process was appropriate and reproducible. The hardness and low friability ensured that the lozenges were durable and resistant to breakage. The dissolution profile indicated slow release of herbal constituents, which is essential for prolonged local action in the throat.

The combination of herbs showed synergistic action. Liquorice and honey provided a soothing demulcent effect, while ginger, tulsi, and clove contributed anti-inflammatory and antimicrobial activities. Peppermint

enhanced the cooling sensation and improved overall acceptability.

VI. CONCLUSION

The study successfully formulated and evaluated polyherbal lozenges containing liquorice root and other medicinal herbs for the treatment of sore throat. The prepared lozenges showed satisfactory physicochemical properties, good stability, and acceptable organoleptic characteristics.

The formulation demonstrated effective soothing, anti-inflammatory, and antimicrobial properties due to the combined action of herbal ingredients. The lozenges are safe, cost-effective, and patient-friendly, making them a promising alternative to synthetic formulations.

Thus, polyherbal lozenges can be considered an effective natural remedy for sore throat, with potential for further development and large-scale production.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to several individuals and organizations for supporting me throughout my Graduate study. First, I wish to express my gratitude to my supervisor Professor, Colleagues for their enthusiasm, patience insightful comments, helpful information, practical advice and unceasing ideas that have helped me tremendously all the times in my research project and report writing Her immense knowledge, profound experience and professional expertise in Data Quality has enabled me to complete this research successfully Without her support and guidance this project would not have been possible.

My profound gratitude goes to my supervisor, Mrs. Arti Khamat for her valuable support, time and guidance in seeing me to the completion of this research work. I would like to express my special thanks to Mrs. Arti Khamat for her guidance and support in completing my project.

I express my sincere thanks to Shri Dhaneshwari Manav Vikas Mandal's Dr. Vedprakash Patil Pharmacy college, Chh. Sambhajinagar for providing facilities. It is my privilege to express thanks to respected Principal of Dr Vedprakash Patil Pharmacy College, Chh Sambhajinagar

I am thankful to librarian and teaching and non-teaching staff for their help and cooperation

DECLARATION

I, Ms. Tanuja Mahadev Kale, student of Bachelor of pharmacy (B. pharmacy) Final year, at Dr. Vedprakash Patil Pharmacy College, Chh. Sambhajinagar, hereby declare that the final project work entitled “Formulation and evaluation of Herbal lozenges by using liquorice roots (*Glycyrrhiza glabra*) for the treatment of sore throat” is an original work submitted by me in partial fulfilments of the requirements for the 8th semester review writing project. This work has been carried out under the valuable guidance of Mrs. Arti Khamat (Assist. Prof.). Faculty of the Dr. Vedprakash Patil Pharmacy College, Chh. Sambhajinagar. I further declare that this Final project work is based on information collected from various Authentic scientific sources, research journals, published literature, and it has not been previously submitted to any other institution or university for the award of any degree.

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