International Journal of Pharmaceutical Drug Design (IJPDD)
Website: https://ijpdd.org/
ISSN: 2584-2897
Vol. 3, Issue 1, January-June, 2026
Page No.: 177-187

Research

Formulation and Evaluation of Medicated Chewing Gum containing Tulsi and Liquorice for Sore Throat

Anurag Chaudhary[1], Rajat Koundal[2], Hurmandeep Kaur[3], Shubham Garg[4], Ridham Agnihotri[5]

[1,5] Student, College of Pharmacy, RIMT University, Mandi Gobindgarh, Punjab, India-147301
[2]Associate Professor, College of Pharmacy, RIMT University, Mandi Gobindgarh, Punjab, India-147301
[3,5]Assistant Professor, College of Pharmacy, RIMT University, Mandi Gobindgarh, Punjab, India-147301

Corresponding Author:
Anurag Chaudhary

Email:
anuragchaudhary8785@gmail.com

DOI: *10.62896/ijpdd.3.1.22*

Conflict of interest: *NIL*

Article History
Received: 12/02/2026
Accepted: 10/04/2026
Published: 01/05/2026

Abstract:
The increased preference for natural therapeutics and patient friendly dosage forms has speeded up the formulating design of novel herbal drug delivery systems. The present study, therefore, focused on the development and evaluation of herbal medicated chewing gum (MCG) incorporated with Tulsi (Ocimum sanctum), Liquorice (Glycyrrhiza glabra) and mastic for effective amelioration of sore throat and oral discomfort. Many researchers have developed new formulations and technologies through oral drug delivery systems. Such researches exhibit importance of oral route amongst patients. The selected herbal ingredients have a strong antimicrobial, anti-inflammatory, and soothing effect creating a synergized therapeutic action. To evaluate the effect of mastic gum, beeswax and glycerol on important quality attributes, a set of different concentration formulations (F1–F5) were prepared in this study. The formulations were analyzed for various physicochemical and organoleptic parameters such as appearance, weight variation, hardness, moisture content, chewability, friability and taste acceptability. Results demonstrated formulation parameters have a considerable effect on the product's efficiency. F3 was identified as the aptly optimized formulation, exhibiting optimal hardness, outstanding chewability (with less than 1% friability), appropriate moisture content, and good palatability. Also, the formulation showed enhanced therapeutic effect due to synergestic action of tulsi, liquorice and mastic gum. This medicated chewing gum is identified as a patient-compliant oral drug delivery system with sustained and prolong therapeutic effect which can improve the acceptability for its use in the throat-related disorders management.

Keywords: Medicated chewing gum, Tulsi, Liquorice, Mastic gum, Synergestic effect, chewability, Sore Throat.

This is an Open Access article that uses a funding model which does not charge readers or their institutions for access and distributed under the terms of the Creative Commons Attribution License (http://creativecommons.org/licenses/by/4.0) and the Budapest Open Access Initiative (http://www.budapestopenaccessinitiative.org/read), which permit unrestricted use, distribution, and reproduction in any medium, provided original work is properly credited.

Introduction:

Historically, herbal products have been in use by humans for centuries and have been handed down through the generations with a proven record of being effective while having veritably many, if any, side effects when compared to conventional medicinal-type specifics. More lately, pharmaceutical companies have concentrated their exploration efforts on the development of a new class of products known as herbal drug delivery systems. Conventional chewing gum is produced on a large scale and it, thus, contains a high percentage of rubbery substances. Conventional chewing gum primarily uses a gum base derived from petroleum-based products; therefore they are synthetic and non-biodegradable product that has been shown to have no positive environmental impact on the world and contributes heavily to environmental pollution In light of these data, numerous researchers have concentrated their resources on developing chewing gum products made with natural, biodegradable ingredients, thereby reducing negative environmental impact on

International Journal of Pharmaceutical Drug Design (IJPDD)
Website: https://ijpdd.org/
ISSN: 2584-2897
Vol. 3, Issue 1, January-June, 2026
Page No.: 177-187

the earth [1]. Thus, many researchers have now produced medicated chewing gums made with either natural plant or animal based active ingredients for the treatment of various medical conditions, including sore throat, cough, and oral discomfort.

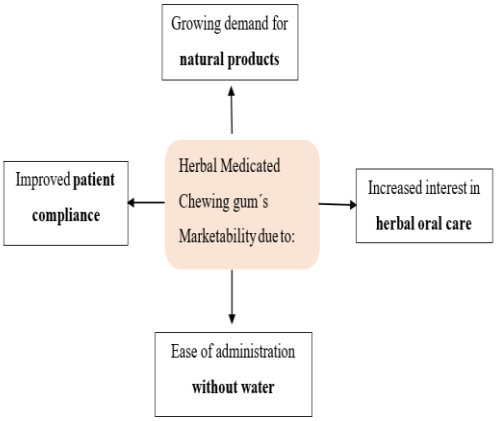


Fig 1: Reasons for the increased demand of Herbal Medicated Chewing gum

Medicated chewing gum is a novel drug delivery system which is a solid or semisolid oral dosage form containing masticatory gum base with one or more pharmacologically active ingredients providing either local or systemic delivery of drug and maintains constant level of drug in the oral cavity. [2] Medicated chewing gums are placed in the oral cavity and chewed for a predetermined time period for the slow release of medication to improve health. [3] The introduction and later success of nicotine chewing gum in the 1980s led to the broader acceptance of chewing gum as a method for drug delivery. [4-8]

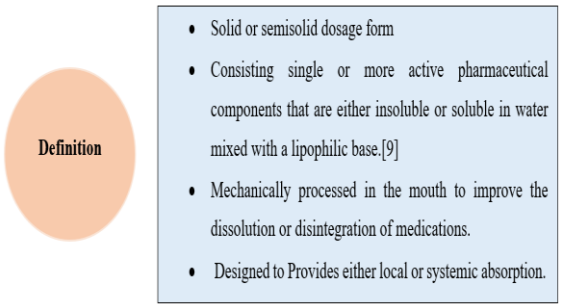


Fig 2: Definition of Medicated Chewing gum

The duration it takes for chewing gum to break down varies depending on the person using it, as they influence the disintegration process by controlling how long they chew it in their mouth. Many medicated chewing gums are available over the counter, whereas certain medications are prescribed by doctors and need a prescription. MCG stands for the latest system with possible applications in pharmaceuticals, over-the-counter medications, and nutraceuticals. [10]

The use of medicated chewing in various therapies such as:

- Smoking cessation
- Dental care
- Motion sickness
- Pain relief

Advantages of Medicated Chewing Gums

1. Rapid onset of action.
2. Risk of overdose is minimized in the event of the gum being ingested in whole pieces.
3. Have high acceptability levels in the pediatric and teenage population.[11],[12]
4. Have a low first-pass effect.[11]
5. Reduce the risk of gastric mucosa intolerance.[12]
6. Relieve xerostomia, or dry mouth, in patients.[13]
7. Relieve difficulties in swallowing in patients after tonsillectomy.[14]
8. May improve work performance and mental performance.[15]
9. Reduce the risk of hypoglycemic attacks in patients using diabetes medications.[16]
10. Increase alertness in patients by enhancing the amount of blood circulating in the brain.[17]

Disadvantages of Medicated Chewing Gums

1. Loss in the mouth cavity after the salivary dilution of the drug.
2. Various release profiles due to differences in style of chewing.
3. Transient administration temporary on account of eating, speaking, and drinking. [18]
4. Constant stress on jaws that can lead to temporomandibular joint disorder.
5. Rotting of teeth proceeds by coating it with sugar.[7], [19].

Medicated chewing gums are preferred over other dosage forms due to

Table 1: Advantages of medicated chewing over other dosage forms

Dosage Form	Advantages of Medicated Chewing Gum over other dosage forms

Solid dosage forms (Tablets, Capsules)	• Provides faster onset of action • Does not require water for administration • Improves patient compliance • Partially bypasses hepatic first-pass metabolism • Allows prolonged drug action in the oral cavity and throat.
Semisolid dosage forms (Gels, Pastes)	• More convenient and hygienic since it does not require direct application • Ensures prolonged residence time in the oral cavity through chewing • Stimulates saliva secretion which enhances drug distribution.
Liquid dosage forms (Syrups, Suspensions)	• Eliminates the need for measuring devices and reduces dosing errors • Provides controlled drug release during chewing • Enhances local therapeutic action in throat infections due to longer mucosal contact.
Lozenges	• Provides controlled drug release through chewing rather than simple dissolution • Stimulates higher saliva production which improves drug distribution • Reduces risk of choking compared to lozenges

Tulsi: The Active Ingredient

Botanical Description: [20], [21]

- **Synonyms:** Holy basil & sacred basil in English, Divya & Vishnupriya in Sanskrit, Raihan in Urdu and Tulsi in Hindi
- **Biological source:** consist of the fresh and dried leaves of the plant of Ocimum species like *Ocimum sanctum L.* & *Ocimum basilicum*
- **Family:** Lamiaceae
- **Parts used:** Fresh and dried leaves of plant
- **Major constituents:** Eugenol, methyleugenol, ursolic acid, rosmarinic acid, flavonoids etc.

- **Pharmacological Activities of Tulsi:**
  1. Anti-cancer activity
  2. Anti-diabetic activity
  3. Antilipidemic activity
  4. Anti-bacterial activity
  5. Anti-fertility activity

Liquorice:

Botanical Description:[22] [23]

- **Synonyms:** Jashtimadhu (Bangla), Muleti (Punjabi), MithiKathi (Sindhi), Khosha Walgi (Pushto), Rub-us-soos (Arabic), Bikhemahaka (Persian), Moyo (Chitrali). Vernacular names: Liquorice (English), Bois doux (French), Regalizia (Spanish). [23]
- **Biological source:** consisted of the dried roots of *Glycyrrhiza glabra*
- **Family:** Leguminosae
- **Parts used:** Rhizomes, rootlets and stolons.
- **Major constituents:** glycyrrhizin, glycyrrhetinic acid and other saponins

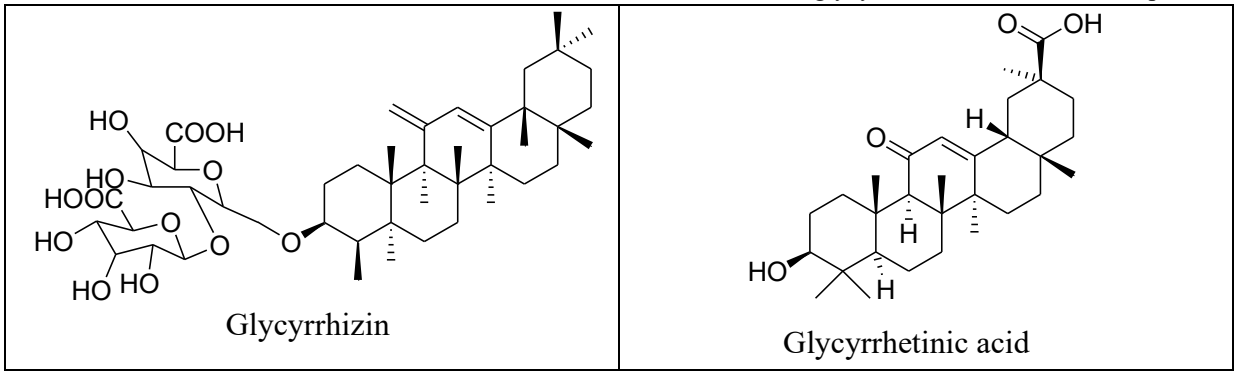


Fig 4: Major chemical constituents of Liquorice

- **Pharmacological Activities of Liquorice:**
  1. Anti-inflammatory activity
  2. Respiratory Support
  3. Anti-cancer activity
  4. Gastroprotective activity
  5. Anti-viral activity
  6. Hepatoprotective activity

- **Synonyms:** Rumi Mastagi, Mastagi, Tears of Chios
- **Biological source:** resin exudate from incisions on *Pistacia lentiscus L.*
- **Family:** Anacardiaceae
- **Parts used:** Resin
- **Major constituents:** Triterpenic acids (masticadienonic acid / oelic acids), polymer, myrcene, limonene

Mastic Gum: The Gum Base
Botanical Description: [24]

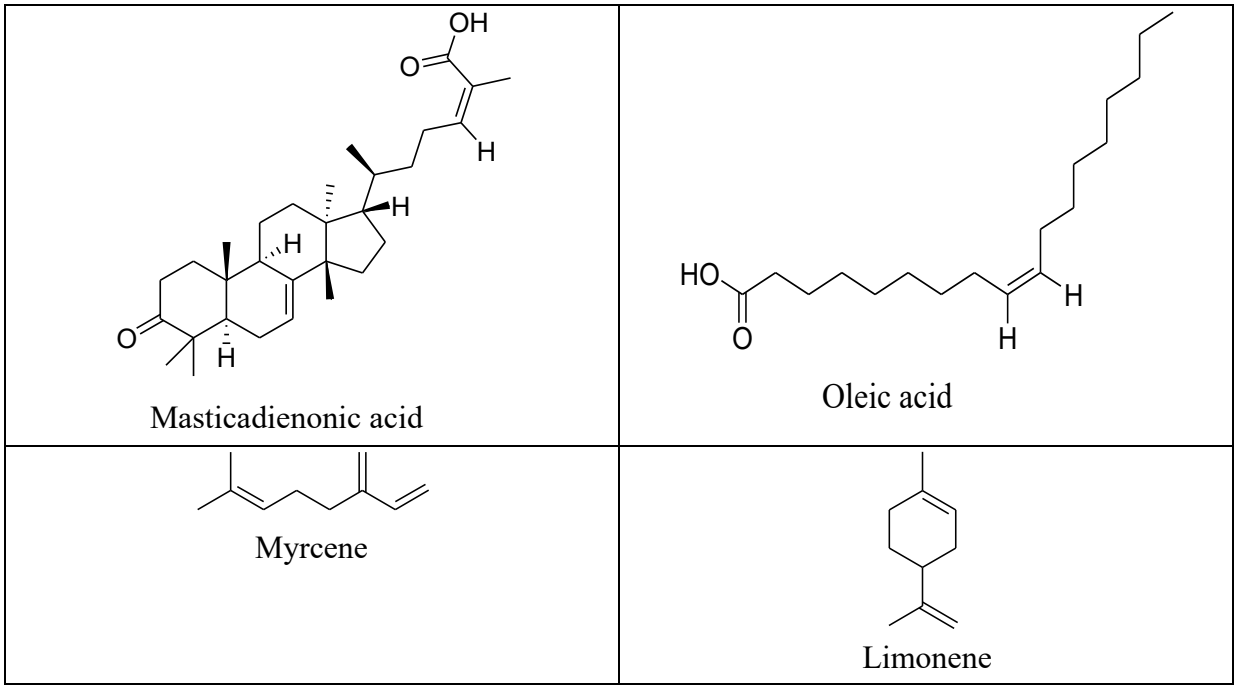


Fig 3: Major chemical constituents of Mastic Gum

- **Pharmacological Activities of Mastic Gum: [25]**
  1. Anti-inflammatory activity
  2. Anti-cancer activity
  3. Anti-oxidant activity
  4. Gastroprotective activity
  5. Anti-bacterial activity
  6. Soothes Respiratory irritation

Selection of Tulsi, Liquorice and Mastic gum primarily due to:
Table no.2: Reasons for the selection of Tulsi, Liquorice & mastic gum in the formulation

Sr.no.	Herb	Therapeutic Role in Sore Throat	Key Active Compounds	Reason for Selection
1.	**Tulsi (*Ocimum sanctum*)**	• Antimicrobial activity • Antiviral • anti- inflammatory properties	• Eugenol • Ursolic acid • Rosmarinic acid, • Flavonoids	• Helps inhibit growth of bacteria responsible for throat infections • Reduces inflammation of throat tissues
1.	**Liquorice (*Glycyrrhiza glabra*)**	• Acts as a demulcent • Soothing agent	• Glycyrrhizin • Glycyrrhetinic acid	• Provides soothing effect

		• Relieves throat irritation	• saponins	• Reduces • irritation • Protects mucosal lining
2.	**Mastic gum (*Pistacia lentiscus L.)***	• Natural chewability • Mucoadhesive • Sustained release • Anti-microbial synergy	• Triterpenic acids (masticadienonic acid / oelic acids) • Polymer • Myrcene • Limonene	• Provides prolonged mastication • Enhances local anti-inflammatory action • Complements tulsi/ liquoricce

Synergistic effects of Tulsi and Liquorice:

1. Tulsi inhibits microbial growth while Liquorice enhances mucosal protection.
2. Both herbs reduce inflammation and swelling in throat tissues.
3. Liquorice coats the throat mucosa while Tulsi reduces irritation.
4. Tulsi enhances immune response and Liquorice has immunomodulatory effects.
5. Combination provides relief from pain, irritation, dryness, and cough.

Combined Therapeutic effect of Tulsi, Liquorice and Mastic gum in Sore Throat

Table 3: Synergestic effect of active ingredients and gum base in sore throat

Individual Action	Synergestic effect
Antimicrobial activity of Tulsi and Mastic gum	Rapid reduction of microbial load
Anti-inflammatory activity of Tulsi and Liquorice	↓ in throat redness, swelling and pain
Demulcent and mucosal protective effect of Liquorice	Immediate soothing of irritated throat
Anti-oxidant action of flavonoids	Protection of throat from oxidative stress & faster recovery
Sustained release through chewing gum	Prolonged action ensuring better therapeutic efficacy
Saliva stimulation during chewing	Enhanced drug distribution

Materials and Methods:

Materials

Table no.4: Ingredients used in the formulation and their roles

Ingredients	Role	Additional function
Mastic gum	Gum base	Provides chewability
Beeswax	Binder	Softening agent
Glycerol	Plasticizer	Improves flexibility
Tulsi extract	Active ingredient	Therapeutic agent
Liquorice extract	Active ingredient	Therapeutic agent
Sorbitol	Sweetener	Enhances taste
Calcium carbonate	Filler	Texture modifier
Peppermint oil	Flavor	Masking agent
Talc	Glidant	Prevents stickiness

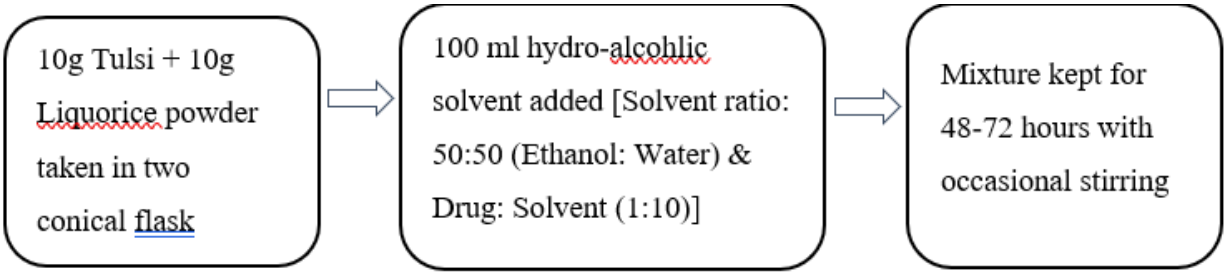
Methods

1. Extraction method

International Journal of Pharmaceutical Drug Design (IJPDD)
Website: https://ijpdd.org/
ISSN: 2584-2897
Vol. 3, Issue 1, January-June, 2026
Page No.: 177-187

- **Drying and Powdering**

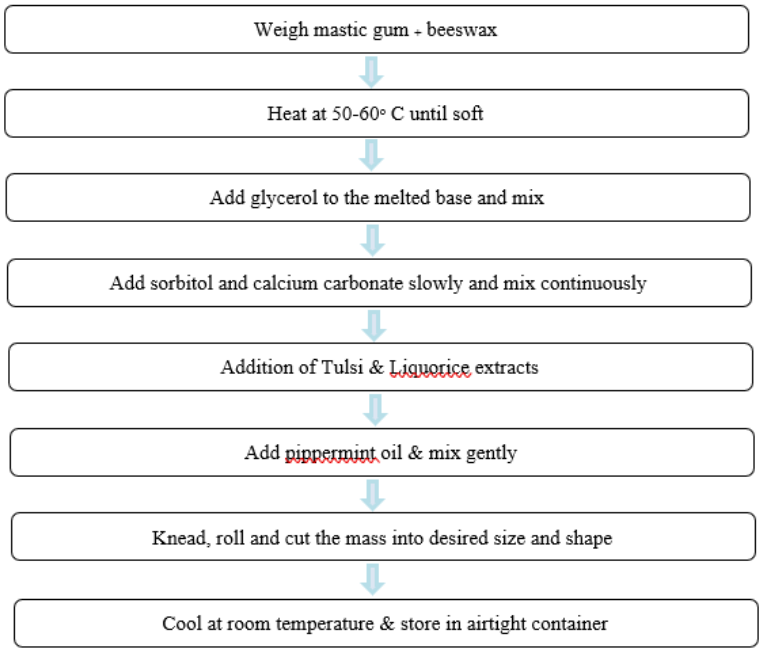
- **Maceration**



- **Filtration:** Filter the extract using muslin cloth or filter paper
- **Concentration:** The filtrate is evaporated on water bath at 40-50° C & thick semi-solid extract is obtained & completely dried in hot air oven at 40°C to get the solid mass
- **Storage:** Store in air tight container for formulation use

Hydroalcohlic extraction was selected because it efficiently extracts both polar and semi polar phytoconstituents from Tulsi and Liquorice.It preserves heat-sensitive compounds, provides better yield and produces a stable dry extract suitable for uniform incorporation into medicated chewing gum.

2. **Manufacturing method: [26], [27]**



This method is used because it is suitable for thermoplastic gum bases like mastic gum and beeswax, ensuring uniform mixing of drug and excipients, being cost-effective it also helps in achieving desired texture and chewability.

Formulation trials:

Different- different formulations were prepared by varying the concentration of mastic gum (gum base), beeswax & glycerol (plasticizer). The concentration was varied to study the effect on texture, hardness, chewability etc., helps in optimization of formulation. While tulsi & liquorice extracts, sorbitol, calcium carbonate, peppermint oil, talc were

International Journal of Pharmaceutical Drug Design (IJPDD)
Website: https://ijpdd.org/
ISSN: 2584-2897
Vol. 3, Issue 1, January-June, 2026
Page No.: 177-187

kept constant to ensure consistent taste & texture.

Table no.5 Formulation table for different batches

Ingredients (g)	F1	F2	F3	F4	F5
Mastic gum	1.0	1.2	1.5	1.7	2.0
Beeswax	0.5	0.6	0.7	0.8	0.9
Tulsi extract	0.5	0.5	0.5	0.5	0.5
Liquorice extract	0.5	0.5	0.5	0.5	0.5
Sorbitol	4.9	4.9	4.9	4.9	4.9
Glycerol	1.5	1.2	0.8	0.5	0.1
Calcium carbonate	0.85	0.85	0.85	0.85	0.85
Peppermint oil	0.1	0.1	0.1	0.1	0.1
Talc	0.1	0.1	0.1	0.1	0.1

Fig 4: Formulation 1

Fig 5: Formulation 2

Fig 6: Formulation 3

Fig 7: Formulation 4

Fig 8: Formulation 5

Evaluation studies:

- **Appearance:** Visually inspect the lozenges under good lighting. Observe and record the shape, color, surface texture etc.
- **Weight Variation:** The weight variation test of MCGs was done using twenty randomly chosen chewing gums. Weight of each chewing gum was taken separately to get the average weight from total weight, and the

deviation percentage was obtained from the average above. not more than 2 samples should differ the average weight. Maximum deviation from the average weight should be 5%. [28]

- **Hardness:** MCGs hardness testing was done by diametrical compression technique using Monsanto hardness tester, and hardness was expressed in kg/cm2. [28]
- **Stickiness:** Determined subjectively during kneading and after 24 hours.
- **Moisture Content:** Moisture content was determined using a desiccator containing a suitable desiccant, such as silica gel or anhydrous calcium chloride, to absorb residual moisture from the chewing gum samples. The moisture content was calculated using the following formula [29]
- **Chewability:** A panel of volunteers chewed the gum and rated its ease of mastication on a scale of 1-5 (1= very poor, 5=very good)
- **Friability:** Ten MCGs were randomly chosen and dusted off; then their weight was determined. The tablets were placed into the Roche friabilator (EF-2, Electrolab®) which was set to rotate the tablets at 25 rpm for 100 rotations. They were again dusted off and their weights were determined. Percentage weight loss from one or mean of three experiments was determined. According to established criteria, the formulation passes the friability test if the percentage weight loss is less than 1%. [30] [31]
- **Taste evaluation:** A panel of 10 volunteers rated taste on a scale of 1-5 (1=poor, 5=excellent). [27]

Table no.6: Evaluation parameters of different formulations

Parameter	F1	F2	F3	F4	F5
Appearance	Hard	Smooth	Glossy	Slightly dull	Micro-cracks
Weight Variation (%)	9.8	7.2	4.1	3.7	3.2
Hardness (kg/cm²)	0.7	1.7	2.6	3.4	4.2
Stickiness	High	Moderate	None	Slight	Slight
Moisture content (%)	5.2	4.3	3.1	2.8	2.4
Chewability (1-5 scale)	1(very poor)	3(passable)	5(very good)	4(good)	2(poor)
Friability (%)	2.1	0.9	0.12	0.08	0.03
Taste acceptability (1-5 scale)	2(slightly bitter)	4(less pleasant)	5(pleasant, acceptable)	3(pleasant)	1(bitter)

Results and Discussion:

The prepared medicated chewing gum formulations (F1–F5) showed significant differences in physicochemical and organoleptic properties as a function of the concentration levels of mastic gum, beeswax and glycerol. The characteristic of the formulation slightly improved, F1 to F3, and once again started performance degradation in compounds (F4) and (F5), due to excessive rigidity.

- **Appearance:** F3 showed the ideal smooth and glossy like surface, while F1 was too hard, and F5 showed structural defects such as micro cracks.
- **Weight Uniformity:** The percentage change in weight was greatly reduced from 9.8% (F1) to 3.2% (F5), pointing towards better content uniformity at optimized formulation composition.
- **Mechanical Strength (Hardness):** Hardness proportionally increased as gum base concentration increased, from 0.7 to 4.2 kg/cm², indicating higher gum base formulations exhibited better structural integrity.
- **Moisture Content:** It had observed a steady decrease (from 5.2% to 2.4%), enhanced stability but affecting chewability at lower concentrations.
- **Chewability:** F3 had better mastication properties (score 5), which implied the mouth feel needed for patient compliance.

- **Friability:** A substantial decrease in friability (2.1% to 0.03%) confirmed enhanced mechanical resistance; batches F3–F5 met the pharmacopeial limit (<1%).
- **Taste Acceptability:** Among these formulations, the highest acceptability was reported for F3 (score 5), suggesting its efficient taste masking and palatability.

Impact of Formulation Variables on Evaluation Parameters

- **Effect of Mastic Gum (1.0 → 2.0 g):**

The hardness (0.7 → 4.2 kg/cm²) and friability (2.1% → 0.03%) increased and decreased, respectively, with an increase in concentration of mastic gum which indicates improved mechanical strength. On the other side, the F4−F5 levels exhibited less chewability and micro-cracks that suggested excessive rigidity.

- **Effect of Beeswax (0.5 → 0.9 g)**

Higher additive levels of beeswax improved binding and structural integrity which led to lower friability and stickiness. However, at higher concentrations it caused hardening of the gum matrix, leading to undesirable textural and chewability characteristics.

- **Effect of glycerol (1.5 → 0.1 g):**

Reduction of glycerol markedly decreased gum flexibility and chewability. Greater concentrations of glycerol (F1eF3) enhanced chewability and softness of the samples, whereas lower levels (F4eF5) showed hardness, poor mastication and brittleness.

Table no.7: Final optimized batch

Ingredient	Quantity (g)
Mastic gum	1.5
Beeswax	0.7
Tulsi extract	0.5
Liquorice extract	0.5
Sorbitol	4.9
Glycerol	0.8
Calcium carbonate	0.85
Peppermint oil	0.1
Talc	0.1

Conclusion:

The present work successfully formulated and optimized a herbal medicated chewing gum containing Tulsi, Liquorice, and mastic gum. The study clearly established that variation in mastic gum, beeswax, and glycerol significantly influences key quality attributes such as hardness, chewability, friability, moisture content, and taste acceptability.

Among all formulations, Formulation F3 was identified as the optimal formulation as it demonstrated:

- Optimal balance between hardness and flexibility

The combination of these excipients thereby demonstrates that chewability is a function of balanced mechanical & elastic properties instead of single component-based effects. This optimal balance was demonstrated with F3 which displayed sufficient hardness without brittleness, low stickiness and high mastication ability.

Moisture content was also supportive, serving moderate levels to maintain flexibility and lower levels to improve mouthfeel while compromising chewability. Alongside the physical and chemical attributes of the formulation, its sensory qualities, mainly those related to taste, have been improved. Improving the sensory aspect of a medication is very important for ensuring compliance from many patients.

This was particularly evident with the optimized batch, in terms of its ability to mask the bitterness of herbal extracts, which was most likely accomplished through the uniform distribution of components and controlled release characteristics during mastication. From a therapeutic point of view, the formulation also takes advantage of the interaction between Tulsi, Liquorice, and Mastic Gum. While Tulsi provides its antimicrobial and anti-inflammatory characteristics, Liquorice offers its demulcent and soothing effects, and Mastic Gum serves as an agent to enhance the duration of residence in the oral cavity as well as the duration of time it takes for the formulation to be released from the delivery system. Together, these components contribute to increased local effectiveness in the management of sore throat and discomfort in the oral cavity.

- Excellent chewability and patient compliance
- Acceptable friability and moisture content
- Superior taste masking and palatability

The formulation also exhibited promising therapeutic potential due to the **synergistic action of herbal ingredients**, providing antimicrobial, anti-inflammatory, and soothing effects for effective management of sore throat. medicated chewing gum emerges as a **promising, patient-friendly, and efficient herbal drug delivery system**, offering advantages such as improved compliance, sustained drug release, and enhanced local therapeutic action.

REFERENCES

1. Thivya, P.; Durgadevi, M.; Sinija, V.R.N. Biodegradable medicated chewing gum: A modernized system for delivering bioactive compounds. Future foods 2021,4, 100054. [Google Scholar] [CrossRef]
2. Gadhavi AG, Patel BN, Patel DM, Patel CN. Medicated chewing gum - A 21st century drug delivery system. Int J Pharm Sci Res 2011; 2: 1961-74.
3. Thube, S. (2024). A review on: Formulation and evaluation of herbal medicated chewing gum. DOI: 10.23880/oajpr16000312.
4. Jain H, Shah M, Shah B, Pasha TY.Medicated Chewing Gum: A Novel Oral Drug Delivery, International Journal of Drug Formulation & Research 2010; 1:80-96.
5. Mateti UV, Adla N, Rajakannan T, Valakkathala R. Insulin Chewing Gum: Need of the day for Diabetic patients, International Journal of Pharmaceutical Investigation. 2011; 1:31-134.
6. Naik H, Gupta S.Medicated Chewing Gum-Updated Review, International Journal of Pharma Research & Development 2010, 2: 66-76.
7. Pandey S, Goyani M, Devmurari V. Development, In-Vitro Evaluation and Physical Characterization of Medicated Chewing Gum: Chlorohexidine Gluconate, Scholars Research Library 2009; 2:286-292.
8. Gajendran J, KraemerJ, Knudsen SR. Product Performance Test for Medicated Chewing Gums, Pharmacopeial Forum 2008; 34:843-847.
9. Indhumathi, S., & Siva Kumar, K. (2020). A review on medicated chewing gum and its role in mouth ulcers. Research Journal of Pharmacy and Technology, 13(1), 481– 484
10. Lee W.W. Chewing Gum as a delivery vehicle for pharmaceutical and nutraceutical substances, Pharm Tech, 2001; 2:1-11.
11. Imfeld T. Chewing gum - facts and fiction: A review of gum-chewing and oral health Crit Rev Oral Biol Med. 1999;10:405–19
12. Asija R, Patel S, Asija S. Oral dosages forms: Medicine containing chewing gum: A review J Drug Delivery Ther. 2012;2:90–5
13. Heema N, Stuti G. Medicated chewing gums-updated review Int J Pharm Res Dev. 2010;2:66–76
14. Rassing MR. Chewing gum as a drug delivery system Adv Drug Deliv Rev. 1994; 13:89–121
15. Smith AP, Woods M. Effects of chewing gum on the stress and work of university students Appetite. 2012; 58:1037–40
16. Madan N, Rathnam A. Chewing gums for optimal health Chron Young Sci. 2011;2:7
17. Last accessed on 2013 July 15 Available from: Last accessed on 2013 July 15 Available from: http://www.gumassociation.org
18. Athanikar NK, Gubler SA. Process for Manufacturing a Pharmaceutical Chewing Gum US Patent. 2001 No. 6,322,828
19. Last accessed on 2013 July 15 Available from: http://www.chewinggumfacts.com/chewing-gumbenefits/chewing-gum-negative-effects/
20. Shival A, Bornare A, Shinde A, Musmade D. General introduction, classification, morphology, phytoconstituents, traditional & medicinal uses, pharmacological activities of tulsi (Ocimum Sanctum). World Journal of Pharmaceutical Research. 2020 Jun 29;9(9):701-13.
21. Chemical constituents and pharmacological action of Ocimum sanctum (Indian holy basil-Tulsi) by, Sunita Verma Maharaja Ganga Singh University, Bikaner, Rajasthan 334001, India. The Journal of Phytopharmacology, 2016; (5): 205-207
22. Dastagir G, Rizvi MA. Glycyrrhiza glabra

L.(Liquorice). Pakistan journal of pharmaceutical sciences. 2016 Sep 1;29(5).

23. Wahab S, Annadurai S, Abullais SS, Das G, Ahmad W, Ahmad MF, Kandasamy G, Vasudevan R, Ali MS, Amir M. Glycyrrhiza glabra (Licorice): A comprehensive review on its phytochemistry, biological activities, clinical evidence and toxicology. Plants. 2021 Dec;10(12):2751.
24. Ottria R, Xynomilakis O, Casati S, Abbiati E, Maconi G, Ciuffreda P. Chios mastic gum: chemical profile and pharmacological properties in inflammatory bowel disease: from the past to the future. International Journal of Molecular Sciences. 2023 Jul 27;24(15):12038.
25. Pachi VK, Mikropoulou EV, Gkiouvetidis P, Siafakas K, Argyropoulou A, Angelis A, Mitakou S, Halabalaki M. Traditional uses, phytochemistry and pharmacology of Chios mastic gum (Pistacia lentiscus var. Chia, Anacardiaceae): A review. Journal of Ethnopharmacology. 2020 May 23; 254:112485.
26. Rassing MR. Chewing gum as a drug delivery system Adv Drug Deliv Rev. 1994; 13:89–121
27. Aslani A, Rafiei S. Design, formulation and evaluation of nicotine chewing gum Adv Biomed Res. 2012;1:57
28. Directorate for the Quality of Medicine and Health Care of the Council of Europe. European Pharmacopoeia 7th ed Strasbourg; Directorate for the Quality of Medicine and Health Care of the Council of Europe: 2009. p. 289-709.
29. Yadav S, Atram S, Bobade N. Development and evaluation of medicated chewing gum containing ondansetron hydrochloride. EU J Biomed Pharm Sci., 2021; 8: 293-297.
30. Paradkar M, Gajra B, Patel B. Formulation development and evaluation of medicated chewing gum of anti-emetic drug. Saudi Pharmaceutical Journal, 2016; 24(2): 153-164. https://doi.org/10.1016/j.jsps.2015.02.017.
31. Chaudhary SA, Shahiwala AF. Medicated chewing gum–a potential drug delivery system. Expert opinion on drug delivery. 2010 Jul 1;7(7):871-85.
32. Rajwinder, K., Singh, R., Lalit, Jaswinder, K., & Rajat. (2020). Evaluation of the Antidepressant Like Activity of Ethanolic Extract of Calendula officinalis using Rodent Models (Wistar Rat) of Depression. *Current Psychopharmacology*, *9*(1), 58-67.
33. Singh, G., Singh, S., Kaur, H., Garg, S., & Khera, N. (2026). Pearl Millet Starch: A Natural Excipient with Potential for Industrial Pharmaceutical Use.
34. Agrahari, S., Garg, S., War, A. H., Kumar, A., Tantray, M. H., Koundal, R., & Kaur, H. (2024). A Comprehensive Approach to the Management of Severe Coronary Artery Calcification Using Coronary Atherectomy. *Journal of Pharma Insights and Research*, *2*(2), 245-254.
35. Aravanan, P., Karthickeyan Krishnan, D. A., Ranjan, N., Kar, D. V. K. P., Sharang Bali, D. D. S., & Rajat, D. A. (2023). Understanding Menopausal Health: A Comprehensive Review of Menopausal Diseases and Their Impact on Women's Health.
36. Mali, S. K., Gupta, S. K., Yadav, R. P., Sharma, S., & Koundal, R. Unveiling An Antibiofilm Marvel to Combat Antibiotics Resistance.
37. Varma, A. K., Sarvan, S. K., Kumari, R., Kumar, R., Ranjan, R., Rajat, N. R. K., & Kotnala, M. Formulation and Characterization of Toremifene Self-Microemulsifying Drug Delivery System for Enhancement of Oral Bioavailability

*****