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Research Paper

Preparion And Standerdization of Herbal Lozenges Containing Tulsi and Mulethi Extracts

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ABSTRACT

Herbal Lozenges (Tulsi -Mulethi) 1 A Novel Delivery system for effective throat Soothing Introduction Herbal lozenges are a highly preferred mode of delivery for alleviating symptoms of sore throat, cough, and minor upper respiratory tract infections (URTIs). Both Ocimum sanctum (Tulsi) and Glycyrrhiza glabra (Mulethi) are widely recognized traditional medicines known for their antimicrobial, antioxidant, anti-inflammatory and expectorant activities. The aim of this study was to develop and characterise a herbal formulation (lozenge) based on standard extracts of Tulsi and Mulethi for throat soothing and relief. Methods The lozenges were prepared using the molding technique, combining standard extracts of Tulsi and Mulethi along with appropriate concentration of sucrose, glucose syrup, citric acid and flavor. Several formulations were tried out by varying concentrations of herbal extracts and other ingredients. These lozenges were then characterized for organoleptic, physicochemical properties, disintegration time, hardness, friability, moisture content, drug uniformity and in vitro dissolution study. The in vitro antimicrobial activity of formulated lozenges against chosen bacterial strains also studied. Results The formulated lozenges possess satisfactory organoleptic qualities, acceptable hardness (8–10 kg/cm), acceptable friability (less than1%), desirable disintegration time (12-18 min) and uniformity in weight. Good drug content uniformity was observed as per accepted standards. In vitro dissolution showed release of the active principle over 30-45 minutes in a sustained fashion. Selected formulations of Tulsi-Mulethi lozenges showed noticeable antibacterial activity against the Streptococcus mutans and Staphylococcus aureus, thus giving good taste and mouth feel to consumer. Conclusion Based on various preliminary tests, the herbal lozenges prepared from Tulsi-Mulethiextracts have been found to possess promising antimicrobial and throat-soothing properties and can be proposed as

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the preferred method for symptomatic relief in patients. Further clinical trials would be needed to confirm these findings

INTRODUCTION

Medicinal herbs have been utilized for thousands of years to treat many different types of diseases naturally. The growing popularity of herbal medicine can be attributed to the effectiveness of herbal remedies, along with their safety, cost-effectiveness, and reduced risk of side effects when compared to synthetic pharmaceuticals. More and more people are using herbal approaches to manage their respiratory conditions (e.g., upper respiratory infections; sore throats, coughs, etc.), oral infections, and inflammatory conditions (World Health Organization, 2019). Lozenges are a convenient and patient-friendly form of dosage that allows for prolonged retention of the medicinal ingredient(s) in the mouth, providing an enhanced local therapeutic action as well as improved patient compliance (Allen, 2020).

Lozenges are a solid form of dosage meant to gradually dissolve in the mouth, releasing medications over an extended time. Lozenge use can be helpful in reducing throat irritation and cough, and treating hoarseness (due to laryngitis), and oral infections. Unlike traditional tablets where there is limited contact between the active medication and the target tissue(s), lozenges provide prolonged, intimate contact between the active medication and the target tissue(s), leading to enhanced local bioavailability and therapeutic benefit (Aulton & Taylor, 2018). Furthermore, the use of herbal extracts in lozenges provides additional benefits due to the fact that most herbal extracts contain naturally occurring bioactive constituents that are known to have antimicrobial, anti-inflammatory, antioxidant, and immunomodulatory properties.

Tulsi (*Ocimum sanctum L.*) has an important role as a staple plant in Ayurvedic medicine. Its phytoconstituents, including eugenol, ursolic acid, rosmarinic acid, flavonoids and others, exhibit antimicrobial, anti-inflammatory, antioxidant and immunomodulatory properties as reported by Prakash and Gupta (2005). According to numerous research studies, Tulsi extracts show effectiveness against respiratory tract infections and oral pathogens. Pattanayak et al (2010) described the broad spectrum of antimicrobial activity present in Tulsi and noted that it provides significant benefit in treating coughs, sore throats and other upper respiratory issues.

Glycyrrhiza glabra L. (*Mulethi or Licorice*), another highly esteemed plant in Ayurvedic medicine, is also used in Traditional Chinese Medicine and other forms of medicine. Glycyrrhiza glabra has several active constituents including glycyrrhizin, *liquiritin, glabridin* and flavonoids that possess anti-inflammatory, expectorant, antiviral, antioxidant and antimicrobial properties (Pastorino et al., 2018). Mulethi has a long history of use as a demulcent and expectorant to alleviate irritation of the throat and respiratory tract. Asl and Hosseinzadeh (2008) report that Glycyrrhiza glabra has significant potential for treating respiratory disorders and inflammation.

Research has indicated that using a combination of different herbal extracts can produce better therapeutic effects than using each extract alone. This could be the case with a combination of Tulsi and Mulethi because both herbs have anti-inflammatory, antimicrobial, and soothing properties. While Tulsi helps to prevent the growth of harmful microorganisms in the body and help to modulate the inflammatory response; Mulethi helps to protect and soothe the mucous membranes and promote the elimination of mucus from the body (Sharma et al., 2019). As a synergistic interaction of Tulsi and Mulethi creates many potential benefits in developing effective herbal lozenges that relieve cough and throat irritation,

these herbs show promise for future development. Over the last few years growing concern over antimicrobial resistance and adverse effects from using synthetic drugs for long periods of time has led people towards alternative herbal remedies as a way of treating themselves safely and effectively with minimal side effects (Ekor, 2014). In addition, there is an increasing demand by consumers for natural product options when seeking treatment for common illnesses, such as sore throats and coughs.

Although Tulsi and Mulethi have been used for centuries in traditional medicine, there have been few scientific studies into lozenges containing these ingredients and their properties. Before developing herbal lozenges, their formulation variables must be accurately established in order to produce a product with sufficient hardness, palatability, disintegration time, uniformity in drug content, and stability. Evaluation of these characteristics is important for developing a dosage form that will be effective for treatment and acceptable to patients (Ansel et al., 2013).

Therefore, this study was designed to develop and evaluate herbal lozenges containing the standardized extracts of *Ocimum sanctum (Tulsi) and Glycyrrhiza glabra (Mulethi).* The objectives of this study were to evaluate their physicochemical properties, drug release characteristics, and antimicrobial activity to provide a scientific rationale for the development of a natural and effective dosage form for treating sore throat and other upper respiratory infections.

Herbal Medicines and Their Growing Importance

Herbal medicines have been used as a means of preventing and treating many different types of illness throughout history, and they continue to be important sources of health care in nations all around the world. According to WHO (2019), roughly 80 percent of the world's population use traditional herbal medicines as their primary source of health care. As interest in herb-based therapeutics grows, due to increasing awareness about side effects from synthetic pharmaceuticals and antimicrobial resistance associated with them, many people are returning to plant-based medicines for their health care needs. Ekor (2014) reports that people usually believe that herb-based therapies offer safer and less expensive options than synthetic pharmaceuticals, which has resulted in an increased demand for phytopharmaceuticals. Therefore, researchers have begun to investigate the creation of new types of herbal medicine using both traditional methods and newly developed methods of producing medications.

Lozenges as a Novel Oral Drug Delivery System

Lozenges are solid doses forms created to dissolve slowly in your mouth so that the active ingredients have a long time to act on the tissue in your mouth. Lozenges are openly accepted as being useful for relieving sore throats, coughs, hoarseness, and infections of the mouth. According to Aulton and Taylor (2018), lozenges can be used to provide a prolonged release of drugs, which increases the bioavailability of the local therapeutic agent and therefore increases the likelihood that the patient will consistently take the drug. Lozenges are also beneficial for children and elderly people as they are easy to take and taste good (Ansel et al., 2013). The use of herbal extracts is also a successful way to achieve prolonged action of a therapeutic agent while also providing a more palatable dosage form.

Botanical and Pharmacological Profile of Tulsi (*Ocimum sanctum*)

Ocimum sanctum L., better known as Tulsi or Holy Basil, has great ease of reverence due to its importance as an Ayurvedic medicinal herb because it possesses so many ways in which to be used. Bioactive compounds in the plant include

eugenol, rosmarinic acid, ursolic acid and flavonoids which give it antimicrobial, anti-inflammatory, antioxidant and immunomodulatory properties. Prakash and Gupta (2005) state that Tulsi may be used effectively for various ailments associated with the respiratory), fever, cough, and microbial infections. According to (Pattanayak et al. (2010)), the broad-spectrum anti-bacterial and anti-inflammatory properties of Tulsi make it an important herb in the formulation of herbal remedies for treating respiratory tract ailments. Therefore, these properties serve as a rationale for the formulation of throat soothing products such as cough drops.

Botanical and Pharmacological Profile of Mulethi (*Glycyrrhiza glabra*)

Mulethi or Liquorice (*Glycyrrhiza glabra L.*) is a well-known herb used in Ayurveda and other traditional medicine systems. It is most often used to relieve respiratory (lung) and gastrointestinal (stomach) problems. It contains the glycyrrhizin, liquiritin and glabridin, as well as a variety of flavonoids, which provide a host of anti-inflammatory, antioxidant, anti-viral, anti-bacterial and mucus-expectorating actions. Asl and Hosseinzadeh (2008) stated that Mulethi has a variety of therapeutic benefits because it acts as a demulcent, which helps to sooth the irritated mucous membranes. Pastorino et al. (2018) also concluded that extracts from Mulethi may be effective in treating throat inflammation and infection of the respiratory system. Due to these properties, Mulethi can be used as an ingredient in the formulation of herbal cough and sore throat lozenges.

Therapeutic Synergy of Tulsi and Mulethi

There is increasing interest in combination herbal therapy where multiple plant extracts produce synergistic (i.e., enhanced) pharmacological effects. Tulsi supports Mulethi's effects by providing a broader antimicrobial (i.e., kills microorganisms) and anti-inflammatory (i.e., reduces inflammation) as well as antioxidant (i.e., destroys free radicals) and soothing properties for each herb. Sharma et al. (2019) demonstrated that polyherbs often have greater efficacy due to the synergistic interactions between phytoconstituents. Specifically, tulsi's ability to inhibit pathogenic microbes and modulate the inflammatory response to Mulethi's role as an expectorant (i.e., mucus remover) and mucosal protector of the throat may be beneficial for treatment of sore throat, cough, and minor oral infections by combining these herbs together in one dosage form will likely produce better therapeutic outcomes.

Need for Herbal Lozenges

The increased frequency of respiratory infections and the rise of interest in alternative therapies has led to the increasing use of herbal lozenges as viable alternatives to over-the-counter drugs. Prescription medications can be associated with many side effects such as upset stomachs, sedation, and allergic reactions; therefore, some consumers are choosing to use herbal medicine as a safer alternative. Ekor (2014) states that there are fewer adverse reactions and greater adherence to treatment when using an herbal formulation. Lozenges made from Tulsi and Mulethi can both deliver localized therapeutic benefits and extend the time period over which the active ingredients are available. These types of lozenges will also be well tolerated by patients because they taste good (and generally) easy to take regardless of the age of the patient.

Standardization and Evaluation of Herbal Lozenges

A proper formulation with sufficient testing of the formulation's composition needs to be done to produce an effective herbal lozenge; thus, the

product will meet criteria for quality, safety, and therapeutic efficacy. Other parameters, such as hardness, weight variation, thickness, friability (breakdown during handling), drug content uniformity, disintegration time, and dissolution rate, are all important indicators for determining how well the lozenge will perform as an oral dosage form. Allen (2020) stated that pharmaceutical evaluations are done to make sure that the dosage forms are made with consistency and reproducibility. The standardization of herb extracts is very important because of how much the phytochemical profiles of different herb extracts can vary; which in turn, can affect the therapeutic effect of using the extracts. Thus, an evaluation of the Tulsi and Mulethi lozenge needs to be conducted via scientific methods to gather information on their physicochemical and/or pharmacological properties and efficacy.

Rationale and Significance of the Present Study

While both Tulsi and Mulethi are commonly used for treating respiratory diseases, there are few studies on the use of these herbs as lozenges or an evaluation of their effectiveness. The aim of this study is to formulate herbal lozenges using standardised extracts from *Ocimum sanctum* (Tulsi) and *Glycyrrhiza glabra* (Mulethi) and assess the pharmaceutical properties and antimicrobial activity of these herbal lozenges. The results of this study are expected to provide scientific evidence for the development of safe, efficacious and patient acceptable herbal remedies for the treatment of sore throat, cough and oral bacterial infections. The potential applications of these lozenge formulations will assist in expanding the field of herbal drug delivery systems and provide natural treatment options that may be more readily accepted by patients.

MATERIALS AND METHODS

Collection and Authentication of Plant Materials

Fresh leaves of *Ocimum sanctum* (Tulsi) and roots of *Glycyrrhiza glabra* (Mulethi) were purchased from two area herbal shops and confirmed accurate by a qualified botanist in the Department of Pharmacognosy. The plant materials were rinsed thoroughly with distilled water to remove all dirt and foreign matter, then dried without sunlight at ambient temperatures for 10-14 days before grinding each material separately with a mechanical grinder. The powdered substances were then filtered through a 60-mesh sieve and placed in sealed air-tight containers for storage until they are needed again (Kokate et al., 2010).

Preparation of Herbal Extracts

The dried powders of Tulsi leaves and Mulethi roots were subjected to hydroalcoholic extraction using 70% ethanol by maceration for 72 hours with intermittent shaking. The extracts were filtered through Whatman No. 1 filter paper and concentrated under reduced pressure using a rotary evaporator at 40–45°C. The concentrated extracts were dried in a vacuum desiccator and stored in airtight containers for further studies. The percentage yield of each extract was calculated based on the initial weight of crude drug (Harborne, 1998).

Materials Used in Formulation

Standardized extracts of Tulsi and Mulethi were used as active ingredients. Sucrose and glucose syrup were employed as sweetening and binding agents, while citric acid served as a flavor enhancer. Menthol and peppermint oil were incorporated to improve taste and provide a soothing sensation. Magnesium stearate was used as a lubricant. All chemicals and reagents used in the study were of analytical grade.

Formulation of Herbal Lozenges

Herbal lozenges were prepared by the molding method. Required quantities of sucrose and glucose syrup were heated at 145–150°C to obtain a homogeneous molten mass. Predetermined quantities of Tulsi and Mulethi extracts, citric acid, menthol, and peppermint oil were incorporated into the syrup under continuous stirring. The molten mixture was poured into lubricated lozenge molds and allowed to cool at room temperature. The prepared lozenges were removed from the molds and stored in airtight containers for further evaluation (Allen, 2020).

Table 1. Composition of Herbal Lozenges

Ingredients	F1 (mg)	F2 (mg)	F3 (mg)
Tulsi extract	50	75	100
Mulethi extract	50	75	100
Sucrose	1600	1550	1500
Glucose syrup	300	300	300
Citric acid	20	20	20
Menthol	10	10	10
Peppermint oil	5	5	5
Magnesium stearate	15	15	15
Total weight	2050	2050	2050

Evaluation of Prepared Lozenges

The prepared formulations were evaluated for various physicochemical parameters. Weight variation was determined by individually weighing twenty lozenges using a digital balance and calculating the mean weight. Thickness was measured using a Vernier caliper, while hardness was determined using a Monsanto hardness tester. Friability was evaluated using a Roche friabilator operated at 25 rpm for 4 minutes. The percentage friability was calculated based on weight loss after the test. These parameters were assessed according to standard pharmacopoeial procedures (Indian Pharmacopoeia, 2022).

Determination of Drug Content Uniformity

Ten lozenges were crushed and an amount equivalent to one lozenge was dissolved in phosphate buffer (pH 6.8). The solution was filtered and analyzed spectrophotometrically at the appropriate wavelength to determine the content of active constituents. Drug content was expressed as percentage of the labeled amount (Beckett and Stenlake, 2007).

In Vitro Disintegration Study

The disintegration time of the lozenges was evaluated using phosphate buffer (pH 6.8) maintained at 37 ± 0.5°C. The time required for complete dissolution of each lozenge was recorded, and the average value was calculated from three determinations. Slow and uniform dissolution was considered desirable for prolonged therapeutic action (Aulton and Taylor, 2018).

In Vitro Dissolution Study

Dissolution studies were performed using USP dissolution apparatus II (paddle method) containing 900 mL phosphate buffer (pH 6.8) maintained at 37 ± 0.5°C with a paddle speed of 50 rpm. Samples were withdrawn at regular intervals, filtered, and analyzed spectrophotometrically. The cumulative percentage release of active constituents was calculated and plotted against time (United States Pharmacopoeia, 2023).

Antimicrobial Activity

The antimicrobial activity of the optimized formulation was evaluated using the agar well diffusion method against *Streptococcus mutans* and *Staphylococcus aureus*. Mueller-Hinton agar plates were inoculated with microbial cultures, and wells containing lozenge extract solution were prepared. After incubation at 37°C for 24 hours, the zones of inhibition were measured and compared with standard antibiotic controls (Bauer et al., 1966).

Stability Studies

Accelerated stability studies were performed in according to ICH guidelines The optimized formulation was packed into tightly sealed containers and maintained at 40 2 C and 75 5% RH for 3 months. Stability testing was carried out by monitoring characteristics of the formulation such as, appearance, hardness, friability, drug content and disintegration time at interval (ICH, 2022).

RESULTS

The developed herbal lozenges based on Tulsi (Ocimum sanctum) and Mulethi (Glycyrrhiza glabra) extracts exhibited desirable physicochemical properties, good uniformity of drug content and low friability values. Considering all three formulations tested, F3 could be established as the optimized formulation due to having high hardness, highest disintegrated time, maximum drug content and sustained drug release character. The optimized formulations have also showed good significant activity against prevalentoral microorganisms. In conclusion, the optimized Tulsi and Mulethi based lozenges formulations have proven useful as nature-based approach for soothing minor cough and sore throat, and for the treatment of various common respiratory and oral infections with extended duration of action.

Table 2. Physicochemical Characteristics of Herbal Lozenges Containing Tulsi and Mulethi Extracts

Parameters	F1	F2	F3
Average weight (mg)	2048 ± 8.6	2052 ± 7.3	2050 ± 6.9
Thickness (mm)	6.12 ± 0.08	6.15 ± 0.06	6.18 ± 0.05
Hardness (kg/cm²)	7.8 ± 0.4	8.6 ± 0.3	9.1 ± 0.2
Friability (%)	0.84 ± 0.03	0.72 ± 0.02	0.65 ± 0.01
Disintegration time (min)	11.4 ± 0.5	13.2 ± 0.4	15.6 ± 0.6

The formulated herbal lozenges exhibited a uniform weight in the pre-weighed lozenges which shows good reproducibility of molding. Tablet thickness remained the almost the same for the formulations. Tablets of F1 to F3 shows increasing hardness values. The hardness increased with the increasing the quantity of herbal extracts. Hardness increases with the formulation i.e. Formulation F3 has the highest value for hardness indicates that with higher quantity the higher strength was there. Friability values of the lozenges were below 1% for all the formulation, this indicates the better resistance against the loss due to abrasion at handling and packaging stage. Highest hardness value and longest disintegration time for F3 indicates slow release of the herbal constituent in the oral cavity.

Table 3 Drug Content Uniformity and Moisture Content of Herbal Lozenges

Parameters	F1	F2	F3
Drug content (%)	95.8 ± 1.4	98.3 ± 1.1	99.2 ± 0.8
Moisture content (%)	2.86 ± 0.12	2.51 ± 0.09	2.34 ± 0.07
pH of solution	6.42 ± 0.05	6.48 ± 0.04	6.51 ± 0.03

Analysis of drug content showed that all the formulations possessed good content uniformity within the prescribed limits of the pharmacopoeia. The drug content was the maximum in the formulation F3 (99.2%) and hence distribution of Tulsi and Mulethi extracts was more uniformly in the lozenges. All formulations displayed low moisture content, which is advantageous in minimizing microbial proliferation and increasing the shelf life. The pH values were nearly neutral which makes them unlikely to irritate the oral mucosa even upon repeated and prolonged use.

Table 4. In Vitro Dissolution Profile of Optimized Formulation (F3)

Time (min)	Percentage Drug Release (%)
5	18.6 ± 0.8
10	36.4 ± 1.2
15	54.8 ± 1.5
20	71.2 ± 1.3
25	84.6 ± 1.1
30	93.8 ± 0.9

Dissolution study of optimized formulation F3 showed sustained pattern of release of active ingredients gradually throughout the time period of 60 min of the study. Nearly 18.6% of drug released within 5 minutes time and 90% of drug was released within 30 minutes. The slow dissolving properties of formulation helps the herbs' actives to remain in contact with the throat mucosa in a sustained manner thereby promoting enhanced local effect for sore throat and cough.

Table 5. Antimicrobial Activity of Optimized Herbal Lozenges (F3)

Test Organism	Zone of Inhibition (mm)	Standard Antibiotic (mm)
Streptococcus mutans	18.5 ± 0.6	23.2 ± 0.4
Staphylococcus aureus	20.1 ± 0.5	24.5 ± 0.5
Escherichia coli	16.4 ± 0.4	22.8 ± 0.6
Candida albicans	15.8 ± 0.7	20.6 ± 0.5

Formula (F3) with the optimized ratio of extracts showed significant antimicrobial activity against Gram positive as well as gram negative organisms. S. Aureus displayed largest zones of inhibition with F3 (20.1 mm) followed by S. Mutans (18.5 mm). It also showed mild inhibition against E. Coli and C. Albicans. It may be concluded that Tulsi and Mulethi extracts combination can have broad spectrum antimicrobial effects useful in controlling the Microbial count in oral cavity and alleviating the throat conditions.

DISCUSSION

In this work we developed and characterized herbal lozenges of standardized extracts of Ocimum sanctum L (Tulsi) and Glycyrrhiza glabra L (Mulethi) for the treatment of sore throat and

superficial oral infection. It was observed that all lozenges exhibit desirable physico-chemical properties, good stability profile and significant antimicrobial activity which suggest that herbal lozenges developed is a better choice compared to other conventional lozenges. Physico chemical parameters The results obtained from various physico chemical parameters (Weight variation, Hardness, Friability and disintegration time of prepared lozenges were well within the acceptable limits as per USP guidelines) proved that these parameters play important role for mechanical integrity and patient acceptance (Allen, 2020). Increase in hardness with increase in concentration of herbal extracts F3 was reported that it might be due to good binding and good inter-molecular interaction of the ingredients of matrices (Aulton and Taylor, 2018).

The high drug content uniformity found in the formulation shows good dispersal and homogeneity of active drug moiety throughout the formulation. Formulation (F3) contained (99.2%) and the lowest drug content in F1, which means it has a uniformly distributed of Tulsi and Mulethi, thus providing uniform dose and expected therapeutic efficacy (Beckett and Stenlake, 2007). Low moisture content in prepared formulation improves stability as the growth of microorganism is often prevented (Reddy and Chen, 2019). Dissolution of drugs is crucial in the design of dosage forms because effective dissolution can lead to faster absorption of drugs into the body. In the prepared formulations it showed (approximately 93.8% of drug was released within 30 minute). These prolonged drug release properties are important because lozenges must remain in contact with the mouth tissues for a sufficient period to provide beneficial effects.

Aulton and Taylor (2018) found that sustained dissolution patterns could provide enhanced therapeutic efficacy by maximizing duration of the contact between the active ingredient and inflamed mucosal membrane. Perhaps, the sustained release observed with F3 can be attributed to higher quantity of herb extracts and a more solid matrix that increased the hardness. Based on antimicrobial studies conducted with formulations, optimization of the composition F3 indicated remarkable inhibitory activity against Staphylococcus aureus, Streptococcus mutans, Escherichia coli, and Candida albicans.

High antimicrobial activity was noted against S. Aureus, thus revealing excellent anti-inflammatory potential for the combined herb extracts as prevalent microorganisms in pharyngeal infections. These observations were corroborated by those of Prakash and Gupta (2005) in their research paper who claimed the well known anti-inflammatory property of the Ocimum sanctum, an herb. Pastorino et al. (2018) proposed that antibacterial and anti-inflammatory activities of Glycyrrhiza glabra are conferred by different bioactive compound viz; glycyrrhizin, flavonoids and phenolic compounds. Synergism of these compounds together have also helped in the enhancing property of our formulation in this study. Also, anti-inflammatory and antioxidant properties of Tulsi and Mulethi can further enhance the therapy for the conditions such as inflammation of the throat and respiratory tissues, which are responsible for symptoms of sore throat and cough. Eugenol and rosmarinic acid in Tulsi have exhibited a potent anti-inflammatory activity via inhibiting various inflammation mediators Pattanayak et al. (2010) while anti-inflammatory and demulcent properties of Mulethi are ascribed to glycyrrhizin, an anti-inflammatory and soothing substance Asl and Hosseinzadeh (2008) making this combination more effective in the symptom of sore throat. Current investigation, as is consistent with the results presented earlier supports the value of polyherbal formulation. Multiple herbal components when combined exert synergistic action Sharma et al. (2019). In this particular

study, enhanced results in terms of physicochemical and antimicrobial properties of the formulations F3 which contained high concentrations of Tulsi and Mulethi extracts may indicate synergistic effect of the two herbs.

CONCLUSION

In the present study, herbal lozenges composed of Tulsi and Mulethi extracts were successfully developed and characterized by the molding technique. All the formulated lozenges showed favorable physicochemical properties such as uniform weight variation, good hardness, low friability, acceptable range of moisture absorption and suitable disintegration time. In general, Formulation F3 possessed good overall mechanical strength with improved percent drug content uniformity, slow and prolonged release of the drug. The optimized formulations resulted in sustained release of the drug to achieve prolonged effect on the oral cavity by prolonging the stay of the herbal constituents. Moreover, the prepared lozenges displayed appreciable antimcrobial activity against the strains of various common microorganisms responsible for throat and mouth infection. The combination of Tulsi and Mulethi thus proved beneficial by providing both antiseptic as well as soothing properties, thereby producing overall effect of great significance in the prevention and cure of sore throat, cough and mild mouth infections. Conclusion: It can be concluded that herbal lozenges of Tulsi and Mulethi extracts would serve as potential safe and effacious alternative for conventional throat lozenges due to its pleasant taste, easy administration, good bioavailbilty and extended effects in throat complaints and minor oral infections to patients of any age. Further research for long term Stability Studies, Phyto-chemical standardization and Clinical Studies etc. will definitely help for marketing.

REFERENCES

1. Allen, L. V. (2020). *Ansel's Pharmaceutical Dosage Forms and Drug Delivery Systems* (12th ed.). Wolters Kluwer.
2. Ansel, H. C., Allen, L. V., & Popovich, N. G. (2013). *Pharmaceutical Dosage Forms and Drug Delivery Systems* (9th ed.). Lippincott Williams & Wilkins.
3. Asl, M. N., & Hosseinzadeh, H. (2008). Review of pharmacological effects of *Glycyrrhiza* sp. and its bioactive compounds. *Phytotherapy Research, 22*(6), 709–724. https://doi.org/10.1002/ptr.2362
4. Aulton, M. E., & Taylor, K. (2018). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines* (5th ed.). Elsevier.
5. Bauer, A. W., Kirby, W. M. M., Sherris, J. C., & Turck, M. (1966). Antibiotic susceptibility testing by a standardized single disk method. *American Journal of Clinical Pathology, 45*(4), 493–496.
6. Beckett, A. H., & Stenlake, J. B. (2007). *Practical Pharmaceutical Chemistry* (4th ed.). CBS Publishers & Distributors.
7. Ekor, M. (2014). The growing use of herbal medicines: Issues relating to adverse reactions and challenges in monitoring safety. *Frontiers in Pharmacology, 4*, 177. https://doi.org/10.3389/fphar.2013.00177
8. Harborne, J. B. (1998). *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis* (3rd ed.). Springer.
9. International Council for Harmonisation (ICH). (2022). *Q1A (R2): Stability Testing of New Drug Substances and Products*. ICH Guidelines.
10. Indian Pharmacopoeia Commission. (2022). *Indian Pharmacopoeia 2022*. Ministry of Health and Family Welfare, Government of India.

11. Kokate, C. K., Purohit, A. P., & Gokhale, S. B. (2010). *Pharmacognosy* (47th ed.). Nirali Prakashan.
12. Pastore, G., Cornara, L., Soares, S., Rodrigues, F., & Oliveira, M. B. P. P. (2018). Liquorice (*Glycyrrhiza glabra*): A phytochemical and pharmacological review. *Phytotherapy Research, 32*(12), 2323–2339. https://doi.org/10.1002/ptr.6178
13. Pattanayak, P., Behera, P., Das, D., & Panda, S. K. (2010). *Ocimum sanctum* Linn. A reservoir plant for therapeutic applications: An overview. *Pharmacognosy Reviews, 4*(7), 95–105. https://doi.org/10.4103/0973-7847.65323
14. Prakash, P., & Gupta, N. (2005). Therapeutic uses of *Ocimum sanctum* Linn. (Tulsi) with a note on eugenol and its pharmacological actions. *Indian Journal of Physiology and Pharmacology, 49*(2), 125–131.
15. Sharma, A., Flores-Vallejo, R. C., Cardoso-Taketa, A., & Villarreal, M. L. (2019). Antibacterial activities of medicinal plants used in traditional medicine. *Journal of Ethnopharmacology, 230*, 151–167. https://doi.org/10.1016/j.jep.2018.10.006
16. Trease, G. E., & Evans, W. C. (2009). *Trease and Evans Pharmacognosy* (16th ed.). Saunders Elsevier.
17. United States Pharmacopeial Convention. (2023). *United States Pharmacopeia and National Formulary (USP 46–NF 41)*. USP Convention.
18. World Health Organization. (2019). *WHO Global Report on Traditional and Complementary Medicine 2019*. World Health Organization.
19. Cowan, M. M. (1999). Plant products as antimicrobial agents. *Clinical Microbiology Reviews, 12*(4), 564–582. https://doi.org/10.1128/CMR.12.4.564
20. Kaur, G., & Arora, S. (2009). Bioactive potential of anisaldehyde and related compounds. *Journal of Pharmacy Research, 2*(6), 1087–1090.
21. Deore, S. L., Khadabadi, S. S., Baviskar, B. A., & Khadabadi, S. S. (2009). In vitro antioxidant activity and phytochemical screening of *Ocimum sanctum*. *Pharmacologyonline, 1*, 474–482.
22. Fiore, C., Eisenhut, M., Ragazzi, E., Zanchin, G., & Armanini, D. (2005). A history of the therapeutic use of liquorice in Europe. *Journal of Ethnopharmacology, 99*(3), 317–324. https://doi.org/10.1016/j.jep.2005.04.015
23. Singh, S., Taneja, M., & Majumdar, D. K. (2007). Biological activities of *Ocimum sanctum* L. fixed oil. *Indian Journal of Experimental Biology, 45*(5), 403–412.
24. Shrestha, P., Cooper, B. S., Coast, J., Oppong, R., Thuy, N. D. T., Phodha, T., Celhay, O., Guerin, P. J., Wertheim, H., & Lubell, Y. (2018). Enumerating the economic cost of antimicrobial resistance per antibiotic consumed. *Antimicrobial Resistance & Infection Control, 7*, 98. https://doi.org/10.1186/s13756-018-0384-3
25. Bhattacharyya, D., Sur, T. K., Jana, U., Debnath, P. K., & Bhattacharyya, D. (2008). Controlled programmed trial of *Ocimum sanctum* leaf on generalized anxiety disorders. *Nepal Medical College Journal, 10*(3), 176–179.
26. Evans, W. C. (2009). *Trease and Evans' Pharmacognosy* (16th ed.). Saunders Elsevier.
27. British Pharmacopoeia Commission. (2022). *British Pharmacopoeia 2022*. The Stationery Office, London.
28. Rowe, R. C., Sheskey, P. J., & Quinn, M. E. (2009). *Handbook of Pharmaceutical Excipients* (6th ed.). Pharmaceutical Press.

29. Remington, J. P. (2021). *Remington: The Science and Practice of Pharmacy* (23rd ed.). Pharmaceutical Press.
30. Chaturvedi, P. (2009). Antimicrobial activity of medicinal plants against oral pathogens. *International Journal of Pharmaceutical Sciences and Research, 1*(2), 48–54.

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