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Original Research Article

DEVELOPMENT AND EVALUATION OF A RASAYANA-BASED POLYHERBAL CHEWABLE TABLET WITH EXPECTORANT PROPERTIES

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Abstracts: In recent years, the pharmaceutical industry has witnessed a significant resurgence of interest in Ayurvedic medicine. Traditional herbs such as Glycyrrhiza glabra (Liquorice), Zingiberofficinale (Ginger), Foeniculumvulgare (Fennel)and Ocimum sanctum (Tulsi) have been utilized since antiquity for their antitussive and expectorant properties. These therapeutic applications are deeply rooted in the foundational texts of Ayurveda. Because cough is a universal ailment affecting patients across all age demographics, it remains a primary focus of drug development. The oral route remains the most favoured path for drug administration. This popularity is due to superior patient compliance, the ability to design flexible dosages, and the simplicity of administration, which avoids the rigorous sterility demands of parenteral forms. The primary objective of this research was to develop and standardize polyherbal chewable tablets using a combination of Liquorice, Ginger, Fennal and Tulsi. To achieve this, the tablets were manufactured using the wet granulation technique, employing a 5% w/v solution of MCC as a binder. The development process involved a rigorous two-tier evaluation. First, pre-formulation studies were conducted on the powder blend to determine flowability and compressibility; this included measuring bulk and tapped densities, the angle of repose, Carr's index, and Hausner's ratio. Second, the final chewable tablets underwent post-formulation testing to ensure quality. These parameters included physical appearance, size, shape, hardness, and friability. Furthermore, the tablets were checked for weight variation and disintegration time to ensure they meet modern pharmaceutical standards.

Keywords: Polyherbal Chewable Tablet, Expectorant, Glycyrrhiza glabra, Foeniculum vulgare, Zingiber officinale, Ocimum sanctum, Wet granulation method; Cough; Antitussive; Demulcent; Expectorant; Cough relieving activity; Disintegration Test.

INTRODUCTION

Cough is an important protective reflex of the human body that helps prevent foreign substances such as irritant particles, fluids, and microorganisms from entering the respiratory tract. Based on how long it persists, cough is commonly

categorized as acute, subacute, or chronic. Acute cough is usually defined as one lasting up to three weeks and is most often associated with upper respiratory tract infections, acute bronchitis, or tracheobronchitis. These conditions are predominantly caused by viral pathogens, while bacterial infections occur less frequently. Subacute cough typically lasts between three and eight weeks and is often a residual symptom following recovery from an acute respiratory illness [1].

Chronic cough is commonly linked to conditions such as upper airway cough syndrome (UACS), asthma, cough-variant asthma (CVA), gastroesophageal reflux disease (GERD) and eosinophilic bronchitis. In routine clinical practice, physicians often initiate empirical treatment based on the patient's medical history and physical examination, targeting these common underlying causes [2].

Physiologically, cough plays a beneficial role by clearing excess mucus and foreign materials from the airways and therefore should not be suppressed without proper consideration [3, 4]. For centuries, natural sources particularly medicinal plants have played a significant role in the treatment of various diseases. Many modern drugs have been developed from plant-derived compounds that were originally used in traditional medicine. With advancements in medicinal chemistry and biosynthetic technologies, these natural compounds continue to be refined to produce effective therapeutic agents. In recent decades, the use of herbal and natural therapies has gained increasing popularity, especially in industrialized nations [5].

Expectorants are therapeutic agents that assist in loosening and expelling mucus from the respiratory tract, although their clinical usefulness is limited. Despite their frequent use—reported in approximately 10% of American children on a weekly basis expectorants are not recommended for children under six years of age due to limited evidence of benefit and potential safety concerns [6].

Fennel (*Foeniculum vulgare*) is another widely used traditional herb with a long history in medicinal practice. Studies have demonstrated its effectiveness against various infectious diseases caused by bacteria, fungi, viruses, mycobacteria, and protozoa [8]. In addition, fennel exhibits mucolytic and anti-inflammatory properties, making it useful in respiratory conditions [9].

Ginger (*Zingiber officinale*) has been used in traditional medicine for thousands of years and is highly valued for its therapeutic properties. Originally native to Southeast Asia, ginger has been incorporated into many medical systems and is particularly recognized for its benefits in the management of respiratory ailments [10].

In addition to its well-known anti-inflammatory and bronchodilatory actions, *Zingiber officinale* has also been shown to possess mucolytic and expectorant properties. Research involving herbal formulations containing ginger has reported a dose-dependent mucoactive response, leading to increased mucus secretion and improved clearance from the respiratory tract. These effects have been found to be comparable to those of commonly used expectorant agents such as guaifenesin [11,12].

Tulsi (*Ocimum sanctum*), widely known as Holy Basil, is a highly respected medicinal plant in Indian tradition, particularly within the Ayurvedic system of medicine. Often referred to as the "Queen of Herbs," tulsi holds deep cultural, spiritual, and therapeutic importance. It has been cultivated for thousands of years throughout India and other tropical regions due to its extensive medicinal value. In Ayurveda, tulsi is classified as a *Rasayana*, a category of herbs believed to promote longevity, rejuvenation, and overall vitality. It is commonly used to enhance immune function, alleviate stress, and support general health and well-being [13].

Tulsi is also recognized for its adaptogenic and anti-inflammatory properties. It has been traditionally used as an anti-asthmatic agent and has demonstrated additional pharmacological activities, including hypoglycemic, hepatoprotective, antihypertensive, hypolipidemic, and immunomodulatory effects [14].

An ideal herbal chewable tablet should possess several key characteristics. It should disintegrate rapidly and promote quick dissolution of the active ingredients. This dosage form is particularly beneficial for individuals who have difficulty swallowing conventional tablets. A pleasant taste and the availability of different flavor options improve patient acceptability. Chewable tablets are simple to administer, do not require water and offer convenience for use anytime and anywhere, making

them especially suitable for on-the-go consumption [15].

Table 1: Synonyms, biological sources, family, Chemical constituents and uses of Ingredients

S.No	Ingredients	Synonyms	Biological Source	Chemical Constituents	uses
1	Liquorice (Leguminosae)	Mulethi, Radix glycyrrhizae, Licorice, Jethi Madh, Yashtimadhu, Jeshtamadh	Stems along with roots of Glycyrrhiza Glabra.	Glycyrrhetic acid, glycyrrhizin, Liquiritin, isoliquiritin, liquiritigenin, isoliquiritigenin Glyceramarin Herniarin and umbelliferone, Starch, resin, asparase, β-sitosterol, and malic acid.	Expectorant, Demulcent, Anti-inflammatory, treats Bronchial problems such as Catarrh bronchitis, cold flu and coughs Agent, Sweetening.
2	Fennal (Apiaceae)	Fennal fruit, Fenkel, Saunf, sweet fennal	Dried ripe fruits Foeniculum vulgare Miller	1-4%, Volatile oil, fixed oil 9-12%,	anti-inflammatory action, antispasmodic
3	Ginger (Zingiberaceae) a	Zinziber Soonth, Saunth	Dried rhizomes of Zingiber officinale	5 to 8% pungent material, 1 to 2 % volatile oil, starch The volatile oil, sesquiterpene alcohol, besaabolene, zingiberene, and 6% sesquiterpene hydrocarbon zingiberol, gingirone, aliphatic aldehyde and a ketone.	Antitussive, Antiviral, Antiemetic, Anti-inflammatory
4	Tulsi (Lamiaceae)	Holy Basil, Indian Basil	Dried leaves, seeds and roots of Ocimum sanctum Linn.	70% Eugenol, Eugenol methyl ether,carvacrol, linalool,cineole, camphor.	Relieving the symptoms of cough and cold by its Antiviral, Antibacterial, Anti-inflammatory properties.

MATERIALS AND METHODS

A.Materials

Liquorice, ginger, and fennel were obtained from the local market. Tulsi (*Ocimum sanctum*) plants were collected

from the local region. Excipients including talc, magnesium stearate, microcrystalline cellulose (MCC), and saccharin were procured from Park Pharmaceuticals, Baddi.

B. Formulation and Development:

Polyherbal chewable tablets containing liquorice (*Glycyrrhiza glabra*), fennel (*Foeniculum vulgare*), ginger (*Zingiber officinale*), and tulsi (*Ocimum sanctum*) were formulated using the wet granulation technique.

Table 2: Role of Ingredients

Sr. No.	Ingredients Role	Role
1	Liquorice	Expectorant, Demulcent, Anti-inflammatory, treats Bronchial problems such as Catarrh bronchitis, cold flu and coughs Agent, Sweetening.
	Fennal	Loosens phlegm and soothes the respiratory tract, anti-inflammatory action, antispasmodic
2	Ginger	Antitussive, Antiviral, Antiemetic, Anti-inflammatory
3	Tulsi	Relieving the symptoms of cough and cold by its Antiviral, Antibacterial, Anti-inflammatory properties.
4	MCC	Disintegrator &Binder
5	Starch	Filler
6	Magnesium Stearate	Lubricant
7	Talc	Glidants

Preparation of Liquorice Powder

Dried liquorice stems were purchased from the local market and pulverized using an electrical grinder. The resulting material was passed through sieve number 18 to obtain a fine and uniform powder [16].

Preparation of Ginger Powder

Dried ginger roots were procured from the local market and ground using an electrical grinder. The powdered material was then passed through sieve number 18 to achieve a fine, refined powder suitable for formulation [16].

Preparation of Fennel Seed Powder

Mature, greenish-brown fennel seeds (*Foeniculum vulgare*) were obtained from the local market and allowed to dry naturally during storage. The dried seeds were crushed and subsequently sieved to obtain particles with a size not exceeding 1 mm [17].

Preparation of Tulsi Powder

Tulsi (*Ocimum sanctum*) plants were collected from the local region. The collected plant material was shade-dried, after which the leaves were separated and washed with sterile water to remove surface impurities. The cleaned leaves were then dried again under shade conditions and subsequently powdered using a mechanical grinder. The resulting powder was stored in a clean, airtight container until further use [18].

Formulation of Chewable tablets:

Wet Granulation Method

For small-scale preparation of chewable tablets, the wet granulation method was employed due to its convenience and reproducibility. All formulation ingredients were accurately weighed, pulverized, and individually passed through sieve no. 80. Magnesium stearate and talc were separately triturated using a mortar and pestle and subsequently sieved through sieve no. 80.

A. The screened ingredients, excluding magnesium stearate and talc, were thoroughly blended. A 5% w/v binder solution of microcrystalline cellulose (MCC) was then added gradually to the blended powder while mixing to form a cohesive wet mass. The resulting mass was passed repeatedly through sieve no. 18 to produce granules, which were dried in a vacuum dryer at 35 °C.

B. After drying, the granules were resieved through sieve no. 18 to remove oversized particles and then stored in desiccators until further use. Prior to compression, the dried granules were mixed uniformly with magnesium stearate and talc. The final blend was compressed into tablets using a tablet punching machine after adjusting the die cavity to obtain the required tablet weight [19].

Table 3: Composition of Polyherbal Chewable Tablet

Sr. No.	Ingredients	Quantity Taken (mg)
1.	Liquorice	530 mg
2.	Ginger	10 mg
3.	Fennel	10 mg
4.	Tulsi	10 mg
6	Starch	40 mg
7.	Talc	10 mg
8.	Magnesium Stearate	10 mg
9.	MC	5% w/v solution (29.5 mg)

Evaluation of granules

The prepared granules were evaluated for angle of repose, loose bulk density (LBD), tapped bulk density (TBD), compressibility index and Hausner's ratio. The angle of repose was determined by funnel method. By using cylinder method, bulk density and tapped density were measured. Carr's index (CI) was used to evaluate the rate at which the powder was packed down. Hausner's ratio was used to predict the flow properties of prepared granules. It ranges from 1.12 to 1.25, was thought to indicate good flow properties [19-20].

Evaluation of Tablets:

The formulated polyherbal tablets were evaluated for weight variation, hardness, thickness, friability and disintegration rate. The weight variation test was performed according to the official method by comparing individual weights with that of their average weight. The hardness of the tablets was tested using a Monsanto hardness tester (Keshav Int. Pvt Ltd.India). The Friability of the tablets was determined in a Roche friabilator (Keshav Int.Pvt.Ltd.India). The thickness of the tablets was measured by a vernier caliper. (16, 17). The Disintegration test was performed by disintegration test measures the amount of time needed for a group of tablets to break up into tiny particles and pass through a 10-mesh screen under a specific set of circumstances. With the use of the disintegration tester, the disintegration test is conducted. A basket rack carrying six plastic tubes that are open at both the upper and lower and have a 10-mesh screen across the bottom is known as the disintegration tester. That basket was submerged in a suitable liquid bath of 37°C temperature, preferably in beaker of 1000 mL. Water heated to 37°C was typically used as the testing liquid for compressed uncoated tablets. The test was carried out on 12 tablets if one or two of the tested tablets failed to disintegrate. The required disintegration time has to take place based to each drug's monograph in order for it to comply with pharmacopoeial specifications. [21-24]

RESULTS AND DISCUSSION

Evaluation of granules

The prepared granules were evaluated for pre-compression parameters such as angle of repose, bulk density, tapped density, carr's index, hausner's ratio and LOD were shown in Table 4. The angle of repose was found to be 24 ± 0.35. Bulk density was

found to be between 0.385 ± 0.021 gm/cm^3 and tapped density between 0.502 ± 0.031 gm/cm^3 for all formulations. Hausner's ratio was found 1.30 ± 0.021, Carr's index was found 23.31 ± 1.04 and Moisture content (%) was 4.31. All the batches have shown good to excellent flow properties. Hence, tablets were prepared with these granules in combination by the wet granulation method.

Evaluation of tablet

The formulated tablet were evaluated by post-compression parameters such as weight variation, thickness & diameter hardness, friability that were shown in Table 5. weight variation was found to be 0.0262 (Under + / – 0.5 %) mg. The thickness & diameter of all the batches was found to be 4.4mm and 15.91mm. The hardness of the tablet was found to be 5.2 ± 0.24. The % friability was found to be 0.47 that below 1% indicating the friability is within the prescribed limits. The disintegration time of tablet was found to be 14 min.

Table 4: Evaluation of Tablet Properties

Sr. No	Parameter	Observation
1.	Colour	Dark Brown
2.	Odour	Aromatic
3.	Weight variation test	0.0262 (Under + / – 0.5 %) mg
4.	Thickness & Diameter	4.4mm and 15.91mm.
5.	Friability Test	0.47%
6.	Hardness Test	5.2 ± 0.24 kg/cm2
7.	Time required for complete chewing	10-15 min
8.	Disintegration Time (min)	14

CONCLUSION:

Glycyrrhizaglabra (Liquorice), *Zingiberofficinale* (Gin ger), *Foeniculumvulgare* (Fennel)and *Ocimum sanctum* (Tulsi) are well-established and widely used Ayurvedic medicinal plants recommended by practitioners for the management of cough. The present study demonstrated that these herbal drug powders can be successfully formulated into chewable tablet dosage forms. The prepared tablets exhibited acceptable results in both pre-compression and post-compression evaluation parameters.

The formulation containing liquorice, ginger, fennal and Tulsi may offer enhanced therapeutic benefits in the treatment of cough due to their combined antitussive, expectorant and demulcent properties. The findings of this polyherbal chewable tablet study indicate that similar formulation approaches and methodologies can be applied to other herbal or Ayurvedic drugs to meet patient preferences, consumer demand and pharmaceutical industry requirements. In conclusion, the developed chewable tablets represent a promising and patient-friendly alternative to the conventional use of herbal substances. Furthermore, this research may contribute to future advancements and innovations in the field of herbal pharmaceutical technology.

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