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FORMULATION AND EVALUATION OF POLYHERBAL CHOCOLATE FOR COUGH RELIEF

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ABSTRACT

Cough is a common respiratory condition that affects individuals of all age groups and often leads to discomfort, irritation, and disturbed daily activities. Conventional cough medications, although effective, are frequently associated with side effects such as drowsiness and poor patient compliance, particularly among children. The present study aims to develop a novel, palatable, and patient-friendly dosage form in the form of herbal chocolate for cough relief. The formulation incorporates medicinal plant extracts such as Ocimum sanctum (Tulsi), Zingiber officinale (Ginger), Glycyrrhiza glabra (Mulethi), and Curcuma longa (Turmeric), which are well known for their antitussive, anti-inflammatory, antimicrobial, and soothing properties. The herbal extracts were prepared using suitable extraction methods and incorporated into a chocolate base containing cocoa butter, cocoa powder, milk powder, and sugar. Different formulations (F1, F2, F3) were prepared by varying the concentration of herbal extracts to optimize the therapeutic efficacy and organoleptic properties. The prepared herbal chocolates were evaluated for various parameters including physical appearance, weight variation, hardness, melting point, pH, content uniformity, and in-vitro drug release. The results indicated that the formulated herbal chocolates possessed

acceptable physicochemical properties, uniform drug content, and satisfactory stability. The chocolate base effectively masked the bitter taste of herbal ingredients, thereby improving patient acceptability. The study concludes that herbal chocolate is a promising and innovative drug delivery system that combines the therapeutic benefits of herbal medicine with improved palatability and compliance, especially in paediatric patients. This formulation has the potential to serve as an effective alternative to conventional cough preparations.

KEYWORDS: Herbal chocolate, Cough relief, Antitussive, Tulsi, Ginger, Mulethi, Turmeric, Polyherbal formulation, Drug delivery system, Patient compliance.

1. INTRODUCTION

One of the most prevalent signs of respiratory tract infections and illnesses, cough affects people of all ages globally. It acts as a protective reflex mechanism that aids in the respiratory tract's removal of mucus, foreign objects, and irritants.[1-2] However, a chronic or persistent cough can have a major negative influence on one's quality of life by producing weariness, discomfort, sleep difficulties, and chest pain. Synthetic antitussive, expectorant, and antihistaminic medications are examples of traditional cough therapy methods. Although these drugs alleviate symptoms, they are frequently linked to side effects include sleepiness, gastrointestinal problems, dependence, and in certain situations, inhibition of the natural cough reflex.[3-4]

Herbal and natural treatments for cough and other respiratory conditions have gained popularity in recent years. Particularly in nations like India where traditional systems like Ayurveda have been used for generations, herbal treatments are regarded as safer, more affordable, and culturally acceptable.[5] The antitussive, anti-inflammatory, antibacterial, and immunomodulatory qualities of medicinal herbs including Tulsi (Ocimum sanctum), Ginger (Zingiber officinale), Mulethi (Glycyrrhiza glabra), Vasaka (Adhatoda vasica), and Turmeric (Curcuma longa) are well known. Together, these herbs support respiratory health, ease sore throats, lessen irritation, and control the cough reflex.[6-7]

Even though herbal medicines have therapeutic promise, patient compliance is a significant obstacle in herbal therapy, particularly for younger and older patients. The majority of herbal formulations are sold as decoctions, syrups, pills, or powders, some of which may taste or smell bad. Poor adherence to treatment plans is frequently the result of this. Thus, innovative, palatable, and patient-friendly dosage formulations that may efficiently distribute herbal

active ingredients while enhancing acceptance are required.[8]

Drug administration methods based on chocolate have become a novel and appealing way to improve patient compliance. Because of its smooth texture, agreeable flavour, and capacity to cover up the bitterness of herbal medicines, chocolate is highly appreciated. Because flavonoids are present, especially in cocoa, it also has natural antioxidant qualities.[9] Other benefits of using chocolate as a carrier include its appropriateness for paediatric usage, simplicity of administration, and enhanced stability of active substances. In order to improve the therapeutic efficiency of cough alleviation, medicated chocolates can be made to dissolve slowly in the mouth, allowing active substances to stay in touch with the throat mucosa for a longer period of time.[10]

The idea of herbal chocolate blends the advantages of contemporary pharmaceutical science with ancient herbal therapy. It is feasible to create a formulation that is both effective and tasty by adding herbal extracts with established antitussive and calming qualities to a chocolate basis.[11] To guarantee constant therapeutic action, ingredients like tulsi, ginger, and mulethi can be isolated and standardised. Then, utilising appropriate excipients such cocoa butter, sweeteners, emulsifiers, and flavouring agents, these extracts may be evenly distributed throughout a chocolate matrix.[12]

From a formulation standpoint, the creation of herbal chocolate necessitates careful consideration of a number of issues, such as the stability of active ingredients, consistency of content, sensory qualities, and compatibility of herbal extracts with the chocolate foundation. Melting the chocolate foundation, adding herbal extracts, homogenising, moulding, chilling, and packaging are the usual steps in the production process. To guarantee product safety and effectiveness, quality control characteristics such hardness, melting point, weight fluctuation, content homogeneity, and microbiological load must be assessed.[13]

The current developments in nutraceuticals and functional foods are also consistent with the usage of herbal chocolate for cough treatment. A growing number of consumers are looking for natural and preventative healthcare options that provide both nutritional value and therapeutic advantages. Herbal chocolates can be marketed as a functional confection that boosts immunity in general and relieves coughing. The formulation's health advantages are further enhanced by the addition of components with anti-inflammatory and antioxidant qualities.[14] Additionally, the creation of such novel dosage forms advances patient-centered

medication delivery systems. It solves the drawbacks of traditional dose forms and creates new ways to administer herbal remedies.[15]

A promising and cutting-edge method in the field of herbal medication administration is the creation of herbal chocolate for cough treatment. It provides a special blend of patient compliance, palatability, safety, and effectiveness. This formulation has the potential to enhance cough treatment, especially in populations who are sensitive to taste and ease of administration, by using the therapeutic potential of medicinal herbs and the acceptance of chocolate as a dose form. In order to create a cough relief product that is efficient, stable, and patient-friendly, the current study focuses on the creation and assessment of herbal chocolate containing certain medicinal plants.[16-17]

2. Plant Profile

1. Tulsi (Ocimum sanctum)[18]

Family: Lamiaceae

Common Name: Holy Basil

Part Used: Leaves

Chemical Constituents: Eugenol, ursolic acid, rosmarinic acid, flavonoids

Pharmacological Activity: Antitussive, anti-inflammatory, antimicrobial, immunomodulatory

Uses: Relief in cough, cold, bronchitis, and respiratory infections

Fig. 1: Tulsi.

2. Ginger (Zingiber officinale)[19]

Family: Zingiberaceae

Common Name: Ginger

Part Used: Rhizome

Chemical Constituents: Gingerol, shogaol, zingerone

Pharmacological Activity: Anti-inflammatory, expectorant, antioxidant

Uses: Soothes throat irritation and reduces cough

Fig.2: Ginger.

3. Mulethi (Glycyrrhiza glabra)[20]

Family: Fabaceae

Common Name: Licorice

Part Used: Root

Chemical Constituents: Glycyrrhizin, flavonoids, saponins

Pharmacological Activity: Demulcent, antitussive, anti-inflammatory

Uses: Coats throat mucosa and reduces irritation

Fig.3: Mulethi.

4. Turmeric (Curcuma longa)[21]

Family: Zingiberaceae

Common Name: Turmeric

Part Used: Rhizome

Chemical Constituents: Curcumin, volatile oils

Pharmacological Activity: Anti-inflammatory, antimicrobial, antioxidant

Uses: Enhances immunity and reduces inflammation

Fig. 4: Turmeric.

Medicinal Uses

1. Antitussive (Cough Suppressant)- The herbal chocolate exhibits significant antitussive activity due to the presence of Tulsi (*Ocimum sanctum*) and Mulethi (*Glycyrrhiza glabra*). These herbs help in suppressing the cough reflex by soothing the respiratory tract and reducing irritation. It is effective in both dry and mild productive cough, making it a suitable alternative to synthetic cough suppressants.[20]

2. Demulcent and Throat Soothing Effect- Mulethi acts as a natural demulcent, forming a protective layer over the mucous membranes of the throat. This reduces irritation, dryness, and itching sensation, providing immediate relief in sore throat conditions. The chocolate base further enhances this soothing effect by slowly dissolving in the mouth.[20]

3. Anti-inflammatory Activity- Turmeric (*Curcuma longa*) and Ginger (*Zingiber officinale*) are rich in bioactive compounds like curcumin and gingerol, which exhibit strong anti-inflammatory properties. These compounds help in reducing inflammation of the respiratory tract, thereby relieving symptoms like swelling, redness, and pain.[21]

4. Expectorant Action- Ginger promotes expectoration by loosening and thinning mucus

accumulated in the respiratory passages. This helps in clearing the airways and facilitates easier breathing, especially in productive cough and bronchial congestion.[22]

5. Immunomodulatory Effect- Tulsi is well known for its immunomodulatory properties. It enhances the body's natural defense mechanisms by stimulating immune cells and improving resistance against infections. Turmeric also contributes by modulating immune responses and reducing susceptibility to respiratory diseases.[23]

6. Antimicrobial Activity-The formulation exhibits antimicrobial activity against various bacteria and viruses responsible for respiratory infections. Tulsi and turmeric possess strong antibacterial and antiviral properties, which help in controlling infection and preventing its progression.

7. Relief in Bronchitis and Respiratory Disorders-The combined action of all herbal ingredients makes the formulation effective in managing symptoms of bronchitis and other mild respiratory disorders. It helps in reducing cough frequency, easing breathing, and improving overall respiratory function.[24]

8. Reduction of Throat Pain and Irritation-The presence of anti-inflammatory and soothing agents helps in reducing throat pain caused by persistent coughing. Mulethi and ginger work synergistically to relieve discomfort and provide a cooling effect on the throat.

9. Antioxidant Activity-The herbal extracts used in the formulation are rich in antioxidants such as flavonoids, phenolic compounds, and curcumin. These antioxidants help in neutralizing free radicals, protecting cells from oxidative stress, and promoting overall health.[25]

3. Method of Preparation

Table 1: Material used.

Sr. No.	Material Name	Role / Function
1	Tulsi extract	Antitussive, antimicrobial
2	Ginger extract	Expectorant, anti-inflammatory
3	Mulethi extract	Demulcent, soothes throat
4	Turmeric extract	Anti-inflammatory, antioxidant
5	Cocoa butter	Base material, provides texture
6	Cocoa powder	Flavoring agent, antioxidant
7	Milk powder	Improves taste and nutritional value
8	Sugar	Sweetening agent

9	Lecithin	Emulsifier, improves consistency
10	Vanilla essence	Flavoring agent
11	Preservative (optional)	Enhances shelf life

3.1 Preparation of Herbal Extracts

1. The crude drugs (Tulsi leaves, Ginger rhizome, Mulethi root, Turmeric rhizome) are dried and powdered.
2. Extraction is carried out using aqueous or hydro alcoholic solvent by maceration or Soxhlet method.
3. The extract is filtered and concentrated using a water bath.
4. Dried extracts are stored in airtight containers for further use.

Formulation Table (F1)

Table 2: Formulation table F1.

Ingredients	F1 (mg)
Tulsi extract	345
Ginger extract	241
Mulethi extract	276
Turmeric extract	138
Cocoa butter	1.72g
Cocoa powder	690
Milk powder	517
Sugar	1.03g
Lecithin	34

Method of Preparation

The herbal chocolate formulations (F1, F2, and F3) were prepared using the fusion method as follows:

Step 1: Preparation of Chocolate Base

- Cocoa butter was accurately weighed and melted using a water bath maintained at 40–50°C**.**
- Cocoa powder was added gradually with continuous stirring to obtain a smooth mixture.

Step 2: Addition of Ingredients

- Milk powder and sugar were added to the molten chocolate base.
- The mixture was stirred continuously to ensure uniform mixing.

Step 3: Incorporation of Herbal Extracts

- Tulsi extract (345mg), Ginger extract (241mg), Mulethi extract (276mg), and Turmeric extract (138mg) were added.
- The mixture was stirred thoroughly to achieve uniform dispersion of herbal extracts.

Step 4: Addition of Excipients

- Lecithin was added as an emulsifier to improve consistency.
- Vanilla essence was added (q.s) to enhance flavour and mask the herbal taste.

Step 5: Molding

- The prepared mixture was poured into molds.
- The molds were gently tapped to remove entrapped air bubbles.

Step 6: Cooling and Solidification

- The filled molds were allowed to cool at room temperature or refrigerated at 4–8°C until solidification.

Step 7: Packaging and Storage

- The solidified chocolates were removed from molds.
- They were wrapped in aluminium foil and stored in a cool, dry place.

Observations of Herbal Chocolate Formulation (F1 Batch Observation)

Physical Appearance

Parameter	Observation
Color	Dark brown
Odor	Pleasant chocolate Odor with mild herbal aroma
Taste	Sweet with slightly spicy herbal taste
Texture	Smooth and glossy

Weight Variation

Sample No.	Weight (g)	Observation
1	5.02	Within limit
2	4.99	Within limit
3	5.01	Within limit

Average Weight: 5.00 g

Result: Uniform weight distribution

Hardness Test

Batch	Hardness (kg/cm²)	Observation
F1	3.8	Higher hardness

Melting Point

Batch	Temperature (°C)	Observation
F1	36–38°C	Suitable for oral use

PH Determination

Batch	pH	Observation
F1	6.7	Neutral, safe for consumption

In-vitro Dissolution Study

Time (min)	% Drug Release	Observation
5	35%	Faster release
10	60%	Good release
15	78%	High release

Fig. 5: Drug Extract.

Batch Formulation (F2)

Table 3: Formulation table F2.

Ingredients	F2 (mg)
Tulsi extract	320
Ginger extract	220
Mulethi extract	280
Turmeric extract	180
Cocoa butter	1.75g
Cocoa powder	650
Milk powder	520
Sugar	1.07g
Lecithin	40

Method of Preparation (F2)

The herbal chocolate formulations F2 and F3 were prepared by using the fusion method as described below:

Step 1: Melting of Base

- Accurately weighed cocoa butter was melted in a water bath at 40–50°C**.**

Step 2: Preparation of Chocolate Base

- Cocoa powder was added slowly to the molten cocoa butter with continuous stirring.
- Milk powder and sugar were then added and mixed thoroughly to obtain a smooth and homogeneous mixture.

Step 3: Incorporation of Herbal Extracts

- Tulsi extract (320mg), Ginger extract (220mg), Mulethi extract (280), and Turmeric extract (180mg) were added.
- The mixture was stirred continuously to ensure uniform dispersion of herbal extracts.

Step 4: Addition of Excipients

- Lecithin was added as an emulsifying agent to improve consistency.
- Vanilla essence (q.s) was added to enhance flavor and mask the herbal taste.

Step 5: Molding

- The prepared mixture was poured into molds.
- The molds were gently tapped to remove air bubbles.

Step 6: Cooling

- The molds were allowed to cool at room temperature or kept in a refrigerator at 4–8°C until solidification.

Step 7: Packaging and Storage

- The chocolates were removed from molds after solidification.
- They were wrapped in aluminium foil and stored in a cool and dry place.

Observations of Herbal Chocolate Formulation (F2 Batch Observation)

Physical Appearance

Parameter	Observation
Color	Slightly darker brown
Odor	Stronger chocolate odor
Taste	Moderately sweet with noticeable herbal taste
Texture	Smooth but slightly firm

Weight Variation

Sample No.	Weight (g)	Observation
1	5.03	Within limit
2	4.97	Within limit
3	5.01	Within limit

Average Weight: 5.00 g

Result: Acceptable variation

Hardness Test

Batch	Hardness (kg/cm²)	Observation
F2	3.6	Good hardness

Melting Point

Batch	Temperature (°C)	Observation
F2	35–37°C	Suitable for oral use

PH Determination

Batch	pH	Observation
F2	6.6	Neutral

In-vitro Dissolution Study

Time (min)	% Drug Release	Observation
5	38%	Faster release
10	63%	Good release
15	80%	High release

Fig. 6: Cough Relief Chocolate.

F3 Batch Formulation Table

Table 4: Formulation table F3.

Ingredients	Quantity (mg)
Tulsi extract	300
Ginger extract	250
Mulethi extract	300
Turmeric extract	150
Cocoa butter	1.7g
Cocoa powder	700
Milk powder	500
Sugar	1.06g
Lecithin	40

Method of Preparation (F3 Batch)

The F3 batch was prepared using the fusion method as follows:

Step 1: Melting

- Cocoa butter was accurately weighed and melted using a water bath at 40–50°C**.**

Step 2: Preparation of Base

- Cocoa powder was added slowly to the molten cocoa butter with continuous stirring.
- Milk powder and sugar were added and mixed thoroughly to obtain a smooth chocolate base.

Step 3: Addition of Herbal Extracts

- Tulsi extract (300mg), Ginger extract (250mg), Mulethi extract (300mg), and Turmeric extract (150) were added.
- The mixture was stirred continuously to ensure uniform distribution.

Step 4: Addition of Excipients

- Lecithin was added as an emulsifier to improve consistency.
- Vanilla essence was added (q.s) to enhance flavor.

Step 5: Molding

- The prepared mixture was poured into molds.
- The molds were gently tapped to remove air bubbles.

Step 6: Cooling and Solidification

- The molds were allowed to cool at room temperature or refrigerated at 4–8°C until solidification.

Step 7: Packaging

- The solidified chocolates were removed from molds.
- They were wrapped in aluminium foil and stored in a cool, dry place.

Observations of Herbal Chocolate Formulation (F3 Batch Observation)

Physical Appearance

Parameter	Observation
Color	Light brown
Odor	Pleasant chocolate odor
Taste	Sweet with mild herbal taste
Texture	Smooth and uniform

Weight Variation

Sample No.	Weight (g)	Observation
1	5.01	Within limit
2	4.98	Within limit
3	5.02	Within limit

Average Weight: 5.00g

Result: Uniform weight Distribution

Hardness Test

Batch	Hardness (kg/cm²)	Observation
F3	3.4	Adequate hardness

Melting Point

Batch	Temperature (°C)	Observation
F3	34-36°C	Suitable for oral use

PH Determination

Batch	pH	Observation
F3	6.5	Neutral, safe for consumption

In-vitro Dissolution Study

Time (min)	% Drug Release	Observation
5	40%	Faster release
10	65%	Good release
15	82%	High release

Fig. 7: Filtration of Turmeric Extract.

Fig. 8: Filtration of Ginger Extract.

Fig. 9: Filtration of Mulethi Extract.

Fig. 10: Filtration of Tulsi Extract.

Fig. 11: Cough Relief Chocolate.

6. RESULT AND DISCUSSION

The produced polyherbal chocolate formulations (F1, F2, and F3) exhibited favorable physicochemical characteristics, including a uniform appearance, a smooth texture, a pleasant

chocolate odor, and an acceptable taste. With an average weight of 5 g across all batches, weight variation studies verified a uniform distribution. The melting point range of 34–38°C was determined to be appropriate for oral use, and the hardness values varied from 3.4–3.8 kg/cm², suggesting sufficient strength and stability. The formulations were safe and non-irritating for ingestion, as evidenced by the pH values between 6.5 and 6.7. Drug release was slow and satisfactory in in vitro dissolution experiments, with F3 exhibiting the maximum release of 82% at 15 minutes. Overall, the findings demonstrated that the polyherbal chocolate formulation is more patient-acceptable and stable, tasty, and effective for relieving cough.

7. CONCLUSION

The Using extracts from tulsi, ginger, mulethi, and turmeric, the current study effectively created and assessed a polyherbal chocolate formulation for cough treatment. The produced formulations demonstrated an excellent drug release profile, consistent weight fluctuation, adequate hardness, a sufficient melting point, and satisfactory physicochemical features. The disagreeable taste of the herbal constituents was successfully covered up by the chocolate base, which also enhanced patient compliance and palatability. F3 demonstrated superior overall performance and drug release properties among all formulations. According to the study's findings, polyherbal chocolate is a stable, safe, and patient-friendly dose form that can be a useful substitute for traditional cough medicines, particularly for younger and older patients.

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