

Development and Evaluation of Herbal Formulation for Cough Syrup

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Abstract:

Coughing is a common defence mechanism of the respiratory system that aids in the removal of foreign particles, mucus, and irritants from the airways. Depending on how long it lasts, it can be categorized as acute, subacute, or chronic. It can be brought on by a variety of factors, such as allergies, respiratory infections, pollutants in the environment, and underlying conditions like asthma or chronic bronchitis. Effector muscles, the central nervous system, and sensory receptors in the airways interact intricately to mediate the cough reflex. Coughing can help maintain good airway hygiene, but excessive or persistent coughing can negatively affect quality of life and may be a sign of serious health issues. Clinical evaluation, patient history, and occasionally laboratory or imaging tests to determine the underlying cause are all part of the diagnosis process. Management strategies depend on etiology and may include pharmacological treatments such as antitussives, expectorants, bronchodilators, and antibiotics, along with non-pharmacological approaches like hydration and avoidance of triggers. Understanding the mechanisms and causes of cough is essential for effective treatment and improved patient outcomes. Diagnosis is based on clinical evaluation and supportive investigations, while treatment focuses on addressing the root cause and symptomatic relief through pharmacological and non-pharmacological interventions. Recent advances in cough research have contributed to the development of more effective and targeted therapeutic strategies.

Keywords: Cough reflex, respiratory system, airway clearance, chronic cough

1. Introduction

Cough is one of the most common symptoms encountered in clinical practice and serves as an important protective reflex of the respiratory system. It plays a vital role in clearing the airways of mucus, microorganisms, and foreign particles, thereby maintaining respiratory health and preventing infection. The cough reflex is initiated by the stimulation of specialized sensory receptors located in the respiratory tract, which transmit signals to the cough centre in the brain, resulting in a coordinated expulsion of air from the lungs.

Based on its duration, cough is broadly classified into acute (lasting less than three weeks), subacute (three to eight weeks), and chronic (persisting for more than eight weeks). Acute cough is most often associated with viral upper respiratory tract infections, whereas chronic cough may be linked to underlying conditions such as asthma, chronic bronchitis, gastroesophageal reflux disease, and environmental irritants like smoke and pollution.

Although cough is beneficial in protecting the respiratory system, excessive or persistent coughing can significantly affect an individual's quality of life by causing discomfort, sleep disturbances, and social inconvenience. It may also be a symptom of serious underlying diseases requiring medical attention. Therefore, understanding the underlying mechanisms, causes, and classifications of cough is essential for accurate diagnosis and effective management.

Advancements in medical research have improved the understanding of cough physiology and pathophysiology, leading to the development of better diagnostic tools and targeted therapies. This has enhanced the ability to manage cough more effectively and improve patient outcomes.

1.1 Types of the cough

Cough is classified depending upon duration, character and type.

A] Depending upon type Cough is classified into two types as dry and wet cough which is depend upon type.

This are identified using signs and symptoms.

1) Dry cough

- Productive and effective cough
- Signs associated for dry cough
 - i. Sensitive throat
 - ii. Non mucus expelled
 - iii Short, dry and frequent cough
 - iv. Persistent or constant tickle [Ken , 2021, Herbycin, 2020].
- Medicine: Cough suppressant and antitussive.

2) Wet cough

- Non effective and infective cough
- Signs associated with wet cough
 - i. Coughs up phlegm
 - ii. Wheezing
 - iii. Chest tightness
 - iv. Difficulty in breathing [Patil et al, 2020, Herbycin, 2020].
- Medicine: Expectorant.

B] Depending upon duration It may be classified into acute, sub acute and chronic cough depending upon duration [Patil et al, 2020].

1) Acute cough

- The cough lasting for less than 3 weeks are categorized under this type. 2) 3) Sub acute cough Chronic cough
- Causes for acute cough is due to common cold, URTI, COPD, environmental pollution, and infective bronchitis [Kalpesh, 2013, Kathleen, 2021].
- The cough lasting for at least the period of 3 to 8 weeks is categorized under this type.
- The respiratory causes are pneumonia, and B. pertussis infection.
- Non respiratory causes are GERD and rarely Tourette's syndrome [Kalpesh, 2013, Kathleen, 2021].
- The cough lasting for more than period of 8 weeks or more are chronic coughs.
- The respiratory causes are COPD, asthma, lung cancer, tuberculosis and pneumoconiosis [Kalpesh, 2013, Kathleen, 2021]. Coughs in paediatrics A cough is a sign that indicates that the child's body is trying to get out of itself from irritant, pollutants, and other foreign particles. Cough is one of the most common problems of visiting parents with their child to healthcare practitioner.

Common causes of cough include:

- 1) Allergies or sinusitis: It can cause a prolong cough including an itchy throat, runny nose, watery eyes, sore throat, or rash. Allergy tests are done to find out which allergens cause the problem and doctor advice how to avoid those allergens.
- 2) Asthma: Asthma can be very difficult to diagnose in children as symptoms may vary from every child child.
- 3) Infection: Cold, flu, and croup this leads to a prolong cough for children. Colds cause mild to moderate hacking cough while the flu a sometimes cause severe, dry cough and croup has a “barking” cough mostly occurs at night with noisy breathing.

2. Pathophysiology of Cough

Irritant Stimulus

(Dust, smoke, mucus, microbes, allergens)



Stimulation of Cough Receptors

(Mechanoreceptors & chemoreceptors in respiratory tract)



Activation of Afferent Nerves

(Vagus nerve carries signals)



Cough Centre Activation

(Medulla oblongata in brain)



Signal via Efferent Pathways

(To diaphragm, intercostal & abdominal muscles)



Deep Inspiration



Closure of Glottis



Forceful Contraction of Respiratory Muscles



Sudden Opening of Glottis



Expulsion of Air at High Velocity



Removal of Irritants/Mucus from Airways

When any irritant enters the airway, receptors detect it and send signals to the brain. The brain then triggers a sequence of actions—deep breath, closure of the airway, pressure buildup, and sudden release—resulting in a cough that clears the airway.

3. Mechanism of action of herbal cough syrup

Herbal Cough Syrup

(Tulsi + Ginger + Honey + Turmeric)



Soothes Throat Irritation

(Demulcent Action)



Reduces Inflammation

(Anti-inflammatory Effect)



Loosens and Removes Mucus

(Expectorant Action)



Fights Bacteria & Viruses

(Antimicrobial Effect)



Relaxes Bronchial Muscles
(Bronchodilator Effect)



Cough Relief
Improved Respiratory Health

4. Ingredient table

Table 4.1

S.no	Ingredient	Functions
1	Turmeric	Antioxidant
2	Betal leaves	Antiseptic, Stimulant
3	Tulsi leaves	Antibacterial, anti tussive
4	Orange peel	Flavouring agent
5	Honey	Sweetening agent
6	Alcohol	Preservative

5. Drug profile

5.1. Tulsi (*Ocimum sanctum*)

Family: Lamiaceae

Common Name: Holy Basil / Tulsi

Biological Source: Tulsi consists of the fresh or dried leaves and flowering tops of the plant *Ocimum sanctum*.

Chemical Constituents: Eugenol, Ursolic acid, Linalool, Flavonoids

Uses: Antitussive (relieves cough), Antimicrobial, Anti-inflammatory

5.2. Ginger (*Zingiber officinale*)

Family: Zingiberaceae

Biological Source: It is the dried rhizome of *Zingiber officinale*.

Chemical Constituents: Gingerol, Shogaol, Zingerone, Volatile oils

Uses: Expectorant Anti-inflammatory, Improves digestion, Used in cough syrup formulations.

5.3. Mulethi (*Glycyrrhiza glabra*)

Family: Fabaceae

Biological Source: It consists of dried roots and stolons of *Glycyrrhiza glabra*.

Chemical Constituents: Glycyrrhizin Liquiritin Flavonoids Saponins

Uses: Demulcent (soothes throat) Expectorant Anti-ulcer Used in cough and throat medicines.

5.4. Honey –

Source: Honey Bee

Scientific Name: *Apis mellifera*

Chemical Constituents: Fructose, Glucose, Enzymes, Vitamins, Minerals

Uses: Natural sweetener, Soothes throat irritation, Antimicrobial

6. Procedure

Collection of Raw Materials



Washing of Herbs (Tulsi, Ginger, Mulethi)



Crushing / Grinding of Herbs

↓

Soxhlet Extraction

↓

Filtration (Muslin Cloth / Filter Paper)

↓

Preparation of Simple Syrup (Sucrose + Water with Heating)

↓

Mixing of Herbal Extract with Syrup

↓

Addition of Honey

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Addition of Preservative (Sodium Benzoate)

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Final Volume Adjustment with Water

↓

Final Filtration

↓

Filling in Clean Bottles & Labelling

7.Evaluation Tests

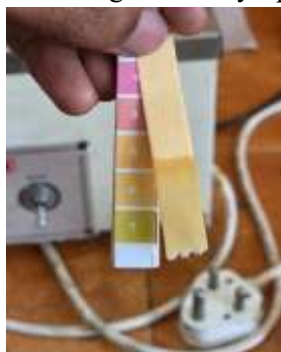
7.1 Organoleptic Properties

S. No.	Parameter	Observation
1	Colour	Light brown / Pale yellow
2	Odour	Pleasant herbal smell
3	Taste	Sweet with slight pungency
4	Appearance	Slightly turbid (semi-clear)
5	Texture	Smooth and viscous

7.2 pH Determination

- The pH of the prepared herbal cough syrup was determined using pH paper by dipping the strip into the syrup sample.
- The color change of the pH strip was compared with the standard color scale provided to estimate the pH value.

- The pH of the formulation was found to be approximately 6–7, indicating that the syrup is nearly neutral and suitable for oral use.



7.3 Stability testing

S. No.	Parameter	Initial (0 Day)	After 7 Days
1	Colour	Light brown	No change
2	Odour	Pleasant	No change
3	Taste	Sweet	No change
4	Appearance	Slightly turbid	No precipitation



7.4 Viscosity

Parameter	Water (Standard)	Syrup (Sample)
Density (g/ml)	1.0	1.2
Time of flow (sec)	50 sec	85 sec



8. Calculation

$$\eta_{\text{syrup}} = \eta_{\text{water}} \times d_{\text{water}} \times t_{\text{water}} \div d_{\text{syrup}} \times t_{\text{syrup}}$$

$$\eta_{\text{syrup}} = 1 \times \frac{1.2 \times 85}{1 \times 50}$$
$$\eta_{\text{syrup}} = 2.04 \text{ cP}$$

9. Future Prospects of Herbal Cough Syrup

- The demand for herbal cough syrups is expected to grow significantly in the coming years due to increasing awareness about the side effects of synthetic drugs and a rising preference for natural and plant-based remedies. Herbal formulations are generally perceived as safer, cost-effective, and suitable for long-term use, making them highly acceptable among all age groups.
- Advancements in phytochemistry and pharmaceutical technology are creating new opportunities to improve the efficacy and stability of herbal cough syrups. Techniques such as standardization of plant extracts, nano formulations, and improved extraction methods can enhance bioavailability and ensure consistent therapeutic effects. This will help overcome one of the major limitations of herbal medicines, which is variability in composition.
- In addition, increasing scientific validation through clinical trials and evidence-based research will strengthen the credibility of herbal cough syrups in modern medicine. Integration of traditional knowledge systems like Ayurveda with modern drug development approaches can lead to the discovery of more effective and targeted herbal combinations for treating different types of coughs.
- The global market for herbal products is expanding rapidly, providing opportunities for commercialization and large-scale production. With proper regulatory support, quality control, and safety evaluation, herbal cough syrups can gain wider acceptance in both domestic and international markets.
- Furthermore, the incorporation of innovative delivery systems, improved flavouring, and sugar-free formulations can make herbal cough syrups more patient-friendly, especially for children and diabetic patients. Overall, the future of herbal cough syrup development is promising, with potential for safer, more effective, and widely accessible treatments for cough and related respiratory conditions.

10. Conclusion

All of these formulations' formulation studies met requirements. Additionally, the resulting syrup's color, flavour, density, and viscosity were all satisfactory. The ultimate formulation that was produced is reliable. The formula was arrived at by reducing the inaccuracy. Because the formulation combines antioxidant and vitamin C qualities, it will be very beneficial for enterprises and researchers to produce similar formulations on a wide scale. We successfully made the herbal honey-based immune booster syrup by utilizing all the herbal products, and we conducted all the evaluation tests necessary to support the conclusion that the prepared immune booster syrup may be stable for an extended period of time. The study emphasized that sugarcane juice, which is used to manufacture gur and honey, offers a variety of nutrients and has favorable health impacts, in contrast to white sugar, which is

connected to disorders like diabetes and obesity. This is accurate despite a dramatic increase in the consumption of goods with added sugar. Using honey and its byproducts more frequently may boost immunity and general health.

11. Result

The prepared herbal cough syrup was evaluated using various physicochemical and organoleptic parameters. The formulation exhibited a pleasant brownish color, characteristic aromatic odor, and a sweet, slightly herbal taste, making it acceptable for oral administration. The pH of the syrup was found to be within the acceptable range (approximately 5–6), indicating suitability for consumption without causing throat irritation. The viscosity was moderate, ensuring ease of pouring while maintaining sufficient coating ability on the throat mucosa. The syrup showed good homogeneity with no visible particles or phase separation, indicating proper mixing and stability of ingredients. The specific gravity was within the standard range for liquid oral preparations, confirming uniformity. Microbial evaluation suggested that the formulation was free from microbial contamination, indicating good hygienic preparation and preservation. The stability study conducted over a short period revealed no significant change in color, odor, or consistency, confirming the formulation's stability. Overall, the herbal cough syrup demonstrated satisfactory physicochemical properties, stability, and patient acceptability, suggesting its potential effectiveness as a natural remedy for cough management.

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