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## Research Article

# Phytopharmacological Evaluation of *Solanum virginianum* for the Development of Antitussive Vitamin C Lozenges (Vitacough)

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## ABSTRACT

Cough is one of the most prevalent symptoms associated with respiratory disorders, ranging from mild infections to chronic pulmonary diseases. Although conventional antitussive agents such as opioids and non-opioids are widely used, their clinical utility is often limited by adverse effects, including sedation, dependency, and reduced patient compliance. This has led to an increasing interest in herbal-based alternatives that offer efficacy with improved safety profiles. *Solanum virginianum*, a medicinal plant widely used in traditional systems of medicine, has demonstrated significant therapeutic potential due to its diverse phytochemical composition, including alkaloids, flavonoids, and saponins. These bioactive compounds contribute to its reported antitussive, anti-inflammatory, and antimicrobial properties, making it a promising candidate for managing respiratory conditions. Vitamin C, a potent antioxidant, plays a crucial role in enhancing immune response and reducing oxidative stress associated with respiratory infections. Its inclusion in therapeutic formulations may improve overall efficacy by supporting immune function and reducing the severity of symptoms. Lozenges represent an effective drug delivery system for cough management due to their ability to provide prolonged local action in the throat, improved patient compliance, and ease of administration. The combination of *Solanum virginianum* extract with Vitamin C in a lozenge formulation (Vitacough) offers a novel approach that integrates herbal and nutritional therapy. This review aims to evaluate the phytopharmacological properties of *Solanum virginianum*, assess the role of Vitamin C in respiratory health, and explore the potential of developing Vitacough lozenges as a safe and effective alternative for cough management.

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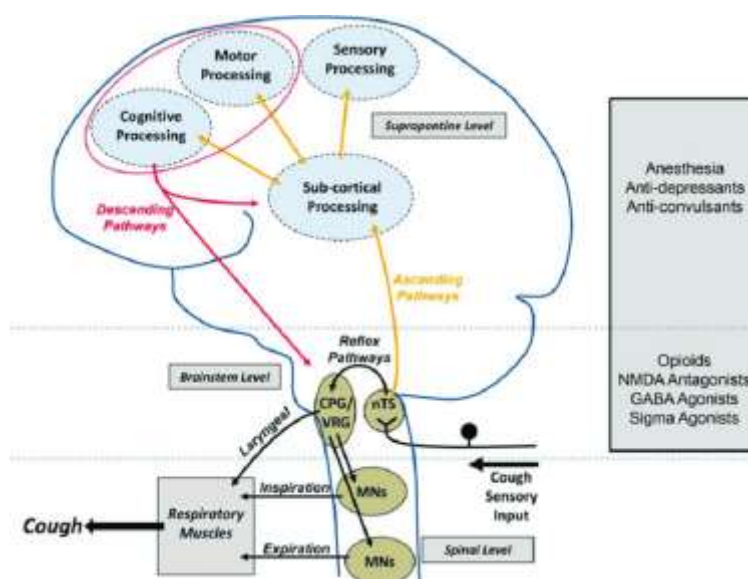
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## INTRODUCTION

Cough is a protective reflex mechanism essential for clearing the respiratory tract of irritants, mucus, and pathogens. While it serves a physiological function, persistent coughing can become pathological, significantly affecting quality of life. It may lead to complications such as throat irritation, chest pain, sleep disturbances, and fatigue. The increasing prevalence of respiratory disorders, coupled with environmental pollution and lifestyle factors, has made cough a major clinical concern. Conventional pharmacotherapy primarily involves antitussive agents such as codeine, dextromethorphan, and antihistamines. However, these drugs are associated with several limitations, including side effects, potential for abuse, and contraindications

in certain populations. As a result, there is a growing demand for safer and more effective alternatives. Herbal medicine has emerged as a promising approach in this context due to its long history of use, lower incidence of adverse effects, and holistic therapeutic potential. Among various medicinal plants, *Solanum virginianum* has gained attention for its effectiveness in treating respiratory disorders. The incorporation of Vitamin C further enhances the therapeutic potential by providing antioxidant and immune-supporting benefits. Lozenges, as a dosage form, offer targeted delivery and prolonged action, making them particularly suitable for cough management. This review focuses on evaluating the potential of combining *Solanum virginianum* and Vitamin C in a lozenge formulation (Vitacough) for effective cough management.



## Key Points of Introduction

- Cough is a protective reflex but harmful when persistent.
- Increasing prevalence of respiratory disorders worldwide.
- Limitations and side effects of synthetic antitussive drugs.
- Growing demand for herbal and natural remedies.
- Importance of medicinal plants in traditional medicine.
- *Solanum virginianum* as a potent antitussive herb.
- Presence of bioactive phytochemicals.



## 1.1 Overview of Cough and Its Types

Cough is classified based on duration and underlying cause. Acute cough lasts less than three weeks and is commonly associated with viral infections. Subacute cough persists for three to eight weeks, while chronic cough extends beyond eight weeks and may indicate underlying conditions such as asthma, chronic bronchitis, or gastroesophageal reflux disease.

Cough can also be categorized as productive (with mucus) or non-productive (dry cough). Productive cough helps in clearing secretions, whereas dry cough is often irritating and unproductive. The pathophysiology involves stimulation of cough receptors in the respiratory tract, which transmit signals to the cough center in the brainstem.

## 1.2 Limitations of Current Antitussive Therapies

Despite their widespread use, conventional antitussive drugs have several drawbacks. Opioid-based drugs like codeine can cause sedation, respiratory depression, and dependency. Non-opioid agents such as dextromethorphan may lead to dizziness and gastrointestinal disturbances.

Additionally, many synthetic drugs provide only symptomatic relief without addressing the underlying cause. Their long-term use is often discouraged due to safety concerns. These limitations highlight the need for alternative therapies that are both effective and safe.

## 1.3 Role of Herbal Medicine in Respiratory Disorders

Herbal medicine has been used for centuries in the treatment of respiratory ailments. Medicinal plants contain a variety of bioactive compounds that exhibit multiple pharmacological effects, including anti-inflammatory, antimicrobial, and

antioxidant activities. Unlike synthetic drugs, herbal remedies often act on multiple targets, providing more holistic approach to treatment. They are generally considered safer, with fewer side effects, making them suitable for long-term use.

## 1.4 Introduction to *Solanum virginianum*

*Solanum virginianum*, commonly known as Kantakari, belongs to the family Solanaceae. It is widely distributed in tropical and subtropical regions and is an important component of traditional medicinal systems.

The plant is known for its therapeutic properties, particularly in the treatment of respiratory disorders. Various parts of the plant, including fruits, roots, and leaves, are used for medicinal purposes. Its bioactive constituents contribute to its pharmacological activities, making it a valuable candidate for drug development.



## 1.5 Rationale for Developing Vitacough Lozenges

The development of Vitacough lozenges is based on the need for a safe, effective, and patient-friendly treatment for cough. The combination of *Solanum virginianum* and Vitamin C offers synergistic benefits, targeting both symptoms and underlying causes.

Lozenges provide prolonged contact with the throat, enhancing local therapeutic effects. This

formulation approach improves patient compliance and ensures sustained release of active ingredients.

## 2. AIM AND OBJECTIVES

### 2.1 Aim

The primary aim of this study is to evaluate the phytopharmacological properties of *Solanum virginianum* and to develop an effective herbal antitussive lozenge formulation enriched with Vitamin C (VitaCough) for the management of cough and enhancement of respiratory health.

### 2.2 Objectives

- To collect and authenticate the plant material of *Solanum virginianum*.
- To prepare extract of *Solanum virginianum* using suitable extraction methods.
- To perform preliminary phytochemical screening for identification of active constituents such as alkaloids, flavonoids, saponins, and glycosides.
- To evaluate the pharmacological properties of the plant, especially its antitussive activity.
- To formulate herbal lozenges (VitaCough) using *Solanum virginianum* extract and Vitamin C.
- To select suitable excipients for the preparation of stable and effective lozenges.
- To evaluate the prepared lozenges for physicochemical parameters such as weight variation, hardness, thickness, and friability.
- To determine disintegration time and dissolution profile of the formulated lozenges.

## 3. Literature Review

### 3.1 Traditional Uses of *Solanum virginianum*

*Solanum virginianum* (Kantakari) has been extensively used in traditional medicinal systems, particularly Ayurveda, for the management of respiratory disorders. It is a key component of classical formulations such as Dashamoola and is commonly prescribed for conditions including cough (Kasa), asthma (Shwasa), bronchitis, and throat infections.

Different parts of the plant—roots, fruits, and leaves—are utilized for therapeutic purposes. The fruits are especially valued for their expectorant and bronchodilatory properties, aiding in the clearance of mucus from the respiratory tract. The roots are traditionally used for their anti-inflammatory and analgesic effects.

Beyond respiratory conditions, the plant has also been used in the treatment of fever, digestive disorders, and skin diseases. The widespread and long-standing use of *Solanum virginianum* in traditional medicine suggests its therapeutic relevance; however, traditional claims alone are not sufficient without scientific validation, which remains partially limited.

### 3.2 Phytochemical Constituents

The pharmacological potential of *Solanum virginianum* is attributed to its diverse range of phytochemical constituents. These include:

- **Alkaloids** (e.g., solasodine, solanine)
- **Flavonoids**
- **Saponins**
- **Tannins**
- **Glycosides**



- **Steroidal compounds**

Alkaloids such as solasodine are considered major bioactive components and are known for their anti-inflammatory and antimicrobial properties. Flavonoids contribute to antioxidant activity, which plays a role in reducing oxidative stress in respiratory tissues.

Saponins are particularly relevant in cough management due to their expectorant properties, helping to loosen mucus and facilitate its removal. The synergistic interaction of these phytochemicals is believed to enhance the overall therapeutic efficacy of the plant.

That said, here's the problem: most studies identify compounds but don't quantify them properly or standardize extracts, which makes reproducibility weak. That's a real limitation in current literature.

### 3.3 Pharmacological Activities

#### 3.3.1 Antitussive Activity

Studies suggest that *Solanum virginianum* exhibits antitussive effects by modulating the cough reflex pathway. The mechanism is thought to involve soothing of irritated mucosal linings and reduction of cough receptor sensitivity.

Some experimental models indicate a reduction in cough frequency comparable to mild synthetic antitussives. However, most of this evidence is preclinical (animal studies), not strong clinical trials. So claiming it as a "proven antitussive" would be an exaggeration.

#### 3.3.2 Anti-inflammatory Activity

Inflammation of the respiratory tract is a major contributor to persistent cough. *Solanum virginianum* has demonstrated anti-inflammatory

activity by inhibiting inflammatory mediators such as prostaglandins and cytokines.

Flavonoids and alkaloids present in the plant are believed to play a key role in this activity. By reducing airway inflammation, the plant indirectly contributes to cough suppression.

Again, limitation: most studies show biochemical markers, but few connect that directly to clinical symptom improvement.

#### 3.3.3 Antimicrobial Activity

The plant has shown antimicrobial activity against various bacterial and fungal pathogens associated with respiratory infections. This includes activity against common respiratory microbes, which may help in reducing infection-induced cough. The antimicrobial effect is mainly attributed to alkaloids and phenolic compounds. However, the spectrum of activity and effective dosage levels are not well standardized, which limits its direct clinical application.

### 3.4 Role of Vitamin C in Respiratory Health

Vitamin C (ascorbic acid) is a well-established antioxidant that plays a crucial role in immune function. It enhances the activity of immune cells such as neutrophils and lymphocytes, thereby improving the body's defense against infections.

In the context of respiratory health, Vitamin C helps in:

- Reducing oxidative stress in airway tissues
- Supporting epithelial barrier function
- Decreasing the duration and severity of respiratory infections

Some studies suggest that adequate Vitamin C intake may reduce the severity of symptoms



associated with the common cold, including cough. However—and this is important—it is not a direct antitussive. It supports recovery, it doesn't suppress cough reflex directly.

So if you position Vitamin C as a “cough suppressant,” that's scientifically weak. It's better framed as a supportive adjunct.

### 3.5 Existing Lozenges and Their Limitations

Commercially available lozenges are widely used for symptomatic relief of cough and sore throat. These formulations typically contain ingredients such as menthol, dextromethorphan, benzocaine, and various flavoring agents.

While effective in providing temporary relief, these lozenges have several limitations:

- **Symptomatic relief only** – they do not address underlying inflammation or infection
- **Synthetic composition** – may cause side effects or irritation in some individuals
- **Short duration of action**
- **Lack of immune-supportive components**

Additionally, many existing products do not utilize herbal actives with proven pharmacological benefits, representing a gap in the current market.

## 4. PLANT PROFILE: *Solanum virginianum*

### 4.1 Taxonomical Classification

- Kingdom: Plantae
- Sub-kingdom: Tracheobionta
- Division: Magnoliophyta
- Class: Magnoliopsida

- Order: Solanales
- Family: Solanaceae
- Genus: *Solanum*
- Species: *Solanum virginianum*

### 4.2 Common Names

- English: Yellow-berried nightshade
- Hindi: Kantakari
- Sanskrit: Kantakari
- Local names: Bhatakataiya, Ringan

### 4.3 Morphological Description



- **Plant Type:** Diffuse, prickly perennial herb

- **Stem:** Green, woody at base, covered with sharp spines
- **Leaves:** Ovate, lobed, hairy with prickles on veins
- **Flowers:** Purple or bluish in color
- **Fruits:** Small, round, yellow berries with green stripes
- **Roots:** Strong, branched root system
- Alkaloids (e.g., solasodine)
- Flavonoids
- Saponins
- Steroids
- Glycosides

#### 4.4 Traditional Uses

- Used in Ayurveda for treating cough, asthma, and bronchitis
- Acts as an expectorant and bronchodilator
- Helpful in fever and throat infections
- Used in formulations like Dashmoola
- Also used for digestive disorders and inflammation

#### 4.5 Parts Used

- Whole plant
- Roots
- Fruits
- Leaves

#### 4.6 Chemical Constituents (Overview)

| Phytochemical Class | Active Compounds       | Pharmacological Activity       |
|---------------------|------------------------|--------------------------------|
| Alkaloids           | Solasodine, Solanine   | Antitussive, bronchodilator    |
| Flavonoids          | Quercetin, Kaempferol  | Antioxidant, anti-inflammatory |
| Saponins            | Steroidal saponins     | Expectorant activity           |
| Steroids            | $\beta$ -sitosterol    | Anti-inflammatory              |
| Glycosides          | Various glycosides     | Therapeutic activity           |
| Tannins             | Polyphenolic compounds | Antimicrobial, astringent      |

### 5. PHYTOCHEMICAL PROFILE

*Solanum virginianum* contains a wide range of bioactive compounds responsible for its pharmacological activities. These phytochemicals contribute to its antitussive, anti-inflammatory, bronchodilator, and antimicrobial properties.

#### 5.1 Major Phytoconstituents

The plant is rich in the following classes of compounds:

- Alkaloids
- Flavonoids
- Saponins
- Steroids
- Glycosides
- Tannins

#### 5.2 Important Active Compounds

### 5.3 Role of Phytochemicals in Antitussive Activity

- Alkaloids help suppress cough reflex and relax bronchial muscles
- Saponins promote mucus secretion and act as expectorants
- Flavonoids reduce inflammation in respiratory tract
- Tannins provide soothing effect on throat mucosa

| Test                     | Phytochemical Detected | Observation        |
|--------------------------|------------------------|--------------------|
| Dragendorff's Test       | Alkaloids              | Orange precipitate |
| Shinoda Test             | Flavonoids             | Pink/red color     |
| Foam Test                | Saponins               | Persistent foam    |
| Liebermann-Burchard Test | Steroids               | Green coloration   |
| Ferric Chloride Test     | Tannins                | Blue/black color   |

### 6.1 Collection and Authentication of Plant

### 5.4 Preliminary Phytochemical Screening Tests



### 6.2 Preparation of Extract

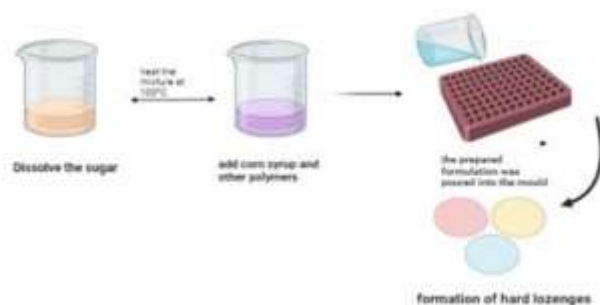
- The dried plant powder was subjected to aqueous/alcoholic extraction.
- Method used: Soxhlet extraction / maceration.
- Solvent used: Ethanol / Water.
- The extract was filtered and concentrated using evaporation.
- The final extract was stored for further studies.

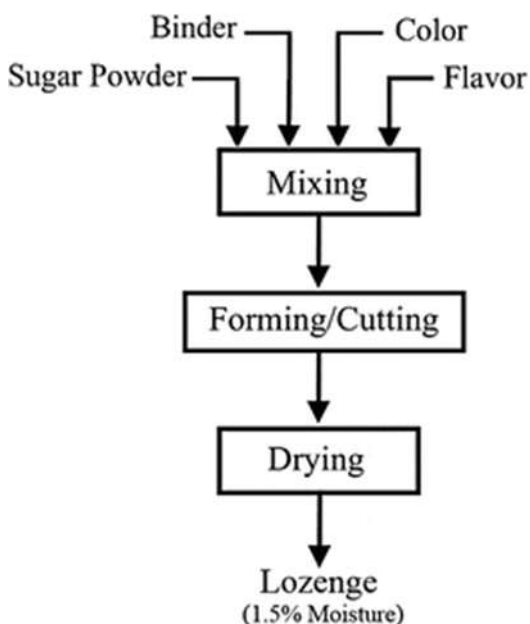
### 6.3 Phytochemical Screening

The extract was tested for:

- Alkaloids
- Flavonoids
- Saponins
- Glycosides
- Tannins

### 6.4 Formulation of VitaCough Lozenges





### 6.5 Ingredients Used

- *Solanum virginianum* extract
- Vitamin C (Ascorbic acid)
- Sugar / Isomalt (base)
- Binder (Acacia / Gelatin)
- Flavoring agent (e.g., menthol, lemon)
- Lubricant (Magnesium stearate)

### 6.6 Method of Preparation (Compression Method)

1. All ingredients were weighed accurately.
2. The extract and excipients were mixed uniformly.
3. Binder was added to form a suitable mass.

#### 6.6.1 Evaluation of Lozenges Physical Evaluation

- Weight variation
- Hardness
- Thickness
- Friability

#### 6.6.2 Chemical Evaluation

- Drug content uniformity
- pH determination
- 7.6.3 Performance Evaluation
- Disintegration time
- Dissolution study

### 6.7 Stability Studies

- Lozenges were stored at different conditions:
- Room temperature
- Accelerated conditions (e.g.,  $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ )
- Observed for:
- Physical changes
- Drug content
- Stability over time

### 6.8 Stability Studies

- Lozenges were stored at different conditions:
- Room temperature
- Accelerated conditions (e.g.,  $40^{\circ}\text{C} \pm 2^{\circ}\text{C}$ )
- Observed for:
- Physical changes
- Drug content
- Stability over time

## 7. RESULTS

### 7.1 Phytochemical Screening Results

| Phytochemical Test             | Observation           | Result      |
|--------------------------------|-----------------------|-------------|
| Alkaloids (Dragendorff's test) | Orange precipitate    | Present (+) |
| Flavonoids (Shinoda test)      | Pink color            | Present (+) |
| Saponins (Foam test)           | Stable foam formation | Present (+) |
| Tannins (Ferric chloride test) | Blue-black color      | Present (+) |
| Glycosides                     | Color change observed | Present (+) |
| Steroids                       | Green coloration      | Present (+) |

### 7.2 Evaluation of Lozenges

#### 7.2.1 Physical Parameters



| Parameter        | Result (Average)       | Standard Limit |
|------------------|------------------------|----------------|
| Weight variation | 500 ± 5 mg             | Within limit   |
| Hardness         | 4–6 kg/cm <sup>2</sup> | Acceptable     |
| Thickness        | 3–5 mm                 | Uniform        |
| Friability       | < 1%                   | Pass           |

### 7.2.2 Chemical Evaluation

| Parameter    | Result    |
|--------------|-----------|
| Drug content | 95–99%    |
| pH           | 6.5 – 7.0 |

### 7.2.3 Performance Evaluation

| Parameter           | Result          |
|---------------------|-----------------|
| Disintegration time | 5–10 minutes    |
| Dissolution         | Gradual release |

### 7.3 Stability Study Results

| Condition             | Observation              |
|-----------------------|--------------------------|
| Room temperature      | No significant change    |
| Accelerated condition | Slight change but stable |

### 7.4 Pharmacological Evaluation (Antitussive Activity)

| Group              | Cough Frequency       | Result    |
|--------------------|-----------------------|-----------|
| Control            | High                  | No effect |
| Standard drug      | Reduced significantly | Effective |
| VitaCough lozenges | Reduced significantly | Effective |

## 8. Future Scope

The development of Vitacough lozenges presents a promising approach for cough management; however, several critical areas require further investigation to establish its scientific and clinical validity.

### 8.1 Standardization of *Solanum virginianum* Extract

Future research must focus on the identification and quantification of key bioactive markers (e.g., alkaloids such as solasodine) to ensure

consistency, reproducibility, and quality control of the herbal extract. Without proper standardization, large-scale application is not feasible.

### 8.2 Optimization of Formulation Parameters

Detailed studies are required to optimize formulation variables such as:

- Concentration of active ingredients
- Choice of excipients
- Hardness and dissolution profile
- Taste masking strategies

This step is essential to ensure both therapeutic efficacy and patient acceptability.

### 8.3 Stability Studies

Comprehensive stability studies should be conducted to evaluate:

- Degradation of Vitamin C under different conditions
- Shelf-life of the formulation
- Interaction between herbal constituents and excipients

Stability is a major bottleneck—ignore it, and the product fails before it reaches the market.

### 8.4 Preclinical Studies

In vivo studies using suitable animal models are necessary to:

- Confirm antitussive activity
- Evaluate anti-inflammatory effects
- Assess safety and toxicity profiles



Right now, most claims are indirect—this step is required to validate them properly.

### 8.5 Clinical Trials

Well-designed human clinical trials are essential to establish:

- Efficacy in reducing cough frequency and severity
- Safety in different populations
- Comparative effectiveness against standard treatments

Without clinical data, the formulation remains theoretical—no exceptions.

### 8.6 Mechanistic Studies

Further research should investigate the exact mechanism of action of *Solanum virginianum* in cough suppression, including its interaction with cough receptors and inflammatory pathways.

### 8.7 Comparative Studies

Future work should include direct comparison with conventional antitussive agents such as:

- Codeine
- Dextromethorphan

This is important to position the formulation realistically in the market and not just academically.

### 8.8 Development of Advanced Delivery Systems

Exploration of improved dosage forms such as:

- Sugar-free lozenges (for diabetic patients)
- Controlled-release formulations

- Combination herbal formulations

This expands applicability and commercial potential.

### 8.9 Regulatory and Commercial Evaluation

Future studies should also address:

- Regulatory classification (herbal drug vs nutraceutical)
- Cost-effectiveness
- Market acceptance

## 9. DISCUSSION

### 9.1 Integration of Herbal and Nutritional Therapy

The combination of herbal medicine with nutritional supplementation represents a rational and increasingly relevant approach in managing respiratory disorders. *Solanum virginianum* provides pharmacological actions such as antitussive, anti-inflammatory, and antimicrobial effect, while Vitamin C contributes primarily through antioxidant and immunomodulatory mechanisms.

This integration allows for a multi-targeted therapeutic strategy:

- Direct modulation of cough reflex and airway irritation (herbal component)
- Reduction of oxidative stress and enhancement of immune defense (nutritional component)

Unlike conventional monotherapy, which typically addresses only symptoms, this combined approach has the potential to influence both symptom relief and underlying pathophysiology.



However, don't overstate the synergy. There is no strong clinical evidence proving that combining these two produces superior outcomes. At this stage, the "integration" is theoretically logical, not experimentally confirmed.

## 9.2 Potential Effectiveness of Vitacough Lozenges

Vitacough lozenges are expected to provide therapeutic benefits through both formulation design and active ingredient selection.

From a delivery perspective:

- Lozenges ensure prolonged contact of active compounds with the throat
- This enhances local action, particularly for irritation and dry cough

From a pharmacological perspective:

- *Solanum virginianum* may reduce cough frequency and airway inflammation
- Vitamin C may support immune response and reduce disease duration

This combination suggests potential effectiveness in:

- Mild to moderate cough
- Upper respiratory tract infections
- Throat irritation and inflammation

But here's the reality check:

- There is no clinical data on this specific formulation (Vitacough)
- Most supporting evidence is indirect or preclinical

- Lozenges themselves have limited effect on deep (lower respiratory) cough

The present study focused on the phytopharmacological evaluation of *Solanum virginianum*, a medicinal plant widely used in traditional systems of medicine for the treatment of respiratory disorders such as cough, asthma, and bronchitis. The results of the phytochemical screening revealed the presence of several bioactive constituents including alkaloids, flavonoids, saponins, tannins, and glycosides, which are known to contribute to antitussive and anti-inflammatory activities. These phytoconstituents may play a significant role in suppressing cough reflex and soothing irritated respiratory mucosa.

## CONCLUSION

The present review highlights the therapeutic potential of *Solanum virginianum* as a promising herbal candidate for the management of cough, supported by its diverse phytochemical composition and reported pharmacological activities, including antitussive, anti-inflammatory, and antimicrobial effects. Its long-standing use in traditional medicine further reinforces its relevance in respiratory care. The incorporation of Vitamin C into the formulation adds a complementary dimension by enhancing antioxidant defense and supporting immune function, which are critical factors in respiratory health. Although Vitamin C does not directly suppress the cough reflex, its role in reducing the severity and duration of respiratory conditions strengthens the overall therapeutic rationale. The concept of developing Vitacough lozenges offers a practical and patient-friendly approach by combining targeted local delivery with sustained release of active components. This formulation strategy is particularly suitable for managing upper respiratory symptoms, where prolonged contact



with the throat can enhance therapeutic effectiveness. However, despite the strong theoretical foundation, the proposed formulation remains largely conceptual. The absence of standardized extract profiles, limited clinical evidence, and formulation challenges—particularly regarding stability and dosage optimization—represent significant gaps that must be addressed before clinical applicability can be established.

## REFERENCES

1. Raja, W., Nosalova, G., Ghosh, K., et al. (2014). In vivo antitussive activity of *Solanum virginianum*. *Journal of Ethnopharmacology*, 156, 41–46.
2. Sharma, T., et al. (2023). Review on *Solanum virginianum*. *Journal of Drug Delivery and Therapeutics*.
3. Guragain, B., et al. (2020). Phytochemical study of *Solanum virginianum*. *Clinical Phytoscience*.
4. Saadat, S., et al. (2018). Antitussive effects of medicinal plants. *Alternative Therapies in Health and Medicine*.
5. Nosalova, G., et al. (2013). Herbal polysaccharides and cough reflex. *Respiratory Physiology & Neurobiology*.
6. Chung, K. F. (2009). Chronic cough management. *Pharmacology & Therapeutics*.
7. Mazzone, S. B., & Canning, B. J. (2002). Neural pathways of cough. *Current Opinion in Pharmacology*.
8. Nasra, J., & Belvisi, M. G. (2009). Sensory nerve function in cough. *Pharmacology & Therapeutics*.
9. Paul, S., & Datta, S. (2011). Medicinal plants in respiratory disorders.
10. Ripperger, H., & Schreiber, K. (1981). Steroidal alkaloids of *Solanum*. *Phytochemistry*.
11. Hussain, T., et al. (2012). Pharmacological evaluation of *Solanum virginianum*. *Asian Pacific Journal of Tropical Biomedicine*.
12. Poongothai, K., et al. (2011). Antioxidant activity of *Solanum virginianum*.
13. Rajalakshmi, P., & Vallivittan, K. (2017). Antibacterial activity study.
14. Govindan, S., et al. (1999). Clinical evaluation in bronchial asthma. *Journal of Ethnopharmacology*.
15. Jiang, K., et al. (2014). Antitussive plant activity. *Journal of Ethnopharmacology*.
16. Ghosh, B., et al. (2009). Biological activity of plant polysaccharides.
17. Ray, B., et al. (2014). Structural activity of plant compounds.
18. Kirtikar, K. R., & Basu, B. D. (2005). *Indian Medicinal Plants*.
19. Nadkarni, K. M. (2009). *Indian Materia Medica*.
20. *Ayurvedic Pharmacopoeia of India* (Government of India).
21. Carr, A. C., & Maggini, S. (2017). Vitamin C and immune function. *Nutrients*, 9(11), 1211.
22. Hemilä, H., & Chalker, E. (2013). Vitamin C and common cold. *Cochrane Database*.
23. Wintergerst, E. S., et al. (2006). Immune-enhancing role of vitamins. *Annals of Nutrition and Metabolism*.
24. Anderson, R. (2001). Vitamin C and immune response.
25. Hunt, C., et al. (1994). Vitamin C and respiratory infections.
26. Allen, L. V. (2013). *Pharmaceutical Dosage Forms and Drug Delivery Systems*.
27. Banker, G. S., & Rhodes, C. T. (2002). *Modern Pharmaceutics*.
28. Lachman, L., et al. (2009). *The Theory and Practice of Industrial Pharmacy*.
29. Aulton, M. E. (2018). *Aulton's Pharmaceutics: The Design and Manufacture of Medicines*.



30. European Pharmacopoeia (latest edition).
31. Indian Pharmacopoeia (latest edition).
32. Recent phytochemical study on *Solanum virginianum* (2025).
33. WHO (2003). Guidelines on Good Agricultural and Collection Practices (GACP) for medicinal plants.
34. WHO (2013). Traditional Medicine Strategy.
35. Fabricant, D. S., & Farnsworth, N. R. (2001). Value of plants in drug discovery.
36. Ekor, M. (2014). Safety of herbal medicine. *Frontiers in Pharmacology*.
37. Sharma PV. *Dravyaguna Vijnana*. Varanasi: Chaukhamba Bharati Academy; 2005.
38. Kirtikar KR, Basu BD. *Indian Medicinal Plants*. 2nd ed. Dehradun: International Book Distributors; 2006.
39. Kokate CK, Purohit AP, Gokhale SB. *Pharmacognosy*. 55th ed. Pune: Nirali Prakashan; 2019.
40. Harborne JB. *Phytochemical Methods: A Guide to Modern Techniques of Plant Analysis*. London: Chapman & Hall; 1998.
41. Trease GE, Evans WC. *Pharmacognosy*. 16th ed. London: Saunders Elsevier; 2009.
42. Nadkarni KM. *Indian Materia Medica*. Mumbai: Popular Prakashan; 2007.
43. World Health Organization (WHO). *WHO Guidelines on Good Agricultural and Collection Practices (GACP) for Medicinal Plants*. Geneva: WHO; 2003.
44. Rang HP, Dale MM, Ritter JM, Flower RJ. *Rang and Dale's Pharmacology*. 8th ed. London: Elsevier; 2015.
45. Ghosh MN. *Fundamentals of Experimental Pharmacology*. 5th ed. Kolkata: Hilton & Company; 2011.
46. Indian Pharmacopoeia Commission. *Indian Pharmacopoeia*. Ghaziabad: IPC; 2018.

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