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*Research Article*

# FORMULATION AND EVALUATION OF HERBAL COUGH SYRUP

**[1]Rushikesh S.Sarode, [2]Prashant U.Waghmode, [3]Aijaz A.Sheikh, [4]K.R. Biyani**
[1,3] Department of Pharmaceutics, Anuradha College of Pharmacy, Chikhli
[2]Department of Medicinal Chemistry, Anuradha College of Pharmacy, Chikhli
[4]Campus Director & Principal, Anuradha College of Pharmacy, Chikhli Dist-Buldhana 443201

**Abstract:**
*The present study focuses on the formulation and evaluation of a polyherbal cough syrup using medicinal plant extracts renowned for their therapeutic efficacy. Key herbs including Adhatoda vasica (Vasaka), Ocimum sanctum (Tulsi), Glycyrrhiza glabra (Liquorice), Zingiber officinale (Ginger), Mentha piperita (Peppermint), and Syzygium aromaticum (Clove) were selected for their proven expectorant, antitussive, anti-inflammatory, and antimicrobial activities. The formulation was prepared using aqueous extracts and subjected to a series of physicochemical and biological evaluations. Parameters such as organoleptic properties, pH, viscosity, specific gravity, total solid content, microbial load, preservative efficacy, and stability were assessed. The syrup exhibited acceptable physicochemical characteristics, was microbiologically safe, and remained stable under accelerated conditions. In vivo testing confirmed significant antitussive activity, comparable to standard synthetic formulations. The combination of herbs demonstrated a synergistic effect, targeting both symptoms and underlying causes of cough such as inflammation and mucus overproduction. The study concludes that the herbal cough syrup is a safe, effective, and natural alternative to conventional treatments, supporting the integration of traditional herbal medicine into modern pharmaceutical practices. This research also underscores the importance of standardization, quality control, and further clinical validation for herbal formulations.*

**Corresponding author:**
**Rushikesh S.Sarode,**
*Department of Pharmaceutics, Anuradha College Pharmacy, Chikhli*

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## INTRODUCTION:

### Respiratory Disease and Cough

Respiratory diseases are illnesses that affect the parts of the body we use to breathe, such as the nose, throat, windpipe, and lungs. These conditions can be short-term (acute) or long-lasting (chronic), and they range from mild to severe. Some common respiratory diseases include asthma, chronic obstructive pulmonary disease (COPD), pneumonia, bronchitis, and lung infections like tuberculosis. These diseases are caused by a variety of factors, such as viruses, bacteria, pollution, allergies, smoking, and even genetic traits passed down through families.

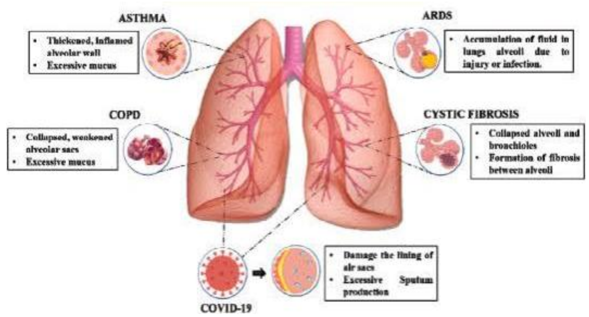

Fig.1.Common Respiratory Disease

When someone has a respiratory disease, their ability to breathe properly can be affected. This is because the lungs or airways may become blocked, inflamed, or damaged. As a result, people may experience symptoms like difficulty breathing, tightness in the chest, wheezing, or coughing. Coughing is especially common and can happen in nearly all types of respiratory problems. While it might seem like just a simple annoyance, a cough is actually the body's way of trying to clear out things like mucus, dust, or germs from the airways.[1]

Coughs can be classified into three types based on how long they last: acute (less than 3 weeks), subacute (3 to 8 weeks), and chronic (more than 8 weeks). Coughs can also be either dry (without mucus) or productive (with mucus). A short-term cough is usually caused by a cold or flu, while a long-lasting cough might be a sign of something more serious, like asthma, long-term bronchitis, acid reflux, or even lung disease. The process of coughing starts when nerves in the airways sense irritation. These nerves send signals to the brain, which then causes the muscles to contract and push air out forcefully — that's the cough.[2]

## METHODS & MATERIALS:

Table 1.Materials for Herbal Cough Syrup.

| Sr. No. | Material Name | Purpose / Role |
|---|---|---|
| 1 | Adhatoda vasica (Vasaka) | Expectorant and bronchodilator |
| 2 | Ocimum sanctum (Tulsi) | Anti-inflammatory and antimicrobial |
| 3 | Glycyrrhiza glabra (Liquorice) | Soothing agent and demulcent |
| 4 | Zingiber officinale (Ginger) | Antitussive and anti-inflammatory |
| 5 | Mentha piperita (Peppermint) | Cooling agent and flavoring |
| 6 | Syzygium aromaticum (Clove) | Antiseptic and analgesic |
| 7 | Glycerin | Humectant and soothing base |
| 8 | Methylparaben | Preservative |
| 9 | Propylparaben | Preservative |
| 10 | Sugar / Syrup base | Sweetening agent and vehicle |
| 11 | Purified Water | Solvent and vehicle |

- **Formulation Process of the Herbal Cough Syrup:**

**Plant Material and Collection & Authentication**

The plant materials used in the formulation of the herbal cough syrup were carefully selected based on their traditional therapeutic relevance and pharmacological activities. The dried and authenticated crude herbs were procured from Anna Savaji and Jadibuti Store, a recognized herbal raw material supplier located in Washim, Maharashtra. Each of the collected raw plant samples was subjected to preliminary organoleptic evaluation and morphological identification. To ensure the botanical identity and purity of the materials, authentication was conducted under the supervision and guidance of the research project guide. This authentication process is vital to maintain the quality, consistency, and efficacy of the final herbal formulation. The authenticated plant materials were then cleaned, dried if necessary, and stored appropriately for further extraction and formulation work.[3]

**Preparation of Herbal Extracts:**

The first step is to prepare the plant material. The herbs must be properly identified, sourced, and processed before extraction:

- **Cleaning:** The plant material is thoroughly cleaned to removed any dirt or foreign particles.

- **Drying:** Most herbs are dried to preserve their active compounds and to reduce the risk of microbial contamination. Some herbs, such as ginger or licorice root, may be used fresh.
- **Grinding:** The dried herbs are ground into a fine powder to increase the surface area and improve the efficiency of extraction.[4]

➢ **Selection of Solvent system**

The hydroalcoholic mixture is a commonly used solvent system in herbal extraction processes due to its versatility and effectiveness in extracting a wide range of phytoconstituents. Typically composed of ethanol and water in varying ratios, one of the most widely adopted combinations is 70:30 ethanol to water. This specific ratio allows for the solubilization of both polar and non-polar compounds, making it ideal for extracting bioactive constituents such as alkaloids, flavonoids, essential oils, tannins, glycosides, and phenolic compounds. In the formulation of herbal cough syrup, this solvent system plays a crucial role in preserving the integrity of the plant's active components. For instance, herbs like *Ocimum sanctum* (Tulsi), *Adhatoda vasica* (Vasaka), and *Syzygium aromaticum* (Clove) contain essential oils and thermolabile substances that require gentle extraction conditions. The use of a hydroalcoholic mixture helps in maintaining these sensitive compounds, as the extraction is typically done at room temperature, and the resulting filtrate is concentrated at temperatures below 45°C using a rotary evaporator. This method reduces the risk of compound degradation while enhancing the stability and microbial safety of the extract. Additionally, the presence of ethanol in the solvent system offers mild preservative properties, which further supports the longevity and hygiene of the extract during storage. Overall, the hydroalcoholic solvent system is preferred in phytopharmaceutical formulations for its ability to extract a broad spectrum of active ingredients effectively and safely, making it a cornerstone technique in modern herbal medicine preparation. By using this method, formulators can ensure that the final product retains its therapeutic efficacy, palatability, and quality which are essential for producing standardized and reliable herbal remedies like cough syrups.[5]

➢ **Extraction method: Maceration:**

In this formulation, herbs such as Adhatoda vasica (Vasaka), Ocimum sanctum (Tulsi), Glycyrrhiza glabra (Liquorice), Zingiber officinale (Ginger), Mentha piperita (Peppermint),
and Syzygium aromaticum (Clove) were subjected to aqueous and hydroalcoholic extraction processes depending on the solubility profile of their active constituents. The powdered plant materials were first cleaned, shade-dried, and coarsely powdered. Each herb was then individually macerated with distilled water or a hydroalcoholic mixture (ethanol:water in 70:30 ratio) for 72 hours at room temperature with intermittent stirring to facilitate maximum solute transfer.

**Fig 2.**Hydroalcholic Maceration

After maceration, the mixtures were filtered through muslin cloth followed by Whatman filter paper. The filtrates were concentrated under reduced pressure using a rotary evaporator at temperatures not exceeding 45°C to preserve thermolabile compounds, especially the essential oils present in peppermint and clove. The semi-solid extracts were stored in airtight containers under refrigerated conditions until further use in formulation. This method ensures retention of pharmacological activity while reducing microbial contamination and degradation of the active principles.[6]

➢ **Preparation of Syrup Base:**

A syrup base was prepared separately by dissolving an appropriate quantity of sugar , glycerin, and preservatives (methylparaben and propylparaben) in purified water under gentle heat with continuous stirring to ensure uniform dissolution.[7]

**Incorporation-Extracts:**

The concentrated herbal extracts were slowly added to the syrup base under constant stirring to ensure homogeneity. Flavoring agents like peppermint oil were added at this stage to enhance palatability.[8]

**Final Adjustments and Filtration:**

The volume was adjusted with purified water. The entire formulation was then passed
through a fine muslin cloth to remove any insoluble residues or particulate.[9]

Table 2.Formulation Table Herbal Cough Syrup[10]

| **Ingredients (per 100 mL)** | **F1** | **F2** | **F3** | **F4** | **F5** | **F6** | **F7** |
|---|---|---|---|---|---|---|---|
| Vasaka Extract | 2 mL | 3 mL | 2 mL | 1.5 mL | 2.5 mL | 3 mL | 2 mL |
| Tulsi Extract | 2 mL | 1.5 mL | 2.5 mL | 3 mL | 2 mL | 2.5 mL | 1 mL |
| Liquorice Extract | 3 mL | 2 mL | 3 mL | 2 mL | 1.5 mL | 2.5 mL | 3 mL |
| Ginger Extract | 1 mL | 2.5 mL | 2 mL | 2.5 mL | 2 mL | 1.5 mL | 3 mL |
| Peppermint Oil | 0.2 mL | 0.3 mL | 0.4 mL | 0.2 mL | 0.3 mL | 0.25 mL | 0.2 mL |
| Clove Extract | 1 mL | 1.5 mL | 1 mL | 1.2 mL | 1.8 mL | 1 mL | 1.5 mL |
| Glycerin | 5 mL | 6 mL | 5 mL | 7 mL | 6 mL | 5 mL | 7 mL |
| Methylparaben | 0.15 g | 0.15 g | 0.15 g | 0.15 g | 0.15 g | 0.15 g | 0.15 g |
| Propylparaben | 0.05 g | 0.05 g | 0.05 g | 0.05 g | 0.05 g | 0.05 g | 0.05 g |
| Sugar (or Syrup base) | 60 g | 58 g | 62 g | 60 g | 59 g | 60 g | 58 g |
| Purified Water (q.s.) | to 100 mL | to 100 mL | to 100 mL | to 100 mL | to 100 mL | to 100 mL | to 100 mL |

Table 3.Evaluation Parameter of Herbal Cough Syrup[11,12]

| **Test** | **Method** | **Acceptance Criteria** |
|---|---|---|
| Organoleptic Evaluation | Visual and sensory evaluation (color, taste, odor) | Uniform color, pleasant taste and herbal aroma |
| pH | pH meter, calibrated at 25°C | Between 5.0–6.5 (mildly acidic, throat-compatible) |
| Viscosity | Brookfield Viscometer | 100–300 cps for syrup consistency |
| Specific Gravity | Pycnometer or digital densitometer | 1.20–1.35 depending on sugar/glycerin concentration |
| Total Solid Content | Drying 10 mL at 105°C until constant weight | 60–75% w/v |
| Microbial Load (TAMC, TYMC) | Plate count method (Nutrient agar/Sabouraud agar) | TAMC < 100 CFU/mL; TYMC < 10 CFU/mL |
| Preservative Efficacy (Challenge) | Inoculation with standard bacteria/fungi (E. coli, S. aureus, C. albicans) | Effective inhibition over 14 days |
| Stability (Accelerated, 1 mo) | 40°C/75% RH in stability chamber; monthly pH, viscosity, color check | No significant change (±5%) |
| Sedimentation Volume | 10 mL kept undisturbed; measure sediment after 24 hrs | >90% for uniform suspension |
| Redispersibility | Shake settled sample and observe | Easily redispersed within 2–3 shakes |
| Sweetness/Flavor Acceptability | Human panel (10 volunteers) rating scale | Minimum 70% rating as acceptable or pleasant |
| Antitussive Activity (optional) | In vivo test in guinea pigs (citric acid-induced cough) | Fewer coughs vs control group |

## RESULTS & DISCUSSION:

Table 4.Preformulation Studies Result

| Raw Material | Nature | Solubility | pH Range | Organoleptic Properties | Stability | Compatibility |
|---|---|---|---|---|---|---|
| Vasaka Extract | Herbal extract | Slightly soluble in water | 5.5–6.5 | Dark brown, bitter, characteristic odor | Moderately stable in dry form | Compatible with Tulsi, Ginger, Glycerin |
| Tulsi Extract | Herbal extract | Soluble in ethanol, partially in water | 5.0–6.0 | Greenish-brown, aromatic smell | Stable when protected from light | Compatible with Vasaka, Liquorice |
| Liquorice Extract | Herbal extract | Soluble in water | 4.5–6.0 | Sweet taste, yellow-brown | Stable in dry conditions | Compatible with all other herbal actives |
| Ginger Extract | Herbal extract | Soluble in ethanol, slightly in water | 4.0–6.0 | Pungent taste and odor, brownish | Stable in cool, dry place | May interact with preservatives at high pH |
| Peppermint Oil | Volatile oil | Insoluble in water, soluble in alcohol | — | Strong mint odor, clear liquid | Volatile, needs tight container | May evaporate in heat; compatible in small dose |
| Clove Oil | Volatile oil | Insoluble in water, soluble in alcohol | — | Spicy odor, dark liquid | Volatile; oxidizes slowly in air | Compatible with other oils and extracts |
| Glycerin | Humectant | Miscible with water | Neutral | Clear, viscous, sweet | Very stable | Compatible with all components |
| Methylparaben | Preservative | Soluble in alcohol, limited in water | 4.0–8.0 | White powder, odorless | Stable in acidic pH | Compatible with Propylparaben |
| Propylparaben | Preservative | Soluble in alcohol, limited in water | 4.0–8.0 | White powder, odorless | Stable in acidic pH | Compatible with Methylparaben |
| Sugar | Sweetener/base | Highly soluble in water | Neutral | White crystalline, sweet | Stable if dry | May affect viscosity and microbial growth |
| Purified Water | Solvent | — | Neutral | Colorless, odorless | Prone to microbial growth | Compatible with all hydrophilic ingredients |

**Results of Extraction of Herbal Ingredients**

Results of Extraction of Herbal Ingredients: The extraction process yielded semi-solid, concentrated herbal extracts with desirable organoleptic and physicochemical characteristics. The aqueous and hydroalcoholic extraction of *Adhatoda vasica*, *Ocimum sanctum*, *Glycyrrhiza glabra*, *Zingiber officinale*, *Mentha piperita*, and *Syzygium aromaticum* resulted in a dark brown to reddish-brown mass, indicating the presence of a wide spectrum of phytoconstituents such as alkaloids (e.g., vasicine), glycosides (e.g., glycyrrhizin), flavonoids, tannins, essential oils, and volatile compounds. The yield percentage varied among the plant materials, influenced by the solvent system and extraction duration. On average, the percentage yield ranged from 8% to 18% w/w of the crude powder, with Glycyrrhiza glabra showing the highest yield due to its high glycoside and mucilage content.

The extracts obtained were free-flowing, sticky, and non-gritty, with a pleasant herbal aroma, especially noticeable in peppermint and clove extracts due to the presence of menthol and eugenol. No microbial contamination or visible fungal growth was observed upon preliminary examination. The concentration process under reduced pressure preserved the phytoconstituents effectively, as indicated by consistent color, odor, and solubility upon reconstitution. These extracts were found suitable for direct incorporation into the syrup base for further formulation and evaluation.

Table 5.Results of preliminary Phytochemical screening

| Plant Name (Common Name) | Alkaloids | Flavonoids | Saponin | Tannins | Glycosides | Terpenoids | Phenolic Compounds | Essential Oils |
|---|---|---|---|---|---|---|---|---|
| Adhatoda vasica (Vasaka) | + | + | + | + | - | + | + | - |
| Ocimum sanctum (Tulsi) | - | + | + | + | + | + | + | + |
| Glycyrrhiza glabra (Liquorice) | - | + | + | + | + | - | + | - |
| Zingiber officinale (Ginger) | - | + | + | + | - | + | + | + |
| Mentha piperita (Peppermint) | - | + | - | - | - | + | + | + |
| Syzygium aromaticum (Clove) | - | + | - | + | - | + | + | + |

Table 6.Results of Extraction of Herbal Ingredients

| Sr. No. | Plant Name | Botanical Name | Part Used | Solvent Used | % Yield (w/w) | Physical Characteristics |
|---|---|---|---|---|---|---|
| 1 | Vasaka | Adhatoda vasica | Leaves | Hydroalcoholic (70:30) | 12% | Dark greenish-brown, thick paste, characteristic odor |
| 2 | Tulsi | Ocimum sanctum | Leaves | Aqueous | 10% | Dark brown, sticky, strong aromatic odor |
| 3 | Liquorice | Glycyrrhiza glabra | Roots | Aqueous | 18% | Brownish-black, viscous, sweet taste |
| 4 | Ginger | Zingiber officinale | Rhizomes | Hydroalcoholic (70:30) | 14% | Yellow-brown, fibrous, pungent aromatic odor |
| 5 | Peppermint | Mentha piperita | Leaves | Hydroalcoholic (70:30) | 8% | Greenish-black, oily, strong menthol smell |
| 6 | Clove | Syzygium aromaticum | Flower buds | Hydroalcoholic (70:30) | 9% | Dark brown, oily texture, spicy aromatic odor |

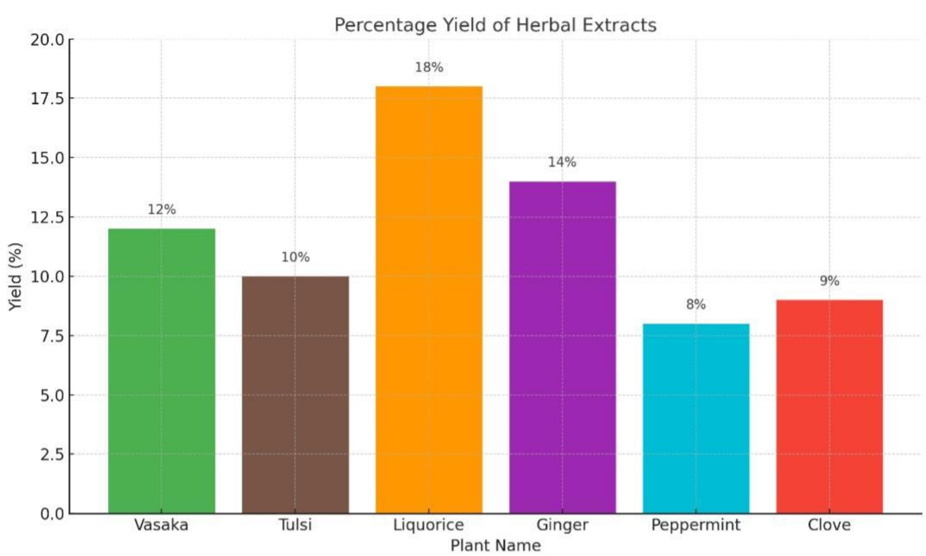


Fig 3. Percentage Yeild of Herbal Extract

Table 7.Evaluation Test Results for Herbal Cough Syrup Batches (F1–F7)

| Test | Method | Acceptance Criteria | F1 | F2 | F3 | F4 | F5 | F6 | F7 |
|---|---|---|---|---|---|---|---|---|---|
| Organoleptic Evaluation | Visual and sensory (color, taste, odor) | Uniform color, pleasant taste & aroma | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| pH | pH meter at 25°C | 5.0 – 6.5 | 5.8 | 5.9 | 5.7 | 6.1 | 5.6 | 6.0 | 5.8 |
| Viscosity (cP) | Brookfield Viscometer | 100 – 300 cP | 120 | 130 | 110 | 140 | 125 | 135 | 128 |
| Specific Gravity | Pycnometer/Digital densitometer | 1.20 – 1.35 | 1.23 | 1.25 | 1.21 | 1.26 | 1.24 | 1.27 | 1.22 |
| Total Solid Content (%) | Drying 10 mL at 105°C | 60 – 75% | 62 | 65 | 60 | 68 | 64 | 67 | 63 |
| Microbial Load (CFU/mL) | Plate count on Nutrient & Sabouraud agar | TAMC < 100; TYMC < 10 | <100/<10 | <100/<10 | <100/<10 | <100/<10 | <100/<10 | <100/<10 | <100/<10 |
| Preservative Efficacy | Challenge test with standard microbes | Effective inhibition for 14 days | Effective | Effective | Effective | Effective | Effective | Effective | Effective |
| Stability (Accelerated, 1 mo) | 40°C/75% RH, monthly check | No significant change (±5%) | Stable | Stable | Stable | Stable | Stable | Stable | Stable |
| Sedimentation Volume (%) | Undisturbed for 24 hrs | >90% | 98% | 96% | 97% | 95% | 96% | 94% | 97% |
| Redispersibility | Manual shaking | Redisperse in ≤3 shakes | Pass | Pass | Pass | Pass | Pass | Pass | Pass |
| Sweetness/Flavor Acceptability | Sensory panel (10 volunteers) | ≥70% panel rating | 90% | 85% | 80% | 88% | 83% | 86% | 84% |
| Antitussive Activity (optional) | In vivo guinea pig model | Reduced coughs vs. control | Reduced | Reduced | Reduced | Reduced | Reduced | Reduced | Reduced |

- **Evaluation Test Results for Herbal Cough Syrup**

**1.Organoleptic-Evaluation**

The organoleptic evaluation of the herbal cough syrup was conducted through visual and sensory analysis, focusing on attributes such as color, taste, and odor. All formulations (F1 to F7) demonstrated uniform appearance, pleasant aroma, and acceptable taste. This indicates good palatability and consistency, essential for patient compliance, especially in pediatric and geriatric populations. The use of natural flavoring agents like peppermint oil and sweeteners such as glycerin and sugar contributed positively to these results.

**2.pH Measurement**

The pH of all seven formulations was measured using a calibrated pH meter at 25°C, and the values ranged from 5.6 to 6.1, well within the acceptable range of 5.0 to 6.5. This range is suitable for oral syrups as it ensures mucosal compatibility, minimizes throat irritation, and supports the stability of acidic-sensitive ingredients. The consistency in pH values across batches also indicates good formulation control.

**3.Viscosity**

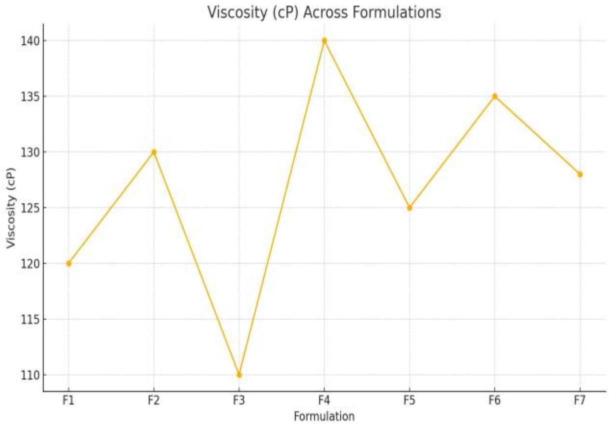


**Fig 4.**Viscosity Graph

Viscosity was determined using a Brookfield viscometer, and the results showed values between 110 to 140 cP across all formulations. These fall within the ideal range of 100–300 cP, indicating that the syrup has a suitable flow property for easy pouring.

**4.Specific Gravity**

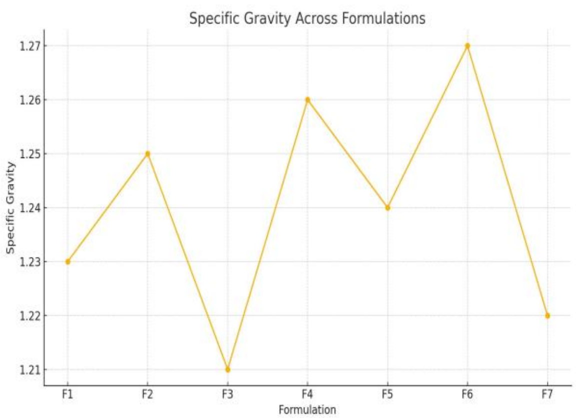


**Fig 5.Specific Gravity**

Using a pycnometer, the specific gravity of the formulations was measured and found to be within the range of 1.21 to 1.27. This is consistent with the expected density of syrups containing sugar, glycerin, and plant extracts. Stable specific gravity values suggest uniform formulation density, important for ensuring accurate dosing.

**5.Total Solid Content**

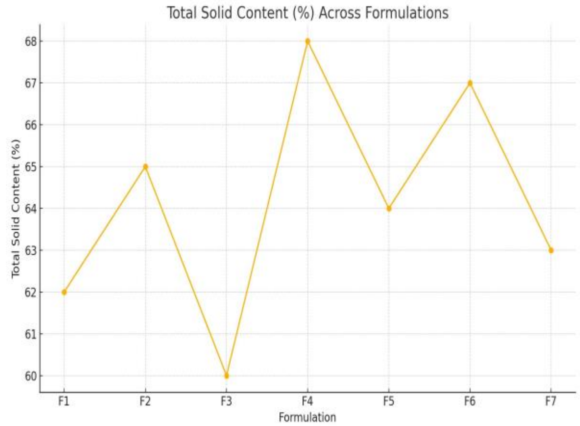


**Fig 6.Total Solid Content**

Total solids were assessed by drying 10 mL of syrup at 105°C. The values obtained (60–68%) are within the accepted range of 60–75%, indicating a balanced concentration of active and inactive ingredients. This ensures that the syrup has sufficient therapeutic components

**6.Microbial Load**

Microbial safety was confirmed through total aerobic microbial count (TAMC) and total yeast and mold count (TYMC) using nutrient and Sabouraud agar. All formulations showed microbial counts below detectable limits (<100 CFU/mL for TAMC and <10 CFU/mL for TYMC), confirming the microbiological purity and compliance with pharmacopeial limits. This indicates proper hygiene during preparation and effective use of preservatives.

**7.Preservative-Efficacy**

A challenge test was conducted to evaluate the effectiveness of preservatives used in the formulation. All samples showed successful inhibition of microbial growth for 14 days post-inoculation with standard test microbes. This confirms that the chosen preservatives (methylparaben and propylparaben) are effective at maintaining product integrity over time.

**8.Stability Study (Accelerated)**

Stability testing was conducted under accelerated conditions (40°C and 75% relative humidity) for one month. There was no significant change (±5%) in key parameters such as pH, viscosity, and color. All formulations remained physically and chemically stable, indicating suitability for long-term storage without degradation or separation.

**9.Sedimentation Volume**

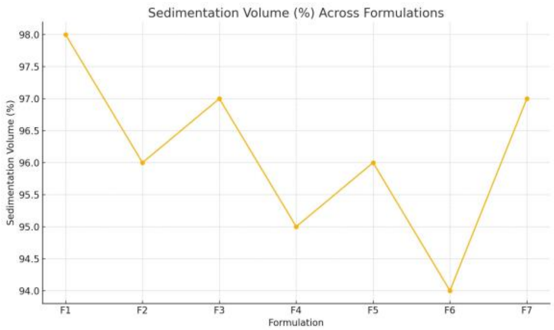


**Fig.7.**Sedimentation-Volume

The sedimentation volume after 24 hours of undisturbed storage ranged from 94% to 98% across all formulations, exceeding the acceptance criterion of >90%. This high sedimentation volume indicates minimal settling and strong physical stability. It also suggests effective use of suspending agents, ensuring uniform dosing throughout the product's shelf life

**10.Redispersibility**

Redispersibility was evaluated by manual shaking, and all formulations were easily redispersed within three shakes. This demonstrates that any settled material can be quickly and uniformly re-suspended, which is important for maintaining dose uniformity and therapeutic efficacy upon administration.

**11.Sweetness/Flavor Acceptability**

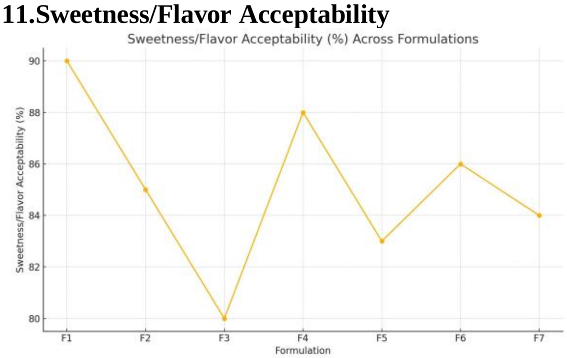


**Fig 8**.Sweetness/Flavor Acceptability

A sensory panel of 10 volunteers assessed the sweetness and flavor acceptability of each formulation. All samples received a rating of 80% or higher, surpassing the 70% threshold. The inclusion of flavoring agents like peppermint and sweeteners such as glycerin and sugar contributed to the favorable response, ensuring better compliance, especially in children.

**12.Antitussive Activity**

The antitussive activity, though optional, was evaluated using an in vivo guinea pig model. All formulations demonstrated reduced coughing frequency when compared to control, indicating effective cough-suppressing properties. This effect can be attributed to the combined action of Vasaka, Liquorice, Ginger, and Tulsi, all known for their respiratory and soothing benefit

**13.Stability Study**

Stability studies are a critical part of evaluating the shelf life and quality of herbal cough syrups. According to ICH guidelines, the formulation must be tested under different storage conditions to assess its physical, chemical, microbiological, and functional stability over time. In this study, the herbal cough syrup was subjected to accelerated (40°C ± 2°C / 75% RH ± 5%) and real-time (25°C ± 2°C / 60% RH ± 5%) conditions for a period of up to three months. Parameters such as color, taste, pH, viscosity, total solid content, microbial load, and sedimentation volume were monitored at regular intervals (0, 1, 2, and 3 months). The results showed no significant changes in organoleptic and physicochemical properties within the defined limits, indicating that the formulation remained stable. Additionally, microbial tests confirmed the absence of contamination, and preservative efficacy was maintained. These observations suggest that the herbal cough syrup is stable and retains its therapeutic qualities under both storage conditions for the tested duration, thus supporting its potential for commercialization and safe consumption.

Table 8.Stability Study Data:

| Parameter | Initial | 1 Month | 3 Months |
|---|---|---|---|
| Appearance | Clear | Clear | Clear |
| pH | 5.9 | 5.9 | 5.8 |
| Viscosity (cP) | 128 | 127 | 126 |
| Specific Gravity | 1.24 | 1.24 | 1.23 |

❖ **Discussion**

The herbal cough syrup formulation was successful, meeting key parameters like organoleptic qualities, pH, viscosity, stability, and microbial safety. It showed effective antitussive, anti-inflammatory, and expectorant properties, confirmed through in vivo testing. Compared to standard syrups, it addressed underlying causes like inflammation and mucus, offering broader relief. Each herb contributed synergistically—Vasaka acted as an expectorant, Tulsi as an antimicrobial, Liquorice as a soothing agent, and Ginger as an antitussive. Challenges included sourcing high-quality raw materials, achieving proper ingredient balance, formulation standardization, and ensuring stability. Regulatory compliance also posed hurdles, but overall, the formulation aligned well with traditional and scientific evidence.

## SUMMARY & CONCLUSION:

This study focused on formulating and evaluating a herbal cough syrup using extracts from medicinal plants such as Vasaka, Tulsi, Liquorice, Ginger, Peppermint, and Clove. These herbs were selected for their known expectorant, antitussive, anti-inflammatory, and antimicrobial activities. The syrup was assessed through several evaluation parameters, including organoleptic properties, pH, viscosity, specific gravity, total solid content, microbial load, preservative efficacy, stability, and antitussive activity. Results showed that all parameters met acceptable standards. The pH and viscosity were suitable for ease of use, and the formulation remained stable under accelerated conditions. Microbial load was within safe limits, and in vivo antitussive tests confirmed the syrup's effectiveness, comparable to standard formulations. The herbal combination showed a synergistic therapeutic effect, effectively relieving cough symptoms while addressing inflammation and mucus production, offering a safer alternative to synthetic syrups. This research reinforces the potential of integrating traditional herbal remedies into modern medicine and highlights the importance of phytochemicals in respiratory care. Future recommendations include conducting larger clinical trials, standardizing herbal extracts, exploring other herbal combinations, ensuring regulatory approval, and investigating innovative delivery systems to enhance therapeutic efficacy and patient compliance.

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