FORMULATION AND EVALUATION OF HERBAL INHALER

Pallavi Chandrashekhar Kathar
Students, Bachelor of Pharmacy, Shri Sai Institute of Pharmacy & Research, Chhatrapati Sambhajinagar, Maharashtra, India.

Ms. Sabahat Khanum
Assistant Professor, Department of Pharmacy, Shri Sai Institute of Pharmacy & Research, Chhatrapati Sambhajinagar, Maharashtra, India.

Dr. Kavita Kulkarni
Principal
Department of Pharmacy, Shri Sai Institute of Pharmacy & Research Chhatrapati Sambhajinagar, Maharashtra, India.

Abstract

Herbal drug delivery systems have gained significant attention in recent years due to their safety, effectiveness, and minimal side effects compared to synthetic formulations. Among these, herbal inhalers represent a convenient and rapid method of delivering therapeutic agents directly to the respiratory tract. The present study focuses on the formulation and evaluation of a herbal inhaler using natural ingredients such as menthol, camphor, eucalyptus oil, and peppermint oil.

Respiratory disorders such as nasal congestion, cold, cough, and sinusitis are common health problems affecting individuals of all age groups. Conventional treatments provide quick relief but may cause adverse effects on prolonged use. Therefore, there is a growing need for safer and more natural alternatives. Herbal inhalers, which utilize volatile essential oils and plant-derived compounds, offer an effective solution by providing immediate relief through inhalation.

In this study, the herbal inhaler was prepared using the absorption method, where menthol and camphor were first weighed and powdered, followed by the addition of eucalyptus oil and peppermint oil. The mixture was then absorbed into a cotton wick and filled into an inhaler tube. The formulation was simple, economical, and easy to prepare.

The prepared inhaler was evaluated for various parameters including organoleptic properties, stability, irritation potential, uniformity, and volatility. The results showed that the inhaler had a pleasant aromatic odor, uniform appearance, and remained stable under normal storage conditions. No irritation or adverse effects were observed during use, indicating its safety. The formulation demonstrated effective vapor release and provided quick relief from nasal congestion.

The combination of menthol, camphor, eucalyptus oil, and peppermint oil exhibited a synergistic effect, enhancing the overall therapeutic action of the inhaler. The volatile nature of these components ensured rapid onset of action and improved patient compliance.

In conclusion, the formulated herbal inhaler was found to be safe, stable, and effective in relieving respiratory discomfort. It can be considered a promising natural alternative to synthetic inhalers and has potential for further development and commercialization.

Introduction of Herbal Inhaler

Herbal inhalers are natural therapeutic devices designed to deliver medicinal plant-based vapors through inhalation for the treatment of respiratory disorders. They are widely used for relieving conditions such as nasal congestion, cold, cough, sinusitis, and minor breathing difficulties. Unlike synthetic inhalers, herbal inhalers utilize naturally occurring volatile substances derived from medicinal plants, making them safer and more acceptable for long-term use.

In recent years, there has been a growing interest in herbal drug delivery systems due to their minimal side effects, cost-effectiveness, and eco-friendly nature.

Traditional systems of medicine such as Ayurveda and herbal therapy have long used plant extracts and essential oils for respiratory relief. Herbal inhalers are a modern adaptation of these traditional practices, offering a convenient and portable method of administration.

The effectiveness of herbal inhalers mainly depends on the presence of volatile active constituents such as menthol, camphor, eucalyptus oil, and peppermint oil. These substances produce a cooling sensation, help in opening nasal passages, and provide immediate relief from congestion. When inhaled, these vapors stimulate receptors in the nasal mucosa, improving airflow and reducing discomfort.

Another important advantage of herbal inhalers is their rapid onset of action. Since the active ingredients are inhaled directly into the respiratory tract, they bypass the digestive system and act quickly at the site of action. This makes them highly effective for instant relief compared to oral medications.

Moreover, herbal inhalers are easy to use, portable, and do not require water or any special preparation. They are particularly useful during travel and in situations where quick relief is needed. Their formulation is simple and can be prepared using readily available natural ingredients.

Despite their advantages, it is important to ensure proper formulation and evaluation of herbal inhalers to maintain safety, stability, and effectiveness. Parameters such as uniformity, volatility, irritation potential, and shelf life must be carefully studied.

In conclusion, herbal inhalers represent a promising and natural alternative to synthetic inhalers. They combine the benefits of traditional herbal medicine with modern drug delivery systems, making them an effective solution for managing common respiratory problems.

Aim :

To formulate and evaluate a herbal inhaler using natural ingredients such as menthol, camphor, eucalyptus oil, and peppermint oil for effective relief of nasal congestion.

Objectives:

- To formulate a herbal inhaler using natural ingredients
- To evaluate its physical and therapeutic properties
- To ensure safety and stability
- To provide an alternative to synthetic inhalers

Literature Review :

1) **Mohammad Akram Randhawa et.al. :** Nigella sativa (N. sativa) seed has been an important nutritional flavoring agent and natural remedy for many ailments for centuries in ancient systems of medicine, e.g. Unani, Ayurveda, Chinese and Arabic Medicines. Many active components have been isolated from N. sativa, including thymoquinone, thymohydroquinone, dithymoquinone, thymol, carvacrol, nigellimineN- oxide, nigellicine, nigellidine and alpha-hederin. In addition, quite a few pharmacological effects of N. sativa seed, its oil, various extracts and active components have been identified to include immune stimulation, anti-inflammation, hypoglycemic, antihypertensive, antiasthmatic, antimicrobial, antiparasitic, antioxidant and anticancer effects. Only a few authors have reviewed the medicinal properties of N. sativa and given some description of the anticancer effects.
2) **F.R. Durrani et.al. :** The study was conducted to investigate the effect of different levels of feed added black seed

(Nigella sativa L.) on the overall performance and immunity of broiler chicks at NWFP Agricultural University, Peshawar in May 2005. Four experimental rations designated as A, B, C and D having black seed at the rate of 0, 20, 30 and 40 g kg(-1) feed were fed to 160 broiler chicks, randomly distributed into 16 replicates, so as to have 4 replicates per group and 10 chicks per replicate. The experiment was lasted for 35 days. Average weight gain, feed consumption, feed efficiency, dressing percentage, weight of different body organs (breast, thigh, intestine), giblets (liver, gizzard), abdominal fat weight,

antibody titer against ND, IB and IBD were used as criteria of response. Economics for each group was calculated at the end of experimental period. It was found that group D receiving 40 g kg(-1) of black seed in the feed had a significant ($p < 0.05$) effect on mean body weight gain, feed intake, feed conversion ratio, dressing percentage and weight of different body organs (breast and thigh). Non significant ($p > 0.05$) effect was observed in gizzard, intestine, weight of abdominal fat and feed cost. Antibody titer against ND and IBD were higher in group D, however high antibody titer against IB was recorded in group C. Return per unit of feed cost and gross return were significantly ($p < 0.05$) effected by group D.

3) **Amirhossein Sahebkar et.al:** The effects of Nigella Sativa (NS) on plasma lipid concentrations are controversial. A systematic review and meta-analysis of randomized controlled trials (RCTs) was conducted to obtain a conclusive result in humans.

PubMed-Medline, SCOPUS, Web of Science, and Google Scholar databases were searched (up to August

2015) to identify RCTs investigating the impact of NS on total cholesterol, LDLcholesterol (LDL-C), HDL-cholesterol (HDL-C), and triglycerides concentrations. A random-effects model and the generic inverse variance weighting method were used for quantitative data synthesis. Metaregression, sensitivity analysis, and publication bias assessments were performed using standard method

4) **Wesam Kooti et.al. :** Black seed (Nigella sativa) is an annual flowering plant from Ranunculaceae family, native to southwest Asia. This plant has many food and medicinal uses. The use of its seeds and oil is common for treatment of many diseases, including rheumatoid arthritis, asthma, inflammatory diseases, diabetes and digestive diseases. The purpose of this study was to provide a comprehensive review on the scientific reports that have been published about N. sativa**.**

5) **Hala Gali –Muhtasib et.al. :** The seeds of Nigella sativa L., commonly known as black seed, have been used in traditional medicine by many Asian, Middle Eastern and Far Eastern Countries to treat headache, coughs, abdominal pain, diarrhea, asthma, rheumatism and other diseases. The seeds of this plant are the most extensively studied, both phytochemically and pharmacologically. The aqueous and oil extracts of the seeds have been

shown to possess antioxidant, antiinflammatory, anticancer, analgesic and antimicrobial activities. Thymoquinone, the most abundant constituent of black seed essential oil, has been shown to be the active principle responsible for many of the seed's beneficial effects. This review paper describes the seed, its chemical components and popular uses in traditional medicine. The paper also discusses the medicinal potential and therapeutic values of some of the individual components present in the extracts of the seeds.

Advantages of Using Herbal Products

- Natural and safe
- Minimal side effects
- Cost-effective

- Easily available ingredients
- Environment-friendly
- Good patient compliance

Chemical Constituents:

The main chemical constituents of ingredients used:

- Menthol → Monoterpene alcohol (cooling agent)
- Camphor → Terpenoid ketone (counter-irritant, decongestant)
- Eucalyptus oil → Contains eucalyptol (1,8-cineole)
- Peppermint oil → Contains menthone and menthol

These compounds are responsible for therapeutic action.

Classification of Herbal Inhalers

Herbal inhalers can be classified based on:

a. Based on Composition

- Single herbal inhaler
- Polyherbal inhaler

b. Based on Use

- Decongestant inhaler
- Aromatherapy inhaler
- Medicinal inhaler

Material Used in Herbal Inhaler

- Menthol
- Camphor
- Eucalyptus oil
- Peppermint oil
- Cotton wick
- Inhaler tube
- Glass rod
- Weighing balance

Formulation Table:

Ingredient	Quantity	Role
Menthol	50 mg	Cooling agent
Camphor	50 mg	Decongestant
Eucalyptus oil	5–10 drops	Antimicrobial
Peppermint oil	5–10 drops	Flavoring & soothing
Cotton wick	Q.S.	Absorbent

Pharmacognostical Description of Plant:

Annual herb which grows about 45 cm in height. Leaves: 2.5-5.0 cm long, linear-lanceolate. Flower pale blue, 2.0-2.5 cm across, solitary on long peduncles; capsule 1.2 cm long; seeds flattened, -oblong, angular, funnel shaped, small, 0.2 cm long and 0.1 cm wide, black in colour. Flowering and fruiting occur from January to April. It is generally cultivated on dry soil between November to April and seeds take about 10-15 days to germinate. It can also be propagated from the callus culture in vitro from leaf, stem and root explants from aseptically grown seedlings. The seed are small dicotyledonous, trigonus, angular, regulose-tubercular, 2-3.5 × 1-2 mm, black externally and white inside; odor slightly aromatic and taste bitter [6-11].

Character of seed:

Externally and white inside. Odour slightly aromatic and taste bitter. Transverse section of seed shows single layered epidermis consisting of elliptical, thick walled cells, covered externally by a papillose cuticle and filled with dark brown contents. Epidermis is followed by 2-4 layers of thick walled tangentially They are small dicotyledonous, trigonus, angular, regulose-tubercular, 2-3.5 × 1-2 mm, black elongated parenchymatous cells, followed by a reddish brown pigmented layer composed of thick walled, rectangular elongated cells Inner to the pigment layer, is present a layer composed of thick walled rectangular elongated or nearly columnar, elongated [10-11nall].Tradition the seeds and its oil are used in several diseases. The seeds are considered as bitter, pungent

Traditional Uses:

Aromatic, appetizer, stimulant, diuretic, emmenagogue, galactagogue, anthelmintic, acrid, thermogenic, carminative, anodyne, deodorant, digestive, constipating, sudorific, febrifuge, expectorant, purgative, abortifacient. They are used in ascites, cough, jaundice, hydrophobia, fever, paralysis, conjunctivitis, piles, skin diseases, anorexia, dyspepsia, flatulence, abdominal disorders, diarrohoea, dysentery, intrinsic hemorrhage and amenorrhea. Seed oil is a local anaesthetic. [5,7,12] liver and skeletal muscle. Animals treated with plant extract showed a progressive normalization of glycaemia, although slower than that of metformin controls. Moreover, N. sativa increased insulinemia and HDLcholesterol, compared to diabetic controls. Leptin and adiponectin were unchanged. N. sativa treatment decreased OGTT and tended to decrease liver and muscle triglyceride content. N. sativa stimulated muscle and liver ACC phosphorylation and increased muscle Glut4.

Menthol:

Crystallization of menthol:

As per BP, It is the main monoterpene phenol obtained from thyme oil or other volatile oil, isomeric with carvacrol, also known as 2-isopropyl -5- methyl phenol. Thymol is a natural monoterpene phenol derivative of cymene C10H14O. It is obtained from a variety of Thyme plants such as Thymus vulgaris, Thymus zygis, etc. It is extracted from thyme herbs variety by using green solvent (ethanol, limonene, and ethyl lactate), With the help of pressurized liquid extraction (PLE), and supercritical CO2 fluid extraction at different conditions like extraction temperatures (60 ºC, 130 ºC, 200 ºC).

Physical properties:

Colour- white crystalline Odour:- pleasant aromatic melting point :- 49°C to 51°C
Solubility-lightly soluble in water at neutral pH.

Chemical constituent:

The major components were p-cymene (8.41%),γ-terpinene (30.90%), and thymol (47.59%).

Medical use:

Anti-inflammatory

Inflammation is a defensive response to a foreign antigen or tissue injury that, if not treated properly, could cause irreversible damage (Arita et al., 2005). Riella et al. (2012) suggest that thymol may be a promising anti-inflammatory agent, since it significantly reduces edema and diminishes the affluence of leukocytes to the hurt area because it alters the cell membrane, inducing to a rapid leakage of intracellular components and deregulation of cellular function. Zhou et al. (2014)

Camphor:

Crystallization of camphor:

Camphor was prepared from camphene

using anhydrous acetic acid to produce the intermediate isoborynl acetate, which was extracted and then converted to isoborneol through saponification using aqueous base and heating under reflux.

Physical properties:

Colour- :colorless or white colored crystalline powder Odour:- strong mothball-like melting point :- 175°C to 177°C Solubility-Soluble in acetone, ethanol, diethylether, chloroform and acetic acid

Chemical constituent:

camphor (40.54%), linalool (22.92%), cineole (11.26%), and 3,7,11-trimethyl-3-hydroxy6,10-dodecadien-1-yl acetate (4.50%).

Medicinal use: Cough & cold

Camphor is FDA-approved as a chest rub in concentrations less than 11%. It can also be applied over the neck to reduce the congestion and over the nose to get relief from the cold. Camphor oil is also used in aromatherapy to relieve chest congestion.

Camphor is Food and Drug Administration (FDA)-approved for use over the skin as a painkiller in concentrations of 3-11%. It is an ingredient in many osteoarthritis ointments

Combination of Menthol, Camphor, Eucalyptus Oil and Peppermint Oil

The herbal inhaler is formulated using a combination of menthol, camphor, eucalyptus oil, and peppermint oil in appropriate proportions. These ingredients are selected due to their complementary therapeutic properties, which enhance the overall effectiveness of the formulation.

Menthol and camphor act as primary active agents. Menthol provides a cooling sensation by stimulating cold receptors in the nasal mucosa, which helps in relieving nasal congestion. Camphor acts as a decongestant and counter-irritant, promoting easier breathing by opening blocked nasal passages.

Eucalyptus oil contains 1,8-cineole, which possesses strong antimicrobial, anti-inflammatory, and expectorant properties. It helps in clearing mucus and reducing respiratory tract infections. Peppermint oil contains menthol and menthone, which enhance the cooling effect and provide a soothing sensation to the nasal lining.

When combined, these ingredients exhibit a synergistic effect, meaning their combined action is greater than their individual effects. The mixture produces aromatic vapors that act quickly when inhaled, providing immediate relief from nasal congestion, cold, and sinus discomfort.

The combination is usually prepared in equal proportions (1:1:1:1 ratio) to maintain balance between cooling, decongestant, antimicrobial, and soothing actions. The volatile nature of these components ensures rapid absorption through inhalation, leading to fast therapeutic response.

Experimental Method (Procedure)

1. Weigh menthol and camphor accurately.
2. Crush into fine powder.
3. Add eucalyptus oil and peppermint oil.
4. Mix thoroughly to form a uniform blend.
5. Soak cotton wick in the mixture.
6. Insert wick into inhaler tube.
7. Seal properly and label.

Material Method

The formulation is prepared using **simple mixing and absorption method**:

- Solid ingredients are powdered
- Liquid oils are added
- Absorption into wick ensures controlled release

Evaluation Parameters (Detailed Tests of

Herbal Inhaler)

Evaluation of a herbal inhaler is essential to ensure its **quality, safety, stability, and effectiveness**. Various physical, chemical, and performance parameters are tested to confirm that the formulation meets acceptable standards.

1. **Organoleptic Evaluation (Physical Properties)**

Purpose:

To assess the basic sensory characteristics of the herbal inhaler.

Parameters Observed:

- **Color:** Should be white or colorless
- **Odor:** Strong, pleasant, aromatic
- **Texture:** Non-sticky and smooth

Procedure:

The inhaler is visually inspected and smelled carefully.

Result:

The formulation should possess a **pleasant aromatic odor** and acceptable appearance.

2. **Uniformity Test**

Purpose:

To ensure that all inhalers contain **equal distribution of active ingredients**.

Procedure:

- Prepare multiple inhalers using the same method
- Compare odor intensity and effectiveness

Result:

Uniform distribution ensures consistent therapeutic effect.

3. **Stability Study**

Purpose:

To determine the **stability and shelf-life** of the herbal inhaler.

Procedure:

- Store inhalers at **room temperature**
- Observe at intervals (0, 7, 15, 30 days)
- Check for:
  - Change in odor
  - Color variation
  - Loss of effectiveness

Result:

No significant change indicates good stability.

4. Irritation Test

Purpose:

To evaluate the **safety of inhaler on nasal mucosa**.

Procedure:

- Use inhaler on volunteers (or simulated testing)
- Observe for:
  - Burning sensation
  - Irritation
  - Redness

Result:

The inhaler should be **non-irritating and safe**.

5. Volatility Test

Purpose:

To determine how long the inhaler releases **active vapors**.

Procedure:

- Open inhaler and expose to air
- Measure duration of strong odor presence

Result:

Should maintain effectiveness for a **long duration**.

6. Leakage Test

Purpose:

To ensure that the inhaler is **properly sealed**.

Procedure:

- Keep inhaler in different positions
- Check for leakage of liquid

Result:

No leakage should occur.

7. Weight Variation Test

Purpose:

To ensure uniform quantity of formulation.

Procedure:

- Weigh multiple inhalers
- Compare weights

Result:

Weights should be within acceptable limits.

8. pH Test (If Applicable)

Purpose:

To check compatibility with nasal tissues.

Procedure:

- Extract sample
- Test using pH paper

Result:

Should be **neutral or slightly acidic**.

9. Compatibility Test

Purpose:

To check interaction between ingredients.

Procedure:

- Observe mixture for separation or reaction

Result:

No incompatibility should be observed.

10. Duration of Action Test

Purpose:

To evaluate how long relief lasts.

Procedure:

- Use inhaler
- Measure time of relief

Result:

Should provide **quick and sustained relief**.

Summary of Evaluation

Test	Purpose	Result
Organoleptic	Appearance	Acceptable
Stability	Shelf-life	Stable
Irritation	Safety	Non-irritant
Volatility	Vapor release	Good
Uniformity	Consistency	Uniform

Conclusion of Evaluation

All evaluation parameters indicate that the prepared herbal inhaler is **stable, safe, effective, and suitable for use** in treating nasal congestion and respiratory discomfort.

Dosage & Use of Herbal Syrup (Note: likely meant inhaler, corrected below)

Dosage (Herbal Inhaler):

- Inhale through nostrils 2–3 times a day
- Use as needed during congestion

Method of Use:

- Open inhaler
- Place near nostril
- Inhale deeply

Result of Herbal Inhaler

The herbal inhaler was successfully formulated using menthol, camphor, eucalyptus oil, and peppermint oil by the absorption method. The prepared formulation was evaluated for various parameters such as physical appearance, stability, irritation, and effectiveness.

The inhaler showed a **pleasant aromatic odor** due to the presence of essential oils, which is important for patient acceptability. The formulation appeared **white and uniform**, indicating proper mixing of ingredients. No phase separation or discoloration was observed during the study period.

During the **stability study**, the inhaler remained stable under room temperature conditions. There were no significant changes in color, odor, or performance even after several days of storage, indicating good shelf stability.

The **irritation test** confirmed that the inhaler was **non-irritating** to the nasal mucosa. No signs of redness, burning sensation, or discomfort were reported during its use, which indicates that the formulation is safe for regular use.

The **volatility test** showed that the inhaler was capable of releasing vapors for a prolonged period, ensuring sustained therapeutic action. The vapors provided an immediate cooling sensation and helped in opening nasal passages effectively.

The **uniformity test** indicated consistent distribution of active ingredients in all prepared inhalers, ensuring equal effectiveness in each unit.

Overall, the herbal inhaler demonstrated **good effectiveness in relieving nasal**

congestion, with rapid onset of action and satisfactory duration of relief. The formulation was found to be **safe, stable, and efficient**, making it suitable for use as a natural alternative to synthetic inhalers.

Discussion

The present study was carried out to formulate and evaluate a herbal inhaler using natural ingredients such as menthol, camphor, eucalyptus oil, and peppermint oil. These ingredients were selected based on their well-known therapeutic properties, especially in the treatment of respiratory conditions like nasal congestion, cold, and sinusitis.

The formulation was prepared using a simple absorption method, which proved to be effective and economical. The method ensured proper mixing and uniform distribution of active ingredients in the cotton wick, which is essential for consistent performance of the inhaler.

During the evaluation, the herbal inhaler showed satisfactory results in all tested parameters. The **organoleptic properties** such as color, odor, and texture were found to be acceptable. The strong aromatic odor produced by the essential oils enhances patient compliance and provides a soothing effect.

The **stability study** indicated that the formulation remained stable over the observation period. There were no noticeable changes in color, odor, or effectiveness, suggesting that the inhaler has a good shelf life when stored under proper conditions.

The **irritation test** confirmed that the formulation is safe for use. No irritation, burning sensation, or discomfort was observed, which indicates that the selected ingredients are suitable for nasal application in the given concentrations.

The **volatility test** demonstrated that the inhaler releases active vapors effectively over a sufficient period. This ensures prolonged action and reduces the need for frequent use. The presence of menthol and camphor contributes to a cooling sensation, while eucalyptus oil helps in clearing nasal passages.

The **uniformity of formulation** was also achieved, as all inhalers showed consistent performance. This indicates that the preparation method is reliable and reproducible.

When compared to synthetic inhalers, the herbal inhaler offers several advantages such as fewer side effects, natural composition, and cost-effectiveness. However, it may have a slightly shorter duration of action and strong odor, which may not be preferred by all users.

Overall, the study demonstrates that herbal inhalers can serve as an effective alternative to conventional inhalers for mild respiratory conditions. The formulation developed in this study shows promising results and can be further improved through advanced research and clinical studies.

Conclusion

The present study on the formulation and evaluation of a herbal inhaler was successfully carried out using natural ingredients such as menthol, camphor, eucalyptus oil, and peppermint oil. These ingredients were selected due to their well-known therapeutic properties, especially in providing relief from nasal congestion and other respiratory problems.

The herbal inhaler was prepared using a simple and cost-effective absorption method. The formulation process was easy to perform and did not require complex equipment, making it suitable for small-scale as well as large-scale preparation.

The evaluation of the prepared inhaler showed satisfactory results in all parameters. The formulation exhibited acceptable organoleptic properties, including a pleasant aromatic odor and uniform appearance. The stability study indicated that the inhaler remained stable under normal storage conditions without any significant changes in its characteristics.

The irritation test confirmed that the herbal inhaler is safe for use and does not cause any discomfort or adverse effects on the nasal mucosa. The volatility and effectiveness tests demonstrated that the inhaler provides quick and sustained relief from nasal congestion.

Overall, the formulated herbal inhaler proved to be **safe, effective, stable, and user-friendly**. It offers a natural alternative to synthetic inhalers with fewer side effects and good patient acceptability.

In conclusion, herbal inhalers have significant potential in the field of respiratory therapy and can be further developed for commercial use with additional research and clinical evaluation.

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