

Review On Formulation and Evaluation of Herbal Steam Inhalation Capsule for the Management of Acute Respiratory Conditions

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Abstract:

Acute respiratory conditions such as cold, cough, nasal congestion, and bronchitis are prevalent diseases impacting the respiratory tract. Steam inhalation is a conventional and effective approach utilized to relieve respiratory discomfort by aiding in clearing mucus and improve breathing. The current study focuses on the development and testing of herbal steam inhalation capsules comprising natural constituents such as eucalyptus oil, tulsi oil, peppermint oil, camphor, vitamin e, and liquid paraffin. These herbal constituents possess antimicrobial, anti-inflammatory, and congestion reliever properties that assist in relieving respiratory symptoms. The formulated capsules are designed to release curative vapours when added to hot water, facilitating easy inhalation. The formulation was evaluated using parameters such as physical appearance, stability, and percentage moisture loss. The results propose that herbal steam inhalation capsules may provide a simple, effective, and natural approach for the therapeutic management of acute respiratory clinical conditions.

Introduction :

Respiratory tract infections (rtis) are among the most prevalent diseases affecting population globally and recurrent a significant cause of morbidity and mortality (world health organization, 2023; centers for disease control and prevention, 2023).the respiratory system plays a crucial role in the interchange of oxygen and carbon dioxide and comprises organs such as the nose, throat, trachea, bronchi, and lungs (davidson's principles and practice of medicine, 2022; harrison's principles of internal medicine, 2022). Any infection or inflammation impacting these organs can lead to pulmonary disorders that impair normal breathing and overall health (the lancet respiratory medicine, 2018). Respiratory tract infections are generally classified into two categories: upper respiratory tract infections (urtis) and lower respiratory tract infections (lrtis) (centers for disease control and prevention, 2023; nature reviews disease primers, 2021). Urtis affect the upper parts of the respiratory system such as the nose, sinuses, pharynx, and larynx, while lrtis involve the lower parts including the trachea, bronchi, bronchioles, and lungs (davidson's principles and practice of medicine, 2022).

In recent years, herbal medicines have gained significant attention due to their natural origin, therapeutic benefits, and minimal side effects (world health organization, 2023). Many medicinal plants contain biologically active compounds that exhibit antimicrobial, anti-inflammatory, and expectorant properties (journal of ethnopharmacology, 2020). The inhalation of warm, moist vapours assists in thinning mucus, reducing nasal congestion, soothing inflamed airways, and improving airflow in the respiratory tract (centers for disease control and prevention, 2023). Steam inhalation therapy can also facilitate the delivery of volatile medicinal substances directly into the respiratory system, thereby providing faster symptomatic relief (nature reviews disease primers, 2021).

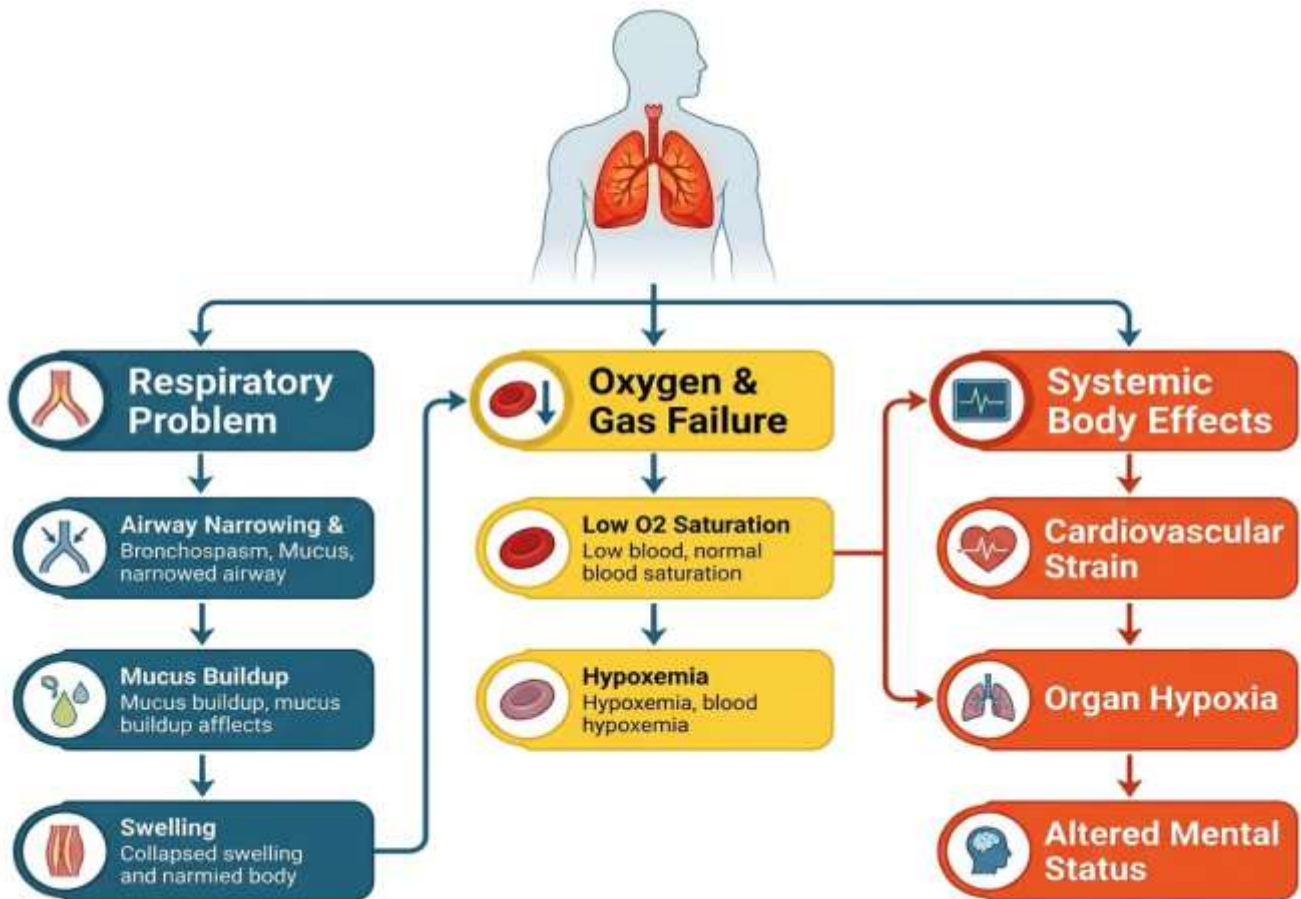
Components release aromatic vapours that assist clear the respiratory passages during steam inhalation (evidence-based complementary and alternative medicine, 2021).

To improve the convenience and effectiveness of steam inhalation therapy, herbal constituents can be formulated into steam inhalation capsules (journal of ethnopharmacology, 2020). These capsules contain volatile herbal oils and other

supportive constituents that release therapeutic vapors when added to hot water (remington: the science and practice of pharmacy, 2021). This formulation provides a standardized, easy-to-use, and portable dosage form compared to traditional herbal preparations (world health organization, 2023).

Pathophysiology of acute respiratory conditions:

Acute respiratory conditions encompass a range of disorders affecting the respiratory tract, primarily caused by infectious agents (viral or bacterial) or environmental irritants such as allergens, smoke, and pollutants. The pathophysiology involves a complex interaction between the causative agent and the host immune response, leading to structural and functional alterations in the respiratory system.



Initially, the pathogen or irritant gains entry into the respiratory tract through inhalation and adheres to the epithelial lining of the airways. This triggers activation of the innate immune response, resulting in the release of inflammatory mediators, including cytokines, histamine, and prostaglandins. These mediators promote vasodilation and increased vascular permeability, leading to mucosal edema.

Mucosal edema + excess mucus secretion

↓

Airway narrowing / obstruction

(± bronchospasm in some conditions)

↓

Impaired airflow

↓

Alveolar involvement (in severe cases)

(fluid/exudate accumulation)

↓

Impaired gas exchange + v/q mismatch

↓

Hypoxia ± hypercapnia

↓

Clinical symptoms

Cough • wheezing • dyspnea • fever • chest discomfort

Simultaneously, there is stimulation of goblet cells and submucosal glands, causing excessive mucus secretion. The combined effect of mucosal swelling and mucus accumulation leads to narrowing of the airways and increased airway resistance. In certain conditions, such as acute asthma exacerbations, bronchospasm further contributes to airflow limitation.

In cases where the lower respiratory tract is involved, particularly at the level of the alveoli as seen in pneumonia, inflammatory exudates, fluid, and cellular debris accumulate within the alveolar spaces. This impairs normal gas exchange by reducing the diffusion of oxygen into the bloodstream and limiting the removal of carbon dioxide. Consequently, hypoxemia and, in severe cases, hypercapnia may develop.

Additionally, ventilation-perfusion (v/q) mismatch occurs due to uneven distribution of airflow and blood flow within the lungs, further compromising oxygenation. The systemic effects of the inflammatory response include fever, malaise, tachypnea, and increased metabolic demand.

If the condition progresses without appropriate management, it may lead to severe complications such as acute respiratory distress syndrome (ARDS), respiratory failure, or systemic spread of infection.

Drug profile:

Tulsi oil (Ocimum sanctum essential oil) :

Composition:

Primary constituents: eugenol (60-70%), linalool (3-5%), methyl eugenol, caryophyllene, 1,8-cineole

Steam-distilled from leaves/flowers of holy basil (Ocimum sanctum/tenuiflorum)

Pharmacological actions:

Eugenol (main active)

↓

Anti-inflammatory (COX/LOX inhibition)

↓

Antimicrobial (membrane disruption)

↓

Bronchodilatory (Ca²⁺ channel block)

↓

Anxiolytic (gaba-a modulation)

Clinical uses:

Respiratory: cough, bronchitis, asthma (expectorant, mucolytic, anti-spasm)

Infectious: topical antifungal (candida), antibacterial (staph/strep)

Pain: muscle/joint pain, toothache (eugenol = clove oil active)

Stress/anxiety: aromatherapy (inhalation reduces cortisol)

Tulsi oil is obtained from the plant *ocimum sanctum* (also known as *ocimum tenuiflorum*), prevalently known as holy basil (journal of ethnopharmacology, 2020; world health organization, 2023). It is widely utilized in traditional medicine for the treatment of pulmonary disorders due to its antimicrobial, anti-inflammatory, and immunomodulatory properties (evidence-based complementary and alternative medicine, 2021). The major phytoconstituents current in tulsi oil comprises eugenol, ursolic acid, rosmarinic acid, and linalool . These compounds assist in combating microbial infections, reducing inflammation in the respiratory tract, and improving immunity. In steam inhalation therapy, tulsi oil assists relieve symptoms such as cough, cold, and throat irritation.

Eucalyptus oil :**Composition:**

eucalyptus globulus / radiata leaf oil

- cineole (eucalyptol) 70-85% (main active)
- α -pinene, limonene, α -terpineol
- steam distilled from leaves

Pharmacological actions:

Cineole (1,8-cineole)

↓

Mucolytic (\uparrow cilia beat frequency)

↓

Anti-inflammatory (\downarrow cytokines il-6/tnf- α)

↓

Bronchodilator (β 2 agonist-like)

↓

Antimicrobial (gram+/- disruption)

↓expectorant (\uparrow tracheobronchial secretions)

Clinical use:

Acute respiratory conditions:

- cough, bronchitis, sinusitis (mucolytic)
- common cold, flu (decongestant)
- asthma/copd (bronchodilator support)

Topical: muscle pain, arthritis (rubefacient)

Inhalation: respiratory infections, stress

Eucalyptus oil is obtained from the leaves of eucalyptus globulus. It is prevalently utilized in respiratory treatments because of its strong congestion reliever and expectorant properties. The major phytoconstituents current in eucalyptus oil comprises eucalyptol (1,8-cineole), α -pinene, and limonene (journal of ethnopharmacology, 2020; world health organization, 2023). Eucalyptol is the main active component responsible for loosening mucus, clearing nasal passages, and improving airflow in the respiratory system. During steam inhalation, eucalyptus oil releases aromatic vapours that assist reduce nasal congestion and promote easier breathing (evidence-based complementary and alternative medicine, 2021).

Conclusion :

The current work successfully demonstrates the formulation and evaluation of herbal steam inhalation capsules for the treatment of acute respiratory conditions. The formulation was prepared using selected herbal constituents including tulsi oil (ocimum sanctum), eucalyptus oil (eucalyptus globulus), peppermint oil (mentha piperita), camphor (cinnamomum camphora), vitamin e, and liquid paraffin. These herbal components are widely known for their antimicrobial, anti-inflammatory, congestion reliever, and expectorant activities, which make them useful in the management of respiratory problems such as cold, cough, sinusitis, and nasal blockage.

The formulated capsules were evaluated using several parameters such as physical appearance, weight uniformity, leakage test, odor evaluation, moisture content, and stability studies. The formulation also remained stable under normal storage conditions without any noticeable change in color, odor, or overall appearance.

The presence of essential oils in the formulation produces aromatic vapors during steam inhalation, which assist in clearing the respiratory tract and providing relief from congestion. The combined action of the herbal constituents assists in loosening mucus, reducing inflammation of the airways, and improving breathing comfort in individuals suffering from acute respiratory conditions.

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