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Formulation and evaluation of herbal anti-stress nasal inhaler

Kalash Deshbhratar *, Rahul Jadhav, Abhinav Bais and V. S. Babu Agala

G H Raisoni Institute of Life Sciences, Nagpur.

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Abstract

Stress is a major health concern in today's fast-moving and competitive lifestyle, affecting both physical and mental well-being. Continuous stress may lead to anxiety, depression, insomnia, headache, fatigue, reduced concentration, and other psychological disorders. Although synthetic medications are commonly used for stress management, prolonged use of these drugs may produce side effects such as drowsiness, dependency, and reduced mental alertness. Therefore, there is an increasing demand for safe, natural, and effective herbal alternatives for stress relief. Aromatherapy is one of the most widely accepted natural therapies that utilize essential oils extracted from medicinal plants to promote relaxation, improve mood, and reduce stress through inhalation. The present study focuses on the formulation of an herbal aromatherapy inhaler for stress relief using essential oils of sweet orange, rosemary, peppermint, and tulsi. These selected herbal oils possess significant therapeutic properties that contribute to mental relaxation and emotional balance. Sweet orange essential oil is known for its anxiolytic and uplifting effects that help prevent nervous tension and enhance positivity. Rosemary oil enhances mental clarity, concentration, and memory while reducing mental fatigue. Peppermint oil gives a cooling, refreshing, and energizing effect that helps reduce stress, headache, and tiredness. Tulsi (Holy Basil) is a well-known adaptogenic herb that helps the body cope with stress and provides calming and rejuvenating effects. The developed formulation demonstrated pleasant aroma, good stability, easy usability, and satisfactory stress-relieving effects. The synergistic combination of herbal essential Oils showed potential in reducing mental stress, improving mood, and promoting relaxation without causing harmful side effects. Thus, the herbal aromatherapy inhaler can be considered a safe, economical, convenient, and natural alternative to synthetic stress-relief therapies for daily use.

Keywords: Aroma; Essential Oil; Inhaler; Stress Relief

1. Introduction

Stress is a condition of physical and mental tension that arises when an individual is unable to cope with daily emotional pressure, workload, or environmental factors. In modern society, stress has become one of the most common health problems affecting people of all age groups. Previous scientific studies supported the use of essential oils and herbal aromatherapy for stress relief and mood enhancement. Studies conducted [1] reported that the aroma of sweet orange helps reduce anxiety and improves mood in stressful conditions. That essential rosemary oil enhances concentration, memory, and mental relaxation [2]. Another study by Moss showed that peppermint aroma improves alertness, cognitive performance, and reduces mental fatigue [3]. The study reported that *Ocimum sanctum* (Tulsi) possesses significant anti-stress and anxiolytic activity [4]. These scientific findings support the selection of Sweet Orange, Rosemary, Peppermint, and Tulsi oils in the formulation of the herbal anti-stress inhaler [5,6]. Stress is a major health concern in today's fast-moving and competitive lifestyle, affecting both physical and mental well-being. Stress is defined as a physiological and psychological response of the body toward internal or external challenges that disturb normal homeostasis. Continuous stress may lead to anxiety, depression, insomnia, headache, fatigue, hypertension, reduced concentration, and other psychological disorders [7]. Prolonged stress exposure produces "allostatic load," which negatively affects brain function,

* Corresponding author: Kalash Deshbhratar

immunity, and overall health [8]. Stress develops when an individual perceives environmental demands as exceeding their coping ability [9]. In modern society, increasing workload, emotional pressure, unhealthy lifestyle, and competitive environments have significantly increased stress-related disorders. Chronic stress not only affects emotional balance but also contributes to cardiovascular, neurological, and metabolic disturbances. Stress alters the body's adaptive mechanisms and disrupts physiological stability, leading to various health complications [10]. Conventional medications such as sedatives, anxiolytics, and antidepressants are commonly used for stress management; however, their prolonged use may produce side effects including drowsiness, dizziness, dependency, and reduced mental alertness. Therefore, there is an increasing demand for safe, effective, and natural therapies with minimal adverse effects. Among various alternative therapies, aromatherapy has gained considerable popularity for stress relief and relaxation. Aromatherapy is a holistic healing therapy that utilizes essential oils extracted from aromatic medicinal plants to improve physical, emotional, and psychological well-being. Essential oils exert therapeutic effects mainly through inhalation, where volatile compounds stimulate olfactory receptors and influence the limbic system of the brain, which regulates mood, emotions, memory, and stress response. Inhalation aromatherapy acts as an effective Complementary therapy for reducing stress and anxiety in clinical settings [11].

The present study focuses on the formulation of a herbal anti-stress inhaler using essential oils of Sweet Orange *(Citrus sinensis)*, Rosemary *(Rosmarinus officinalis)*, Peppermint *(Mentha piperita)*, and Tulsi *(Ocimum sanctum)*. These medicinal plants were selected due to their well-known calming, refreshing, and adaptogenic properties. Sweet orange oil possesses uplifting and anxiolytic activity that helps improve mood and reduce nervousness. Rosemary oil enhances concentration, memory, and mental alertness while reducing fatigue. Peppermint oil provides cooling and refreshing effects that relieve headache, mental exhaustion, and stress. Tulsi acts as an adaptogen that helps the body cope with stress and promotes emotional balance. The herbal Inhaler was prepared by Incorporating the extracted essential oils into a suitable absorbent medium enclosed within a portable inhaler device. Upon inhalation, the volatile aromatic compounds rapidly enter the nasal cavity and exert therapeutic effects through the olfactory pathway. The synergistic combination of selected herbal oils is expected to provide effective stress relief, mental relaxation, and mood enhancement naturally and safely.

1.1. Reasons for Selection of Essential Oils

Considering their capability in aromatherapy and relieving stress, sweet oranges *(Citrus sinensis),* peppermint *(Mentha piperita)*, tulsi *(Ocimum sanctum)*, and rosemary *(Rosmarinus officinalis)* were selected as essential components of the formula. Based on research done previously, peppermint oil improves focus and alleviates mental fatigue; on the other hand, sweet orange oil is helpful in alleviating symptoms of anxiety and lifting one's spirit up. Though rosemary oil can improve one's concentration, memory, and psychological well-being, tulsi oil has gained its reputation because of its adaptogenic property and its capacity to increase the body's response to stress.

1.2. Plant profile

Table 1 Selected Medicinal Plants Used in the Herbal Anti-Stress Inhaler

Plants profile	Plants	Botanical Name	Major Constituents	Activity
	Sweet Orange	*Citrus sinensis*	Limonene, flavonoids β-Myrcene, Linalool, Citral, (Hesperidin, Naringin)	Mood uplifting aroma, helps reduce anxiety, improves mood, and promotes relaxation

	Peppermint	*Mentha piperita*	Menthol, menthone Menthyl acetate, Limonene, Pulegone	Provide relaxation, increase calmness, producing cooling effect.
	Tulsi	*Ocimum sanctum*	Eugenol, rosmarinic acid Linalool, Caryophyllene	Act Adaptogenic, help the body cope the stress And support Emotional balance.
	Rosemary	*Rosmarinus officinalis*	1,8-cineole, rosmarinic acid	Increasing Mental alertness,and provide relaxation

The selected plants were chosen based on their reported aroma therapeutic, adaptogenic, and stress-relieving properties.

2. Material and method

2.1. Materials

- Sweet orange peels *(Citrus sinensis)*
- Peppermint *(mentha piperita)*
- Tulsi *(Ocimum sanctum)*
- Rosemary *(Rosmarinus officinalis)*
- Distilled water
- Anhydrous sodium sulfate
- Cotton wick
- Plastic inhaler tube
- TLC plate (silica gel coated)
- Hexane
- Ethyl acetate
- Vanilline-sulphuric acid reagent

2.2. Method

2.2.1. Collection of Plant Materials

Fresh plant materials including sweet orange peel, peppermint leaves, tulsi leaves, and rosemary leaves were collected from local sources. The collected materials were cleaned properly to remove dust and impurities and were identified based on their botanical characteristics.

2.2.2. Extraction of Essential Oils by Hydrodistillation

Essential oils were extracted from the selected plant materials using the hydrodistillation method with a Clevenger apparatus. The plant materials were washed, crushed, and placed in a round bottom flask containing distilled water.

The mixture was heated continuously, and the vapors containing volatile oils were condensed and collected through the Clevenger apparatus. The extracted oils were separated and stored in airtight containers for further study [12].

Fresh Sweet Orange peels *(Citrus sinensis)*, Peppermint leaves *(Mentha piperita)*, Tulsi leaves *(Ocimum sanctum)*, and Rosemary leaves *(Rosmarinus officinalis)* were gathered and thoroughly rinsed with distilled water to eliminate dust and other contaminants. The plant materials were dried in the shade to remove residual moisture and subsequently coarsely crushed to enhance the surface area for effective extraction. Around 200 g of each plant material was separately placed into a 2 L round-bottom flask containing an adequate amount of distilled water. The flask was connected to a Clevenger-type apparatus equipped with a condenser. The mixture was heated using a heating mantle, which caused the water to boil and produce steam. The steam extracted volatile aromatic compounds and essential oils from the plant material. The vapors traveled through the condenser, where they were cooled down and transformed into a liquid state. The resultant liquid, made up of water and essential oil, gathered in the graduated receiver of the Clevenger apparatus. Because of their differing densities and immiscibility, the essential oil separated from the water layer and collected in the apparatus's collection arm. Hydrodistillation was carried on for about 3–4 hours until no additional increase in oil volume was detected. The gathered essential oils were then carefully separated and dried with anhydrous sodium sulfate to eliminate any remaining moisture. Ultimately, the oils were placed into sealed amber glass bottles and stored in a cool, dry location until they were ready for further analysis and formulation.

Figure 1 Extraction of essential oil by Clevenger apparatus

2.2.3. Percentage yield of essential oils

The percentage yield of essential oils extracted from Sweet Orange peel, Peppermint leaves, Tulsi leaves, and Rosemary leaves were determined after completion of Hydrodistillation using a Clevenger apparatus. Percentage yield is an important parameter used to evaluate the efficiency of extraction of volatile oils from plant materials. In the present study, approximately 200 g of fresh plant material from each selected medicinal plant was used for extraction. After completion of hydrodistillation, the extracted essential oil was separated carefully from the aqueous layer and collected in clean, dry measuring tubes. The obtained oils were dried using anhydrous sodium sulfate to remove traces of moisture and then measured accurately in milliliters (ml) [12]. The percentage yield of essential oil was calculated by comparing the quantity of oil obtained with the quantity of plant material used for extraction.

$$Percentage\ yield\ = \frac{volume\ of\ essential\ oil\ obtained}{Weight\ of\ plant\ material} \times 100$$

2.2.4. Phytochemical Screening

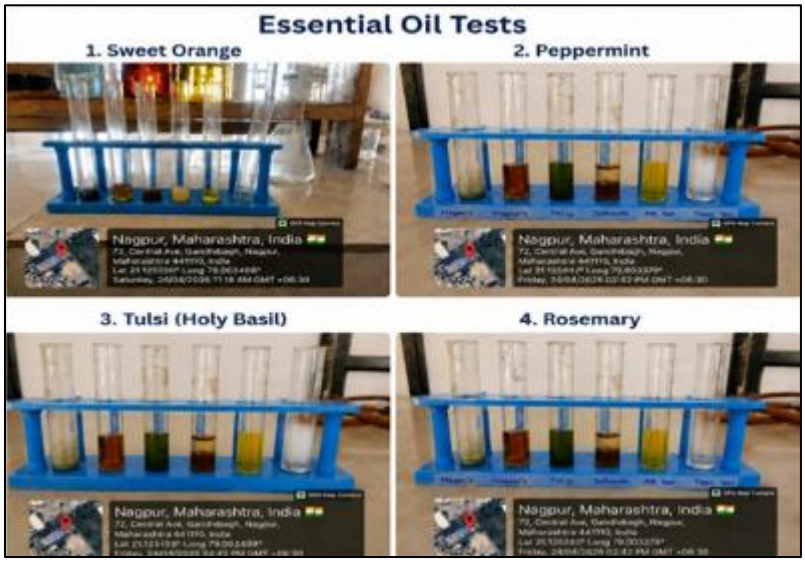

Figure 2 Essential oil test

The essential oils were subjected to preliminary phytochemical tests for identification of active constituents such as terpenoids, flavonoids, alkaloids, phenols, and Saponin. These tests are used to identify essential oil components by using standard chemical tests.

2.2.5. Thin Layer Chromatography of Essential Oil

Thin Layer Chromatography (TLC) is a straightforward, fast, and affordable method used for separating and identifying plant-based compounds found in herbal extracts and essential oils [13]. In this technique, silica gel coated plates serve as the stationary phase, while a hexane and ethyl acetate solvent system acts as the mobile phase. Compounds move at different speeds based on their polarity and how strongly they interact with the stationery and mobile phases, which allows for the separation of various phytochemicals. After the separation process, the spots are made visible using reagents like vanillin–sulfuric acid, which are often used to detect terpenoids and other volatile compounds in essential oils [14]. TLC is widely used in the analysis of plant-based substances, ensuring quality and helping in the identification of herbal products due to its ease of use, dependable results, and low cost.

$$RF\ value\ =\ distance\ traveled\ by\ solute\ /\ Distance\ traveled\ by\ solvent$$

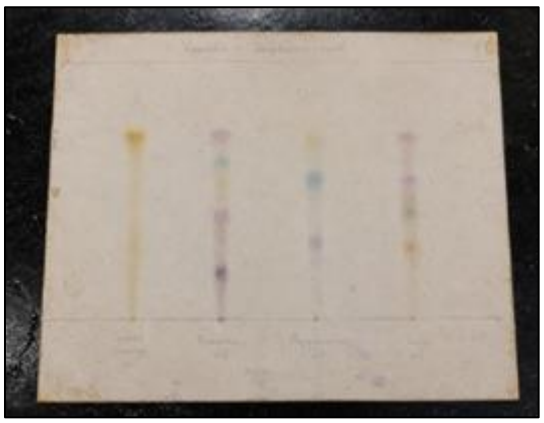

Figure 3 TLC Of Essential Oils

The TLC analysis of sweet orange oil revealed a faint yellowish spot with an Rf value of 0.82, suggesting the presence of volatile terpenoid compounds like limonene. Limonene is the primary component that gives the oil its distinct citrus scent and calming properties. Rosemary oil displayed several colored spots with Rf values ranging from 0.22 to 0.78.

The presence of multiple spots indicates that the oil contains various phytoconstituents such as cineole, camphor, and rosmarinic acid, which are known for their refreshing aroma, ability to enhance mental alertness, and stress-relieving effects. Peppermint oil showed blue- and yellow-colored spots with Rf values between 0.28 and 0.75. These spots confirm the presence of menthol, menthone, and related monoterpenes, which contribute to the cooling, refreshing, and relaxing effects of the oil. Tulsi oil produced a number of purple and brown spots with Rf values ranging from 0.24 to 0.76. These spots indicate the presence of compounds such as eugenol, flavonoids, and phenolic substances, which are responsible for the adaptogenic, anti-stress, and calming effects of tulsi.

2.2.6. Formulation Of Herbal Anti-Stress Inhaler

Herbal aromatherapy inhalers are portable forms of medication designed to deliver essential oils through nasal inhalation, offering quick therapeutic benefits. These inhalers offer a convenient, non-invasive, and fast-acting way to use essential oils for reducing stress, promoting relaxation, and improving mental well-being [15]. Essential oils like Sweet Orange, Peppermint, Rosemary, and Tulsi have calming, refreshing, and mood-enhancing effects that help alleviate stress and support emotional balance. The process of making herbal inhalers usually involves mixing essential oils with an absorbent material, such as a cotton wick, which is placed inside a sealed inhaler. When inhaled, the volatile components of the oils interact with the olfactory receptors in the nose and affect the limbic system of the brain, leading to feelings of relaxation and stress relief [16]. Aromatherapy inhalers are popular because they are easy to carry, simple to use, act quickly, and have fewer risks of side effects compared to synthetic drugs. It is important to choose the right essential oils and use them at safe concentrations during the formulation process to ensure the inhaler is both effective and safe [17].

Table 2 Ingredients Use in Formulation of Herbal Anti-Stress Nasal Inhaler

Sr No.	Ingredients	Quantity
1	Sweet orange oil	2-3 drops
2	Peppermint oil	1-2 drops
3	Tulsi oil	1-2drops
4	Rosemary oil	2-3 drops
5	Cotton wick	q.s.
6	Inhaler tube	1

Procedure

- A clean and dry inhaler tube was selected for formulation.
- Sterile absorbent cotton wick was inserted into the inhaler device.
- Measured quantities of Sweet Orange, Peppermint, Tulsi, and Rosemary essential oils were mixed thoroughly.
- The prepared essential oil blend was carefully transferred onto the cotton wick using a dropper.
- The inhaler tube was tightly closed immediately to minimize evaporation of volatile constituents.
- The inhaler stored in cool or dry place.

Figure 4 Formulation of Herbal Anti-Stress Nasal Inhaler

2.3. Evaluation parameter of Anti-stress Inhaler

2.3.1. Organoleptic characters

The prepared herbal anti-stress inhaler was evaluated for organoleptic characteristics such as color, odor, appearance, and texture. The formulation showed a pleasant aromatic odor and satisfactory appearance, indicating acceptable sensory properties suitable for inhalation use.

Parameter	Observation
Color	Colorless to pale yellow
Odor	Pleasant aromatic odor
Appearance	Clear liquid
Texture Of Cotton Wick	Uniformly soaked wick

2.3.2. Stability study

The prepared inhaler was subjected to stability studies under room temperature conditions to evaluate changes in odor, appearance, and consistency over a specified period. No significant changes were observed, indicating good stability of the formulation.

2.3.3. Leakage Test

The inhaler container was checked for leakage and proper sealing. No leakage was observed during storage, indicating good packaging integrity and suitability for handling.

2.3.4. Aroma Retention Study

The formulation was evaluated for aroma retention during storage. The essential oils retained their characteristic fragrance without significant loss, suggesting good retention of volatile constituents

2.3.5. TLC Analysis OF Essential Oil

Thin Layer Chromatography (TLC) was performed for identification and separation of phytoconstituents present in the essential oils used in the inhaler formulation. Different spots with characteristic Rf values confirmed the presence of multiple volatile constituents.

3. Result

Table 3 Observation Table: Percentage Yield of Essential Oils

Plant Material	Quantity Taken	Oil Obtained	Percentage Yield
Sweet Orange Peel	200 g	5.6 ml	2.8%
Peppermint Leaves	200 g	3.8 ml	1.9%
Tulsi Leaves	200 g	3.0 ml	1.5%
Rosemary Leaves	200 g	4.2 ml	2.1%

The extracted essential oils showed satisfactory percentage yield by hydrodistillation method. Sweet orange showed the highest oil yield due to the presence of high volatile oil content in the citrus peel. The obtained oils possessed characteristic aromatic odor and were suitable for formulation of herbal anti-stress inhaler.

Table 4 Observation Table of phytochemical screening of Essential Oil

Chemical test and phytoconstituent	**Sweet orange oil**	**Peppermint oil**	**Tulsi oil**	**Rosemary oil**
Mayer's test [18] (Alkaloids)	No cream precipitate form (alkaloid absent)	No Creamish white precipitate form (alkaloid absent)	No Creamed colour precipitate form (alkaloid absent)	No Pale cream precipitate form (alkaloid absent)
Wagner's test [19] (Alkaloid test)	No Reddish- brown precipitate observed (alkaloid absent)	No Brown precipitate observed (alkaloid absent)	No Reddish-brown precipitate form (alkaloid absent)	No Dark brown precipitate observed (alkaloid absent)
Alkaline reagent test [20] (flavonoid test)	Yellow colour observed (Flavonoid present)	Bright yellow colour observed (Flavonoid present)	Yellow colour observed (Flavonoid	Yellow coloration observed (Flavonoid present)
Ferric chloride Test [21] (Phenols and tannin test)	Green colour observed (Tannin present)	Dark green colour observed (Phenolic compound present)	Green colour observed (tannin present	Greenish-black colour develop (Phenolic compound may be present)
Salkowaski test [22] (Terpenoids)	Reddish-brown interface observed (Terpenoids present)	Brownish red ring observed (Terpenoids present)	Brown layer observed (Terpenoids	Dark reddish-brown interface observed (Terpenoids present)
Foam test [23] (Saponin test)	No stable foam observed (Saponin absent)	Thin foam observed (Saponin present)	Creamy foam Observed (Saponin)	No foam formed (saponin absent)

The extracted essential oils showed satisfactory percentage yield by hydrodistillation method. Sweet orange showed the highest oil yield due to the presence of high volatile oil content in thcitrus peel. The obtained oils possessed characteristic aromatic odor and were suitable for formulation of herbal anti-stress inhaler.

Table 5 TLC of Essential Oil

Sample	**Visualization reagent**	**Observation**	**Rf value**
Sweet orange oil	Vanilline-sulphuric acid	Faint yellowish spot observed	0.82
Rosemary oil	Vanilline-sulphuric acid	Multiple spot colour Observed	0.22-0.78
Peppermint oil	Vanilline-sulphuric acid	Blue yellow spots Observed	0.28-0.75
Tulsi oil	Vanilline-sulphuric acid	Multiple purple/brown spots observed	0.24-0.76

The TLC analysis showed distinct spots indicating the presence of active phytoconstituents in the extracted essential oils. The obtained Rf value confirmed the separation of volatile compounds present in the herbal extract.

4. Discussion

The present study successfully formulated and evaluated a herbal anti-stress nasal inhaler using essential oils of Sweet Orange, Peppermint, Rosemary, and Tulsi. The extracted oils showed satisfactory percentage yield and presence of important phytoconstituents such as terpenoids, flavonoids, and phenolic compounds. TLC analysis confirmed the presence of active volatile constituents. The developed inhaler exhibited pleasant aroma, acceptable organoleptic properties, and good stability. The synergistic action of herbal essential oils may help reduce stress, anxiety, mental fatigue, and improve emotional well-being naturally without producing harmful side effect.

5. Conclusion

The present study successfully formulated and evaluated a herbal anti-stress nasal inhaler containing essential oils of *Citrus sinensis, Mentha piperita, Ocimum sanctum, and Rosmarinus officinalis.* The extracted essential oils showed satisfactory percentage yield and the presence of important phytoconstituents. TLC analysis confirmed the presence of volatile bioactive compounds in the extracted oils. The formulated inhaler exhibited pleasant aroma, acceptable organoleptic properties, good aroma retention, and satisfactory stability. The synergistic combination of selected essential oils may help in reducing stress, mental fatigue, and anxiety while promoting relaxation and emotional well-being. Therefore, the developed herbal anti-stress nasal inhaler can be considered a safe, convenient, economical, and natural alternative for stress management through aromatherapy.

Future scope of the study

The current study on the preparation and assessment of an anti-stress herbal inhaler with essential oils showed good physical and chemical properties and showed potential for use in aromatherapy. However, more research is needed to confirm its effectiveness in treating stress, ensure its safety, and determine its suitability for use in pharmaceutical products.

- Future research could focus on testing the anti-stress, calming, and relaxation effects of the formulation using appropriate laboratory and experimental methods.
- Clinical trials involving human subjects may be carried out to evaluate the safety, effectiveness, user-friendliness, and how well the inhaler works when used.
- More advanced testing methods such as Gas Chromatography–Mass Spectrometry (GC–MS) could be used to thoroughly examine and identify the volatile plant-based compounds found in the essential oils.
- Studies on how the product behaves over time under different storage conditions could be conducted to find out how long it lasts, how stable it is, and how well the volatile components remain in the formulation.
- The formulation could be further improved by adjusting the amounts and mix of essential oils to enhance its ability to treat stress, its fragrance retention, and its stability in the product.
- Side effects such as mild headaches and sleep problems may also be studied in future research.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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