Development and Evaluation of Herbal Inhaler Formulation for Anxiety and Stress Relief

Jharna Sahu*, Harsh Sahu[1], Lekhraj sahu[2], Suchita Wamankar[1], Gyanesh Kumar Sahu[2], Chanchal deep Kaur[1]

[1]Rungta Institute of Pharmaceutical Sciences, Kohka Kurud, Bhilai

[2]Rungta Institute of Pharmaceutical Sciences and Research, Bhilai, Chhattisgarh

Abstract:

Stress and anxiety are common psychological conditions that affect the mental, emotional, and physical well-being of individuals. In modern society, academic pressure, work demands, social expectations, and lifestyle changes have significantly increased the prevalence of these conditions. Stress is the body's natural response to challenging or threatening situations, while anxiety is characterized by persistent feelings of worry, fear, or uneasiness that may occur even in the absence of an immediate threat. When experienced for prolonged periods, both stress and anxiety can negatively influence cognitive performance, sleep patterns, cardiovascular health, and overall quality of life.

Physiologically, stress and anxiety involve activation of the hypothalamic–pituitary–adrenal (HPA) axis, resulting in the release of stress hormones such as cortisol and adrenaline. Continuous stimulation of this system can lead to psychological disorders, weakened immune response, and increased risk of chronic diseases. Management strategies include lifestyle modification, psychological therapy, pharmacological treatment, and the use of natural or herbal remedies aimed at promoting relaxation and emotional balance.

Keywords: Stress, Anxiety, Mental health, HPA axis, Psychological disorders, Stress management.

1.Introduction

Stress has become an inevitable component of modern life, contributing significantly to psychological disturbances, sleep disorders, reduced productivity, and the development of chronic diseases. Persistent exposure to stress activates the hypothalamic–pituitary–adrenal (HPA) axis and increases cortisol secretion, which may negatively affect cognitive performance, emotional stability, and immune function. Although conventional pharmacological treatments such as anxiolytics and antidepressants are available, their long-term use is often associated with adverse effects, dependency risks, and reduced patient compliance. These limitations have encouraged growing interest in safer, non-invasive, and plant-based therapeutic alternatives.

Aromatherapy, a complementary healing approach that utilizes volatile plant extracts, has gained recognition for its potential role in stress and anxiety management. Essential oils derived from medicinal plants possess bioactive constituents capable of influencing neurological pathways through olfactory stimulation.

1.2 Stress

Stress is a natural physical and psychological response that the body experiences when faced with challenging, demanding, or threatening situations. It triggers a chain of reactions known as the "fight-or flight" response, in which hormones like adrenaline and cortisol prepare the body to take quick action. While short-term stress can motivate and enhance performance, prolonged or excessive stress can disturb mental balance and affect overall

health. It may lead to conditions such as anxiety, irritability, fatigue, sleep disturbances, and weakened immunity. In today's fast-paced lifestyle, stress has become a common experience across all age groups, making stress management essential for maintaining emotional well-being and physical health.

1.3 Anxiety

Anxiety is a natural emotional response characterized by feelings of worry, fear, or uneasiness in situations perceived as uncertain or threatening. It is a normal part of life and often helps individuals stay alert and prepared. However, when anxiety becomes persistent, excessive, or difficult to control, it can interfere with daily activities and overall well-being. Anxiety activates the body's stress response, causing physical symptoms such as rapid heartbeat, sweating, restlessness, and difficulty concentrating. Modern lifestyle pressures, academic and work demands, social challenges, and health concerns often contribute to rising anxiety levels. Understanding anxiety and its triggers is essential for early recognition, effective management, and maintaining a balanced emotional state.

2. Pathophysiology of Stress

Stressful Stimulus

⬇

Brain perceives stress (cerebral cortex & amygdala)

⬇

Hypothalamus is activated

⬇

Two pathways start

1. Sympathetic Nervous System (SNS)

⬇

Release of adrenaline & noradrenaline

⬇

Fight-or-flight response

(increased heart rate, breathing, alertness)

2. HPA Axis Activation

⬇

CRH → ACTH → Cortisol release

⬇

Prolonged stress response

⬇

Neurotransmitter imbalance

(↓ Serotonin, ↓ GABA)

⬇

Symptoms of Stress & Anxiety

(worry, restlessness, sleep disturbance)

3. Drugs available for treatment

Several classes of medications are used to treat stress and anxiety disorders. These drugs mainly work by balancing neurotransmitters in the brain such as serotonin, norepinephrine, dopamine, and GABA, which regulate mood and emotional responses.

Major drug classes used for stress and anxiety include:

- SSRIs (e.g., Fluoxetine, Sertraline)
- SNRIs (e.g., Venlafaxine, Duloxetine)
- Benzodiazepines (e.g., Diazepam, Alprazolam)
- Azapirones (Buspirone)
- Beta-blockers (Propranolol)
- Tricyclic antidepressants

4. Recent advanced treatments

Recent research has introduced several innovative approaches for treating stress and anxiety, including new medications, digital therapies, brain-stimulation techniques, and personalized treatment strategies[2]. These advancements aim to improve effectiveness, reduce side effects, and make treatment more accessible.

Recent advancements in stress and anxiety treatment include:

- Digital CBT and AI-based therapy platforms
- Virtual reality exposure therapy
- Brain-stimulation technologies
- Psychedelic-assisted psychotherapy
- New pharmacological drugs targeting novel pathways
- Personalized psychiatry and gut-brain interventions

5. Ingredient table

Table 5.1

SR.NO	INGRIDENT	QUANTITY For 5 ml	PROPERTIES
1	Ashwagandha	0.25 ml	Reduce cortisol and anxiety
2	Lavender	0.08 ml	Relaxant, anxiolytic
3	Holy basil (Tulsi)	0.15 ml	Reduce anxiety
4	Rose oil	0.07 ml	Gentle mood lift
5	Menthol	0.04 ml	Cooling agent

6. Drug profile

6.1 Ashwagandha

Ashwagandha significantly reduced stress and anxiety levels (subjectively measured by validated rating scales), reduced sleeplessness and fatigue, and reduced serum cortisol levels (a stress hormone) when compared with placebo.

Scientific Name: Withania somnifera

Kingdom: Plantae

Family: Solanaceae

Genus: Withania

Species: somnifera

6.2 Lavender

Lavender can be used in an inhaler to reduce anxiety, pain, and stress, and to improve mood.

Scientific Name: Lavandula angustifolia

Kingdom: Plantae

Family: Lamiaceae

Genus: Lavandula

Species: angustifolia

6.3 Holy basil (Tulsi)

Holy basil (Tulsi) is used in Ayurvedic medicine for its potential to support the immune system, reduce stress, and aid respiratory health.

Scientific Name: Ocimum tenuiflorum

Kingdom: Plantae

Family: Lamiaceae

Genus: Ocimum

Species: tenuiflorum

6.4 Rose petals

Fresh or dried rose petals for aromatherapy to inhale their scent, which may have calming effects.

Scientific Name: Rosa indica

Kingdom: Plantae

Family: Rosaceae

Genus: Rosa

Species: indica

7. Mechanism of Action of Lavender in Stress Relief

Inhalation of Lavender Essential Oil
(main components: linalool, linalyl acetate)

⬇

Stimulation of Olfactory Receptors (Nose)

⬇

Signal Transmission to Brain (Limbic System)

(especially amygdala & hippocampus)

⬇

Modulation of Neurotransmitters

↑ GABA (calming effect)

↑ Serotonin (mood stabilization)

⬇

Reduction in Sympathetic Activity

⬇

Decreased Stress Hormones (Cortisol)

⬇

Physiological Effects

Reduced heart rate

Lower blood pressure

Relaxed muscles

⬇

Final Outcome: Stress & Anxiety Reduction

8. Procedure

Step 1 Extraction

Fig 8.1 Extraction of Lavender, Ashwagandha & Tulsi

The oil of Lavender, Ashwagandha & Tulsi has been extracted by using Soxhlet apparatus.

Step 2 Collection of oils

Fig 8.2 Collection of extracted oil

The extracted oils of the Lavender, Tulsi & Ashwagandha has been collected in beakers.

Step 3 pouring

Fig 8.3 pouring oils in cotton wick

The cotton wick-soaked extracted oils one by one in calculated quantity. Menthol is also added in the last in calculated quantity.

Step 4 Filling cotton wick

Fig 8.4 Filling cotton wick

Cotton wick is inserted inside the container.

9. Evaluation tests

Table 9.1

S.no	Parameter	Result
1	Organoleptic Evaluation	Pleasant aroma, no discoloration, uniform appearance
2	Leakage Test	No leakage
3	Aroma Persistence Test	Minimum 2–4 weeks fragrance
4	Stability Study (25°C ± 2°C)	No major change in odor or structure
5	Stability Study (40°C ± 2°C)	Slight reduction in aroma acceptable
6	Volatility / Weight Loss Study	gradual weight loss
7	Irritation Test	No irritation, headache, or discomfort
8	User Acceptability Test	Average score ≥3
9	Packaging Integrity	Proper sealing and closure

10. Future prospects

The use of herbal inhalers for managing stress and anxiety holds significant promise due to their non-invasive nature, rapid onset of action, and minimal side effects. With the increasing global burden of stress-related disorders and the limitations associated with conventional pharmacotherapy, there is a growing demand for

safer, natural, and patient-friendly alternatives. Herbal inhalers, based on aromatherapy principles, are well-positioned to meet this need.

Future advancements may focus on the standardization of essential oil compositions, ensuring consistent quality, safety, and therapeutic efficacy. The incorporation of scientifically validated plant extracts and optimization of their synergistic combinations could enhance the anxiolytic potential of such formulations. Additionally, the development of controlled-release inhaler systems may improve the duration and stability of aroma delivery.

In conclusion, herbal anti-stress inhalers represent a promising, innovative approach in mental health management, with strong potential for future development through scientific research, technological innovation, and clinical validation.

11. Conclusion

The present study successfully demonstrated the formulation and evaluation of a herbal anti-stress inhaler incorporating essential oils of Lavandula angustifolia, Matricaria chamomilla, and Boswellia serrata, with menthol as a supportive aromatic agent. Pre-formulation studies confirmed the physicochemical suitability, compatibility, and stability of the selected ingredients for incorporation into a wick-based inhalation system. The prepared inhaler showed satisfactory organoleptic properties, uniform oil distribution, absence of leakage, acceptable aroma persistence, and good stability under both room temperature and accelerated conditions.

12. Result and Discussion

The herbal anti-stress inhaler was successfully formulated using selected essential oils known for their calming and anxiolytic properties. The prepared inhaler was evaluated for various parameters, and the results indicated that the formulation met acceptable standards for effectiveness, stability, and user convenience.

The organoleptic evaluation revealed that the inhaler possessed a pleasant and characteristic aroma, which is essential for aromatherapy-based formulations. The appearance was uniform, and the cotton wick was properly impregnated with essential oils, indicating good formulation technique. The uniformity of impregnation ensured consistent delivery of active constituents during each use.

The leakage test showed no signs of oil leakage, confirming proper sealing and structural integrity of the inhaler device. This is important for maintaining the stability and shelf-life of the formulation. The inhaler also demonstrated good aroma persistence, with the fragrance lasting for an extended duration, which contributes to prolonged therapeutic effect.

During the inhalation test, the device provided smooth and unobstructed airflow, ensuring ease of administration. The irritation test indicated that the formulation was non-irritant and safe for nasal use, with no discomfort or adverse reactions observed. This suggests good compatibility of the selected essential oils with the nasal mucosa.

From a mechanistic perspective, the effectiveness of the inhaler can be attributed to the action of volatile constituents of essential oils on the olfactory system. Upon inhalation, these compounds stimulate olfactory receptors and transmit signals to the limbic system of the brain, which plays a key role in emotional regulation. This leads to modulation of neurotransmitters such as GABA and serotonin, along with reduction in cortisol levels, ultimately producing a calming and stress-relieving effect.

Overall, the results suggest that the formulated herbal inhaler is effective, safe, stable, and user-friendly. It offers a natural and non-invasive approach for managing stress and anxiety. However, further studies such as clinical

trials and standardization of essential oil composition are recommended to validate its therapeutic efficacy and ensure reproducibility.

13. References

1. Bhargava K, Conti D. Eucalyptus oil: Traditional usesand scientific support. Phytother Res. 2013;27(6):823-831.

2. McKay DL, Blumberg JB. A review of the bioactivityand potential health benefits of peppermint tea (Menthapiperita L.). Phytother Res. 2006;20(8):619-633.

3. Kurokawa M, Arakawa T. Anti-inflammatoryproperties of essential oils: Clove and cinnamon asexamples. J Essent Oil Res. 1998;10(2):221-228.

4. Derkatch C. Why wellness sells: Natural health in a pharmaceutical culture. Baltimore: JHU Press; 2022

6. Sherman A, Chin J. Cannabis and CBD for Health and Wellness: An Essential Guide for Using Nature's

7. Medicine to Relieve Stress, Anxiety, Chronic Pain,Inflammation, and More. Berkeley: Ten Speed Press;

9. Rahm C. Impacts of Natural Ingredients and Supplements on Health and Wellness.

10. Lepe-Camacho A. Natural Wellness Essentials Solutions.

11. Kennedy A. The Portable Essential Oils: A Pocket Reference of Everyday Remedies for Natural Health & Wellness. Naperville: Sourcebooks, Inc.; 2016 Jun 21.

12. Salas E, Oliveira J, Perez-Gregorio R. Natural extracts as food ingredients: From chemistry to health. Front Nutr. 2023 Oct 31;10:1306307.

13. Pursell JJ. Medicinal Herbs for Family Health and Wellness: 123 Trusted Recipes for Common Concerns, from Allergies and Asthma to Sunburns and Toothaches. Portland: Timber Press; 2021 Feb 2.

14. Hedigan F, Sheridan H, Sasse A. Benefit of inhalation aromatherapy as a complementary treatment for stress and anxiety in a clinical setting–A systematic review. Complementary Therapies in Clinical Practice. 2023 Apr 5:101750.

15. Axe J, Rubin J, Bollinger T. The Beginner's Guide to Essential Oils: Ancient Medicine. Destiny Image Publishers; 2019 Dec 17. Axe J, Rubin J, Bollinger T. The Beginner's Guide to Essential Oils: Ancient Medicine. Destiny Image Publishers; 2019 Dec 17.

16. Salamung N, Elmiyanti NK. Effect of Aromatherapy on Sleep Quality: A Systematic Review. International Journal of Nursing and Health Services (IJNHS). 2023 Oct 20;6(5):292-302.

17. Dagli R, Avcu M, Metin M, Kiymaz S, Ciftci H. The effects of aromatherapy using rose oil (Rosa damascena Mill.) on preoperative anxiety: A prospective randomized clinical trial. European Journal of Integrative Medicine. 2019 Feb 1;26:37-42.

18. Mohammadi-Dashtaki R, Heidari-Soureshjani S, Sherwin CM. The Effect of Inhalation Aromatherapy on Patients with Cardiovascular Disease Seeking Pain Relief: A Systematic Review and Meta-analysis. Current Drug Therapy. 2023 Jun 1;18(3):262-70.

19. Saha P, Kathuria H, Pandey MM. Intranasal nanotherapeutics for brain targeting and clinical studies in Parkinson's disease. Journal of Controlled Release. 2023 Jun 1;358:293-318.

20. Childers PM, Aleshire ME. What's that smell?: Essential oil aromatherapy. Journal of Psychosocial Nursing and Mental Health Services. 2020 Feb 1;58(2):4-5.

21. Schmidt E. Production of essential oils. InHandbook of essential oils 2020 Aug 10 (pp. 125-160). CRC Press.

22. Silva JC, Pereira RL, de Freitas TS, Rocha JE, Macedo NS, Nonato CD, Linhares ML, Tavares DS, da Cunha FA, Coutinho HD, de Lima SG. Evaluation of antibacterial and toxicological activities of essential oil of Ocimum gratissimum L. and its major constituent eugenol. Food Bioscience. 2022 Dec 1;50:102128..

23. Li D, Li Y, Bai X, Wang M, Yan J, Cao Y. The effects of aromatherapy on anxiety and depression in people with cancer: a systematic review and meta-analysis. Frontiers in public health. 2022 May 30;10:853056.

24. Crowe TP, Greenlee MH, Kanthasamy AG, Hsu WH. Mechanism of intranasal drug delivery directly tothe brain. Life sciences. 2018 Feb 15;195:44-52.

25. Trevino JT, Quispe RC, Khan F, Novak V. Non-invasive strategies for nose-to-brain drug delivery. Journal of clinical trials. 2020;10(7).