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REVIEW ARTICLE

OLFACTORY INTERVENTIONS FOR SLEEP ENHANCEMENT: A REVIEW

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Abstract

Sleep is essential for cognitive function, emotional balance, and overall well-being. Disruptions like insomnia or poor sleep quality can have negative consequences. Various methods, including bedtime perfumes, have been studied to improve sleep. This review examines the scientific basis of scent-based sleep enhancement, focusing on the olfactory system and the effects of specific aromatic compounds on sleep. The olfactory system plays a crucial role in how scents influence sleep. Odor molecules bind to receptors in the nasal cavity, sending signals to the olfactory bulb, which processes these signals and relays them to the limbic system. This connection allows scents to evoke emotional responses and impact sleep. Historically, scent therapy has been used across cultures. The effectiveness of bedtime perfumes depends on their delivery methods. Diffusers, sprays and roll-on oils are common ways to disperse essential oils. Incorporating these perfumes into comprehensive sleep hygiene routine, including a consistent sleep schedule and a calming environment, maximizes their benefits. Future research should identify specific scent compounds that induce sleep, explore the interaction between olfactory stimuli and sleep stages and investigate the long-term safety and efficacy of bedtime perfumes. In conclusion, bedtime perfumes can improve sleep quality through the power of scent. Understanding olfactory pathways, calming scents and the historical context of scent therapy helps individuals make informed choices about using these fragrances.

Keywords: Aromatherapy, essential oils, neurotransmitters, olfactory system, sleep disorders.

INTRODUCTION

Sleep, a necessary biological function, is indispensable for cognitive processes, emotional stability and optimal health[1]. Disrupted sleep patterns, including insomnia and poor sleep, can lead to adverse effects on physical and mental health[2]. In the quest for optimal sleep, various interventions have been explored, including the use of bedtime perfumes[3]. These specially formulated scents aim to induce a state of relaxation, promoting deeper and more restful sleep[4]. This review delves into the scientific underpinnings of scent-based sleep enhancement, examining the olfactory pathways and the impact of specific aromatic materials on sleep architecture[5]. The olfactory system plays a pivotal role in how scents influence sleep. Odorant molecules, when attached to olfactory receptors, initiate a chain of biochemical events culminating in a nerve signal. This signal is sent to the olfactory bulb, a brain region situated beneath the frontal lobe. The olfactory bulb then forwards the signal to various brain areas, including the limbic system, which governs emotions and memory. This neural pathway clarifies why specific scents can elicit intense emotional reactions and mood shifts, potentially affecting sleep patterns. Historical perspectives on scent therapy reveal its long-standing use across various cultures. The efficacy of various delivery methods for bedtime perfumes is a critical aspect of their use. Diffusers, for instance, utilize water or heat to disperse essential oils into the air, creating a fragrant atmosphere in the bedroom. This approach guarantees a steady release of fragrance, helping to keep a soothing atmosphere all night long. Sprays, such as room or linen sprays, provide another way to disperse scent. They can be used to lightly mist bedding or the room just before sleep, offering an instant and invigorating burst of aroma. Roll-on oils offer a more precise method, enabling the direct application of essential oils to pulse points like the wrists, temples, or neck. This technique can be especially effective as the warmth from these areas helps to spread the scent, creating a personal and intimate aromatic experience. Aromatherapy, using scents to promote relaxation and sleep, can be enhanced by combining it with relaxation techniques like meditation and deep breathing. These techniques,

along with soothing scents, create a powerful bedtime ritual. While research shows promise, more studies are needed to fully understand the mechanisms and optimize the use of aromatherapy. Future research could involve neuroimaging studies, clinical trials, and exploring combinations with other therapies. By understanding how scents influence the brain and incorporating them into a comprehensive sleep hygiene routine, a restful sleep environment can be created[6-16]. Continued research into the precise mechanisms and optimal applications of these essential oils will further elucidate their role in sleep therapy and contribute to the development of effective aromatherapy interventions for sleep disorders.

The olfactory pathway and sleep regulation

The olfactory system, responsible for the sense of smell, plays a crucial role in our perception of the environment and human emotional responses[6]. Odor molecules, upon inhalation, travel through the nasal cavity to the olfactory epithelium, where they bind to specific receptors[7]. These receptors transmit signals to the olfactory bulb, a specialized brain region responsible for processing scent information[5]. Unlike other sensory systems, the olfactory pathway has direct connections to the limbic system, the emotional and memory center of the brain. This unique anatomical arrangement allows scents to evoke immediate emotional and physiological responses, bypassing the thalamus, a sensory relay station. The limbic system, in turn, influences various brain regions involved in sleep regulation, including the hypothalamus and the brainstem. Figure 1 illustrates a simplified overview of the olfactory pathway.

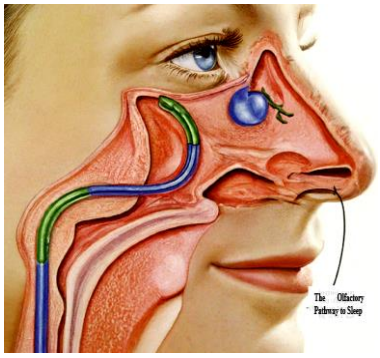

Figure 1: A simplified diagram of the olfactory pathway, highlighting the olfactory bulb, olfactory nerve and limbic system.

This sensory pathway, involving several key components, begins in the olfactory epithelium, a specialized tissue in the nasal cavity. Here, odorant molecules are detected by olfactory receptor proteins located on the cilia of olfactory sensory neurons. The axons of these neurons converge to form the olfactory nerve (Cranial Nerve I), which traverses the cribriform plate of the ethmoid bone. The olfactory bulb, a relay station situated above the cribriform plate, receives signals from the olfactory nerve and processes them through mitral cells. The axons of these mitral cells form the olfactory tract, which transmits the olfactory information to various brain regions, including the piriform cortex, amygdala and entorhinal cortex. These brain regions, collectively part of the limbic system, are involved in processing and interpreting olfactory sensations[5-8,17-19]. This connection elucidates why smells can trigger strong emotions and memories.

Historical perspective on scent therapy

The use of scents for therapeutic purposes dates back to ancient civilizations, with the Egyptians being among the earliest to incorporate aromatic plants into their religious rituals and medicinal practices. They believed in the power of these plants to promote well-being and spiritual connection. Aromatic substances such as frankincense, myrrh and various essential oils were used in embalming processes, religious ceremonies and daily life to enhance physical and spiritual health. Similarly, Ayurvedic medicine, which originated in India, emphasizes the use of aromatic herbs and oils for balancing the mind and body. This traditional system of medicine focuses on relaxation and sleep promotion, utilizing scents like sandalwood, jasmine and tulsi to harmonize the body's energies and promote restful sleep. Traditional Chinese Medicine (TCM) also incorporates aromatic plants and herbs into its therapeutic practices, aiming to restore harmony and balance within the body. TCM practitioners use a variety of aromatic substances, including ginger, cinnamon and ginseng, to treat ailments and enhance overall health. These plants are believed to influence the body's qi (vital energy) and help maintain the balance between yin and yang, which is essential for good health and well-being. In medieval Europe, the use of herbs and spices for medicinal purposes flourished. Plants like lavender and chamomile gained popularity for their calming properties and were commonly used to treat anxiety, insomnia and other ailments. Herbalists and apothecaries of the time relied on the therapeutic properties of these plants to create remedies for a wide range of health issues. The Renaissance period witnessed a renewed interest in botanicals, leading to the development of early forms of aromatherapy. This era saw the publication of numerous herbals and botanical texts that documented the medicinal uses of plants and laid the groundwork for modern herbal medicine. The 19th and 20th centuries marked a significant turning point in the history of aromatherapy, with the emergence of modern scientific inquiry into the therapeutic properties of essential oils. The work of René-Maurice Gattefossé, a French chemist, laid the foundation for the field of aromatherapy. Gattefossé is credited with coining the term "aromatherapy" and popularizing the use of essential oils for various health conditions, including sleep disorders[3-5,10,11,13-16,21]. His research demonstrated the potential of essential oils to promote healing and well-being, and his work inspired further scientific investigation into their therapeutic effects.

Throughout the 20th century, the field of aromatherapy continued to evolve, with researchers and practitioners exploring the benefits of essential oils for physical and mental health. Studies have shown that certain essential oils, such as lavender, chamomile and bergamot, can have calming and sedative effects, making them useful for promoting relaxation and improving sleep quality.

The use of essential oils in aromatherapy has become increasingly popular as a complementary therapy for managing stress, anxiety and sleep disorders. In recent years, the scientific community has continued to investigate the mechanisms underlying the therapeutic effects of essential oils. Research has focused on understanding how these aromatic compounds interact with the brain and nervous system to influence mood, stress levels and sleep patterns. Advances in neuroimaging and other technologies have provided new insights into the ways in which essential oils can modulate brain activity and promote relaxation. The integration of aromatherapy into modern healthcare practices reflects a growing recognition of the importance of holistic approaches to health and well-being. By combining traditional knowledge with contemporary scientific research, practitioners of aromatherapy aim to provide safe and effective treatments that support the body's natural healing processes. The ongoing exploration of the therapeutic potential of essential oils holds promise for the development of new and innovative approaches to managing sleep disorders and enhancing overall health. Finally, the use of scents for therapeutic purposes has a rich history that spans ancient civilizations to modern scientific inquiry. The incorporation of aromatic plants and essential oils into medicinal practices has evolved over time, reflecting a deepening understanding of their potential benefits for health and well-being[3-5,10,11,13-16,21]. As research continues to uncover the mechanisms behind the therapeutic effects of essential oils, aromatherapy is likely to play an increasingly important role in promoting relaxation, improving sleep quality and supporting holistic health.

The science behind scent-based sleep enhancement

While the historical use of aromatherapy for sleep promotion is well-documented, contemporary research has begun to investigate the underlying mechanisms by which scents can influence sleep quality. Studies have explored the effects of specific aromatic compounds on brain activity, neurotransmitter levels and physiological responses associated with sleep. Lavender (*Lavandula angustifolia*), one of the most commonly studied scents for sleep promotion, has been shown to have sedative and anxiolytic properties. Lavender oil inhalation has been found to reduce anxiety, improve sleep quality and decrease cortisol levels, a stress hormone that can interfere with sleep. Additionally, lavender oil has been found to increase levels of serotonin and GABA, two neurotransmitters crucial for sleep regulation. The reduction in cortisol levels further supports its role in promoting restful sleep. Chamomile (*Matricaria recutita*), another popular choice for bedtime fragrances, contains apigenin, a flavonoid with potential anxiolytic effects. While research on the direct impact of chamomile on sleep is limited, its calming properties suggest that it may contribute to improved sleep quality. Chamomile is known for its ability to influence GABAergic activity, promoting relaxation and sleep. The presence of apigenin, which binds to benzodiazepine receptors in the brain, enhances its calming effects, making it a valuable component in sleep-promoting aromatherapy blends. Sandalwood (*Santalum album*), known for its grounding and calming aroma, has also been investigated for its potential sleep-promoting effects. Studies have shown that inhaling sandalwood oil can reduce anxiety and improve sleep quality in individuals with insomnia. The calming effects of sandalwood are believed to be mediated through its interaction with the GABAergic system, which plays a crucial role in regulating sleep and reducing anxiety. The unique composition of sandalwood oil, rich in sesquiterpenes, contributes to its therapeutic properties. Vanilla (*Vanilla planifolia*), with its sweet and comforting scent, is often associated with relaxation and feelings of security. While research on the direct impact of vanilla on sleep is limited, its psychological associations with comfort and safety may contribute to a more conducive sleep environment. The soothing aroma of vanilla can evoke positive emotional responses, which can help create a calming atmosphere that is beneficial for sleep. The olfactory system's connection to the limbic system, which governs emotions and memories, underscores the potential of vanilla to enhance sleep quality through its comforting scent. Vetiver (*Vetiveria zizanoides*), characterized by its earthy and grounding aroma, has been traditionally used for its calming properties. While research on vetiver and sleep is limited, its anxiolytic effects suggest potential benefits for sleep quality. Vetiver oil is known for its ability to reduce stress and anxiety, which are common barriers to restful sleep. The deep, woody scent of vetiver can create a tranquil environment, promoting relaxation and aiding in the transition to sleep. Bergamot (*Citrus bergamia*) is a citrus fruit known for its unique aromatic properties. This citrus oil has been associated with reduced anxiety and improved mood, which may indirectly contribute to better sleep. Bergamot oil contains compounds such as linalool and linalyl acetate, which have been shown to possess anxiolytic and sedative effects. The uplifting yet calming aroma of bergamot can help alleviate stress and create a peaceful atmosphere conducive to sleep. The exploration of specific aromatic compounds and their effects on sleep quality has provided valuable insights into the potential mechanisms by which aromatherapy can promote restful sleep. The sedative and anxiolytic properties of essential oils such as common, true or English lavender, German or Roman chamomile, Australian or Indian sandalwood, vanilla bean or extract, vetiver grass, Khus or Khus-Khusand bergamot orange highlight their therapeutic potential in sleep promotion. By influencing neurotransmitter levels, reducing cortisol and creating a calming environment, these aromatic compounds can enhance sleep quality and overall well-being[5,10-16,22-34]. Continued research into the precise mechanisms and optimal applications of these essential oils will further elucidate their role in sleep therapy and contribute to the development of effective aromatherapy interventions for sleep disorders. Table 1 provides summary of the important herbs/essential oils involved in aromatherapy.

Table 1: A summary of the most commonly used herbal remedies in aromatherapy, along with their scientific and clinical evidence[24-34].

Herb/Essential Oil**	Scientific Name	Common Uses	Scientific/Clinical Evidence
Lavender	*Lavandula angustifolia*	Anxiety, insomnia, sleep quality	Studies show lavender oil can reduce anxiety, improve sleep quality and decrease cortisol levels.
Chamomile	*Matricaria recutita*	Anxiety, insomnia	Chamomile contains apigenin, which promotes relaxation and sleep by binding to benzodiazepine receptors.
Sandalwood	*Santalum album*	Anxiety, sleep disorders	Sandalwood oil can reduce anxiety and improve sleep quality through its effects on the GABAergic system.
Bergamot	*Citrus bergamia*	Anxiety, mood enhancement	Bergamot oil has been found to reduce anxiety and improve mood, which may indirectly improve sleep.
Vetiver	*Vetiveria zizanoides*	Anxiety, sleep quality	Vetiver oil is known for its calming properties and potential benefits for sleep quality.
Valerian	*Valeriana officinalis*	Insomnia, anxiety	Valerian root has sedative effects and can improve sleep quality by increasing GABA levels.
Passion flower	*Passiflora incarnata*	Anxiety, insomnia	Passionflower has been shown to reduce anxiety and improve sleep quality by enhancing GABA activity.
Lemon Balm	*Melissa officinalis*	Anxiety, sleep disorders	Lemon balm has calming effects and can improve sleep quality and reduce anxiety.
Ashwagandha	*Withania somnifera*	Anxiety, stress, sleep quality	Ashwagandha has been shown to reduce stress and anxiety and improve sleep quality.
Hops	*Humulus lupulus*	Insomnia, anxiety	Hops have sedative properties and can improve sleep quality, often used in combination with valerian.

** Other possible synonyms for these herbal remedies are as the following: **Lavender:** Purple Bloom, Fragrant Herb, Calming

The neurobiological basis of sleep and the role of neurotransmitters

Sleep is a complex physiological process regulated by a network of neurotransmitters within the brain. Key neurotransmitters involved in sleep regulation include serotonin, GABA (Gamma-Aminobutyric Acid), dopamine, acetylcholine and norepinephrine. Serotonin plays a crucial role in regulating mood, appetite and sleep-wake cycles. Its levels fluctuate throughout the day, with lower levels promoting sleepiness. This neurotransmitter is synthesized from the amino acid tryptophan and is primarily found in the gastrointestinal tract, blood platelets and the Central Nervous System (CNS). It is involved in various functions, including the modulation of mood and behavior and its role in sleep regulation is significant due to its influence on the circadian rhythm. GABA, the primary inhibitory neurotransmitter in the brain, promotes relaxation and reduces anxiety. It plays a significant role in inducing and maintaining sleep by inhibiting neural activity. GABAergic neurons are widely distributed throughout the brain and their activation leads to a calming effect on the nervous system. This neurotransmitter is essential for reducing neuronal excitability and preventing overstimulation, which is crucial for the onset and maintenance of sleep. The balance between excitatory and inhibitory signals in the brain is vital for healthy sleep patterns and GABA is a key player in maintaining this balance. Dopamine is involved in reward, motivation and arousal. While it can promote wakefulness, it also plays a role in regulating molecular clockcycles. Dopamine levels are higher during wakefulness and lower during sleep, indicating its role in promoting alertness and vigilance. This neurotransmitter is produced in several areas of the brain, including the substantia nigra and the ventral tegmental area and it influences various physiological processes. The dual role of dopamine in promoting wakefulness and regulating sleep highlights its importance in maintaining the balance between sleep and wake states. Acetylcholine is involved in both wakefulness and Rapid Eye Movement (REM)- the phase of slumber during which the majority of dreams occur - sleep. It helps to regulate the transition between sleep stages by modulating the activity of neurons in the brainstem and other regions involved in sleep regulation.

Table 2: Key neurotransmitters involved in sleep regulation, locations and their roles.

Neurotransmitter	Role in Sleep	Additional Functions	Location
Serotonin	Regulates mood, appetite and sleep-wake cycles. Lower levels promote sleepiness.	Modulates mood and behavior, influences circadian rhythm.	Gastrointestinal Tract (GIT), blood platelets, Central Nervous System (CNS)
GABA	Promotes relaxation and reduces anxiety. Induces and maintains sleep by inhibiting neural activity.	Reduces neuronal excitability, prevents overstimulation.	Widely distributed throughout the brain
Dopamine	Involved in reward, motivation and arousal. Promotes wakefulness and regulates molecular clock cycles.	Influences various physiological processes.	Substantia nigra, ventral tegmental area
Acetylcholine	Involved in wakefulness and REM sleep. Regulates transition between sleep stages.	Promotes cortical arousal, facilitates vivid dreaming during REM sleep.	Synthesized from choline and acetyl-CoA, released by cholinergic neurons
Norepinephrine	Promotes arousal and alertness. Decreased levels allow for sleep onset.	Influences attention, arousal and stress response.	Produced in the locus coeruleus

Acetylcholine levels are high during wakefulness and REM sleep, facilitating cortical activation and the vivid dreaming associated with REM sleep. This neurotransmitter is synthesized from choline and acetyl-CoA and is released by cholinergic neurons. Its role in promoting cortical arousal and facilitating the transition between different sleep stages underscores its importance in the master clock cycle. Norepinephrine is a neurotransmitter that promotes arousal and alertness. Decreased levels of norepinephrine are associated with sleep onset, as its reduction allows for the transition from wakefulness to sleep. Norepinephrine is produced in the locus coeruleus, a small nucleus in the brainstem, and it influences various physiological processes, including attention, arousal and the stress response[35-40]. The decrease in norepinephrine levels during sleep onset is crucial for allowing the brain to transition into a state conducive to sleep. Table 2 summarizes the roles of the important neurotransmitters in sleep.

Delivery methods and integration into sleep hygiene

Bedtime perfumes are available in various delivery methods, each with its distinct advantages. Diffusers, for instance, utilize water or heat to disperse essential oils into the air, thereby creating a fragrant atmosphere in the bedroom[41]. This method ensures a continuous release of scent, which can help maintain a calming environment throughout the night[42]. Sprays, including room sprays or linen sprays, offer another method of delivery. These can be used to mist bedding or the room with a calming scent shortly before bedtime, providing an immediate and refreshing burst of fragrance[43]. Roll-on oils represent a more targeted approach, allowing for the application of essential oils directly pulsing points such as the wrists, temples or neck. This method can be particularly effective as the warmth of these areas helps to diffuse the scent, creating a personal and intimate aromatic experience[44].To maximize the benefits of bedtime perfumes, it is essential to incorporate them into a relaxing bedtime routine[45]. Establishing a consistent sleep schedule is fundamental, as it helps regulate the body's internal clock, making it easier to fall asleep and wake up at the same times each day[46]. Creating a calming sleep environment is equally important[47]. This can be achieved by ensuring the bedroom is cool, dark and quiet and by removing any distractions that might interfere with sleep[46,47]. The use of bedtime perfumes can enhance this environment by adding a layer of sensory comfort[48]. Engaging in calming exercises such as meditation or deep breathing can further enhance the effects of these fragrant sleep aids. Meditation can help clear the mind of the day's stresses, making it easier to relax and fall asleep. Deep breathing exercises can slow the heart rate and promote a state of calm, which is conducive to sleep. When combined with the soothing scents of bedtime perfumes, these techniques can create a powerful bedtime ritual that promotes restful and rejuvenating sleep. The choice of essential oils used in bedtime perfumes can also play a significant role in their effectiveness. Lavender, for example, is well-known for its calming and sedative properties, making it a popular choice for bedtime use. Chamomile is another excellent option, as it has been shown to reduce anxiety and promote relaxation. Other essential oils that can be beneficial for sleep include sandalwood, which has grounding properties and bergamot, which can help reduce stress and improve mood. In addition to their calming effects, bedtime perfumes can also contribute to overall well-being by improving sleep quality. Poor sleep has been linked to a variety of health issues, including weakened immune function, increased stress levels and impaired cognitive function. By promoting better sleep, bedtime perfumes can help mitigate these risks and support overall health. It is also worth noting that the use of bedtime perfumes can be a deeply personal experience. The scents that are most effective can vary from person to person, depending on individual preferences and sensitivities. Experimenting with different essential oils and delivery methods can help identify the combinations that work best for each individual. Needless to say, the cosmetic or pharmaceutical form of aromatherapy has an undeniable impact on the effectiveness and quality of the aromatherapy. Finally, bedtime perfumes offer a versatile and effective way to enhance sleep quality and promote relaxation. By incorporating them into a consistent and calming bedtime routine, and by choosing the right essential oils, it is possible to create a soothing and restful sleep environment[49-52]. Whether through the continuous release of scent from a diffuser, the immediate burst of fragrance from a spray or the targeted application of roll-on oils, bedtime perfumes can play a valuable role in supporting healthy sleep habits and overall well-being.

Clinical evidence and future directions

While the mechanisms underlying the effects of aromatherapy on sleep are still being explored, numerous studies have investigated its efficacy for various sleep disorders. It has been demonstrated in some studies that aromatherapy can improve sleep quality, reduce insomnia symptoms and enhance overall sleep satisfaction. However, further research is required to establish the optimal dosages, delivery methods and combinations of essential oils for maximizing therapeutic benefits. Future research directions may include neuroimaging studies to investigate the neural mechanisms underlying the effects of aromatherapy on sleep. Clinical trials with larger sample sizes and longer durations are necessary to assess the long-term efficacy and safety of aromatherapy for sleep disorders. Additionally, the exploration of synergistic effects, such as the potential benefits of combining aromatherapy with other therapeutic interventions like cognitive-behavioral therapy for insomnia (CBT-I), is warranted.

Personalized aromatherapy, which involves developing individualized treatment plans based on specific needs and preferences, also represents a promising area for future research. Neuroimaging studies could provide valuable insights into how aromatherapy influences brain activity related to sleep. Techniques such as functional Magnetic Resonance Imaging (fMRI) and Positron Emission Tomography (PET) could be employed to observe changes in brain regions associated with sleep regulation and emotional

processing. Understanding these neural mechanisms could help in identifying the most effective essential oils and delivery methods for promoting sleep. Experiments at the clinical levels are crucial for establishing the long-term benefits and safety of aromatherapy. Many existing studies have small sample sizes and short follow-up periods, which limit the generalizability of their findings. Larger, well-designed trials could provide more robust evidence on the efficacy of aromatherapy for sleep disorders and help determine the optimal dosages and delivery methods. The exploration of synergistic effects involves investigating how aromatherapy can be combined with other therapeutic interventions to enhance its efficacy. For example, combining aromatherapy with CBT-I could potentially yield better outcomes than either intervention alone. CBT-I is a well-established treatment for insomnia that focuses on changing sleep-related behaviors and thoughts. Integrating aromatherapy into CBT-I could provide an adjuvant approach to managing sleep disorders, addressing both the psychological and physiological aspects of sleep. Personalized aromatherapy represents another promising area for future research. Individual differences in preferences and responses to essential oils suggest that a one-size-fits-all approach may not be optimal. Developing individualized treatment plans based on factors such as age, gender, medical history and personal preferences could enhance the effectiveness of aromatherapy. Personalized aromatherapy could involve tailoring the selection of essential oils, dosages and delivery methods to meet the specific needs of each individual. At last, while aromatherapy shows promise as a treatment for sleep disorders, further deep exploration is needed to fully understand its mechanisms and optimize its use. Neuroimaging studies, larger clinical trials, exploration of synergistic effects and personalized treatment plans are all important areas for future investigation[53-60]. By addressing these research gaps, it may be possible to develop more effective and individualized aroma-therapy interventions for improving sleep quality and managing sleep disorders.

Choosing and using bedtime perfumes effectively

Selecting the right bedtime perfume involves considering personal preferences, ingredient quality and delivery methods. As demonstrated earlier, popular choices include lavender, chamomile, sandalwood, vanilla and vetiver, either as single-note fragrances or in blended formulations. Delivery methods range from diffusers, which disperse essential oils into the air, to sprays and roll-on oils for targeted application. To maximize the benefits of bedtime perfumes, it is essential to incorporate them into a relaxing bedtime routine. Establishing a consistent sleep schedule, creating a calming sleep environment and practicing relaxation techniques such as meditation or deep breathing can enhance the effects of these fragrant sleep aids. However, it is crucial to use bedtime perfumes responsibly. Some individuals may experience skin irritation or allergic reactions to certain essential oils. It is preferable to perform a patch test before applying essential oils topically and to dilute them properly with a carrier oil[61-65]. Additionally, pregnant women, breastfeeding mothers and individuals with underlying health conditions should consult with a healthcare professional before using essential oils as personalization and customization is crucial during establishment of the best aromatherapy for everyone in case-by-case assessment.

The holistic approach: Sleep hygiene and beyond

A good night's sleep is a multi-faceted issue and bedtime perfumes are just one piece of the puzzle. For optimal sleep, it is essential to adopt a holistic approach that incorporates healthy sleep hygiene practices and relaxation techniques alongside the use of these fragrant sleep aids. There are some additional factors to consider for a good night's sleep[62,63, 66-70]:

- **Regular exercise:** Engaging in regular physical activity can improve sleep quality but avoiding strenuous exercise too close to bedtime is recommended as it can be stimulating.
- **Diet and nutrition:** Maintaining a healthy diet and avoiding heavy meals or stimulants like caffeine close to bedtime can contribute to better sleep.
- **Managing stress:** Chronic stress can significantly disrupt sleep patterns. Techniques like meditation, deep breathing exercises and cognitive behavioral therapy (CBT) can be helpful in managing stress and promoting relaxation.

By implementing these practices alongside the use of bedtime perfumes, the affected individuals can create a comprehensive sleep hygiene routine that promotes deeper, more restful sleep. A high sleep quality is reflected on human health and productivity in the sake of benefit for better society.

CONCLUSIONS

While promising research exists on the potential benefits of certain scents for relaxation and sleep promotion, further investigations are warranted to elucidate the underlying mechanisms and optimize the use of bedtime perfumes for diverse populations. Future research should focus on identifying specific scent compounds responsible for sleep-inducing effects, exploring the interaction between olfactory stimuli and sleep stages and investigating the long-term safety and efficacy of bedtime perfume use, in addition to the impact of combined effect of different compounds. In conclusion, bedtime perfumes offer a potential avenue for improving sleep quality through the pharmacological effect of scent. By understanding the olfactory pathways, the properties of calming scents and the historical context of scent therapy, individuals can make informed choices about incorporating these fragrances into their sleep routines. However, a holistic approach to sleep, encompassing sleep hygiene practices, stress management and regular exercise, is essential for achieving optimal sleep health. By integrating these practices with the use of bedtime perfumes, individuals can indeed foster a comprehensive sleep hygiene routine that enhances both the quality and depth of their sleep. Improved sleep quality not only benefits personal health and

productivity but also contributes positively to society as a whole. Better-rested individuals are often more focused, efficient and capable of contributing effectively to their communities. Incorporation of the scent in medically and pharmaceutically handy forms could facilitate the implementation of aromatherapy appropriately for the ease of use by the final consumers.

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AUTHOR'S CONTRIBUTION

Eissa ME: writing original draft, methodology, investigation, formal analysis, data curation, conceptualization.

CONFLICT OF INTEREST

None to declare.

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