EEET ECOLOGICAL ENGINEERING & ENVIRONMENTAL TECHNOLOGY

Ecological Engineering & Environmental Technology, 2026, 27(1), 154–163
https://doi.org/10.12912/27197050/215071
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Received: 2025.11.05
Accepted: 2025.12.01
Published: 2026.01.01

An overview of lavender's effect on cognitive functions and neurodegenerative disorder

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ABSTRACT

Lavandula *angustifolia,* commonly known as lavender, has garnered growing scientific interest for its neuroprotective properties and its potential role in managing cognitive impairments associated with neurodegenerative disorders, particularly Alzheimer's disease. This bibliographic overview synthesizes current research on the pharmacological effects of lavender essential oils, focusing on their antioxidant, anti-inflammatory, antiapoptotic, and acetylcholinesterase-inhibiting properties. Bioactive compounds such as linalool and thymol appear to play a central role in enhancing memory, attention, and overall cognitive performance. Studies in both animal models and human subjects suggest that lavender, particularly through inhalation, can positively influence the limbic system, modulating emotional regulation and cognitive processes. These findings support the consideration of lavender as a complementary therapeutic strategy alongside conventional treatments for dementia-related conditions, while underlining the need for further clinical trials to validate its efficacy and optimize its use.

Keywords: *Lavandula angustifolia*, lavender, cognitive functions, neurodegenerative diseases, Alzheimer's.

INTRODUCTION

The medicinal and aromatic plants (MAP) sector has been expanding steadily in recent years, driven by a growing global demand for specialized plant-based raw materials and by the diversification of their industrial applications. Within this sector, essential oils represent one of the most important product categories. Although nearly 3.000 essential oils have been identified, only about 150 are considered commercially relevant on the global market (Héral et al., 2021). Crops destined for essential oil extraction currently occupy more than half a million hectares worldwide, although precise estimates of global output remain difficult due to inconsistent reporting. In Europe, production continues to grow, supported by the strong presence of perfume, cosmetics, and flavor industries, which motivate various countries to increase their cultivation efforts (Bachiri et al., 2016). Among the medicinal plants of economic interest, lavender holds an especially prominent position, as it is extensively cultivated for industrial use. Lavender essential oil is the primary product obtained from this crop and is incorporated into a wide spectrum of commercial items. Across the different *Lavandula* species and their hybrids, annual production is estimated at approximately 1.500 tons of essential oil, of which 300 to 500 tons originate specifically from true lavender (*Lavandula angustifolia* Mill.) (Crișan et al., 2023). Determining the real quantity of lavender essential oil available on the world market remains challenging, largely because official statistics may not include synthetic or adulterated oils. France, widely recognized as a historical leader in lavender cultivation and the main global exporter of lavender essential oil for the cosmetics industry, is accompanied by major producers such as Bulgaria (Pokajewicz et al., 2021).

Despite the long tradition of lavender cultivation in Europe and in many other regions, recent scientific literature still lacks a comprehensive and integrated overview of the entire production chain, from agricultural practices to product development. New challenges—such as climate stress, sustainability requirements, market competition, and quality standards—underscore the need for updated analyses for growers, processors, and manufacturers. Traditionally, lavender production has relied on a linear approach focused almost exclusively on obtaining essential oil through distillation. However, this model overlooks modern opportunities for product diversification and valorization of by-products, which are increasingly essential to meeting evolving consumer preferences and industry demands (Ez Zoubi et al., 2020). The objective of this review is therefore to address this gap by synthesizing current knowledge, documenting traditional strategies, and identifying emerging directions for the future of lavender cultivation and use.

Scientific evidence shows that aromatic plants can strongly influence brain function and physiological responses. Aromas have been reported to modulate executive functions, affective states, and cognitive performance. For example, rosemary fragrance has been shown to enhance working memory and cognitive flexibility (Moss et al., 2003). Essential oils also demonstrate significant biological effects in animal studies; exposure to green tea aroma, for instance, produced notable antidepressant-like responses in rodent models (Zhu et al., 2012). Among essential oils, lavender oil has gained particular attention for its effects on neural activity, mood regulation, and cognition (Zhu et al., 2012; Özkaraman et al., 2018). Inhaling lavender oil prior to sleep has been reported to reduce trait anxiety in chemotherapy patients (Zhu et al., 2012) and to help prevent postpartum depressive symptoms (Özkaraman et al., 2018). Additionally, findings from electroencephalogram (EEG) recordings indicate that lavender aroma promotes the onset of slow-wave sleep, supporting deeper and more restorative rest (Kianpour et al., 2016). A recent systematic review also demonstrated that lavender inhalation can enhance cognitive functions by decreasing arousal and improving sustained attention and mental focus (Ko et al., 2021).

Given the longstanding cultural importance of lavender, its established use in aromatherapy, and the mounting scientific evidence supporting its neurocognitive benefits, the aim of the present study is to assess the effects of lavender on cognitive functions based on a comprehensive review of the available literature.

LAVENDER AND ITS BIOACTIVE COMPOUNDS

The Lamiaceae family encompasses numerous aromatic herbs and medicinal plants of substantial economic and cultural importance, cultivated globally for their culinary, therapeutic, and industrial uses (Figure 1). Within this diverse family, *Lavandula* L. species hold a prominent position due to their rich essential-oil profiles and long-standing applications in perfumery, cosmetics, traditional medicine, and food processing. Over the past decades, a wide variety of *Lavandula* cultivars have been selectively bred to enhance essential-oil quality and yield (Laib and Barkat, 2011). Among these, the cultivar 'Maillette' is recognized as a benchmark in France for premium oil production. Other cultivars, such as 'Compacta', 'Irene Doyle', and 'Twickel Purple', exhibit similarly desirable agronomic and aromatic characteristics. Cultivars like 'Buena Vista' are recommended for potpourri due to their fragrance strength, whereas 'Blue Mountain' is valued for hedging applications. Several cultivars have also been developed for ornamental landscaping, displaying flowers ranging from white and soft pink to deep violet, offering horticulturists a broad chromatic spectrum for aesthetic design. Beyond appearance, some cultivars demonstrate superior environmental resilience, particularly enhanced cold tolerance, making them suitable for regions with harsh winters (Garzoli et al., 2020).

Among lavender species, *Lavandula angustifolia* is the most sought after in the perfumery and cosmetics industries because of its refined volatile composition, rich in linalool and linalyl acetate. Conversely, lavender species with higher camphor content, such as *Lavandula latifolia*, are typically directed toward pharmaceutical or industrial applications rather than perfumery. Selecting the appropriate cultivar is therefore fundamental for producers aiming to optimize the value of lavender-derived products. Although recent studies suggest that producers could diversify by developing novel products or targeting emerging markets, traditional practices – particularly essential-oil distillation – remain dominant due to high consumer demand and well-established commercial pathways (Sayout et al., 2020).

Lavender flower buds and essential oils have also attracted considerable interest in the food and beverage industry. In culinary applications, lavender functions as a natural flavoring agent and herbal seasoning. Additionally, its essential oil possesses notable antimicrobial and antiseptic properties, making it a promising candidate for preventing food spoilage and extending shelf life. For instance, lavender essential oil has demonstrated effectiveness in meat preservation and in suppressing common foodborne pathogens (Rudrapal et al., 2023). Beyond essential oils, the solid residues remaining after hydrodistillation contain phenolic compounds with potent antioxidant and antibacterial activities. These residues can be incorporated into food products, nutritional supplements, or active packaging materials. A practical example comes from the bakery sector, where bread enriched with 2.5% lavender co-product exhibited increased loaf volume, enhanced shelf life, and greater consumer acceptance. Such findings highlight the potential for lavender by-products to contribute to sustainable and value-added food-processing practices. Active packaging infused with lavender essential oil is also emerging as a promising strategy to enhance food safety and extend product freshness (Tofah et al., 2022).

The cosmetic and personal-care industries have shown increasing interest in plant-based ingredients, driven by consumer demand for natural, safe, and environmentally friendly alternatives. Lavender essential oil and its floral extracts are widely used in aromatherapy, perfumery, therapeutic formulations, bath products, and home-care items. Aromatherapy applications often involve inhalation or topical application of diluted essential oil to promote relaxation and psychological well-being. The plant material left after oil extraction also serves as a valuable source of natural polysaccharides for skincare products. Moreover, the steam distillation process generates hydrosols—aromatic waters containing trace amounts of linalool, α-terpineol, lavandulol, lavandulyl acetate, caryophyllene, and camphor. Although hydrosols possess mild antimicrobial and soothing properties and exhibit a pleasant floral-herbal aroma, they remain underexploited in commercial formulations, representing an area with strong potential for innovation and product diversification (Sahinler et al., 2022).

Lavender also plays an important role in traditional and contemporary medicinal practices. Historically, lavender preparations have been used to treat wounds, lice infestations, migraines, anxiety, cardiac ailments, respiratory congestion, insect bites, muscle cramps, and sleep disturbances. Several of these uses have since been validated scientifically to varying degrees. Strong clinical and preclinical evidence supports lavender's anxiolytic properties, while moderate evidence supports its sedative activity, its beneficial effects on postpartum pain, and its antibacterial and spasmolytic actions. Notably, the lavender-derived compound perillyl alcohol has shown anticancer potential in phase I clinical trials. Furthermore, in vitro studies reveal that lavender essential oils and certain isolated constituents exhibit cytotoxic effects against multiple cancer cell lines, including colon, melanoma, leukemia, breast, and ovarian cancers (Mavandi et al., 2021).

The pharmacological activity of lavender is largely attributed to its major bioactive compounds, particularly linalool and linalyl acetate, which exert antioxidant, anti-inflammatory, neuroprotective, and antimicrobial effects. These constituents interact with neuronal pathways involved in stress regulation, memory function, and mood stabilization. Lavender's neuroprotective properties are of particular interest in the context of neurodegenerative diseases, including Alzheimer's disease (AD) and dementia. Preclinical studies indicate that lavender extracts may reduce oxidative stress, inhibit acetylcholinesterase activity, suppress neuroinflammation, and improve cognitive performance in animal models. Such effects make lavender an attractive candidate for non-pharmacological interventions targeting cognitive decline. Although more clinical trials are needed, early evidence suggests that integrating lavender into therapeutic regimens may complement existing treatments and improve quality of life for individuals with cognitive impairments.

Overall, lavender represents a multifunctional botanical resource with broad applications across the cosmetic, food, pharmaceutical, and wellness industries. Its diverse chemical composition, strong consumer acceptance, and wide range of biological activities continue to drive scientific interest and industrial development. Further research exploring valorization pathways, by-product utilization, and innovative formulations will be essential to unlocking the full potential of lavender and its bioactive compounds in modern applications.

GENERAL CHARACTERISTICS OF LAVENDER

Plants of the Lavandula genus are distributed across various regions of the world, mainly in the Mediterranean region, India, and western Asia.

They are classified as sub-shrubs, characterized by flowering stems with quadrangular branches. Besides their diverse geographical presence, these plants are notable for their bitter and aromatic properties, making them commercially significant (Fakhriddinova et al., 2020). These plants exhibit several remarkable morphological features. Their leaves are evergreen with an ashy-green color. They are elongated, and entirely arranged in an opposite-decussate pattern, meaning the leaves cross perpendicularly when viewed from the front. The leaves are sessile, directly attached to the stem, and have curled edges. This particular leaf structure, especially in xerophytic species, helps reduce water loss through transpiration by protecting the stomata (Trifonova et al., 2021). The inflorescence generally appears as a spike, varying in density, with distinct bracts compared to the leaves. The flowers are blue-violet in color, giving the plant its distinctive visual appeal. The tubular and striated calyx features 13 to 15 main veins and ends with five uneven teeth, with the upper tooth extending into a heart-shaped appendage (Richards et al., 2023). The corolla is also characterized, with a blue hue and a bilabiate structure consisting of five divisions. The upper lip is bifid, while the lower lip is trilobed. The anthers have a single chamber that opens through an arched slit, and the ovary is superior. The carpels are glabrous and smooth, contributing to the plant's overall texture (Paniagua-Zambrana et al., 2024). The fruit is a tetrakene, comprising four oval, compressed, shiny brown segments. The seeds within this fruit are ovoid, blackish-brown, and smooth to the touch. These distinctive morphological characteristics give Lavandula plants their unique identity and botanical value.

LAVENDER PROPAGATION

By seed

Lavender seeds can be harvested yourself or purchased from a garden center. The seeds contain a large amount of essential oils, which reduces their germination rate. To facilitate germination, a stratification process is carried out—cold conditions are created to mimic winter. To do this, the seeds are soaked in a solution with a growth stimulant, spread on damp gauze or a fine cloth, and placed in the refrigerator for 30 to 45 days. In March, they are planted in a moist substrate and kept warm. When lavender is grown from seeds, it is expected to bloom only in the second or third year (Benyammi et al., 2023).

Cuttings

A quicker method to get a flowering plant is to grow it from a cutting. From mid-spring to mid-summer, sturdy green shoots are cut from lavender branches, with the inflorescences and lower leaves removed. The cutting is then placed in a separate container with a light, moist substrate. By the end of the season, the cutting will root and

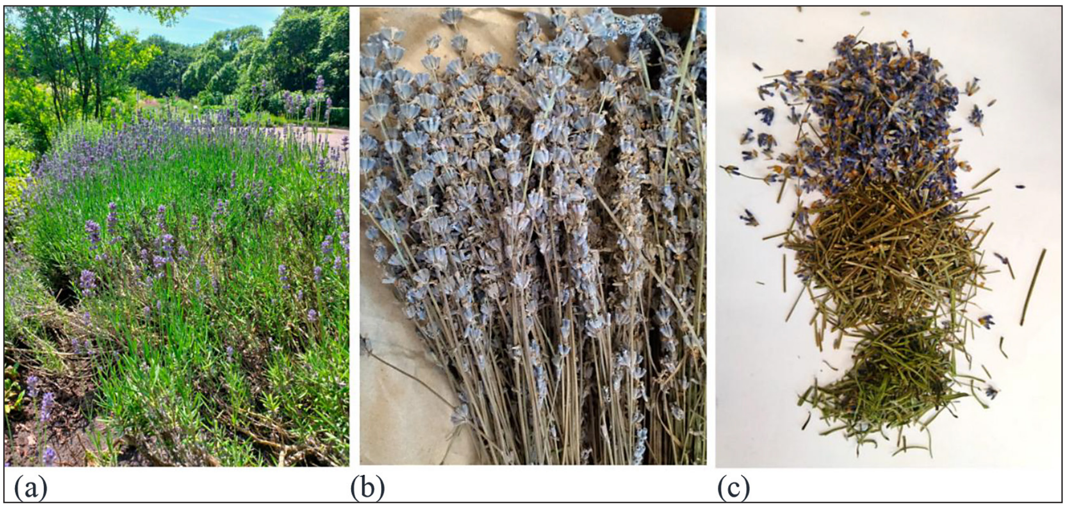

Figure 1. Lavandula *angustifolia* and its raw material: (a) general view of plants grown in the Lviv Botanical Garden of the National University named after Ivan Franko (Lviv in Ukraine 2022), photo by Mykhailenko; (b) general appearance of dry lavender grass; (c) separate lavender flowers, leaves and stems (Mykhailenko et al., 2025)

strengthen enough to be planted outside for the winter (with mandatory coverage). The cuttings can be kept inside until spring for further growth (Schriner et al., 2022).

Layering

Layering is a popular propagation method due to its simplicity. The procedure is done early in the season: the lowest lavender branches closest to the ground are selected, and at the point where the shoot grows from the stem, it is fixed to the ground with a hairpin or bent wire. The contact point with the soil should be intensively watered, and soon roots will appear here. After rooting, the layer is cut from the mother plant below the roots and transplanted (Mykhailenko et al., 2025).

BIOLOGICAL ACTIVITIES OF BIOACTIVE COMPOUNDS IN LAVENDER

Lavender (*Lavandula* spp.) is a medicinal plant widely recognized not only for its aromatic properties but also for its rich profile of bioactive compounds. The primary secondary metabolites identified in lavender include essential oils, phenolic compounds, flavonoids, tannins, and coumarins. The essential oils are mainly composed of monoterpenes and sesquiterpenes, such as linalool, linalyl acetate, camphor, and 1,8-cineole, which contribute to the plant's characteristic fragrance and exhibit a range of therapeutic properties. Phenolic compounds, particularly flavonoids such as apigenin, luteolin, and quercetin derivatives, are abundant in lavender and are largely responsible for its antioxidant and antimicrobial activities. Tannins and coumarins also contribute to the plant's protective effects against pathogens and oxidative stress.

Various studies have highlighted the defensive properties of flavonoids against pathogenic organisms, which have been explored for their therapeutic potential. These compounds exhibit antiviral, anti-tumoral, anti-inflammatory, antiallergic, and anticancer activities. They also show beneficial effects in the management of diabetes, Alzheimer's disease, and Parkinson's disease (Borromeo et al., 2010). The treatment of bacterial infections largely depends on the use of antibiotics. However, the widespread and sometimes inappropriate use of these agents has led to the emergence of multidrug-resistant bacterial strains, emphasizing the need for alternative approaches, particularly plant-based drug discovery. Secondary metabolites, such as phenolic compounds – especially flavonoids and tannins – are commonly used in the food and cosmetic industries, as well as in traditional medicine, due to their antimicrobial properties. Their toxicity toward microorganisms is often attributed to their ability to inhibit hydrolytic enzymes and to interact with and inactivate microbial adhesins, transport proteins, and cellular membranes (Mykhailenko et al., 2025). Flavonoids interact with a wide range of free radicals, a feature that has been extensively studied to understand the mechanisms underlying their antioxidant activity. Due to their reducing potential, flavonoids are capable of neutralizing oxidative free radicals – such as superoxide, peroxyl, alkoxyl, and hydroxyl radicals – through hydrogen transfer mechanisms (Batiha et al., 2023). Many flavonoids also demonstrate antiparasitic effects. Plants that contain rotenoids, including rotenone, have traditionally been used to combat both internal and external parasites. Veterinary formulations containing rotenone are available for the treatment of parasites in domestic animals such as cats, dogs, ruminants, and pigs (Benyammi et al., 2023).

THE BENEFITS OF LAVENDER ON COGNITIVE ABILITIES

Lavender essential oil (EO) has been investigated for its potential effects on cognitive performance, particularly in relation to attention and arousal. A common finding across studies is that lavender EO inhalation can decrease reaction times in sustained attention tasks, suggesting a positive influence on sustained attention. However, this improvement may come at the cost of focused attention, as demonstrated by an increase in the Simon effect, which indicates difficulty in conflict monitoring tasks (Sellaro et al., 2015). Some studies also point to lavender EO's role in modulating attention via arousal mechanisms. Several studies have highlighted how lavender EO may decrease physiological arousal, potentially improving cognitive performance in sustained attention tasks. For instance, lavender inhalation is associated with increased alpha, beta, and theta brainwave activity, which are linked to relaxation and decreased arousal (Malloggi el al., 2021). This aligns with the Yerkes-Dodson law (Yerkes et al., 1908), suggesting that decreased arousal can enhance cognitive performance, particularly in tasks requiring sustained attention. However, not all studies confirm a positive impact on cognitive performance, particularly working memory, with some reports indicating cognitive decline after lavender inhalation (Afghan et al., 2024). The mechanisms behind these effects are likely mediated by the principal component of lavender EO, linalool, which is known to interact with GABA A receptors (López et al., 2017). GABAergic pathways are implicated in the regulation of arousal, with studies suggesting that lavender may reduce arousal via modulation of the locus coeruleus, a key structure involved in attention and arousal (Breton-Provencher and Sur, 2019). These findings are consistent with research on the olfactory system, showing that olfactory input, particularly from lavender, can influence brain areas related to emotion, memory, and cognitive functions (Zelano et al., 2016). Despite these promising findings, the role of placebo effects in these studies cannot be entirely ruled out. Some research has shown that expectations and the context of lavender EO use may also play a role in cognitive enhancements (Chamine and Oken, 2016). Therefore, while lavender EO shows potential as a cognitive enhancer, further studies are needed to clarify its specific effects and underlying mechanisms. The effects of lavender essential oil (EO) inhalation on memory have been explored in two studies with contrasting results (Zelano et al., 2016). In the study by (Chamine and Oken, 2016), lavender EO inhalation was associated with an improvement in working memory performance. They assessed working memory using the WAIS-III backward digit span task, a well-established measure of cognitive functioning. Their findings suggested that lavender EO enhanced memory performance compared to placebo and water inhalation. Notably, they did not report any priming or placebo effects, implying that the cognitive improvement observed was likely attributable to the lavender EO itself.

In contrast, Moss et al. (2003) reported the reverse impact. In their study, participants who inhaled lavender EO performed worse on working memory tasks compared to those who inhaled rosemary EO and a control group that received no odor. The working memory tasks used in this study were part of the CDR battery, which comprises numerical and spatial working memory assessments, measuring both speed and accuracy. These results suggest that lavender EO may have impaired working memory in this context, differing from the positive effects reported by (Chamine and Oken, 2016). The disparity between these studies could be due to differences in experimental design, including the specific neuropsychological tasks used to assess working memory (WAIS-III vs. CDR battery), as well as potential variations in the context of the studies, such as odor intensity, duration of exposure, or individual differences in response to lavender EO. In summary, while lavender EO has been shown to influence memory performance, the direction of its effects remains inconclusive, with some studies indicating improvements in working memory, while others report a decline. Further research is needed to better understand these discrepancies and the factors that might mediate the effects of lavender EO on memory.

LAVENDER AND ALZHEIMER'S

Every year, millions of individuals develop dementia, with approximately six million cases occurring in low- and middle-income countries. According to the cholinergic hypothesis, degeneration of the cholinergic system in the hippocampus and cortex is closely linked to cognitive decline in dementia. Acetylcholinesterase (AChE), the enzyme responsible for hydrolyzing acetylcholine (ACh), becomes overactive in these conditions, contributing to the formation of beta-amyloid (Aβ), a process associated with spatial memory loss. Because ACh plays a central role in cognitive function and is found at reduced levels in patients with Alzheimer's disease (AD), strategies aimed at increasing ACh concentrations in the brain are considered promising therapeutic approaches.

Dementia treatment currently includes pharmacological and non-pharmacological options; however, available medications only slow disease progression or provide temporary symptomatic relief. They cannot reverse or halt the underlying neurodegenerative processes and often produce significant side effects that reduce patient adherence (Chen et al., 2022). Consequently, interest in alternative therapies has increased, including aromatherapy, a branch of phytotherapy that uses essential oils and plant extracts administered through inhalation or topical application.

Lavender (*Lavandula* spp.), a member of the Lamiaceae family, is among the most widely used aromatic plants in traditional memory disorder treatments. Its small purple flowers are rich in essential oils containing over 100 constituents, including linalool, linalyl acetate, 1,8-cineole, and camphor. Lavender extracts possess multiple pharmacological properties, such as anti-inflammatory, antimicrobial, and anticancer potential. Ethanolic extracts of *Lavandula officinalis* have demonstrated beneficial effects on spatial learning, memory, and motor coordination in animal models (Hajhashemi et al., 2003; Bagetta et al., 2015; Dalilan et al., 2013; Khosravi-Boroujeni et al., 2012). Furthermore, inhibitory effects of lavender extracts on AChE activity have been documented in several cell line studies.

Essential oils from *Lavandula angustifolia* also exhibit sedative, anxiolytic, and analgesic effects and have been shown to increase melatonin production (Hajhashemi et al., 2003). Additional neuroprotective effects, such as reduced infarct size and lower levels of reactive oxygen species, have been observed in ischemia–reperfusion rat models (Wang et al., 2012). Given the increasing prevalence of neurodegenerative diseases and the limitations of conventional treatments, natural products—including essential oils – represent a valuable area of research for AD therapies (Nedel et al., 2020).

Medicinal plants continue to inspire the discovery of new therapeutic agents, and several studies have highlighted the potential of plant-derived phytoconstituents for AD treatment (Malloggi et al., 2021). Essential oils rich in antioxidants help counteract free radicals involved in oxidative stress, a key contributor to AD pathology (Benyammi et al., 2023; Yerkes et al., 1908; Afghan et al., 2024; López et al., 2017). Approved AD medications include acetylcholinesterase inhibitors such as rivastigmine, galantamine, and donepezil; however, earlier drugs such as tacrine were discontinued due to severe adverse effects (Colovic et al., 2013; Breton-Provencher et al., 2019; Zelano et al., 2016).

Essential oils can cross the blood–brain barrier and influence brain function (Benyammi et al., 2023). Their aromatic compounds, absorbed through inhalation or massage, reach the bloodstream and act on the limbic system, thereby affecting cognition (Chamine and Oken, 2016). Many animal and human studies confirm that inhalation is the most effective method for evaluating essential oils in AD research. Oils entering the nasal cavity interact with the olfactory nerve and pulmonary mucosa, ultimately influencing neuronal circuits associated with memory and emotion. The therapeutic effects of essential oils are associated with both the cholinergic and oxidative stress hypotheses. Reduced ACh levels and cholinergic neuron loss impair memory and cognitive processing, while oxidative stress contributes to Aβ-induced neuronal damage, tau pathology, mitochondrial dysfunction, and metal dysregulation (Chen et al., 2022; Hajhashemi et al., 2003; Bagetta et al., 2015). Essential oils demonstrate anti-amyloid, antioxidant, and AChE-inhibitory activities, making them attractive complementary options for AD treatment (Dalilan et al., 2013).

Clinical evidence supports these findings. In 2007, Lin et al. reported that essential oils from *L. angustifolia* reduced agitation in patients with dementia. Other studies confirmed that *L. angustifolia*, *L. angustifolia* Mill., and hybrid lavender exhibit strong antioxidant and anti-apoptotic effects in scopolamine-induced dementia models, enhancing antioxidant enzyme levels (Hancianu et al., 2013). Essential oils from *L. angustifolia* Mill. have demonstrated long-term benefits for attention (Wang et al., 2012). The essential oils of *Rosmarinus officinalis*—rich in potent antioxidants—also reduce oxidative stress and improve memory in both dogs and rats (Nedel et al., 2020). Likewise, *Melissa officinalis* L. exhibits neuroprotective and antioxidant effects that help prevent oxidative damage (Colovic et al., 2013).

Essential oils derived from *L. angustifolia* are particularly rich in thymol. Azizi et al. (2012) showed that thymol and carvacrol (0.5–2 mg/kg) improved cognition in animals with scopolamine- or Aβ25–35-induced memory impairment. These effects are likely due to the compounds' AChE-inhibitory, antioxidant, and anti-inflammatory activities (Hancianu et al., 2013; Herman et al., 2016; Ono et al., 2012). Numerous studies also confirm that essential oils from *L. angustifolia* and *R. officinalis* improve cognition and memory in animal models.

Human evidence also supports aromatherapy's potential benefits. In a notable study by Jimbo et al. (2009), 28 elderly participants – 17 diagnosed with AD – received aromatherapy using rosemary, lavender, lemon, and orange essential oils for 28 days. All participants demonstrated improved personal orientation, and those with AD showed significant improvement in cognitive scores. Similarly, Kashani et al. (2011) found that aqueous extracts of *L. angustifolia* improved spatial performance in AD-induced rats at doses of 100 and 200 mg/kg, likely due to anti-inflammatory actions. Additional studies further highlight lavender's anxiolytic, antidepressant, and neuroprotective potential, suggesting that lavender-based therapies may enhance cognitive function in dementia.

CONCLUSIONS

This work successfully achieved its objective by providing a comprehensive synthesis of current evidence on lavender's cognitive and neuroprotective properties. It provided new integrative knowledge by connecting lavender's principal bioactive compounds particularly linalool and linalyl acetate to anxiolytic, antioxidant, anti-inflammatory, and acetylcholinesterase-inhibiting mechanisms which collectively contribute to cognitive improvement and neuroprotective effects. The review fills a major gap in the literature by unifying scattered findings on attention, memory, arousal regulation, and Alzheimer's-related pathways into a coherent framework. It also clarifies inconsistencies in previous studies by highlighting methodological limitations such as small sample sizes and lack of standardized administration protocols. The study opens promising prospects for evidence-based aromatherapy, the development of optimized lavender-derived formulations, and the integration of natural compounds into complementary strategies for cognitive decline and Alzheimer's disease. Consequently, lavender is positioned as a promising candidate for future clinical evaluation and therapeutic development.

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