

Alternative therapeutic approach for anxiety and depression: Review on the use of different essential oils

Abordagem terapêutica alternativa para ansiedade e depressão: Revisão sobre o uso de diferentes óleos essenciais

Enfoque terapéutico alternativo para la ansiedad y la depresión: Revisión del uso de diferentes aceites esenciales

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Abstract

Depression, a prevalent psychiatric condition, affects over 300 million people worldwide, according to the World Health Organization. Despite the effectiveness of conventional treatments such as antidepressants and psychotherapy, many patients do not respond adequately, sparking interest in alternative therapies. The objective of this review is to explore the therapeutic potential of essential oils from lavender, bergamot, Sicilian lemon, clove, ylang-ylang, chamomile, and lemon balm in the treatment of anxiety and depression, based on extensive bibliographic research from databases like SciELO, PubMed, SciFinder, and Elsevier. The results show that lavender essential oil significantly reduces depression symptoms through inhalation and topical application. Bergamot, clove, and Sicilian lemon oils also demonstrated antidepressant properties. However, ylang-ylang oil did not show significant results in reducing depressive behaviors. It is important to note that further research is needed to understand their mechanisms of action and strengthen the evidence base. While alternative therapies offer benefits, they should not replace established pharmacological treatments.

Keywords: Aromatherapy; Essential oil; Therapeutic properties; Anxiety; Depression.

Resumo

De acordo com a Organização Mundial da Saúde, a depressão é uma condição psiquiátrica prevalente que afeta mais de 300 milhões de pessoas no mundo. Apesar da eficácia dos tratamentos convencionais, como antidepressivos e psicoterapia, muitos pacientes não respondem adequadamente, gerando interesse em terapias alternativas. O objetivo desta revisão é explorar o potencial terapêutico dos óleos essenciais de lavanda, bergamota, limão siciliano, cravo, ylang-ylang, camomila e melissa no tratamento de ansiedade e depressão, com base em extensa pesquisa bibliográfica em bases de dados como SciELO, PubMed, SciFinder e Elsevier. Como resultados, o óleo essencial de lavanda demonstrou eficácia significativa na redução dos sintomas de depressão, tanto por inalação quanto por aplicação tópica. Óleos de bergamota, cravo e limão siciliano também apresentaram propriedades antidepressivas. Já o óleo de ylang-ylang não mostrou resultados significativos na redução de comportamentos depressivos. Vale ressaltar que mais pesquisas são necessárias para compreender melhor seus mecanismos de ação e fortalecer a base de evidências. As terapias alternativas oferecem benefícios, mas não devem substituir os tratamentos farmacológicos já estabelecidos.

Palavras-chave: Aromaterapia; Óleo essencial; Propriedades terapêuticas; Ansiedade; Depressão.

Resumen

La depresión, una condición psiquiátrica prevalente, afecta a más de 300 millones de personas en todo el mundo, según la Organización Mundial de la Salud. A pesar de la eficacia de los tratamientos convencionales como los antidepresivos y la psicoterapia, muchos pacientes no responden adecuadamente, lo que genera interés en las terapias alternativas. El objetivo de esta revisión es explorar el potencial terapéutico de los aceites esenciales de lavanda, bergamota, limón de Sicilia, clavo, ylang-ylang, manzanilla y melisa en el tratamiento de la ansiedad y la depresión, a partir de una amplia investigación bibliográfica en bases de datos como SciELO, PubMed, SciFinder y Elsevier. Los resultados muestran que el aceite esencial de lavanda reduce significativamente los síntomas de la depresión tanto por inhalación como por aplicación tópica. Los aceites de bergamota, clavo y limón siciliano también demostraron propiedades antidepresivas. Sin embargo, el aceite de ylang-ylang no mostró resultados significativos en la reducción de comportamientos depresivos. Es importante señalar que se necesitan más investigaciones para comprender mejor sus mecanismos de acción y fortalecer la base de evidencias. Las terapias alternativas ofrecen beneficios, pero no deben reemplazar los tratamientos farmacológicos ya establecidos.

Palabras clave: Terapia alternativa; Aceite esencial; Propiedades terapéuticas; Ansiedad; Depresión.

1. Introduction

Major Depressive Disorder (MDD), also popularly known as depression, is one of the most common psychiatric conditions today. The disease is characterized by problems associated with mood, low energy, lack or excess of appetite and consequently changes in body mass and sleep pattern, fatigue, and even suicidal thoughts, among other symptoms (Salahudeen et al., 2020; Fava & Kendler, 2000).

The World Health Organization (WHO) has stated that more than 300 million people have major depressive disorder and that depression is one of the main mental problems (WHO, 2017). This disorder is responsible for approximately 800,000 suicides a year (Cheung et al., 2019). Brazil is considered the country with the highest prevalence of cases of depression among all Latin American countries and the second country in the Americas. It is estimated that cases of conditions such as anxiety and depression have increased by around 25% following the COVID-19 pandemic (WHO 2022). Depression is a multifactorial pathology caused by numerous factors, which can have biological, social, or psychological origins. In addition, it should be noted that throughout life, a combination of events such as childhood trauma, significant changes, the loss of loved ones, or the use of substances that affect the central nervous system can be triggers for depression and anxiety.

It is estimated that between 13% and 15% of the global population may suffer from MDD. Conventional treatments include medications such as antidepressants and constant medical consultations (Jaffe et al., 2019; National Institute for Health and Care Excellence, 2022). Drug therapies are limited by their potential for abuse, delayed therapeutic effects, dependence, and tolerance. It is worth noting that many patients do not respond adequately to conventional treatments and develop resistance to such drugs (Souery et al., 1999).

Around 1/3 of patients diagnosed with depression are affected by drug resistance, which results in a decrease in health-related quality of life (Al-Harbi, 2012; Jaffe et al., 2019). Therefore, safe and evidence-based complementary or alternative therapies can significantly benefit patient care (Souto-Maior et al, 2012). Alternative therapies can be defined as health promotion and disease prevention practices, which use natural resources. For example, natural therapies can use essential oils by inhalation, massage, or baths (Cruz et al., 2012).

The therapeutic use of plant products has played a positive role in promoting health and well-being. One of the crucial examples is the use of essential oils, which have specific pharmacological properties that play an important role in the prevention and treatment of various diseases, ranging from cardiovascular conditions and diabetes to psychological illnesses and cancer (Villemure & Bushnell, 2009). Studies have shown that these oils, when inhaled or applied topically, not only have a psychological effect but also enter the bloodstream, providing measurable effects (Edris, 2007). This suggests that its benefits go beyond the psychological aspect, highlighting its pharmacological potential in the therapeutic context.

Some studies have proven the efficacy of medicinal plants in the treatment of mild depression, such as *Hypericum sp.*,

which can provide therapeutic action for the treatment of mild depression with fewer side effects than synthetic drugs (Yunes & Calixto, 2001). In Brazil, some research has also shown that essential oils from pau-rosa, macacaporanga, and catinga-de-mulata, containing linalool, have antidepressant properties (Santos et al., 2018). In addition, Lemon (2004) demonstrated the efficacy of *Lavandula angustifolia* oil in reducing anxiety and depression in patients by massaging different control groups.

Based on the fact that some plants have reports of antidepressant or anxiety therapeutic use, a literature review selected some plants that have reports of the use of these essential oils as an adjunct in treating symptoms. Therefore a list of plants, their chemical composition, and the active principles that act as antidepressants in the central nervous system are described.

The objective of this review is to explore the therapeutic potential of essential oils from lavender, bergamot, Sicilian lemon, clove, ylang-ylang, chamomile, and lemon balm in the treatment of anxiety and depression, based on extensive bibliographic research from databases like SciELO, PubMed, SciFinder, and Elsevier.

2. Methodology

The narrative review research (Rother, 2007) was conducted with SciELO, PubMed, SciFinder, and Elsevier databases, covering publications from 2004 to 2024 (20 years). The search terms used were "essential oils", "antidepressant properties", "alternative therapy", "treatment of depression", "medicinal plant species" and "plant extracts and depression" in Portuguese and English. The articles selected were focused specifically on the essential oils of various common plants, exploring the chemical compounds responsible for their antidepressant properties.

3. Results and Discussion

3.1 Medicinal plants and the main components of essential oils

Essential oils (EOs) are composed of terpenoids and phenylpropanoids, and have lipophilic properties, allowing them to cross the blood-brain barrier and interact with the central nervous system (Monteiro; Brandelli, 2017; Vizzoto; Krolow; Weber, 2010). Inhaling them activates the olfactory nerves, stimulating the limbic system and providing therapeutic benefits such as relieving anxiety and depression (Santos, 2017; Ferreira, 2010). These oils are mainly composed of monoterpenes and sesquiterpenes, as well as other molecules such as alcohols, aldehydes, esters, oxides, ketones, phenols, organic acids, nitrogenous and sulfurous organic compounds (Simões et al., 2010). In this literature review, seven medicinal plants with antidepressant therapeutic potential were selected, all of which act on the central nervous system, as shown in Table 1.

Table 1 - Plants selected in the literature with therapeutic properties.

Plant family	Essential Oil	Plant name
Lamiaceae	Lavender	<i>Lavandula angustifolia</i>
Lamiaceae	Clary sage	<i>Salvia sclarea</i>
Rutaceae	Bergamot	<i>Citrus bergamia</i>
Rutaceae	Sicilian Lemon	<i>Citrus lemon</i>
Myrtaceae	Clove	<i>Eugenia caryophyllus</i>
Annonaceae	Ylang-ylang	<i>Cananga odorata</i>
Asteraceae	Chamomile	<i>Matricaria chamomilla</i>
Lamiaceae	Lemon Balm	<i>Melissa officinalis</i>

Source: Authors.

Two of the eight essential oils mentioned (bergamot and Sicilian lemon) have monoterpene limonene as their main component. Lavender and *Salvia sclarea* EOs have linalyl acetate and linalool as their main constituents. The main constituent

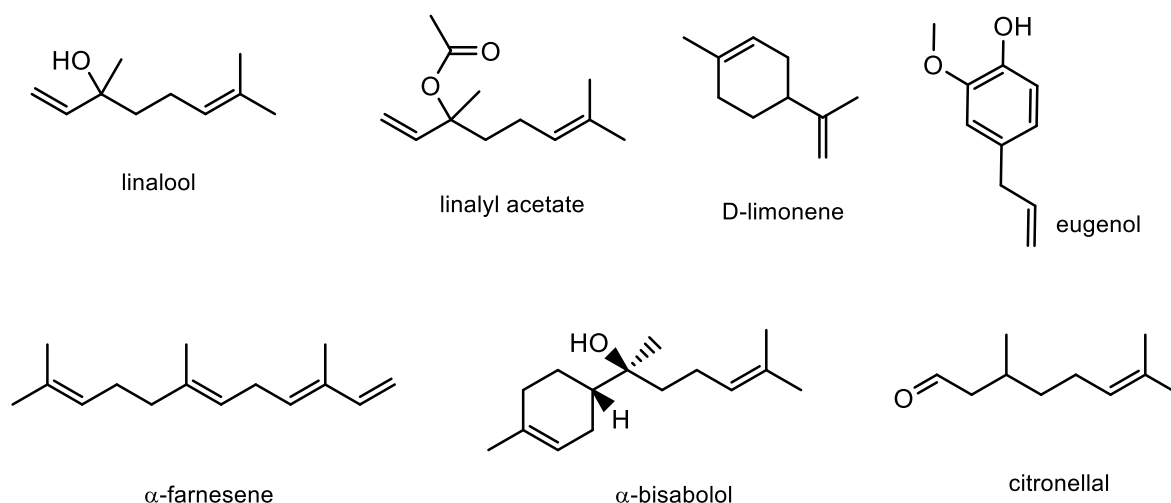
of *Eugenia caryophylls* EO is Eugenol. For Ylang-ylang, the main constituent is α -farnesene. For chamomile EO is α -bisabolol and for Lemon Balm EO is citronellal its the principal chemical component. Table 2 and Figure 1 show the most abundant components in each essential oil of the selected plants.

Table 2 - Major chemical components of essential oil of selected plants.

Essential Oil	1st component	2st component	3st component	Reference
Lavender	Linalool	Linalyl acetate	Terpinen-4-ol	Groot & Schmidt, 2016
Clary sage	Linalyl acetate	linalool	Germacrene D	Raveau et al., 2021
Bergamot	Limonene	Linalool	Linalyl acetate	Fantin et al., 2010
Sicilian lemon	Limonene	β -pinene	γ -terpinene	Dugo et al., 2010
Clove	Eugenol	β -caryophyllene	α -humulene	Haro-González et al., 2021
Ylang Ylang	α -farnesene	Germacrene D	β -caryophyllene	Groot & Schmidt, 2017
Chamomile	α -bisabolol	Chamazulene	β -farnesene	McKay & Blumberg, 2006
Lemon Balm	Citronellal	Citral	β -caryophyllene	Silva et al., 2021

Source: Authors.

Figure 1 - Chemical structures of major constituents of essential oils from selected plants.



Source: Authors.

3.2 Lavender (*Lavandula angustifolia*)

The use of lavender essential oil as an alternative in the treatment of depression has been investigated in several studies, many of which have adopted rigorous methodologies to evaluate its effectiveness. Specific research by Ebrahimi et al. (2022) used inhalation aromatherapy on patients with depression, employing a controlled method to ensure the validity of the results. Patients were divided into groups, where some received aromatherapy with lavender oil while others received alternative treatments or placebo. The severity of depression symptoms was measured before and after the intervention using recognized depression scales. The results of the studies indicate that aromatherapy with lavender essential oil can have a significant positive impact on reducing symptoms of depression. Patients participating in the studies reported a noticeable decrease in the severity of depressive symptoms after inhaling lavender oil. In addition, additional effects such as improved sleep quality and stress reduction were also observed. These findings suggest that lavender aromatherapy may be an effective complementary approach to managing depression, especially in populations that may be sensitive to the side effects of traditional antidepressants.

In another study, Xiong et al. (2018) conducted a study with elderly people from the Chinese community, applying

aromatherapy massage and lavender essential oil inhalation. The results indicated a significant reduction in depression among the participants, suggesting that lavender may be an effective intervention for improving mental health in older populations.

Bagheri-Nesami et al. (2017) investigated the use of EO in patients undergoing hemodialysis treatment where aromatherapy was performed with 3 drops of 5% lavender essential oil for 10 minutes during each hemodialysis session for one month. The results showed a significant reduction in depression in the patients who received aromatherapy compared to the control group, highlighting the effectiveness of lavender as a therapeutic intervention in this population. Complementing these findings, Tayebi et al. (2015) also studied hemodialysis patients, using inhalation of lavender essential oil applied to a tissue for one hour during hemodialysis sessions. The results showed a significant reduction in depression, anxiety, and stress in the intervention group, reinforcing the benefits of lavender on the mental health of chronic patients.

In research focused on postpartum depression, Sehhatie et al. (2015) applied non-pharmacological methods of pain relief during labor, including aromatherapy with lavender. There was a significant improvement in symptoms of postpartum depression, suggesting that lavender may be a viable option for improving mental well-being in the postpartum period. Similarly, Kianpour et al. (2018) investigated women at high risk of postpartum depression using aromatherapy inhalation with rose and lavender at 38 weeks gestation and in the postpartum period. The results showed a significant improvement in symptoms, indicating the benefits of aromatherapy during and after pregnancy.

Bahrami et al. (2017) explored the effects of aromatherapy massage on elderly patients with acute coronary syndrome. The study revealed a significant reduction in anxiety and depression, showing that aromatherapy can be a useful tool for improving mental health in patients with heart conditions. In the context of migraines, Jafari-Koulaee et al. (2019) studied patients using aromatherapy with lavender essence. The results indicated a positive effect in reducing depression and disability caused by headaches, highlighting the potential application of lavender in chronic pain conditions.

The study by Yin et al. (2024) investigated the effects of aromatherapy with lavender essential oil on depression and sleep quality in 40 patients with post-stroke depression at the Zhejiang Provincial People's Hospital in China. The patients, aged between 18 and 75 and with a minimum score of 17 on the Hamilton Rating Scale for Depression, were randomly divided into two groups (experimental and placebo). The experimental group inhaled lavender essential oil every night for four weeks. The results showed significant improvements in both groups, but more marked in the experimental group, with an average reduction of 5.95 in the HAMD-17 score, compared to a decrease of 3.15 in the placebo group.

The research carried out by Sánchez-Vidaña and collaborators used 24 adult male mice of the Sprague Dawley strain, divided into four groups: Control, Corticosterone (Cort), Lavender Essential Oil (LEO), and LEO + Cort. After 14 days of treatment and behavioral tests, serum samples were collected for biochemical analysis of BDNF, corticosterone, and oxytocin levels, and the rats' brains were analyzed for BrdU and DCX-positive cells in the hippocampus and subventricular zone. The results showed that LEO treatment significantly improved corticosterone-induced depressive behavior in the LEO + Cort group. Corticosterone administration reduced the number of BrdU-positive cells in the hippocampus and subventricular zone, but LEO treatment prevented this reduction. In addition, LEO increased neurogenesis and the dendritic complexity of immature neurons, indicating its therapeutic potential in improving symptoms of depression.

Mehrabian et al. (2022) investigated the effect of aromatherapy massage using lavender, chamomile, and rosemary oils on depression and anxiety in 38 elderly nursing home residents. Participants were randomly allocated to the intervention and control groups through convenience sampling, with 19 in each group. The main intervention of this randomized controlled trial was aromatherapy massage. The intervention group received massage using a mixture of lavender, chamomile, and rosemary essential oils, diluted in 3% jojoba oil. The results showed a significant reduction in the average anxiety and depression scores of the intervention group.

3.3 Clary Sage (*Salvia sclarea*)

According to a study by Seol et al. (2010), the aim was to identify essential oils with antidepressant effects and to explore the mechanisms regulating these effects, especially focusing on *Salvia sclarea* oil. To this end, the study was carried out on 8-week-old Sprague-Dawley rats, kept under controlled conditions of temperature and light cycle. The rats were treated with essential oils by intraperitoneal injection or inhalation to evaluate the antidepressant effects of *Salvia sclarea* (clary sage), *Anthemis nobilis* (chamomile), *Rosmarinus officinalis* (rosemary) and *Lavandula angustifolia* (lavender) oils. The results showed that 5% clary sage oil had the strongest anti-stress effect, significantly reducing the immobility time of the rats, comparable to the effectiveness of traditional antidepressants such as imipramine and fluoxetine. The antidepressant effect of clary sage oil was blocked by buspirone (5-HT_{1A} agonist), SCH-23390 (D₁ receptor antagonist), and haloperidol (D₂, D₃, and D₄ receptor antagonist), suggesting that the oil's mechanism of action is associated with modulation of the dopaminergic and serotonergic pathways. Both inhalation and injection of clary sage oil were effective in reducing immobility, indicating that administration by inhalation is also feasible. There was no significant difference in serum corticosterone levels between the groups treated with clary sage and the control group, possibly due to the time chosen for post-test sampling.

3.4 Bergamot (*Citrus bergamia*)

Bergamot essential oil is rich in the monoterpene D-limonene, which has numerous properties such as antitumor and antiparasitic (Vandresen et al. 2014; Almeida-Batista et al. 2019; Vandresen et al. 2022; Contato et al 2023). Scuteri et al. (2019) investigated the effects of bergamot essential oil in the treatment of neuropsychiatric symptoms, such as depression, in patients with dementia. The aim was to assess the efficacy and safety of this oil as a complementary therapy to relieve symptoms of depression and anxiety. The methodology included behavioral tests on animal models and clinical trials with human patients. In tests with rats, a significant reduction in anxiety and depressive behaviors was observed, without the sedative effects common in drugs such as benzodiazepines. In patients with dementia, aromatherapy with bergamot oil reduced symptoms of agitation and improved general well-being. In addition, bergamot oil increased the levels of neurotransmitters such as aspartate, glycine, and taurine in the hippocampus. These results suggest that bergamot essential oil is an effective and safe complementary therapy for treating symptoms of depression and anxiety in dementia patients, potentially improving their quality of life.

Another research performed by Chang et al. (2023) investigated the effects of bergamot essential oil on depression using a rat model subjected to chronic unpredictable mild stress. The aim was to provide a scientific basis for its use in the treatment of depression. The rats were divided into four groups: control, stress with Tween 80, bergamot oil, and fluoxetine. The oil was administered via inhalation for one hour daily for five weeks. The rats faced various random stresses, such as food deprivation and electric shocks. Behavioral tests measured anhedonia, immobility, and locomotor activity. Histological and biochemical analyses assessed neuronal plasticity and serotonin, IGF-1, and IL-1 β levels. The results showed that bergamot oil significantly improved depressive behavior, increased the number of Nissl bodies, dendritic length, the density of dendritic spines, and the levels of proteins associated with neuronal plasticity, as well as increased serotonin and IGF-1 and reduced IL-1 β . This suggests that bergamot oil may protect the plasticity of hippocampal neurons and offer new options for treating depression.

Another study by Rombolà et al. (2017) investigates the neurobiological effects of bergamot essential oil in the treatment of depression and anxiety, using behavioral tests. Male Wistar rats were used, divided into groups, and treated with different doses of bergamot oil, diazepam, or jojoba oil. The rats treated with bergamot oil showed a reduction in grooming time and immobility in the open field test, indicating a stress reduction. In other tests carried out on the rats, results were obtained indicating a decrease in anxiety and antidepressant effects.

The results of the articles presented above tend to indicate that bergamot essential oil has anxiolytic and antidepressant properties, supporting its potential use in complementary therapies for the treatment of anxiety and depression disorders.

3.5 Sicilian Lemon (*Citrus lemon*)

In a study by Alkanat and Alkanat (2023), verified the use of D-limonene as a possible therapy for depression, and in Sicilian lemon essential oil, this is the major component. This study investigates the effects of D-limonene on depressive behaviors and memory in rats subjected to chronic restraint stress. Forty rats were used, divided into five groups: control, limonene, restraint stress, stress + limonene, and stress + fluoxetine. D-limonene was administered by gavage (10 mg/kg) for 21 days. Behavioral tests (sucrose preference, open field, novel object recognition, and forced swimming) and biochemical measurements (BDNF, IL-1 β , IL-6, and caspase-1 in the hippocampus) were performed. The results showed that D-limonene increased sucrose preference and activity in the open field, as well as reducing defensive behaviors. In the novel object recognition test, the discrimination index improved with D-limonene. The compound also normalized BDNF levels and reduced IL-1 β and caspase-1 in the stress group. The article therefore concludes that D-limonene has antidepressant properties and improves memory, mitigating the negative effects of chronic stress.

Komiya et al. (2006) explored the anti-stress effects of lemon essential oil in rats, focusing on the modulation of the serotonin (5-HT) and dopamine systems. The aim was to investigate the anxiolytic and antidepressant effects of lemon oil and its mechanisms of action. Male rats were exposed to inhalation of the oil and subjected to behavioral tests (elevated cross maze, forced swimming, and open field), as well as treatments with receptor agonists and antagonists. The results showed that lemon oil has anxiolytic and antidepressant effects, suppressing dopamine activity by modulating 5-HT neurons. Inhalation of the oil significantly increased the levels of 5-HT and its metabolites in various regions of the brain, suggesting that the antidepressant effect is related to the 5-HT_{1A} pathway.

3.6 Clove (*Eugenia caryophyllus*)

Mehta et al. (2013) investigated the effects of *Eugenia caryophyllus* essential oil (clove oil) on animal models of depression and locomotor activity. Male Swiss albino mice were divided into groups and treated with different doses of clove oil (0.025, 0.05, and 0.1 ml/kg/day) intraperitoneally for three weeks. The forced swim test (FST) and the tail suspension test (TST) were used to assess depression. Locomotor activity was measured using the rota rod test and the photoactometer procedure. The results showed that clove oil at doses of 0.05 and 0.1 ml/kg significantly reduced immobility in the FST and TST tests, indicating an antidepressant effect. The 0.025 ml/kg dose increased immobility but without statistical significance. In the rota rod test, the 0.1 ml/kg dose increased the latency to fall, improving muscle coordination, while lower doses reduced this latency. The photoactometer showed an increase in locomotor activity at all doses, with significance at the 0.1 ml/kg dose. It is concluded that clove oil has antidepressant properties and improves locomotor activity and muscle coordination, especially at higher doses, suggesting its potential use in treating depression and improving motor function.

The study by Ansariniaki et al. (2022) does not focus directly on depression, but studies memory-related functions. The article is a randomized clinical trial investigating the effects of aromatherapy with clove essential oil on the memory function of patients during electroconvulsive therapy. 100 patients took part, divided into two groups: an experimental group, which received clove essential oil at 2.5% three times a week for 5 minutes, and a control group, which received routine care. However, the results showed that clove essential oil did not improve the patient's memory or significantly affect cortisol levels after therapy. Memory scores increased in the first week after therapy, but decreased in the second week in both groups, with no significant differences in total memory scores between the groups. Cortisol levels decreased significantly in both groups

after therapy but with no significant difference between them. As a result, the study concluded that aromatherapy with clove essential oil had no significant effect on improving memory or reducing cortisol levels in patients undergoing electroconvulsive therapy.

The study by Godoy et al. (2023) used male Swiss albino mice to investigate the effects of ortho-eugenol, a synthetic isomer of eugenol, on anxiety behaviors, working memory, and oxidative stress. The animals were divided into groups and given doses of 50, 75, or 100 mg/kg of ortho-eugenol, with behavioral tests including the perforated board test and the Y maze test. The results showed that the 100 mg/kg dose of ortho-eugenol significantly increased the number of head dips and reduced latency in the perforated board test, indicating an anxiolytic effect. However, none of the doses improved working memory in the Y maze test. The study did not focus directly on the use of ortho-eugenol for the treatment of depression, but the anxiolytic effects observed may have indirect implications, given that anxiety and depression often coexist and share neurobiological mechanisms.

3.7 Ylang Ylang (*Cananga odorata*)

Ylang-ylang essential oil, obtained from the flowers of the tropical species tree *Cananga odorata*, is widely used in traditional medicine, with many uses including the treatment of anxiety and altered neuronal states. According to a study by Borgonetti et al. (2022), male mice of the CD1 strain, aged between four and six weeks and weighing approximately 22 to 24 grams, were chosen to evaluate the therapeutic potential of ylang-ylang essential oil in reducing neuropathic pain and the symptoms of anxiety and depression associated with this condition. Oral administration of ylang-ylang essential oil resulted in a significant reduction in neuropathic pain induced by nerve damage. However, although the oil showed anxiolytic effects in mice with neuropathy, it was not effective in reducing the depressive behaviors induced by sciatic nerve injury. This suggests that the mechanisms underlying the anxiolytic and antidepressant effects may be distinct and that Ylang Ylang may be more effective in treating anxiety than depression associated with neuropathy.

Gnatta et al (2014) investigated the effects of ylang-ylang essential oil on perceived anxiety, self-esteem, and physiological parameters in nursing staff. Thirty-four participants were randomized into three groups: G1 received ylang-ylang oil via skin application, G2 received a placebo essence, and G3 received ylang-ylang EO via inhalation. The Anxiety Inventory and the Dela Coleta self-esteem scale were used for evaluation at five points throughout the study. The results showed significant increases in self-esteem in the three groups, but no significant differences in anxiety or physiological parameters were observed between the groups.

In another study, Amadeó et al (2020) investigated the use of ylang-ylang essential oil as an intervention to prevent suicidal behavior in individuals with a history of suicide attempts, a significant risk factor for completed suicide. Several strategies to prevent these behaviors have already been proposed, including individual and group therapies, and support methods that involve maintaining contact with individuals. The study methodology was prospective and included 140 patients, divided into 68 cases (intervention group) and 72 controls. The results showed that the interventions significantly reduced the number of suicide attempts and suicides (3%) after 6 months, compared to the control condition (12%). Loss to follow-up was lower in the intervention group (7.35%) than in the control group (9.72%). There was a significant reduction in depression, anxiety, and suicidal ideation scores after treatment compared to before treatment. Specifically, the mean score on the Montgomery-Åsberg Depression Rating Scale decreased from 26 to 7.4, and the mean score on the Hamilton Anxiety Rating Scale decreased from 25.79 to 7.96.

3.8 Chamomile (*Matricaria chamomilla*)

Ebrahimi et al. (2020) conducted studies using lavender essential oil, analyzing the possible actions of chamomile oil.

The study investigated the effects of aromatherapy on depression, anxiety, and stress in the elderly. 183 participants were included, divided into three groups: lavender, chamomile, and control. The participants inhaled three drops of the essential oils or distilled water for 30 nights. Levels of depression, anxiety, and stress were measured at the beginning, immediately after the intervention, and one month later. The results showed that both lavender and chamomile significantly reduced levels of depression, anxiety, and stress immediately after the intervention and one month later, compared to the control group.

3.9 Lemon Balm (*Melissa officinalis*)

Using animal models, Stojanović et al. (2023) investigated the anxiolytic potential of *Melissa officinalis* essential oil and its main component, citronellal. Male BALB/c mice were treated with intraperitoneal injections of essential oil at doses of 12.5 to 100 mg/kg and with corresponding doses of citronellal. The animals' anxiety behavior was assessed using the light/dark, perforated field, and marble burying tests, while the motor effects were assessed using the open field, rota-rod, and horizontal wire tests. The results showed that *Melissa officinalis* essential oil has significant anxiolytic potential, significantly altering the parameters measured in the tests. However, the effects of citronellal were inconclusive, suggesting a combination of anxiolytic and motor inhibitory effects. This study provides a basis for future research into the mechanisms of action of *M. officinalis* essential oil on anxiety-related neurotransmitter systems.

In a research performed by Taiwo et al. (2011), the anxiolytic and antidepressant effects of *M. officinalis* extract were investigated in Wistar rats. Using both male and female rats, the researchers administered acute (single dose) and subacute (10 consecutive days) doses of 30, 100, or 300 mg/kg of the plant's ethanolic extract. Diazepam (1 mg/kg) and fluoxetine (10 mg/kg) were used as positive controls. Anxiolytic and antidepressant behaviors were evaluated using the elevated cross maze (EPM), forced swimming (FS), and open field (OF) tests. The results showed that subacute treatment with *M. officinalis* significantly increased the percentage of entries and time in the open arms of the EPM, indicating an anxiolytic effect similar to that of diazepam. In the forced swim test, immobility decreased significantly after subacute treatment with *M. officinalis*, showing an antidepressant effect, although fluoxetine was more effective. There were no significant changes in the rats' locomotion, suggesting that the effects observed were not due to changes in motor activity. The study concluded that *M. officinalis* extract has anxiolytic and antidepressant properties in rats, with efficacy varying according to the duration of treatment and the gender of the animals.

Another study by Bett (2013) attempted to identify and determine the anxiolytic actions of *M. officinalis* extract. The extract was administered to mice for 15 consecutive days. The use of the plant extract was analyzed in rats, in an elevated cross maze and an open field. In the open field test, no significant effect was identified, but in the elevated cross maze, an anxiolytic activity similar to that of benzodiazepines was observed. The results indicate that *M. officinalis* extract has anxiolytic effects under conditions of moderate stress, without altering motor activity levels.

In a study by Lin et al. (2015), the antidepressant activity of the aqueous extract of this plant was investigated in rats. Two experimental models were conducted: acute and subacute. In the acute model, the rats received ultrapure water (control), fluoxetine, *M. officinalis* extract, or rosmarinic acid three times in one day. In the subacute model, they received ultrapure water, fluoxetine, or three doses of the extract daily for 10 days. Locomotor activity and depressive behavior were assessed by the open field test and forced swimming, respectively, while neurotransmitter levels in the brain were analyzed by HPLC. The results showed that *M. officinalis* extract and rosmarinic acid significantly reduced depressive behavior, increased swimming time, and reduced the rate of serotonin turnover, indicating modulation of serotonergic neurotransmission. It was concluded that such use may offer a serotonergic antidepressant activity useful in preventing and complementing conventional therapies for depression.

A slightly different study by Kennedy et al. (2006) evaluated the anxiolytic effects of a combination of *M. officinalis*

(lemon balm) and *Valeriana officinalis* (valerian) in laboratory-induced stress situations. A double-blind, placebo-controlled, randomized, crossover experiment was carried out with 24 healthy volunteers. Each participant received three separate single doses (600 mg, 1200 mg, 1800 mg) of a standardized product containing extracts of *M. officinalis* and *V. officinalis*, plus a placebo, on separate days for a washout period of 7 days. The effects on mood and anxiety were assessed pre-dose and 1, 3, and 6 hours post-dose using a 20-minute version of the Defined Intensity Stress Simulation (DISS) battery. Cognitive performance in four concurrent tasks was also assessed. The 600 mg dose of the combination reduced the negative effects of the DISS on anxiety assessments. However, the highest dose (1800 mg) increased anxiety during a test session. In addition, all three doses led to a decrease in performance on the Stroop task of the DISS battery, and the two lowest doses resulted in decreases in the overall score of the DISS battery. The results were partially positive, but require further investigation.

4. Conclusion

Essential oils have shown promising potential as complementary therapies in the treatment of depression and anxiety, as evidenced by various studies that have explored their therapeutic properties. Among the oils analyzed, lavender, bergamot, Sicilian lemon, clove, chamomile, and lemon balm stood out for their positive effects in reducing depressive symptoms. Lavender essential oil, for example, has shown significant efficacy in reducing symptoms of depression in several controlled studies, whether by inhalation or topical application. Similar results have been observed with the use of bergamot oil, which in addition to relieving depressive symptoms, has been shown to improve anxiety and general well-being. Sicilian lemon essential oil, with its major component D-limonene, also showed antidepressant and anxiolytic properties, enhancing memory and reducing the negative effects of chronic stress. In addition, clove oil has shown antidepressant properties and improved locomotor activity and muscle coordination in animal studies. Studies have also shown that oil from the *Melissa officinalis* plant has anxiolytic and antidepressant potential, showing efficacy in reducing anxiety and depression behaviors in animal and human models, with variations in efficacy depending on dosage and combination with other extracts. On the Other hand, ylang-ylang oil has not shown good results in the literature in reducing anxiety and depression behaviors.

However, it is crucial to point out that although the results are generally positive, essential oils should only be considered as alternative and complementary therapies for depression and anxiety treatment. There is not enough scientific evidence for them to be used as a substitute for traditional pharmacological treatments. The evidence is not yet robust enough for these oils to be recommended as the main treatment for depression. Conventional treatments, such as antidepressants and psychotherapy, are still the most effective and well-documented options for managing depression. Any use of essential oils must be supervised by a health professional and integrated into a comprehensive treatment plan, especially considering the risks of drug interactions and possible adverse effects. We hope that this article can contribute to further studies into the use of other essential oils in the treatment of depression and anxiety.

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