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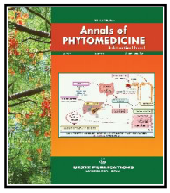

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Neuroprotective capabilities of essential oils with its potential therapeutic implications

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Abstract

Neuroprotection research holds promise for protecting nerves and preventing brain damage. Essential oils, a complex mixture of small plant compounds, have gained a reputation for tissue protection. This study aims to provide insight into the neuroprotective and therapeutic properties of essential oils, discussing the significance of dental care and methods for preserving tissues, with a focus on cell biology. This article explores a diverse range of neuroprotective agents, including essential oils, antibiotics, antioxidants, metabolites, and excitotoxins, delving into their effects on biological systems and their use in safeguarding neuronal health. Essential oils exhibit neuroprotective and antiageing potentials, as evidenced by various studies. They have been reported to have neuroprotective effects against neurodegenerative disorders such as Alzheimer's disease and Parkinson's disease. This review delves into the curative powers of essential oils, highlighting their antibacterial, antifungal, and antibacterial properties, while recognizing the need for further research to fully understand their healing properties and the limitations of current analytical techniques.

1. Introduction

Herbal medications, consisting of natural components, enhance excellent health and wellbeing. Medicinal herbs have been used since ancient times to Figureht sickness and are an integral element of human culture. Current trends in herbal medicine include doing research on the pharmacological effects of herbs to verify the information found in authoritative publications (Sukeshini *et al.,* 2023). Since ancient times, aromatherapy and traditional medicine have used essential oils (EOs), which are derived from fragrant and therapeutic plants, to treat a wide range of illnesses. Researchers have recently assessed the potential for neuroprotection and antiageing properties of EOs as well as potential mechanisms of action (Ayaz *et al.,* 2017). Pharmaceutical dosage forms, including tablets, capsules, creams, ointments, liquids, pills, suppositories, aerosols, and several other formulations, have long been essential in diagnosing infectious diseases and chronic conditions. Additionally eessential oil nanoparticles having the greater therapeutic effect and targeted effect than the other dosage forms (Nikhita *et al.,* 2023). Research has examined the neuroprotective properties of essential oils (EOs) in relation to age-related neurodegenerative disorders including Alzheimer's and Parkinson's disease. The potential therapeutic benefits of essential oils on mood disorders including anxiety and depression have also been studied (Rashed *et al.,* 2021). EOs are a desirable alternative for neuroprotection due to their minimal risk for adverse effects and their ability to create a broad variety of therapeutic benefits *via* action on different neuronal circuits (Soares *et al.,* 2021). The objective of this study is to provide a summary of the possible therapeutic applications and neuroprotective benefits of EOs.

The effective chemicals of flora are encased in hydrophobic liquids with excessive awareness, making them vital oils**.** Essential oils are usually water-immiscible (immiscible) lipophilic compounds (literally: 'lipophilic'). The complexity of essential oils stems from their plant origins, with variations in composition depending on plant species, harvested parts, and extraction techniques. Combining these compounds is what makes essential oils so different, with each one having its own unique characteristics, and esters (Sadgrove and Jones, 2015).

1.1 Role of essential oil and their derivatives

Two separate isoprenoid routes create different chemicals found in essential oils. Essential oils are frequently utilized in aromatherapy, cosmetics and perfumes for their medicinal effects. Complex molecular mixes frequently have more than twenty primary components and smaller molecular weights of variable degrees. Monoterpenes and sesquiterpenes are the predominant components of essential oils; however, diterpenes and phenylpropanoids can be hazardous at varied quantities.

1.1.1 Importance of neuroprotection and its implications in therapeutic interventions

Neuroprotection is an important therapeutic component for many neurological diseases including Parkinson's disease, Alzheimer's disease, Epilepsy and Migraine (Corps *et al.,* 2015; Mallah *et al.,*

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2020). Over 10 million individuals throughout the globe are impacted Parkinson's disease (PD), the most prevalent degenerative neurological movement sickness. The condition is more common as people age. With an estimated 4% of cases identified before the age of 50, men are more prone than women to have PD (Pranali *et al.,* 2023). The goal of treatment has shifted from symptoms management to strategies for tissue protection and regeneration (Mallah *et al.,* 2020). Importantly, in the context of Parkinson's disease, neuroprotective sellers may halt or delay the death of cells that produce dopamine. Some substances with neuroprotective abilities include antioxidants, Anti-inflammatory dealers, antiapoptotic dealers and antiexcitotoxic dealers. Natural merchandise, including natural drug treatments and nutraceuticals, additionally have neuroprotective consequences and may be used inside the prevention of neurological issues (Mallah *et al.,* 2020). However, the shortage of reliable markers and adequate models has hindered the progress of neuroprotective therapies. Clinicians have seen in this decade that the illness is also affecting the younger segments of society. There will reportedly be twice as many patients by the end of 2050 as there are now (Pranali *et al.,* 2023). Further research is wanted to increase neuroprotective marketers which could lessen the pathology of neurological issues (Ahlskog and Uitti, 2010).

The need for effective strategies for tissue protection and repair in cases of neurodegenerative diseases and central nervous system lesions remains unmet. Protecting white matter neurons was the primary emphasis of earlier work. Unfortunately, clinical trials targeting these mechanisms have been disappointing, hindering further research progress. Retardants, like as sulfonylureas, are oral hypoglycemic drugs that bind selectively to sulfonylurea receptors on the surface of pancreatic beta-cells. The display occurred because it does not bind to sulfonylurea (SUR-2A) in the heart; thereby, offering cardiovascular protection (Awdhut *et al.,* 2023). Nevertheless, dormant monopotent stem cells have the potential to be reactivated by a variety of inflammatory stimuli. This reworking stimulates activities such as proliferation, migration, and differentiation. Notably, these cells may indirectly contribute to neuroprotection by repairing myelin and remyelinating axons. Although the goal of neuroprotection in various neurological disorders is recognized, the development of successful neuroprotective agents remains a formidable challenge (Baldassarro *et al.,* 2022).

Multiple sclerosis (MS), which affects the nervous system, Alzheimer's disease (AD), Parkinson's disease (PD), and other neurological disorders have been shown to protect the body after key events like stroke or nerve injury. Looking for ways to help others.

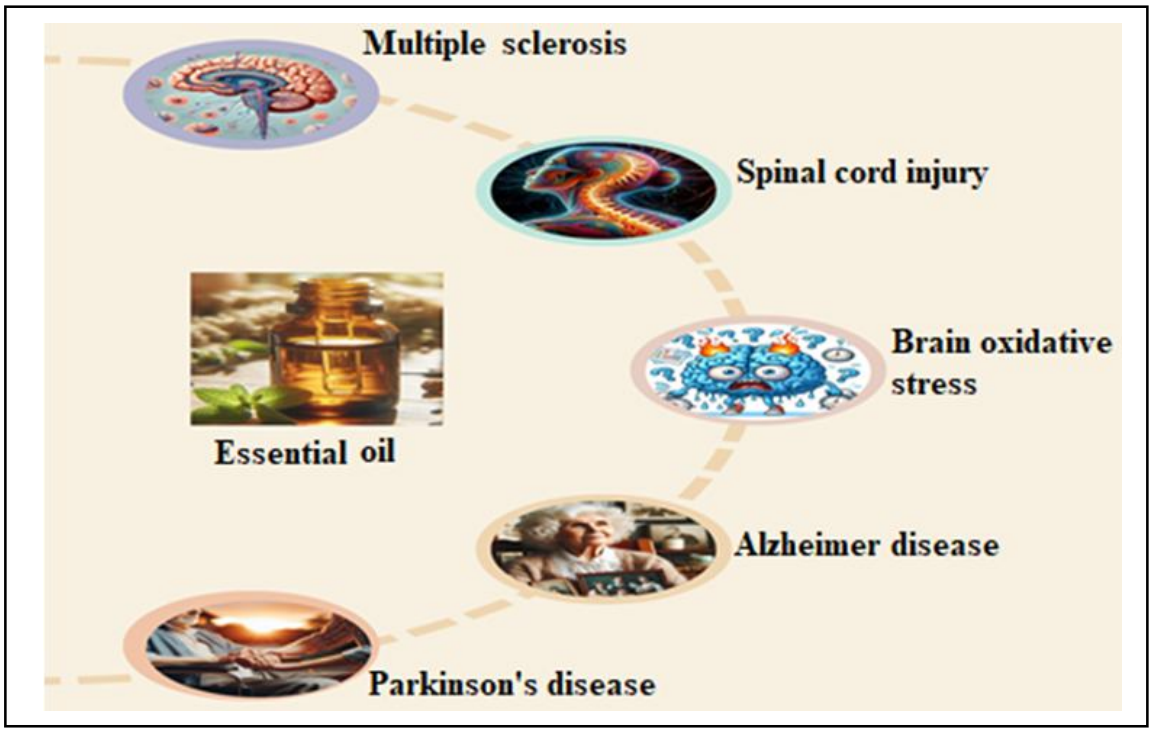

Figure 1: Beneficial effects of essential oil on the nervous system.

Since ancient times, volatile aromatic molecules known as essential oils have been collected from plants and utilized in cosmetics, ointments, perfumes, and medicine. Researchers have recently focused on the potential uses of various essential oils in acute, chronic, and viral disorders as well as their medicinal qualities. The possible neuroprotective properties of essential oils are one area of investigation. According to studies, essential oils may reduce stress, weariness, memory issues, behavioral symptoms, inhalant desires, and sleep issues without having the risk of misuse (Sattayakhom *et al.,* 2023).

Numerous research works have shown the neuroprotective properties of essential oils derived from various plant species. For instance, it has been shown that *Pinus halepensis* essential oil reduces oxidative stress and the harmful memory impairment caused by Alzheimer's amyloid beta in the rat hippocampal tissue (Rashed *et al.,* 2021). It has been discovered that lavender oil protects PC12 (pheochromoc

ytoma) cells against H_2O_2-induced cytotoxicity and mice that have cognitive abnormalities brought on by scopolamine. In rats treated with scopolamine, it has been shown that inhaling essential oil of *Anthriscus nemorosa* prevents memory impairment, anxiety, and depression. According to their research, essential oils may be able to enhance cognitive performance and shield the brain from harm.

The precise ingredients in the product determine the possible effects of essential oils on the brain. For instance, linalool, an ingredient in lavender essential oil, which is often used to treat stress and anxiety, has been shown in animal experiments to have sedative properties. Studies on cerebral ischemia have shown that the oils of bergamot and curcuma have neuroprotective and antioxidant properties. These results imply that, depending on their chemical makeup, certain essential oils may have various neuroprotective effects.

Essential oils have shown encouraging outcomes in enhancing cognitive function and shielding the brain from harm. Though, more investigation is necessary to completely comprehend the neuroprotective properties of essential oils, current research indicates that they may hold promise as a treatment for age-related neurodegenerative disorders as well as mental health conditions including dementia, anxiety, and depression.

1.2 Therapeutic potential of essential oils

Since they have been used for millennia in traditional medicine, essential oils may have therapeutic uses for a range of illnesses, according to current studies (Aljaafari *et al.,* 2021).

1.2.1 Antibacterial activity

Studies have shown the antibacterial effects of essential oils against a range of human diseases. Tea tree oil, for instance, has been shown to possess antiviral, antifungal, and antibacterial activities (Aljaafari *et al.,* 2021). It has been discovered that clove oil has antifungal and antibacterial qualities. These results imply that essential oils may be used in conjunction with or as an alternative treatment for infectious disorders.

1.2.2 Mental health

Research has shown that essential oils may improve mental health by easing the symptoms of anxiety and sadness. According to these results, essential oils may be used as a complementary treatment for mental health conditions (Fung *et al.,* 2021).

1.2.3 Neuroprotection

Research on the neuroprotective properties of essential oils suggests that they may be useful in the treatment of neurodegenerative illnesses. For instance, it has been shown that rosemary oil protects the brain against neuroinflammation and oxidative stress. These results imply that essential oils may provide a treatment alternative for neurological illnesses associated with aging (Ayaz *et al.,* 2017).

1.2.4 Pain relief

It has been shown that essential oils possess analgesic attributes, which may be helpful in the management of pain. For instance, it has been discovered that peppermint oil has a cooling effect and may be used topically to ease discomfort. These results imply the potential use of essential oils as a natural painkiller (Aljaafari *et al.,* 2021).

1.2.5 Anti-inflammatory activity

Studies have shown that essential oils include anti-inflammatory qualities, which may help cure inflammatory illnesses. For instance, it has been discovered that frankincense oil contains anti-inflammatory properties and may be used to treat inflammatory conditions like arthritis. These results imply that essential oils may be a useful treatment for conditions involving inflammation.

2. Neuroprotection against neurological disorders

These conditions affecting the nervous system's various components, neurological disorders are a diverse group. The underlying causes of these disorders can involve trauma, degeneration, and autoimmune factors. The CNS's complex web of neuroprotection shields the body from both acute and chronic neurodegenerative disorders.

2.1 Neuroprotection

A concentrated effort to safeguard the nervous system, neuroprotection targets injury prevention. Efforts to shield the nervous system from harm can hinder nerve damage and slow CNS degeneration. Neuroprotectants protect against nerve damage by not allowing it to occur.

2.2 Prevention of neurological disorders

For neurological disorders, herbal treatments and nutritional products are a valuable resource. The nervous system's protection from harm can slow the progression of neurological disorders (Rehman *et al.,* 2019).

2.3 Treatment of neurological disorders

By using neuroprotective approaches, we may precisely focus on certain illnesses and provide efficacious therapies for Alzheimer's disease, Parkinson's disease, multiple sclerosis, and epilepsy. In order to protect the neurological system from further damage and slow down the evolution of the illness, various measures may be used.

A vital aspect of treatment, neuroprotective measures aim to shield the brain from harm. The nervous system's primary protection comes from its ability to shield it, preventing injury and damage and slowing disease progression. The investigation of common disease pathways can reveal innovative treatment options, including neuron safeguards, restoration, and regeneration. By addressing a range of neurological conditions, these strategies showcase their versatility and efficacy.

2.4 Ease of essential oil extraction techniques

For the purpose of separating, identifying, and using valuable phytoconstituents from various plants, extraction is a crucial step. The best method for achieving the highest purity and maximum yield depends on the specifics of the desired chemical. Compounds from plants are extracted using a variety of chemical and mechanical techniques, such as solvent extraction and steam distillation. According to Wang and Weller, the methods now in use for extracting fat, oils, and essential oils include Soxhlet, hydro distillation, and alcohol-based maceration. The application of conventional Soxhlet extraction procedures is frequently restricted by the mass transfer resistances resulting from the involvement of many phases in the system.

The length of time needed for this separation process varies based on the solvents' speeds of diffusion. Moreover, conventional extraction methods require a lot of energy. Since these methods involve manual operations, repeatability presents a significant difficulty.

Low extraction yields are caused by the heating process deteriorating thermally sensitive components. The pressure, temperature, and pH levels that are employed may change these active molecules. The aforementioned constraints, when paired with the notable surge in the requirement for bioactive elements, essential oils, fat, and oils, have necessitated the development of suitable, discriminating, economical, and environmentally sustainable extraction methods that are speedy, yield greater quantities, and conform to applicable regulations. In order to improve the product, this has led to the development of novel extraction techniques as supercritical fluid extraction (SFE) (Danlami *et al.,* 2014).

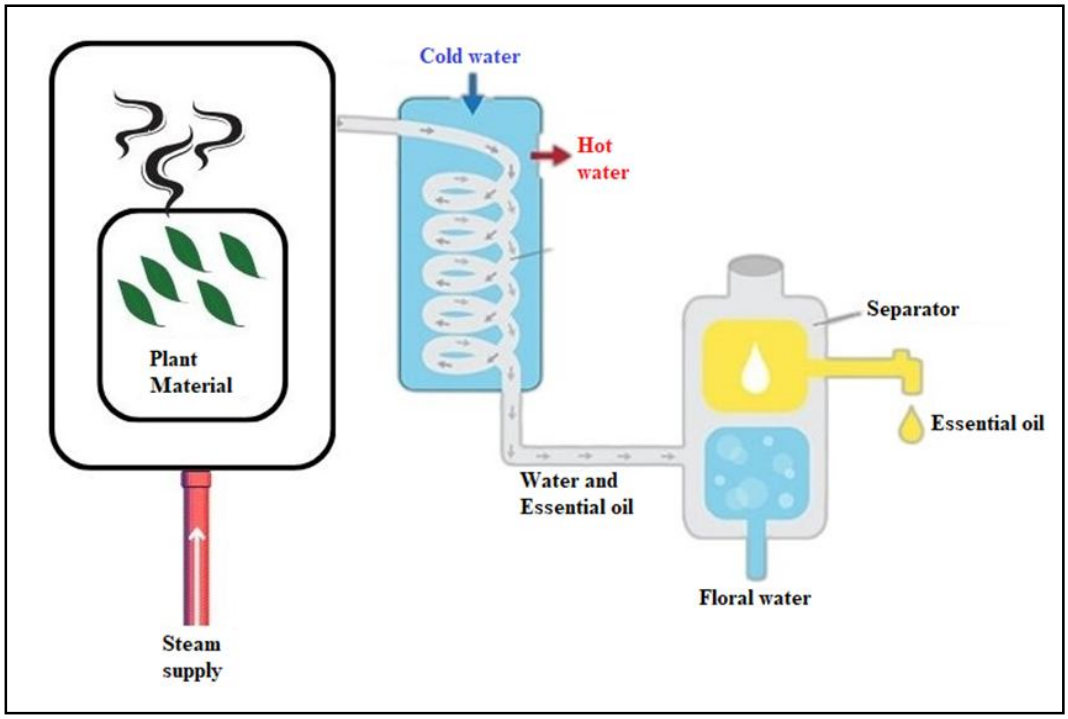

Figure 2: Steam distillation.

2.5 Essential oil extraction techniques

2.5.1 Steam distillation

Steam distillation is one of the most widely used procedures for isolating and extracting essential oils from plants for use in natural goods. Essential oils may be collected from different portions of plants using different techniques. A popular technique for removing volatile components is steam distillation, particularly when leaves and flowers are used as the starting material. The plant material used in steam distillation is positioned in a column above a water-filled boiler. After the water reaches a boil, the essential oils are released from the oil glands in the plant tissue and transported to the condenser by the vapor's high temperature. The cooling water condenses the water and oil vapor combination, which is then gathered in an essential oil separator and allowed to naturally separate the oil from the hydrosol. Because water vapor is used as the solvent instead of organic solvents, steam distillation is a technology that is less harmful to the environment. More aroma is produced with this approach than with any other distillation process. To preserve the essential oils throughout the extraction process, steam distillation requires careful attention to temperature and pressure management. Steam distillation might take many hours or even days, depending on the plant, to completely extract the oils from the biomass (Machado *et al.,* 2022).

Hydrodistillation is not viable method for extracting all essential oils. This is mostly because various essential oils in the plant material, particularly the fragile blossoms, are sensitive to heat. Various plant species will need different extraction techniques based on their distinct qualities. To guarantee the maximum quality and quantity of essential oils, research into the most effective extraction techniques for various plant species should be conducted.

One popular technique for extracting essential oils from plants is steam distillation. Compared to other distillation techniques, it yields a finer smell and is a clean approach. To prevent deteriorating the essential oils during the extraction process, attention must be made to regulate pressure and temperature.

2.5.2 Solvent extraction

Solvent extraction is one of the processes used to extract and isolate essential oils from plants for use in natural goods. Essential oils are extracted from various areas of plants using different procedures. A more recent technique called solvent extraction uses food-grade solvents such ethanol, benzene, dimethyl, or hexane to separate the oils. Essential oils from delicate aromatics, like rose or jasmine, are often extracted using this method since they cannot normally tolerate the pressure of steam distillation.

Although, all plant materials may be treated using solvent extraction, flowers that are too delicate or unable to withstand the additional conditions needed for steam distillation are the most often treated. Absolutes are derived *via* solvent extraction techniques and vary from essential oils in that they may include both aromatic and non-aromatic chemical components. Selecting a suitable solvent is a crucial first step.

An absolute, a highly concentrated aromatic compound that closely mimics the plant's inherent scent, is the result of solvent extraction. This procedure produces a thick, waxy substance known as "concrete." All of the plant's strong aromatic compounds are present in concretes, along with a wide range of other lipid-soluble substances.

The yield of this process is a thick, waxy material called a "concrete" which is further processed with a second solvent to produce a pure mixture of only absolute.

2.5.3 CO_2 extraction

Steam distillation and CO_2 extraction are two methods that may be used to extract essential oils from different portions of plants. Steam distillation is a conventional technique that extracts essential oils from plant material by heating water or steam to a high temperature. The essential oils are released from the oil glands in the plant tissue and transported to the condenser along with the vapor by pushing pressure steam through the plant material.

On the other hand, carbon dioxide is used as the solvent in CO_2 extraction rather than steam or hot water. In order to start the extraction process, pressurized CO_2 is pumped into a chamber containing raw plant material. Pressure causes CO_2 to become "supercritical," meaning that while it is still a gas, it now possesses liquid characteristics.

2.5.4 Cold pressing

The process of cold pressing is used to extract essential oils from a variety of plant parts, such as fruits, flowers, seeds, vegetables, and other plant or herb components. Since the extraction process is mechanical, no outside heat is needed for it to continue. The temperature is maintained at or below 120°C to prevent the inherent essence of oil from being ruined by excessive heat.

To extract the whole juice, the fatty part of these raw materials which include oil glands is punctured and forcefully compressed. The pure essential oil is separated from the resulting juice using a centrifuge technique in the final stage. Although, the essential oil produced by the cold-pressed process has a limited shelf life, the quality is nevertheless thought to be superior to that of other methods (Geramitcioski *et al.,* 2018).

A delicate but efficient process for extracting pure, premium, organic essential oils is cold pressing. This method's pressure is sufficient to burst the plant material's oil glands and release the essential oils. The inherent taste, fragrance, and medicinal qualities of the essential oils acquired by cold processing are retained. The fact that cold processing is a more ecologically responsible way to extract essential oils is another benefit.

Many uses for cold-processed essential oils exist, such as aromatherapy, cosmetics products, and natural cleaning solutions. These are popular oils for natural health and skincare since they are high-quality and retain their original aroma and medicinal qualities. Cold-processed essential oils are used in aromatherapy to enhance mood, encourage relaxation, and reduce tension and anxiety. They work well with massage oils, bath salts, and diffusers. Because these oils are not heated throughout the extraction process, their original scent is maintained.

The mechanical extraction method known as cold pressing is used to extract essential oils from different plant components. It is a safe and efficient way to extract pure, premium, organic essential oils. The inherent taste, fragrance, and medicinal qualities of the essential oils acquired by cold processing are retained. Many uses for cold-processed essential oils exist, such as aromatherapy, cosmetics products, and natural cleaning solutions.

3. Neuroprotective effects of essential oils

Essential oils have been reported to have neuroprotective properties and may be used in the treatment of various arthritis (Lizarraga Valderrama, 2021; Sattayakhom *et al.,* 2023). Studies have shown that essential oils can produce a variety of pharmacological effects targeted at the central nervous system (CNS), such as anxiolytic, antidepressant, and neuroprotective oil an essentially the components exert their effects synergistically to produce chemical and physiological effects (Rashed *et al.,* 2021).

The neuroprotective effect of essential oils is related to their chemistry, especially the presence of certain substances (Ayaz *et al.,* 2017). For example, essential oils such as *Nigella sativa, Acorus gramineus, Lavandula angustifolia, Eucalyptus globulus, Mentha piperita* have been found to have antiageing neuroprotective properties (Ayaz *et al.,* 2017; Sattayakhom *et al.,* 2023). Chios mastic and oregano essential oils were the most active in their effects on the central nervous system, while *Melissa officinalis* essential oil showed antidepressant-like effects (Rashed *et al.,* 2021).

Essential oils have been reported to have neuroprotective properties and may be used in the treatment of various arthritis. The root-protective properties of essential oils are attributed to their chemical properties, especially specific compounds. Neuroprotective and antigenomic properties of essential oils from various plants have been reported. Further research is needed to gain a better understanding of the neuroprotective effects of essential oils and their potential therapeutic applications (Ayaz *et al.,* 2017; Sattayakhom *et al.,* 2023).

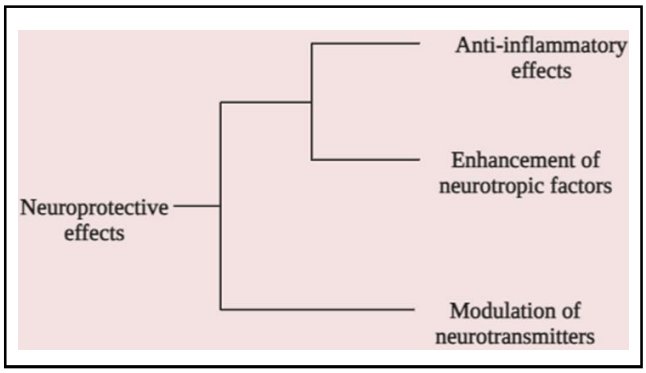

Figure 3: Neuroprotective capabilities of essential oils.

3.1 Neuroprotective mechanism of essential oils

The mode of action of essential oils includes various interactions and effects on biological systems. The root-protective qualities of essential

oils are ascribed to their chemical features, particularly specific molecules (Rashed *et al.,* 2021). The constituents of the essential oil exert their influence synergistically to produce various chemical and physiological effects. The mechanism of action of essential oils is not fully understood, but studies in animal models and humans have found several neurotransmitters involved (Lizarraga Valderrama, 2021).

3.1.1 Anti-inflammatory

Essential oils were reported in the habitat, which contributes to tissue protection (Soares *et al.,* 2021). They can suppress the production of pro-anti-inflammatory molecules and modulate signaling pathways related to inflammation, thus reducing the pathogenicity of the frame (Rashed *et al.,* 2021).

The antioxidant properties of essential oils are attributed to their active chemical properties, particularly beneficial components (Lizarraga Valderrama, 2021). Undulata essential oil has anti-inflammatory and anti-inflammatory properties, helpinge to protect tissues (Lizarraga Valderrama, 2021).

Another study showed that sandalwood essential oil has anti-inflammatory properties bacteria and improved neurodegeneration in a rat model of cerebral ischemia/reperfusion injury.

3.1.2 Antioxidant activity

Essential oils have received much attention in recent years for their potential tissue protection. Many studies have shown the interesting anti-inflammatory properties of essential oils, which occupy an important place in protecting tissues from damage caused by oxidative stress, manifested by an imbalance in reactive oxygen species (ROS) formation and antioxidant defense mechanisms in frame, pathogenesis of Alzheimer's disease problem of many neurological disorders including Parkinson's disease and stroke.

Essential oils have been shown to have neuroprotective effects through their antioxidant properties. The antioxidant properties of essential oils help reduce oxidative stress and protect cells from damage by reactive oxygen species. Undulata essential oil, which helped to protect tissues while another study showed that sandalwood oil importance showed anti-inflammatory effects and ameliorated neurological defects in mouse brain ischemia/ reperfusion injury (Soares *et al.,* 2021).

At least part of the ability of essential oils to protect tissue is due to their ability to scavenge free radicals and protect you from oxidative damage by reducing oxidative stress, essential oils can further help build tissue and protect other cells in systems of high concern from damage and destruction. These findings support that the antioxidant habitat of essential oils plays an important role in their neuroprotection.

3.1.3 Modulation of neurotransmitters

Nervous systems are essential for the functioning of the body's complex muscles. Essential oils have been found to modulate neurotransmitter systems, helping to protect nerves.

3.1.3.1 Some studies highlighting that how essential oils modulate neurotransmitters:

Researchers have found that *Melissa officinalis* essential oil exhibits antidepressant-like effects by modulating levels of neurotransmitters such as serotonin, dopamine and norepinephrine (Choudhury *et al.,* 2018).

Another study showed that lavender essential oil has the ability to reduce anxiety by modulating the levels of neurotransmitters such as gamma aminobutyric acid (GABA), serotonin and more (Stagg *et al.,* 2009).

Essential oils were observed to modulate neurotransmitter structures, which in flip facilitates guard nerves. Neurotransmitter modulation by means of crucial oils can be a potential therapeutic method for numerous neurological issues.

Table 1: Therapeutic and neuroprotective properties of essential oil

Essential oil	Plant source	Type of neuroprotection	Therapeutic potential
Lavender	*Lavandula angustifolia*	Anxiolytic and antidepressant effects	Management of minor depression and anxiety effects
Rosemary	*Rosmarinus officinalis*	Improved cognitive function and memory	Management of Alzheimer's disease
Thyme	*Thymus vulgaris*	Enhanced mental performance and defense against brain damage brought on by oxidative stress.	Management of Alzheimer's disease
Lemon	*Citrus limon*	Improvements in cognitive function and suppression of cholinesterase activity	Handling Alzheimer's illness
Sandalwood	*Santalum album*	Neuroprotective effects	Management of neurodegenerative disorders
Cinnamon bark	*Cinnamomum verum*	Anti-cholinesterase and neuroprotective activity	Management of Alzheimer's disease

3.1.4 Enhancement of neurotropic factors

The central nervous system requires large amounts of neurotransmitters to promote vascular growth, differentiation, and neuroprotection. Neuronal factors such as brain growth factor (BDNF) and nerve growth factor (NGF) play an important role in the development and maintenance of neurons (Fukuyama *et al.,* 2020; Vaynman and Gomez-Pinilla, 2006).

One observes highlighted the significance of endogenous neurotrophic factors in promoting neurogenesis and neuroprotection. Researchers searched for small-molecule natural products that could act as

neurotrophins to enhance neurotransmission, stimulate neuronal growth, and protect against neuronal death. Research work focuses on identifying compounds with vasoconstrictor properties and exploring their pharmacological and biological profiles (Fukuyama *et al.,* 2020).

Another study highlighted BDNF's function as a regulator of neuronal survival, proliferation, and differentiation, and also examined the effects of lifestyle on neural and cognitive fitness. The study found that energy metabolism and neural plasticity are interconnected chemical structures, and that lifestyle variables may influence these structures, ultimately influencing neurotrophic factor levels. (Vaynman and Gomez-Pinilla, 2006).

Furthermore, modulation of neurotrophic factors is associated with potential therapeutic benefit in neurodegenerative diseases. Neurotransmitter dysfunction may contribute to neurodegenerative diseases, emphasizing the importance of maintaining adequate levels of neurotrophic factors (Razak *et al.,* 2023).

4. Essential oils with neuroprotective capabilities

Essential oils have been known to have neuroprotective effects, here are some examples. Lavender oil, Rosemary oil, *etc*.

4.1 Lavender oil

Several studies have been conducted on lavender oil to investigate its anxiolytic and calming properties, as well as its potential benefits for patients with Alzheimer's disease.

4.1.1 Anxiolytic and sedative effects

- Animal studies have shown that lavender has anxiolytic, calming, pain relieving, anti-inflammatory and neuroprotective properties.
- Sedative properties of lavender essential oil in neurophysiological research and animals (O'Connor *et al.,* 2013).

4.1.2 Potential benefits for Alzheimer's disease patients

- Lavender oil has been studied as a treatment for obsessive-compulsive behavior in patients with Schizophrenia. A randomized, controlled trial showed that transdermal lavender oil shows promise in reducing aggressive behaviour (O'Connor *et al.,* 2013).
- The neuroprotective impact of lasers has been studied inside the context of Alzheimer's disorder. Essential oils, including lavender oil, had been shown to have anti-Alzheimer's properties.

4.2 Rosemary oil

Rosemary oil is a popular essential oil known for its benefits for cognitive performance and memory, as well as protection against oxidative stress.

4.2.1 Enhancing cognitive overall performance and reminiscence

- Eight-cineole, one of the chemicals in rosemary oil that may be involved for memory changes, may increase the body's synthesis of the neurotransmitter acetylcholine (Araki *et al.,* 2020).
- Inhaling the aroma of rosemary essential oil can improve memory and mental alertness. Rosemary oil has been used to improve cognitive function in older people.
- Rosemary oil has been used to improve cognition in older people (Araki *et al.,* 2020).

4.2.2 Protective effects towards oxidative pressure

- Rosemary extract has anti-inflammatory properties and can reduce oxidative stress in the hippocampus (Dabaghzadeh *et al.,* 2022).
- Rosemary and lemon oil can improve mood disorders by regulating memory and reducing oxidative stress (Faridzadeh *et al.,* 2022).
- Inhaling the essential oil of rosemary has the potential to reduce levels of the stress hormone cortisol in the blood, which might ultimately lead to an increase in oxidative stress (Faridzadeh *et al.,* 2022).

Research has shown that lavender oil exhibits anxiolytic and calming properties, making it a natural choice to deal with anxiety and promote relaxation in addition, they are still making a profit if it can range from lavender oil to challenge Alzheimer's patients. However, further research is needed to understand the mechanisms of action and improve the therapeutic potential of lavender oil (O'Connor *et al.,* 2013).

5. Challenges and limitations in using essential oils for neuroprotection

Despite the ability blessings, there are demanding situations and barriers to the use of critical oils for dental protection.

The interplay of variables in essential oils, such as plant species, extraction techniques, location, and more, has complicated the standardization of their use in medicine, resulting in unpredictable quality and efficacy.

Essential oils can have side effects in some people, such as skin rashes or rashes that need to be topically applied.

Some critical oils can be toxic to ingest and it's far important to apply them adequately and appropriately.

Essential oils may be expensive, some oils are rare or tough to discover and can be used for medicinal purposes (Rashed *et al.,* 2021).

The loss of standards and fine inside the petroleum industry could make it tough to make sure high-quality and sustainability.

While essential oils demonstrate promise as neuroprotective agents, challenges and limitations must be overcome. A deficiency of standardization, inspection, safety measures, and resources are present. It is crucial to ensure consistent quality of essential oils for medical use, and efforts should be made to obtain them.

6. Conclusion

Essential oils have been shown to have neuroprotective and potentially healing properties. The focus of neuroprotection research is safeguarding neurons and preserving brain health. Plant molecules,

combined in complex ways, are essential oils' appeal. The properties of essential oils depend on the plant species, extraction technique, and plant part. Aromatherapy using essential oils has long been thought to have immunomodulatory, antimicrobial, antifungal, and antibacterial properties. Essential oils have many potential health benefits, including a reduced risk of cancer, inflammation, and autoimmune disorders; they also have neuroprotective properties that can help ward off neurodegenerative diseases like Alzheimer's and Parkinson's, but many studies on their use in fitness sports have serious methodological issues.

Crop merchandise with related biochemical companies and vitamins have neuroprotective results and may be used to treat root issues, however the lack of reliable marker fashions hampers a root-blanketed development application treatment of muscle products that could lessen hits. The field of neuroprotection aims to enhance methods and therapies that may slow down or prevent the onset of neurological diseases and promote neuron survival. This study's overarching goal is to aid people in crucial situations including trauma or nerve damage by protecting the frame from such events. It has an effect on the anxiety machine that is significant.

Conflict of interest

The authors declare no conflicts of interest relevant to this article.

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