



PHARMACOLOGICAL NEUROPROTECTIVE EFFICACY OF ESSENTIAL OILS (EO) BASED AROMATHERAPY: AN INSIGHT

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Article Info: Received 10 August 2019; Accepted 16 September. 2019

DOI: <https://doi.org/10.32553/jbpr.v8i5.646>

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Conflict of interest statement: No conflict of interest

ABSTRACT:

Aromatherapy or Essential oil therapy is attributed towards the field of conventional, alternative or complementary therapies which requires essential oils and other aromatic plant compounds. Essential oils (EOs) belong to the class of highly volatile compounds which, due to their higher concentrated natural constituents acquire unique properties and hence, are being used for its wide range of therapeutic health benefits. Their benefits widely range from being a potential antimicrobial, antidepressant, antiviral and antiseptic agents to the elevator of many CNS related behaviours like - anxiety, stress, wisdom, memory, attention, relaxation, sedation, and sleep. Furthermore, the effects on mood, pain, and perception too are being influenced by the use of essential oils. It also helps in the treatment of epilepsy, stress, dementia by giving calming and soothing effects to the nerve cells and is also effective against dementia and on the treatment of Alzheimer's disease.

Keywords: Alzheimer's disease, Analgesic Action, dementia, epilepsy, aromatherapy.

INTRODUCTION

Essential oils (EO) are considered as the most integral part of the tradition from the ancient civilization till present as it indistinguishably intertwines the religious and the therapeutic roles[1]. Few of the practices are still in use, for instance, the junipers are burnt in Tibetan temples as it is considered as a purification ceremony and, in the west, frankincense is used by the Roman Catholics during their masses[2]. The production of EO by the alchemists can be traced back to at least 2000 years, which was done through the simple extraction method and led to a major step towards the later herbal development which targeted the health, endurance, and spiritual knowledge. The Chinese traditional medicinal (CTM) system quoted that the essential oils are considered as the medicine which not only benefits the health but governs the consciousness of the human beings too[3]. Similarly, according to the Ayurvedic practices, EOs enhances the life, longevity and brightens the intellect levels in living beings[4]. Essential Oils are low molecular weight hydrophobic liquids, extracted from plants and are rich in bioactive and aromatic phytochemicals

exhibiting various therapeutic properties. EOs are the class of highly volatile compounds which are having a high concentration of natural constituents, derived from plants for its unique properties[5]. The essential oils which are extracted from the plants, exhibits various characteristics i.e. odour characteristics, healing power and various therapeutic properties thereby use for wide range of health benefits[6]. Numerous chemical compounds are present in the essential oils and each of its compounds possesses unique and therapeutic properties ranging from anti-microbial, antidepressant, antiviral and antiseptic agents to various other properties which make it an important candidate in eliminating various health-related disorder[7]. Even a small quantity of these oils can cure various common health challenges specifically health-related disorders, aiming at restoring the comfort, peace of mind, healthy skin and help in maintaining a healthy functional body[8]. For example, Thyme[9], Sage[10], Eucalyptus Oil[11] are used as antiseptics. The German chamomile[12] and lavender[13] are used as anti-inflammation oils which gives a soothing effect to the skin. The geranium[14] and Rose oil[15] are used as granulation stimulating or as

healing agents. There are a vast variety of essential oils presents which are capable of treating various ailments and therefore this field has become an important field of research lately as a single essential oil extracted from a plant can cure thousands of diseases and thereby various studies are in progress in order to define essential oils role in treating various health-related disorder with an adding advantage that they have few or no side effects and less toxic in comparison to the synthetic compounds which are available in the market[16][17].

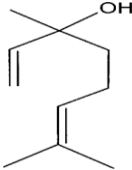
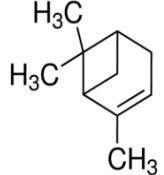
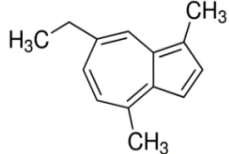
Characteristics of Essential Oil:

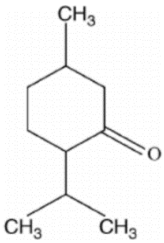
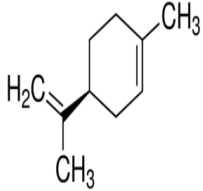
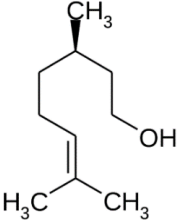
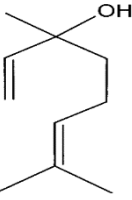
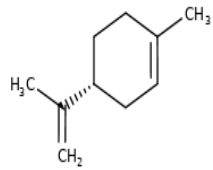
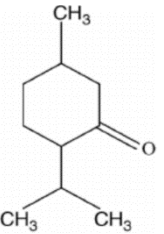
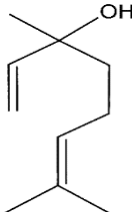
Essential oils are known to exhibit a variety of characteristics as they are highly rich in various phytocompounds derived from the plant specifically the roots, stems, leaves, fruits and the flowers[18]. The presence of these phytocompounds or the secondary metabolites including alkaloids, flavonoids, phenols, saponins, terpenoids and many more are beneficial in treating various health-related disorder as they exhibit numerous properties including

antimicrobial, antioxidant, antiseptic, anti-inflammatory, antidepressant and anti-anxiety properties[19][20].

Various essential oils including Lavender Oil, Rosemary oil, Geranium oil, Peppermint oil, etc have profound effects on treating neurological disorders[20]. They stimulates the limbic coordination and triggers different parts of the brain including hypothalamus and the feel good hormones serotonin[21]. The list of the essential oils with its medicinal properties are listed in Table 1. The essential oils are derived from the plants and thereby they are organic and are generally regarded as safe (GRAS) and non-toxic[22]. These essential oils are readily available and affordable and heal mentally, emotionally and therapeutically. Different essential oils have different therapeutic properties and even a single drop of this aromatic essential oil and work wonders in healing the mind, body and the soul[23]. Essential Oils are quite effective against various neurological disorder as they are rich in phytocompounds and exhibit various major functions listed in Table 1.

Table 1: List of different essential oils and its major functions.

S. No.	Essential Oil (Botanical Name)	Botanical Name	Major component present	Structure	Function
1.	Lavender Oil	<i>Lavandula angustifolia</i>	Linalool		It provides calm and soothing that helps reduce stress and also alleviates pain.
2.	Rosemary Oil	<i>Rosmarinus officinalis</i>	a-pinene		They help to alleviate mental strain and fatigue.
3.	Chamomile oil	<i>Matricaria chamomilla</i>	Chamazulene		It promotes sleep and treat insomnia

4.	Peppermint oil	<i>Mentha piperita</i>	menthone		It eliminates pain and nausea and improves memory and alertness.
5.	Lemon oil	<i>Citrus limonum</i>	Limonene		They are known to exhibit anxiety reducing and pain-relieving properties.
6.	Rose oil	<i>Rose ottos</i>	Citronellol		It is linked with the limbic system and thereby controls emotions, improves memory and hormone balancing.
7.	Ylang-Ylang Oil	<i>Canangaodorata</i>	Linalool		It alleviates stress-induced mental illnesses.
8.	Bergamot Oil	<i>Monarda didyma</i>	Limonene		Prophylactics for Nervous conditions and for sleeplessness.
9.	Geranium Oil	<i>Pelargonium graveolens</i>	Methone		Used for mental illnesses including bipolar disorder and schizoaffective disorder
10.	Basil Oil	<i>Ocimumbasilicum</i>	Linalool		It eliminates social stress-induced mental illnesses.

Mechanism of action:

Essential Oils are rich in bioactive compounds which have putative therapeutic benefits and helps in alleviating various neurological and psychiatric disorders associated with the central nervous system (CNS) and the Peripheral nervous system (PNS)[24]. Aromatherapy or essential oil therapy is achieved either through inhalation or through direct contact with the skin[25][26]. It works by the activation of the smell receptors in the nose which links directly through the nervous system to the brain[27]. Thereby, activating various areas particularly the limbic system, which plays a prime role in emotions and the feel-good brain chemicals like serotonin are activated by the impact of the essential oils on the hypothalamus[28]. The activation of response through the skin membranes can be generated either by massage or through topical applications which can effectively eliminate various health-related disorders[29]. Also, it exhibits immense effects on the deepest level of the body and enhances immunity.

Therapeutic effect of EO on neurological and psychiatric disorders

Many studies have been carried out to determine the therapeutic effects of essential oil on the central nervous system (CNS). They are used for Analgesic action, treatment of stress, memory, effects on learning, attention, effects on relaxation, sedation, and sleep, effects on mood, behaviour, and perception, and finally effects on the treatment of Alzheimer's disease.

Analgesic Action

The common reaction of the body when being hurt, damaged or inflammation is pain which is regarded as one of the dangers signs or a warning system and its lost lasting effects can turn into a serious problem which is needed to be dealt with the increasing dose of an analgesic[30]. The prime role of the painkiller medications is to ease pain and are known to effectively work on the central nervous system (CNS) and the peripheral nervous system (PNS). The analgesics can be further divided into two major groups: opioids such as morphine and non-opioids such as aspirin and other non-steroidal anti-inflammatory drugs[31]. The opioids bind with its respective receptors on the central nervous system whereas the non-opioids inhibit

the Cox catalyst (COX) within the outer periphery. Opioids are considered as the most effective analgesic, however pertaining to the listed concerns such as nausea, vomiting, constipation, drowsiness, respiratory depression and ultimately the drug tolerance, therefore in order to hunt for a complementary (even daily) medical treatment which escapes synthetic medicines is a worthwhile objective to alleviate pain. Therefore, in this respect EOs play a key role.

The case study conducted by Batista et al[32] analysed the contribution of the glutamatergic system within the antinociception caused by linalool EO in mice. Linalool is a major constituent which exists in practically all the aromatic plants like *Lavandula angustifolia* Mill, *Salvia sclarea* L. (less than 20%), both Lamiaceae. The observation was done on the idea of how typically the mice defeated the injected hind paw or bit the target organ following glutamate receptor agonist injections. Afterwards the application of linalool, dose-dependent inhibition of glutamate-induced nociception was witnessed which significantly reduced the biting responses of the mice. And henceforth, ultimately that linalool produced marked antinociception against glutamate-induced pain in mice, probably by mechanisms worked by ionotropic glutamate receptors AMPA, NMDA, and kainite. Similarly, research was conducted by Peng et al[33]. He stated that from Chinese traditional medicine (CTM), the Essential Oil is obtained from the stem of *Ligustici Chuanxiong* Hort. (Apiaceae) which has been used comprehensively for numerous years to treat headache, but its chemical examination has been studied lately. The study indicates that the most abundant constituent i.e. ligustilide is a phthalide derivative and its detection could be seen in rats' brain through the nasal administration even after 5 min. And therefore, the analgesic and neuroprotective effect of the essential oils could be explained. Further various studies are ongoing conducted to establish the role of essential oils as suitable anti-analgesic in alleviating pain and providing immediate relief.

Treatment of Stress

In psychology and biological terms, "Stress" is regarded as a condition in which an organism cannot cope with the disbalance of the emotions and the physical strains thereby, leading to

sustained stress that can result in a long-term illness and mental disorders concerning the mankind. The symptoms include increased adrenaline production, muscular tension, excitability, abnormal fatigue, lack of concentration and severe physiological conditions like increased heart rate, high blood pressure, and severe headache. There are numerous Essential oils reported to possess distinct stress-reducing activity like lavender, Ylang-Ylang, Bergamot, Chamomile, and etc can act as an alternative method to eliminate stress and psychological conditions.

An experiment conducted by Toda and Morimoto [34] in accordance to the impact of the effect of Lavender EO's aroma on salivary endocrinological stress markers. A study was conducted on thirty healthy students, on the abatement of stress by lavender EO and consequently measured the sensitive salivary endocrinological stress markers cortisol and chromogranin A (CgA). The group was divided into two, one being the aroma group and other i.e. the control group were assigned to fulfil the arithmetic task for 10 mins with an interval of 10 mins. The aroma group was exposed to the lavender EO within the air and the saliva samples of the students were collected before and after the arithmetic task, as well as 5 and 10 mins after them. The cortisol and CgA level were analysed by enzyme-linked immunosorbent assay and resulted that the CgA levels were significantly lower after the task as compared to those assessed directly after the tasks, whereas control group displayed no changes indicating that lavender EO has anti-stress effects. Lavender EO has also demonstrated the most remarkable results on the stress of babies which were represented by the studies on mother and child interaction and the sleeping behaviour of the baby when exposed to the lavender bath. Similarly, the citrus essential oil particularly the lemon essential oils are known to exhibit the anti-stress effect as proposed by Domingos et al[35]. The EO components such as limonene, γ terpinene, and citral are reported to lessen down the physical and psychological stress. Thereby, all the studies conducted till present determines the possible stress eliminating effects of Essential oil, alternative therapy for mankind.

Effect of Essential Oil on Dementia & Alzheimer's

When brain nerve cells get damaged, it leads to dementia and affects several areas of the brain[36]. There are various types of dementia, and are categorized by the part of the brain had got damaged[37]. Alzheimer's disease is the most common cause of dementia and is mostly figured at the age of 65. The effects of aromatherapy were studied on elderly people suffering from dementia, with the majority being diagnosed with Alzheimer's disease were found to have a success rate of recovery as compared to the alternative therapeutic tool with no side effects[38]. Alzheimer disease is one of the most prevalent neurodegenerative disorders, characterized by, scarcity in cholinergic neurotransmission, cognitive dysfunctions, behavioral turbulence, gradual memory loss oxidative stress, accumulation of amyloid plaques and neurofibrillary tangles in the brain areas. Essential oils or plant oils have been reported to show high therapeutic value for treating dementia with no rate of side effects[39]. Rosemary and Lemon inhalations in the morning, then lavender and orange in the evening are researched and reported to be one of the best treatments for neurodegenerative diseases. It is studied through multiple studies and analysis that the patients showed significant improvement in personal orientation while being treated with essential oil without any deleterious side effects[40]. Unfortunately, like most topics in natural therapies, there is not a preponderance of research on how Alzheimer's natural treatment with essential oils can help. Mechanism noted in research studies explains that, when we smell lemon oil, molecules get dissolved in the mucus lining of the olfactory epithelium, the roof of the nasal cavity and it stimulates the olfactory receptors. Smell sensory neurons (olfactory system) carries the signals from the receptors to the olfactory bulb which filters and begins processing the input signals of the scent of given essential oil and is then taken up by mitral cells which carry the output signals from the olfactory bulb to the olfactory cortex that allows to perceive and recognize the scent of essential oil and connect directly to the amygdala, the brain structure which is involved in emotional learning and memory.[41] Therefore, the olfactory system is the only sensory system that involves the amygdala and the limbic system in its primary processing pathway. Hence, essential oils have always been the best alternative

therapeutic tool with a higher efficacy rate with lower or no side effects on treating brain-related disorders[42].

Influence on Learning, Memory, and Attention

Attention deficit hyperactivity disorder in children has been increased. Therefore, along with the identification of risk groups by such important characteristics as memory, attention and the response rate are necessary, but also the study of the possibilities of their correction are relevant. It is desirable to use natural compounds with a decreased risk of side effects compared to synthetic components of drugs. Considering the current methods of alternative medicine aromatherapy is highly popular and reasonably trustworthy among the professionals[38]. The topicality of studying the effects of essential oils is induced by a number of advantageous points. namely, the relatively high rate of their impact, ease of use, safety and relatively low costs. It is considered to be traditional that the essential oils of rosemary and peppermint have a stimulating effect on the central nervous system, and the essential oils of ylang-ylang and lavender, exhibit the sedative response[43]. The rosemary essential oil is used in aromatherapy for a relatively long time; however, its effects on the human body, particularly on the nervous system, have not been sufficiently studied[44]. It is observed and studied on healthy volunteers who inhaled the rosemary essential oil felt more refreshed. After performing a number of studies, it is analysed that lavender produces a significant decrement in performance of working memory, and impaired reaction times for both memory and attention-based tasks compared to controls [45]. It's also noted that that rosemary increases performance for overall quality of memory and secondary memory factors. Olfactory properties of the essential oils can produce certain effects on cognitive performance and thus can be used as an effective alternative therapeutic tool for treating certain CNS disorders [46].

Conclusion

The recent increase in the popularity of alternative medicine and natural products has renewed interest in plant extracts and their essential oils as potential natural remedies. This chapter may be useful to increase our knowledge of Essential oil

pharmacological effects and improve our future experimental and clinical research plans. EOs exhibit various therapeutic properties and can be used as a conventional method for alleviating neurological and psychiatric disorders. It is shown that EOs have may have a significant clinical potential either in their own right or as adjuvant therapy in different disorders, however, due to some issues, EOs are not exploited to its fullest potential. The essential oils are rich in hydrocarbons especially the terpenes including monoterpenes, diterpenes and sesquiterpenes and oxygenated compounds such as carbonyls and alcohols, they tend to be highly volatile in nature, lack of information regarding dose rationale, short duration of application, , variation between efficacy and effectiveness trials, variability of administration methods, the absence of a placebo or lack of control groups more standard experiments and researches which are primarily required to confirm the beneficial effect of EO in the neurological disorders.

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