



Role of MAP'S and their essential oils in aromatherapy: a review

Tuybia Bilal¹, Bilkees Ayoob^{1*} and Uzma Bashir²

¹Faculty of Forestry, Sher-e-Kashmir University of Agricultural Sciences of Technology of Kashmir, Benhama, Ganderbal, 191 201, Jammu and Kashmir (India); ²Krishi Vigyan Kendra (KVK), Srinagar, SKUAST-K, Shalimar
*e-mail: bilkees098@gmail.com

(Received September 19, 2023; accepted November 01, 2023)

ABSTRACT

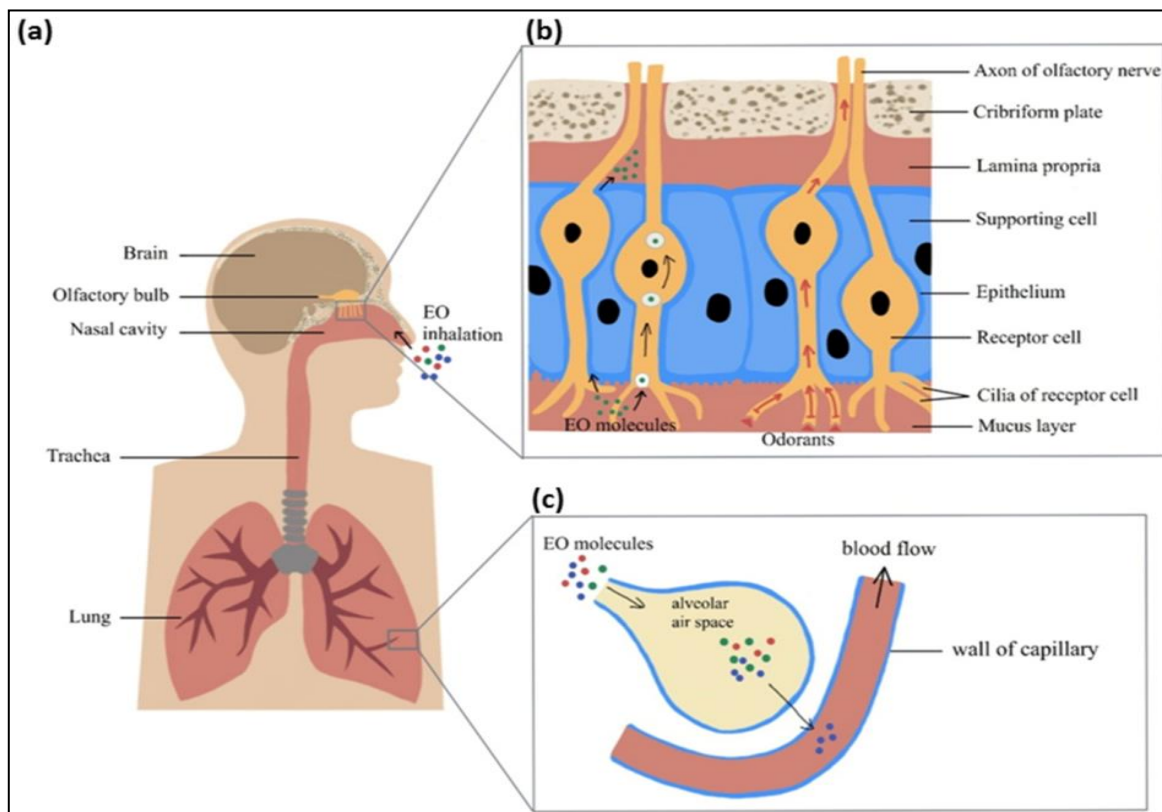
Aromatherapy, a form of alternative medicine that uses essential oils and aromatic compounds for the purpose of altering a person's mind, mood and to get relief from numerous ailments like depression, indigestion, headache, insomnia, muscular pain, respiratory problems etc. The main motto of aromatherapy is the absorption and penetration of the essential oils to the human skin surface through inhalation and local application as the name signifies essential oils are much essential on one hand and friendlier on the other hand. The phytochemicals gets absorbed through skin or nose and lungs, ultimately reaches the limbic system – the nerve network in brain that controls emotion and instinct. It is medically proven that aromatherapy can lower cortisol level, heart rate, inflammation, depression or anxiety and alleviation from different problems like cerebral pain, stomach ache, conjunctivitis, mononucleosis, indigestion, arthritis, skin allergies, respiratory problems, cardiovascular disorders and urine associated diseases. This review probes the particulars present in the literature regarding the functioning of aromatherapy, its classification, different medicinal plants used, pharmacological actions and safety issues.

Keywords: Aromatherapy, essential oils, fragrance, inhalations, therapeutic.

The term aromatherapy was coined by Rene-Maurice Gattefosse in the early 20th century in his book, Gattefosse's Aromatherapy. Aroma is derived from Latin word Aromata which means spices and aromatherapy is derived from French word Aromatherapie in which *Aroma* means sweet smell or sweet herb and *Therapeia* means healing. It is a therapy that employs aromatic essential oils or fragrances in the form of massage, compresses and inhalation to treat physical, mental and spiritual well-being (Worwood, 2000). In today's culture, complementary and alternative medicine (CAM) is flourishing and aromatherapy is becoming increasingly popular among health-conscious people concerned about the negative effects of synthetic medications (Gaware *et al.*, 2013). In addition many scientists have proven that essential oils used in aromatherapy have antibacterial, antiviral, anti-inflammatory nature as well as immune booster with hormonal, glandular, emotional, circulatory, relaxing impact, memory and alertness enhancer (Teixeira *et al.*, 2013; Said *et al.*, 2016). According to estimates, there are about 350,000 plant species, out of which 17,500 are aromatic species which can be employed in aromatherapy (Bhadra and Parida, 2021). In 2019, it has been estimated that aromatherapy has a global market size of USD 1.37 billion with an anticipated annual growth rate of 11.8 percent from 2020 to 2029 (Grandview Research, 2020). Electronic databases were used to gather the most recent information on aromatherapy. The search was restricted to seventy eight year period (1945-2023) and only English language studies were included. A total of 67 articles have been included in this review.

Mode of Action of Aromatherapy: In aromatherapy, mostly essential oils are used, as they have the ability to reach the subcutaneous tissue. The mode of action of aromatherapy involves the integration of essential oils into a biological signal of the receptor cells in the nose when inhaled.

Through olfactory bulb the signal is transmitted to the limbic and hypothalamus parts of the brain and cause the brain to release neuro-messengers like serotonin and endorphin to link our nervous and other body systems, ensuring the desired change and providing a sense of comfort (Buchbauer and Jirovetz, 1994).



Classification of Aromatherapy: Certain essential oils are used in cosmetic items for the skin, body, face and hair for a variety of purposes, including cleaning, moisturising, drying and toning (Ziosi, 2010). This is known as cosmetic aromatherapy. Another is massage aromatherapy, which involves the utilization of grape seed, almond or jojoba oil in pure vegetable oil during rub, also known as massage therapy's healing touch (Soden *et al.*, 2004). In medical aromatherapy, essential oils are utilized to massage patients during medical procedure. Olfactory aromatherapy is a type of aromatherapy in which essential oils are inhaled to improve emotional wellbeing, serenity and restoration of the human body. In psycho-aromatherapy, essential oils are used to provide the pleasure of rest, invigoration or a good recollection (Perry and Perry, 2006).

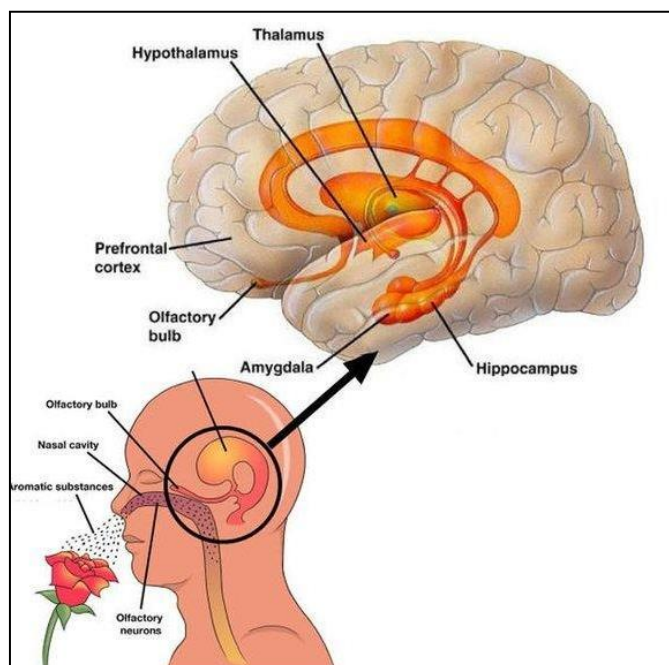


Fig. 1. Inhaled EO response delivery to brain through the respiratory and olfactory systems: (a) Inhaled EO passes through the nasal cavity and reaches the olfactory system or respiratory system (b) Overview of EO molecules' delivery pathway in the olfactory system (c) Overview of EO molecules crossing the air–blood barrier to reach the circulatory system (Fung *et al.*, 2021)

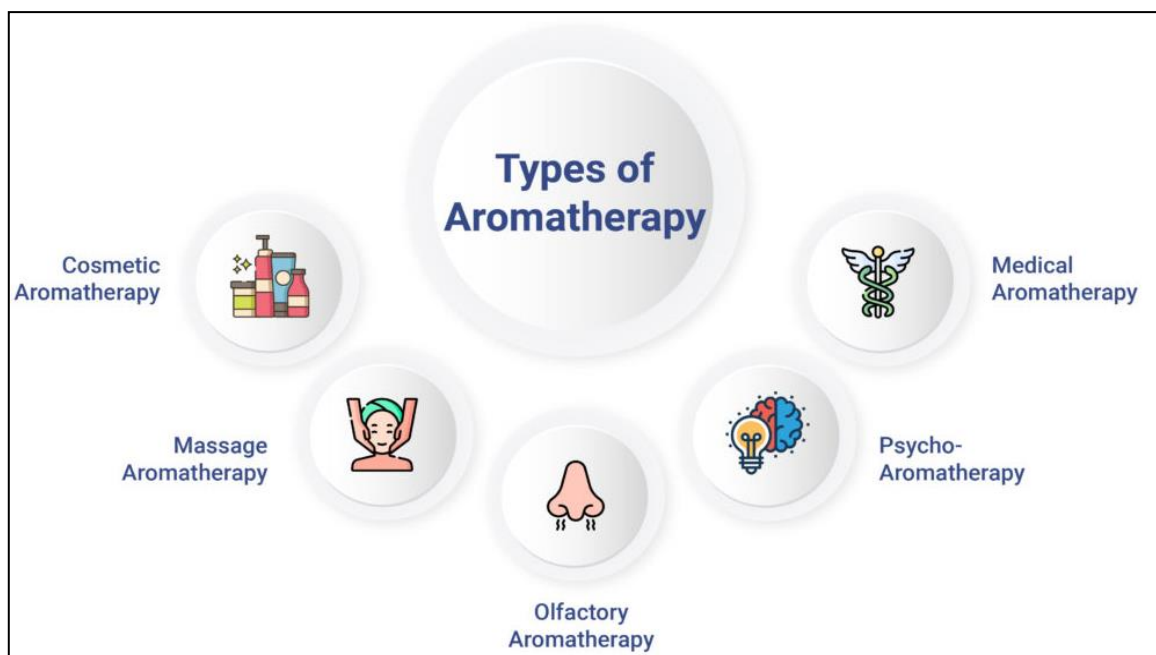


Fig- 2. Classification of Aromatherapy

Role of Essential Oils Used in Aromatherapy in Reducing Mental Stress: Essential oils are neither medicines nor a treatment for depression, but they are drug-free alternatives that have the ability to calm our minds due to their direct effects on our brain (Smith, 2008). For hundreds of years essential oils have been utilized to boost mood, to get rid of bad sensations and enhances general mental wellness, as the research has shown that they have the ability to alter the body's neurochemistry through the release of the neurotransmitter serotonin that can improve mood by lowering anxiety. Oils can be used in a variety of ways, including inhalation or application to the skin through massage, sometimes also used as a room refresher and in the bath (Rho *et al.*, 2006; Kim, 2007; Dwivedi *et al.*, 2010). According to research, when we are sad, depressed or stressed, a massage with essential oils soothes our physical stress while a pleasant scent relaxes our thoughts. The popular oils that are effective in reducing stress are Lavender, Rosemary, Damascus rose, Orange citrus, Lemon, Sandalwood, Jasmine etc. (Panda, 2021).

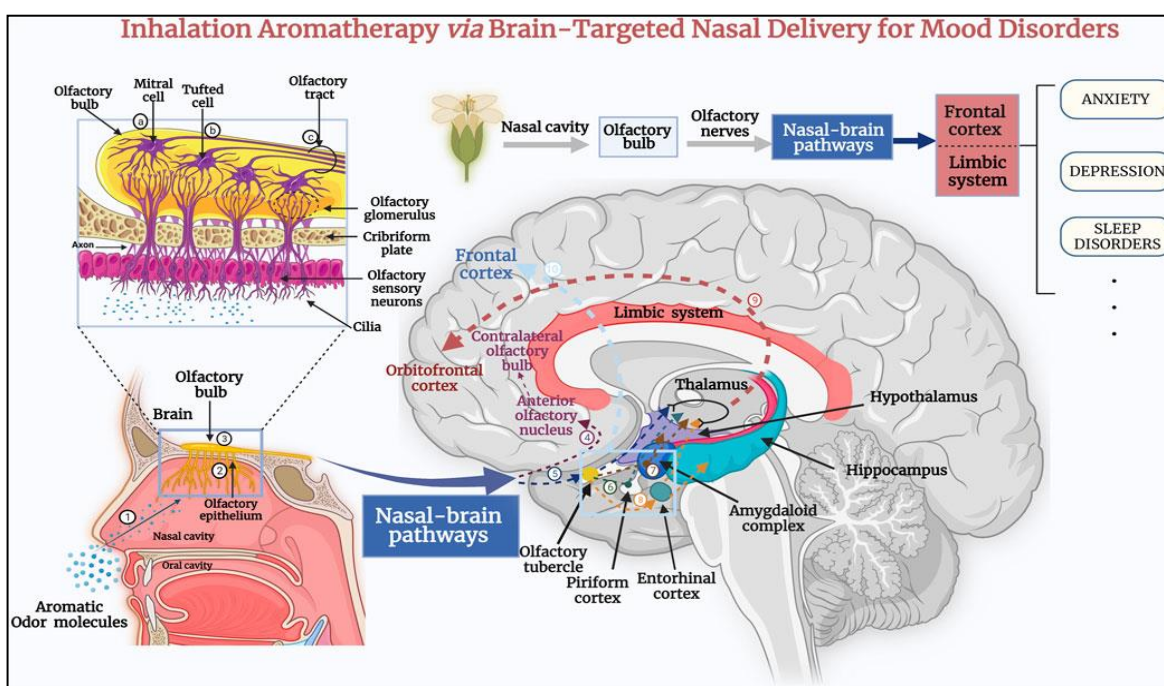


Fig. 3 Inhalation of the extracts of aromatic plant *via* the nose sends signals directly to the olfactory system, where odor molecules target therapeutic drugs to brain tissue *via* nasal-brain channels. Subsequently, they

act on the cerebral cortex, the thalamus, and the limbic system of the brain, and stimulate the brain to produce neurotransmitters to treat the symptoms of anxiety and depression, as well as improve sleep quality. The aromatic odor molecules are inhaled through the nasal cavity (1) to reach the olfactory epithelium (2) of the nasal mucosa. First-order neurons transmit the odor-evoked response to the olfactory bulb (3). In the olfactory bulb, the axons of mitral cells (a) and some tufted cells (b) (secondary neurons) form the olfactory tract (c). The axons of some mitral cells or lateral branches enter the anterior olfactory nucleus (4) and pass to the contralateral olfactory bulb. Additional secondary neurons enter the olfactory striatum (medial, lateral, and medial) and then project to central olfactory areas, including the olfactory tubercle (5), piriform cortex (6), amygdala (7), and the entorhinal cortex (8). The entorhinal cortex partially transmits to the hippocampus. Eventually, the central olfactory-area signals are transmitted through the thalamus to the orbitofrontal cortex (9). An additional olfactory signaling pathway passes directly from the central olfactory area to the prefrontal cortex (10). These impulses induce the release of neurotransmitters such as serotonin or endorphin, which act as a “bridge” between nerves and other bodily systems (Cui *et al.*, 2022).

Pharmacological Action of Essential Oils Used in Aromatherapy

Antibacterial: Many essential oils have been tested for antifungal and antibacterial activities against Gram-positive and Gram-negative bacteria (Said *et al.*, 2016). These essential oils have been extensively researched for their antibacterial qualities and they have proved to be effective against salmonella, staphylococci and other oral infections. If used properly, they can be excellent antibiotic substitutes (Karbach *et al.*, 2015). Basil essential oil is one of these oils, and it has antibacterial properties. *Aeromonas*, *Hydrophila* and *Pseudomonas fluorescens* are all susceptible to it (Wan *et al.*, 1998). Antibacterial effects on oral microorganisms such as *Fusobacterium nucleatum*, *Porphyromonas gingivalis*, *Streptococcus mutans*, *Actinobacillus actinomycetemcomitans* and *Streptococcus sobrinus* were shown to be favourable. Manuka oil surpassed eucalyptus oil, rosmarinus oil, lavandula oil and tea tree oil in terms of antibacterial activity. *Melaleuca alternifolia* (tea tree) oil was shown to be sensitive to 161 isolates from 15 genera of oral bacteria, showing that it has health-promoting effects for oral hygiene (Hammer *et al.*, 2003). Essential oils from the leaves of *Pittosporum undulatum* and *Hedychium gardnerianum* were sensitive to *Staphylococcus epidermis*, *Hedychium gardnerianum* and *Pittosporum undulatum*, with the highest activity against *Staphylococcus aureus* and *Staphylococcus epidermis*. On the other hand, *Pittosporum undulatum* has a high antithrombin activity (Medeiros *et al.*, 2003).

Antifungal: Many medicinal plants have been investigated for antifungal action, including *Mentha piperita*, *Brassica nigra*, *Angelica archangelica*, *Cymbopogon nardus*, *Skimmia laureola*, *Artemisia sieberi* and *Cuminum cyminum*. According to Hammer *et al.* (1999) most of the components of *Melaleuca alternifolia* (tea tree oil), have fungicidal activity, particularly against dermatophytes and filamentous fungi. In one study, germinated *Aspergillus niger* conidia were shown to be more sensitive to non-germinated conidia. *Melaleuca ericifolia*, *Melaleuca armillaris*, *Melaleuca leucadendron* and *Melaleuca styphelioides* essential oils have strong antifungal action against *Aspergillus niger*. Hence medicinal plants can be a great replacement for existing antifungal medicines that aren't widely used.

Antiviral: Deans and Ritchie tested the antiviral activity of essential oils of *Melaleuca ericifolia*, *M. leucadendron*, *M. armillaris* and *Melaleuca styphelioides* on kidney cells of African green monkeys using a plaque reduction assay on herpes simplex virus type 1 and found that *M. armillaris* (up to 99%) outperformed *M. leucadendron* (92%) and *M. leucadendron* (91.5%).

Anti-dandruff : Shampoos contain 5% tea tree oil were shown to be efficient and well tolerated by patients with mild to moderate dandruff in a single blind and parallel-group trial, with at least 41% improvement seen (Satchell *et al.*, 2002). There hasn't been much research into the antidandruff potential of plant compounds, especially volatile ones. Anjum *et al.* (2014) have made some attempts, but the findings aren't encouraging.

Anti-tumor: Tea tree oil and terpinen-4-ol both inhibited the development of M14 WT and M14 adriamycin resistant human melanoma cells. In melanoma cells, this activity was related to apoptosis via a caspase-dependent pathway. When human colon cancer cells are sensitized by geraniol, a component of plant essential oils, 5-fluorouracil therapy is improved (Bhattacharjee, 2013).

Anti-inflammatory: Tea tree oil decreased the histamine reactivity of weal and flare in humans. After 10 minutes, topical applications of 100 percent tea tree oil can decrease the irritation caused by histamine diphosphate (Koh *et al.*, 2002). Non cytotoxic doses of essential oils have been shown to have an anti-inflammatory effect via boosting interleukin-10 production, according to existing evidence on different essential oils (Murbach *et al.*, 2014).

Table-1: Plant species, part used and essential oil used in aromatherapy:

Plant species	Part used	Essential oil	Medicinal and Aromatherapeutic Importance	References
<i>Valeriana officinalis</i> L.	Root	Valerian oil	Reduces mental stress and insomnia	Azizi <i>et al.</i> , 2019
<i>Vetiver zizanioides</i> L.		Vetiver oil	Fixative in perfumery and cosmetics	Balasankar <i>et al.</i> , 2013
<i>Iris florentiana</i> L.		Oriss oil	Flavouring agent and in Perfumery	Khatib <i>et al.</i> , 2022
<i>Sassafras albidum</i>	Root bark	Sassafras oil	Soap industry and Perfumery	Auten, 1945
<i>Zingiber officinale</i> L.	Rhizome	Ginger oil	Postoperative nausea and vomiting	Endo <i>et al.</i> , 1990
<i>Curcuma longa</i> L.		Turmeric oil	Anti-nociceptive/ Anti-oxidant activity	Sanmukhani <i>et al.</i> , 2011
<i>Cinnamomum zeylanicum</i>	Stem bark	Cinnamon oil	Stress relieving, cold and flu relief	Ghaderi <i>et al.</i> , 2018
<i>Betula lenta</i> L.		Birch essential oil	Perfumery	Ward, 2007
<i>Cedrus deodara</i> (Himalayan Cedar)	wood	Cedar oil	Soap	Kumar <i>et al.</i> , 2019
<i>Juniperus mexicana</i> (Texas cedar)			Expectorant and skin rashes	Adams, 1991
<i>Santalum album</i> L.		Sandal wood oil	Perfumes	Kumar <i>et al.</i> , 2015
<i>Aniba rosaeodora</i>		Rosewood oil	Skin care	Amusant, 2016
<i>Aquilaria malaccensis</i> Lam		Agar wood oil	Perfume/ fragrances	Nath and Saikia, 2002
<i>Cinnamomum camphora</i> L.	Leaves	Camphor oil	Perfumes, treat muscular strain and inflammation.	Hamidpour <i>et al.</i> , 2013
<i>Cymbopogon nardus</i> L.		Citronella oil	Insect repellent	De silva <i>et al.</i> , 2021
<i>C. citratus</i>		Lemon grass	Insect repellent	Majewska <i>et al.</i> , 2019
<i>C. martini</i>		Palmarosa oil	Perfumery and skin care	Pattnaik <i>et al.</i> , 1996
<i>Pogostemon cablin</i>		Patchouli oil	Depression	Chakrapani <i>et al.</i> , 2013
<i>Ocimum basilicum</i> L.		Basil oil	Perfumery, relieves headache and depression	Wan <i>et al.</i> , 1998
<i>Mentha arvensis</i>		Mint oil	Flavoring toothpastes	Pattnaik <i>et al.</i> , 1996
<i>Pelargonium graveolens</i> L.		Geranium oil	Perfumery	Bilal <i>et al.</i> , 2022
<i>Rosmarinus officinalis</i> L.		Rosemary oil	Relieves anxiety	Ayoob <i>et al.</i> , 2023
<i>Picea mariana</i>		Spruce oil	Revive tired muscles	Rasheed <i>et al.</i> , 2020
<i>Jasminum officinale</i> L.		Jasmine oil	Fragrance	Rasheed <i>et al.</i> , 2020
<i>Rosmarinus officinalis</i> L.		Rosemary oil	Inflammatory diseases, muscular and articular pain	Ayoob <i>et al.</i> , 2023
<i>Citrus limon</i> Linn.		Lemon	Reduce anxiety and depression, Relieves pain	Mahato <i>et al.</i> , 2020
<i>Citrus bergamia</i>		Bergamot oil	Perfumery	Navarra <i>et al.</i> , 2015
<i>C. aurantifolia</i>		Lime	Anti-inflammatory agent	Jain <i>et al.</i> , 2020
<i>Schisandra chinensis</i>		Schisandra oil	Reduce stress, anxiety and weakness, revitalizes skin and induces mental clarity	Sun <i>et al.</i> , 2021

Anti-lice: Tea tree oil is included in the majority of head lice treatment products. Tea tree oil has insecticidal properties due to its anticholinesterase properties (Mills *et al.*, 2004).

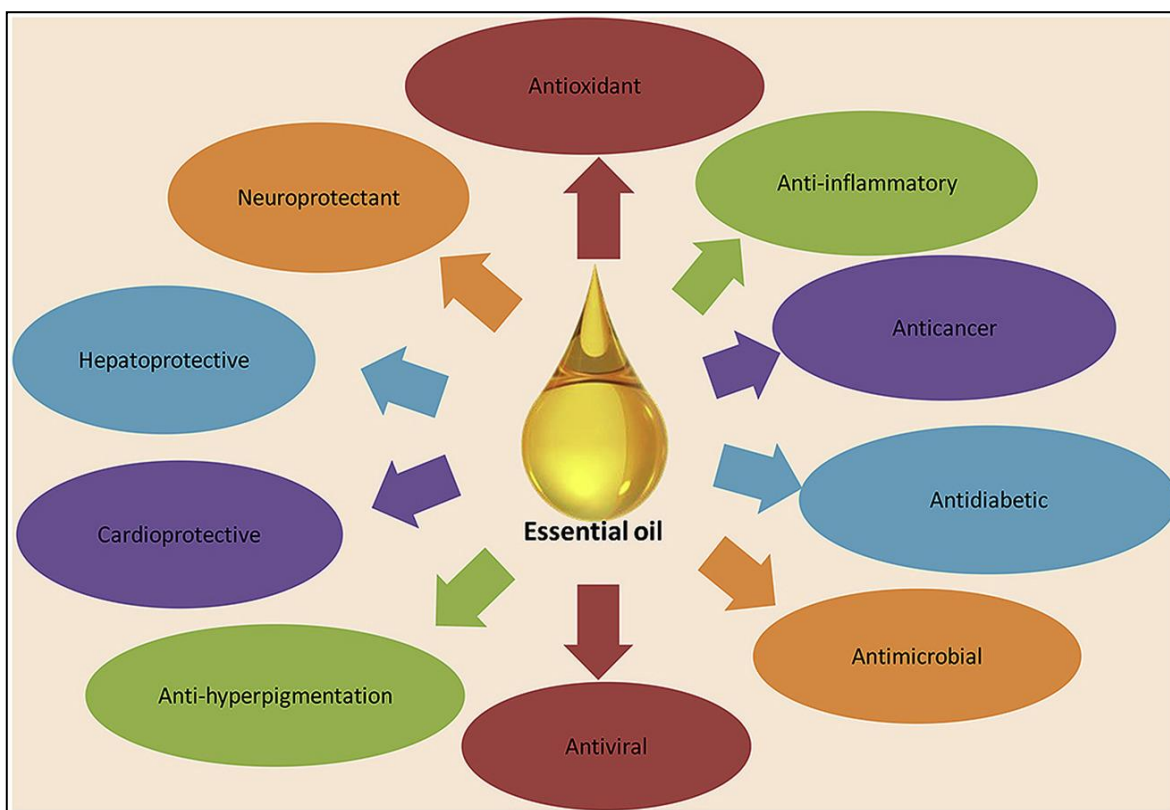


Fig. 4. Biological activities of essential oils (Jugreet *et al.*, 2020)

Anti-oxidant: The essential oil of *Nigella sativa* L. seeds is a powerful antioxidant with excellent hydroxyl radical scavenging action. *Kunzea ericoides*, *Leptospermum scoparium* and *Leptospermum petersonii* are plants with antibacterial and antioxidant characteristics. The essential oil of *M. armillaris* has strong antioxidant properties; it changes the parameters of superoxide dismutase and boosts vitamin E and C levels (Baratta *et al.*, 1998). Gene mutations and posttranslational changes of different proteins can be caused by free radicals generated during inflammation. If not, removing it risks introducing harmful radicals into the system as a whole. Antioxidant properties of substances usually counteract this process. *Thymus vulgaris*, *Citrus limon*, *Euphorbia globules* and *Cupressus sempervirens* have all been shown to have anti-inflammatory properties in animal studies (Aazza *et al.*, 2014).

Insecticidal action: Insect repellency/toxicity results were promising from the essential oils of *Nepeta parnassica* on the *Culex pipiens molestus* (Gkinis *et al.*, 2003).

Spasmodic action: When evaluated on isolated rat ileum, *Kunzea ericoides* and *Leptospermum scoparium* essential oils, as well as their different preparations, showed strong spasmogenic and spasmolytic action. *Ferula gummosa* is considerably better at calming the ileum's contractile over-activity, which is the root of many gastrointestinal problems (Sadraei *et al.*, 2001).

Hormonal action: When compared to eugenol, which has anti-estrogenic action, geraniol, neral, geraniol, nerol and trans-anethole are well known for their promotion of estrogenic response. Citra, a blend of geraniol, nerol and eugenol, was shown to be efficient in recombinant yeast cells in replacing [3H] 17-estradiol at oestrogen receptors (Howes *et al.*, 2002).

Role of Essential Oils Used in Aromatherapy in Relieving Pain: Pain, in medical terms, is an unpleasant sensation that typically indicates an injury or sickness. Essential oils are only advised as a complementary treatment for less severe conditions. Essential oils were developed to relieve joint pain and inflammation, but they also have additional health advantages when massaged. Aromatherapy has a considerable beneficial effect in decreasing pain, and ancient literature has looked at its usefulness in treating pain. Pain is constantly worsened by age-related diseases including dementia, heart disease, diabetes, arthritis, and so on. Aromatherapy is a method of therapy that involves the use of essential oils, which are extracted fragrant

essences from plants. Aromatherapy should also be regarded safe for current pain management, according to recent studies (Banerjee *et al.*, 2021).

Table-2: Essential oils used for different health related disorders

Condition	Essential oils	References
Anxiety Agitation Stress	<i>Lavendula angustifolia</i> (lavender) <i>Pelargonium graveolens</i> (geranium) <i>Valeriana officinalis</i> (valerin)	Farooq <i>et al.</i> , 2022 Bilal <i>et al.</i> , 2022 Jugran <i>et al.</i> , 2018
End of life agitation	<i>Santlum album</i> (sandalwood) <i>Lavendula angustifolia</i> (lavender)	Kumar <i>et al.</i> , 2015 Farooq <i>et al.</i> , 2022
Fatigue	<i>Citrus paradisi</i> (grape fruit) <i>Rosmarinus officinalis</i> (rosemary) <i>Cymbopogan nardus</i> (citronella)	Anwar <i>et al.</i> , 2017 Ayoob <i>et al.</i> , 2023 De silva <i>et al.</i> , 2020
Insomnia	<i>Thymus vulgaris</i> (sweet thyme) <i>Cananga odorata</i> (ylang ylang) <i>Chamaemelum nobile</i> (Roman chamomile)	Ghafarifarsani <i>et al.</i> , 2022 Ali <i>et al.</i> , 2015 Ali <i>et al.</i> , 2015
Memory loss	<i>Litsea cubeba</i> <i>M. piperita</i> (peppermint) <i>Rosmarinus officinalis</i> (rosemary)	Chen <i>et al.</i> , 2012 Mir <i>et al.</i> , 2022 Ayoob <i>et al.</i> , 2023
Mental exhaustion, burnout	<i>M. piperita</i> (peppermint) <i>Ocimum basilicum</i> (basil) <i>Helichrysum aungustifolium</i>	Ali <i>et al.</i> , 2015 Mir <i>et al.</i> , 2022 Gismondi <i>et al.</i> , 2020
Pain management	<i>Eucalyptus smithii</i> (gully gum) <i>Lavandula angustifolia</i> (lavender) <i>Matricaria recutita</i> (German chamomile) <i>Leptospermum scoparium</i> (manuka) <i>Origanum majorana</i> (sweet marjoram) <i>Pinus mugo</i> var. <i>pumilio</i> (dwarf pine) <i>Rosmarinus officinalis</i> (rosemary) <i>Zingiber officinale</i> (ginger)	Baptista <i>et al.</i> , 2015 Farooq <i>et al.</i> , 2022 Ali <i>et al.</i> , 2015 Muturi <i>et al.</i> , 2020 Raina and Negi, 2011 Hajdari <i>et al.</i> , 2015 Ayoob <i>et al.</i> , 2023 Endo <i>et al.</i> , 1990

Role of Plant Resins Used in Aromatherapy: Aromas are produced by a variety of plant species and can be found in resins, gum resins and oleo gum resins. Aromatic resins are produced by several species and can be used in aromatherapy. The plant resin has been said to provide a variety of health advantages, including bettering sleeping quality, treating headaches and migraines, reducing stress, reducing anxiety, increasing digestion and strengthening the immune system. Natural resins are a viscous, sticky and occasionally solid substance produced by some plants when they are wounded. Natural resin has medicinal properties, and some varieties are utilized in aromatherapy. A resin is the sticky ooze exuding from the tree, mostly from the plant species belonging to Pinaceae family. It poured out from the tree's bark as an oxidation byproduct of essential oils and then solidified after exposure to air. Resins are soluble in alcohol and other solvents but not in water. Plant resins can be used in aromatherapy because of their potent natural scent, which can help to relieve headaches or modify one's mood. Essential oils, such as frank incense, myrrh and elemi, are produced from resin and utilized in aromatherapy, perfumery and room scent to help with relaxation and spiritual feelings. Resins are utilized in almost varnishes, paints, and culinary applications; aromatic resins, oleo resins and oleo gum resins are also employed in cosmetics, soap manufacturing, perfumery as a fixative and incense production (Panda, 2021).

CONCLUSION

The review underscores the significant role that MAP's and their essential oils play in aromatherapy. Through a comprehensive analysis of existing literature, it becomes evident that MAP's offer a diverse array

of therapeutic benefits, ranging from stress relief to immune system support. MAP's and their essential oils, with their potent aromatic properties, serve as powerful tool for promoting physical, mental, and emotional well-being. However, further research is warranted to explore their full potential and efficacy in clinical settings. Overall, this review highlights the promising avenues for harnessing the healing potential of MAP's and their essential oils in the practice of aromatherapy.

REFERENCE

- Aazza, S., Lyoussi, B., Megias, C., Giraldo, I., Vioque, J. and Figueiredo, A. C. 2014. Anti-oxidant, anti-inflammatory and anti-proliferative activities of Moroccan commercial essential oils. *Natural Product Communications*, **9**: 587-94.
- Adams, R.P. 1991. Cedar wood oil—Analyses and properties. In *Essential oils and waxes*. Berlin, Heidelberg: Springer Berlin Heidelberg pp 159-173.
- Ali, B., Wabel, N. A., Shams, S., Ahamad, A., Khan, S. A. and Anwar, F. 2015. Essential oils used in aromatherapy: A systemic review. *Asian Pacific Journal of Tropical Biomedicine*, **5**: 601-611.
- Amusant, N., Beauchène, J., Digeon, A. and Chaix, G. 2016. Essential oil yield in rosewood (*Aniba rosaeodora* Ducke): initial application of rapid prediction by near infrared spectroscopy based on wood spectra. *Journal of Near Infrared Spectroscopy*, **24**: 507-515.
- Anjum, F., Bukhari, S. A., Shahid, M., Bokhari, T.H. and Talpur, M.M. 2014. Exploration of nutraceutical potential of herbal oil formulated from parasitic plant. *African Journal of Traditional Complementary and Alternative Medicines*, **11**: 78-86.
- Anwar, I., Saeed, U., Bukhari, M. H. and Saeed, S. 2017. A Study of Antimicrobial Effects of *Citrus Paradisi* 'Grape Fruit' **12**: 1454-1456.
- Arunjyothi, B., Venkatesh, K., Chakrapani, P. and Anupalli, R.R., 2011. Phytochemical and Pharmacological potential of *Annona cherimola*- A Review. *International Journal of Phytomedicine*, **3**:439.
- Auten, J.T. 1945. Relative influence of *Sassafras albidum*, black locust, and pines upon old field soils. *Journal of Forestry*, **43**: 441-49
- Ayoob, B., Singh, A., Gangoo, S. A., Malik, A. R., Raj, A., Akhter, A. and Bilal, T. 2023. Effect of Plant Spacing and Nitrogen Levels on Growth, Yield and Essential Oil Content of Rosemary (*Salvia rosmarinus* Spenn) under Marginal Land Conditions. *Journal of Essential Oil Bearing Plants*, **26**: 21-31.
- Azizi, H., Shojaii, A., Dabaghian, F., Noras, M., Boroumand, A., Haghani, B.E. and Ghods, R. 2020. Effects of *Valeriana officinalis* (Valerian) on tension-type headache: A randomized, placebo-controlled, double-blind clinical trial. *Avicenna Journal of Phytomedicine*, **10**: 297-304.
- Balasankar, D., Vanilarasu, K., Preetha, P.S., Umadevi, S.R.M. and Bhowmik, D. 2013. Journal of medicinal plants studies. *Journal of Medicinal Plants*, **1**: 191-200.
- Banerjee, P., Rout, A. and Panda, N. 2021. Role of Aromatherapy in relieving pain. In P. Bhadra and S. Parida (ed). *Aromatherapy and its Benefits*. Renu Publishers, New Delhi, India. pp. 119-128.
- Baptista, E. B., Franco, D. C., Lataliza, A. A. B. and Raposo, N. R. B. 2015. Chemical composition and antifungal activity of essential oil from *Eucalyptus smithii* against dermatophytes. *Revista da Sociedade Brasileira de Medicina Tropical*, **48**:746-752.
- Baratta, M.T., Dorman, H.D., Deans, S.G., Figueiredo, A.C., Barroso, J.G. and Ruberto, G. 1998. Antimicrobial and antioxidant properties of some commercial essential oils. *Flavour and Fragrance Journal*, **13**: 235-244.
- Bhadra, P. and Parida, S. 2021. *Aromatherapy and its Benefits*. Renu Publishers, New Delhi, India. 153pp
- Bhattacharjee, B. and Chatterjee, J. 2013. Identification of proapoptotic, antiinflammatory, anti-proliferative, anti-invasive and anti-angiogenic targets of essential oils in cardamom by dual reverse virtual screening and binding pose analysis. *Asian Pacific Journal of Cancer Prevention*, **14**: 373-380.
- Bilal, T., Mushtaq, T., Ahmad, P. I., Gangoo, S. A., Behar, B., Ayoob, B. and Mushtaq, I. 2022. Botanicals their use as antimicrobial, antifungal and anti insecticides. *Pharma Innovations Journal*, **11**: 1521-1528.
- Buchbauer, G. and Jirovetz, L. 1994. Aromatherapy—use of fragrances and essential oils as medicaments. *Flavour and Fragrance Journal*, **9**: 217-222.
- Chakrapani, P., Venkatesh, K., Singh, B.C.S., Jyothi, B.A., Kumar, P., Amareshwari, P. and Roja, A.R. 2013. Phytochemical, pharmacological importance of Patchouli (*Pogostemon cablin* Blanco) Benth) an aromatic medicinal plant. *Int. J. Pharm. Sci. Rev. Res*, **21**: 7-15.

- Chen, C. J., Tseng, Y. H., Chu, F. H., Wen, T. Y., Cheng, W. W., Chen, Y. T. and Wang, S. Y. 2012. Neuropharmacological activities of fruit essential oil from *Litsea cubeba* Persoon. *Journal of Wood Science*, **58**: 538-543.
- Cui, J., Li, M., Wei, Y., Li, H., He, X., Yang, Q., Li, Z., Duan, J., Wu, Z., Chen, Q., Chen, B., Li, G., Ming, X., Xiong, L. and Qin, D. Inhalation aromatherapy via brain-targeted nasal delivery: natural volatiles or essential oils on mood disorders. *Frontiers in Pharmacology*, **13**: 1-15.
- Silva, G.B.V.U., Dharmadasa, R.M., Senanayake, R.A.S.P. and Lintha, A. 2021. Selection of superior quality *Cymbopogon nardus* (L.) Rendle (Poaceae) populations by means of quantity and quality of essential oils. *World*, **9**: 1-8.
- Dwivedi, A., Rahul, M. and Chaturvedi, M. 2010. Aromatherapy a holistic cure: Current approaches and future concerns. *International Journal of Pharmaceutical and Life Science*, **1**: 23-29.
- Endo, K., Kanno, E. and Oshima, Y. 1990. Structures of antifungal diarylheptenones, gingerenones A, B, C and isogingerenone B, isolated from the rhizome of *Zingiber officinale*. *Phytochemistry*, **29**: 797-799.
- Farooq, S., Gangoo, S. A., Sultan, A., Rafiq, N., Bilal, T. and Ayoob, B. 2022. Influence of plant spacing on essential oil content of lavender (*Lavandula officinalis*) on southern slopes of Kashmir Valley. *Medicinal Plants-International Journal of Phytomedicines and Related Industries*, **14**: 462-466.
- Fung, T.K.H., Lau, B. W. M., Ngai, S.P.C., Hector, W. H. and Tsang, H.W.H. 2021. Therapeutic effect and mechanisms of essential oils in mood disorders: interaction between the nervous and respiratory systems. *International Journal of Molecular Sciences*, **22**: 1-17.
- Gaware, V.M., Nagare, R., Dhamak, K.B., Khadse, A.N., Kotade, K.B., Kashid, V.A. and Laware, R.B. 2013. Aromatherapy: Art or science. *International Journal of Biomedical Research*, **4**: 74-83.
- Ghaderi, H., Rafieian, M. and Nezhad, H. 2018. Effect of hydroalcoholic *Cinnamomum zeylanicum* extract on reserpine-induced depression symptoms in mice. *Pharmacophore*, **9**: 35-44.
- Ghafariarsani, H., Hoseinifar, S. H., Sheikhlari, A., Raissy, M., Chaharmahali, F. H., Maneepitaksanti, W. and Van Doan, H. 2022. The effects of dietary thyme oil (*Thymus vulgaris*) essential oils for common carp (*Cyprinus carpio*): growth performance, digestive enzyme activity, antioxidant defense, tissue and mucus immune parameters, and resistance against *Aeromonas hydrophila*. *Aquaculture Nutrition*, **2022**: 1-12.
- Gismondi, A., Marco, G. and Canini, A. 2020. *Helichrysum italicum* (Roth) G. Don essential oil: Composition and potential antineoplastic effect. *South African Journal of Botany*, **133**: 222-226.
- Grandview Research. 2020. Aromatherapy Market Size, Share & Trends Analysis Report. Available at: <https://www.grandviewresearch.com/industry-analysis/aromatherapy-market>.
- Hajdari, A., Mustafa, B., Ahmeti, G., Pulaj, B., Lukas, B., Ibraliu, A. and Novak, J. 2015. Essential oil composition variability among natural populations of *Pinus mugo Turra* in Kosovo. *SpringerPlus* **4**:1-13.
- Hamidpour, R., Hamidpour, S., Hamidpour, M. and Shahlari, M. 2013. Camphor (*Cinnamomum camphora*), a traditional remedy with the history of treating several diseases. *Int. J. Case Rep. Images*, **4**: 86-89.
- Hammer, K.A., Carson, C.F. and Riley, T. V. 1999. Antimicrobial activity of essential oils and other plant extracts. *Journal of Applied Microbiology*, **86**: 985-990.
- Howes, M. J., Houghton, P. J., Barlow, D. J., Pocock, V. J. and Milligan, S. R. 2002. Assessment of estrogenic activity in some common essential oil constituents. *Journal of Pharmacy and Pharmacology*, **54**: 1521-1528.
- Jain, S., Arora, P. and Popli, H. 2020. A comprehensive review on *Citrus aurantifolia* essential oil: its phytochemistry and pharmacological aspects. *Brazilian Journal of Natural sciences* **3**: 354-364.
- Jugran, A.K., Rawat, S., Bhatt, I.D. and Rawal, R.S. 2019. *Valeriana Jatamansi*: An herbaceous plant with multiple medicinal uses. *Phytotherapy Research*, **33**: 482-503.
- Jugreet, S., Suroowan, S., Rengasamy, K. and Mahomoodally, F. 2020. Chemistry, bioactivities, mode of action and industrial applications of essential oils. *Trends in Food Science &Technology*, **101**: 89-105.
- Karbach, J., Ebenezer, S., Warnke, P.H., Behrens, E. and Nawas, B. 2015. Antimicrobial effect of Australian antibacterial essential oils as alternative to common antiseptic solutions against clinically relevant oral pathogens. *Clinical Laboratory*, **61**: 61-8.
- Khatib, S., Faraloni, C. and Bouissane, L. 2022. Exploring the use of iris species: Antioxidant properties, phytochemistry, medicinal and industrial applications. *Antioxidants*, **11**: 1-30.
- Kim, H.J. 2007. Effect of aromatherapy massage on abdominal fat and body image in postmenopausal women (in Korean). *Taehan Kanho Hakhoe Chi*, **37**: 603-12.

- Koh, K. J., Pearce, A. L., Marshman, G., Jones, J. J. and Hart, P. H. 2002. Tea tree oil reduces histamine-induced skin inflammation. *British Journal of Dermatology* **147**: 1212-1217.
- Kumar, R., Anjum, N. and Tripathi, Y.C. 2015. Phytochemistry and pharmacology of *Santalum album* L.: a review. *World Journal of Pharmaceutical Research*, **4**: 1842-1876.
- Kumar, S., Kumar, A. and Kumar, R. 2019. Himalayan (Himachal region) cedar wood (*Cedrus deodara*: Pinaceae) essential oil, its processing, ingredients and uses: A review. *Journal of Pharmacognosy and Phytochemistry*, **8**: 2228-2238.
- Mahato, N., Sharma, K., Koteswararao, R., Sinha, M., Baral, E. and Cho, M. H. 2019. Citrus essential oils: Extraction, authentication and application in food preservation. *Critical Reviews in Food Science and Nutrition*, **59**, 611-625.
- Majewska, E., Kozłowska, M., Gruszczynska-Sekowska, E., Kowalska, D. and Tarnowska, K. 2019. Lemongrass (*Cymbopogon citratus*) essential oil: extraction, composition, bioactivity and uses for food preservation-a review. *Polish Journal of Food and Nutrition Sciences*, **69**: 327-341.
- Medeiros, J.R., Campos, L. B., Mendonca, S. C., Davin, L.B. and Lewis, N.G. 2003. Composition and antimicrobial activity of the essential oils from invasive species of the Azores, *Hedychium gardnerianum* and *Pittosporum undulatum*. *Phytochemistry*, **64**: 561-5.
- Mills, C., Cleary, B. J., Gilmer, J. F. and Walsh, J. J. 2004. Inhibition of acetylcholinesterase by tea tree oil. *Journal of Pharmacy and Pharmacology*, **56**: 375-9.
- Mir, T. A., Jan, M., Bussmann, R. W. and Bilal, T. 2022. Inventory of medicinal herbs utilized for the treatment of musculoskeletal disorders in district Kupwara of Jammu and Kashmir. *Ethnobotany Research and Applications*, **24**: 1-13.
- Andrade, B. F., Conti, B.J., Santiago, K.B., Junior, A. and Sforcin J .M. 2014. *Cymbopogon martinii* essential oil and geraniol at noncytotoxic concentrations exerted immunomodulatory/antiinflammatory effects in human monocytes. *Journal of Pharmacy and Pharmacology*, **66**: 1491-6.
- Muturi, E. J., Selling, G. W., Doll, K. M., Hay, W. T. and Ramirez, J. L. 2020. *Leptospermum scoparium* essential oil is a promising source of mosquito larvicide and its toxicity is enhanced by a biobased emulsifier. *Plos one*, **15**: 1-14.
- Nath, S.C. and Saikia, N. 2002. Indigenous knowledge on utility and utilitarian aspects of *Aquilaria malaccensis* Lamk in northeast India. *Indian Journal of Traditional Knowledge*, **1**: 47-58.
- Navarra, M., Mannucci, C., Delbò, M. and Calapai, G. 2015. Citrus bergamia essential oil: from basic research to clinical application. *Frontiers in pharmacology*, **6**:36.
- Panda, N. 2021. Aromatherapy for reducing mental stress. pp 129-139. **In: Aromatherapy and its Benefits** (eds. P. Bhadra and S. Parida). Renu Publishers, New Delhi, India.
- Pattnaik, S., Subramanyam, V.R. and Kole, C.R. 1996. Antibacterial and antifungal activity of ten essential oils in vitro. *Microbios*, **86**: 237-46.
- Perry, N. and Perry, E. 2006. Aromatherapy in the management of psychiatric disorders. *CNS Drugs*, **20**: 257-280.
- Raina, A. P. and Negi, K. S. 2012. Essential oil composition of *Origanum majorana* and *Origanum vulgare* ssp. *hirtum* growing in India. *Chemistry of Natural Compounds*, **47**: 1015-1017.
- Rasheed, H, M., Wahid, F, Qayyum, R., Shah, A. J. and Khan, T. 2020. Chemical composition and pharmacological evaluation of essential oil from *Jasminum officinale* flowers for spasmolytic and vasodilation activities. *Farmacologia*, **68**: 722-727.
- Rho K.H., Han S.H., Kim K.S. and Lee M.S. 2006. Effects of aromatherapy massage on anxiety and self-esteem in Korean elderly women: a pilot study. *International Journal of Neuroscience*, **116**: 1447-1455.
- Sadraei, H., Asghari, G. R., Hajhashemi, V., Kolagar, A. and Ebrahimi, M. 2001. Spasmolytic activity of essential oil and various extracts of *Ferula gummosa* Boiss. on ileum contractions. *Phytomedicine*, **8**: 370-6.
- Said, Z.B., Guemghar, H., Makhoulouf, L., Rigou, P., Remini, H., Adjaoud, A, Khoudja, N.K. and Madani, K. 2016. Essential oils composition, antibacterial and antioxidant activities of hydro distilled extract of *Eucalyptus globulus* fruits. *Industrial Crops and Products*, **89**: 167-175.
- Sanmukhani, J., Anovadiya, A. and Tripathi, C.B. 2011. Evaluation of antidepressant like activity of curcumin and its combination with fluoxetine and imipramine: an acute and chronic study. *Acta Pol Pharm*, **68**: 769-75.
- Satchell, A.C., Saurajen, A., Bell, C. and Barnetson, R. S. 2002. Treatment of dandruff with 5% tea tree oil shampoo. *Journal of the American Academy of Dermatology*, **47**: 852-5.
- Smith, R. 2008. The long slide to happiness. *Journal of Philosophy of Education*, **42**: 559-573.
- Soden, K., Vincent, K., Craske, S., Lucas, C. and Ashley, S. 2004. A randomized controlled trial of aromatherapy massage in a hospice setting. *Palliative Medicine*, **18**: 87-92.

- Sun, W., Shahrajabian, M. H. and Cheng, Q. 2021. *Schisandra chinensis*, Five Flavor Berry, a Traditional Chinese Medicine and a Super-Fruit from North Eastern China. *Pharmacognosy Communications*, **11**: 13-21.
- Teixeira, B., Marques, A., Ramos, C., Neng, N.R., Nogueira, J.M.F., Saraiva, J.A. and Nunes, M.L. 2013. Chemical composition and antibacterial and antioxidant properties of commercial essential oils. *Industrial Crops and Products*, **43**: 587–595.
- Wan, J., Wilcock, A. and Coventry, M. J. 1998. The effect of essential oils of basil on the growth of *Aeromonas hydrophila* and *Pseudomonas fluorescens*. *Journal of Applied Microbiology*, **84**: 152-158.
- Ward, J.S. 2007. Crop-tree release increases growth of black birch (*Betula lenta* L.) in southern New England. *Northern Journal of Applied Forestry*, **24**: 117-122.
- Worwood, V. A. 2000. Aromatherapy for the Healthy Child: More than 300 Natural, Nontoxic, and Fragrant Essential Oil Blends. *New World Library, Novato*