Chapter 02

Holistic Healing: The Modern Role of Essential Oils in Therapeutic and Aromatherapy Practices

Madiha Mustafa[1], Rizwan Asif[1,2], Zaigham Wahhab[1], Imtiaz Mustafa[3], Hamad Ahmad[4], Shahla Umbreen[1], Abdul Rehman[1], Marium Ahsan[5], Minhas Alam[6], Fizza Riaz[1] and Riffat Yasmin[7]

[1]Department of Eastern Medicine, Qarshi University, Lahore, Pakistan
[2]Department of Allied Health Sciences, Qarshi University, Lahore, Pakistan
[3]Institute of Molecular Biology and Biotechnology, the University of Lahore, Pakistan
[4]Department of Eastern Medicine, Government College University Faisalabad, Pakistan
[5]Department of Eastern Medicine, Faculty of pharmacy, Superior University Lahore, Pakistan
[6]Department of Virology, Provincial Headquarter Hospital, Gilgit Baltistan, Pakistan
[7]Faculty of Rehabilitation & Allied Health Sciences, Riphah International University, Faisalabad, Pakistan.
*Corresponding author: rizwan.asif@qu.edu.pk

ABSTRACT

Essential oils in aromatherapy form a powerful synergy with the body and mind, facilitating to alleviate stress, enhance mood, and support overall health and vitality. Various essential oils had history of use in aromatherapy such as eucalyptus, lavender, nutmeg, peppermint, clove, and tea tree oils. Eucalyptus oil, sourced primarily from *E. citriodora*, is globally recognized for its economic extraction and diverse therapeutic applications, owing to its high 1,8-cineole content. Lavender oil, known for its antibacterial properties dating back to World War I, offers sedative and anti-inflammatory benefits. Nutmeg oil, extracted from *Myristica fragrans*, displays antimicrobial, anti-inflammatory, and hepatoprotective properties, utilized traditionally for various ailments. Peppermint oil, rich in menthol and menthone, serves multiple purposes including gastrointestinal relief and mental alertness enhancement. Clove oil, containing eugenol, demonstrates strong antimicrobial and antioxidant effects with notable anticancer properties. Tea tree oil is important for its antimicrobial prowess, addressing skin infections and respiratory issues. This chapter highlight the multiple roles of essential oils, detailing their chemical compositions, pharmacological activities, and therapeutic applications.

KEYWORDS
Essential oils, Aromatherapy, Holistic healing, Alternative medicine

Received: 21-May-2024
Revised: 16-July-2024
Accepted: 02-August-2024

A Publication of Unique Scientific Publishers

Cite this Article as: Mustafa M, Asif R, Wahhab Z, Mustafa I, Umbreen S, Rehman A, Ahsan M, Alam M and Riaz F, 2024. Holistic healing: the modern role of essential oils in therapeutic and aromatherapy practices. In: Zafar MA, Abbas RZ, Imran M, Tahir S and Qamar W (eds), Complementary and Alternative Medicine: Essential oils. Unique Scientific Publishers, Faisalabad, Pakistan, pp: 13-23. https://doi.org/10.47278/book.CAM/2024.011

INTRODUCTION

Aromatherapy originates from "aroma," referring to fragrance or scent, and "therapy," indicating treatment. It is a holistic approach to healing, nurturing the mind, body, and soul through natural ways (Worwood, 2000).

For over 6,000 years, civilizations such as Egypt, China, and India have embraced aromatherapy as a prevalent complementary and alternative therapy. It has proven effective in addressing a wide range of ailments and conditions (Alok et al., 2000). Historical accounts indicate a surge in interest during the late 20th century, and its popularity continues into the 21st century. Given its significance, widespread use, and acknowledgment as an aromatic science therapy, aromatherapy holds a prominent place in modern healthcare (Klein et al., 2014; Svoboda and Deans, 1994).

Aromatherapy employs essential oils as its principal therapeutic agents, purportedly deriving from highly concentrated substances extracted from various botanical sources such as flowers, leaves, stalks, fruits, and roots, with additional distillation processes involving resins (Dunning, 2013).

Aromatherapy has been classified into many classes as depicted in (Fig. 1).

Mechanism of Action

Essential oils have become essential in various realms, including therapy, cosmetics, aromatics, fragrances, and spiritual practices (Figure 2) (Evans, 2009).

These oils, known for their enduring potency, possess specific energetic properties resembling hormones. Their ability

to penetrate tissues is crucial to their therapeutic effect. Upon inhalation, they integrate with nasal receptor cells, triggering signals to the brain, which release neurotransmitters like serotonin and endorphins. Different oils evoke distinct effects, influencing both mind and body (Kumar et al., 2000).

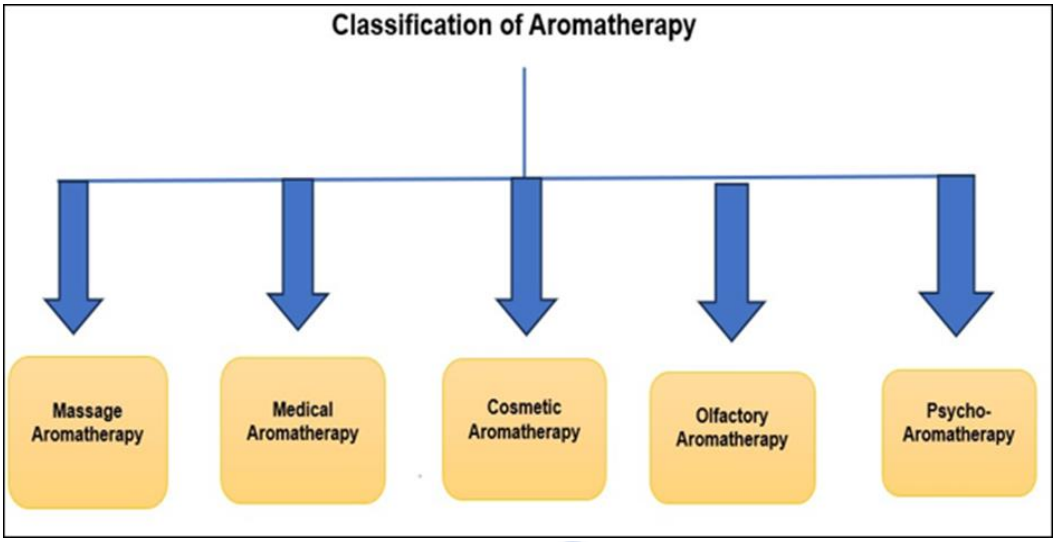

Fig. 1: Classification of Aromatherapy.

Fig. 2: Importance of essential oils in aromatherapy.

Essential oils are used for treatment of many diseases and common problems such as memory loss, pain management, anxiety, stress, fatigue, insomnia ,spasms and behavioural issues (Ali et al., 2015).
Several important aromatic oils have been discussed below for their therapeutic potential.

Eucalyptus Oil

Eucalyptus oil is especially helpful since it can be extracted economically (industrial value) and has many desirable qualities that can be used to treat a wide range of illnesses. Eucalyptus oil is obtained from leaves of plant. (Sharma et al., 2023).

Distribution and Botanical Description

Eucalyptus comprises more than 500 species that are widely distributed in Australia, India, southern Europe, North

Africa and South (Patel et al., 2018). The plant has a totally unique habit. Eucalyptus timber have unmarried stems and big trunks of their herbal shape. With a median top of 30 m, this tree is medium-sized to tall, even as a few writers file timber as tall as 45 m. Grey-blue, alternating, drooping, eight–22 cm lengthy, 1-2 cm wide, often curved or sickle-shaped, tapering, and short-pointed at base are the traits of the leaves (Sabo et al., 2019).

Chemical Compounds

More than 70% (v/v) of 1,8-cineole may be present in eucalyptus leaf essential oil. Other compounds are monoterpenes, macrocarpals, phenols, alkaloids, flavonoids 6,8- dimethylkaempferol-3,7-dimethyl ether, eucalyptin, 8-desmethyl-eucalyptin, oleanolic acid, terpenoid phenolaldehydes, verbenone, and tannins oil (Dhakad et al., 2018). There has been a successful report on fifty constituents of the essential oil from *E. globulus* cultivated in the Cangshan mountain region of Yunnan Province, China (Liu et al., 2009). The essential oils of *Eucalyptus camaldulensis* had a more intricate composition, with fifty-four compounds accounting for 95% of the total oil found in the leaves. However, the average yield of oil recovered from various distillation techniques was a very low 0.25% (w/w). Twenty-two elements, or 95.95% of the primary components of the essential oil, have been discovered based on the chemical makeup of E. grandis oil. These constituents are distinguished by a high amount of 1,8-cineole (Sewanu, 2012).

Pharmacological Activities

Several researchers have investigated the antibacterial properties of eucalyptus essential oil. The main components of eucalyptus essential oils are toxic to a variety of microorganisms, such as bacteria, fungus and soil-borne pathogens. Eucalyptus essential oils exhibits antidiabetic, antioxidant, hepatoprotective (Noumi et al., 2022), anticancer (Abiri et al., 2022) and nerve blocker activities (Cavalu et al., 2021).

Therapeutic Uses

Eucalyptus is used by traditional healers to cure a wide range of ailments, including neuralgia, soreness, stiffness, bronchitis, pneumonia, colds, and flu (Ridouh and Hackshaw, 2022) and (Madankar et al., 2021). The wound healing activity of ethyl acetate and ethanolic extracts of *E. citriodora* in Wister albino rats validated the wound healing activity of eucalyptus. Numerous studies have shown that eucalyptus oil has analgesic, anti-inflammatory and antinociceptive properties (Owemidu et al., 2020).

Lavender Oil

Lavender essential oils are used in numerous over-the-counter alternative medicines and cosmetic items as a complementary medicine. It is collected between late June and August from flowers. Medicines prepared from the lavender have been utilized for medicinal purposes from ancient times. (Saeed et al., 2023).

Distribution and Botanical Description

There are 41 recognized species in the genus Lavandula L. (Lamiaceae), which are either native to Arabian Peninsula, Macaronesia, Northern and North-Eastern Africa, the Mediterranean basin, South-Western Asia, Central and Southern India, or were brought to Australia, New Zealand, and Eastern Europe (Kiprovski et al., 2023). Lavender is an evergreen drooping shrub with strong aromatic properties. The flower-bearing stems are tetrahedral with a protracted higher internode, and the decrease lignified branches are closely branched, rising, and bearing many younger shoots. Leaves: opposite, sessile, oblong-linear, inexperienced or gray-inexperienced from drooping, with curled margins, 2–6 cm long. False whorls of plant life are collected to shape spike-fashioned inflorescences. Corolla: pubescent, usually bluish-purple, two-lipped, approximately 1 cm long. The ultimate cup carries 4 nuts that make up the fruit.(Fakhriddinova et al., 2020)

Chemical Compounds

The majority of lavender essential oils contain camphor,1,8-cineole, thymol, borneol, linalool, ρ-cymene, α-pinene, and β-pinene as their primary ingredients (Dong et al., 2020) separated 40 compounds in lavender essential oil that were shown to be responsible for 92.03% of the compositions of the essential oils by using GC-MS. Column chromatography was used to separate the 19 monomers in this study.

Pharmacological Activities

Studies using isolated components from lavender essential oil, such as linalyl acetate and linalool, have demonstrated hypnotic, anesthetic, and antispasmodic properties. Components including camphor, terpineol, 1,8-cineole, and linalool have been shown to possess anti-inflammatory, antimicrobial, and antioxidant properties (Blažeković et al., 2010). Moreover, linalyl acetate, 1,8-cineole, and linalool have antispasmodic properties. Linalool has been shown to have certain insecticidal properties, and linalyl acetate has been shown to have narcotic properties (Lechat et al., 2015).

Therapeutic Uses

Lavender oil has been shown in numerous studies to promote and enhance sleep while lowering tension and anxiety. Additionally, research indicates that lavender may be used to treat dementia. Because lavender essential oil has significant pharmacological properties as an antioxidant, antibacterial, anti-inflammatory, and anticholinesterase agent, other research recommends using it to treat a variety of health issues (Cardia et al., 2018).Lavender essential oil can potentially help with

neuropathic pain since it has been shown to effectively lower pain perception when applied topically to patients suffering from carpal tunnel syndrome. Lavender essential oil has been shown to be a great substitute for liver disease treatment due to its significant anti-inflammatory properties that protect liver and kidney damage, lower inflammation, and suppress oxidative stress (Kozics et al., 2017) .

Nutmeg Oil

Nutmeg is an evergreen tree with height up to 20–25 ft high belongs to family Myristicaceae. It yields seeds with red arils (mace) and brown kernels (nutmeg) used in oil is obtained from seed kernels in June to August in Pakistan.

Distribution and Botanical Description

Nutmeg is native to Indonesia, but recently cultivated across various regions including Grenada, USA, India, Mauritius, Sri Lanka, South Africa, and Pakistan. Its sweet flavor makes it a popular choice as a flavor enhancer especially in baked goods, dairy products, meats, sauces, and beverages. Additionally, nutmeg oil, valued for its fragrance, is utilized in both the flavoring and perfumery sectors (Khanam et al., 2023). The nut possesses an oval or broadly ovate shape, encased in a tough, coarse, dark-brown shell that appears glossy on the outside and smooth and light-colored within, measuring about half a line in thickness. (Nikolic et al., 2021) .

Compounds

Nearly all parts of nutmeg like leaves, mace, seed, and kernel contain substantial amount of essential oils (Ashokkumar, Simal-Gandara, Murugan, Dhanya, and Pandian, 2022). Previous studies showed that nutmeg leaf oil contains compounds like sabinene (17.2%), eugenol (16.6%), and myristicin (9.1%), while mace oil (8.1% v/w) is rich in sabinene (38.4%) and α-pinene (8.2%). Factors like soil type, season, cultivars, and location influence essential oil yield in regions like India and Pakistan (Ashokkumar et al., 2022). .

Pharmacological Activities

Clinical studies confirmed the antioxidant, antimicrobial, anti-inflammatory, anticancer, antimalarial, anticonvulsant, hepatoprotective, antiparasitic, insecticidal, and nematocidal (Khanam et al., 2023) activities of nutmeg essential oil as shown in (Figure 3). It has antimicrobial activities which have been documented in research.

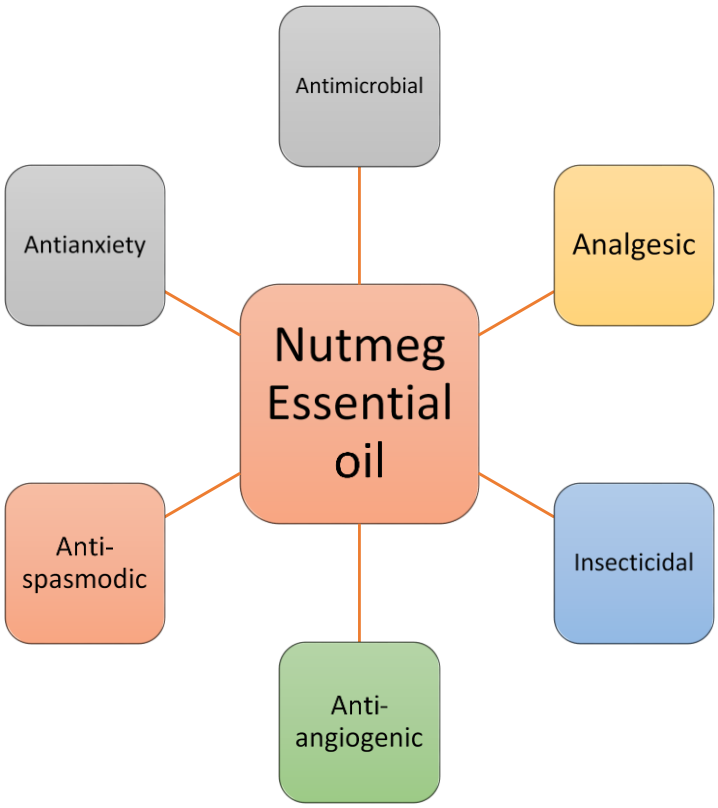

Fig. 3: Pharmacological activities of Nutmeg oil

Therapeutic Uses

Currently nutmeg essential oils gaining interest due to protection from food-borne bacteria and fungi. The demand in food industries is increasing due to safe, cheap and environmental friendly potential as compared to synthetic antibiotics. Spice also contains different essential oils have been reported to inhibit growth of microorganisms. Different studies reported that essential oils with a 0.5% concentration found in nutmeg sufficient to completely suppress the growth of

different bacteria like *E. faecalis* and *S. mutans* Some studies also reported that 0.2% concentration was enough to prevent the growth of *P. multocida* (Ashokkumar et al., 2022). Topical study determined the analgesics potential by inhibiting COX. The insecticidal properties were also found for the management of *M. domestica* and *C. albiceps* (Zhang et al., 2016). MFEO exhibited significant antiangiogenic property and it can be utilized as an anticancer agent as it limits the formation of new blood vessels and inhibits the growth of tumours (Kholibrina and Aswandi, 2021). Traditionally it is also used to cure several other problems like anxiety, nausea, diarrhea, cholera, stomach cramps, parasites, paralysis rheumatism and aphrodisiac (Ashokkumar et al., 2022). Nutmeg plant widely used in Pakistan to treat hypertension and hypertension associated disorders (Malik et al., 2018).

Peppermint Oil

Peppermint essential oils (PEO) of *Mentha piperita L.* and *Mentha arvensis* leaves from Labiatae family, is esteemed for its therapeutic attributes Worldwide, *Mentha arvensisis* well known as field mint, wild mint or corn mint (Balakrishnan, 2015).

Distribution and Botanical Description

Mentha is widely distributed globally in the topical, subtopical and temperate regions. *Mentha arvensis* possess leaves with curled edges. Each pair of leaves grows in opposing directions from one another. Mints display flowers in hues such as soft purple, pink, and white (Kholibrina and Aswandi, 2021). Oil is sourced from the undersides of leaves through steam distillation and is typically subjected to rectification and fractionation before being utilized. Exhibiting a colorless to pale yellow or greenish-yellow hue, this aromatic substance bears a distinct odor and taste, often followed by a pronounced sensation of cold (Sharma et al., 2013).

Active Compounds

PEO principal active compounds include menthol, menthone, menthyl acetate, limonene, cineole, and pulegone. Menthone and iso-menthone undergoing substantial synthesis as the epidermal oil glands during the rapid growth phase of young Mentha plants (Sachan et al., 2013).

Pharmacological Activities

Menthol, one of the major constituents of peppermint oil, has been extensively studied for its various biological activities. It has been shown to possess antimicrobial, antiviral, analgesic , anti-inflammatory (Mogosan et al., 2017), and antioxidant properties as depicting in (Figure 4). Menthone, another important component, has demonstrated antibacterial (Diler et al., 2021) and insecticidal activities . Cineole and limonene, two monoterpenes present in peppermint oil, have also exhibited antimicrobial, anti-inflammatory (Chao et al., 2005),and antioxidant effects.

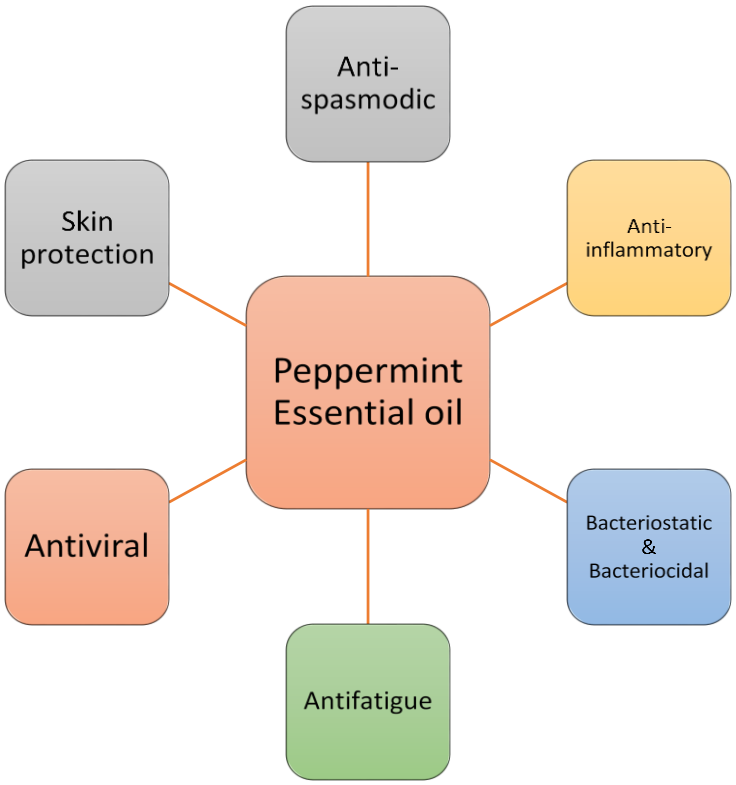

Fig. 4: Pharmacological activities of peppermint oil

Therapeutic Effects

PEO is reported to alleviate gastrointestinal spasms and abdominal pain by functioning as a smooth muscle calcium

channel antagonist. This mechanism involves blocking calcium influx through endomysial L-type calcium channels, thereby potentially reducing the contractility of gastrointestinal smooth muscle (Smith et al., 2018; Zhao et al., 2022).

PEO acts as a choleretic by reducing intrahepatic cholestasis. It can be widely used to treat wounds, skin infections, inflammation, eczema, hives, psoriasis, scabies, and insect bites, among other dermatic disorders (Štefanidesová et al., 2019). Topical PEO relieve itching sensations through the activation of A-delta fibers and k-opioid receptors , Furthermore, it has been observed to alleviate pregnancy-related pruritus (PG) resulting from hormonal changes (Amjadi et al., 2012; Elsaie et al., 2016). It enhances alertness and mental refreshment while also modulating the brain's olfactory pathway to alleviate anxiety, reduce pain and impulse, and improve sleep quality, thus contributing to its antifatigue effects. PEO exhibit bacteriostatic and bactericidal properties against a various species of microbes (Rasooli et al., 2009). PEO effectively alleviates inflammation and oxidative stress (Kim et al., 2021).

Clove Oil

Clove (*Syzygium aromaticum*) a precious herb belongs to family Myrtaceae. Clove essential oil (CEO) obtained from flower bud has long history of use in medicine and food.

Distribution and Botanical Description

Clove encompassing approximately 1200 to 1800 flowering plants species extensively found in Asia, Africa and Madagascar regions (Cock and Cheesman, 2018). *Syzygium aromaticum* is an evergreen tree that can reach heights of 8 to 12 meters, characterized by its sizable square-shaped leaves and clusters of vibrant flowers. Initially pale in color, the young flower buds gradually transition to green before turning a vibrant red when they are ripe for harvesting (Milind and Deepa, 2011).

Active Compounds

The handsome amounts of essential oils are found in the aerial parts of clove which contain chemical profile analysed by GCMS (Milind and Deepa, 2011). These chemical constituents including volatile oil (15 to 20%) comprising eugenol (70 to 85%), eugenyl acetate (10 to 15%), and beta-caryophyllene (5 to 12%), methyl amyl ketone, kaempferol and gallotannic acid (Milind and Deepa, 2011) .

Pharmacological Activities

CEO exhibited various pharmacological activities (Figure 5) such as anti-oxidant (Radünz et al., 2019), anti-inflammatory, anti-Alzheimer's, antiarthritic, cardiovascular, anxiolytic , analgesic , antibacterial, anti-viral, wound-healing effects, dental anesthetic and hepato-protective activity (Thuwaini et al., 2016).

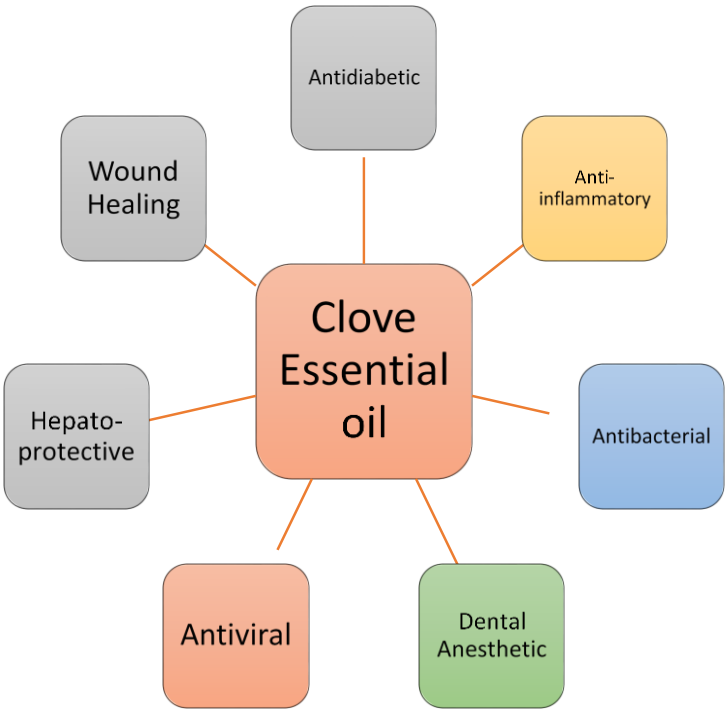

Fig. 5: Pharmacological activities of clove oil

Therapeutic Effects

It demonstrated cytotoxic effects against colon cancer, oesophageal cancer, breast cancer and prostate cancer (Abd El Azim et al., 2014). It acts as antidiabetic agent by dose dependent inhibition of alpha glucoside thus block the absorption of carbohydrate in small intestine (Adefegha et al., 2014). CEO serves a dual purpose of pain relief and infection clearance for abscesses. For individuals with an earache, it is advisable to dilute clove oil with a carrier oil (avoiding water), mixture is

applied to a cotton ball, and carefully insert it into the ear canal. SAEO oil derived from the leaves is renowned for its potent antimicrobial properties. It has found application in wound dressing, the formulation of mouthwash, and the prevention of postnatal sepsis (Chah et al., 2006).

CEO has been added as a main constituent in different formulations due to its antioxidant, anti-inflammatory, antimicrobial, antifungal and antiviral properties. It is also used to treat burns, wounds and pain (Batiha et al., 2020).

Tea Tree Oil

Melaleuca Alterfolia belongs to the *Myrtaceae Family* and is commonly named Cheel Plant, an Australian native. Melaleuca (tea tree) oil has become increasingly commonly used in recent decades. Leaves of this plant are most widely used to extract tea tree oil with 100 % Natural IngredientsIt may be yellow or colorless and fragrances like camphoraceous (Borotová et al., 2022).

Distribution and Botanical Description

Australia is the country where tea tree plants are cultivated in a large hierarchy, other countries like China, South Africa, and New Zealand produce large quantities of *Melaleuca alterfolia* (*M.alternifolia*) due to increasing global demand for tea tree oil. The tea tree has a most morphological top of round 7 metres. Leaves have a linear shape, are easy and velvety, and degree among 10 and 35 mm in duration and 1 mm in width. Plant blooms in the course of the spring and early summer. Along the branches are little, 2-three mm diameter, cup-fashioned, woody fruits.(Mathematics et al., 2023)

Chemical Composition

Tea Tree oil (TTO) contains almost 100 ingredients, including major compounds Terpinen-4-ol, γ-Terpinene, 1,8-cineole, α-Terpinolene, α-Terpinolene, α-pinene and P-Cymene (Kasujja, 2021).

Pharmaceutical Activities

TTO has been extensively studied for its various biological activities. It has been shown to possess antimicrobial, antiviral, analgesic , anti-inflammatory, and antioxidant properties (Borges et al., 2019).

Tea Tree oil affects fungi cells' permeability by suppressing mycelium's conversion into germ tubes. It is used without adverse effects or irritation to treat yeast-causing dandruff. It kills the eggs that cause head lice due to the presence of a naturally occurring substance, Nerolidol. Components of tea tree oil bind within the viral lipid bilayer and increase the thickness of the membrane, causing a change in protein correlation. Its lipophilic activity enables its penetration into the skin, making it easy to treat cutaneous infections (Brun et al., 2019).

Therapeutics Uses

TTO possess anti-inflammatory properties that help to cure inflammation, swelling, and redness. It is used for treating acne problems, eczema, and psoriasis. It is a natural antiseptic that prevents infection from burns, cuts, and scrapes (Romeo et al., 2022). The topical use of tea leaves is beneficial for quick wound healing. It effectively repels insects from surfaces such as mosquitoes and ticks. TTO treats respiratory symptoms like cough, sinusitis, and mucus expulsion. It also relieves itching and skin irritation from insect bites. (Kairey et al., 2023)

Rose Oil

Rosa indica is a woody perennial plant belongs to the Rosaceae family and the genus Rosa. Oil is obtained from petals. It have 200 species and over 18,000 cultivars.(Desta et al., 2022).

Distribution and Botanical Description

The plant of rose is cultivated in many countries such as Iran, Turkey, China, South Italy, Libya, South Russia, and Ukraine etc. The traditional uses of rose oil have been found in food, cosmetics, and medicine. (Seify et al., 2018). It is a tall shrub that can reach a height of 2.5 metres. When fully developed, it produces 500–600 flowers during its yearly bloom, which occurs in May or June..(Galal et al., 2022)

Chemical Compounds

The chemical compounds of rose oil can be divided into different categories, such as phytochemicals, flavors compounds, and mineral contents. Numerous chemical components have been identified in rose flowers and leaves. Geraniol, heneicosane, citronellol, linalool, β phenylethyl alcohol, nerol, neral, geranial, eugenol, methyleugenol, nonadecene, eicosane, and tricosane are the main ingredients of the essential oil. Using gas chromatography (GC), the essential oil's quantifiable contents of citronellol, n-nonadecane, n-heneicosane, geraniol, nerol, citral, and eugenol can be determined. Certain components, such as α, β-unsaturated aldehydes, and alcohols like linalool and eugenol, are known to be abundant in the leaves, while flowers contain 2-phenylethanol. In the cosmetic and perfume sectors, floral oil appears to be more suitable. (Verma et al., 2020).

Phytochemicals

Phytochemicals analysis of Rose oil revealed a cluster of important bioactive constituents like kaempferol, Geraniols (5.5–18%), β-citronellol (14.5–47.5%) and nonadecane (10.5–40.5%) (Alom et al., 2021). The active constituents of *R. damascena* essential oil are β-damascenone, β-damascone and β-ionone obtained from degradation of carotenoid (Kant et al., 2023).

Pharmacological Activities

Rose has a wide range of medicinal uses due to diversity of several active constituents which are biologically active and responsible for medicinal properties (figure 6) (Akram et al., 2020).

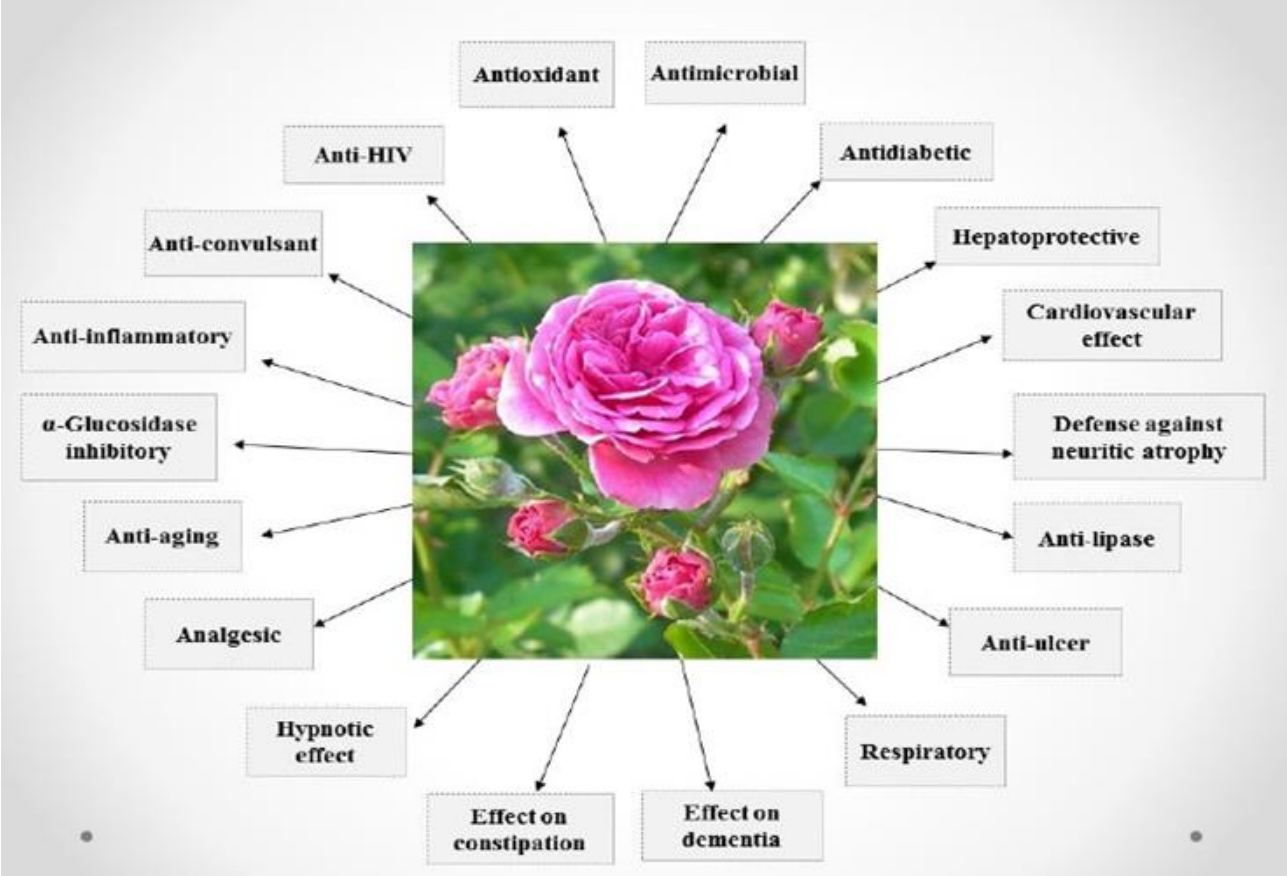

Fig. 6: Pharmacological activities of Rose oil

Clinical studies have been documented in research and proved antimicrobial, anti-inflammatory, anticonvulsant, hepatoprotective and anti-oxidant properties (Fig 6) of rose essential oils (Labban and Thallaj, 2020).

Therapeutic Uses

Rose oil is a nervine tonic, and it is prescribed for patients who are suffering from depressive disorders to elevating mood. Rose oil is very famous alternative herb used from thousands of years against various disorders like gastric ulcers, analgesics properties, cosmetic issues, antibacterial potential and cardiovascular diseases. Rose tea increases the digestion process by supporting the normal flora of gut. Rose oil is very effective for irregular periods and relieve from uterine congestion (Akram et al., 2020).

Conclusion

In conclusion, aromatherapy is a natural, non-invasive therapy that alleviates disease symptoms and rejuvenates the body, promoting overall well-being. It serves as both a preventive measure and a treatment for various conditions. The effectiveness of essential oils depends on the proper selection and collection of plant parts, affecting their active compounds. They can be used alone or complementary conventional medicine, provided safety and quality are considered. The growing scientific interest in complementary and alternative medicine suggests that essential oils could enhance the effects of drugs, especially for CNS diseases, offering significant patient benefits. Aromatherapy's potential, if fully explored, could provide a valuable synergy between natural remedies and modern medicine.

REFERENCES

Abd El Azim, M., El-Mesallamy, A. M., El-Gerby, M., and Awad, A. (2014). Anti-Tumor, antioxidant and antimicrobial and the phenolic constituents of clove flower buds (Syzygium aromaticum). *Journal Microbiology Biochemistry Technology, 10*, s8-s007.

Abiri, R., Atabaki, N., Sanusi, R., Malik, S., Abiri, R., Safa, P., and Abdul-Hamid, H. (2022). New insights into the biological properties of eucalyptus-derived essential oil: A promising green anti-cancer drug. *38*(sup1), 598-633.

Adefegha, S. A., Oboh, G., Adefegha, O. M., Boligon, A. A., and Athayde, M. L. (2014). Antihyperglycemic, hypolipidemic, hepatoprotective and antioxidative effects of dietary clove (Szyzgium aromaticum) bud powder in a high-fat diet/streptozotocin-induced diabetes rat model. *Journal of the Science of Food and Agriculture, 94*(13), 2726-2737.

Akram, M., Riaz, M., Munir, N., Akhter, N., Zafar, S., Jabeen, F., and Pharmacology. (2020). Chemical constituents, experimental and clinical pharmacology of Rosa damascena: a literature review. *72*(2), 161-174.

Ali, B., Al-Wabel, N. A., Shams, S., Ahamad, A., Khan, S. A., and Anwar, F. (2015). Essential oils used in aromatherapy: A systemic review. *5*(8), 601-611.

Alok, K., Rakesh, T., Sushil, K. and Sciences, A. P. (2000). Aromatherapy-an alternative health care through essential oils. *22*(1B), 798-804.

Alok Krishna, A. K., Rakesh Tiwari, R. T., and Sushil Kumar, S. K. (2000). Aromatherapy-an alternative health care through essential oils.

Alom, S., Ali, F., Bezbaruah, R., and Kakoti, B. (2021). Rosa alba Linn.: a comprehensive review on plant profile, phytochemistry, traditional and pharmacological uses. *10*(4), 798-811.

Amjadi, M. A., Mojab, F., and Kamranpour, S. B. (2012). The effect of peppermint oil on symptomatic treatment of pruritus in pregnant women. *Iranian Journal of Pharmaceutical Research: IJPR, 11*(4), 1073.

Ashokkumar, K., Simal-Gandara, J., Murugan, M., Dhanya, M. K., and Pandian, A. (2022). Nutmeg (Myristica fragrans Houtt.) essential oil: A review on its composition, biological, and pharmacological activities. *Phytotherapy Research, 36*(7), 2839-2851.

Balakrishnan, A. (2015). Therapeutic uses of peppermint-a review. *Journal of Pharmaceutical Sciences and Research, 7*(7), 474.

Batiha, G. E.-S., Alkazmi, L. M., Wasef, L. G., Beshbishy, A. M., Nadwa, E. H., and Rashwan, E. K. (2020). Syzygium aromaticum L.(Myrtaceae): Traditional uses, bioactive chemical constituents, pharmacological and toxicological activities. *Biomolecules, 10*(2).

Blažeković, B., Vladimir-Knežević, S., Brantner, A., and Štefan, M. B. J. M. (2010). Evaluation of antioxidant potential of Lavandula x intermedia Emeric ex Loisel.'Budrovka': A comparative study with L. angustifolia Mill. *15*(9), 5971-5987.

Borges, R. S., Ortiz, B. L. S., Pereira, A. C. M., Keita, H., and Carvalho, J. (2019). Rosmarinus officinalis essential oil: A review of its phytochemistry, anti-inflammatory activity, and mechanisms of action involved. *229*, 29-45.

Borotová, P., Galovičová, L., Vukovic, N. L., Vukic, M., Tvrdá, E., and Kačániová, M. J. P. (2022). Chemical and biological characterization of Melaleuca alternifolia essential oil. *11*(4), 558.

Brun, P., Bernabè, G., Filippini, R., and Piovan, A. (2019). In vitro antimicrobial activities of commercially available tea tree (Melaleuca alternifolia) essential oils. *76*, 108-116.

Cardia, G. F. E., Silva-Filho, S. E., Silva, E. L., Uchida, N. S., Cavalcante, H. A. O., Cassarotti, L. L., and Medicine, A. (2018). Effect of lavender (Lavandula angustifolia) essential oil on acute inflammatory response. *2018*.

Chah, K., Eze, C., Emuelosi, C., and Esimone, C. (2006). Antibacterial and wound healing properties of methanolic extracts of some Nigerian medicinal plants. *Journal of Ethnopharmacology, 104*(1-2), 164-167.

Chandorkar, N., Tambe, S., Amin, P., and Madankar, C. (2021). A systematic and comprehensive review on current understanding of the pharmacological actions, molecular mechanisms, and clinical implications of the genus Eucalyptus. *1*(4), 100089.

Chao, L. K., Hua, K.-F., Hsu, H.-Y., Cheng, S.-S., Liu, J.-Y., and Chang, S.-T. (2005). Study on the antiinflammatory activity of essential oil from leaves of Cinnamomum osmophloeum. *Journal of Agricultural and Food Chemistry, 53*(18), 7274-7278.

Cock, I. E., and Cheesman, M. (2018). Plants of the genus Syzygium (Myrtaceae): A review on ethnobotany, medicinal properties and phytochemistry. *Bioactive Compounds of Medicinal Plants: Properties and Potential for Human Health*, 35-84.

Desta, B., Tena, N., Amare, G. and Sciences, S. (2022). Response of rose (Rosa hybrida L.) plant to temperature. *7*(1), 93-101.

Dhakad, A. K., Pandey, V. V., Beg, S., Rawat, J. M., Singh, A. and Agriculture. (2018). Biological, medicinal and toxicological significance of Eucalyptus leaf essential oil: A Review, *98*(3), 833-848.

Dong, G., Bai, X., Aimila, A., Aisa, H. A., and Maiwulanjiang, M. J. M. (2020). Study on lavender essential oil chemical compositions by GC-MS and improved pGC. *25*(14), 3166.

Dunning, T. J. O. A. M. (2013). Aromatherapy: overview, safety and quality issues. *1*(1), 6.

Elsaie, L. T., El Mohsen, A. M., Ibrahim, I. M., Mohey-Eddin, M. H., and Elsaie, M. L. (2016). Effectiveness of topical peppermint oil on symptomatic treatment of chronic pruritus. *Clinical, Cosmetic and Investigational Dermatology*, 333-338.

Eraslan, E. C. J. R., Science, E. I., and Mathematics. (2023). BIOLogical Activities of Melaleuca Alternifolia, Also Known as Tea Tree. 101.

Esposito, E. R., Bystrek, M. V., and Klein, J. (2014). An elective course in aromatherapy science. *78*(4), 79.

Evans, W. C. (2009). *Trease and Evans' Pharmacognosy*: Elsevier Health Sciences.

Fakhriddinova, D. K., Rakhimova, T. R., Dusmuratova, F. M., Duschanova, G. M., Abdinazarov, S. H., and Samadov, I. (2020). The anatomical structure of vegetative organs Lavandula officinalis Chaix in the introduction of Tashkent Botanical garden. *11*(4), 578-588.

Galal, T. M., Majrashi, A., Al-Yasi, H. M., Farahat, E. A., Eid, E. M., and Ali, E. F. J. A. (2022). Taif's rose (Rosa damascena Mill var. trigentipetala) wastes are a potential candidate for heavy metals remediation from agricultural soil. *12*(9), 1319.

Grundmann, O., Yoon, S. L., Mason, S., and Smith, K. (2018). Gastrointestinal symptom improvement from fiber, STW 5, peppermint oil, and probiotics use—Results from an online survey. *Complementary Therapies in Medicine, 41*, 225-230.

Kairey, L., Agnew, T., Bowles, E. J., Barkla, B. J., Wardle, J., and Lauche, R. (2023). Efficacy and safety of Melaleuca alternifolia (tea tree) oil for human health—A systematic review of randomized controlled trials. *14*, 1116077.

Kant, K., Gupta, S., Kaur, N., Jindal, P., and Ali, A. J (2023). Novel foliar approaches enhancing active constituents, flower yield and essential oil content in Damask rose (Rosa damascena Mill.): A Review. *46*(18), 4532-4558.

Kasujja, I. (2021). Critical evaluation of Melaleuca alternifolia: a review of the phytochemical profile, pharmacological attributes and medicinal properties in the botanical, human and global perspectives. *11*(1), 1-15.

Kesharwani, V., Gupta, S., Kushwaha, N., Kesharwani, R., and Patel, D. (2018). A review on therapeutics application of eucalyptus oil. *6*(6), 110-115.

Khanam, M., Dar, A. H., Beg, F., Khan, S. A., Nayik, G. A., and Karabagias, I. K. (2023). Nutmeg essential oil. In *Essential Oils* (pp. 391-399): Elsevier.

Kholibrina, C., and Aswandi, A. (2021). *The Aromatherapy Formulation of Essential Oils in Reducing Stress and Blood Pressure on Human*. Paper presented at the IOP Conference Series: Earth and Environmental Science.

Kim, S.-Y., Han, S.-D., Kim, M., Mony, T. J., Lee, E.-S., Kim, K.-M., and Park, S. J. (2021). Mentha arvensis essential oil exerts anti-inflammatory in LPS-stimulated inflammatory responses via inhibition of ERK/NF-κB signaling pathway and anti-atopic dermatitis-like effects in 2, 4-dinitrochlorobezene-induced BALB/c mice. *Antioxidants, 10*(12), 1941.

Kiprovski, B., Zeremski, T., Varga, A., Čabarkapa, I., Filipović, J., Lončar, B., and Aćimović, M. J. H. (2023). Essential oil quality of lavender grown outside its native distribution range: a study from Serbia. *9*(7), 816.

Kozics, K., Srancikova, A., Sedlackova, E., Horvathova, E., Melusova, M., Melus, V., and Sramkova, M. J. N. (2017). Antioxidant potential of essential oil from Lavandula angustifolia in in vitro and ex vivo cultured liver cells. *64*(4), 485-493.

Labban, L., and Thallaj, N. (2020). The medicinal and pharmacological properties of Damascene Rose (Rosa damascena): A review. *8*, 33-37.

Lechat, C., Lesage-Meessen, L., and Favel, A. (2015). A new species of Ijuhya, I. fournieri, from French Guiana. *7*(3), 101-104.

Malik, K., Ahmad, M., Bussmann, R. W., Tariq, A., Ullah, R., Alqahtani, A. S., and Sultana, S. (2018). Ethnobotany of anti-hypertensive plants used in northern Pakistan. *Frontiers in Pharmacology, 9*, 789.

Metin, S., Didinen, B. I., Telci, I., and Diler, O. (2021). Essential oil of Mentha suaveolens Ehrh., composition and antibacterial activity against bacterial fish pathogens. *Anais da Academia Brasileira de Ciencias, 93*, e20190478.

Milind, P., and Deepa, K. (2011). Clove: a champion spice. *International Journal Research Ayurveda Pharmacy, 2*(1), 47-54.

Mogosan, C., Vostinaru, O., Oprean, R., Heghes, C., Filip, L., Balica, G., and Moldovan, R. I. (2017). A comparative analysis of the chemical composition, anti-inflammatory, and antinociceptive effects of the essential oils from three species of Mentha cultivated in Romania. *Molecules, 22*(2), 263.

Nikolic, V., Nikolic, L., Dinic, A., Gajic, I., Urosevic, M., Stanojevic, L., and Danilovic, B. (2021). Chemical composition, antioxidant and antimicrobial activity of nutmeg (Myristica fragrans Houtt.) seed essential oil. *Journal of Essential Oil Bearing Plants, 24*(2), 218-227.

Noumi, V. D., Deli, M., Nguimbou, R. M., Baudelaire, E., Rup-Jacques, S., Amadou, D., and Pharmacy. (2022). Particle size effects on antioxydant and hepatoprotective potential of essential oil from eucalyptus camaldulensis leaves against carbon tetrachloride-induced hepatotoxicity in rats. *13*(8), 253-272.

Olumorin Owemidu, I., Abraham Taiwo, A., Ojochebo Dangana, E., Achile Jonah, C., Nafiu Negedu, M., Ozovehe Suleiman, H., and Odoma, S. (2020). Anti-nociceptive activity of the ethanol extract of Eucalyptus globulus leaf in experimental animals.

Radünz, M., da Trindade, M. L. M., Camargo, T. M., Radünz, A. L., Borges, C. D., Gandra, E. A., and Helbig, E. (2019). Antimicrobial and antioxidant activity of unencapsulated and encapsulated clove (Syzygium aromaticum, L.) essential oil. *Food Chemistry, 276*, 180-186.

Rasooli, I., Shayegh, S., and Astaneh, S. D. A. (2009). The effect of Mentha spicata and Eucalyptus camaldulensis essential oils on dental biofilm. *International Journal of Dental Hygiene, 7*(3), 196-203.

Ridouh, I., and Hackshaw, K. V. J. P. (2022). Essential Oils and Neuropathic Pain. *11*(14), 1797.

Romeo, A., Iacovelli, F., Scagnolari, C., Scordio, M., Frasca, F., Condò, R., and Divizia, M. J. M. (2022). Potential use of tea tree oil as a disinfectant agent against coronaviruses: a combined experimental and simulation study. *27*(12), 3786.

Sabo, V. A., Knezevic, P. Jand products. (2019). Antimicrobial activity of Eucalyptus camaldulensis Dehn. plant extracts and essential oils: A review. *132*, 413-429.

Sachan, A. K., Das, D. R., Shuaib, M., Gangwar, S. S., and Sharma, R. (2013). An overview on menthae piperitae (peppermint oil). *International Journal Pharmacy Chemistry Biology Science, 3*, 834-838.

Saeed, F., Afzaal, M., Raza, M. A., Rasheed, A., Hussain, M., Nayik, G. A., and Ansari, M. J. (2023). Lavender essential oil: Nutritional, compositional, and therapeutic insights. In *Essential Oils* (pp. 85-101): Elsevier.

Seify, Z., Yadegari, M., Pirbalouti, A. G. J. H. S., and Technology. (2018). Essential oil composition of Rosa damascena Mill. produced with different storage temperatures and durations. *36*(4), 552-559.

Sewanu, S. O. (2012). *The Chemical Composition, Antimicrobial and Antioxidant Properties of the Essential Oils of Tulbaghia Violacea Harv and Eucalyptus grandis W. Hill ex Maiden*.

Sharma, A., Gumber, K., Gohain, A., Bhatia, T., Sohal, H. S., Mutreja, V., and Bhardwaj, G. (2023). Importance of essential oils and current trends in use of essential oils (aroma therapy, agrofood, and medicinal usage). In *Essential Oils* (pp. 53-83): Elsevier.

Soares, G. A., Bhattacharya, T., Chakrabarti, T., Tagde, P., and Cavalu, S. J. P. (2021). Exploring pharmacological mechanisms of essential oils on the central nervous system. *11*(1), 21.

Song, A., Wang, Y., and Liu, Y. J. (2009). Study on the chemical constituents of the essential oil of the leaves of Eucalyptus globulus Labill from China. *4*(4), 134-140.

Štefanidesová, K., Špitalská, E., Csicsay, F., Friedländerová, V., Šáner, A., and Škultéty, Ľ. (2019). Evaluation of the possible use of genus Mentha derived essential oils in the prevention of SENLAT syndrome caused by Rickettsia slovaca. *Journal of Ethnopharmacology, 232*, 55-61.

Svoboda, K., and Deans, S. (1994). *Biological activities of essential oils from selected aromatic plants.* Paper presented at the Internat. Symposium on Medicinal and Aromatic Plants 390.

Thuwaini, M., Abdul-Mounther, M., and Kadhem, H. (2016). Hepatoprotective Effects of the Aqueous Extract of Clove (Syzygium aromaticum) against Paracetamol Induced Hepatotoxicity and Oxidative Stress in Rats. *European Journal of Pharmaceutical and Medical Research, 3*(8), 36-42.

Verma, A., Srivastava, R., Sonar, P. K., and Yadav, R. (2020). Traditional, phytochemical, and biological aspects of Rosa alba L.: A systematic review. *6*(1), 114.

Worwood, V. A. (2000). *Aromatherapy for the healthy child: More than 300 natural, nontoxic, and fragrant essential oil blends*: New World Library.

Zhang, W. K., Tao, S.-S., Li, T.-T., Li, Y.-S., Li, X.-J., Tang, H.-B., and Wan, C.-J. (2016). Nutmeg oil alleviates chronic inflammatory pain through inhibition of COX-2 expression and substance P release in vivo. *Food and Nutrition Research, 60*(1), 30849.

Zhao, H., Ming, T., Tang, S., Ren, S., Yang, H., Liu, M., and Xu, H. (2022). Wnt signaling in colorectal cancer: pathogenic role and therapeutic target. *Molecular Cancer, 21*(1), 144.