



Therapeutic Values of Essential Oils

Reshu Rajput ^{a*}, Anchit Kour ^a and Sabina ^a

^a University Institute of Agricultural Sciences, Chandigarh University, Mohali, Punjab, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/CJAST/2024/v43i64385

Open Peer Review History:

This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: <https://www.sdiarticle5.com/review-history/116421>

Review Article

Received: 29/02/2024

Accepted: 02/05/2024

Published: 09/05/2024

ABSTRACT

Essential oils (EO) are highly concentrated chemicals extracted from leaves, stems, seeds, roots, flowers, resins, and barks. It has been illustrated that essential oils derived from clove, lemon, fennel, eucalyptus, teatree, lavender, peppermint, rosemary have preventive effects on bacteria, fungi and viruses; various studies have been done to evaluate the usefulness of essential oils against microorganisms. Extraction of essential oil from the raw materials is the most time consuming process. There are various methods that are used in extraction of essential oils that are Steam distillation, hydrodistillation, solvent extraction, cold pressing, enfleurage. The combined effects of EO-EO or Essential oil- antibiotic show higher efficacy, according to the strategy of combinatory effects via conventional and non- traditional means. This paper focuses on the various therapeutic uses of essential of different kinds like Peppermint EO, Clove EO, Rosemary EO, Lemon EO etc. Various properties of EO have been mentioned, including anti-diabetic, anti-fungal, anti-mutagenic, anti-viral, anti-bacterial, anti-inflammatory and cancer curing. EO is composed of different components which consists of alcohol, phenol, aldehyde, ketone, terpenoids and ester. Along with beneficial and therapeutic values of EO there also comes some limitations. EO is very useful and is considered as a futuristic approach for clinical operations.

Keywords: Essential oils; antibacterial; anti- viral; anti- inflammatory; microorganisms; contamination.

*Corresponding author: E-mail: reshu.rajput21@gmail.com;

1. INTRODUCTION

The International Organization for Standardization (ISO), defines Essential oil as a product obtained from vegetable raw material, either water distillation or steam distillation, or from the epicarp of citrus fruits by mechanical processes, or by dry distillation [1].

Essential oils have gained popularity in variety of field. They have intriguing physiochemical features and great added values which also make them environmental friendly. Furthermore, essential oils perform a range of biological roles. Numerous investigations have revealed that essential oils have anti bacterial capabilities, including against multi-resistant microorganisms. Furthermore, Essential oils have been used as an aerosol in operating rooms and waiting areas to clean the air and reduce contamination, as well as cleaning liquid to disinfect medical equipment and surfaces and reduce nosocomial infections. Because of their pleasing aroma, they may provide patients with a pleasant sensation of emotional ease [2].

At least 2000 plant species have been exploited to produce around 3000 essential oils, with 300 being commercially relevant. Production of 40,000-60,000 tonnes per year, with an estimated market value of \$700 million USD, demonstrates that essential oil production and use are increasing globally [3]. The use of essential oils are increasing as people have become more health-conscious and prefer natural alternatives to synthetic products. However, it is important to use good quality essential oils for better effectiveness and safety.

Essential oils are a combination of volatile lipophilic (fat-loving, fat-soluble) components derived primarily from higher plants bark, leaves and twigs. Bryophytes, such as liverworts, are frequently found to possess essential oils. Despite the fact that essential oils are only weakly soluble in water, the aqueous solubility of different essential oil components varies according to polarity. In general, it is expected that components with more polar functional groups will dissolve more easily in water than others [4].

Essential oils have antifungal, antiviral, antibacterial and insecticidal characteristics, which help protect plants against herbivores by decreasing their appetite for these plants. They

may also discourage undesirable insects or attract those that aid in the distribution of seeds and pollen [5].

2. PROPERTIES OF ESSENTIAL OILS

1. Antidiabetic properties of essential oil:

Diabetes is distinguished by hyper or hypoglycemia, which is caused by a failure to produce insulin or use it to keep blood glucose levels within normal limits. Several plant chemicals were studied for their potential as antidiabetic medicines. In contrast, there is little research on the ability of plant essential oils to prevent diabetes. Certain essential oils have been found to offer preventive advantages against diabetes related health hazards [3].

2. Antibacterial activity of Essential Oil:

Various essential oils exhibits distinctive antimicrobial properties, which may include antibacterial effectiveness. The processes behind the numerous modes of action that restrict microbial growth remain unknown. The ability of essential oil to inhibit or deactivate bacterial proliferation is referred to as its antibacterial activity. Numerous studies have shown that several essential oils and herbs, such as pimento, clove, cinnamon, oregano and rosemary, have powerful inhibitory effects on a variety of bacterial diseases. According to studies, essential oils antibacterial activity against a variety of bacteria, including *Staphylococcus aureus*, *Bacillus cereus*, *Streptococcus pneumoniae* and *Escherichia coli*, is primarily due to phenolic found in essential oil, such as eugenol, thymol, carvacrol, phenolics refers top essential oil's aromatic feature [6].

3. Antifungal activity of Essential oil:

From the past few years studies and researches are going on how essential oil prevent or control fungal diseases. After some researches, some essential oils were discovered which are thyme oil, tea tree oil, clove oil and peppermint oil which had antifungal properties(D'agostino et al., 2019). Thyme oil consists of thymol and carvacrol. Tea tree oil is good source of terpenes. Thyme oil has the tendency to cure humans infected with fungal infections. Mould species like *Aspergillus spp*, *Penicillium spp* and *Cladosporium spp* can be controlled or completely eliminated with the use of thyme oil with concentration of 9.85, 19.17 and 15.20 µg/m respectively [7].

4. Antiviral activity of Essential oil: Some of the most common and sometimes fatal viral

infections in humans are caused by the herpes simplex virus (type I, II). Not all synthetic antiviral medications are effective in treating genital herpes infections, despite the fact that they have been used to treat herpes infection. One of these, acyclovir, has also caused HSV-1 and HSV-2 resistance, primarily in immunocompromised hosts. Plant extracts, particularly essential oils, have shown virucidal qualities and have the advantage of being less toxic than synthetic antiviral medications, making them a viable substitute for synthetic antiviral treatments [8,9].

5. Anti-inflammatory activities of Essential oils: Inflammation is a physiological response to several stimuli, including cancer, autoimmune diseases such as diabetes and arthritis, skin inflammation and Alzheimer's disease. Corticosteroids and nonsteroidal anti-inflammatory medication (NSAIDs) are among the many treatments that can stop or slow the progression of inflammation [10].

6. Antioxidant activity of Essential oils: The role of oxidative stress in disease, antioxidant properties are vital to several of Essential oil biological roles. These features are due to some of its constituents natural capacity to block or delay the aerobic oxidation of organic materials, particularly phenols. However, because many of these chemicals are non-volatile, the distillation process that removes the oil from the raw material reduces the amount of phenolics in the final matrix. However, there are phenol-free essential oils having antioxidant effects [11].

7. Antimutagenic properties of Essential Oil: Essential oils are known for their antimutagenic effects. These mechanisms include preventing mutagens from entering cells, inactivating them through direct scavenging, capturing free radicals produced by mutagens with antioxidant properties, activating antioxidant enzymes in cells, inhibiting the metabolic conversion of promutagens into mutagens by P450, and initiating enzymatic detoxification of mutagens by essential oil constituents. Effective antimutagenic drugs either promote error-free DNA repair or inhibit error-prone DNA repair. Since Kada and Shimol's study on E coli, no repair by terpenic and phenolic compounds found in essential oils [12].

8. Cancer preventive properties of Essential Oils: There are many studies and researches going on essential oils and their constituents for

their role for curing cancer. Essential oil of different species are found to have anticancer properties against mouth, lungs, liver, colon cancer and brain cancer. Essential oil has two methods for curing cancer: Chemoprevention and Cancer suppression. Essential oils are also beneficial in reducing tumour of animal models. Various attempts are made to stop the growth of cancer cells by essential oils. Also, people suffering from cancer show various side effects due to chemotherapy and any other medicine related to drugs but essential oils are found to be beneficial for decreasing agony of brain cancer patients. Essential oils also helps in reducing depression and anxiety in cancer patients [13].

3. COMPONENTS OF ESSENTIAL OILS

Alcohol: Alcohols are the most therapeutically useful of all the essential oil components and they have no known contraindications, in addition to having attractive scents. They are spasmolytic, tonifying, balanced, antimicrobial and antiseptic [14]. Alcohol changes the smell and therapeutic characteristics of essential oils and it is necessary to include alcohol components in essential oils. These alcohols emit a sweet, floral fragrance. Alcohols are chemical substances containing a hydroxyl group (-OH) linked to a carbon atom. The presence of alcohol in essential oil improves their effectiveness in aromatherapy, which promotes healing, relaxation and stress reduction. These components are also important for oil's solubility and capacity to combine efficiently with other substances.

Phenol: Essential oil contains phenol, which are known for their potent antiseptic, antibacterial and antioxidant properties. Certain aromatic plants produce essential oils, which is mostly composed of aromatic chemicals derived from isoallyl or allyl phenol. The fact that these molecules are more scarce in plants than terpenes only emphasizes their selectivity. Essential oils containing eugenol include anise (*Pimpinella anisum*), star anise (*Illicium verum*), fennel (*Foeniculum vulgare*) and clove (*Syzygium aromaticum*). Cinnamon (*Cinnamomum verum*) contains trans-cinnamic aldehyde [15]. Phenols are aromatic rings with one hydroxyl groups that contribute significantly to the medicinal efficacy of essential oils. High phenol essential oils are powerful and should be used with caution because they can irritate mucous membranes and skin if properly diluted.

Aldehydes: Aldehydes component provide essential oils their distinctive, often intense fragrance, they also impart notes of sweetness, floral and even citrus. Aldehydes are prevalent constituents of essential oils that are prone to oxidation and instability. Numerous aldehydes cause skin sensitization and irritate mucosal membranes. Some of our most well-known culinary herbs, like cumin and cinnamon, contains them and have their distinctive sweet, pleasant fruity smells. Some aldehydes have been described as tonic, antiviral and antimicrobial in therapeutic contexts [14]. Aromatherapy relies heavily on aldehydes to improve mood and relieve tension.

Ketone: Ketone plays a significant role in the powerful therapeutic and aromatic properties of essential oils. Ketones are chemical compounds made up of two alkyl groups connected by a carbonyl group (C=O). These components are well-known for their ability to aid skin healing, increase mental clarity and promote respiratory health. Their integration into essential oils increases the oil's medicinal and aromatic functions.

Ester: One of the main ingredients of essential oils is esters. They enhance the oils's fragrance and medicinal qualities. Esters are recognized for their balancing and relaxing effects on the body and mind. They frequently sweet, fruity or flowery fragrances [14]. Esters are chemical compounds formed when an acid and an alcohol are joined without the presence of water. They are frequently among the safest essential oil constituent, suitable for use with all age groups due to their mild nature.

Terpenoids: Terpenes are made from isoprene, which is a five carbon branching chain. Terpene sizes are thus qualified in terms of five carbon. Sesquiterpenes have 15 carbons (three isoprenes), but monoterpenes have just 10 carbons (two isoprenes). Diterpenes (20 carbons; four isoprenes) are also present in essential oils, though less commonly. Typical terpenoids present in essential oils the following: [16].

Monoterpenes.
Sesquiterpenes.
Diterpenes.
Triterpenes.
Tetraterpenes

4. TYPES OF ESSENTIAL OILS

1. Lavender Oil:

Lavender oil extracted from the flowers of the lavender plant. It is known for its versatile therapeutic properties and has been used for centuries in traditional medicine. Some of the potential benefits of lavender oil includes:

- Antimicrobial activity: The essential oils extracted from *Lavandula stoechas L.* have been shown to benefit the majority of bacteria, filamentous fungus and yeasts. Some researches found that the least inhibitory dose ranges from 0.16 to 11.90 mg/ml. Furthermore, it has antipseudomonal properties.
- Anxiolytic activity: When used orally, lavender essential oil has been demonstrated to reduce tension and anxiety while improving mood. It is ineffective in cases of acute anxiety.
- Antifungal activity: The essential oils of lavender *luisieri* suppress *aspergillus* strains, dermatophytes and yeasts. There have been indications that *Lavender viridis* has fungicidal effects.
- An in vitro study on the antibacterial activity of *Lavandula coronopifolia* essential oil against antibiotic-resistant microbes indicated that the oil has bacterial characteristics [17].

2. Eucalyptus Oil:

Eucalyptus oil is derived from the leaves of the eucalyptus tree, has been traditionally used for its therapeutic properties. Some of the potential benefits of Eucalyptus oil includes:

- Anti-inflammatory Properties: It consists of a strong suppressor (1,8-cineole) of cytokinins used for curing inflammation in steroid disorders. It also shows effect on chronic bronchitis and mucin hypersecretion.
- Antimicrobial Properties: It is used to cure infections, cold, sore throat, flu and aching. It also shows toxic behaviour against microbes like bacteria and fungi.
- Antimalarial Properties: Eucalyptus oil leaves were also tested for malaria and has shown positive result for curing malaria.

- Antihistaminic Properties: In Indonesia, histamine is used as medicine for treating allergy.
- Insect Reppelent: Eucalyptus oil works well as a natural insect repellent when used topically or in diffusers because it has an odor that most insects find repulsive [18].

3. Peppermint Oil:

Peppermint oil is extracted from the leaves of peppermint plant. It is known for its refreshing aroma and numerous therapeutic properties. Some of the potential benefits of peppermint oil includes:

- Antimicrobial/ antifungal properties: Many studies have proved that peppermint oil is effective against fungal, bacterial and viral infections. They also have properties to work against obligate and facultative anaerobes. They show bacterial properties for aroud 20 common pathogens. In a mouse model, a fusion of menthol and menthone were helpful in retarding of *Schistosoma mansoni* eggs in liver and intestine of hepatic granulomas [19].
- Antiinflammatory Properties: Studies have proved that peppermint oil also has antiinflammatory properties. Use of peppermint oil halts gut inflammation in mice and acetic acid give rise to colitis in rats. Peppermint oil also reduce the manufacturing of inflammatory mediators of human monocytes [20].
- Antispasmodic Effects: Peppermint oil cures gastrointestinal smooth muscle by decreasing calcium intrusion in both large and small intestine (in jejunum part). This oil also decrease the activity of calcium channel in rats, rat brain synaptosomes and chick retinal neurons [21].
- Treatment of Irritable Bowel Syndrome(IBS): Many studies have been done on peppermint herb for treating IBS. It is used to relax the lower esophageal sphincter and promotes heart burn symptoms, enteric coated formulations have been the focus of most studies. A statsitical data was collected by experimenting 175 patients in 5 trials and it was found that peppermint oil shows positive effects on reducing symptoms of IBS [22].

4. Clove Oil:

Clove oil derived from the flower buds of clove tree. It has a long history of use in traditional medicine due to its various therapeutic properties. Some of the potential benefits of clove oil includes:

- Antibacterial Properties:The antibacterial action has been connected to the OH-groups at the ortho and meta locations in the primary chemical makeup. These functional groups can interact with microbial cells cytoplasmic membranes. Clove essential oils has shown broad-spectrum inhibitory action against microorganisms [23].
- Antiviral Properties: Clove essential oils has shown antiviral properties against herpes simplex virus types 1 and 2, influenza A virus and Ebola. According to recent study shows, eugenol derivatives may be a viable weapon against flaviviruses such as dengue, Zika and yellow fever [23].
- Anti- inflammatory effects: The main ingredient in clove oil is Euganol. It has anti-inflammatory properties, it might assists in lowering inflammation brought on by ailments like Rheumatoid arthritis, sore throats and inflammatory skin disorders.
- Fungicidal Properties: Natural compounds remain an interesting source of new antifungal metabolites. The phenolic components carvacrol and eugenol are well known for their fungicidal abilities, including the ability to battle fungi seen in cases of onychomycosis. The antifungal activity appears to be directed mostly at the cellular membrane. Eugenol has been found to have antifungal properties against *Trichophyton mentagrophyte* and *Candidaalbicans*. It has also been demonstarted that mixing clove oleoresin with a concentrated sugar solution has a powerful fungicidal effect by reducing the size of the fungal inoculum [24].

5.Rosemary Oil:

Rosemary oil is derived from the aromatic herb Rosmarinus officinalis has been traditionally used for its therapeutic properties. Some of the potential benefits of Rosemary Oil include:

- Anti- inflammatory Properties: Rosemary essential oil and extract have been shown

to significantly suppress leukocyte migration in vivo. This result in an anti-inflammatory response by reducing the number of leukocytes at the site of inflammation [25].

- Antidepressant Properties: In behavioural testing on mice, a hydro- alcoholic extract of rosemary leaves and stem (100mg/kg, PO) for 14 days demonstrated an antidepressant effect. The extract's effect was determined by its interactions with the noradrenergic (α 1- receptor), dopaminergic (D1 and D2) and serotonergic system [26].
- Antibacterial Properties: Several dietary studies shows that rosemary has a adverse effect on cooked beef, pork sausage and beef meatballs. Various studies shows that rosemary oil retards the growth of common food bacteria that cause food spoilage [27].
- Anticancer Activity: Rosemary has been shown to have significant antiproliferative effects on a variety of human cancer cells. It has been established that essential components of the plant extract, such as carnosic acid, carnosol and rosmarinic acid that induce death in cancer cells, most likely via generating nitric oxide production [25].
- Hair and Scalp Properties: Rosemary oil is commonly included in hair care products because it can aid in dandruff prevention, scalp health and hair reduction. It strengthens hair follicles, improves blood circulation to the scalp and regulates sebum production.

6. Lemon Oil:

Lemon oil is extracted from the peel of citrus lemon, and is also renowned for its refreshing citrus aroma and numerous therapeutic properties. Some of the potential benefits of lemon oil includes:

- Anticancer Properties: For cancer therapy, we need to suppress angiogenesis. There are many therapeutic plants which show antiangiogenic property and are used in controlling cancer. Citrus lemon consisting of Vitamin C, dietary fibres, carotenoids, flavonoids and some other bioactive compounds are useful for curing of cancer and deteriorating diseases. Lemon also exhibit anticancer properties in liquid extract of fruit that consists of

compounds, those protect the cell from damage [28].

- Antioxidant Properties: The main source of antioxidants are citrus juices and beverages including phenolic chemicals, flavonoids and ascorbic acids. Citrus peels includes phenols and glycosides. Phenolic acids are bioactive molecules that are responsible for a variety of biological activities, including antioxidant action [28].
- Skin Properties: Lemon essential oil have been well proved for acne with citric acid and Vitamin C. This essential oil has capability of destroying different types of acne producing bacteria. Drinking lemon juice with water early morning is best way to reduce acne. It has also been proved that mixing one portion of lemon juice with rose water and then keep it over the acne have found to be useful [29].
- Antibacterial Properties: Several citrus essential oils have been shown over time to have antibacterial properties against a variety of microorganisms. Their ability to battle germs has been proven through comparative study, making them a viable alternative to synthetic antimicrobials [30].

7. Teatree Oil:

Teatree Oil is derived from the leaves of *Melaleuca alternifolia* tree native to Australia, is widely known for its potent antimicrobial properties and diverse therapeutic benefits. Some of the potential benefits of teatree oil includes:

- Antioxidant Properties: Essential oils have several functional properties, one of them is antioxidant activity. Many researches shows the bioactive principles of essential oils produced from different types of herbs and species has gained acceptance in market. Essential oils are worldwide used in fumigants, aromatherapy and cosmetic [31].
- Antifungal Properties: Teatree oil is effective for treating Athlete's foot, nail fungus and yeast infections such as Candidiasis. It aids in the treatment of existing ailments and inhibits the growth of fungus.
- Antiviral Activity: Tea tree oil has a high virucidal effect on the herpes simplex virus types1 (HSV-1 and HSV-2). It acts on the virus before or during adsorption, rather than after it has entered the host cell [32].

- Antiprotozoal Activity: Some studies shows that tea tree oil inhibits *Leishmania major* and *Trypanosoma brucei* growth by 50%. Tea tree oil also helps in fighting against *Trichomonas vaginalis* [32].

8. Fennel Oil:

Fennel Oil is derived from the seeds of *Foeniculum vulgare* plant and possesses various therapeutic properties that have been utilized in traditional medicines for ecenturies. Some of the potential benefits of Fennel oil includes:

- Digestive Aid: Fennel oil has long been recognised for its digestive effects. It promotes digestion, relieves indigestion, bloating and flatulence, and aids in the formation of stomach juice. It can be especially beneficial in relieving the discomfort caused by certain digestive illness and Irritable Bowel Syndrome (IBS)
- Antibacterial Properties: Fennel’s antibacterial properties make it useful for treating a variety of infectious bacterial, viral, fungal and mycobacterial disorders. Fennel contains 5-hydroxyfuranocomarin, which is an important component of the plant’s antibacterial action [33].
- Antifungal Properties: Fennel extract is antifungal and is also effective against *Aspergillus species*, *Candida albicans* and *dermatophytes*, among other fungi. *Aspergillus niger* and *Fusarium oxysporium*, two fungi commonly found in food waste, and are very resistant to some plants [33].

5. METHODS OF EXTRACTION OF ESSENTIAL OILS

1.Steam distillation: It is the most common method used worldwide for extraction of essential oil of plant species. 93% of oil can be

extracted from plants by using this method and the other 7% can be extracted by using some other methods. Firstly, we take a plant and then heated or boiled under certain temperature. Due to the heat applied, the cell structure of plant material is broken due to which essential oils are liberated from plant material. The temperature must be high enough for breaking down cell structure of plant material, thus releasing aromatic compound. It equipment consists of a bed of plants which we keep above boiling water or steam source and precautions must be taken that the boiling water should be mixed with plant material. Due to steam, essential oil are present in form of steam or droplets which then are condensed through a cooling chamber and then the liquid essential oil is collected in oil separator from where essential oil is separated from the liquid [34].

2.Hydrodistillation: This process is commonly used to separate non water soluble natural compounds with a high boiling point, making it widely preferred method for extracting essential oils from plant materials such as wood or flower. Plant components are totally submerged in water and then cooked as a part of process because the surrounding water acts as a barrier to prevent burning, this process protects the extracted oils to some extent. Condensation of steam and essential oil vapor yields an aqueous fraction. This approach has the advantage of allowing the desired chemical to be distilled at temperature less than 100° C. The impact of several extract procedures, including solvent free microwave extraction and hydrodistillation [34].

3. Cold pressing: The oldest extraction technique, known as cold pressing , is mostly used to generate citrus essential oils. This technique refers to any physical procedure that fractures the essential oil glands in the peel and cuticles, allowing the oil to be released. This technique produces a watery emulsion, which is then centrifuged to extract the essential oil [35].

Table 1. Components of essential oil

Components	Description
Alcohol	Have antimicrobial properties eg: Linalool
Ketone	Known for their strong aroma eg: Camphor
Aldehyde	Often have antifungal properties eg: Citral
Phenol	Exhibits strong antimicrobial properties
Ester	Have fruity or floral aromas eg: Linalyl acetate
Terpenoid	Hydrocarbons responsible for aroma

Table 2. Types of essential oils

Essential oils	Therapeutic Properties
Lavender Oil	Sedative and pharmacological effects
Eucalyptus Oil	Nervous system activation increases immunity
Lemon Oil	Revitalize dull skin
Peppermint Oil	Anti-inflammatory, carminative
Teatree Oil	Burns, dandruff and herpes

Table 3. Methods of extraction of essential oils

Methods	Description
Steam distillation	Uses steam to extract oils from plants
Cold pressing	Presses oils from fruits or peels without heat
Solvent extraction	Uses solvents like hexane to dissolve oils from plant material
Enfleurage	Absorbs fragrant compound into odorless fats or oils
CO ₂ extraction	Utilizes CO ₂ under high pressure to extract oils

4. Solvent extraction: Heat labile essential oils (such as those found in flowers) can be extracted by a procedure known as Solvent extraction, which involves dissolving the plant material in a solvent bath. The liquid combination comprising the essential oil and other chemicals is filtered and then distilled. Methanol, alcohol, hexane and petroleum ether are often utilized solvents in this process [35].

5. Enfleurage: It is a centuries long oil extraction method. Its principle application has been to extract essential oils from flowers such as Jasmine. This approach involves applying a pure, odorless cold fat to plant material (such as flower). The scents are generated by the flowers and eventually dissolve in the fat. Old flowers are replaced with fresh ones and the process is repeated for an extended period of time until the fat becomes saturated. After that, the fat is collected and alcohol removed. According to current norms, it is expensive, labor-intensive and time-consuming techniques [35].

6. CO₂ extraction: It is a process that extracts essential oil from plants by compressing and heating carbon dioxide. This process is widely utilized in numerous industries, including the production of essential oils because it is effective, environmentally friendly and yields exceptionally pure and strong extracts.

6. LIMITATIONS OF ESSENTIAL OILS

- Essential oils are often volatile at normal temperatures and must be stored in cool, dry settings.

- Stability is another issue associated with the use of essential oils due to their heat-labile nature.
- High quality essential oils can be costly, particularly those sourced from rare or exotic plants.
- Some essential oils may cause skin irritations, particularly when applied undiluted or in high doses.
- Some people may have allergic reactions or sensitivities to a particular essential oils. It is critical to be aware of potential allergies and do test before use.
- High cost of equipment, installation and maintenance operations
- Organic solvents can cause chemical changes or toxic effects in final product.

7. CONCLUSION

In summary, it is concluded that EO have many therapeutic values which can be useful in treatment of various disorders using different types of EO because each EO having different physical and chemical properties. Evidence have been found that EO have been used for several years for their beneficial properties for curing many discomforts and now days have gained immense popularity and many researches and studies are still going on for further future prospective. EO needs to be used responsibly otherwise may lead to undesirable effects but can be harmful for human use. EO are still undergoing researches for their further complete and large scale use to be totally sure for their use and eliminating side effects.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Turek C, Stintzing FC. Stability of essential oils: a review. *Comprehensive reviews in food science and food safety*. 2013;12(1):40-53.
2. Mahian RA, Sani AM. Essential oils in food systems: A systemic review. *International journal of PharmTech research*. 2016;9(6):409-416.
3. Raut JS, Karuppaiyl SM. A status review on the medicinal properties of essential oils. *Industrial crops and products*. 2014;62:250-264.
4. Sadgrove N, Jones G. A contemporary introduction to essential oils: Chemistry, bioactivity and prospects for Australian agriculture. *Agriculture*. 2015;5(1):48-102.
5. Bakkali F, Averbeck S, Averbeck D, Idaomar M. Biological effects of essential oils—a review. *Food and chemical toxicology*. 2008;46(2):446-475.
6. Aljaafari MN, AlAli AO, Baqais L, Alqubaisy M, AlAli M, Molouki A, Lim SHE. An overview of the potential therapeutic applications of essential oils. *Molecules*. 2021;26(3):628.
7. D'agostino M, Tesse N, Frippiat JP, Machouart M, Debourgogne A. Essential oils and their natural active compounds presenting antifungal properties. *Molecules*. 2019;24(20):3713.
8. Šegvić Klarić M, Kosalec I, Mastelić J, Pieckova E, Pepeljnak S. Antifungal activity of thyme (*Thymus vulgaris* L.) essential oil and thymol against moulds from damp dwellings. *Letters in applied microbiology*. 2007;44(1):36-42.
9. Shuaib A, Rohit A, Piyush M. A review article on essential oils. *Journal of Medicinal Plants Studies*. 2016;4(3):237-240.
10. Tung YT, Yen PL, Lin CY, Chang ST. Anti-inflammatory activities of essential oils and their constituents from different provenances of indigenous cinnamon (*Cinnamomum osmophloeum*) leaves. *Pharmaceutical biology*. 2010;48(10):1130-1136.
11. Amorati R, Foti MC, Valgimigli L. Antioxidant activity of essential oils. *Journal of agricultural and food chemistry*. 2013;61(46):10835-10847.
12. Bhalla Y, Gupta VK, Jaitak V. Anticancer activity of essential oils: a review. *Journal of the Science of Food and Agriculture*. 2013;93(15):3643-3653.
13. Ramana KV, Singhal SS, Reddy AB. Therapeutic potential of natural pharmacological agents in the treatment of human diseases. *BioMed research international*; 2014.
14. Djalani A, Dicko A. The therapeutic benefits of essential oils. *Nutrition, well-being and health*. 2012;7:155-179.
15. Rios JL. Essential oils: What they are and how the terms are used and defined. In *Essential oils in food preservation, flavor and safety* Academic Press. 2016;3-10.
16. Sadgrove NJ, Padilla-González GF, Phumthum M. Fundamental chemistry of essential oils and volatile organic compounds, methods of analysis and authentication. *Plants*. 2022;11(6):789.
17. Dagli N, Dagli R, Mahmoud RS, Baroudi K. Essential oils, their therapeutic properties, and implication in dentistry: A review. *Journal of International Society of Preventive and Community Dentistry*. 2015;5(5):335-340.
18. Dhakad AK, Pandey VV, Beg S, Rawat JM, Singh A. Biological, medicinal and toxicological significance of Eucalyptus leaf essential oil: a review. *Journal of the Science of Food*; 2018.
19. Chumpitazi BP, Kearns GL, Shulman RJ. The physiological effects and safety of peppermint oil and its efficacy in irritable bowel syndrome and other functional disorders. *Alimentary pharmacology & therapeutics*. 2018;47(6):738-752.
20. Ghasemi-Pirbaluti M, Motaghi E, Bozorgi H. The effect of menthol on acute experimental colitis in rats. *Eur J Pharmacol*. 2017;805:101-107.
21. Loolaie M, Moasefi N, Rasouli H, Adibi H. Peppermint and its functionality: A review. *Arch Clin Microbiol*. 2017;8(4):54.
22. Kligler B, Chaudhary S. Peppermint oil. *American family physician*. 2007;75(7):1027-1030.
23. Haro-González JN, Castillo-Herrera GA, Martínez-Velázquez M, Espinosa-Andrews H. Clove essential oil (*Syzygium aromaticum* L. Myrtaceae): Extraction, chemical composition, food applications, and essential bioactivity for human health. *Molecules*. 2021;26(21):6387.

24. Chaieb K, Hajlaoui H, Zmantar T, Kahla-Nakbi AB, Rouabhia M, Mahdouani K, Bakhrouf A. The chemical composition and biological activity of clove essential oil, *Eugenia caryophyllata* (*Syzigium aromaticum* L. Myrtaceae): a short review. *Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives*. 2007;21(6):501-506.
25. Rafie H, Soheila H, Grant E. *Rosmarinus officinalis* (rosemary): a novel therapeutic agent for antioxidant, antimicrobial, anticancer, antidiabetic, antidepressant, neuroprotective, anti-inflammatory and anti-obesity treatment. *J Herbal Med*. 2017;3(2):8.
26. Rahbardar MG, Hosseinzadeh H. Therapeutic effects of rosemary (*Rosmarinus officinalis* L.) and its active constituents on nervous system disorders. *Iranian journal of basic medical sciences*. 2020;23(9): 1100.
27. Nieto G, Ros G, Castillo J. Antioxidant and antimicrobial properties of rosemary (*Rosmarinus officinalis*, L.): A review. *Medicines*. 2018;5(3):98.
28. Rafique S, Hassan SM, Mughal SS, Hassan SK, Shabbir N, Pervez S, Farman M. Biological attributes of lemon: a review. *J Addict Med Ther Sci*. 2020;6 (1):030-034.
29. Al-Qudah TS, Zahra U, Rehman R, Majeed MI, Sadique S, Nisar S, Tahtamouni RW. Lemon as a source of functional and medicinal ingredient: A review. *Int. J. Chem. Biochem. Sci*. 2018; 14:55-61.
30. Brah AS, Armah FA, Obuah C, Akwetey SA, Adokoh CK. Toxicity and therapeutic applications of citrus essential oils (CEOs): A review. *International Journal of Food Properties*. 2023;26(1): 301-326.
31. Puvača N, Čabarkapa I, Bursić V, Petrović A, Aćimović M. Antimicrobial, antioxidant and acaricidal properties of tea tree (*Melaleuca alternifolia*). *Journal of Agronomy*. 2018;15.
32. Pazyar N, Yaghoobi R, Bagherani N, Kazerouni A. A review of applications of tea tree oil in dermatology. *International journal of dermatology*. 2013;52(7):784-790.
33. Noreen S, Tufail T, Badar Ul Ain H, Awuchi CG. Pharmacological, nutraceutical, functional and therapeutic properties of fennel (*Foeniculum vulgare*). *International Journal of Food Properties*. 2023;26(1): 915-927.
34. Tongnuanchan P, Benjakul S. Essential oils: extraction, bioactivities, and their uses for food preservation. *Journal of food science*. 2014;79(7):R1231-R1249.
35. Stratakos AC, Koidis A. Methods for extracting essential oils. In *Essential oils in food preservation, flavor and safety*. 2016;31-38.

© Copyright (2024): Author(s). The licensee is the journal publisher. This is an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0>), which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Peer-review history:

The peer review history for this paper can be accessed here:
<https://www.sdiarticle5.com/review-history/116421>