



EUCALYPTUS OIL A HERBAL DRUG: DIFFERENT METHODS OF EXTRACTION

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ABSTRACT: Pure essential oils are concentrated oils generated from a variety of natural plants, flowers, plant roots, seeds, resins, plant exterior tissue, trees or shrubs, and fruit rinds. These oils are well-known among humans for their benefits to the body, skin, and spirit. These oils are also commercially employed due to their superior medicinal or odoriferous characteristics.

To research extraction strategies available to extract oils from plants and trees, to come across pros and disadvantages of a few extraction methods, selection and efficiency of a single method. The method used to extract essential oil from plants is critical, as some processes employ solvents that can harm the healing benefits of plants and trees. There are different extraction procedures, but the oil's quality and production never remain consistent. The Soxhlet apparatus technique was used in this investigation because of its mild extraction conditions and low operating cost. Steam is a critical component in the oil extraction process. Extraction of essential oils using diverse methods and innovative techniques reduces the risk of losing the vital component of plants and trees, reduces chemical risk, shortens extraction time, is environmentally friendly, and improves the quality and production of essential oils.

Keywords: Eucalyptus oil, Steam Distillation using Soxhlet apparatus

INTRODUCTION

For thousands of years, humans have used plants and trees to heal, and we utilise essential oils for the same purpose. These essential oils were utilised in the embalming process, medicinal preparations, and a few ceremonies. According to research, essential oils have been used for millennia for their "fragrant pharmacy" ingredients and biochemical effects.^{1,2} Essential oils are available in 300 distinct varieties and are utilised by a variety of expert practitioners. With the persistence of virus, bacterium, parasite, and fungal contamination in our environment, essential oils provide an excellent antiviral therapy for our bodies and homes. Our immune system requires protection from foreign particles, and essential oils assist us in doing this.^{3,4}

Essential oils are concentrated volatiles with strong aromatic components derived from plants. They are easily evaporated essences that provide plants with their natural fragrances. Every complex, extremely valuable liquid is extracted from a variety of plant species.^{5,6} Each plant species comes from a distinct corner of the planet, each with its own set of environmental circumstances, fauna, and flora. Essential oils are commonly referred to as the "life force" of plants. Unlike fatty oils, essential oils are volatile, highly concentrated substances taken from flowers, plant stems, roots, seeds, bark, resins, and fruit rinds. The amount of essential oil found in a plant fluctuates between 0.01% and 10% of the total, therefore tonnes of plant material are required for only a few hundred pounds of oil.⁷

Essential oils contain antibacterial capabilities and a high therapeutic content. As a result, they are frequently utilised in food, pharmaceuticals, and cosmetics. Synthetic substances cannot replace essential oils. Pure essential oil contains a diverse range of components that cheap imitations cannot match.⁸

The major raw material utilised in the extraction of essential oil⁹

Leaves	Flowers	Peel	Seed	Wood
Basil, Bay leaf, Cinnamon, Eucalyptus, Lemon Grass, Melaleuca, Oregano, Patchouli, Peppermint, Pine, Rose marry, Spear mint, Tea Tree, Winter Green and Thyme	Chamomile, Clary Sage, Clove, Geranium, Hyssop, Jasmine, Lavender, Manuka, Marjoram, Orange, Rose, Ylang-Ylang	Bergamot, Grape fruit, Lemon, Lime, Orange and Tangerine	Almond, Anise, Celery, Cumin, and Nutmeg Oil	Camphor, Cedar, Rosewood, Sandalwood

Essential oils have pharmacological characteristics

- **Antiseptic:** Essential oils consist of antiseptic properties and are stands strong against bacteria as well as an antibio-resistant strain.
- **Expectorants and diuretics:** They have the property to act as a slight local anaesthetic substance and provide relieve from sprains and other articular pains.
- **Spasmolytic and sedative:** The umbellifereae family's, Mentha and verbena species essential oil are reputed to decrease gastrointestinal spasms.
- **Others:** Chologogue, anti-inflammatory, cicatrizing.^{10,11}

Chemical Composition of Essential Oil

Natural and pure essential oils are made up of about 200 components, most of which are terpenes/phenyl propanic compounds that change only slightly chemically and structurally. They are usually characterised as,

- **Volatile Fraction:** Essential oil that accounts for 90-95% of the oil's weight and contains monoterpene and sesquiterpene hydrocarbons, as well as their oxygenated derivatives, aliphatic aldehydes, alcohol, and esters.¹²
- **Non-volatile essential oil** comprises 1-10% of the oil and contains hydrocarbons, fatty acids, sterols, carotenoids, waxes, and flavonoids.¹³
- **Hydrocarbon:** Essential oils are chemical compounds composed of hydrogen and carbon as building components. The primary hydrocarbon present in plants and trees is isoprene, with the structure as,¹⁴
- **Terpenes:** This frequently has names that end in "ene". Examples include limonene, pinene, piperene, and camphene. Terpenes are anti-inflammatory, antiseptic, antiviral, and antibacterial. Terpenes are further categorised as monoterpenes, sesquiterpenes, and diterpenes. Looking back at isoprene units under the hydrocarbon category, when two of them join head to tail, the outcome is a monoterpene, three joins result in a sesquiterpene, and four linked isoprene units produce diterpenes.¹⁵
- **Alcohols:** Properties: antiviral, antiseptic, bactericidal, and germicidal. Alcohols are hydroxyl chemicals. They occur naturally, either alone or in combination with terpenes or esters. When terpenes are bonded to oxygen and hydrogen atoms, the result is alcohol. Alcohol has a very low nonexistent toxicological reaction on the body and skin, hence it is deemed safe to use. Examples of essential oils include linalool in Ylang-Ylang and lavender, geraniol in geranium and rose, and neroli.¹⁶
- **Aldehydes:** have several properties including antifungal, anti-inflammatory, anti-septic, antiviral, bactericidal, disinfectant, and sedative. Medicinal essential oils containing aldehydes are beneficial in treating candida and other fungal infections. Examples include citral in lemons, lemongrass, and lemon balm. Citronellal can be found in citrus eucalyptus, lemongrass, and lemon balm.¹⁷

- **Acids:**

Properties: Anti-inflammatory.

Organic acids in their free state are usually found in very small amount in essential oil. Plants acids acts as a component or buffer system to level the acidity.

Example:

Cinnamic and benzoic acid in benzoin.

Citric and lactic.¹⁸

- **Ester:**

Ester are created by the reactions between alcohols and acids. Essential oil containing esters are used for their soothing and balancing effect. Due to the presence of alcohol, they are effective antimicrobial agents. Medicinally, esters are characterized as antifungal, sedative with a balanced action on the nervous system.

Example:

linlyl acetate in bergamot and lavender.

Geranyl formate in geranium.^{19,20}

- **Ketones:**

Properties: anti-catarhal, cell proliferant, expectorant, vulnery.

Ketones often are found in plants that are usually used for upper respiratory complaints. Ketones assist flow of mucus and bring ease in congestion. Essential oils containing ketones are helpful in promoting wound healing and building the scar tissue. Ketones are generally very toxic. The highly toxic ketone is Thujone that is found in mugwort, sage, tansy, thuja and wormwood oils, furthermore toxic ketones seen in essential oils are pulegone in pennyroyal, and pinocamphone in hyssops. Few non-toxic ketones are jasmone in jasmine oil, fenchone in fennel oil, carvone in spearmint and dill oil and menthone in peppermint oil.

Example:

fenchone in funnel, Carvone in spearmint and dill.

Menthone in peppermint.^{20,21}

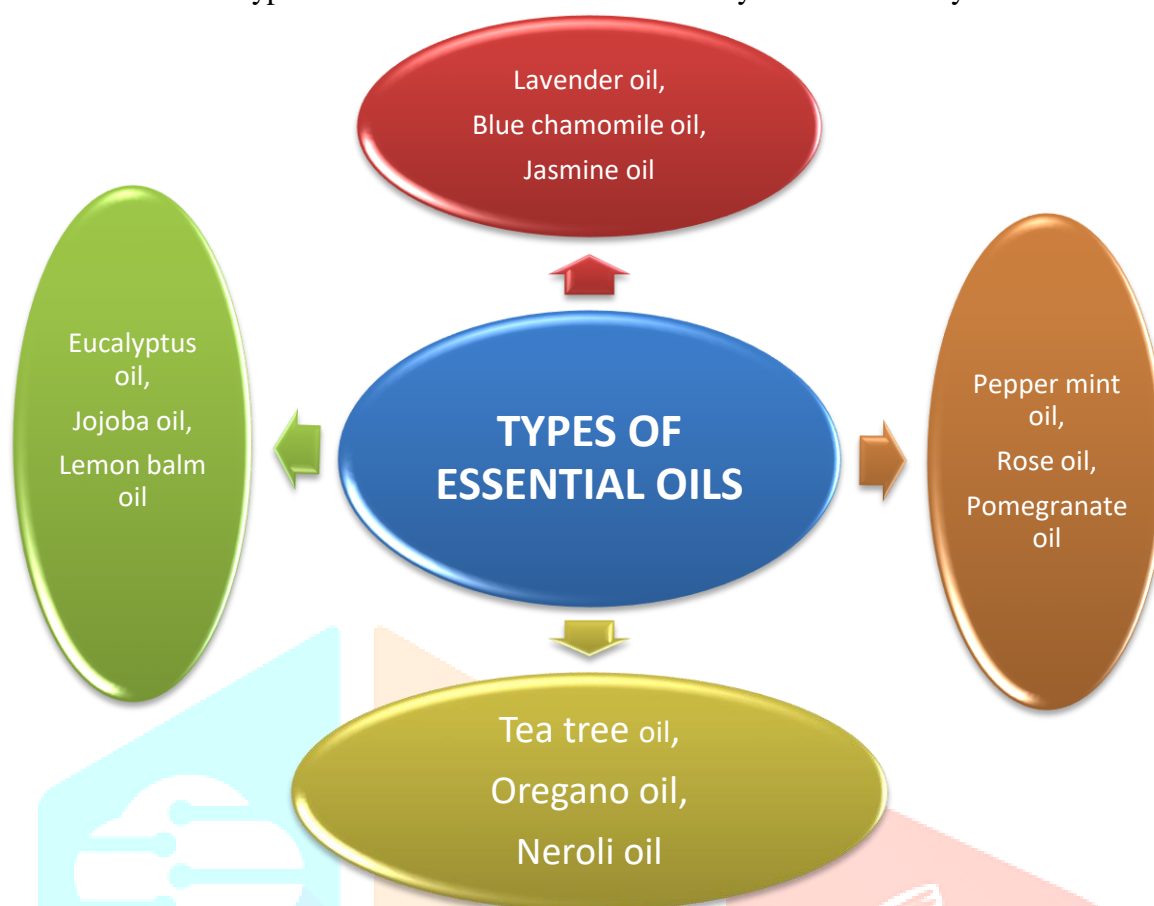
- **LACTONES**

Properties: Anti-inflammatory, Antiphlogistic, Expectorant, Febrifuge.

Lactones are effective for their anti-inflammatory action, by the role of reduction of prostaglandin synthesis and expectorant actions. Lactones have stronger expectorant action then ketones.²²

TYPES OF ESSENTIAL OILS

The most common type of essential oil found commercially and used widely are:



METHODS OF EXTRACTING ESSENTIAL OIL

Previously, extraction was carried out using alcohol and a fermentation process. Recent methods of extracting essential oils are entering the mainstream of aromatherapy, bringing new options in oils that were not before available. Aromatherapy enthusiasts might benefit from education in selecting essential oils, including new labels such as CO₂ and Supercritical CO₂, as well as conventional methods like as steam and hydro distillation, absolutes, and cold pressing.²³ The method used to extract essential oils from plants or other raw materials is critical since certain procedures involve the use of solvents, which might harm medicinal characteristics. Steam distillation is not suitable for some plants and flowers due to their delicate nature or the inability to fully release their fragrances and therapeutic essences.²⁴ Jasmine oil and rose oil, for example, are often found in 'absolute' form. The effectiveness of newer methods depends on the distiller's experience and the intended application of the final product.²⁵

Maceration	Cold pressing	Solvent extraction
<ul style="list-style-type: none"> This method produces more of 'infused oil' instead of 'essential oil'. In this method the plant matter is soaked in vegetable oil, heated and then strained, so that at this point it can be used for massage.^{26,27} 	<ul style="list-style-type: none"> This method is used to extract oils from citrus rind such as lemon, orange, grapefruit and bergamot. In this method the rinds are separated from the fruit and the chopped and pressed at 120 ° F (Degree Fahrenheit) to extract the oil. The results are watery mixture of essential which will be separated later.^{28,29} 	<ul style="list-style-type: none"> Hydrocarbon solvent is added to the plant material to help dissolve the essential oil. The solution is filtered and concentrated by distillation, later a combination of wax and essential oil (known as concrete) remains. Pure alcohol is used to extract the oil from concentrate, and when the alcohol is evaporated, the oil is left behind. However this is not considered to be the best method for extraction because the solvent can leave a small amount of residue behind which can cause allergies and can effect immune system.³⁰

Enfleurance

- An intensive and ancient way of extracting oil from flowers. Enfleurance process involves layering some amount of fat over the flower petals. After the fat absorbs the essential oil from the flower, alcohol is used to separate the essential oil and fat. The oil is later evaporated and essential oil is obtained.^{31,32}

Hydro distillation

- Few processes become obsolete to carry out extraction n process like Hydro distillation which is used in primitive countries. There is a risk of drying off the still, or be overheated, burning the aromatics and resulting in a burnt aroma/smell of essential oil. Hydro distillation seems to be the best method for powders (i.e., spice powders, ground wood etc.) and very tough materials like roots, woods, and nuts.^{32,33}

Turbo distillation extraction

- Turbo distillation is useful for hard to extract or coarse plant material, such as bark, roots, and seeds. In the turbo extraction process, the plants soak in water and steam is circulated through this plant and water mixture. During the entire process, the same water is circulated continuously through the plant material. This method allows faster extraction of essential oil from difficult to extract plant materials.^{34,35}

Steam Distillation

- In this process, the essence is extracted from the plant using a technique called distillation. The flowers or plants are placed on a screen, steam is passes through the area and becomes 'charged' with the essence. The steam is then passed through the condenser (a area to cool the steam). This mixture of water and essential oil is separated and bottled. As plants and flowers contains small amount of this precious oil, several hundred pounds of raw material is required to produce a single ounce.³⁶

CO₂ & Super critical CO₂ Extraction

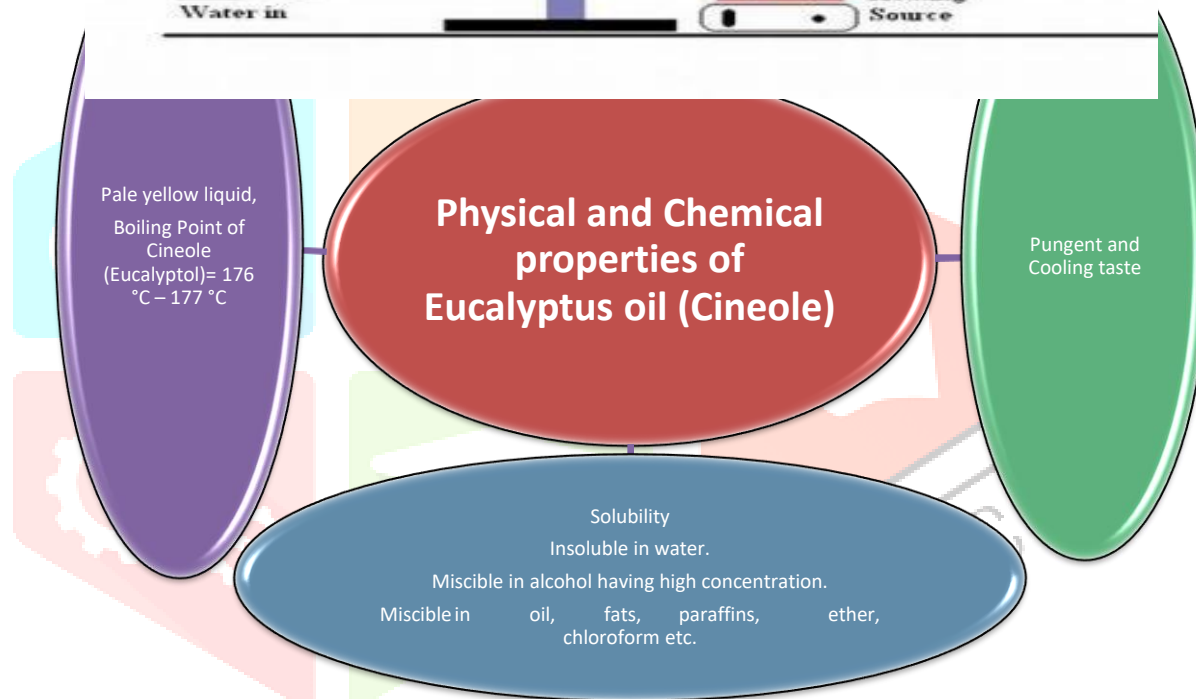
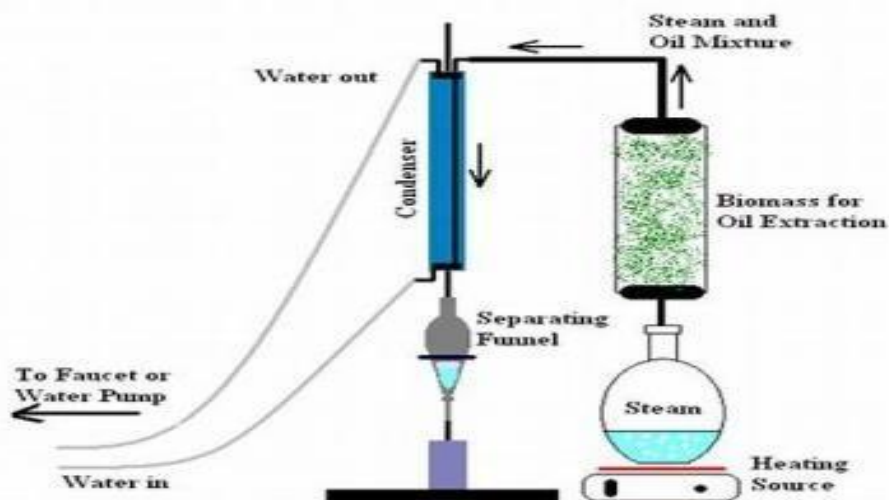
- This is the most modern technology of extracting essential oil. Carbon dioxide and Supercritical Carbon dioxide extraction involve the use of CO₂ as the solvent which carried the essential oil away from the raw plant material. Lower pressure CO₂ extraction involves the cooling of CO₂ between 35 °F and 55 °F, and then pumping it through the plant material at about 1000 psi. The CO₂ in this condition is condensed to a liquid.
- Supercritical extraction involves the heating of CO₂ to 87 °F and pumped it through the plant material at around 8,000 psi. Under both the conditions carbon dioxide is likened to a 'dense fog' or vapor. With the release of pressure in any of the process, the carbon dioxide escapes in its gaseous form, leaving the essential oil behind. After extraction, the properties of a good quality essential oil should be as close as possible to the essence of original plant. The key to excellent essential oil is through low pressure and low temperature processing. The high temperatures, rapid processing and the use of solvents alter the molecule structure, destroys the therapeutic value and alter the fragrance.^{37,38,39}

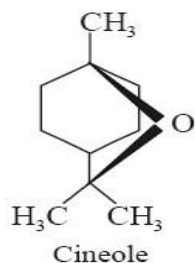
EXTRACTION OF ESSENTIAL OIL USING STEAM DISTILLATION PROCESS

Essential oil can be extracted using a variety of processes, some of which are no longer regularly used. Nowadays, distillers play an essential role in restoring plant properties, but the final medicinal outcomes are rarely obtained unless an extraction technique is used. During extraction, the attributes of the oil change to increase its value; for example, the characteristics of pure blue German chamomile (chamazulene) are generated during the steam distillation process.⁴⁰ Looking at the current situation, essential oil extraction via steam distillation is widely practiced and employed. Steam distillation is a form of distillation or separation technique used for temperature-sensitive compounds such as oils, resins, and hydrocarbons, which are insoluble in water and may disintegrate near their boiling point.⁴¹

The essential principle of steam distillation is that it allows a compound or mixture of compounds to be distilled at temperatures significantly lower than the boiling point(s) of the individual constituent(s). Essential oils contain compounds with boiling points of 200 degrees Celsius or above.⁴² However, in the presence of steam or boiling water, these compounds volatilize at temperatures close to 100 °C and atmospheric pressure. Fresh eucalyptus leaves are cut into pieces less than 2x2 cm within half a day of collecting and placed into the still chamber, where steam is passed from the bottom. The essential oil (eucalyptus oil) is extracted along with the steam from the top of the still and delivered to the condenser. The condenser continuously supplies a cooling water stream to chill the mixture (steam and oil). The mixture is then cooled and collected at the bottom of the condenser. The mixture is then separated with a separating funnel or the water is evaporated, leaving only pure eucalyptus essential oil. The extraction

process should be extended for a set amount of time in order to flush the oil's components from the plant, as some are easy and quick to remove while others take time.⁴²





Chemical Name: 1, 3, 3-Trimethyl 1-2-Oxabicyclo [2. 2. 2.]-Octane or 1, 8-epoxy- p-methane.

Molecular Formula of Cineole: C₁₀H₁₈O

Molecular Weight: 154.25

Precaution of Storing: Eucalyptus oil and the products containing eucalyptus oil should be kept at a temperature less than 25 °C in well filled containers. It should be kept away from sunlight. Liquid products containing eucalyptus oil are good to be stored in child resistant containers.^{.44,45}

PRECAUTIONS

- Temperature of the extraction chamber should not be high, in order to prevent the destruction of the oil components. The same is to be true for the chamber's pressure. High temperature and pressure results in a harsh aroma, more chemical than floral and lessen the oils therapeutic effects.
- The period of extraction must be continued to a certain period of time in order to flush all the oils components from the plant, flowers as some are released more quickly than other.^{.45}

ADVANTAGES OF STEAM DISTILLATION PROCESS

- The advantage of steam distillation is that it is a comparatively cheap process it requires less capital to operate at basic level, and the properties of oil obtained by this process is highly acceptable and known. Newer methodology, such as sub critical water extraction, may eventually replace steam distillation, but so far even contenders such as CO₂ extraction, although establishing a firm market niche-have not really threatened to take over as the major preparative technique.^{.46}

APPLICATION OF ESSENTIAL OIL

- Eucalyptus oil uses have long been known to include anything regarding the respiratory system, deodorize.
- It assists people with clear breathing. Mix with carrier oil and rub on chest to assist with clear breathing.
- Eucalyptus oil supports overall respiratory health.
- Soothes tired and sore muscles.
- Eucalyptus oil contains purifying and cleansing properties.
- If the eucalyptus oil is combined with lemon and peppermint it can be used as effective cleaning spray.
- For jet lag, eucalyptus oil uses include waking up the body with its slightly sweet, fruity, and camphorous aroma. Use topically or aromatically.
- Make a cooling spray, place several drops of eucalyptus oil in a spray bottle, along with peppermint oil if you'd like some extra oomph, and spritz over the body for soothing.
- Eucalyptus oil is also used in pharmaceutical company for producing few cough syrups and lozenges.
- Eucalyptus oil may help to address pain and inflammation, and soothe mucous membrane especially if they have been affected with conditions like allergies and asthma.^{.47}

CONCLUSION

Steam distillation is a type of distillation (a separation technique) used for temperature-sensitive compounds such as oils, resins, and hydrocarbons that are insoluble in water and may disintegrate at their respective boiling points. The temperature of the steam must be sufficient to vaporise the oil present, but not so high that it damages the plants, flowers, or burns the essential oils. The eucalyptus plant contains a large amount of essential oil. Eucalyptus oil has long been utilised in perfumery and as a chemical raw ingredient. Eucalyptus has a higher oil content and is easy to extract. Eucalyptus oil contains more than 65% of 1, 8-cineole. As a result, adding a very little amount of eucalyptus oil as a cosolvent to an aqueous ethanol and petrol mixture increased the system's water tolerance. As a result, the work can be expanded to investigate the ternary phase equilibrium of water, ethanol, and 1, 8-cineole or eucalyptus oil.

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