ESSENTIAL OILS: AT A GLANCE

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ABSTRACT

Essential oils have been important substances since early times. A large number of herb materials contain Essential Oils with extensive bioactivities. Essential oils are highly concentrated substances extracted from flowers, leaves, stems, roots, seeds, barks, resins, or fruit rinds. These oils are often used for their flavor and their therapeutic or odoriferous properties, in a wide selection of products such as foods, medicines, and cosmetics. Acknowledging the importance of plants and its medicinal value, recovery of Essential Oil (the value added product) from the raw botanical starting material, its extraction methods and applications were treated in this study since the quality of the oil is greatly influenced during these steps. There are a variety of methods for obtaining volatile oils from plants. Extraction of essential oils is one of the most time- and effort-consuming processes. The way in which oils are extracted from plants is important because some processes use solvents that can destroy the therapeutic properties. There are wide number of ways to extract the Essential oil but the quality never remains the same. Here we discussed most of the promising techniques for raw material collection, size reduction, drying, extraction, concentration and purification which is the cheapest way for production of essential oils from the different parts of the plants.

KEYWORDS: Essential Oils, Extraction, Aromatherapy, Terpenoids.

INTRODUCTION

Humankind has used plants for healing for thousands of years and it’s from this tradition that use of aromatic plant compounds as medicine begun. Oils were used in the embalming process, in medicine and in purification rituals.
Research has confirmed centuries of practical use of essential oils, and we now know that the 'fragrant pharmacy' contains compounds with an extremely broad range of biochemical effects. There are about three hundred essential oils in general use today by professional practitioners. With the continual bombardment of viral, bacterial, parasitic and fungal contamination in our world, essential oils are a great benefit to help protect our bodies and homes from this onslaught of pathogens.

Because of the enormous amount of raw product used to make wholly natural essential oils, lots of products on the market have been polluted with lower quality, commercial – grade oils or contain other chemical substances to reduce the cost or increase the profit margin – a fact not usually revealed on the label. The application of essential oil has spread evenly throughout the whole world as well as its analysis, which had led to the tremendous increase in the yield and quality of essential oil production. Also in aromatherapy and medicaments, disinfectants and insect repellent, all of which are directly or indirectly applied to human life to suit peoples desires and demand. The general usefulness of essential oil cannot be over emphasized as it is more beneficial than synthetic drugs. This is why it is important to study the chemical composition of the volatile fraction once the essential oil is extracted.

Essential oils are highly concentrated substances extracted from flowers, leaves, stems, roots, seeds, barks, resins, or fruit rinds. These oils are often used for their flavor and their therapeutic or odoriferous properties, in a wide selection of products such as foods, medicines, and cosmetics. Extraction of essential oils is one of the most time- and effort-consuming processes. The way in which oils are extracted from plants is important because some processes use solvents that can destroy the therapeutic properties. There are wide number of ways to extract the Essential oil but the quality never remains the same. After extraction, the properties of a good quality essential oil should be as close as possible to the "essence" of the original plant. The key to a 'good' essential oil is through low pressure and low temperature processing. High temperatures, rapid processing and the use of solvents alter the molecular structure, will destroy the therapeutic value and alter the fragrance.

**ESSENTIAL OILS**

An essential oil is a concentrated hydrophobic liquid containing volatile aroma compounds from plants. Essential oils are also known as volatile oils, ethereal oils or aetherolea, or simply as the "oil of" the plant from which they were extracted, such as oil of
clove. An oil is "essential" in the sense that it carries a distinctive scent, or essence, of the plant. Essential oils do not form a distinctive category for any medical, pharmacological, or culinary purpose.

Volatile oils are products which are generally complex in composition, consisting of the volatile principles contained in plants, and are more or less modified during the preparation process.

Essential oil are present in plants in specialized cells/glands (subcuticular spaces of glandular cells, organelles.), these glands may be at anywhere on plant body depending upon the morphology and physiology of the plant. Some time it may be on leaves, flowers, stems, roots, bark or wood. When these glands rupture by pressing, rubbing or heat the smell /aroma come out. Essential oil are composed of aromatic compounds, volatile and hydrophobic in nature.

**Types of volatile oils**

i. Concretes  
ii. Pomades  
iii. Resinoids  
iv. Absolutes

**CONCRETES**

Concretes are prepared from raw materials of vegetable origin (bark, flowers, leafs, roots etc.) and are extracted by hydrocarbon type solvents, rather than distillation or expression (e.g. jasmine). It produces a more true-to-nature fragrance. Main advantage of concretes is they are more stable and concentrated than pure essential oils.

**POMADES**

True pomades are (volatile) products of a process known as enfleurage. Enfleurage is used for obtaining aromatic materials from flowers containing volatile oils to produce perfume long after they were cut.

**RESINOIDS**

These are prepared from natural resinous material (dried) by extraction with a non-aqueous solvent, e.g. Petroleum ether or hexane.
E.g. Balsams – Peru balsam or benzoin; resins (amber or mastic); Oleoresin (copaiba balsam and turpentine); Oleo gum resins (frankincense and myrrh)

**ABSOLUTES**
It is Obtained from a concrete, pomade, or a resinoid by alcoholic extraction. The extraction process may be repeated. The ethanol solution is cooled & filtered to eliminate waxes. The ethanol is then removed by distillation. They are usually highly concentrated viscous liquids.

**PHYSICAL PROPERTIES OF ESSENTIAL OILS**
1. Essential oils are volatile and become liquid at room temperature.
2. When distilled they are at first colourless or slightly yellowish.
3. They are less dense than water (sassafras essence and clove essence being exceptions). They are nearly always rotational and have a high refractory index.
4. They are soluble in alcohol and in the usual organic solvents, such as ether or chloroform, and also in high grade alcohol.
5. They are lipo-soluble and not very soluble in water, but can be dragged using steam.

**CHEMICAL PROPERTIES OF ESSENTIAL OILS (TERPENOIDS)**
Essential oil components are divided into terpenoids and non-terpenoids.

1. **Non-terpenoids**
   This group contains short-chain aliphatic substances, aromatic substances, nitrogenated substances, and substances with sulphur. They are less important than terpenoids in terms of use and applications.

2. **Terpenoids**
   These are more important commercially and in terms of their properties.

Terpenes are derived from isoprene units (C5) bonded in a chain. Terpenes are a type of chemical substance found in essential oils, resins and other aromatic plant substances, (pines,
citrus fruits etc.). They are usually found in monoterpenes oils and diterpenes. They may be aliphatic, cyclic, or aromatic.

**According to their functional group they can be**

1. Alcohols (menthol, bisabolol) and phenols (timol, carvacrol)
2. Aldehydes (geranial, citral) and cetones (camphor, thuyone)
3. Esters (bornile acetate, linalile acetate, methyl salicylate, anti-inflammatory compound similar to aspirin)
4. Ethers (1.8 - cineol) and peroxides (ascaridol)
5. Hydrocarbons (limonene, pinene α and β)

**PHARMACOLOGICAL PROPERTIES**

**Antioxidant**

Antioxidants are often added to foods to prevent the radical chain reactions of oxidation, and they act by inhibiting the initiation and propagation step leading to the termination of the reaction and delay the oxidation process. However, the commonly used synthetic antioxidants such as BHA and BHT are restricted by legislative rules because of doubts over their toxic and carcinogenic effects. Therefore, there has been a considerable interest in the food industry to find natural antioxidants to replace synthetic compounds in food applications, and a growing trend in consumer preferences for natural antioxidants, all of which has given more importance to explore natural sources of antioxidants.

**Anti-ulcer**

The utilization of Cinnamon extract to inhibit both growth and urease activity of H. pylori in-vitro has in our hands proved to be more effective than thyme extract. The efficiency of Cinnamon extracts in liquid medium and its resistance to low pH levels may enhance its effect in an environment such as the human stomach.

**Anti-microbial**

The volatile gas phase of combinations of Cinnamon oil and clove oil showed good potential to inhibit growth of spoilage fungi, yeast and bacteria normally found on IMF (Intermediate Moisture Foods) when combined with a modified atmosphere comprising a high concentration of carbon dioxide (40%) and low concentration of Oxygen (<0.05%).
Anti-diabetic
Cinnamaldehyde is use as a natural oral agent, with both hypoglycemic and hypolipidemic effects. Cinnamon extract and polyphenols with procyanidin type-A polymers exhibit the potential to increase the amount of TTP (Thrombotic Thrombocytopenic Purpura), IR (Insulin Resistance), and GLUT4 (Glucose Transporter-4) in 3T3-L1 Adipocytes. The mechanism of Cinnamon’s insulin-like activity may be in part due to increase in the amounts of TTP, IRβ and GLUT4 and that Cinnamon polyphenols may have additional roles as anti-inflammatory and/or anti-angiogenesis agents.

Anti-inflammatory
Essential oil of C. osmophloeum twigs has excellent anti-inflammatory activities and cytotoxicity against HepG2 (Human Hepatocellular Liver Carcinoma Cell Line) cells. Furthermore, it also indicated that the constituents of C. osmophloeum twig exhibited excellent anti-inflammatory activities in suppressing nitric oxide production by LPS (Lipopolysaccharide)-stimulated macrophages.

Antiseptics
The antiseptic properties of Essential Oil make them active against wide range of bacteria as on antibiotic resistant strains. In addition to this they are also used against fungi and yeasts. The most common sources of essential oils used as antiseptics are Cinnamon, Thyme, Clover, Eucalyptus, Culinsavory, and Lavender. Citral, geraniol, linalool and thymol are much more potent than phenol.

Spasmolytic and sedative
Essential oils from the Umbellifereae family, Mentha species and verbena are reputed to decrease or eliminate gastrointestinal spasms. These essential oils increase secretion of gastric juices. In other cases, they are known to be effective against insomnia.

AROMATHERAPY
“The treatment of anxiety or minor medical conditions by rubbing pleasant smelling natural oils into the skin or breathing in their smell.” It is the use of aromatic essential oils to benefit the body – in emotional and physical health and beauty. Science has discovered that our sense of smell plays a significant role in our overall health. Many common essential oils have medicinal properties that have been applied in medicine since ancient times and are still widely used today. For example, many essential oils have antiseptic properties, though some
are stronger than the other. In addition, many have an uplifting effect on the mind, though different essential oils have different properties.

**The beginning of modern Aromatherapy**

The first modern-day distillation of essential oil was performed by the Persian philosopher Avicenna (980-1037 A.D.) who extracted the essence of rose petals through the 'enfleurage' process. His discovery and subsequent use of a wonderful perfume substance eventually lead him to write a book on the healing properties of essential oil of Rose. Early in the 20th century a French Chemist, Rene-Maurice Gattefosse, began studying what he called “Aromatherapy”. After several burning on his arm in a laboratory accident, he thrust the arm into the nearest liquid, which happened to be tub of Lavender Oil. Surprised by the quick healing that followed, Dr. Gattefosse spent the remainder of his life researching the value of Essential Oils. His success made aromatherapy popular, and it became well-known in Europe.

**Essential Oil in Aromatherapy**

An Essential Oil is inhaled or directly applied on skin. In true, the brain responds to the particular scent affecting our emotions and chemical balance. Essential Oils also absorbed by the skin and carried throughout the body via the circulatory system to reach all internal organs. By carefully choosing one or more oils, you can experience several benefits of essential oils.

**Other Uses of essential oils**

**Food industry**

They are used to season or condiment meats, dried and cured meats, soups, ice-cream, cheese etc. the most commonly used essential oils are cilantrum, orange, and mint. They are also used in the elaboration of alcoholic and soft drinks, especially the latter. We should make specific mention here of the essences of orange, lemon, mint and fennel, which are also used in the making of sweets and chocolates.

**Pharmaceutical industry**

They are used in toothpastes (mint and fennel essences), analgesics, and decongestant inhalers (eucalyptus). Eucalyptol is also widely used in dentistry. They are used in many medicines to neutralize unpleasant tastes (essence of orange or mint, for example).
Cosmetic industry
This industry uses essential oils to make cosmetics, soaps, scents and perfumes. We should mention geranium, lavender, roses and patchouli essences as common examples.

Veterinary product industry
This industry uses the essential oil of the *Chenopodium ambrosoides*, which is highly prized for its ascaridol (worm-killer) content. Limonene and menthol are also used to make insecticides.

Industrial deodorants.
At present, the use of essences to disguise the unpleasant smell of industrial products like rubber, plastic and paint is being developed. Paint manufacturers use limonene as a biodegradable solvent. Toys are also scented. In the textile industry they are used to mask unpleasant smells before and after dyeing. In paper manufacture, products such as notebooks, toilet paper and face wipes are scented.

Biocides and insecticides
1. There are certain substances such as thyme, cloves, salvia, mint, oregano, pine etc. with bactericidal properties.
   Others are insecticides:
3. Against aphids: garlic, other Allium, coriander, aniseed, basil.
4. Against fleas: lavender, mints, lemongrass etc.
5. Against flies: rue, citronella, mint etc.
6. Against lice: *Mentha spicata*, basil, rue etc.
7. Against moths: mints, Hisopo, rosemary, dill etc.
8. Against coleoptera: *Tanacetum*, cumin, wormwood and thyme etc.
9. Against cockroaches: mint, wormwood, eucalyptus, laurel etc.
10. Against nematods: *Tagetes*, salvia, calendula, Asparagus etc.

EXTRACTION OF ESSENTIAL OILS FROM MEDICINAL PLANTS
In order to extract medicinal ingredients from plant material, the following sequential steps are involved.
1. Size reduction
2. Drying
3. Extraction
4. Concentration
5. Purification

1. Size Reduction
The dried plant material is disintegrated by feeding it into a hammer mill or a disc pulverizer which has built-in sieves. The particle size is controlled by varying the speed of the rotor, clearance between the hammers and the lining of the grinder and also by varying the opening of the discharge of the mill. Usually, the plant material is reduced to a size between 30 and 40 mesh, but this can be changed if the need arises. The objective for powdering the plant material is to rupture its organ, tissue and cell structures so that its medicinal ingredients are exposed to the extraction solvent. Furthermore, size reduction maximizes the surface area, which in turn enhances the mass transfer of active principle from plant material to the solvent. The 30-40 mesh size is optimal, while smaller particles may become slimy during extraction and create difficulty during filtration.

The parts of plants yielding essential oils
Flowers: Jasmine, Rose, Violet, Hyacinth etc.
Leaves: Lavender, Rosemary, Eucalyptus, peppermint etc.
Fruits: Lemon, Oranges, Bergamot, Bursera etc.
Barks: Cinnamon, Casia, Camella etc.
Stem: Citronella, Geranium, Patchouli etc.
Wood: Sandal, Cedar, Bursera etc.
Rhizome: Ginger, Calamus etc.
Roots: Vetiver etc.

2. Drying
Drying is the most commonly important processing technique for MAPs, since many more specialized processing technologies require dried MAP material. Options include shade, oven or freeze drying. Shade drying is the lowest cost option. Plant material should be chopped into small pieces and placed onto permeable material that allows air flow from all directions, and dried away from air pollution and dust. Oven drying is faster and more effective than shade-drying and as such involves less risk of fungal contamination and “aflatoxin” infection.
(toxic compounds produced by certain moulds). However large drying ovens are an expensive investment for a small-scale producer/processor. Freeze drying is the most expensive and comprehensive drying technology, reducing plant material to very low moisture contents, and providing stable material with limited risk of infection and concentrated medicinal properties, for long periods of time.

3. Extraction

Essential oils are valuable plant products, generally of complex composition comprising the volatile principles contained in the plant and the more or less modified during the preparation process. The oil droplets being stored in the oil glands or sacs can be removed by either accelerated diffusion through the cell wall or crush the cell wall. The adopted techniques depend on the part of the plants where the oil is to be extracted, the stability of the oil to heat and susceptibility of the oil constituents to chemical reactions. Common techniques used for the extraction of essential oils are as follow.

**Traditional Methods of Extraction of Essential Oils**

**Steam distillation**

This is the most common method of extracting oils and is the oldest form of essential oils extraction. The raw materials are collected and placed in large vats with water and then heated.

Next steam is added and passed through the plant that contains the plants aromatic molecules. Once the plant releases these aromatic molecules, the fragrant molecules travel within a closed system towards the cooling device, and the vapour produced passes into a condenser and is then cooled with the essential oil separating from the floral water.

**Advantages of using Steam Distillation**

The advantage of Steam Distillation is that it is a relatively cheap process to operate at a basic level, and the properties of oils produced by this method are not altered. As steam reduces the boiling point of a particular component of the oil, it never decomposes in this method. This method apart from being economical, is relatively faster than other methods.
Expression

This method is used for citrus oils such as lemon, lime, mandarin, orange and bergamot and the essential oil is expressed by squeezing it from the rind or peel of the fruit. This method is referred to as the cold press method and the best source of raw material would be organically grown fruit, which has not been sprayed with pesticides.

Solvent extraction

This method involves the extraction of the oils from the oil bearing materials with the use of solvent. Delicate flower material such as jasmine, hyacinth or tuberose have their essential oil
Extracted by this method as their delicacy would not withstand the heat of steam distillation. Solvent used depends on the part of the plant to be used for extraction. For instance, leaves, roots, fruits are extracted with benzene with or without mixture of acetone or petroleum ether, in the cold or at boiling point while flowers are extracted with ethers.

The flowers are covered by a solvent such as ether, petroleum, hexane or acetone and then heated to extract the essential oil. This is then filtered which leaves a paste called concrete made up of wax and fragrance which is then mixed with alcohol and distilled at low temperatures, the alcohol absorbs the fragrance and when the alcohol is evaporated off an aromatic absolute remains. This method is used on delicate flowers such as rose and jasmine and as many tones of the flowers are needed and it is a relatively time consuming process this method makes the oils more expensive than others. Some consider this not the best method of extraction as minute traces of the solvent can be left behind.

**Super Critical CO2 Extraction**

Supercritical CO2 extraction (SCO2) involves carbon dioxide heated to 87 degrees F and pumped through the plant material at around 8,000 psi, under these conditions; the carbon dioxide is likened to a ‘dense fog’ or vapor. With release of the pressure in either process, the carbon dioxide escapes in its gaseous form, leaving the Essential Oil behind. The usual method of extraction is through steam distillation. After extraction, the properties of a good quality essential oil should be as close as possible to the "essence" of the original plant. The key to a 'good' essential oil is through low pressure and low temperature processing. High temperatures, rapid processing and the use of solvents alter the molecular structure, will destroy the therapeutic value and alter the fragrance.

![Fig no: 03 Super Critical CO2 Extraction.](image)
**Enfleurage**
This is one of the earliest methods used to extract essential oils from flowers. A pure, odorless, cold fat is placed in a thin layer on a glass frame and the flower petals are placed in layers on top. Every day or every few hours after the vegetable or fat has absorbed as much essential oil as possible; the depleted petals are removed and replaced with fresh ones. This procedure continues until the fat or oil becomes saturated with the essential oil. Eventually the fragrance-saturated fat, known as pomade, may be treated with alcohol to extract the oil from the fat. This is called Enfleurage mixture, is washed with alcohol. Addition of alcohol helps to separate the essential oil from the fatty substances and finally the alcohol is evaporated off leaving pure essential oil.

This process is applicable to flowers such as jasmine or tuberose, that have low content of essential oil and so delicate that heating would destroy the blossoms before releasing the essential oils, hence enfleurage method is the best method when the source from which the oil is to be extracted is flower or petals. This is an expensive method of extraction, which is not in common use.

**Fig no: 04 Hydrodiffusion.**

**Hydrodiffusion**
Hydrodiffusion is a method of extracting essential oils in which steam at atmospheric pressure (low-pressure steam <0-1 bar) is passed through the plant material from the top of the extraction chamber, thus resulting in the oils that retain the original aroma of the plants.
Hydrodistillation
The technique involves distillation of water that is in direct contact with fresh or sometimes dried macerated plant materials. Plant material is grinded and weighed, then transferred into the Clevenger set up. Plant material is heated in two to three times its weight of water with direct steam. The distillation vessel is heated over heating mantle and the water vapour and oil are removed through a water cooled condenser.

Cold pressing
Another method of extracting essential oil that has not found high application in scientific research is cold pressing. It is used to obtain citrus fruits oils such as bergamot, grape fruit, lemon, lime, etc. The fruits to be extracted are rolled over a trough with sharp projections that penetrate the peels, this pierce the tiny pouches containing the essential oil. The whole fruit is pressed to squeeze the juice and is separated from the juice by centrifugation.

Microwave assisted process (MAP)
The MAP process uses microwave to excite water molecules in plant tissue causing the cells to rupture and release the essential oil trapped in the extra cellular tissue of the plants. This technique has been developed and reported by many authors as a technique for extraction of essential oils in order to obtain a good yield of the essence and to reduce the time of extraction. This technique has also been applied for the extraction of saponins from some medicinal plants.

Hot Maceration Process
In this process, the long enfleurage time is reduced by the immersion of petals in molten fat heated at 45°-60° C for 1 to 2 hrs. Depending upon the plant species. After each immersion, the fat is filtered and separated from the petals. After 10 to 20 immersions, the fat is separated from waste flowers and water. Absolute of maceration is then produced from fat containing oil through the process of extraction and concentration under reduced pressure. It is mainly used for highly delicate flowers whose physiological activities are lost rapidly after their harvest, such as lily of valley.

Percolation
This is the procedure used most frequently to extract active ingredients in the preparation of tinctures and fluid extracts. A percolator (a narrow, cone-shaped vessel open at both ends) is generally used. The solid ingredients are moistened with an appropriate amount of the
specified menstruum and allowed to stand for approximately 4 hrs. in a well closed container, after which the mass is packed and the top of the percolator is closed. Additional menstruum is added to form a shallow layer above the mass, and the mixture is allowed to macerate in the closed percolator for 24 hr. The outlet of the percolator then is opened and the liquid contained therein is allowed to drip slowly. Additional menstruum is added as required, until the percolate measures about three-quarters of the required volume of the finished product. The marc is then pressed and the expressed liquid is added to the percolate. Sufficient menstruum is added to produce the required volume and the mixed liquid is clarified by filtration or by standing followed by decanting.

**Hot Continuous Extraction (Soxhlet)**

In this method, the finely ground crude drug is placed in a porous bag or “thimble” made of strong filter paper, which is placed in chamber of the Soxhlet apparatus. The extracting solvent in flask is heated, and its vapors condense in condenser. The condensed extractant drips into the thimble containing the crude drug, and extracts it by contact. When the level of liquid in chamber rises to the top of siphon tube the liquid contents of chamber siphon into flask. This process is continuous and is carried out until a drop of solvent from the siphon tube does not leave residue when evaporated. The advantage of this method, compared to previously described methods, is that large amounts of drug can be extracted with a much smaller quantity of solvent. This effects tremendous economy in terms of time, energy and consequently financial inputs. At small scale, it is employed as a batch process only, but it becomes much more economical and viable when converted into a continuous extraction procedure on medium or large scale.

![Diagram of Soxhlet apparatus](image)

**Fig no: 05 Hot Continuous Extraction.**
Ultrasound Extraction (Sonication)

The procedure involves the use of ultrasound with frequencies ranging from 20 kHz to 2000 kHz; this increases the permeability of cell walls and produces cavitation. Although the process is useful in some cases, like extraction of rauwolfia root, its large-scale application is limited due to the higher costs. One disadvantage of the procedure is the occasional but known deleterious effect of ultrasound energy (more than 20 kHz) on the active constituents of medicinal plants through formation of free radicals and consequently undesirable changes in the drug molecules.

Turbo Distillation Extraction

Turbo distillation is suitable for hard-to-extract or coarse plant material, such as bark, roots, and seeds. In this process, the plants soak in water and steam is circulated through this plant and water mixture. Throughout the entire process, the same water is continually recycled through the plant material. This method allows faster extraction of essential oils from hard-to-extract plant materials. Steam Distillation is a special type of distillation or a separation process for temperature sensitive materials like oils, resins, hydrocarbons, etc. which are insoluble in water and may decompose at their boiling point. The temperature of the steam must be high enough to vaporize the oil present, yet not so high that it destroys the plants or burns the essential oils.

Modern (Non-traditional) Methods of Extraction of Essential Oils

Traditional methods of extraction of essential oils have been discussed and these are the methods most widely used on commercial scale. However, with technological advancement, new techniques have been developed which may not necessarily be widely used for commercial production of essential oils but are considered valuable in certain situations, such as the production of costly essential oils in a natural state without any alteration of their thermo-sensitive components or the extraction of essential oils for micro-analysis. These techniques are as follows.

- Headspace trapping techniques.
- Static headspace technique.
- Vacuum headspace technique.
- Dynamic headspace technique.
- Solid phase micro-extraction (SPME).
- Supercritical fluid extraction (SFE).
• Phytosol (phytol) extraction.
• Protoplast technique.
• Simultaneous distillation extraction (SDE).
• Microwave distillation.
• Controlled instantaneous decomposition (CID).
• Thermomicrodistillation.
• Microdistillation.
• Molecular spinning band distillation.
• Membrane extraction.

4. Concentration
The enriched extract from percolators or extractors, known as miscella, is fed into a wiped film evaporator where it is concentrated under vacuum to produce a thick concentrated extract. The concentrated extract is further fed into a vacuum chamber dryer to produce a solid mass free from solvent. The solvent recovered from the wiped film evaporator and vacuum chamber dryer is recycled back to the percolator or extractor for the next batch of plant material. The solid mass thus obtained is pulverized and used directly for the desired pharmaceutical formulations or further processed for isolation of its phytoconstituents.

SOLVENTS
If the products are to be used with foods then there are regulations in the use of appropriate solvents. According to European Union and governmental regulations the following solvents are allowed.
• Water (with admixture of acids or base)
• Other foodstuffs with solvent properties and
• Solvents like propene, butane, ethylacetate, ethanol, carbon dioxide, acetone etc.

Besides solubility, which is a key feature in obtaining a crude extract with any solvent, there are additional criteria for solvent selection, similar to those in liquid – liquid extraction.

• Selectivity
high selectivity enables fewer stages to be used. If the feed is a complex mixture where multiple components need to be extracted, group selectivities become important.
• **Recoverability of solvent**

recovery of the solvent phase should be easy. If evaporation or distillation is used the solvent should have a low heat of evaporation, should not form azeotropes and be easily condensed by cooling water. With liquid carbon dioxide or other subcritical fluids only a flash is necessary. Ionic liquids cannot be evaporated thus the product must be volatile.

• **Viscosity and melting point**

high viscosities reduce the mass transfer efficiency and lead to difficulties with pumping and dispersion. The melting temperature of the solvent should preferably be lower than ambient for ease of handling.

• **Surface tension**

low surface tension promotes wetting of the solids. Wetting ability is important since the solvent must penetrate the matrix (pores, capillaries etc.).

• **Toxicity and flammability**

for food processing only nontoxic solvents will be taken into consideration. In general, any hazard associated with the solvent will require extra safety measures. As to this, aliphatic diluents are preferred to aromatic or halogenated ones.

• **Corrosivity**

corrosive solvents increase equipment cost but might also require expensive pre- and post-treatment of streams.

• **Thermal and chemical stability**

it’s important that the solvent should be thermally and chemically stable as it is recycled. Especially it should resist breakdown during the solvent recovery in an evaporator.

• **Availability and costs**

solvent should be ready available. It is not the price of the solvent that is important, but the annual cost due to the inevitable operation losses.

• **Environmental impact**

the solvent should not only be compatible with downstream process steps, but also with the environment (minimal losses due to evaporation, solubility and entrainment). Removal of solvents from residual plant material (and spent solids) can cause serious problems and post
treatment may be necessary to reduce the residue level. This is mainly by mechanical pressing since further treatment using another solvent is not economic.

5. Purification

The purification methods relay mainly on chromatography and the final product is then obtained by crystallization. In applications with nutraceuticals, cosmetics and fragrances there is no needs for ultrapure products, which is in strong contrast to the pharmaceutical field. Chromatographic methods are very flexible due to their separation principles which are out of the scope of this topic.

Chromatography

- Adsorption Chromatography
- Partition Chromatography
- Ion Exchange Chromatography
- Gel Chromatography
- (Bio -) Affinity Chromatography

Continuous Techniques

The mechanical techniques are with batch, semi - continuous and continuous chromatographic apparatuses.

- True Moving Bed (TMB) Chromatography
- Simulated Moving Bed (SMB) Chromatography
- Annular Chromatography
- Carrousel Adsorbers

THE DIFFERENCE BETWEEN AN ESSENTIAL OIL AND FRAGRANCE OIL

Although both essential oils and fragrance oils can be used to scent products there are some differences between the two that should be noted. First, essential oils are pure extracts from plants in general whereas fragrance oils are synthetically prepared in labs, however, some fragrance oils do contain essential oil components. Essential oils are known for having a very strong scent, but unlike their counterpart fragrance oils, the scent variety is very limited. Cost is yet another difference to be noted. Essential oils are very costly, fragrance oils are very economical. And on a final note, essential oils can be limited, and may vary based on the
weather, the crop itself, and even the temperatures used in distillation, whereas fragrance oils are widely available and do not deviate in formula since they are synthetically produced.

CONCLUSION
Some of the major constraints in sustainable industrial exploitation of medicinal and aromatic plants (MAPs) are due to poor agricultural practices for MAPs, unscientific and indiscriminate gathering practices from the wild, poor postharvest and post-gathering practices leading to poor quality raw material, lack of research for the development of high-yielding varieties of MAPs, poor propagation methods, inefficient processing techniques, poor quality control procedures, lack of research on process and product development, difficulty in marketing, non-availability of trained personnel, lack of facilities and tools to fabricate equipment locally and finally lack of access to the latest technologies and market information. This calls for co-operation and coordination among various institutes and organizations of the region, in order to develop MAPs for sustainable commercial exploitation. Important factors that can affect the efficiency of extraction, such as post-harvest processing, solid characteristics, choice of solvent, method of contact and temperature, should be optimized for best yield. The choice of solvent especially for commercial plants and high efficiency usually depends on many factors such as selectivity, polarity, boiling point, chemical and thermal stability, safety, flammability and costs. Despite the economic advantages of solvent extraction, the use of volatile organic solvents such as hexane, acetone and methanol for processing medicinal plants has been limited due to environmental considerations. Hot continuous extraction technology shall always remain the method of choice for high efficiency, economical extraction and with less capital investment. The process of extracting MAPs determines how efficiently we add value to MAP bio-resources. In the case of essential oils, the extraction process affects the physical as well as internal composition.

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