Essential oils

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Introduction

Essential oils are used in a wide variety of consumer goods such as detergents, soaps, toilet products, cosmetics, pharmaceuticals, perfumes, confectionery food products, soft drinks, distilled alcoholic beverages (hard drinks) and insecticides. The world production and consumption of essential oils and perfumes are increasing very fast. Production technology is an essential element to improve the overall yield and quality of essential oil. The traditional technologies pertaining to essential oil processing are of great significance and are still being used in many parts of the globe. Water distillation, water and steam distillation, steam distillation, cohobation, maceration and effleurage are the most traditional and commonly used methods. Maceration is adaptable when oil yield from distillation is poor. Distillation methods are good for powdered almonds, rose petals and rose blossoms, whereas solvent extraction is suitable for expensive, delicate and thermally unstable materials like jasmine, tuberose, and hyacinth. Water distillation is the most favored method of production of citronella oil from plant material.

Sources of natural essential oil

Essential oils are generally derived from one or more plant parts, such as flowers (e.g. rose, jasmine, carnation, clove, mimosa, rosemary, lavander), leaves (e.g. mint, *Ocimum* spp., lemongrass, jamrosa), leaves and stems (e.g. geranium, patchouli, petitgrain, verbena, cinnamon), bark (e.g. cinnamon, cassia, canella), wood (e.g. cedar, sandal, pine), roots (e.g. angelica, sassafras, vetiver, saussurea, valerian), seeds (e.g fennel, coriander, caraway, dill, nutmeg), fruits (bergamot, orange, lemon, juniper), rhizomes (e.g. ginger, calamus, curcuma, orris) and gums or oleoresin exudations (e.g. balsam of Peru, *Myroxylon balsamum*, storax, myrrh, benzoin).

Thus……

• The scented oil obtained from natural sources is called Essential oil.

• An essential oil may be defined as a volatile perfumery material derived from a single source of plant or animal origin, which has been separated from that source by a physical process.

• There are about 1300 plants in India which are known to be aromatic plant. Out of which 65 plant species have demand in the world market.

• India shares the 3rd largest producer of natural essential oils next to USA and Brazil.

• Further, 4th largest economy after USA, China & Japan and second fastest growing economy. Hence there is a demand for the mass consumption items.

• Essential oils from aromatic plants are low volume and of high value. They have a longer shelf life at room temperature than horticultural plants. Some of them can be grown in marginal lands through contract farming.

• The world production and consumption of essential oils and perfumes are increasing very fast.

• Essential oils are used in a wide variety of consumer goods such as detergents, soaps, toilet products, cosmetics, pharmaceuticals, perfumes, confectionery food products, soft drinks, distilled alcoholic beverages (hard drinks) and insecticides.

Different methods of extraction of Essential oils

Methods of Producing Essential Oils

Regarding hydrodistillation, the essential oils industry has developed terminology to distinguish three types: water distillation; water and steam distillation; and direct steam distillation.

Originally introduced by Von Rechenberg, these terms have become established in the essential oil industry. All three methods are subject to the same theoretical considerations which deal with distillation of two-phase systems. The differences lie mainly in the methods of handling the material.

Some volatile oils cannot be distilled without decomposition and thus are usually obtained by expression (lemon oil, orange oil) or by other mechanical means. In certain countries, the general method for obtaining citrus oil involves puncturing the oil glands by rolling the fruit over a trough lined with sharp projections that are long enough to penetrate the epidermis and pierce the oil glands located within outer portion of the peel (*ecuelle* method). A pressing action on the fruit removes the oil from the glands, and a fine spray of water washes the oil from the mashed peel while the juice is extracted through a central tube that cores the fruit. The resulting oil-water emulsion is separated by centrifugation. A variation of this process is to remove the peel from the fruit before the oil is extracted.

Often, the volatile oil content of fresh plant parts (flower petals) is so small that oil removal is not commercially feasible by the aforementioned methods. In such instances, an odorless, bland, fixed oil or fat is spread in a thin layer on glass plates. The flower petals are placed on the fat for a few hours; then repeatedly, the oil petals are removed, and a new layer of petals is introduced. After the fat has absorbed as much fragrance as possible, the oil may be removed by extraction with alcohol. This process, known as effleurage, was formerly used extensively in the production of perfumes and pomades.

In the perfume industry, most modern essential oil production is accomplished by extraction, using volatile solvents such as petroleum ether and hexane. The chief advantages of extraction over distillation is that uniform temperature (usually 50° C) can be maintained during the process, As a result, extracted oils have a more natural odor that is unmatched by distilled oils, which may have undergone chemical alteration by the high temperature. This feature is of

considerable importance to the perfume industry; however, the established distillation method is of lower cost than the extraction process.

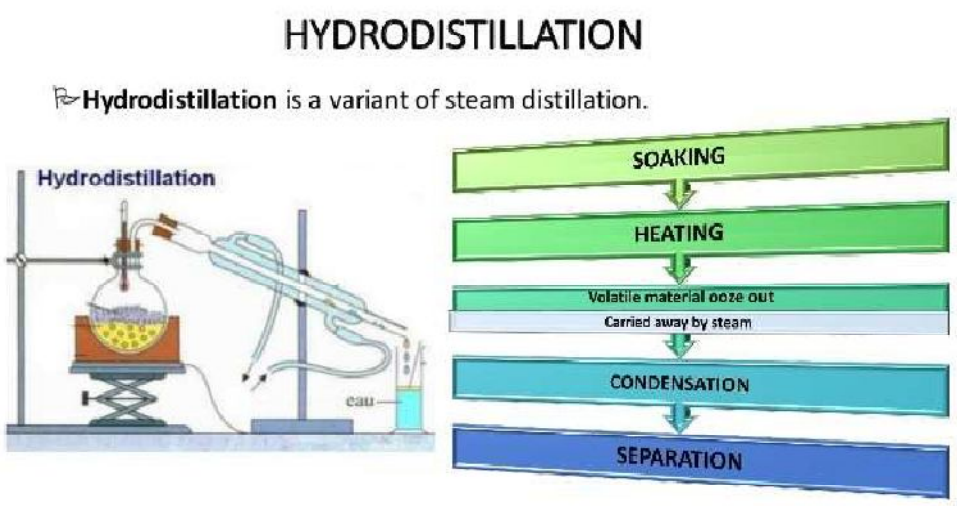
Destructive distillation means distilling volatile oil in the absence of air. When wood or resin of members of the Pinaceae or Cupressaceae is heated without air, decomposition takes place and a number of volatile compounds are driven off. The residual mass is charcoal. The condensed volatile matter usually separates into 2 layers: an aqueous layer containing wood naptha (methyl alcohol) and pyroligneous acid (crude acetic), and a tarry liquid in the form of pine tar, juniper tar, or other tars, depending on the wood used. This dry distillation is usually conducted in retorts and, if the wood is chipped or coarsely ground and the heat is applied rapidly, the yield often represents about 10% of the wood weight used.

Classical and conventional methods:-

1. **Hydro distillation (HD)**
    - Water distillation
    - Water and steam distillation
    - Direct steam distillation
2. **Solvent extraction**
3. **Soxhlet extraction**
4. **Cold pressing method**

Hydro distillation (HD)

- In order to isolate essential oils by hydro distillation, the aromatic plant material is packed in a still and a sufficient quantity of water is added and brought to a boil; alternatively, live steam is injected into the plant charge.
- Due to the influence of hot water and steam, the essential oil is freed from the oil glands in the plant tissue. The vapor mixture of water and oil is condensed by indirect cooling with water. From the condenser, distillate flows into a separator, where oil separates automatically from the distillate water.



Types of hydro distillation

- There are three types of hydro distillation for isolating essential oils from plant materials:

1. Water distillation
2. Water and steam distillation
3. Direct steam distillation

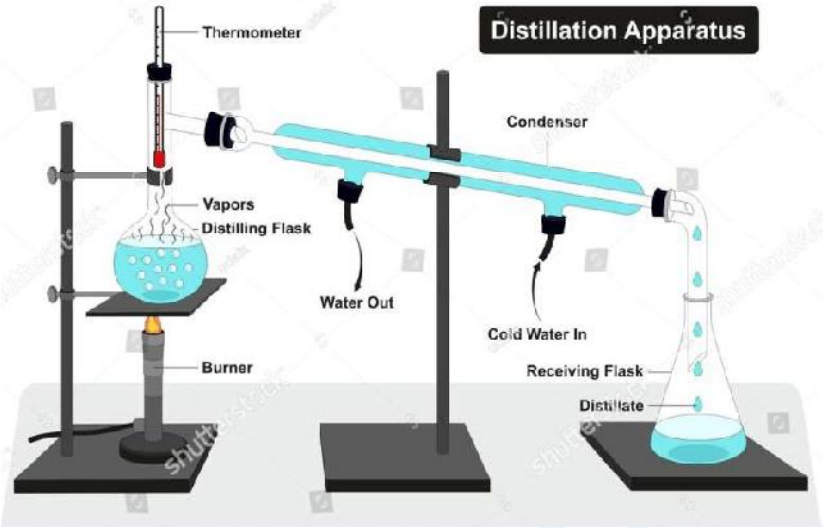
Water distillation

• In this method, the material is completely immersed in water, which is boiled by applying heat by direct fire, steam jacket, closed steam jacket, closed steam coil or open steam coil. The main characteristic of this process is that there is direct contact between boiling water and plant material.

• The plant material in the still must be agitated as the water boils, otherwise agglomerations of dense material will settle on the bottom and become thermally degraded.

• water distillation possesses one distinct advantage, i.e. that it permits processing of finely powdered material or plant parts that, by contact with live steam, would otherwise form lumps through which the steam cannot penetrate.

• The main disadvantage of water distillation is that complete extraction is not possible and is used only in cases in which the plant material by its very nature cannot be processed by water and steam distillation or by direct steam distillation.



Water and steam distillation

• In water and steam distillation, the steam can be generated either in a satellite boiler or within the still, although separated from the plant material.

• Like water distillation, water and steam distillation is widely used in rural areas.

• Moreover, it does not require a great deal more capital expenditure than water distillation. Also, the equipment used is generally similar to that used in water distillation, but the plant material is supported above the boiling water on a perforated grid.

Advantage of water and steam distillation over water distillation

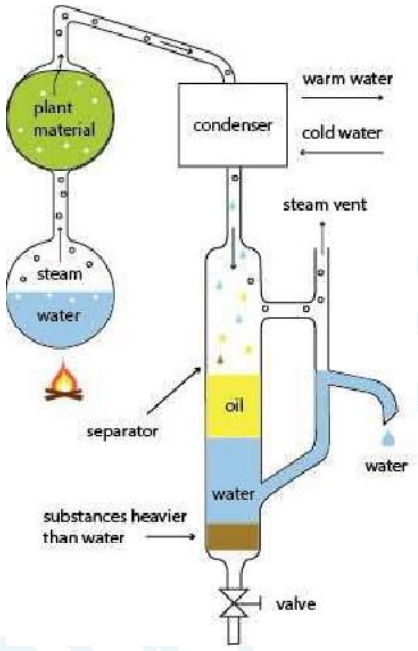
• Higher oil yield.

• Steam and water distillation is faster than water distillation, so it is more energy efficient. Many oils are currently produced by steam and water distillation, for

example lemongrass is produced in Bhutan with a rural steam and water distillation system.

Disadvantages of Water and Steam Distillation

• Due to the low pressure of rising steam, oils of high boiling range require a greater quantity of steam for vaporization -hence longer hours of distillation.



Direct steam distillation

• As the name suggests, direct steam distillation is the process of distilling plant material with steam generated outside the still in a satellite steam generator generally referred to as a boiler.

• As in water and steam distillation, the plant material is supported on a perforated grid above the steam inlet. A real advantage of satellite steam generation is that the amount of steam can be readily controlled. Because steam is generated in a satellite boiler.

• The plant material is heated no higher than 100° C and, consequently, it should not undergo thermal degradation.

• Steam distillation is the most widely accepted process for the production of essential oils on large scale.

Advantages of direct steam distillation

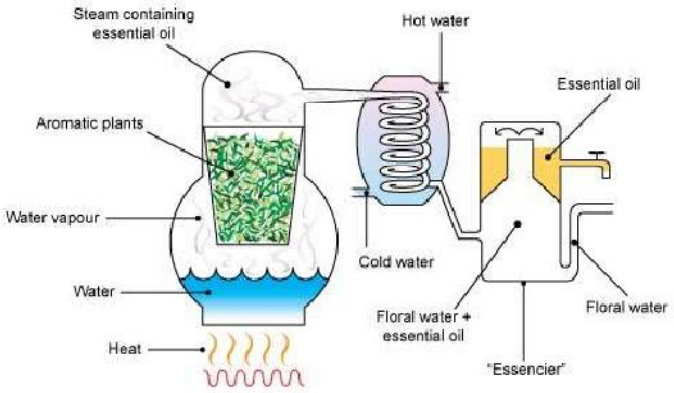
• Amount of steam can be readily controlled.

• No thermal decomposition of oil constituents.

• Most widely accepted process for large-scale oil production, superior to the other two processes.

Disadvantage of Direct Steam Distillation

• Much higher capital expenditure needed to establish this activity than for the other two processes.



Solvent extraction

• This method was used to extract oil from different seeds (lemon seed, aniseed, grape seed) and also from flowers & delicate plant material that would be destroyed by hot water and steam.

• It is complicated and costly procedure using ethanol and n-hexane as a solvents to draw the oils from plant material.

• Solvent extraction, also known as Liquid–liquid extraction.

• This is done using two liquids that don't mix, for example, water and an organic solvent.

• In the Solvent-Extraction method of Essential Oils recovery, an extracting unit is loaded with perforated trays of essential oil plant material and repeatedly washed with the solvent.

• Solvent extraction is used on delicate plants to produce higher amounts of essential oils at a lower cost.

• The quality and quantity of extracted mixture are determined by the type of extra heat applied because of the method is limited by the compound solubility in the specific solvent used.

• Although the method is relatively simple and quite efficient, it suffers from such disadvantages as long extraction time and relatively high solvent consumption.

Cold Pressing (Expression)

• Expression or cold pressing, as it is also known, is only used in the production of citrus oils. The term expression refers to any physical process in which the essential oil glands in the peel are crushed or broken to release the oil.

• In the past the fruit pulp was removed by hands.

• The rind and pith were then soaked in warm water.

• Pith of the fruit absorbed water and exerted pressure due to which it became more elastic.
• It was inverted which helped to rupture the oil cells on a sponge placed next to rind.
• As sponge became saturated with oil it was then squeezed to release the volatile oil which was collected in a vessel and then decanted.

EXTRACTS OF GOOD HEALTH: Aarya Balaji prepares oil with a motor-driven traditional wooden churner to make coconut, gingelly and groundnut oil at his at Adambakkam mill

Soxhlet extraction

• This is a continuous process of extraction with a hot organic solvent.

• The powdered plant material is taken in a thimble which is placed in the soxhlet extractor.

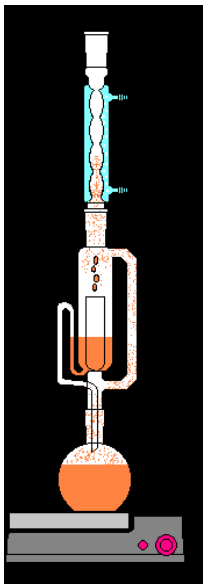
• The extractor, which has a siphoning system is filled on top of a round bottom flask, a condenser is fitted at the top of the extractor.

• Enough quantity of the extracting solvent is poured into the flask placed on a heating mantle.

• On heating the solvent evaporates, rises to the condenser, where it condenses and drains back to the extractor holding the thimble with the plant material.

• When the extractor becomes full with hot solvent the solvent siphons down to flask along with the extracted constituents.

• The recycling of the evaporated solvent is allowed to continue until the extraction is complete.



Non-traditional methods

1. Supercritical fluid extraction (SFE)
2. microwave-assisted hydro-distillation (MAHD)
3. Ultrasound-assisted extraction (UAE)
4. Solvent-free microwave extraction (SFME)
5. Microwave hydro diffusion and gravity (MHG)

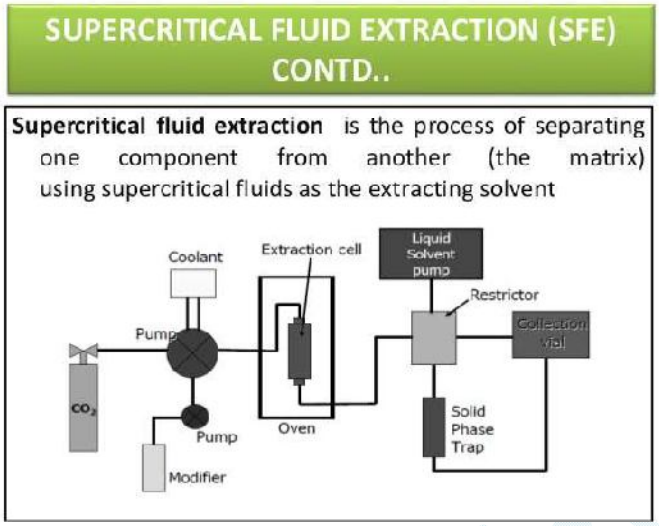
Super fluid extraction (SFE)

• SFE is the process of separating one component (the extractant) from another using supercritical fluid as the extracting solvent.

• In practice, more than 90% of all analytical supercritical fluid extraction is performed with carbon dioxide (Co_2) for several practice reasons.

• Co_2 is the most used supercritical fluid, sometimes modified by co-solvent such as ethanol or methanol.

• This extraction method produces higher yield higher diffusion coefficient and lower viscosity.



Microwave-Assisted Hydrodistillation (MAHD)

• Microwave hydro-distillation has been performed using the tecno kit chen (Italy, tek-2611) microwave oven.

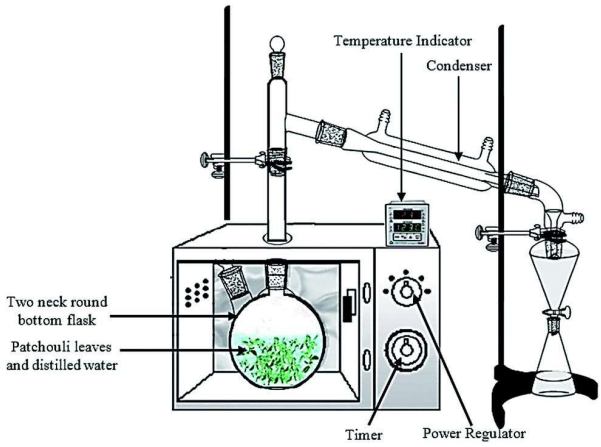
• It is a 2450 Mhz multimode microwave with a maximum delivered power of 900w.

• In a typical MAHD, procedure performed at atmospheric pressure.

• 100gm of plant material were heated for 30 min with addition of 300 ml water.

• This period was sufficient to extract all the essential oils from the sample.

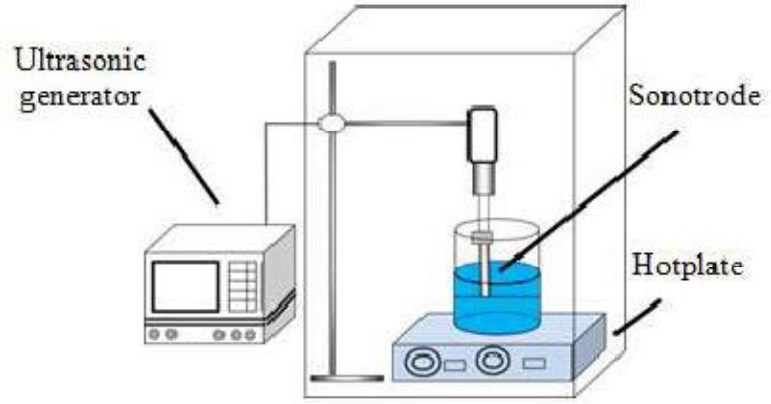
• Each extraction was performed at least three times.



Ultrasound-assisted extraction (UAE)

• Ultrasound is probably the most simple and most versatile method for the disruption of cell and for the production of extracts. It is efficient, safe and reliable.

• Due to ultrasonic cavitation creates shear forces that breaking cell walls mechanically and improving the material transfer; this effect is being used in the extraction of liquid compounds from solid cells (solid-liquid extraction).



Solvent-free microwave extraction (SFME)

• This method is based on the integration of dry distillation and microwave heating energy.

• It consists of the microwave dry-distillation at atmospheric pressure of plant without adding water or any organic solvent.

• In a model SFME procedure, the plant material was moistened before to extraction by soaking in certain amount of water for 1-2 hr and then draining off the excess water.

• After that moistened material were subjected to the microwave oven cavity and a condenser was used to collect the extracted essential oils in a presetting procedure.

• The irradiation power, temperature and extraction time were controlled by the panel in the instrument.

Microwave hydro diffusion and gravity (MHG)

• MHG become clear not only as economic and efficient but also as environment-friendly not require solvent or water and as it does require less energy.

• The performance and advantages of this technique are a reduction of extraction time (in the case of hydro distillation it takes 90 min or more but in this technique only 20 min) and reducing environmental impact and power saving.