Scope of Extraction Unit for Medical and Agricultural Purpose by Steam Distillation Process

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Publication Month and Year: August 2021

Pages: 29

E-BOOK ISBN: 978-81-952994-4-7

Academic Publications
C-11, 169, Sector-3, Rohini, Delhi, India
Website: www.publishbookonline.com
Email: publishbookonline@gmail.com
Phone: +91-9999744933

Acknowledgment

Behind every successful work, there are efforts of many peoples, directly or indirectly. We take this opportunity to thank all those who helped us during this endeavor.

First of all, we would like to express our sincere, profound sense of gratitude towards our guide Dr. R. U. Sambhe & Dr. R. M. Sherekar for the opportunity to conduct study and analysis in this growing and evolving field as well as for his guidance throughout the last year. And of course, the biggest thanks to our Head of Dept. Dr. U. V. Kongre and Principal Dr. R. S. Tatwawadi for their guidance and support throughout the last year. We'd like to thank our family for standing by us and encouraging us throughout graduate school. We would also like to thank all our friends who helped us directly and indirectly during the project work.

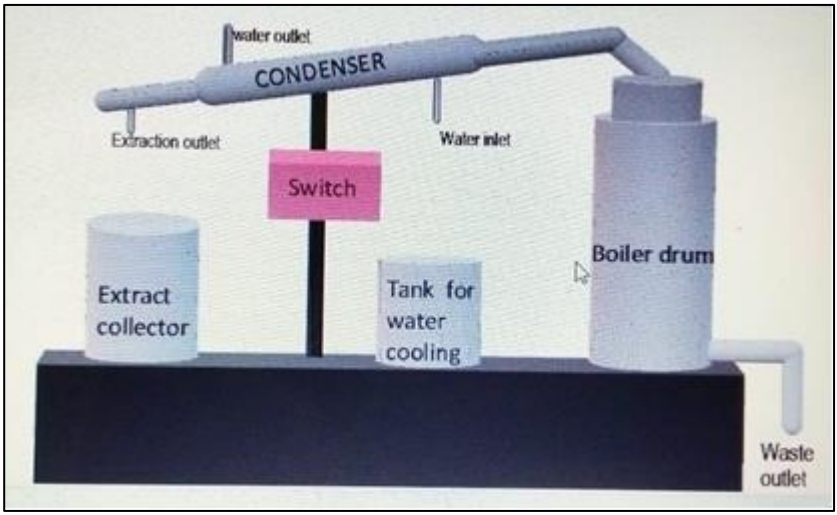
Projectees
(Final Year Mech. Engg.)

Abstract

A large number of herb materials contain Essential Oils with extensive bioactivities. Acknowledging the importance of plants and its Medicinal & Agricultural value, extraction of Essential Oil had been done using Steam Distillation method. In this project Steam Distillation was used to extract oil from different plant materials like eucalyptus leaves, curry leaves, hibiscus leaves, lemon leaves, marigold flowers, Rose flowers, orange peels etc. 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. Essential oils are so termed as they are believed to represent the very essence of odor and flavor. The recovery of Essential Oil (the value-added product) from the raw botanical starting material is very important since the quality of the oil is greatly influenced during this step. There are a variety of methods for obtaining volatile oils from plants. Steam distillation method was found to be one of the promising techniques for the extraction of essential oil from plants as reputable distiller will preserve the original qualities of the plant. The distillation was conducted in Extraction unit in which boiling, condensing and decantation was done. Which gives valuates Essential Oil qualitatively and quantitatively. Volume of Essential Oil obtained was changing w. r. t. temperature and time of heating.

Actual Figure of Extraction Unit

Label Diagram of Extraction Unit



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Chapter - 1

Introduction

Humankind has used plants for healing for many thousands of years, and it's from this tradition of that the use of aromatic plant compounds is medicine & Agriculture began. Oils were used in the embalming process, in medicine and in purification rituals and Growth of plant and protecting from diseases. There are also over 200 references to aromatics, incense and ointments in the Old and New Testaments. It is estimated that there are 250,000 to 500,000 species of plants on Earth. A relatively small percentage (1 to 10%) of these is used as foods by both humans and other animal species. It is possible that even more are used for medicinal purposes (Moerman, D. E. 1996). He reported that while 625 species of plants have been used by various Native American groups as food, 2,564 have found use as drugs. 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. Immune system systems need support and essential oils can give it. 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. This is why it is important to study the chemical composition of the volatile fraction once the essential oil is extracted. This fraction is characterized by the complexity in the separation of its components, which belong to various classes of compounds and which are present in a wide range of concentrations. Steam distillation is used in the extraction of Essential Oil from the plant material. It 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 fundamental nature of steam distillation is that it enables a compound or mixture of compounds to be distilled at a temperature substantially below that

of the boiling point(s) of the individual constituent(s). Essential Oil contains components with boiling points up to 200 °C or higher temperatures. In the presence of steam or boiling water, however, these substances are volatilized at a temperature close to 100 °C, at atmospheric pressure.

Chapter - 2

Literature Survey

2.1 What are essential oils?

Essential oils are concentrated volatile aromatic compounds produced by plants - the easily evaporated essences that give plants their wonderful scents. Each of these complex precious liquids is extracted from a particular species of plant life. Each plant species originates in certain regions of the world, with particular environmental conditions and neighboring fauna and flora.

Essential oils are frequently referred to as the “life force” of plants. Unlike fatty oils, these "essential" oils are volatile, highly concentrated, substances extracted from flowers, leaves, stems, roots, seeds, bark, resin or fruit rinds. The amount of essential oils found in these plants can be anywhere from 0.01 percent to 10 percent of the total. That's why tons of plant material are required for just a few hundred pounds of oil. These oils have potent antimicrobial factors, having wide range of therapeutic constituents. 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. Beware of imitations. Essential oils cannot be substituted with synthetics. Only pure oils contain a full spectrum of compounds that cheap imitations simply cannot duplicate.

What do the essential oils do for the plants?

Essential oils are extracted from oil 'sacs' in flowers, leaves, stems, roots, seeds, wood and bark. They differ significantly from the well-known vegetable, nut and seed oils which are made up of various fatty acids (essential oils are not). Essential oils are used by the plants in somewhat the same way they are by humans - they fight infection, contain hormone-like compounds, initiate cellular regeneration, and work as chemical defense against fungal, viral, and animal foes and used during agriculture processing for better treatment of plant and their Growth. Despite their foliar origins however, essential oils have a similar structure to some compounds found in blood and tissues, allowing them to be compatible with our own physiology.

How to use essential oils?

The most effective way to use most essential oils is by external application or inhalation, though some can be very beneficial when taken internally. The use of essential oils includes body oils, compresses, cosmetic lotions, baths, hair rinses, inhalation by steam, perfumes and room sprays. Essential oils *are very* potent - some will cause skin irritation or have other harmful effects if not used properly. Unless specifically noted, it is best to dilute all essential oils in a carrier of *base* oil like Almond, Jojoba or Apricot Kernel before applying to the skin-Appropriate dilution is usually only 1-10% essential oil in carrier. For inhalation, a diffuser or oil lamp is effective for releasing essential oils into your environment-a very pleasant way of creating a particular atmosphere.

After removing extract from Leaves the remaining material will be used for disinfectant and Antifungal Agents for the plant during agriculture and for better growth of plant this extract is like medicine for growing plant.

Major raw material used in extraction of essential oils

Table 1: Essential oils are derived from various parts of plants

Leaves	**Flowers**	**Peel**	**Seeds**	**Wood**
Basil Bay leaf Cinnamon Eucalyptus Lemon Grass Melaleuca Oregano Patchouli Peppermint Pine Rosemary Spearmint Tea Tree Wintergreen Thyme	Chamomile e Clary Sage Clove Geranium Hyssop Jasmine Lavender Manuka Marjoram Orange Rose Ylang-Ylang	Bergamot Grape fruit Lemon Lime Orange Tangerine	Almond Anise Celery Cumin Nutmeg Oil	Camphor Cedar Rosewood Sandalwood
Berries	**Bark**	**Resins**	**Rhizome**	**Root**
Allspice Juniper	Cassia Cinnamon	Frankincense Myrrh	Ginger	Valerian

2.2 What is 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 beginnings 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 'effleurage' 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 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.

How essential oil works in aromatherapy?

An Essential Oil is inhaled and directly by the olfactory system to the limbic System of the Brain. 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 beneficial effects promoting overall health - and even specific targets. Benefits depend upon the unique nature of each person's response to an aromatic stimulus.

2.3 Pharmacological properties of essential oils

Antiseptics

Essential oils have antiseptic properties and are active against a wide range of bacteria as well as on antibiotic-resistant strains. Moreover, they are also known to be active against fungi and yeasts (Candida). The most common sources of essential oils used as antiseptics are: Cinnamon, Thyme; Clover; Eucalyptus; Culin savory; Lavender. Citral, geranial, linalool and thymol are much more potent than phenol.

Expectorants and diuretics

When used externally, essential oils like (L'essence de terebenthine)

increase microcirculation and provide a slight local anesthetic action. Till now, essential oils are used in a number of ointments, cream and gels, whereby they are known to be very effective in relieving sprains and other particular pains. Oral administration of essential oils like eucalyptus or pin oils, stimulate ciliated epithelial cells to secrete mucus. On the renal system, these are known to increase vasodilatation and in consequence bring about a diuretic effect.

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.

Others

Cholagogue; anti-inflammatory; cicatrizing.

2.4 Chemical constituents of essential oils

Pure essential oils are mixtures of more than 200 components, normally mixtures of terpenes or phenylpropanic derivatives, in which the chemical and structural differences between compounds are minimal. They can be essentially classified into two groups:

Volatile fraction

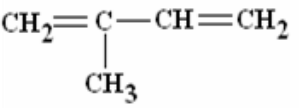
Essential oil constituting of 90-95% of the oil in weight, containing the monoterpene and sesquiterpene hydrocarbons, as well as their oxygenated derivatives along with aliphatic aldehydes, alcohols, and esters.

Non-volatile residue

That comprises 1-10% of the oil, containing hydrocarbons, fatty acids, sterols, carotenoids, waxes, and flavonoids.

Hydrocarbon

Essential Oils consist of Chemical Compounds that have hydrogen and carbon as their building blocks. Basic Hydrocarbon found in plants is isoprene having the following structure.



(Isoprene)

Terpenes

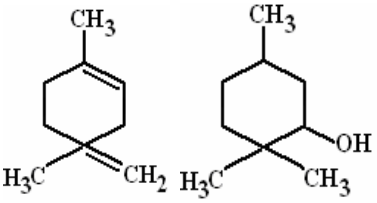
Generally, have names ending in "ene"

For examples: Limonene, Pinene, Piperene, Camphene etc. Terpenes are anti- inflammatory, antiseptic, antiviral, and bactericidal. Terpenes can be further categorized in monoterpenes, sesquiterpenes and diterpenes. Referring back to isoprene units under the Hydrocarbon heading, when two of these isoprene units join head to tail, the result is a monoterpene, when three joins, it's a sesquiterpene and four linked isoprene units are diterpenes.

Monoterpenes [$C_{10}H_{16}$]

Properties: Analgesic, Bactericidal, Expectorant, and Stimulant.

Monoterpenes are naturally occurring compounds, the majority being unsaturated hydrocarbons (C_{10}). But some of their oxygenated derivatives such as alcohols, Ketones, and carboxylic acids known as monoterpenoids.



(Limonene) (Menthol)

The branched-chain C_{10} hydrocarbons comprises of two isoprene units and is widely distributed in nature with more than 400 naturally occurring monoterpenes identified. Moreover, besides being linear derivatives (Geraniol, Citronellol), the monoterpenes can be cyclic molecules (Menthol - Monocyclic; Camphor - bicyclic; Pinenes (α and β) - Pine genera as well. Thujone (a monoterpene) is the toxic agent found in *Artemisia absinthium* (wormwood) from which the liqueur, absinthe, is made. Borneol and camphor are two common monoterpenes. Borneol, derived from pine oil, is used as a disinfectant and deodorant. Camphor is used as a counterirritant, anesthetic, expectorant, and antipruritic, among many other uses.

Example

- Camphene and pinene in cypress oil.
- Camphene, pinene and thujhene in black pepper.

II. Sesquiterpenes

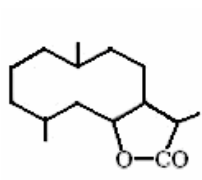
Properties: Anti-inflammatory, anti-septic, analgesic, anti-allergic.

Sesquiterpenes are biogenetically derived from farensyl pyrophosphate and in structure may be linear, monocyclic or bicyclical. They constitute a very large group of secondary metabolites, some having been shown to be stress compounds formed as a result of disease or injury.

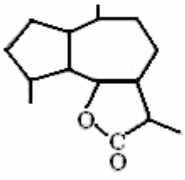
Sesquiterpene lactones

Over 500 compounds of this group are known; they are particularly characteristics of the Compositae but do occur sporadically in other families. Not only have they proved to be of interest from chemical and chemotaxonomic viewpoints, but also possess many antitumor, anti-leukemia, cytotoxic and antimicrobial activities. They can be responsible for skin allergies in humans and they can also act as insect feeding deterrents.

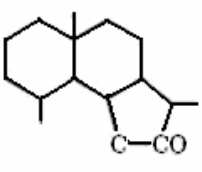
Chemically the compounds can be classified according to their carboxylic skeletons; thus, from the germacranolides can be derived the guaianolides, pseudo guaianolides, eudesmanolides, eremophilanolides, xanthanolides etc.



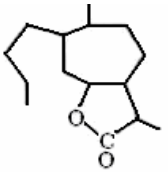
Germacranolides



Guaianlides



Eudesmanolides



Xantnanolides

A structural feature of all these compounds, which appears to be associated with much of the biological activity, is α, β -unsaturated- γ-lactones.

Example

- Farnesene in chamomile and lavender.
- Beta-caryophyllene in basil and black pepper.

Diterpenes

Properties: anti-fungal, expectorant, hormonal balancers, hypotensive.

Diterpenes are made of up four isoprene units. This molecule is too heavy to allow for evaporation with steam in the distillation process, so is rarely found in distilled essential oils. Diterpenes occur in all plant families and consist of compounds having a C20 skeleton. There are about 2500 known diterpenes that belong to 20 major structural types. Plant hormones Gibberellins and phytol occurring as a side chain on chlorophyll are diterpenic derivatives. The biosynthesis occurs in plastids and interestingly mixtures of monoterpenes and diterpenes are the major constituents of plant resins. In a similar manner to monoterpenes, diterpenes arise from metabolism of geranylgeranyl pyrophosphate (GGPP).

Diterpenes have limited therapeutically importance and are used in certain sedatives (coughs) as well as in antispasmodics and antoxiolytics.

Example

- Sclareol in clary sage is an example of a diterpene alcohol.

Alcohols

Properties: anti-septic, anti-viral, bactericidal and germicidal.

Alcohols are the compounds which contains Hydroxyl compounds. Alcohols exist naturally, either as a free compound, or combined with a terpenes or ester. When terpenes are attached to an oxygen atom, and hydrogen atom, the result is an alcohol. When the terpene is monoterpene, the resulting alcohol is called a monoterpenol. Alcohols have a very low or totally absent toxic reaction in the body or on the skin. Therefore, they are considered safe to use.

Example

- Linalool found in ylang-ylang and lavender.
- Geraniol in geranium and rose.
- Nerol inneroli.

Aldehydes

Properties: anti-fungal, anti-inflammatory, anti-septic, anti-viral, bactericidal, disinfectant, sedative.

Medicinally, essential oils containing aldehydes are effective in treating Candida and other fungal infections.

Example

- Citral in lemon.

- Lemongrass and lemon balm.
- Citronellal in lemongrass, lemon balm and citrus eucalyptus.

Acids

Properties: anti-inflammatory.

Organic acids in their free state are generally found in very small quantities within Essential oils. Plant acids act as components or buffer systems to control acidity.

Example

- Cinnamic and benzoic acid in benzoic.
- Citric and lactic.

Esters

Esters are formed through the reaction of alcohols with acids. Essential oils containing esters are used for their soothing, balancing effects. Because of the presence of alcohol, they are effective antimicrobial agents. Medicinally, esters are characterized as antifungal and sedative, with a balancing action on the nervous system. They generally are free from precautions with the exception of methyl salicylate found in birch and wintergreen which is toxic within the system.

Example

- Linalyl acetate in bergamot and lavender.
- Geranyl formate in geranium.

Ketones

Properties: anti-catarrhal, cell prolife rant, expectorant, vulnery.

Ketones often are found in plants that are used for upper respiratory complaints. They assist the flow of mucus and ease congestion. Essential oils containing ketones are beneficial for promoting wound healing and encouraging the formation of scar tissue. Ketones are usually (not always) very toxic**.** The most toxic ketone is Thujone found in mugwort, sage, tansy, thuja and wormwood oils. Other toxic ketones found in essential oils are pulegone in pennyroyal, and pinocamphone in hyssops. Some 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 fennel, carvone in spearmint and dill.

- Menthone in peppermint.

Lactones

Properties: anti-inflammatory, antiphlogistic, expectorant, febrifuge.

Lactones are known to be particularly effective for their anti-inflammatory action, possibly by their role in the reduction of prostaglandin synthesis and expectorant actions. Lactones have an even stronger expectorant action then ketones.

- Lemongrass and lemon balm.
- Citronellal in lemongrass, lemon balm and citrus eucalyptus.

2.5 Methods of extracting essential oils

Early efforts at extraction used alcohol and a fermentation process. New methods of essential oils extraction are entering the mainstream of aromatherapy, offering new choices in oils never before available. With the new labels of CO_2 and Super Critical CO_2, along with the traditional ‘steam’ and ‘hydro’ distillations, 'absolutes', and 'cold pressing', a little education for the aromatherapy enthusiast can go a long way in essential oil selection. Is one process better than another? Does one produce nicer smelling oil, or one with greater aroma therapeutic value? It turns out that essential oil production, like winemaking, is an art form as well as a science. The way in which oils are extracted from plants is important because some processes use solvents that can destroy the therapeutic properties. Some plants, and particularly flowers, do not lend themselves to steam distilling. They are too delicate, or their fragrance and therapeutic essences cannot be completely released by water alone. These oils will be produced as 'absolutes' - and while not technically considered essential oils they can still be of therapeutic value. Jasmine oil and Rose oil in particular are delicate flowers whose oils are often found in 'absolute' form.

The value of the newer processing methods depends greatly on the experience of the distiller, as well as the intended application of the final product. Each method is important, and has its place in the making of aromatherapy-grade essential oils. Some of the few methods are available for extractions of essential oils are given below:

Maceration

Maceration actually creates more of an “infused oil" rather than an "essential oil". The plant matter is soaked in vegetable oil, heated and strained at which point it can be used for massage.

Cold pressing

Cold pressing is used to extract the essential oils from citrus rinds such as orange, lemon, grapefruit and bergamot. This method involves the simple pressing of the rind at about 120'F to extract the oil. The rinds are separated from the fruit, are ground or chopped and are then pressed. The result is a watery mixture of essential oil and liquid which will separate given time. Little, if any, alteration from the oil's original state occurs - these citrus oils retain their bright, fresh, uplifting aromas like that of smelling a wonderfully ripe fruit. oils extracted using this method have a relatively short shelf life, so make or purchase only what you will be using within the next six months.

Solvent extraction

A hydrocarbon solvent is added to the plant material to help dissolve the essential oil. When the solution is filtered and concentrated by distillation, a substance containing resin (resinoid), or a combination of wax and essential oil (known as concrete) remains. From the concentrate, pure alcohol is used to extract the oil. When the alcohol evaporates, the oil is left behind. This is not considered the best method for extraction as the solvents can leave a small amount of residue behind which could cause allergies and effect the immune system.

Effleurage

An intensive and traditional way of extracting oil from flowers. The process involves slavering fat over the flower petals. After the fat has absorbed the essential oils, alcohol is used to separate and extract the oils from the fat. The alcohol is then evaporated and the essential oil collected.

Hydro distillation

Some process becomes obsolete to carry out extraction process like Hydro Distillation which often used in primitive countries. The risk is that the still can run dry, or be overheated, burning the aromatics and resulting in an Essential Oil with a burnt smell. Hydro distillation seems to work best for powders (i.e., spice powders, ground wood, etc.) and very tough materials like roots, wood, or nuts.

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.

CO_2 & super critical CO_2 extraction

The most modern technologies, Carbon Dioxide and Supercritical Carbon Dioxide extraction involve the use of carbon dioxide as the 'solvent' which carries the essential oil away from the raw plant material. The lower pressure CO_2 extraction involves chilling carbon dioxide to between 35 and 55-degrees F, and pumping it through the plant material at about 1000 psi. The carbon dioxide in this condition is condensed to a liquid. Supercritical CO_2 extraction (SCO_2) 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.

Steam distillation

Most commonly, the essence is extracted from the plant using a technique called distillation. One type of distillation places the plants or flowers on a screen. Steam is passed through the area and becomes "charged" with the essence. The steam then passes through an area where it cools and condenses. This mixture of water and essential oil is separated and bottled. Since plants contain such a small amount of this precious oil, several hundred pounds may need to produce a single once.

2.6 Extraction of essential oils using steam distillation method

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 fundamental nature of steam distillation is that it enables a compound or mixture of compounds to be distilled at a temperature substantially below that of the boiling point(s) of the individual constituent(s). Essential oils contain substances with boiling points up to 200 °C or higher temperatures. In the presence of steam or boiling water, however, these substances are volatilized at a temperature close to 100°C, at atmospheric pressure.

Fresh, or sometimes dried, botanical material is placed in the plant chamber of the still and the steam is allowing to pass through the herb material

under pressure which softens the cells and allows the Essential Oil to escape in vapor form. 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. Besides the steam tiny droplets of Essential Oil evaporates and travel through a tube into the still's condensation chamber. Here Essential Oil vapors condense with the steam. The essential oil forms a film on the surface of the water. To separate the Essential Oil from the water, the film is then decanted or skimmed off the top. The remaining water, a byproduct of distillation, is called floral water, distillate, or hydrosol. It retains many of the therapeutic properties of the plant, making it valuable in skin care for facial mists and toners (A solution containing chemicals that can change the color of a photographic print). In certain situations, floral water may be preferable to be pure essential oil, such as when treating a sensitive individual or a child, or when a more diluted treatment is required. Rose hydrosol, for example, is commonly used for its mild antiseptic and soothing properties, as well as its pleasing floral aroma.

A number of factors determine the final quality of a steam distilled essential oil. Apart from the plant material, most important are time, temperature and pressure, and the quality of the distillation equipment. Essential oils are very complex products. Each is made up of many, sometimes hundreds, of distinct molecules which come together to form the oil's aroma and therapeutic properties. Some of these molecules are fairly delicate structures.

Which can be altered or destroyed by adverse environmental conditions? So, much like a fine meal is more flavorful when made with patience, most oils benefit from a long, slow 'cooking' process. It is possible that longer distillation times may give more complete oil. It is also possible however, that longer distillation time may lead to the accumulation of more artifacts than normal. This may have a curious effect of appearing to improving the odor, as sometimes when materials that have a larger number of components are sniffed, the perception is often of slightly increased sophistication, added fullness and character, and possibly, and extra pleasantness.

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, it is also relatively faster than other methods.

Chapter - 3

Experimental Work

3.1 Experimental Set-Up

The diagram of experimental setup is shown below. The experiment was conducted in a Stainless-Steel Extraction Unit. It consists of one round steel drum of dome shape structure capacity of 50 lit approx. which have heating coils inside to heat, which is then connected with steel pipe which goes through one end of condenser which is used for cooling the formed steam and then from other end of condenser the water droplet receiving pipe is connected from which cooled water droplet is goes and collected in collecting drum. The thermostat is also used for measurement of rising temperature of boiling unit and cooling water unit is separated connected at bottom side which supplies continuously cooled water to condenser for cooling the steam. This unit is connected to condenser from two point, one is input and other is output. From input point the cooled water is supplied to condenser to cool down the steam and from output point the heated water is collect out in cooling Drum, then this heated water is again get cooled in cooing drum and it again supply to condenser, this process is happening continuously. The separating funnel is used for the separation of essential Oil and extracts water.

Fig 1: Experimental setup of steam distillation unit

3.2 Experimental procedure

Fresh leaves were cut into pieces less than 2 X 2 cm. The cutted leaves put into the steel drum then add water in it until all cutted leaves is drowned, and then plug the power which starts heating the coil. After sometimes as the temperature increases inside boiler drum which boiled the water, as when water start to boiled the steam get form which content extract of leaves which is then passes through the dome shape structure having SS Pipe connected between boiler drum and condenser. The steam start moving from boiler drum through SS pipe in condenser. In condenser the heated steam gets cooled with the help of cooling water which is supply continuously from cooling unit which is connected separately, then condense steam is from in water droplet of leaves extract. Then this water droplet is collected in collecting drum with the help of pipe. The extract contains Essential oil at top film and the flower water at bottom. The Essential oil is then separated.

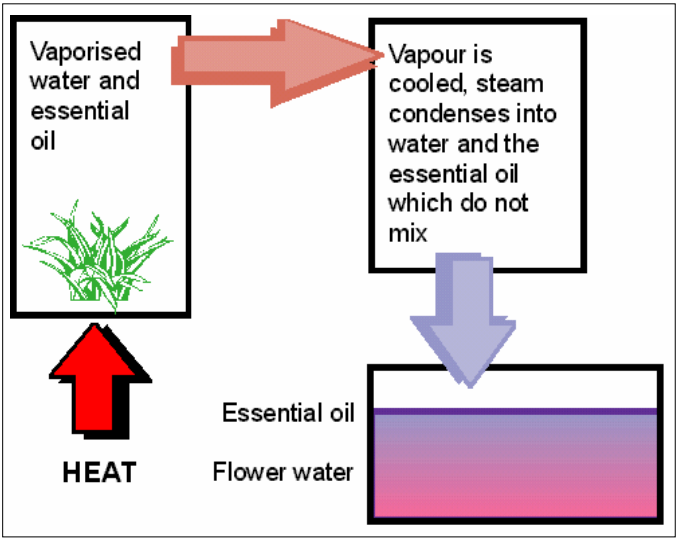


Fig 2: Flow diagram for the steam distillation

3.3 Experimental observation

Table 2: Physical and chemical properties of eucalyptus oil

Color	Pale yellow liquid
State	Liquid-oil
Odor	Camphoraceous odor
Taste	Pungent and cooling taste.
Boiling Point of	1000-1020 °C;

Cineole (Eucalyptol)	
Density of oil	0.921-0.923
Solubility	1) Insoluble in water. 2) Miscible in alcohol having high concentration or in anhydrous alcohol. 3) Miscible in oil; fats; paraffin's; ether; chloroform and glacial Acetic acid.

3.4 Analysis of essential oils

Analysis of Essential Oil was done using Gas Chromatography with Mass spectrometer to know the composition of oil and to the quantity of each composition.

Gas chromatography-mass spectrometer

Gas Chromatography-Mass Spectrometry (GC-MS) is a method that combines the features of gas- liquid chromatography and mass spectrometry to identify different substances within a test sample. Applications of GC-MS include drug detection, fire investigation, environmental analysis, explosives investigation, and identification of unknown samples. Additionally, it can identify trace elements in materials that were previously thought to have disintegrated beyond identification.

Chapter - 4

Result and Discussion

4.1 Inferences

The amount of essential oils obtained by steam distillation, contains more than 2 ml of essential oil per 150 gm of oven dried Eucalyptus leaves, whereas Essential oil obtained from the Bay leaves contains very small amount of oil in comparison to the oil obtained from Eucalyptus. The essential oil forms a film on the surface of the water. To separate the essential oil from the water, the film is then decanted or skimmed off the top. The remaining water, a byproduct of distillation, is called floral water, distillate, or hydrosol. The oil obtained is pale yellow in color, whereas oil obtained from Bay leaves is colorless. After removing extract from Leaves the remaining material will be used for disinfectant and Antifungal Agents for the plant during agriculture and for better growth of plant this extract is like medicine for growing plant.

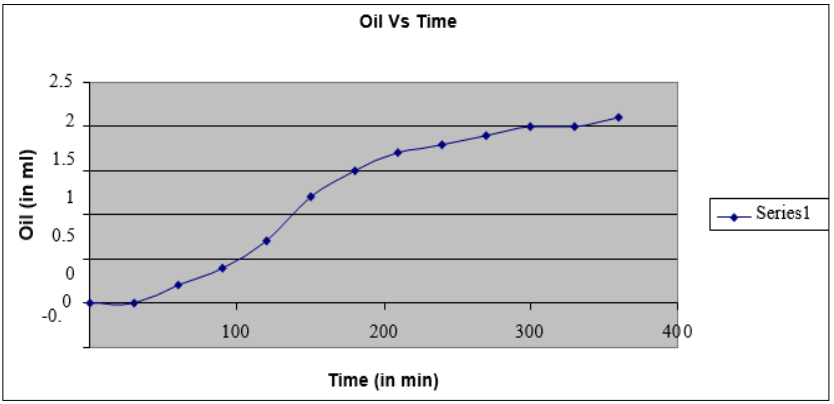


Fig 3: Eucalyptus oil obtained vs Time

Fresh, botanical material is placed in the plant chamber of the still and the steam is allowing to pass through the herb material under pressure which softens the cells and allows the essential oil to escape in vapor form. As the time increases the steam production increases which extract the oil from the leaves at the boiling point of the water. After 4-5 hours of operation the extraction of oil ceased.

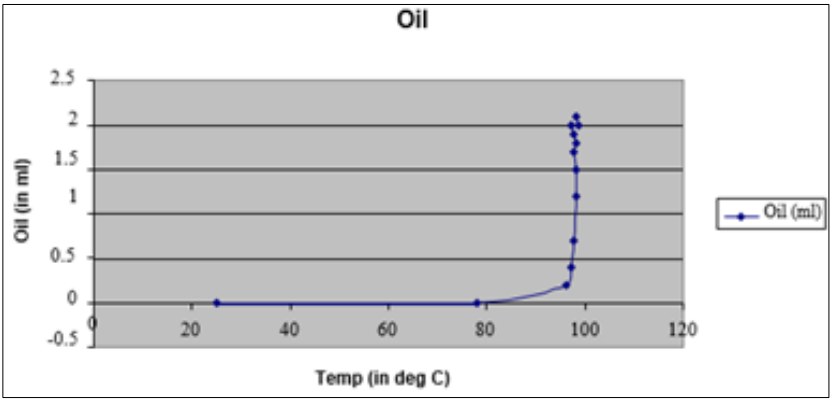


Fig 4: Eucalyptus oil obtained vs Temperature of the water

Chapter - 5

Conclusions

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.

The experiment has been carried out for the extraction of oil from Eucalyptus which have high essential oil content. Such Eucalyptus essential oil, which contain highly medicinal properties have been used as medicinal agent, perfume and chemical raw materials for a long time. After removing extract from Leaves the remaining material will be used for disinfectant and Antifungal Agents for the plant during agriculture and for better growth of plant this extract is like medicine for growing plant.

Future work

Oil contained in Eucalyptus is higher and can be easily extracted. The Eucalyptus oil contains more than 65% of 1.8-cineole. Hence the incorporation of small amount of Eucalyptus oil as co-solvent in aqueous ethanol and petrol mixture improved the water tolerance of the system. Therefore, the work can be extended for the study of ternary phase equilibrium of the water ethanol and 1.8-cineole or Eucalyptus oil.

Applications

1) Extract is used for fertilizer.
2) Neem extract is an essential content in various medicines.
3) Extract also used as organic manure.
4) Neem extract used as a coating agent in "Neem" coated urea".
5) Neem used as a soil conditioner, i.e. help to mention the soil fertility and productivity.
6) Neem extract spraying is a best eco-friendly method for controlling various type of insects and pest.
7) Neem pest is very beneficial for proper crop and pest management.

8) With the help of this extraction unit, preparation of 100% organic Neem sanitizer can be possible.
9) Wide range of sanitizer can be prepared through our extraction unit.
10) Neem extract also used as floor cleaner. Neem leaves and seeds are having antibacterial property.
11) Neem extract is act as an organic replacement for synthetic pesticides, which causes harmful effect on environment.
12) Our Yavatmal district is known as “cotton city in Maharashtra”. But every year, attack of sucking pest like white. Fly, jassids decreases the yield of cotton. But, Spraying of Neem extract is best way to control sucking pest infestation and also it doesn't harm the Mother Nature.
13) Our extraction unit also useful for extraction of essential oil from citronella/lemon grass.

Citronella oil has following benefit

a) Act as an insect repellent, especially against mosquito.
b) Act as anti-fungal agent.
c) To treat parasitic infection.
d) To promote wound healing.
e) In perfumes or as flavor additives in food.

Chapter - 6

Description

Technical field of invention

Present invention in general relates to extracting process of plants and more specifically to an improved plant extraction apparatus by utilizing steam distillation process.

Background of the invention

The background information herein below relates to the present disclosure but is not necessarily prior art.

Biological sources have provided the bases for medicines and cosmetics from the earliest days of mankind. Most such sources have been plants, which initially were used as is. Oftentimes, however, it is desirable to extract materials from plants, as for example when the desired material constitutes only a small proportion of a given plant, or when the material occurs in the presence of other, undesirable constituents.

Essential oil, claims again volatile oil, and English name essential oil is the general name that the class that contains in plant has the oily composition of aromatic odour. It is mixture, concrete comparison of ingredients complexity, and main fatty compounds and aromatics, comprise alcohols, ester class, phenols, ethers, terpenes etc.

Scientific research discovery, plant-derived essential oil mostly has the nerve of releiving, calmness, antibacterial bacteriostatic, beauty treatment, treatment disease texts, is widely used in medical science, food, essence and flavoring agent industry. For example, Flos Rosae Rugosae quintessence oil has anti-melancholy, it is nervous to alleviate, and improves spirit, makes people's excitement, assists body circulation, can shrink capillary blood vessel, and cholecystitis, conjunctivitis, ophthalmia are hard to antiinflammation, can purify the blood, sharp spleen, stomach invigorating, benefit body, preventing or arresting vomiting are told etc. Peppermint essential oil throat-clearing throat-moistening, offset the good effect of anti-halitosis, can shrink capillary blood vessel, get rid of vivotoxin, improve eczema, tinea, relieve itch, inflammation and burning, soft skin, eliminates

blackhead, be of value to oiliness hair quality and skin qualify, the curative effect of the body and mind of releiving in addition.

Essential oil extracting process mainly contains steam distillation, using microwave-assisted, ultrasonic wave auxiliary extraction method, overcritical, subcritical abstraction etc.

Although various attempts are made before, for providing various extraction method of plant and few of them are such as-CN103361180B discloses extraction method of plant essential oil, JP5235206B2 discloses improved extraction of pharmaceutically active ingredients from plant material, US10323055B2 discloses plant extraction method and compositions, CA2671989C discloses steam distillation of catmint plants.

There exist many drawbacks in the existing unit. However, the existing system is very costly, hazardous, acquiring large space, having lots of disadvantages. Therefore, to avoid such limitations of the existing system and methods there is need to introduce a novel and efficient system for extraction of plant. Hence the present invention develops an improved plant extraction unit by utilizing steam distillation process.

Objective of the invention

An objective of the present invention is to attempt to overcome the problems of the prior art and provide an improved plant extraction unit by utilizing steam distillation process.

In a preferred embodiment, the present invention provides plant extraction unit which is cost effective, ecofriendly, less hazardous, highly efficient instrument.

It is therefore an object of the invention to provide extraction unit which is very efficient to prepare an extract of plant within a short period.

These and other objects and characteristics of the present invention will become apparent from the further disclosure to be made in the detailed description given below.

Summary of the invention

Accordingly following invention provides an improved plant extraction unit by utilizing steam distillation process. The proposed invention provides plant extraction unit. The experiment is conduct in a stainless-steel extraction unit. It consists of one round steel drum of dome shape structure capacity of 50 lit approx. having heating coils inside to heat, which is then connected with steel pipe which goes through one end of condenser use for cooling the formed

steam and then from other end of condenser the water droplet receiving pipe is connected from which cool water droplet goes and collected in collecting drum. The thermostat is use for measurement of rising temperature of boiling unit and cooling water unit is separately connected at bottom side which supplies continuously cool water to condenser for cooling the steam. The present unit is connected to condenser from two points, one is input and other is output. From input point the cooled water is supplied to condenser to cool down the steam and from output point the heated water is collect out in cooling drum, then this heated water is again get cooled in cooing drum and it again supply to condenser, this process is happening continuously. The separating funnels are used for the separation of essential oil and extract water.

Brief description of drawing

This invention is described by way of example with reference to the following drawing where, Figure 1 of sheet 1 illustrates basic diagram of proposed invention. Whereas, 100 denotes collecting drum, 101 denotes condenser.

Figure 2 of sheet 1 illustrates work flow chart for proposed invention.

In order that the manner in which the above-cited and other advantages and objects of the invention are obtained, a more particular description of the invention briefly described above will be referred, which are illustrated in the appended drawing. Understanding that these drawing depict only typical embodiment of the invention and therefore not to be considered limiting on its scope, the invention will be described with additional specificity and details through the use of the accompanying drawing.

Detailed description of the invention

The present invention relates to an improved plant extraction unit by utilizing steam distillation process. More particularly the proposed invention provides plant extraction unit.

The proposed device is a stainless-steel extraction unit. It consists of one round steel drum of dome shape structure capacity of 50 lit approx. having heating coils inside to heat, which is then connected with steel pipe goes through one end of condenser use for cooling the formed steam and then from another end of condenser the water droplet receiving pipe is connected from which cool water droplet is goes and collected in collecting drum. The thermostat is use for measurement of rising temperature of boiling unit and cooling water unit is separately connected at bottom side which supplies continuously cool water to condenser for cooling the steam. The present unit

is connected to condenser from two points, one is input and other is output. From input point the cool water is supplied to condenser to cool down the steam and from output point the heated water is collect out in cooling drum, then this heated water is again getting cool in cooling drum and it again supply to condenser, this process is happening continuously. The separating funnels are used for the separation of essential oil and extract water.

In the exemplary embodiment, steam distillation is a separation process which consists of distilling water together with other volatile and non-volatile components. The steam from the boiling water carries the vapor of the volatiles to a condenser, where both are cooled and return to the liquid or solid state; while the non-volatile residues remain behind in the boiling container. If the volatiles are liquids not miscible with water, they will spontaneously form a distinct phase after condensation, allowing them to be separated by decantation or with a separator funnel. In that case, a clevenger apparatus may be used to return the condensed water to the boiling flask, while the distillation is in progress.

Alternatively, the condensed mixture can be processed with fractional distillation or some other separation technique. Steam distillation can be used when the boiling point of the substance to be extracted is higher than that of water, and the starting material cannot be heated to that temperature because of decomposition or other unwanted reactions. It may also be useful when the amount of the desired substance is small compared to that of the non-volatile residues. It is often used to separate volatile essential oils from plant material. It is however much simpler and economical than those alternatives, and remains important in certain industrial sectors.

In exemplary implementations of invention, 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 fundamental nature of steam distillation is that it enables a compound or mixture of compounds to be distilled at a temperature substantially below that of the boiling point of the individual constituent. Essential oils contain substances with boiling points up to 200 °C or higher temperatures. In the presence of steam or boiling water, however, these substances are volatilized at a temperature close to 100 °C, at atmospheric pressure.

Fresh, or sometimes dried, botanical material is placed in the plant chamber of the still and the steam is allowing to pass through the herb material under pressure which softens the cells and allows the essential oil to escape in

vapour form. 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 oil. Besides the steam tiny droplets of essential oil evaporates and travel through a tube into the still's condensation chamber. Here essential oil vapours condense with the steam. The essential oil forms a film on the surface of the water. To separate the essential oil from the water, the film is then decanted or skimmed off the top. The remaining water, a by-product of distillation, is called floral water, distillate, or hydrosol. It retains many of the therapeutic properties of the plant, making it valuable in skin care for facial mists and toners. In certain situations, floral water may be preferable to be pure essential oil, such as when treating a sensitive individual or a child, or when a more diluted treatment is required.

A number of factors determine the final quality of a steam distilled essential oil. Apart from the plant material, most important are time, temperature and pressure, and the quality of the distillation equipment. Essential oils are very complex products. Each is made up of many, sometimes hundreds, of distinct molecules which come together to form the oil's aroma and therapeutic properties. Some of these molecules are fairly delicate structures which can be altered or destroyed by adverse environmental conditions. So, much like a fine meal is more flavourful when made with patience, most oils benefit from a long, slow 'cooking' process. It is possible that longer distillation times may give more complete oil. It is also possible however, that longer distillation time may lead to the accumulation of more artefacts than normal. This may have a curious effect of appearing to improving the odour, as sometimes when materials that have a larger number of components are sniffed, the perception is often of slightly increased sophistication, added fullness and character, and possibly, and extra pleasantness.

Another 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 present method.

The many features and advantages of the invention are apparent from the detailed specification, and thus, it is intended by the appended claims to cover all such features and advantages of the invention which fall within the true spirit and scope of the invention. Further, since numerous modifications and variations will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation illustrated and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

1) An apparatus for plant extraction, characterized in that; a dome shape round steel drum having heating coils inside connected with steel pipe through one end of condenser use for cooling the formed steam and from other end of condenser the water droplet receiving pipe is connected from which cool water droplet is goes and collected in said collecting drum; a cooling water unit is separately connected at bottom side which supplies continuously cool water to condenser for cooling the steam.
2) The apparatus for plant extraction as claimed in claim 1 wherein a thermostat is use for measurement of rising temperature of boiling unit.
3) The apparatus for plant extraction as claimed in claim 1 wherein said apparatus connected to the condenser from two points, one is input and other is output.
4) The apparatus for plant extraction as claimed in claim 1 wherein a separating funnel are used for the separation of essential oil and extract water.

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Effective leaders help others to understand the necessity of change and to accept a common vision of the desired outcome.