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EXTRACTION OF ESSENTIAL OILS FROM LEMONGRASS BY STEAM DISTILLATION

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Abstract - 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. 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 are using the "Steam Distillation" method for extraction which is the cheapest way for the extraction of Oils from the different parts of the plants. In this process steam is allowed to pass through the extraction chamber which contains plant matter. When steam passes through the herb material under pressure which softens the cells and allows the essential oil to escape in vapor form. The vapor allows passing through condenser and oil is collected in separating funnel and separated. The process selection product any specific product is depends on the properties of reactants & product, temperature, pressure, kinetics data of any reaction. In this project process is selected on the basis of product & economy of the process.

Key Words: Lemongrass, Essential Oil, Therapeutic, Odoriferous properties, Steam Distillation.

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 began. Oils were used in the embalming process, in medicine and in purification rituals. There are also over 200 references to aromatics, incense and ointments in the Old and New Testaments; Frankincense, Myrrh, Galbanum, Cinnamon, Cassia, Rosemary, Hyssop and Spikenard are noted for being used for anointing rituals and healing of the sick. 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. Therefore it is complicated to establish a composition profile of essential oils. The gas chromatographic method (GC) is almost exclusively used for the qualitative analysis of volatiles. The analysis of essential oils was developed in parallel with the technological developments in GC, such as stationary phases, detection devices, etc. However, advances in instrumentation were not the only important factor in the development of analytical methods for essential oils in plants. Sample extraction and concentration were also improved. The most outstanding improvements in the determination of the composition of essential oils came from the introduction of tandem techniques involving prior/further chromatography or spectroscopy.

1.1 What are Lemongrass Oils?

Lemongrass 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 environextracted 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.

1.2 Pharmacological Properties of lemongrass oil:

A. Lemongrass Oils Antiseptics

Lemongrass oils have antiseptic properties and are active against a wide range of bacteria as well as on antibio-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; Lemongrass; Culin savory; Lavender. Citral, geraniol, linalool and thymol are much more potent than phenol.

B. 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 articular pains. Oral administration of essential oils like lemongrass or pin oils, stimulate ciliated epithelial cells to secrete mucus. On the renal system, these are known to increase vasodilation and in consequence bring about a diuretic effect.

C. 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.

D. Others:

Cholagogue, anti-inflammatory, cicatrizing.

1.3 Chemical Constituents of Lemongrass Oils:

Pure Lemongrass oils are mixtures of more than 200 components, normally mixtures of terpenes or phenyl-propanic derivatives, in which the chemical and structural differences between compounds are minimal.

They can be essentially classified into two groups:

A. Volatile fraction: lemongrass oil constituting of 90–95% of the oil in weight, containing the monoterpene and Sesquiterpeness hydrocarbons, as well as their oxygenated derivatives along with aliphatic aldehydes, alcohols, and esters.

B. Nonvolatile residue: That comprises 1–10% of the oil, containing hydrocarbons, fatty acids, sterols, carotenoids, waxes, and flavonoids.

2. METHODS OF EXTRACTING ESSENTIAL OILS

Early efforts at extraction used alcohol and a fermentation process. New methods of lemongrass oils extraction are entering the mainstream of aromatherapy, offering new choices in oils never before available. With the new labels of CO2 and Super Critical CO2, 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 lemongrass oil selection.

Some of the few methods are available for extractions of lemongrass oils are given below;

2.1 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.

2.2 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 degrees 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. It is important to note that 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.

2.3 Solvent Extraction: A hydrocarbon solvent is added to the plant material to help dissolve the lemongrass oil. When the solution is filtered and concentrated by distillation, a substance containing resin (resinoid), or a combination of wax and lemongrass 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.

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

2.5 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.

2.6 CO2 & Super Critical CO2 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 CO2 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 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 frageance.

2.7. 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.

2.8. Steam Distillation: Most commonly, the essence is extracted from the plant using an 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 ounce.

3. METHODOLOGY

3.1 Extraction of Lemongrass Oils Using Steam Distillation Method

Lemongrass oils can be extracted using a variety of methods, although some are not commonly used today. Nowadays, a reputable distiller will try to preserve the original qualities of the plant, but the final therapeutic result is often not formed until after the extraction process. During extraction, the qualities of the oil change to give it more value for example, chamazulene (characteristic of the pure blue colour of German Chamomile) is formed during the steam distillation process. Currently, the most popular method for extraction is steam distillation.

Many old-time distillers favor this method for most oils, and say that none of the newer methods produces better quality oils. 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 allows 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.

As they are released, the tiny droplets of essential oil evaporate and, together with the steam molecules, travel through a tube into the still's condensation chamber. As the steam cools, it condenses into water. 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. 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 it's mild antiseptic and soothing properties, as well as it's pleasing floral aroma.

lemongrass oil isolated by steam distillation are different in composition to those naturally occurring in the oil bearing glands of plants, since the steam distillation conditions cause chemical reactions to occur which result in the formation of certain artificial chemicals, called artifacts. Some of these are considered beneficial e.g. the formation of chamazulene during the steam distillation of Chamomile oil; whilst others may not be e.g. the hydrolysis of linalyl

acetate during the distillation of clary sage. Few, if any, essential oils are unscathed by the thermal conditions of steam distillation, but some distillation techniques can, in certain instances, be a measure less damaging than others (e.g. hydro diffusion – a sort of inverted steam distillation where steam is introduced at the top of the vegetable material-packed container, and oil and condensate issue from the bottom – can produce oils with higher ester contents i.e. less thermally induced hydrolysis

A number of factors determine the final quality of a steam distilled essential oil. Aside from the plant material itself, 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.

3.2 Advantages:

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 well known. Newer methodology, such as sub critical water extraction, may well eventually replace steam distillation, but so far even contenders such as carbon dioxide extraction - although establishing a firm market niche - have not really threatened to take over as the major preparative technique.

4. MODERN (NON-TRADITIONAL) METHODS OF EXTRACTION OF ESSENTIAL OILS.

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
• Micro distillation
• Molecular spinning band distillation
• Membrane extraction

5. SEPARATION OF OIL AND WATER

Fig.1 Separating funnel

A separating funnel takes the shape of cone with hemispherical end. It has a stopper at the top and stopcock (tap), at the bottom. Separating funnels used in laboratories are typically made from borosilicate glass and their stopcocks are made from glass or PTFE. Typical sizes are between 30ml and 3L. In industrial chemistry, they can be much bigger and for much larger volumes, centrifuges are used. The slopping sides are designed to drain the liquid out of the funnel. Top of the funnel there is a standard taper joint, which fits with a ground glass or Teflon stopper.

To use a separatory funnel, the two phases and the two phases and mixtures to be separated in solution are added through the top with stopcock at the bottom closed. The funnel is then closed and shaken gently by inverting the funnel multiple times: if the two solutions are mixed together, too vigorously emulsion will from. The funnel is then inverted and the tap carefully opened to release excess vapour pressure. The separating funnel is set aside to allow for the complete separation of the phases. The top must be opened while releasing the lower phase to allow pressure equalization between the inside of the funnel and the atmosphere. When the bottom layer has been removed, the stopcock is closed and the upper layer is poured out through the top into another container

6. USES AND APPLICATION OF LEMONGRASS OIL:

Benefits & Uses:

6.1 Lemongrass may have to following benefits:

- Calming the stomach muscles and improving the flow of bile. This aids in the digestion of fat and helps food to pass through the digestive system more quickly.
- Reduce flatulence by relaxing the muscles that allow the body to rid itself of painful gas.
- Treatment of the symptoms of the irritable bowel syndrome (IBS), such as pain, bloating gas, and diarrhea. Some studies have shown that Lemongrass may be helpful to treat these condition. There are enteric-coated capsules that keep the oil from being released into the stomach. This can help to protect from heart burn and indigestion.
- Help the body break down gallstones.
- Help relieve menstrual cramps by relaxing smooth muscles.
- Treatment of skin conditions such as poison ivy and poison oak. When applied topically, Lemongrass soothes and cools the skin on contact, which may be helpful with these problems.
- Treatment of headaches by applying it to the forehead and temples.
- Lemongrass oil has also exhibited antiviral properties against a number of infections agents, including herpes.
- Promotes healthy respiratory functional clear breathing.
- Promotes digestive health.
- Repels bugs naturally.

6.2 Lemongrass may have to following uses:

6.2.1 Home uses:

- Clam a tempest, just one drop of Lemongrass oil rubbed on the stomach or taken internally can indigestion, an upset stomach or other internal digestive commotion. A must have when travelling. Restore vitality in the mouth, when your breath is sharp and your mouth feels flurry, Lemongrass oil with water creates a healthy, refreshing mouth rinse that leaves a lasting crisp, cleaning felling.
- Its about air flow, when sinuses seem to be clogged, and swollen and scratchy, diffuse Lemongrass oil for almost relief and revitalizing air flow. Lemongrass acts as an expectorant and may provide relief for colds, cough, sinusitis, asthma and bronchitis.
- Cool the joints, when the ravages of time wreak havoc on your joints, leaving that hot and achy feelings, Lemongrass oil mixed with lavender oil cools like an ice bath, but you to stay warm and dry.
- Cool your tootsies, if you have been on your feel all day or religiously wear hard soled shoes, just add Lemongrass oil to cold water compress to cool your overworked, overheated tootsies.

- Perk up, the invigorating aroma of Lemongrass is a wonderful, non-stimulating way to perk up on long drives, in school, during late night homework or any other time you need to "burn the midnight oil."
- Energize your lather, some shampoo and conditioner combos can make you want to go back to sleep. No energy. No pep. No fun. Not good, add to your potions to stimulate the scalp, energize and wake up! The oil is an antiseptic in nature, and can also help removed and ruff and lice.
- Allergies beware, Lemongrass oil has the ability to relax smooth muscles in the body the same muscles that our air ways and become affected in allergy treatment quiver.
- Chase away tension headaches, got mind numbing headache? A few drops of Lemongrass dabbed on your temples, neck and sinuses can quickly spring into action and chase that away headache away Seep, soak & revitalize, after a long day apply Lemongrass, let it seep in and then soak in a warm bath or shower. The refreshing Lemongrass vapour will make you feel cool, relaxed and energized again.

6.2.2 Cooking & Food:

- Add zip to all things chocolate, enhance your chocolate in a gazillion ways ;gourmet hot chocolate , Lemongrass brown frosting, Lemongrass bark, Lemongrass patties bundt cake, red velvet cupcakes with white chocolate Lemongrass cream cheese,yum.
- Brisk, Delightful Confection, Lemongrass chiffon cake, homemade candy canes, butter Lemongrass, Lemongrass ice creams, Lemongrass glaze over pastries and cookies, homemade Lemongrass patties.
- Unforgettable Beverages, Lemongrass water on ice, Lemongrass mocha, Lemongrass tea, Lemongrass hot chocolate, that's rights …its all delish

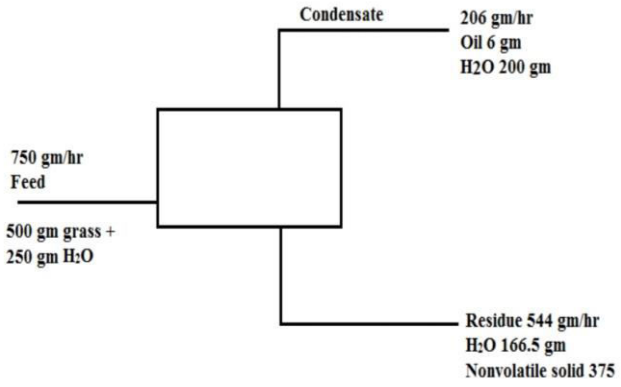
6.2.3 Body and Mind :

- Wake up your mind, Lemongrass oil activates the limbic function in your brain. The limbic function helps control things like emotions and long term memory and is related to olfactory structures in your nose.
- An Itch Fix, if you have the after effects of a sunburn where skin is a little warm and itchy, apply a drop of Lemongrass oil to cool, soothe and stop itching
- Theme park Relief, if you have got that "I my gosh ,I can't believe I just went on a spinning ride." Feeling, four or five drop of Lemongrass rubbed on the stomach can clam smooth muscles and help dispel discomfort.
- Travel to the Aretic, Without travelling, when you add a few drop of Lemongrass to your ice water ,it not only improve the taste, but also leaves you with a feeling of cool, refreshing arctic wind in your airways
- Don't make it easy on the criteria, many household bugs do not like Lemongrass oil ants aphids, beetles, plant lice, mice and cockroach try to steer clear of Lemongrass just add to water in a spray bottle and spray where you think pests grace you with their presence.
- Clean naturally, Lemongrass oil is a wonderful natural cleaning agent because it has antifungal and antibacterial properties. Spray on counter tops and bathroom surface scrub and enjoy cleaner clean.

6.2.4 Medical uses:

- Indigestion, nausea, symptoms of the common cold, headaches and muscles pain have been soothed by the use of Lemongrass oil throughout the years. The herb also stimulate the sense, is an antiseptic to clean wounds, an expectorant to clear excessive mucus build up and is used in aromatherapy treatment for depression and mental fatigue.
- Lemongrass has promising radio protective effects for cancer patients undergoing cancer treatment.
- Lemongrass flowers are large nectar producer and honey bees as well as other nectar harvesting organism forage them heavily. A mild, pleasant varietal honey can be produced if there is sufficient area of plants.
- Lemongrass oil has a high concentration of natural pesticides, mainly methane.

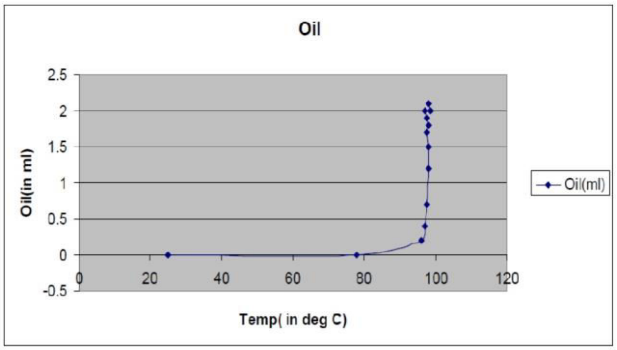
7. YIELD OF OIL THAT OBTAINED WAS CALCULATED BY:



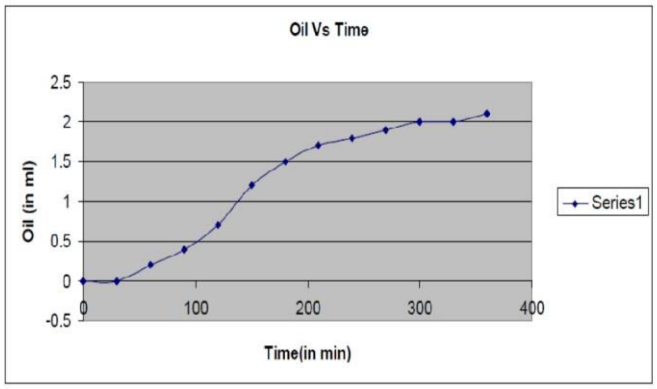
Overall material balance over distillation:
Feed = Condensate + residue

8. RESULT & DESCISION

1. Graph: DISTILLATE OIL V/S TIME



2. Graph: DISTILLATE (OIL) V/S TEMP



9. CONCLUSION

In steam distillation we observe that higher yield of Lemongrass oil can be obtain and higher economical process for production of essential oil. We conclude that steam distillation is the best and easiest way to obtain higher concentrated Lemongrass oil. Steam distillation method was found to be one for the promising techniques for the extraction of essential oil from plants as this process will preserve the original qualities of the plant. 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 (which can be prevented using steam distillation method). Volume of essential oil increases with increase in temperature by keeping time of heating as constant. Volume of essential oil increases with increase in time of heating by keeping temperature constant. On decreasing the pressure, we can extract essential oils of different plant materials at relatively less temperature and within less time of heating. Extraction of essential oils using steam distillation can be used on industrial scale to make various finished products which includes body oils, cosmetics lotions, baths, hair rinses, soaps, perfumes and room sprays.

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