

EXTRACTION AND FORMULATION OF PERFUME FROM
LEMONGRASS LEAVES

BY

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APPROVAL PAGE

This is to certify that ORJI ONYINYECHI A. registration number CHE/2007/086 carried out this project in partial fulfillment for the award of bachelor of Engineering in Chemical engineering Caritas University.

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DEDICATION

I dedicate this work to God Almighty and to my mother for sponsoring me throughout my stay in Caritas University.

ACKNOWLEDGEMENT

My greatest gratitude goes to God Almighty, the infinity of goodness, from whom every good gift comes, for the gifts of life and knowledge and who permitted the success and completion of this report.

I also express my profound gratitude to my mother Mrs. J.A Orji and my brothers whose prayers and support went a long way in the success of this project work and during my course of study in Caritas University. Not forgetting the woman I call my mumi² Hajia R.S Jemeta mni, whose encouragement and support well never be forgotten.

I also want to express my gratitude to all lecturers and staff in the department of Chemical Engineering; whose efforts in producing great leaders of tomorrow will never be in vain. Particularly I express my gratitude to my supervisor, Engr. Mrs. Odilinye, who made this project work a success through her encouragement, patience and support.

My gratitude to my friends, my roommates and my well wishers, for their encouragements and prayers during this research project work, may Almighty God bless and protect every one of them in all that they do, Amen.

ABSTRACT

Perfume extraction refers to the extraction of aromatic compounds from raw materials, using methods such as distillation, solvent extraction, expression or enfleurage. The extracts are either essential oils, absolutes, concretes, or butters, depending on the amount of waxes in the extracted product. Heat, chemical solvents, or exposure to oxygen in the extraction process denature the aromatic compounds, either changing their odour, character or rendering them odourless. In this work three methods, solvent extraction, hydro distillation and enfleurage methods were used to extract essential oil from lemongrass. Solvent extraction method yielded 2.08%, enfleurage method yielded 1.96% and hydro distillation methods yielded 0.95% essential oil respectively. From the analysis solvent extraction gave the highest yield because of the less exposure air and heat and this conform the literature value. The extracted essential oil was formulated into perfume using a fixative and carrier solvent.

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CHAPTER ONE

INTRODUCTION

1.1 Background

Perfume is a fragrant liquid made from an extract that has been distilled in alcohol and water.

Since the beginning of recorded history, humans have attempted to mask or enhance their own odor by using perfume, which emulates nature's pleasant smells. Many natural and man-made materials have been used to make perfume to apply to the skin and clothing, to put in cleaners and cosmetics, or to scent the air. Because of differences in body chemistry, temperature, and body odors, no perfume will smell exactly the same on any two people.

Perfume comes from the Latin "per" meaning "through" and "fume," or "smoke." Many ancient perfumes were made by extracting natural oils from plants through pressing and steaming. The oil was then burned to scent the air. Today, most perfume is used to scent bar soaps. Some products are even perfumed with industrial odorants to mask unpleasant smells or to appear "unscented."

While fragrant liquids used for the body are often considered perfume, true perfumes are defined as extracts or essences and contain a percentage of oil distilled in alcohol.

A perfume is composed of three notes. The base note is what a fragrance will smell like after it has dried. The smell that develops after the perfume has mixed with unique body chemistry is referred to as the middle note. And the top note is

the first smell experienced in an aroma. Each perfumery has a preferred perfume manufacturing process, but there are some basic steps. The notes unfold over time, with the immediate impression of the top note leading to the deeper middle notes, and the base notes gradually appearing as the final stage. These notes are created carefully with knowledge of the evaporation process of the perfume. The top note consists of small light molecules that evaporate quickly. The middle note forms the heart of main body of a perfume and act to mask the often unpleasant initial impression of base notes.

Traditionally perfumes were made from plant and animal substances and prepared in the form of waters, oils, unguents, powders, and incense. This last method of fragrance gives us our word 'perfume' which means 'to smoke through'. Most modern perfumes are alcohol-based and contain synthetic scents. While the term 'perfume' usually refers to fragrances in general, in the more technical language of the perfumer, a perfume must contain over 15% of fragrance oils in alcohol.

The preferred fragrances for perfumes are by no means universal, but differ according to cultural dictates and fashions. In the sixteenth century, for example, pungent animal scents such as musk and civet were very popular. In the nineteenth century, by contrast, such animal scents were generally considered too crude, and light floral fragrances were favored.

Perfumes were held in high esteem and widely employed in the ancient world. The wealthy would perfume not only the body, but their furnishings and their favorite horses and dogs. On ancient altars perfumes were offered to the gods, while in the

kitchens of antiquity the same scents — Saffron, Cinnamon, Rose, Myrrh — might be used to flavor food and wine.

Techniques involved in perfume extraction from plants include; solvent extraction, distillation and effleurage method. These methods to a certain extent, distort the odor of the aromatic compounds that are obtained from the raw materials.

Important thing in relation to perfume making is that there are three key ingredients you will need to produce perfume:

1. Essential Oils (these have been extracted from various plants (organic or nonorganic) and when combined give the smell of the perfume you are trying to produce.
2. Pure Grain Oil
3. Water

1.2 LEMONGRASS

Family: Poaceae (Gramineae), Cymbopogon species

The genus has about 55 species, most of which are native to South Asia, Southeast Asia and Australia. Two major types have considerable relevance for commercial use: East Indian lemongrass (*Cymbopogon flexuosus*) is native to India, Sri Lanka, Burma and Thailand, whereas West Indian lemongrass (*Cymbopogon citratus*) is assumed to originate in Malaysia. The plants grow in dense clumps up to 2 meters in diameter and have leaves up to 1 meter long. Further *Cymbopogon martini* (Roxb.) J.F. Watson var. *martini*, which is native to India and cultivated in Java is

worth mentioning as it also grows in Bhutan and is extracted for palmarosa oil. Another species with commercial relevance is citronella grass (*Cymbopogon winterianus* Jowitt) which also stems from India, but is today grown throughout the tropics.

The reported life zone for lemongrass is 18 to 29 degrees centigrade with an annual precipitation of 0.7 to 4.1 meters with a soil pH of 5.0 to 5.8 (East Indian) or 4.3 to 8.4 (West Indian). The plants need a warm, humid climate in full sun. They grow well in sandy soils with adequate drainage. Since the plants rarely flower or set seed, propagation is by root or plant division. The plants are harvested mechanically or by hand about four times each year with the productive populations lasting between four and eight years. Extensive breeding programs have developed many varieties of lemongrass.

The quality of lemongrass oil is generally determined by the content of citral, the aldehyde responsible for the lemon odor. Some other constituents of the essential oils are α -terpineol, myrcene, citronellol, methyl heptenone, dipentene, geraniol, limonene, nerol, and farnesol. West Indian oil differs from East Indian oil in that it is less soluble in 70 percent alcohol and has a slightly lower citral content.

Lemongrass is used in herbal teas and other nonalcoholic beverages in baked goods, and in confections. Oil from lemongrass is widely used as a fragrance in perfumes and cosmetics, such as soaps and creams. Citral, extracted from the oil, is used in flavoring soft drinks in scenting soaps and detergents, as a fragrance in perfumes and cosmetics, and as a mask for disagreeable odors in several industrial products. Citral is also used in the synthesis of ionones used in perfumes and cosmetics.

As a medicinal plant, lemongrass has been considered a carminative and insect repellent. West Indian lemongrass is reported to have antimicrobial activity .Oil of West Indian lemongrass acts as a central nervous system depressant .Oil of East Indian lemongrass has antifungal activity .The volatile oils may also have some pesticide and mutagenic activities .*Cymbopogon nardus* is a source of citronella oil. *Cymbopogon martinii* is reportedly toxic to fungi.

1.3 STATEMENT OF PROBLEMS

The problem of perfume extraction process is the distortion of the odor of the aromatic compounds obtained from the raw materials. This is due to heat, harsh solvents and also through the exposure to oxygen which will denature the aromatic compounds. These will either change their odor, character or render them odorless.

The problem of formulation of perfume involves knowing the proportion in which essential oil, and other materials to be mixed to avoid skin irritation and increase the intensity and longevity of the perfume.

Most imported perfumes are synthetic odorant which are not pure chemical substance but are mixture of organic compounds that are harmful when applied.

There are limited perfume plants, from which perfume can be made; this can lead to importation of perfume thereby causing the decline of foreign reserves and unemployment.

1.4 OBJECTIVE OF PROJECT

The main objective of this project is to extract and formulate perfume from Lemon grass (CYMBOPOGON FLEXUOSUS).

1.5 JUSTIFICATION/SIGNIFICANCE OF THE STUDY

This project focuses on the production of perfumes from natural/plant sources as against synthetic chemicals thereby will reduce any side effect resulting from synthetic chemicals.

The success of this work will stimulate the development of the perfume industry locally because of available, cheap raw materials.

More jobs will be created by those that will be engaged in planting/cultivating of the plant as well as establishing small scale extraction plants.

There will be reduction on the resources spent on importation of lemon grass fragrance by end users.

1.6 SCOPE OF THE WORK

This project work is on how perfumes are extracted and formulated from lemongrass. It further entails;

- The synthetic and aromatic sources of perfumes.
- The composition of perfumes and its concentration
- The extraction methods and formulation process involved
- The economic importance of lemongrass and the uses of lemongrass oil in perfume production process.

1.7 USES OF PERFUMES

- 1) The sense of smell is considered a right brain activity, which rules emotions, memory and creativity.
- 2) Perfumes are used to mask body odor.
- 3) Used to make people feel good
- 4) To heal and cure physical and emotional problems
- 5) Perfumes are being revived to help balance hormonal and body energy.
- 6) It helps to bolster the immune system when inhaled or applied topically.
- 7) Smelling sweet smells also affects ones mood and can be used as a form of psychotherapy.
- 8) Perfumes are being created to duplicate the effect of pheromones and stimulate sexual arousal receptors in the brain.

CHAPTER TWO

LITERATURE REVIEW

2.1 HISTORICAL DEVELOPMENT OF PERFUMES

Perfume is a fragrant liquid made from an extract of plants or animal that has been distilled in alcohol and water. The odoriferous compounds that make up perfume can be manufactured synthetically or extracted from plant or animal sources. Perfumes have been known to exist in some of the earliest human civilizations, either through ancient texts or from archaeological digs.

Modern perfumery began in the late 19th century with the commercial synthesis of aroma compounds such as vanillin, which allowed for the composition of perfumes with smells previously unattainable solely from natural aromatics alone.

The word perfume used today derives from the Latin word "per fumus", meaning "through smoke." Perfumery, or the art of making perfumes, began in ancient Mesopotamia and Egypt and was further refined by the Romans and Persians.

Although perfume and perfumery also existed in India, much of its fragrances are incense based. The earliest distillation of Ittar, Arabic meaning scent, was mentioned in the Hindu Ayurvedic.

In 2005 archaeologists uncovered what are believed to be the world's oldest perfumes in Pyrgos (Cyprus). The perfumes date back more than 4,000 years. The

perfumes were discovered in an ancient perfumery. In ancient times people used herbs and spices, like, myrtle conifer resin, bergamot, as well as flowers.

The art of perfumery was known in western Europe ever since 1221, considering the monks' recipes of Santa Maria delle Vigne or Santa Maria Novella of Florence, Italy. In the east, the Hungarians produced in 1370 a perfume made of scented oils blended in an alcohol solution at the command of Queen Elizabeth of Hungary, best known as Hungary Water. The art of perfumery prospered in Renaissance Italy, and in the 16th century, Italian refinements were taken to France Catherine de' Medici's personal perfumer, Rene the Florentine (Renato oil fiorentino). His laboratory was connected with her apartment by a secret passageway, so that no formulas could be stolen en route. France quickly became one of the European centers of perfume and cosmetic manufacture. Cultivation of flowers for their perfume essence, which had begun in the 14th century, grew into a major industry in the south of France.

Between the 16th and 17th century, perfumes were used primarily by the wealthy to mask body odors resulting from infrequent bathing. Partly due to this patronage, the perfumery industry was created. In Germany, Italian barber Giovanni Paolo Feminis created a perfume water called Aqua Adminabilis, today best known as eau de cologne, and his business was taken over by his nephew Johann Maria Farina (Giovanni Maria Farina) in 1732.

By the 18th century, aromatic plants were being grown in the Grasse region of France, in Sicily, and in Calabria, Italy to provide the growing perfume industry

with raw materials. Even today, Italy and France remain the center of the European perfume design and trade.

2.2 PERFUME CONCENTRATION

Perfume types reflect the concentration of aromatic compounds in a solvent, (which in fine fragrance) is typically ethanol or a mix of water and ethanol. Various sources differ considerably in the definitions of perfume types. The intensity and longevity of a perfume is based on the concentration, intensity and longevity of the aromatic compounds (natural essential oils / perfume oils) used: As the percentage of aromatic compounds increases, so does the intensity and longevity of the scent created. Specific terms are used to describe a fragrance's approximate concentration by percent/volume on perfume oil, which are typically vague or imprecise. A list of common terms (Perfume-Classification) is as follows:

- Perfume extract, or simply perfume (Extract): 15-40% aromatic compounds.
- Esprit de Parfum (ESdP): 15-30% aromatic compounds, a seldom used strength concentration in between EdP and perfume.
- Eau de Parfum (EdP), Parfum de Toilette (PdT): 10-20% (typical 15%) aromatic compounds.
- Eau de toilette (EdT): 5-15% (typical 10%) aromatic compounds.
- Eau de Cologne (EdC): Chypre citrus type perfumes with 3-8% (typical 5%) aromatic compounds.
- Perfume mist: 3-8% aromatic compounds (typical non-alcohol solvent).
- Splash (EdS) and Aftershave: 1-3% aromatic compounds.

2.3 PERFUME NOTES

Perfume is described in a musical metaphor as having three sets of notes, making the harmonious scent accord. The notes unfold over time, with the immediate impression of the top note leading to the keeper middle notes, and the base notes gradually appearing as the final stage. These notes are created carefully with knowledge of the evaporation process of the perfume.

- Top notes: The scents that are perceived immediately on application of a perfume. Top notes consist of small, light molecules that evaporate quickly. They form a person's initial impression of a perfume and thus are very important in the selling of a perfume. Also called the head notes
- Middle notes: The scent of a perfume that emerges just prior to when the top notes dissipate. The middle note compounds form the "heart" or main body of a perfume and act to mask the often unpleasant initial impression of base notes, which become more pleasant with time. They are also called the heart notes.
- Base notes: The scent of a perfume that appears close to the departure of the middle notes. The base and middle notes together are the main theme of a perfume. Base notes bring depth and solidity to a perfume. Compounds of this class of scents are typically rich and "deep" and are usually not perceived until 30 minutes after application.

The scents in the top and middle notes are influenced by the base notes; as well the scents of the base notes will be altered by the type of fragrance materials used as middle notes.

2.4 SOURCES OF PERFUMES

2.4.1 Aromatics sources

Plant sources

Plants have long been used in perfumery as a source of essential oils and aroma compounds. These aromatics are usually secondary metabolites produced by plants as protection against herbivores, infections, as well as to attract pollinators. Plants are by far the largest source of fragrant compounds used in perfumery. The sources of these compounds may be derived from various parts of a plant. A plant can offer more than one source of aromatics, for instance the aerial portions and seeds of coriander have remarkably different odors from each other. Orange leaves, blossoms, and fruit zest are the respective sources of petitgrain neroli, and orange oils.

- **Bark:** Commonly used barks include cinnamon and cascarilla. The fragrant oil in sassafras root bark is also used either directly or purified for its main constituent, safrole, which is used in the synthesis of other fragrant compounds.
- **Flowers and blossoms:** Undoubtedly the largest and most common source of perfume aromatics. Includes the flowers of several species of rose and jasmine, as well as osmanthus, plumeria, miosa, tuberose, narcissus, scented geranium, cassie, ambrette as well as the blossoms of citrus and ylang-ylang trees. Although not traditionally thought of as a flower, the unopened flower buds of the clove are also commonly used. Most orchid flowers are most

commercially used to produce essential oils or absolutes, except in the case of Vanilla, an orchid, which must be pollinated first and made into seed pods before use in perfumery.

- Fruits: Fresh fruits such as apples, strawberries, cherries unfortunately do not yield the expected odors when extracted; if such fragrance notes are found in a perfume, they are synthetic. Notable exceptions include litsea cubeba, vanilla, and juniper berry. The most commonly used fruits yield their aromatics from the rind; they include citrus such as oranges, lemons, and limes. Although grapefruit rind is still used for aromatics, more and more commercially used grapefruit aromatics are artificially synthesized since the natural aromatic contains Sulfur and its degradation product is quite unpleasant in smell.
- Leaves and twigs: Commonly used for perfumery are lavender leaf, patchouli, sage, violets rosemary, and citrus leaves. Sometimes leaves are valued for the "green" smell they bring to perfumes, examples of this include hay and tomato leaf.
- Resins: Valued since antiquity, resins have been widely used in incense and perfumery. Highly fragrant and antiseptic resins and resin-containing perfumes have been used by many cultures as medicines for a large variety of ailments. Commonly used resins in perfumery include labdanum, frankincense, myrrh, Perusbalsam, gum benzoin. Pine and fir resins are a particularly valued source of terpenes used in the organic synthesis of many other synthetic or naturally occurring aromatic compounds. Some of what is called amber and copal in perfumery today is the resinous secretion of fossil conifers.

- Roots, rhizomes and bulbs: Commonly used terrestrial portions in perfumers include iris rhizomes, Vetiver roots, various rhizomes of the ginger family.
- Seeds: Commonly used seeds include Tonka bean, carrot seed, coriander, caraway, cocoa, nutmeg, mace, cardamom, and anise.
- Woods: Highly important in providing the base notes to a perfume, wood oils and distillates are indispensable in perfumery. Commonly used woods include sandalwood, rosewood, Agarwood, birch, cedar, juniper, and pine. These are used in the form of macerations orry-distilled (rectified) forms.

Animal sources

- Ambergris: Lumps of oxidized fatty compounds, whose precursors were secreted and excreted by the sperm whale. Ambergris should not be confused with yellow amber, which is used in jewelry. Because the harvesting of ambergris involves no harm to its animal source, it remains one of the few animalic fragrance agents around which little controversy now exists.
- Castoreum: Obtained from the odorous sacs of the North American beaver.
- Civet: Also called Civet Musk, this is obtained from the odorous sacs of the civets, animals in the family Viverridaemongoose. The World Society for the Protection of Animals investigated African civets caught for this purpose.
- Hyraceum: Commonly known as "Africa Stone", is the petrified excrement of the Rock Hyrax.
- Honeycomb: From the honeycomb of the honeybee. Both beeswax and honey can be solvent extracted to produce an absolute. Beeswax is extracted with ethanol and the ethanol evaporated to produce beeswax absolute.

- Deer musk: Originally derived from the musk sacs from the Asian musk deer, it has now been replaced by the use of synthetic musk sometimes known as "white musk".

Other natural sources

- Lichens: Commonly used lichens include oakmoss and treemoss thalli.
- "Seaweed": Distillates are sometimes used as essential oil in perfumes. An example of commonly used seaweed is Fucus vesiculosus, which is commonly referred to as bladder wrack. Natural seaweed fragrances are rarely used due to their higher cost and lower potency than synthetics.

2.4.2 Synthetic sources

Aroma compound

Many modern perfumes contain synthesized odorants. Synthetics can provide fragrances which are not found in nature. For instance, Calone, a compound of synthetic origin, imparts a fresh ozonous metallic marine scent that is widely used in contemporary perfumes. Synthetic aromatics are often used as an alternate source of compounds that are not easily obtained from natural sources. For example, linalool and coumarin are both naturally occurring compounds that can be inexpensively synthesized from a terpenes. Orchid scents (typically salicylates) are usually not obtained directly from the plant itself but are instead synthetically created to match the fragrant compounds found in various orchids.

One of the most commonly used classes of synthetic aromatic by far are the white musk. These materials are found in all forms of commercial perfumes as neutral background to the middle notes. This musk is added in large quantities to laundry detergents in order to give washed clothes a lasting "clean" scent.

2.5 ESSENTIAL OIL

Essential oils, or volatile oils, are found in many different plants. These oils are different from fatty oils because they evaporate or volatilize on contact with the air and they possess a pleasant taste and strong aromatic odor. They are readily removed from plant tissues without any change in composition. Essential oils are very complex in their chemical nature. The two main groups are the hydrocarbon terpenes and the oxygenated and sulphured oils.

These oils do not have any obvious physiological significance for the plant. They may represent byproducts or metabolism rather than foods. The characteristic flavor and aroma that they impart are probably to some advantage in attracting insects and other animals, which play a role in pollination or in the dispersal of the fruits and seeds. When in high concentration, these same odors may serve to repel enemies of the plants (pest). The oils may also have some antiseptic and bactericidal value. There is some evidence that they play an even more vital role as hydrogen donors in oxide reduction reactions, as potential sources of energy, or in affecting transpiration and other physiological processes (Hill 1952).

Almost any part of a plant may be the source of the oil. Examples are flowers (rose), leaves (mint), fruits (lemon), bark (cinnamon), wood (cedar), root (ginger) or seeds (cardamom), and many resinous exudations as well.

Some of the most important essential oils used in the manufacture of perfumes are as follows:

Rosemary

Rosemary, (Rosmarinus officinalis), is a native of the Mediterranean region. It has long been a favored sweet-scented plant and has been important in the folklore of many countries. It is one of the least expensive and most refreshing odors. The plant is a small evergreen shrub that is cultivated in Europe and the United States. The oil is extracted by distillation of the leaves and fresh flowering tops or by solvent extraction. The leaves are valuable as a spice.

Violet

One of the most popular perfumes is made from violets. Blue and purple double varieties of *Viola odorata*, native to Europe, are grown mainly in the vicinity of Nice. Solvents or maceration with hot fats extracts the oil. It occurs in such minute amounts that 15 tons of flowers are required to obtain only one pound of oil. Genuine violet perfume is rare and expensive, and it has been almost entirely replaced by synthetic products derived from ionone.

Calamus

The roots of Calamus are the sweet and aromatic rhizomes of the sweet flag, *Acorus calamus*. It is a common plant of marshy ground in Europe, Asia and America. In powdered form Calamus is used for sachet and toilet powders, while the distilled oil is used in making perfumes. It has also been used for medicinal and flavoring purposes.

Otto of Roses

This is valuable oil that is also called **Attar of Roses**. It has been one of the most favorite perfumes either in combination with other oils or alone. Bulgaria supplied most the commercial supply in the 20th Century. The damask rose, *Rosa damascena*, was the main source. Flowers are picked in the early morning just as they are opening and are distilled immediately. The oil is colorless at first but gradually turns to a yellowish or greenish color.

Geranium

Pelargonium spp. leaves yield an essential oil after distillation. . *Pelargonium graveolens* is most frequently grown especially in Algeria and Reunion and to a lesser extent in southern France and Spain. They must be grown in minimum frost areas. A good grade of oil is obtained from the leaves of this species.

Grass Oils

Several important essential oils are derived from grasses and used in the perfume industry. The genus *Cymbopogon* (formerly *Andropogon*) is especially rich in perfume species.

Lavender

Lavender perfumes are very old and were used by the Romans in their baths. It is still one of the most important scents. It is a low shrub with terminal spikes of very fragrant bluish flowers. . The oil is important in the manufacture of Eau de Cologne and other perfumes and is also used in soaps, cosmetics and medicine as a mild stimulant. Lavender water, a mixture of the oil in water and alcohol, is popular in England (Yardley brand).

Jasmine

A highly esteemed perfume, jasmine is cultivated in southern France and surrounding areas. The main source is *Jasminum officinarum* var. *grandiflorum*, which is usually grafted on a less desirable variety. The flowers are picked as soon as they are open and the oil is extracted by effleurage.

Oak Moss

Oak Moss, also called Mousse de Chene, is a valuable addition to the raw materials of the perfume industry. It comprises various lichens that grow on the bark of trees. These lichens contain oleoresins that are extracted by means of solvents. After they have been collected, the lichens are dried. Then the perfume

develops in storage. Oak moss not only has a heavy, penetrating odor and blends well, but also has a high fixative value. It is an essential element in lavender perfumes and soap and in the better grades of cosmetics.

Lemon-grass Oil

Leaves of Cymbopogon citratus yield reddish-yellow oil with a strong odor and taste of lemons upon distillation. There is a very high content of citral in the leaves (70-80%). It is used in soaps and medicine. Citral is extensively used in perfumes, bath salts, cosmetics and toilet soaps and as a food flavoring. It is also the source of the aromatic substances known as ionones, which have many uses. One of the ionones is required in the synthesis of Vitamin A; another is the raw material for synthetic violet.

Lemon grass is common in the eastern tropics and is cultivated in Sri-Lanka, East Africa, India, the Congo and Madagascar.

2.6. Chemical Constituents of Essential Oils

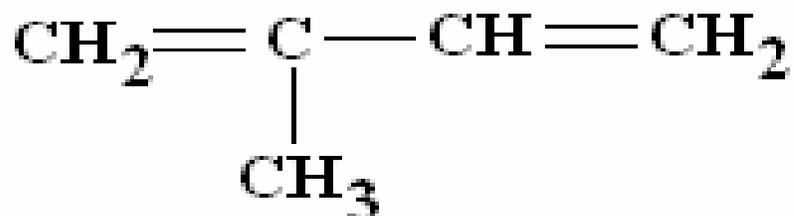
Pure essential oils are mixtures of more than 200 components, normally mixtures of terpenes or phenylpropanic derivatives, in which the chemical and structural differences between compounds are minimal. They can be essentially classified into two groups:

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.

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

2.6.1. Hydrocarbon:

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



(Isoprene)

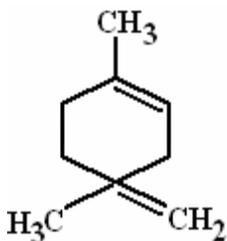
2.6.2. Terpenes:

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 join, it’s a sesquiterpene and four linked isoprene units are diterpenes.

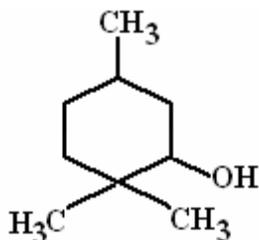
i. Monoterpenes [$C_{10}H_{16}$]

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.

ii. Sesquiterpenes

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

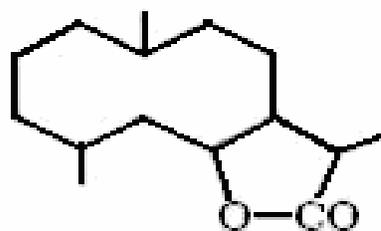
Sesquiterpenes are biogenetically derived from farnesyl pyrophosphate and in structure may be linear, monocyclic or bicyclic. They constitute a very large group of secondary metabolites, some having been shown to be stress compounds formed as a result of disease or injury.

iii. Sesquiterpene Lactones:

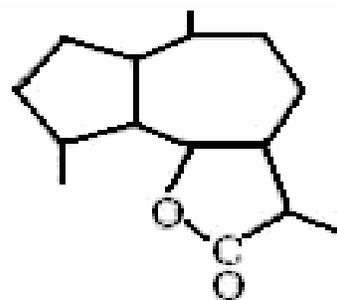
Over 500 compounds of this group are known; they are particularly characteristics of the Composite but do occur sporadically in other families. Not only have they proved to be of interest from chemical and chemotaxonomic

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.

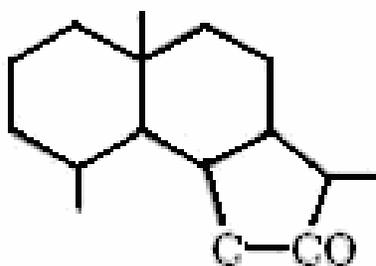
Chemically the compounds can be classified according to their carboxylic skeletons; thus, from the germacranolides can be derived the guaianolides, pseudoguaianolides, eudesmanolides, eremophilanolides, xanthanolides, etc.



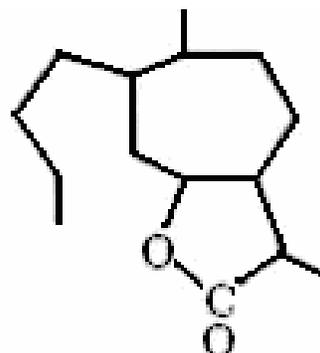
Germacranolides



Guaianolides



Eudesmanolides



Xanthanolides

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

iv. 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 geranyl geranyl pyrophosphate (GGPP).

2.6.3. 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.

2.6.4. 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 and Citronellal in lemongrass, lemon balm and citrus eucalyptus.

2.6.5. 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.

2.6.6. 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.

2.6.7. Ketones:

Properties: anti-catarrhal, cell proliferant, expectorant, vulnerary.

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.

2.6.8. 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 than ketones.

PARAMETERS EFFECTING YIELD & QUALITY OF ESSENTIAL OILS

- Mode of Distillation;

Technique for the distillation should be chosen on basis of oil boiling point and nature of herb as the heat content and temperature of steam can alter the distillation characteristics.

- Proper design of equipment's;

Improper designing of tank, condenser or separators can lead to loss of oils and high capital investments.

- Material of Construction of equipment's;

Essential oils which are corrosive in nature should be preferably distilled in stills made of resistant materials like aluminum, copper or stainless steel.

- Condition of Raw material;

Condition of raw material is important because some materials like roots and seeds will not yield essential oil easily if distilled in their natural state. These materials have to be crushed, powdered or soaked in water to expose their oil cells.

- Filling of raw material / steam distribution;

Improper loading of the herb may result in steam channeling causing incomplete distillation.

- Operating parameters like steam injection rate inlet pressure/ condensate temperature;

Proper control of injection rates and pressure in boiler operated units is necessary, to optimize the temperature of extraction for maximal yield

Temperature of condensate should not be high as can result in oil loss due to evaporation.

- Time given for distillation

Different constituents of the essential oil get distilled in the order of their boiling points. Thus the highest boiling fractions will be last to come over when, generally, very little oil is distilling. If the distillation is terminated too soon, the high boiling constituents will be lost.

- Pre condition of tank / equipments

Tanks should be well steamed for multiple crop distillation

Tank / equipments should not be rusted for quality oil.

2.7 TREATMENT / PURIFICATION OF ESSENTIAL OILS

Essential oil as obtained from the oil separator is in crude form.

It may have suspended impurities and appreciable moisture content. It might even contain some objectionable constituents which degrade its flavour/fragrance quality.

The presence of moisture and impurities adversely affects the keeping quality of oil and accelerates the polymerization and other undesirable reactions.

Remedies

Filtration of oil through Marbling is a simple method for removal of impurities. For removal of the moisture and free the oil of suspended impurities, addition of a drying agent like Anhydrous Sodium Sulphate to the oil, standing the oil overnight will get the oil clear of moisture. On industrial scale use of high speed centrifuge to clarify the essential oils can be also used.

Essential oils can also be rectified or re-distilled to remove objectionable constituents, dark colour or polymerized oil.

2.8 STORAGE OF ESSENTIAL OILS

- Oils should be stored in shaded areas away from direct sunlight
- Should always be filled up to brim level
- Containers / bottles should be well cleaned / steamed

2.9 PERFUME EXTRACTION METHOD

Fragrance extraction refers to the extraction of aromatic compounds from raw materials, using methods such as distillation, solvent extraction, expression¹ or enfleurage. The results of the extracts are either essential oils, absolutes, concretes, or butters, depending on the amount of waxes in the extracted product.

To a certain extent, all of these techniques tend to distort the odour of the aromatic compounds obtained from the raw materials. Heat, chemical solvents, or exposure to oxygen in the extraction process denature the aromatic compounds, either changing their odour character or rendering them odourless.

2.9.1 Extraction (fragrance)

Before perfumes can be composed, the odorants used in various perfume compositions must first be obtained. Synthetic odorants are produced through organic synthesis and purified. Odorants from natural sources require the use of various methods to extract the aromatics from the raw materials. The results of the extraction are essential oils, absolutes, concretes, or butters, depending on the amount of waxes in the extracted produced.

All these techniques will, to a certain extent, distort the odor of the aromatic compounds obtained from the raw materials.

Maceration/Solvent extraction: This is most used and economically important technique for extracting aromatics in the modern perfume industry. Raw materials are submerged in a solvent that can dissolve the desired aromatic compounds. Maceration lasts anywhere from hours to months. Fragrant compounds from woody and fibrous plant materials are often obtained in this manner as are all aromatics from animal sources. The technique can also be used to extract odorants that are too volatile for distillation or easily denatured by heat. Commonly used solvents for maceration/solvent extraction include hexane, and dimethyl ether. The product of this process is called a "concrete."

Supercritical fluid extraction: A relatively new technique for extracting fragrant compounds from a raw material, which often employs Supercritical CO₂. Due to the low heat of process and the relatively nonreactive solvent use in the extraction, the fragrant compounds derived often closely resemble the original odor of the raw material.

Ethanol extraction: A type of solvent extraction used to extract fragrant compounds directly from dry raw materials, as well as the impure oily compounds materials resulting from solvent extraction or effleurage. Ethanol extraction is not used to extract fragrance from fresh plant materials since these contain large quantities of water, which will also be extracted into the ethanol.

2.9.2 Distillation

Distillation is the process in which a liquid or vapour mixture of two or more substance is separated into its component fractions of desired purity, by the application and removal of heat. In simpler term, implies vaporizing or liberating the oils from the trichomes / plant cell membranes of the herb in presence of high temperature and moisture and then cooling the vapour mixture to separate out the oil from water.

Distillation is a common technique for obtaining aromatic compounds from plants, such as orange blossoms and roses. The raw material is heated and the fragrant compounds are re-collected through condensation of the distilled vapor. Distilled products, whether through steam or dry distillation are known either as essential oils or ottos.

Today, most common essential oils, such as lavender, peppermint, and eucalyptus, are distilled. Raw plant material, consisting of the flowers, leaves, wood, bark, roots, seeds, or peel, are put into an alembic (distillation apparatus) over water.

Steam distillation: Steam from boiling water is passed through the raw material for 60-105 minutes, which drives out most of their volatile fragrant compounds. The condensate from distillation, which contains both water and the aromatics, is

settled in a Florentine flask. This allows for the easy separation of the fragrant oils from the water as the oil will float to the top of the distillate where it is removed, leaving behind the watery distillate. The water collected from the condensate, which retains some of the fragrant compounds and oils from the raw material, is called hydrosol and is sometimes sold for consumer and commercial use. This method is most commonly used for fresh plant materials such as flowers, leaves, and stems.



Fig 2.1 Solvent Extraction Technique.

<http://theresaann.hubpages.com/>

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.

Dry/destructive distillation: Also known as rectification, the raw materials are directly heated in a still without a carrier solvent such as water. Fragrant compounds that are released from the raw material by the high heat often undergo anhydrous pyrolysis, which results in the formation of different fragrant compounds, and thus different fragrant notes. This method is used to obtain fragrant compounds from fossil amber and fragrant woods (such as birch tar) where an intentional "burned" or "toasted" odour is desired.

Fractionation distillation: Through the use of a fractionation column, different fractions distilled from a material can be selectively excluded to manipulate the scent of the final product. Although the product is more expensive, this is sometimes performed to remove unpleasant or undesirable scents of a material and affords the perfumer more control over their composition process.

Hydro distillation

Hydro / water distillation is one of the simplest, oldest and primitive process known to man for obtaining essential oils from plants.

Mostly used by small scale producers of essential oils in water / hydro distillation the plant material is almost entirely covered with water as suspension in the still which is placed on a furnace. Water is made to boil and essential oil is carried over to the condenser along with the steam. It is useful for distillation of powders of spices and comminuted herbs etc. The Deg Bhabka method of India using copper stills is an example of this technique. 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.

DISADVANTAGES OF THE HYDRO DISTILLATION

- The process is slow and the distillation time is much longer thereby consuming more firewood / fuel making process uneconomical.
- Variable rate of distillation due to difficult control of heat.
- Extraction of the herb is not always complete
- As the plant material near the bottom walls of the still comes in direct contact with the fire from furnace there is a likelihood of its getting charred and thus imparting an objectionable odor to the essential oil
- Prolong action of hot water can cause hydrolysis of some constituents of the essential oils such as esters etc which reacts with the water at high temperatures to form acids & alcohols
- Not suitable for large capacity / commercial scale distillations

- Not suitable for high boiling hardy roots / woody plant materials

2.9.3 Expression

Expression as a method of fragrance extraction where raw materials are pressed squeezed or compressed and the oils are collected. In contemporary times, the only fragrant oils obtained using this method is the peels of fruits in the citrus family. This is due to the large quantity of oil present in the peels of these fruits as to make this extraction method economically feasible.

2.9.4 Enfleurage

This is the absorption of aroma materials into solid fat or wax and extracting the odorous oil with ethyl alcohol. Extraction by enfleurage was commonly used when distillation was not possible because some fragrant compounds denature through high heat. This technique is not commonly used in the present day industry due to its prohibitive cost and the existence of more efficient and effective extraction methods.

Enfleurage is a two-step process during which the odour of aromatic materials is absorbed into wax or fat, and then extracted with alcohol.

2.10 FORMULATION OF PERFUMES

Although fragrant extracts are known generally by the general term “essential oil”, a more specific language is used in the fragrance industry to

describe the source, purity and techniques used to obtain a particular fragrant extract. The following fragrance extracts are used in perfume formulation

- **Absolute:** Fragrant materials that are purified from a pomade or concrete by soaking them in ethanol. By using a slightly hydrophilic compound such as ethanol, most of the fragrant compounds from the waxy source materials can be extracted without dissolving any of the fragrant waxy molecules. Absolutes are usually found in the form of an oily liquid.
- **Concrete:** Fragrant materials that have been extracted from raw materials through solvent extraction using volatile hydrocarbons. Concretes usually contain a large amount of wax due to the ease in which the solvents dissolve various hydrophobic compounds. As such concretes are usually further purified through distillation or ethanol based solvent extraction. Concretes are typically either waxy or resinous solids or thick oily liquids.
- **Essential oil:** Fragrant materials that have been extracted from a source material directly through distillation or expression and obtained in the form of an oily liquid. Oils extracted through expression are sometimes called expression oils.
- **Pomade:** A fragrant mass of solid fat created from the enfleurage process in which odorous compounds in raw materials are absorbed into animal fats. Pomades are found in the form of an oily and sticky solid.
- **Tincture:** Fragrant materials produced by directly soaking and infusing raw material in ethanol. Tinctures are typically thin liquids.

2.11 LEMON GRASS (Cymbopogon Citratus)

Lemongrass is an aromatic grass about 210 to 315 cm tall, and belong to the plant family called Gramineae. The leaves are linear, Lanceolate (125 x 1.7 cm); panicle very large (30 to 80 cm long), drooping and lax. The color is grayish or grayish green, rarely with a tinge of purple. It is the compound with raceme pairs in dense masses, spreading and slightly hairy. It has low glumes of the sessile spikelet with 1 to 3 definite nerves, shallowly concave with 1 or 2 depressions. The crop is propagated vegetatively through slips obtained by the splitting up of individual clumps which give about 110 to 150 tiller/clump. Clumps bearing well over 200 slips have been observed.

It is fresh smelling oil that can be used with success for fighting jet lag, cellulite, revitalizing a tired body and mind, as well as keeping the family pet free of fleas and ticks.

PROPAGATION

It is a vegetative propagated obtained through the splitting up of individual clumps which give about 110 to 150 tiller/clump. Clumps bearing well over 200 slips have been observed.

MANAGEMENT

Ideal spacing in planting lemongrass is 60 cm apart in rows and 90 cm apart each segment. Closely spaced plants yield more grass than wide spaced ones but increase in oil is not as much as the increase in grass yield. Fertilization is encouraged to achieve higher oil content.

Economic Uses of lemon grass

- Flavoring
 - adds flavor to food such as in chicken recipes;
 - used as flavoring for drinks such as tea; and
 - used as a spice in sherbet.
- Soil Erosion Control
 - a good crop for checking soil erosion; and
 - used as mulching material for various plants and trees.
- Oil
 - distillation yields commercial lemongrass oil or Indian verbena oil which has a reddish yellow color with the intense odor and taste of lemons.
 - Used for isolation of citral for manufacturing Vitamin C. Citral is the starting material for the manufacture of ionone and in preparing food flavoring.
 - Small amount of oil is used in making soap, detergent and other preparations.
- Fuel – the plants waste after oil extraction is used as fuel for distillation process.
- Medicinal
 - Crushed leaves are applied to the forehead and face as a cure for headache.
 - Root decoction serves as a diuretic.

- Chewed leaves are held in the mouth to alleviate toothache.
- Acts as a mild diuretic, promotes perspiration and serves as an emmenagogue (agents that promote the menstrual discharge).
- Excellent stomachic (stimulating the function of the stomach) for children.
- With black pepper, it is useful in checking menstrual disorders.
- A carminative and tonic to the intestinal mucus membrane; useful in cases of vomiting and diarrhea.
- Lemon grass oil mixed with equal quantity of pure coconut oil makes liniments for lumbago, chronic rheumatism, neuralgia, sprains and other painful afflictions. It is also helpful in treating ringworm.
- When taken internally, oil acts as stimulant and diaphoretic (having the property of promoting perspiration).

2.12 LEMONGRASS OIL

2.12.1 Origin of lemongrass oil

It is a perennial fast-growing aromatic grass, growing to about 1 meter (3 feet) high with long, thin leaves and originally was growing wild in India. It produces a network of roots and rootlets that rapidly exhaust the soil.

In India it is known as 'choomana poolu' and is also referred to as 'Indian Verbena' or 'Indian Melissa oil' and used in Ayurvedic medicine to help bring down fevers and treat infectious illnesses. It is a valuable ingredient in perfumes and citrus-type soaps and is also an insect deterrent.

2.12.2 Properties of lemon grass oil

Lemongrass oil has a lemony, sweet smell and is dark yellow to amber and reddish in color, with a watery viscosity.

2.12.3 Chemical composition

The main chemical components of lemongrass oil are myrcene, citronellal, geranyl acetate, nerol, geraniol, neral and traces of limonene and citral.

2.12.4 Extraction

Lemongrass oil is extracted from the fresh or partly dried leaves by steam distillation.

2.12.5 Uses of lemon grass

Lemongrass oil revitalizes the body and relieves the symptoms of jetlag, clears headaches and helps to combat nervous exhaustion and stress-related conditions.

It is a great overall tonic for the body and it boosts the parasympathetic nervous system, which is a boon when recovering from illness, as it also stimulates glandular secretions.

It is useful with respiratory infections such as sore throats, laryngitis and fever and helps prevent spreading of infectious diseases. It is helpful with colitis, indigestion and gastro-enteritis.

Lemongrass oil helps tone the muscles and tissue, relieves muscle pains by making the muscle suppler. It helps with correcting poor circulation and as an insect repellent. It helps to keep pets clean of fleas, ticks and lice.

It also is used for clearing up oily skin and acne, as well as athlete's foot. It alleviates excessive perspiration.

CHAPTER THREE

MATERIAL AND METHODS

3.1 SAMPLE SOURCE AND PREPARATION

Fresh Lemongrass sample was collected from the garden in Caritas University Amorji Nike Enugu State and was allowed to dry for about three days in the laboratory. The leaves were later cut into slices to reveal the tighter inner stem. Till when ready for use.



Fig 3.1 Fresh Lemongrass leaves in the garden

3.2 APPARATUS AND SOLVENTS

- A retort stand
- 500ml Separation funnel
- 250ml and 100ml Beakers
- Electronics weighting balance (500g/0.01g. DT-500B)
- Water bath(KW 1000DC)
- Mortar and pestle
- 500ml Round bottom flask

- Knife
- Aluminum foil
- Electric heater
- Distilled water
- N-hexane
- Ethanol
- Olive oil

3.3 SOLVENT EXTRACTION METHOD

130g of the dry sample of lemongrass were weighed from the sliced lemongrass sample and placed in a 500ml clean flat bottom flask. 600ml of N-hexane solvent were poured into the 500ml flask and stopped. The flask and content were allowed to stand for 24hrs; this was done to extract all the oil content in the lemongrass and for complete extraction. After which the extract was decanted into another 500ml beaker. 200ml of Ethanol were added to extract the essential oil since essential oil is soluble in Ethanol. The mixture was then transferred to 500ml separating funnel and separated by a process called liquid/liquid separation process. The content of the separating funnel was allowed to come to equilibrium, which separated into two layers (depending on their different density). The lower Ethanol extract and the upper Hexane layer were collected into two separate 250ml beaker and were placed in a water bath at 78°C. This was done to remove the Ethanol leaving only the natural essential oil. The yield of oil was determined by weighing the extract on an electronic weighing balance. The difference between the final weight of the beaker with extract and the initial weight of the empty beaker gave the weight of essential oil.

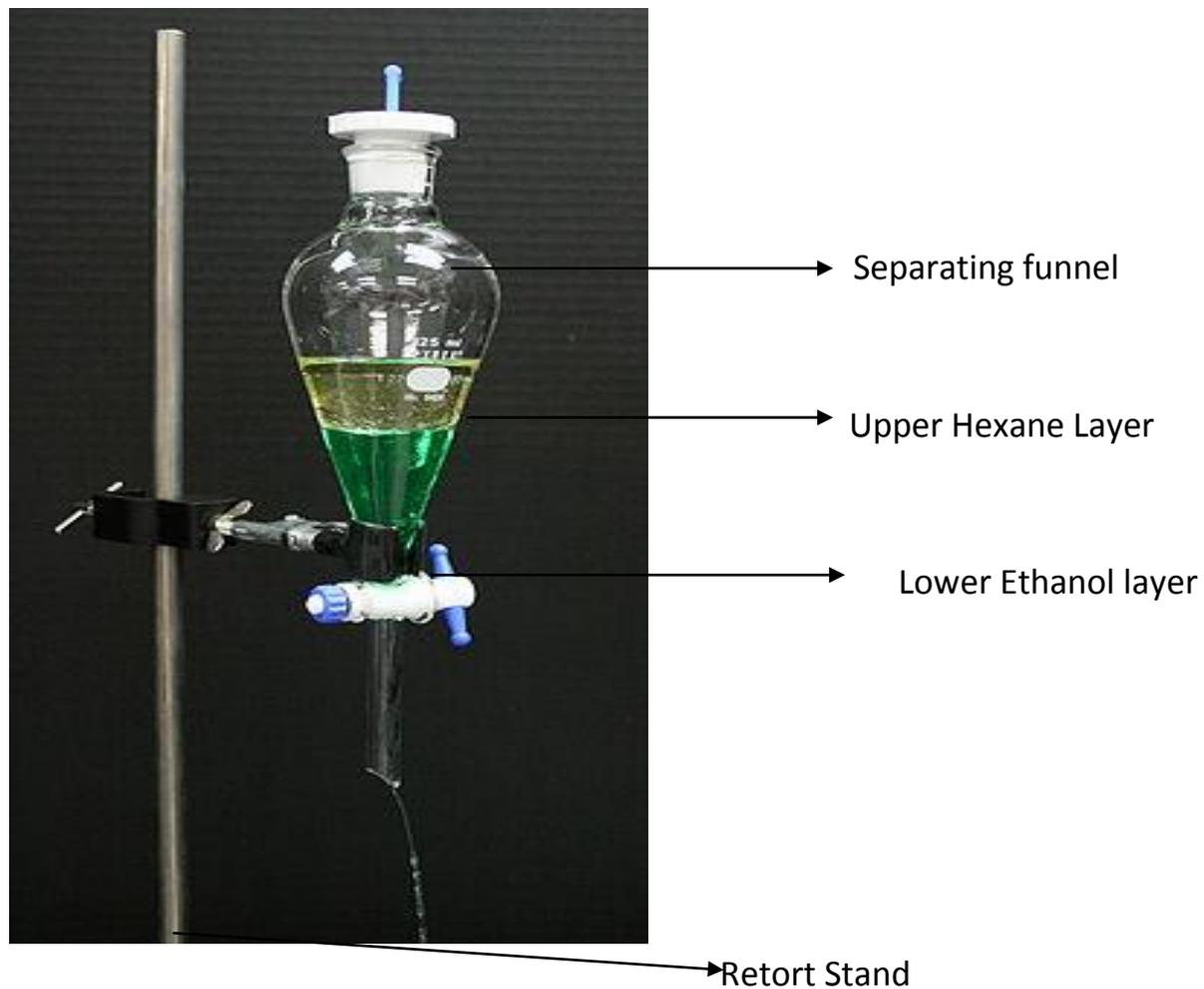


Fig 3.1 LIQUID-LIQUID EXTRACTION IN A SEPARATING FUNNEL

3.4 ENFLEURAGE METHOD

130g of the dry sample of lemongrass were weighed out and pounded with mortar and pestle (to reveal the tighter inner stem). The pounded sample was then placed in a 500ml beaker. About 70ml of light-flavored olive oil were warmed and mixed with the mashed lemongrass (to allow for efficient absorption of the

essential oil). The beaker was covered with aluminum foil and shaken until the lemongrass was distributed throughout the oil. It was then allowed to stand for 24 hours at room temperature for proper absorption. 140ml Ethanol were added to absorb the essential oil leaving behind the light-flavoured olive oil and the lemongrass residue. The Ethanol extract was decanted and placed on a water bath at 78°C to vaporize the Ethanol leaving behind the essential oil. The yield of oil was determined by weighing on an electronic weighing balance. The difference between the final weight of the beaker and the initial weight gave the yield of essential oil.

3.5 HYDRODISTILLATION METHOD

130g of fresh lemongrass sample were placed into a 500ml round bottom flask containing 250ml of distilled water. The flask was fitted with a rubber stopper connected to a condenser and heated. Water at 0°C flowed counter currently through the condenser to condense the ensuring steam. When the water reached 100°C it started boiling ripping off the essential oil from the lemongrass. When the lemongrass got heated up, the essential oil that was extracted from the leaf mixed with the water vapour. Both passed through the condenser and the vapour was condensed into liquid. With the use of ice block, cooling was made possible and volatilization of the essential oil was avoided.

The condensate was directly collected using a 500ml beaker and then poured into a separating funnel. This formed two layers of oil and water. The tap of the separating funnel was opened to let out the water while the oil was immediately collected into a 100ml stoppered. The bottle was closed tightly to prevent

vaporization of the essential oil. The oil was collected and the volume of oil obtained was weighed.

3.6 FORMULATION OF PERFUME WITH ESSENTIAL OIL PRODUCED

Apparatus and Reagents

- Pipette
- Funnel
- 50ml and 120ml beakers
- Perfume bottle
- Fixatives (Surprise and Dream)
- Methanol
- Distilled water
- Lemongrass essential oil

PROCEDURE

10ml of lemongrass essential oil extract were measured and placed in a 120ml beaker containing 5ml of Methanol. 5ml of the Fixatives were added to the mixture (to improve the longevity of the perfume). The solution were shaken and poured into a 50ml bottle.

CHAPTER FOUR

RESULTS AND DISCUSSION

4.1 SOLVENT EXTRACTION METHOD

Table 4.1 weight of oil with respect to time

Weight of oil (g)	Time (mins)
0.2	240
0.3	480
0.7	720
0.72	960
0.78	1200

The amount of essential oils obtained by solvent extraction method was 2.7g of essential oil per 130g of dry lemongrass sample. This gives about 2.08% yield of essential oil per 130g of dry lemongrass. The temperature used was 78⁰C i.e. the boiling point of ethanol. The volume of oil was measured at every 4hr interval to determine the oil yield at varying time. As the time increases the Ethanol solvent reduces thereby leaving the essential oil in the mixture.

4.2 ENFLEURAGE EXTRACTION METHOD

Table 4.2 weight of oil with respect to time

Weight (g)	Time (mins)
0.31	240
0.41	480
0.55	720
0.58	960
0.70	1200

The essential oil produced by enfleurage method was 2.55g weight of essential oil per 130g of dry lemongrass sample thereby producing 1.96% oil yield at 78^oC.

4.3 HYDRO DISTILLATION METHOD

Table 4.3 weight of oil yield with respect to time

Weight (g)	Time (mins)
0.10	240
0.14	480
0.26	720
0.35	960
0.38	1200

The result of hydro distillation process was 1.23g weight of 130g of lemongrass sample giving 0.95% yield of oil.

Physical and Chemical Properties of lemongrass oil

The oil produced was pale yellow, with an aromatic camphoraceous odour, pungent and cooling taste. Because of its high volatility, it was stored in a well field air-tight container protected from light in cool place. The essential oil was insoluble in water, miscible in alcohol and in oil.

Table 4.4 Result of Essential oil Extraction

Method of extraction	% yield
Solvent extraction	2.08
Enfleurage	1.96
Hydro distillation	0.95

From the experiment carried out it was observed that the best method used in extraction is solvent extraction method because it gave more oil than any other method. This conforms to works done by other researchers.

Enfleurage method, yielded less oil when compared to the solvent extraction this is because most volatile content gets lost during the pounding process while hydro distillation was low because the extraction of the essential oil was not always complete due to variable rate of distillation caused by heat. Essential oil produced with this method is not usually used for perfume production because of the burnt smell of the essential oil. Experiment was not carried out with steam distillation method because the equipments were not easily found and they are expensive. This makes steam distillation a rare method of essential oil extraction. Literarily, steam distillation yield about 3-4% aromatic compound of a given weight of sample.

GENERAL OBSERVATION ON THE PREFUME PRODUCED

- The quantity of essential oil has the highest yield in solvent extraction
- The essential is pale yellow and completely insoluble in water.
- Has a clear lemongrass fragrance.
- It is volatile and has a cooling effect in the skin.

CHAPTER FIVE

CONCLUSION

The experiment was carried out for the extraction of essential oil from lemongrass which has high essential oil content, which was used for perfume formulation. Analyses carried out were to determine the various oil yields using different extraction methods and the formulation of perfume with the essential oil produced. The result from the experiment yielded more with solvent extraction, followed by the effleurage method and the hydro distillation method. The extraction of essential oils by distillation is governed by the sensitivity of the essential oil to the action of heat, water and alcohol. (Thus essential oils with high solubility in water are susceptible to damage by action of heat therefore cannot be steam distilled). The oil must be steam volatile for steam distillation to be feasible. Most of the essential oils of commercial purposes are steam volatile, reasonably stable to action of heat and practically insoluble in water and hence suitable for processing by steam.

All these methods of extraction are special type of separation process used for heat sensitive materials like essential 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 essential oil present, yet not destroy or burns the essential oils. In summary these methods used chemical engineering unit operations of leaching, liquid-liquid extraction and evaporation techniques.

RECOMMENDATION

I recommend that solvent extraction method should be adopted in the extraction of essential oil for maximum yield. Also most plant materials yield well with steam distillation. I recommend the appropriate techniques for distillation processes.

I also recommend that in the formulation of perfume, the appropriate quantity of essential oil and other fixatives should be ensured to avoid skin reaction and to increase its intensity.

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[AWorldofAromatherapy.com/essential_oils.](http://AWorldofAromatherapy.com/essential_oils)

[http://www.theherbsplace.com/index.html.](http://www.theherbsplace.com/index.html)

<http://healingdeva.com/selena2.htm>

<http://healingdeva.com/selena3.htm>

<http://www.deancoleman.com/index.htm>

<http://www.heartmagic.com/>

APPENDIX A

CALCULATION OF PERCENTAGE YIELD OF ESSENTIAL OIL

FOR SOLVENT EXTRACTION METHOD

MATERIAL BALANCE

Weight of sliced lemongrass leave= 130g

Quantity of hexane used= 600ml

Quantity of Ethanol used= 200ml

Weight of beaker= 105.26g

Weight ethanol and essential oil= 202.7g

The weight of oil obtained= 2.7g

$$\% \text{yield} = \text{ME}/\text{ML} \times 100$$

Where ME = Mass of essential oil

ML = Mass of lemongrass sample

$$\text{ME} = 2.7\text{g}$$

$$\text{ML} = 130\text{g}$$

By substituting values

$$\% \text{yield} = 2.7/130 \times 100 = 2.08\%$$

Therefore % yield= 2.08%

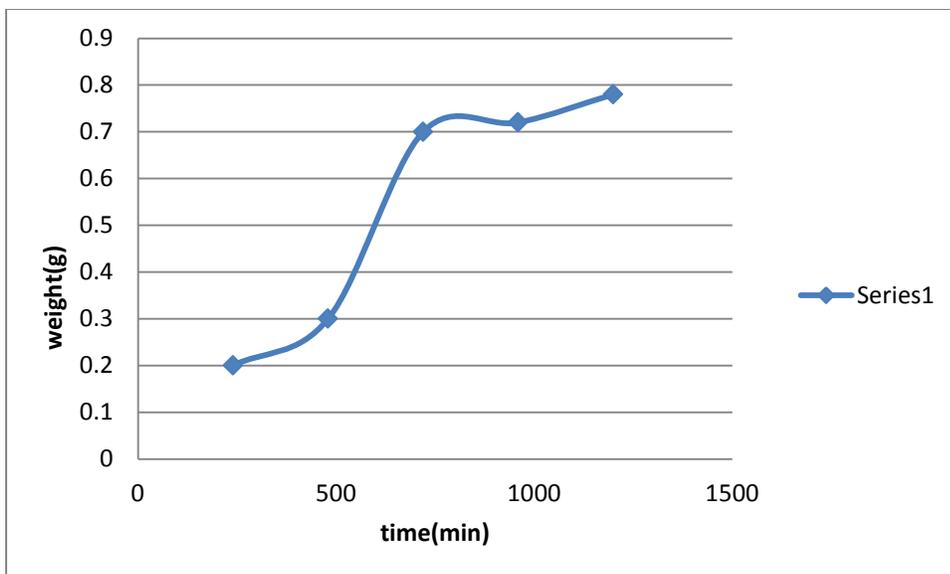


Fig 1 Graph of the weight (g) of essential oil to the time (mins)

APPENDIX B

MATERIAL BALANCE FOR ENFLEURAGE DISTILLATION METHOD

Weight of sliced lemongrass leave= 130g

Quantity of Olive oil used= 600ml

Quantity of Ethanol used= 140ml

Weight of beaker= 97.86g

Weight ethanol and essential oil= 100.41g

The total weight= 2.55g

$$\% \text{yield} = \text{ME/ML} \times 100$$

Where ME = Mass of essential oil

ML = Mass of lemongrass sample

ME = 2.55g

ML = 130g

By substituting values

$$\% \text{yield} = 2.55/130 \times 100 = 1.96\%$$

Therefore % yield= 1.96%

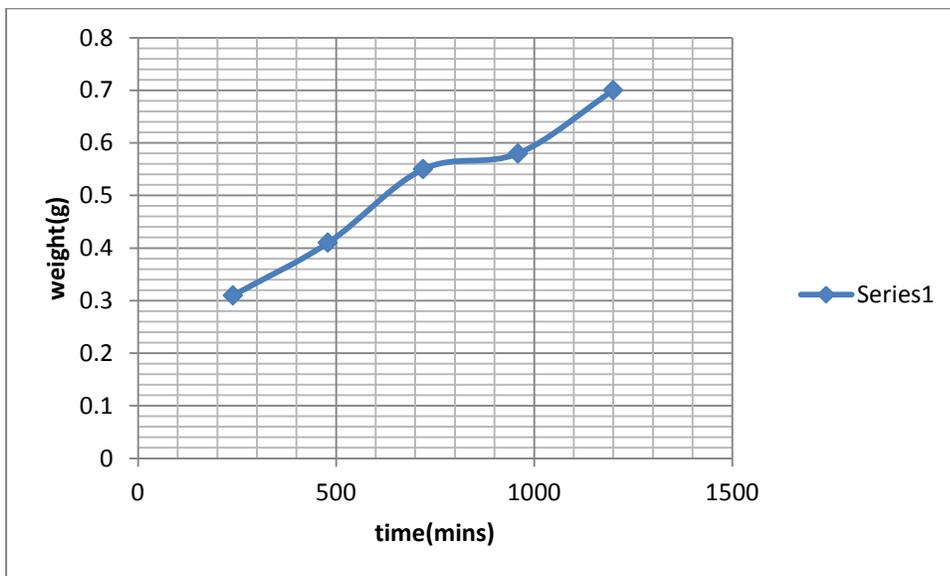


Fig2 Graph of the weight (g) of essential oil against the time (mins) for enfleurage extraction method

APPENDIX C

MATERIAL BALANCE FOR HYDRO DISTILLATION

Weight of sliced lemongrass leave= 130g

Quantity of Water used= 250g

Weight of beaker= 500g

The weight of oil obtained= 1.23 g

$$\% \text{yield} = \text{ME}/\text{ML} \times 100$$

Where ME = Mass of essential oil

ML = Mass of lemongrass sample

$$\text{ME} = 1.23\text{g}$$

$$\text{ML} = 130\text{g}$$

By substituting values

$$\% \text{yield} = 1.23/130 \times 100 = 0.95\%$$

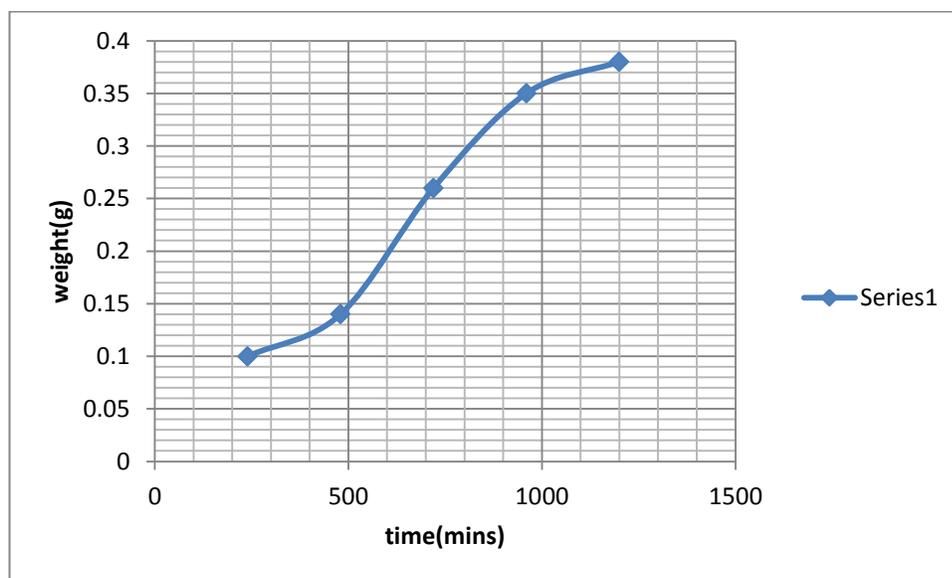


Fig3 Graph showing the weight (g) of essential oil against the time (mins) for Hydro distillation method.