EXTRACTION OF ESSENTIAL OIL FROM *CINNAMOMUM ZEYLANICUM* BY VARIOUS METHODS AS A PERFUME OIL

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SUPERVISOR'S DECLARATION

I hereby declare that I have checked this thesis and in my opinion, this thesis is sdequate in terms of scope and quality for the award of the degree of Bachelor of Engineering in Chemical Engineering.

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STUDENT'S DECLARATION

I hereby declare that the work in this project is my own except for quotations and summaries which have been duly acknowledged. The project has not been accepted for any degree and is not concurrently submitted for award of other degree.

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Dedicated to my parents, family and friends

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ABSTRACT

Cinnamomum Zeylanicum is a very popular spice and very useful substances in medicines and food, said to be originated from the island Sri Lanka, southeast of India. The plant is also playing an important role in aromatherapy due to its chemical constituent and also its aroma and scent. It contains cinnamaldehyde, an aromatic compound that have a very pleasant smell that can relax and soothe the mind and body, and also eugenol that have a strong aromatic odor and a spicy, pungent taste. The aims of this research are to extract and obtain essential oils from *Cinnamomum zeylanicum* using hydro distillation technique and ultrasonic extraction method, to analyze the chemical compound present in the essential oil using Gas Chromatography-Mass Spectrometer (GCMS), and to use the extracted essential oil in aromatherapy as a perfume oil. The hydro distillation method is used to obtain the essential oil from *Cinnamomum Zeylanicum* by grinding the leaves into a fine powder, weighing and then extracted the essential oil by Soxhlet apparatus while by ultrasonic extraction, the samples will soak in a mixture of ethanol and water in ultrasonic bath then will centrifuge to separate the solid and liquid. Next, the sample will be analyzed by GS/MS technique after rotary evaporating to separate between oil and water, in order to determine the chemical composition in the leaves of the plant. The percentage of essential oil yield is calculated as the weight of essential oils divided by the weight of leaf powder. Then, the essential oil will be tested as aromatherapy oil by using sensory evaluation. The result showed only essential oil by hydrodistillation contains eugenol and others 29 volatile and aromatic compounds while the essential oil by ultrasonic extraction, it contains no eugenol but more antioxidant compound. The time of extraction and weight of dry leaves should be varied in order to get better results in term of yield and active compound in the essential oil.

ABSTRAK

Cinnamomum Zeylanicum adalah rempah yang sangat popular dan sangat berguna dalam ubat-ubatan dan makanan, berasal dari pulau Sri Lanka, tenggara India. Tumbuhan itu juga memainkan peranan yang penting dalam aromaterapi kerana komposisi kimia dan juga kerana aroma dan bau. Ia mengandungi cinnamaldehyde, sebatian aromatik yang mempunyai bau yang sangat menyenangkan yang boleh merehatkan dan menenangkan fikiran serta dan tubuh badan, dan juga mengandungi eugenol yang mempunyai bau aromatik yang kuat dan rasa yang pedas. Matlamat kajian ini adalah untuk mendapatkan pati minyak dari Cinnamomum zeylanicum dengan menggunakan teknik penyulingan hidro dan kaedah pengekstrakan ultrasonik, untuk menganalisis sebatian kimia yang terdapat di dalam pati minyak dengan menggunakan Gas Chromatography Mass Spectrometer (GCMS), dan untuk menggunakan minyak pati yang diekstrak sebagai minyak wangi. Cara penyulingan hidro yang digunakan untuk mendapatkan pati minyak dari Cinnamomum Zeylanicum dengan mengisar daun ke dalam serbuk halus, menimbang dan kemudian mengekstrak pati minyak dengan menggunakan radas Soxhlet, manakala cara pengekstrakan ultrasonik, serbuk daun Cinnamomum Zeylanicum akan dicampur dengan campuran etanol dan air dan akan direndam di dalam larutan ultrasonik, kemudian akan disentrifuse untuk memisahkan pepejal dan cecair. Seterusnya, sampel akan dianalisis oleh GC/MS teknik setelah proses pengewapan putaran untuk memisahkan antara minyak dan air, untuk menentukan komposisi bahan kimia yang terdapat di dalam tumbuhan tersebut. Peratusan hasil minyak pati dikira sebagai berat minyak pati dibahagikan dengan berat serbuk daun. Kemudian, minyak pati akan diuji sebagai minyak aromaterapi dengan menggunakan kaedah penilaian deria. Hasil yang diperoleh menunjukkan hanya minyak pati yang diekstrak oleh kaedah penyulingan hidro mengandungi eugenol dan 29 sebatian aromatik yang lain manakala minyak pati oleh pengekstrakan ultrasonik, tidak mengandungi eugenol tetapi mengandungi banyak sebatian antioksida. Masa pengekstrakan dan berat daun kering perlu diubah untuk mendapatkan keputusan yang lebih baik untuk peratusan hasil minyak dan bahan kimia yang aktik di dalam minyak pati.

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CHAPTER 1

INTRODUCTION

1.1 Overview of *Cinnamomum Zeylanicum*

Cinnamon, a very popular culinary spice and a very useful substance in medicines, is said to be originated from the island Sri Lanka, southeast of India. It is also native to south-west India and the Tenasserim Hills of Burma. It is also now cultivated in many tropical countries such as Vietnam and Madagascar and Mexico. Cinnamon is scientifically named as *Cinnamomum Zeylanicum Blume* or *Cinnamomum Verum J.S. Presl* and also known as Ceylon cinnamon, true cinnamon, Ceylon-Zimtbaum and cannelle de Ceylan.

1.2 Physical Properties of *Cinnamomum Zeylanicum*

The name cinnamon is consequent from the Greek word ‘kinnamon’. *Cinnamomum Zeylanicum* belong to the diminutive evergreen tree in the Laurel (Lauraceae) family. The tree can grow up and reach a height in a range 6 m to 12 m. The stem is robust with between 30 – 60 cm diameters. Mature trees have a thick skin brown or gray and have many branches low with the tapered and rounded leaves. Cinnamon has the shape of small diameter stem and has a king-size or short. Exterior and interior color of cinnamon is light brown and the chemical properties of cinnamon are spicy, slightly sweet, warm and fragrant.

Figure 1.1 Bark of *Cinnamomum Zeylanicum*

Figure 1.2 Leaves of *Cinnamomum Zeylanicum*

1.3 Usage of *Cinnamomum Zeylanicum*

Cinnamon has been used for many purposes since very early times. Since the 16th century, cinnamon has been used as cooking spices and as prevention of food from stale. Cinnamon also used as flavoring in cookies, biscuits and cakes. It is also widely used in traditional and modern medicine, perfumes and aromatherapy.

In addition, in medicinal uses, it is used as a treatment for diarrhea, stomach upset, against respiratory ailments and gastric ulcers. The cinnamon bark may also possess a potentiating on insulin and can be used to treat type 2-diabetes and to lower serum cholesterol. (Khan et. al, 2003).

Next, the oil that extracted from cinnamon is employed in aromatherapy as a rub to promote blood circulation because the presence of blood thinning compound in it which help to reduce and remove pain. The pleasant aroma of cinnamon oil makes it a very effective to produce an effect to soothe and relax the mind, body and soul. It is also used as a room freshener and often added in potpourris and also can be used for the treatment of hypertension.

The essential oil of cinnamon contains both antifungal and antibacterial principles that can be used to prevent food spoilage due to bacterial contamination. (Fabio et. al., 2003). Furthermore, it is also proven that cinnamon oil is effective against some species of toxicogenic fungi (Junglal et. al., 2001) and respiratory tract pathogens. (Viollon and Chaumont, 1994).

1.4 Usual Method of Obtaining Cinnamon Essential Oil

In *Cinnamomum Zeylanicum*, there are many constituents such as cimmaldehyde, eugenol, linalool and cinnamic acid. There is various types of extraction that used to obtain essential oils, which are solvent extraction, hydro distillation ultrasonic extraction and also shaking and stirring along with solvent. Solvent extraction method is particularly hard to control. In this method, the less polar of components presents in the herbs or spices which are called oleoresins are extracted together with the essential oils. In addition, small amounts of organic solvents can pollute the extraction product of essential oil and usually the final extract product is very viscous. Ultrasonic extraction uses ultrasonic vibrations to extract samples with polar solvents in an ultrasonic bath. This is often used for chemical extraction from solid samples because it's simple. These methods are in essence derivations of liquid-liquid extraction. Sample extraction is achieved by simply placing solid samples in centrifuge containers with organic solvents and shaking. After extraction, separate sample matrix and extracts by centrifugation or filtration.

1.5 Hydro distillation

The most popular physical method for essential oil isolation is distillation. Prior to distillation, plant materials are in most cases dried and are then suitably ground so that the oil sacs are broken and a maximum of surface area is exposed for efficient oil release. Suitably ground plant materials are placed in a boiler with water completely covering them. As heat is slowly applied, the steam alone will be initially formed, and the distillate will be clear. With continued heating, the essential oil starts

to distill over with the steam, and the distillate becomes milky white. Distillation is continued until the distillate becomes clear, with no more oil distilling over from the material. Even though the essential oils have relatively high boiling points, co distillation like this brings about a satisfactory recovery of the oil because, in accordance with Dalton's law, a mixture boils when the sum of the vapour pressures of the individual components equals the atmospheric pressure. It is because hydro distillation at reduced pressure is better because lower temperature is used. During the process, the essential oil components form an azeotropic mixture with water. Most of the essential oil does not mix well with water in the liquid phase so, after condensation, they are separated by decantation. However, this method is somewhat slow and requires close manual attention and separation of the oil and aqueous phases of the condensate.

1.6 Problem Statement

Generally, there are few problems that arise in *Cinnamomum Zeylanicum* extraction. They are due to too many types of extraction process can be done to obtain essential oil. The traditional method used to produce essential oils is from hydrodistillation process but solvent extraction is also a good extraction process because it will produce a very similar scent to the material from which it was derived. However, the extracted product can be polluted because small amounts of organic solvent so it is not safe anymore. New method of extraction is introduced for example ultrasonic extraction that didn't require much time to extract the essential oil and also a straightforward method. But, different method will give a different yield of the active compound in the essential oil. So, it needs to be determined which

method will produce a higher percentage of the active compound in essential oil of *Cinnamomum Zeylanicum.*

Most of essential oils have medicinal properties and it had been used for a thousand years ago. Today, essential oils from *Cinnamomum Zeylanicum* are widely used in medical field and also in aromatherapy. The aromatic properties of the *Cinnamomum Zeylanicum* which is eugenol and cinnamaldehyde it will give the best scent and fragrance in order to soothe and relax the both mind and soul just by healing them. Furthermore, it also can be used for the treatment of hypertension. Then, it's also used as an aromatherapy oil in order to circulate the blood circulation and remove the pain. (Tisserand, 1995). Therefore, with the aromatic compound found in essential oil of *Cinnamomum Zeylanicum*, it is needed to determine whether it can be aromatherapy or perfume oil or not.

1.7 Research Objectives

The main objectives of this research are:

1. To extract and obtain essential oils from *Cinnamomum Zeylanicum* using various method of extraction.
2. To analyze the chemical compound present in the essential oil using Gas Chromatography-Mass Spectrometer (GCMS).
3. To compare the yield between the essential oil of *Cinnamomum Zeylanicum* from different method of extraction.
4. To use the extracted essential oil as a perfume oil.

1.8 Scope of Proposed Study

This research is an experimental study of hydro distillation method using *Cinnamomum Zeylanicum* as raw material. In order to realize the objectives, three scopes have been identified. The scopes are:

i. To know the yield of *Cinnamomun Zeylanicum* essential oils by different method of extraction.

   The methods that will uses are hydrodistillation, ultrasonic extraction and shaking and stirring along with solvent. The part of plant which is leaves will used in order to get better yield of essential oils.

ii. To analyze the product using chromatography.

   This study is focusing on using the gas chromatography to analyze the active compound in the extracted essential oil of *Cinnamomum Zeylanicum* by different methods of extraction.

iii. To determine whether the extracted essential oils of *Cinnamomum Zeylanicum* can be used as a perfume oil

   The essential oil will be tested using the sensory analysis test based on scent whether it can be perfume oil or not.

1.9 Expected Outcome

The expected outcome of this research is expected that the essential oil of *Cinnamomum Zeylanicum* can be used in aromatherapy as perfume oil in order to promote blood circulation and relaxing the mind and body just by smell the odor.

1.10 Significance of Proposed Study

This research intends to produce essential oil by of *Cinnamomum zeylanicum* from leaves using the various processes of extraction and some other test such as sensory evaluation test. Essential oil also can be used in aromatherapy as perfume oil that can help to soothe and relax the mind and body. In addition, it can be used to promote good blood circulation which it will help to help significantly in removing pain.

1.11 Contribution of the Study

The hydro distillation is expected to produce the best quality of essential oils from *the Cinnamomum zeylanicum bark* and leaves. There are some expected results from this research:

i. The equipment of extraction process will be more efficient and effective to obtain essential oils.

ii. Potential savings in the operational cost.

iii. The environmental friendly experiment will be conducted.

iv. *Cinnamomum zeylanicum* in aromatherapy can be contributed to a modern of application in this world.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This chapter is about literature reviews of the articles of production of essential oils from Cinnamomum zeylanicum extraction by hydro distillation. There are six sub-chapters to look through about overview of Cinnamomum zeylanicum, essential oils, aromatherapy, extraction process, essential oil production method and sensory analysis.

2.1 Overview of Cinnamomum Zeylanicum

Cinnamomum zeylanicum is an herbal substance. The scientific name is Cinnamomum verum J. S. Presl or Cinnamomum zeylanicum Nees). it's characteristics are dried bark, freed from the outer cork and the underlying

parenchyma (ESCOP, 2003; European Pharmacopoeia 6.2, 2009). Cinnamomum verum J. S. Presl. is also known by the synonym Cinnamomum zeylanicum Blume and is member of Lauraceae family (Keller et al., 1992).

2.1.1 History of Cinnamomum zeylanicum

Cinnamon has been used as a spice for thousands of years. In Egypt, cinnamon was a spice used in embalming fluids for preserving cadavers. In Ayurvedic medicine, the world's oldest system, cinnamon bark was used as an antiemetic, anti-diarrheal, anti-flatulent and also as a general stimulant. Moreover, The Portuguese found cinnamon trees growing in Sri Lanka (Ceylon) in the early 16th century; they imported cinnamon to Europe during the 16th and 17th centuries afterwards. The Dutch occupied Sri Lanka in the mid-17th century until the British captured the island in 1796. The East India Company then became the main exporter of cinnamon to Europe. The Dutch cultivated cinnamon in Java and the exports of Ceylon cinnamon decreased as a result of heavy export duties. In spite of that, Sri Lanka is the only regular supplier of cinnamon bark and leaf oils. The food industry chooses Ceylon cinnamon, but pharmaceutical manufacturers use both, oils from Ceylon cinnamon (cinnamon oil) and from Chinese cinnamon (cassia oil) interchangeably. China is the foremost exporter of cassia cinnamon. (Barceloux, 2009).

Cinnamon belongs to the herbal substances with one of the longest medicinal traditions. Conversely, there is no real reference to Ceylon as its

original source. Dioskorides described 5 cassia and 7 cinnamon species. The latter ones were reported as possessing diuretic and digestive properties. From the 8th century, cinnamon was introduced in Europe as an expensive spice that only could be used by kings and popes. There is a written report on the use of cinnamon in an Arabic source from around 1275. In 1310, Johannes of Montevino confirmed the existence of cinnamon trees in Ceylon. About 100 years later, Nicolo Conit accommodated a real prescription of the cinnamon tree.

Introduced by the Portuguese, cinnamon of Ceylon remained the preferred substance in Europe. It has been described, that in 1536 cinnamon of Ceylon would have cost 40 times more than the cinnamon from Java or the Philippines. The herbal substance was first accumulated from wild growing trees. The farming of cinnamon began around 1765, when Holland took the lead in the origin area. The manufacturing was streamlined in the way that a better quality was obtained and Holland could contribute enough cinnamon to cover the European needs. When the English took over in 1796, the cinnamon cultivation and trading became a dominance of the English Eastern-Indian Company. Around 1833, when Holland developed the cultivation of cinnamon in Java and Sumatra, the herb and the essential oil were introduced into medicine as a stimulant. The oil was contrived for the first time by St Amando of Doornyk at the end of the 15th century.

2.1.2 Chemical Constituents in Cinnamomum Zeylanicum

Barceloux, 2008 mentions that volatile oils are products from the distillation process of the bark, leaves, flowers, or buds of *Cinnamomum* species and the chemical composition of these oils varies depending on the part of the plant used for the distillation process. Cinnamon bark and leaf oil are steam distillation products obtained from the inner bark and leaves, respectively, of Cinnamomum Verum. The main components of cinnamon bark oil are cinnamaldehyde while eugenol is the main components about 81-85% of cinnamon leaf oil. A commercial sample of essential oils from Cinnamomum verum contained approximately 63% cinnamaldehyde, 8% limonene, 7% eugenol, 5.5% cinnamaldehyde propylene, and 1-2% of a variety of terpenoid compounds which are pinene, camphene as measured by gas chromatography/mass spectrometry.

According to R. Wang et al., 2009, main constituents of the Cinnamomum zeylanicum leaf are 79.75% eugenol, 16.25% trans-cinnamaldehyde, 0.14% Linalool, Neohexane, cinnamyl alcohol and others various compounds of aldehyde, ester, alcohol, ketone and alkanes. Cinnamon bark contains up to 4% of essential oil consisting primarily of cinnamaldehyde (60-75%), cinnamyl acetate (1-5%), eugenol (1-10%) (WHO Vol. 1, 1999), β-caryophyllene (1-4%), linalool and (1-3%) and 1.8-cineole (1-2%). (ESCOP, 2003). Other constituents are oligopolymeric procyanidins, cinnamic acid, phenolic acids, pentacyclic diterpenes cinnzeylanol and its acetyl derivative cinnzeylanine and the sugar mannitol, L-arabino-D-

xylanose, L-arabinose, D-xylose, α-D-glucose as well as mucilage polysaccharides (Hänsel et al., 1992; ESCOP, 2003).

The essential oil of the bark is described in the European Pharmacopoeia, 2009. There exists a summary report on the essential oil of cinnamon bark by the Committee for Veterinary Medicinal Products. According to this information, the oil mainly contains cinnamaldehyde (55-76%), eugenol (5-18%) and saffrole (up to 2%). This document refers also to human use (CVMP 2000).

2.1.3 Cinnamaldehyde

3-Phenyl-2-propenal is known as cinnamaldehyde, is a pale yellow liquid with a warm, sweet,spicy odor and pungent taste reminiscent of cinnamon. It is found naturally in the essential oils of Chinese cinnamon (Cinnamomum cassia, Blume) (75–90%) and Ceylon cinnamon (Cinnamomum zeylanicum, Nees) (60–75%) as the primary component in the steam distilled oils. It also occurs in many other essential oils at lower levels.

Greater than 95% of the consumption of cinnamaldehyde occurs in flavor uses where a spicy, cinnamon character is needed. It is used in a large range of products including bakery goods, confection, and beverages and also in toothpastes, mouthwashes and chewing gum. Furthermore, it is also used effectively in air fresheners where odor neutralization

can be achieved by reacting with sulfur and nitrogen malodorants. Other uses include its capability as an animal repellent, its use in compositions to attract insects and demonstration of a positive antifungal activity. Cinnamaldehyde has been efficiently isolated in high purity by fractional distillation from cassia and cinnamon bark essential oils and also used in manufacturing protocols for the preparation of natural benzaldehyde through a retro-aldol process.

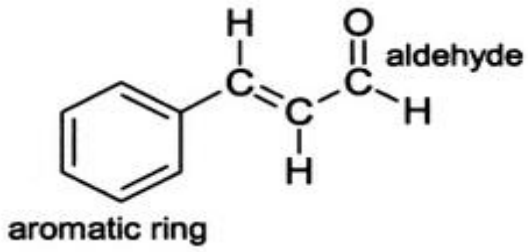
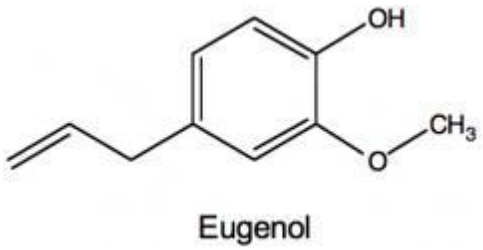


Figure 2.1 Cinnamaldehyde

2.1.4 Eugenol

According to Wikipedia, eugenol is a phenylpropene, an allyl chain-substituted guaiacol. Eugenol is a member of the phenylpropanoids class of chemical compounds. It is a clear to pale yellow oily liquid extracted from certain essential oils especially from clove oil, cinnamon, basil and bay leaf. It is slightly soluble in water and soluble in organic solvents and has a spicy, clove-like aroma. The name is derived from the scientific name

for clove, *Eugenia aromaticum* or *Eugenia caryophyllata*. Eugenol is responsible for the aroma of cloves**.** Eugenol is used in perfumeries, flavorings, essential oils and in medicine as a local antiseptic and anesthetic. It was used in the production of isoeugenol for the manufacture of vanillin, though most vanillin is now produced from phenol or from lignin. Eugenol derivatives or methoxyphenol derivatives in wider classification are used in perfumery and flavoring. They are used in formulating insect attractants and UV absorbers, analgesics, biocides, and antiseptics. Eugenol possesses significant antioxidant, anti-inflammatory and cardiovascular properties, in addition to analgesic and local anesthetic activity. (Pramod, Ansari and Ali, 2010).



Eugenol

Figure 2.2: Eugenol

2.1.5 Usage of Cinnamomum Zeylanicum

When going back in history, cinnamon was used as a stomachic and in case of nerve weakness. As the gastrointestinal user is concerned, cinnamon was used in case of diarrhea, dyspepsia, and hyperacidity with reflux, vomiting and bloating (Madaus, 1938). It is also used poultices to treat minor bacterial and fungal infections of the skin externally and as a rub in

aromatherapy to promote blood circulation. (Tisserand, 1995). It is because the presence of blood thinning compound in it that will help to remove the pain and ensure the oxygen to supply to the body cells leading to higher metabolic activity. It is also suitable to use to increase the appetite and dyspepsia. (Blumenthal, 1998). Khan et. Al, 1990 state that cinnamon bark posses a potentiating effect on insulin which is a water soluble polyphenol compound and can be used in the treatment of type 2 diabetes as well as to lower triglyceride levels and serum cholesterol. (Khan et. al., 2003, Broadhurst et al. 2000, Onderolgu et al, 1999). It also can be used as perfume, room fresheners and also added in potpourris because of the pleasant smell and refreshing aroma that can soothe and relax the mind and body.

2.2 Essential oils

Shahzad, 2008 mentions that the essential oils carry the scent of the spices or aromatic plant in a concentrated form. The essential oils are volatile and do not contain the very high boiling or non-volatile components that are responsible for the characteristic taste of certain spices. For a thousand years ago, essential oil has played an important role in our daily lives. It is said to be used as anointing and healing the sick. (Doterra, 2008). The first people used the essential oils is the Egyptians in medical practice, beauty treatment, food preparations and also in religious ceremony. Apart from that, the Greek uses the essential oil in therapeutics massage and aromatherapy practices meanwhile the Romans use the essential oils to promote health and personal hygiene. It is followed by Chinese and Ayurvedic

whose also use aromatic herbs, the Persians has also started to extract the essential oils from aromatic plants by refining the distillation techniques.

Extraction of essential oil is used throughout the dark ages in Europe for their anti-bacterial and fragrant properties. Nowadays, the supreme healing characteristics of essential oils were rediscovered in 1937 by a French chemist, Rene-Maurice Gattefosse, who healed an awfully burnt hand with pure lavender oil while a French contemporary, Dr. Jean Valnet, used therapeutic-grade essential oils to successfully treat wounded soldiers during World War II. Hence, Dr. Valnet went on to become a world head in the growth of aromatherapy uses. The modern application of essential oils has continued to rise quickly as health scientists and medical practitioners continue to analysis and verify the abundant health and wellness advantages of therapeutic-grade essential oils.

Zubair, 2008 mentioned that essential oil referred to as “essence” are botanical extracts of various plant parts such as leaves, flowers, roots, buds, twigs, bark, seeds and fruits. It is found in special secretory glands or cells within the plant life. The aromatic substances are formed and stored in certain organs of a plant as a byproduct or because of its metabolism. According to Wikipedia, an essential oil is a concentrated hydrophobic liquid comprising volatile substance from the extracted plant which it carries a unique odor or scent of the plant itself. Moreover, essential oils are also known as a natural, aromatic volatile liquids found in shrubs, flowers, trees, roots, bushes and seeds that extract from aromatic plant sources by the distillation process. It is highly concentrated, more effective than dry herbs and it often has a pleasant, sweet smells that make the essential oils is complex and have

various benefits. Furthermore, essential oils are non-water based phytochemicals derived from volatile organic compound that found in the seeds, bark, stem, leaves, roots, flowers and other parts of the plants from the extraction process. Therefore, essential oils are simply defined as an aromatic and volatile oil that have a pleasant smell that extracted from the part of aromatic plants. Examples of essential oils are cinnamon bark essential oils and rosewood essential oil.

The characteristics of essential oils are they are very clean, almost crisp and quickly absorbed by the skin. They are fat soluble but they do not contain any fatty lipids or acids of vegetable and animal oils in them. They are also pure, translucent and have ranged in color from crystal clear to deep blue. They also have sweet, pleasant smell and powerfully fragrant. The chemical composition and aroma of essential oils can give valuable psychological and physical therapeutic advantages. These advantages are usually achieved through techniques including inhalation and usage of the diluted oil to the skin. Essential oils can be used in aromatherapy applications as cleansing and purifying additives to laundry, in topical application as massage and beauty therapy and also in internal uses as dietary supplements.

2.3 Aromatherapy

According to Edge (2003), aromatherapy is known that at the beginning of the 17th century about 60 oils were used in medicines and perfumery. In the 18th and 19th centuries scientists were first able to identify the constituents of plant chemistry. With the research of these active components that extracted from medicinal plants, which in turn led to and became the basis of the development of pharmaceutical

preparations and a subsequent rejection of plant medicine. In the 1920s, largely due to the efforts of a French chemist, Gattefosse, a revival in the use of plant oils came about. Gattefosse discovered that Lavender oil had greatly effective in the burns treatment and many essential oils more effectively antiseptic qualities than their synthetic counterparts. A French army surgeon Dr. Jean Valnet read the Gattefosse's research and used essential oils to treat soldiers wounded in battle. In the 1940s an Austrian biochemist, Marguerite Maury was researching the penetration of essential oils through the skin. She felt that external application could be more beneficial in some ways than internal administration and proceeded to develop the technique of using essential oils in massage, as we know it today.

Aromatherapy is a derivative of herbal medicine, which is itself a subset of the biological or nature-based complementary and alternative medicine (CAM) therapies. Aromatherapy has been defined as the therapeutic use of essential oils from plants for the improvement of physical, emotional, and spiritual well-being. The properties of aromatherapy claim it is an all-natural, nontoxic adjunct to conventional medicines. Edge (2003) describes that aromatherapy has been defined as the controlled use of essential oils to maintain and promote physical and mental well being. Price (1999) also defines aromatherapy is the use of essential oils, all of which are derived from plants while Rose (1992) classifies aromatherapy as the healing of essential oils through the sense of smell by inhalation, and through other application of these therapeutic volatile substances. Kusmerik (1992) also defined aromatherapy as a natural treatment which uses the concentrated essential oils from plants in association with massage, friction, inhalation, compresses and baths and last

but not least, Valnet (1990) writes that aromatherapy involves essences obtained from plants that are generally given in the form of drops, or capsules.

The inhalation of aroma from these "essential" oils is widely believed can stimulate brain function. Essential oils can also be absorbed through the skin, where they travel through the bloodstream and can promote whole-body healing. It is used for a variety of uses, including pain relief, mood enhancement and increased cognitive function. Aromatherapy scents that are perceived through olfaction and transmitted to the body stimulate the brain and the lungs. Practitioners of aromatherapy apply essential oils using several different techniques, including indirect inhalation via a room diffuser or drops of oil placed near the patient, direct inhalation used in an individual inhaler like a few drops of essential oil floated on top of hot water to aid a sinus headache or aromatherapy massage, which is the application to the body of essential oils diluted in a carrier oil. Other direct and indirect applications include mixing essential oils in bath salts and lotions or applying them to dressings. Different aromatherapy practitioners may have different recipes for treating specific conditions, involving various combinations of oils and techniques and uses.

2.3.1 Carrier oil

Carrier oils play a far more significant role in aromatherapy. Carrier oil is a vegetable oil derived from the fatty portion of a plant, usually from the seeds, kernels or the nuts. Carrier oils are so named because they "carry" an essential oil to the skin. Carrier oils refer to base oils that are used

to dilute essential oils before applying them directly to the skin**.** On the other hand, carrier oil is pressed from the fatty portions which are seeds, nuts and kernels and do not evaporate or impart their aroma as strongly as essential oils. Carrier oils can go rancid over time, but essential oils do not. Instead, essential oils "oxidize" and lose their therapeutic benefits, but they don't go rancid. The term carrier oil is generally limited to use within the practice of aromatherapy. In natural skin care, carrier oils are typically referred to as vegetable oils, fixed oils or base oils. Not all fixed oils or base oils are vegetable oils. Emu oil which derived from the emu bird and fish (marine) oils are also classified as fixed or base oils, but these animal-based oils are generally not used for aromatherapy work. Some carrier oils are odourless but generally, most of carrier oils have a faintly sweet and nutty aroma. If you come across carrier oil that has a strong, bitter aroma, the carrier oil may have gone rancid. Some examples of carrier oils are jojoba oil, sunflower oil, sesame oil, olive oil and camellia seed oil.

2.3.2 Perfume Oil

According to Padmar, 2004, perfume oil is a substance that emits and diffuses a fragrant odor. It is a very volatile liquid distilled from a plant part. The essential ‘plant distillates’ interrelate with the human body by four distinct modes of action in pharmacological, physiological, psychological and spiritual. Our body uses the aromatic molecules in two ways which are through our olfactory system which is connected to the brain where our most primal feelings, urges and emotions reside, and by absorption of lower

molecular weight compounds of essential oils through the skin. Perfume oils, also called fragrance oils are almost always synthetic where chemists analyze the plants' chemical composition to reproduce a naturally occurring aroma or they create a fragrance that doesn't exist in nature, such as China Rain or Rainbow. Perfume oils lack therapeutic benefits, their only function is that of a fragrance. Essential oils when properly diluted with carrier oil can be worn as a fragrance, however, and perhaps more importantly they are used in aromatherapy to utilize their therapeutic properties. (Retrieved on 2012, December 5 from http://lib.store.yahoo.net/lib/yhst-16933752324483/brochure911.pdf).

A perfume is a unique mixture of top, middle, and base notes designed to give a particular harmony of scents. The following basic groups are listed in order of decreasing vapor pressure, or volatility. The top notes are those that are detected and fade first providing freshness to the blend. They are responsible for the customer's first impression, and hence, in a way, the selling note of a perfume. They are light scents, lasting 5-10 minutes, and extracted from plant material such as cardamom seed, basil, bergamot and citronella. The middle notes are those that last for several hours and are the most prominent within the fragrance. They are usually combinations of spicy, floral or fruity scents, extracted from ambrete seed, black pepper, carrot seed, cassia, chamomile, cinnamon and clove. The base notes give a perfume the depth and last the longest. They include the extract of plant material such as Amyris, anise, Angelica root, Clary sage, fennel, geranium and lavender. (Padmar, 2004).

2.4 Extraction

According to Wikipedia, extraction in chemistry is a separation process consisting in the separation of a compound from a matrix. Noble and Terry states that extraction is the action to eliminate one or more solutes from a liquid by transferring the solute into a second liquid phase which the solute has a higher affinity. It is a separation process that depends on dissimilarity in both solute solubility and density of the two phases.

There are several types of extraction process. They are dynamic headspace extraction, solid phase extraction, supercritical fluid extraction, solvent extraction and and hydro distillation. Each process has their own advantages and disadvantages for example of the advantages of hydro distillation are low cost and simple method but their disadvantages are it requires more time consuming for extraction.

2.5 Essential Oil Production Method

2.5.1 Hydro Distillation

Water or hydro distillation is one of the oldest and easiest methods being used for the extraction of essential oils. In this method the plant material is fully dipped in the water. Hydro distillation is a simple form of steam distillation which is often used to isolate non-water soluble, high boiling natural products. The advantage of this technique is that the desired

materials distillery at a temperature below 100 °C. The essential oils of the distillate will then be extracted and analyzed.

The disadvantages of the methods are as the plant material near the bottom walls of the still comes in direct contact with the fire from the furnace, there is a likelihood of it getting charred and thus imparting an objectionable odor of the essential oil prolong the action of hot water can cause hydrolysis of some constituents of the essential oils such as ester and the process is slow and the distillation time is much longer thereby consuming more heat.

2.5.2 Ultrasonic Extraction

The sound waves will propagate into the liquid media when sonicating liquids at high intensities, resulting in alternating high-pressure and low-pressure cycles, with rates depending on the frequency. High-intensity ultrasonic waves create small vacuum bubbles or voids in the liquid during the low-pressure cycle and the bubbles will attain a volume at which they can no longer absorb. (Retrieved on 2012, December 4 from http://www.hielscher.com/ultrasonics/extraction_01.htm.). Ultrasonic extraction uses ultrasonic vibrations to extract samples with polar solvents in an ultrasonic bath. This is often used for chemical extraction from solid samples because it's simple. Moreover, according to Harper et al., 1983, ultrasonic extraction can be used for both liquid and solid samples, and also for the extraction of either inorganic or organic compounds while Munoz et

al., 2006 said that ultrasonic extraction is fast, inexpensive, and efficient alternative methods to conventional Soxhlet processes. Many factors affect the efficiency of ultrasonic extraction such as wave frequency, ultrasound intensity, and raw material, duration of extraction, temperature and pressure. (Kobus, 2006).

2.6 Sensory Analysis

According to Yoshiaki and et al (2009), sensory evaluation is a technique of measuring consciousness developed primarily in experimental psychology and mathematical psychology. Sensory experiences can be reported using verbal (semantic) methods. To explain the psychological potency of essential oils, the authors have attempted to develop a sensory (verbal) measure of the identified odor quality for a given aroma and analyze it statistically. Sensory analysis is used in industry and discovers details on:

- Flavor and taste
- Texture
- Appearance – color, shape, size
- Smell/Aroma
- Sounds

The objective of sensory evaluation is to supervise quality control by checking regular samples against specification, to detect differences between products from different runs or batches, to profile the characteristics of new products

and to illustrate specific characteristics. There are two types of sensory analysis test which are preference tests and discrimination test. Preference test is to supply information about people's likes or dislikes of products and it is a test which compares a pair of same products looking at the specific characteristics while discrimination tests is to evaluate specific attributes and it is based on ranking where it allow people to evaluate samples and place them in rank order.

2.7 Conclusion

In this chapter, we were discussing about the overview of Cinnamomum zeylanicum, essential oils, aromatherapy, carrier oil, extraction process, essential oil production method and sensory analysis. In the next chapter, we will discuss more about the method used to produce essential oil from Cinnamomum zaylanicum.

CHAPTER 3

METHODOLOGY

3.0 Introduction

In this chapter, we are discussing more detail about the method to conduct a research on the production of essential oil from *Cinnamomum Zeylanicum* leaves by hydrodistillation and ultrasonic extraction methods. There are four elements that we are focusing in this study which is plant material, essential oil extraction, essential oil analysis and expected result from this study.

3.1 Overview of Methodology

In producing the essential oil of *Cinnamomum Zeylanicum*, there are a few steps that must be done as shown below. In this experiment, hydro distillation and ultrasonic extraction are used to obtain *Cinnamomum Zeylanicum* essential oils.

Different methods are used to extract the essential oil because to compare the yield and chemical compounds in the essential oil. The leaves will be used as the extracted part to get the essential oil of *Cinnamomum Zeylanicum*. In order to complete the experiments, several steps must be taken:

i) Sample preparation of dried *Cinnamomum Zeylanicum*

ii) *Cinnamomum Zeylanicum* extraction

iii) Analysis of essential oil

iv) Testing of essential oil

Below is the flow diagram for each method in order to get essential oil and then used as perfume oil.

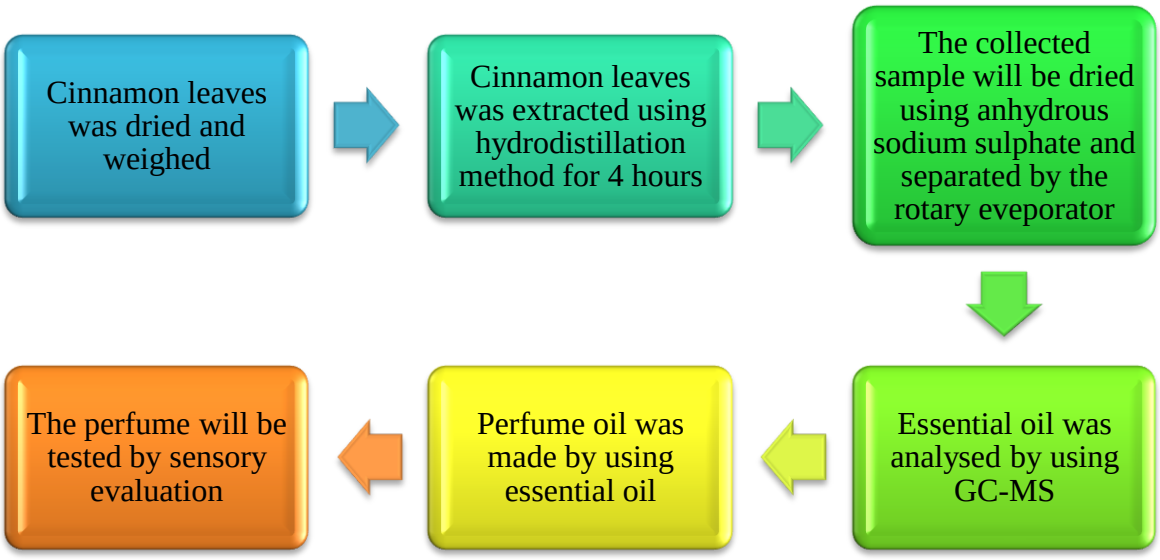


Figure3.0: Flow Diagram for Hydrodistillation Procedure

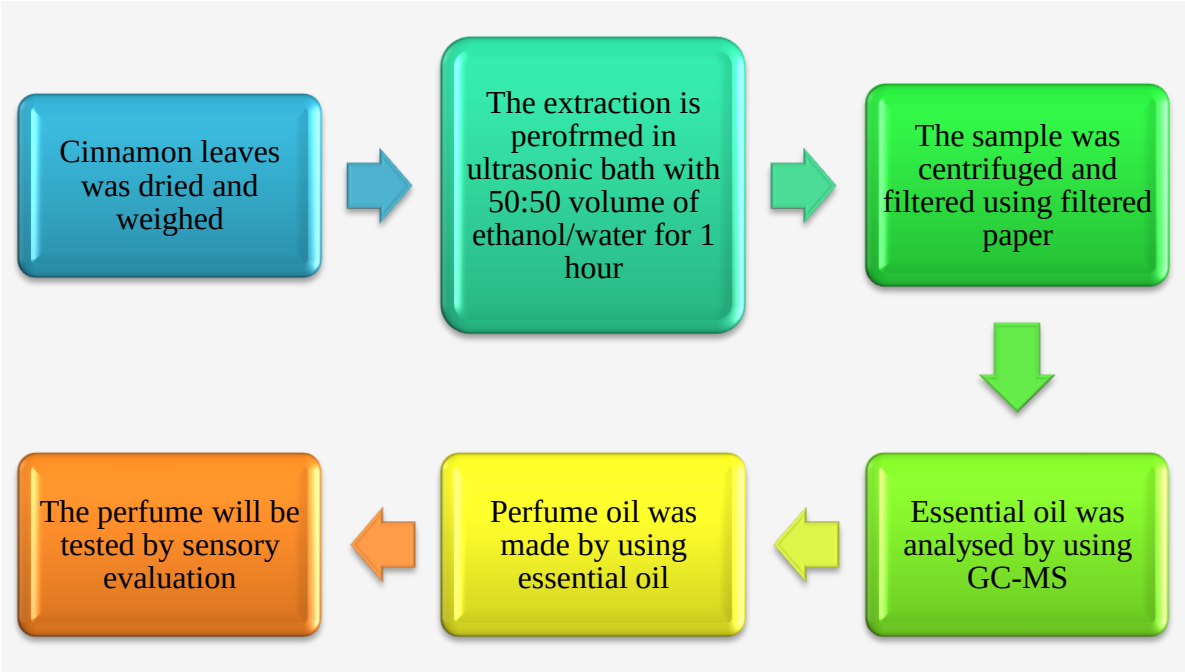


Figure 3.1: Flow Diagram for Ultrasonic Extraction Method

3.2 Material and Methods

3.2.1 Plant Materials

Fresh leaves of *Cinnamomum Zeylanicum* are collected from the plant for extraction process. The species of *Cinnamomum Zeylanicum* that have been collected at a local nursery at Kemaman, Terengganu is from *Laurecea* family.

3.2.2 Essential Oil Extraction

3.2.2.1 Preparation of the Extract

Fresh leaves are collected and dried at 60˚C for 48 hours in an oven and then ground into a fine powder.

3.2.2.2 Hydrodistillation method

The essential oil of *Cinnamomum Zeylanicum* leaves is prepared by hydrodistillation in a Soxhlet apparatus, according to the method of Demirci, Guven, Dadandi and Baser (2008) with minor modification. 10 grams of cinnamon leaf powder are precisely weighed. 200ml of water as solvent is used to extract essential oil from the leaf powder. The sample is then dehydrated over anhydrous sodium sulfate and filtered. After concentration by rotary evaporation at 100˚C, the resulting volatile extract is kept at 4 °C for further analysis. The percentage of essential oil yield is calculated as the weight of essential oils divided by the weight of leaf powder.

3.2.2.3 Ultrasonic Extraction Method

The essential oil of *Cinnamomum Zeylanicum* leaves is prepared by Ultrasonic Extraction method, according to the method of Gallo, Ferrance, Graziani, Ritieni and Fogliano (2010) with minor

modification. 6 grams of leaf powder are weighed and then is extracted with 60mL of water/ethanol (50:50 volumes) and performed in an ultrasonic bath with working frequency of 7MHz at room temperature for 60 minutes. The, the sample is centrifuged to 8000rpm at 8˚C and then filtered with filter paper. The resulting volatile extract is kept at 4 °C for further analysis. The percentage of essential oil yield is calculated as the weight of essential oils divided by the weight of leaf powder.

3.2.3 Essential Oil Analysis

GC/MS analysis is performed according to the method of Wu et al. (2008) on a GC-2010 gas chromatography equipped with a GCMS-QP2010 Plus mass spectrometer. An Rxi-5MS capillary column (30 m×0. 25 mm internal diameter, film thickness 0.25 μm, Shimadzu, Japan) is used for separation. A split/split less injector is used. 0.2 μl of sample is injected into the injector with a split ratio of 1:50. Oven temperature is kept at 40 °C for 3 min, increasing to 120 °C at a rate of 5 °C/min and holding for 3 min, then increasing to 180 °C at a rate of 2 °C/min and holding for 3 min, finally increasing to 230 °C at a rate of 5 °C/min and holding for 3 min. Injector temperature is 250 °C, while the detector temperature is 250 °C. The ion source temperature is 250 °C. Helium is used as the carrier gas. Quantitative analysis of each essential oil component which is expressed as area percentage is carried out by peak area normalization measurement.

3.3 Perfume Oil Method

The perfume of *Cinnamomum Zeylanicum* essential oil is prepared according to the method of Sweet Tea Apothecary (2012) with minor modification. Two different types of essential oil are chosen to be the notes. Lavender fragrance oil is used as heart note, rainforest fragrance oil as head note and cinnamon essential oil as a base note while coconut oil and jojoba oil are used as carrier oil. Next, 40 drops of base note are pipette carefully and slowly into the 5ml bottle. Then, heart and head notes are pipette for 20 drops respectively to the bottle. Lastly, the lid is closed and shakes it up gently to let the oil mix in with each other. The oil is placed at dark place for a week to get a very nice smell and mixed well. After a week, 20 drops of carrier oil which is jojoba oil is added to the oil and is placed in a dark place for two weeks. After two weeks, the perfume oil is ready to be evaluated to check whether it can relax mind and have fragrant smell.

3.3 Sensory Evaluation

The sensory evaluation of cinnamon perfume oil is prepared according to the method of Sugawara et.al (2009) with minor modification. Perfume oil of cinnamon leaves is presented to five judges via an inhalator composed of a 250 ml flask, stopper and filter paper. An inhalator flask was loaded by applying 200 μL of each diluted solution to a small strip of filter paper on the bottom, sealed with a ground-glass stopper and moistened with fragrance. Regarding the intensity of fragrance within the inhalator flask, the following applicable odor detection threshold values (scores) are established:

0 – Odorless,

1 – Odor barely detectable and the nature of the odor cannot be ascertained,

2 – Very weak odor but the nature of the odor can be discriminated,

3 – Weak odor but the odor can be readily detected,

4 – Strong odor, and

5 – Odor so strong that it cannot be tolerated.

Five judges were requested to mark from 0 to 5 each serially diluted test solution.

Aroma perception was evaluated by the following 13 impression descriptors consisting of contrasting pairs of adjectives:

→Fresh-stale

→Soothing-active

→Airy-heavy

→Natural-unnatural

→Soft-strong

→Pleasant-unpleasant

→Comfortable-uncomfortable

→Woodsy-no woodsy

→Floral-peppery

→Lively-dull

The five judges are needed to choose the aroma perception for each perfume oils of different method. The statistical significance is evaluated by the *data analysis* of each descriptor.

3.5 Summary of the Chapter

As a conclusion, methodology is the important part in the production of essential oil from *Cinnamomum Zeylanicum* leaves by different methods. It is important to identify whether the essential oil can be used in aromatherapy or not as perfume oil.

CHAPTER 4

RESULTS AND DISCUSSION

4.0 Result

4.1 Yield of essential oil

The yield of each sample for different methods is determined according Demirci, Guven, Dadandi and Baser (2008) by using the formula:

$$yield\ percentage\ (\%) = \frac{weight\ of\ essential\ oil\ obtained\ (g)}{weight\ of\ leaves\ powder\ (g)} \times 100\%$$

4.1.1 Hydrodistillation Method

The extracted oil collected is 5mL. The conversion from milliliters to grams is

2mL	1L	1kg	= 0.002 g
	1000mL	1L	

$$yield\ percentage\ (\%) = \frac{0.002\ g}{10\ g} \times 100$$

$$= 0.02\%$$

4.1.2 Ultrasonic Extraction Method

The extracted oil collected is 8mL. The conversion from millilitre to grams is

5mL	1L	1kg	= 0.005 g
	1000mL	1L	

$$yield\ percentage\ (\%) = \frac{0.005\ g}{6\ g} \times 100$$

$$= 0.083\%$$

4.2 Analysis of chemical compounds by GC-MS.

4.2.1 Volatile compounds identified from cinnamon essential oil by hydrodistillation method.

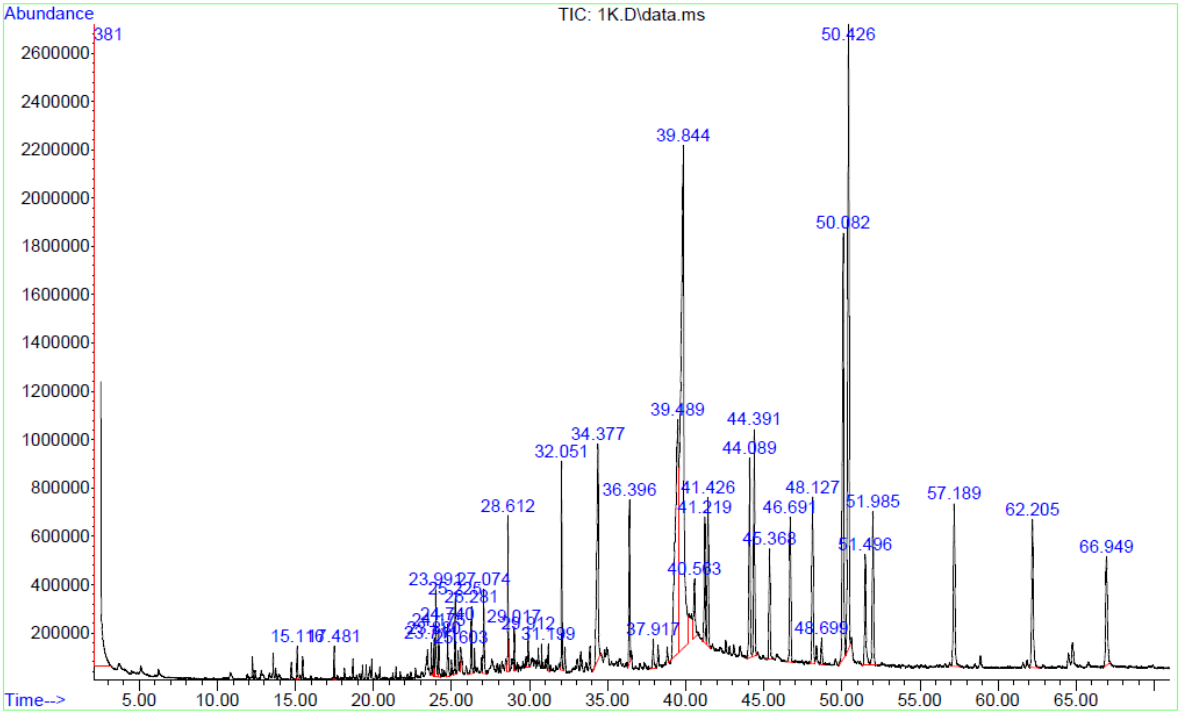


Figure 4.0 Total Abundance of Compound in Essential Oil by Hydrodistillation Method

No	Compounds	Peak area (%)
1	hydroperoxide, hexyl	85.46
2	3-Cyclohexen-1-ol, 4-methyl-1-(1-methylethyl)-, (R)-	0.05
3	Benzene, 1,4-bis(1,1-dimethylethyl)	0.04
4	2-Isopropenyl-4a,8-dimethyl-1,2,3,4,4a,5,6,7-octahydronaphthalene	0.04

5	Ethylparaben	0.04
6	Phenol, 2,4-bis(1,1-dimethylethyl)	0.12
7	Octadecane, 1-iodo-	0.07
8	rans-4-Dimethylamino-4'-methoxychalcone	0.09
9	Nerolidol 2	0.1
10	Phenol, 2,6-dimethoxy-4-(2-propenyl)	0.02
11	tetradecanal	0.12
12	Selina-6-en-4-ol	0.14
13	Benzeneethanamine, N-[(pentafluorophenyl)methylene]-.beta.,3,4-tris[(trimethylsilyl)oxy]	0.19
14	Heptacosane	0.06
15	Tetratriacontane	0.05
16	2-Hexanol, 2,3-dimethyl	0.03
17	4-Methylthio-4'-(4-nitrocinnamoyl)chalcone	0.28
18	n-Hexadecanoic acid	0.63
19	Cycloheptasiloxane, tetradecamethyl	0.29
20	9,12-Octadecadienoic acid, methylester	0.06
21	9,12-Octadecadienoic acid (Z,Z)	1.5
22	Oleic Acid	3.09
23	Hexadecanoic acid, 2-hydroxy-, methyl ester	0.18
24	Hexadecanoic acid, butyl ester	0.25
25	Cycloheptasiloxane, tetradecamethyl	0.32
26	Methyl ricinoleate	0.48
27	Oxalic acid, monoamide, N-(2-octyl)-, isobutyl ester	0.5

28	Phenol, 4-(methylamino)-	0.24
29	Cyclohexasiloxane, dodecamethyl	0.36
30	Octadecanoic acid, butyl ester	0.4
31	Z,Z-3,13-Octadecedien-1-ol	0.07
32	4,5-Nonadiene, 2-methyl-	1.13
33	13-Octadecenal, (Z)-	1.59
34	1,15-Pentadecanedioic acid	0.31
35	Cyclononasiloxane, octadecamethyl	0.42
36	Cyclononasiloxane, octadecamethyl	0.47
37	Cyclononasiloxane, octadecamethyl	0.47
38	Cyclononasiloxane, octadecamethyl	0.35

Table 4.0: List of Compounds in Essential Oil by Hydrodistillation Method

4.2.2 Volatile compounds identified from cinnamon essential oil by ultrasonic extraction method.

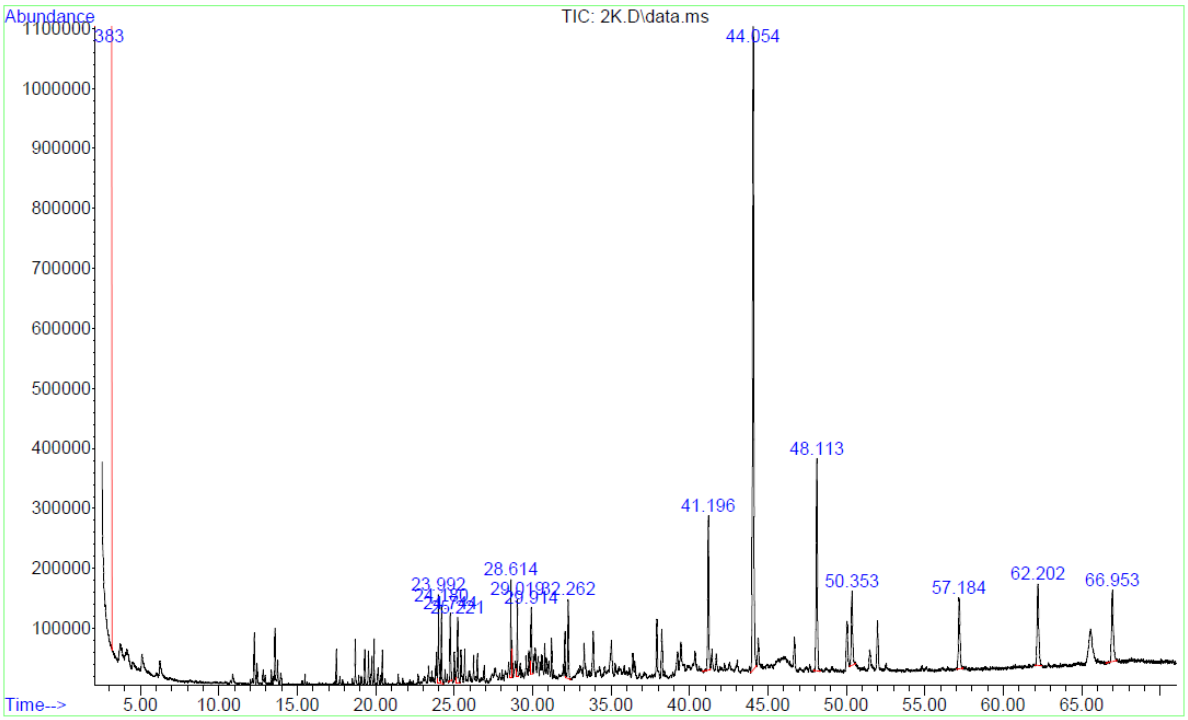


Figure 4.1 Total Abundance of Compound in Essential Oil by Ultrasonic Extraction Method

No	Compounds	Peak area (%)
1	Hexane	103.73
2	Phenol, 2,4-bis(1,1-dimethylethyl)	0.12
3	Sulfurous acid, pentadecyl 2-propyl ester	0.09
4	Dithiocarbonic acid, S-(2,3-diphenyl-1-p-tolyl-cycloprop-2-enyl)ester-O-ethyl ester	0.08

5	Hexacosane	0.1
6	Benzoic acid, 2,5-bis(trimethylsiloxy)-, trimethylsilyl ester	0.11
7	Pentadecane	0.08
8	Octacosane	0.09
9	2,5-Cyclohexadien-1-one, 2,6-bis(1,1-dimethylethyl)-4-ethylidene-	0.12
10	Hexadecanoic acid, butyl ester	0.29
11	9-Octadecenoic acid (Z)-, methyl ester	1.37
12	Octadecanoic acid, butyl ester	0.45
13	2-Methyl-Z,Z-3,13-octadecadienol	0.18
14	Benzoic acid, 2,5-bis(trimethylsiloxy)-, trimethylsilyl ester	0.19
15	Benzoic acid, 2,5-bis(trimethylsiloxy)-, trimethylsilyl ester	0.23
16	Hexasiloxane, tetradecamethyl	0.22

Table 4.1: List of Compounds in Essential Oil by Ultrasonic Extraction Method

4.3 Ratios of perfume oil

For making perfume oil, the fragrance oil used to blend with samples is lavender and rainforest fragrance oils.

Oils	Note	Quantity(drops)	
		Hydroditillation	Ultrasonic Extraction
Cinnamon essential oil	Base	40	40
Lavender fragrance oil	Middle	20	20
Rainforest fragrance oil	Head	20	20
Jojoba carrier oil	-	20	20

Table 4.2: Ratios of Each Oil to Make Perfume Oil

4.4 Discussion

4.4.1 Essential oil yield of different methods

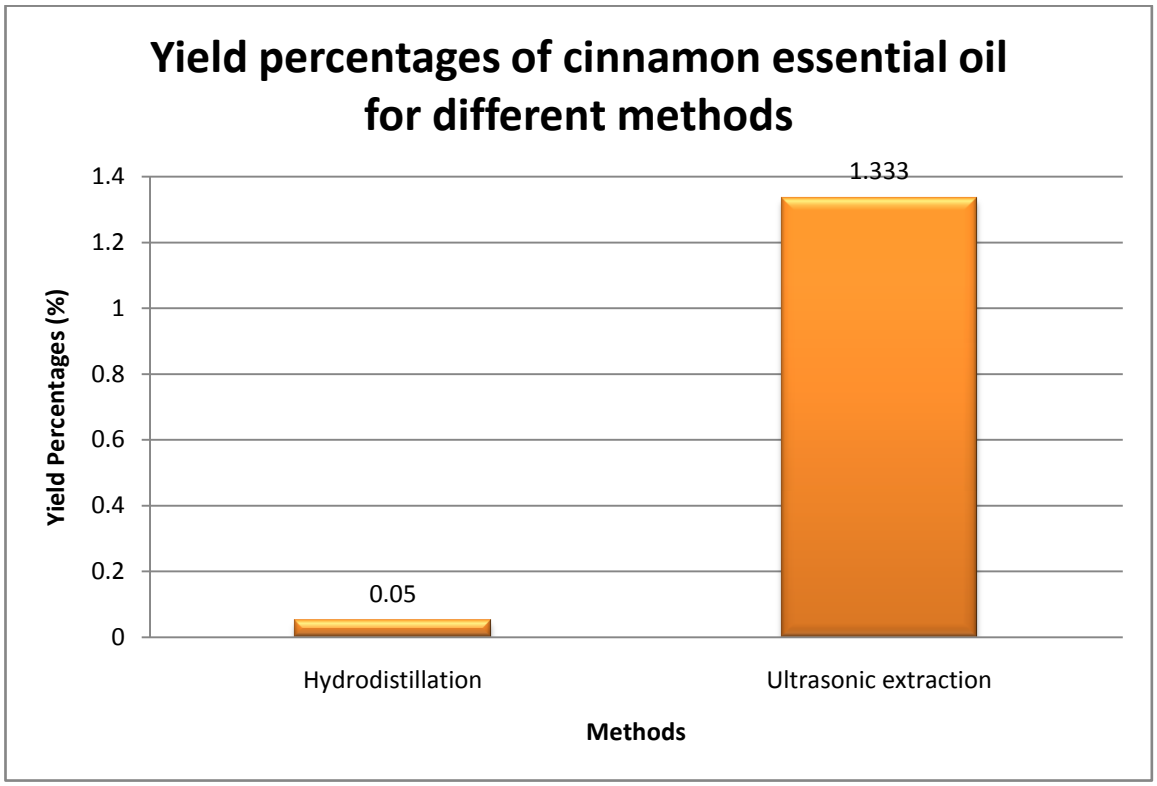


Figure 4.2: Yield Percentages of Cinnamon Essential Oil for Different Methods

Fig. 4.2 shows the essential oil yields of two different methods chosen in this work. The results indicated that extraction method could lead to the change of essential oil yield. The essential oil yields of hydrodistillation and ultrasonic extraction are 0.05% and 1.333% respectively. It shows that ultrasonic extraction is better method than hydroditillation method to get high yield percentage because

4.4.2 Identification of volatile compound in samples

After extraction of essential oil by different methods which are hydrodistillation and ultrasonic extraction, GC-MS is used to identify the volatile compound in it. From table 4.0, thirty volatile compounds, including alcohols, aldehydes, esters, carboxylic acids, alkanes and ketones are detected in the essential oil of Cinnamomum zeylanicum. Through GC/MS analysis, hydroperoxide, hexyl was confirmed to be the major component with the highest area percentage of 85.46%. Other main components included Oleic Acid, 9-Octadecenoic acid (Z)-, methyl ester, 9,12-Octadecadienoic acid (Z,Z), 13-Octadecenal, (Z), 4,5-Nonadiene, 2-methyl with the area percentages of 3.09%, 1.5%, 1.59%, and 1.13% respectively. The area percentages of the rest volatile compound are lower than 1%. The desired compound in essential is found in the essential oil but only with a very small quantity which is Phenol, 2,6-dimethoxy-4-(2-propenyl), also known as **Methoxyeugenol with only 0.02% of area percentage. Other important compounds found in essential oil are** Nerolidol 2, Selina-6-en-4-ol, and Ethylparaben that give influences in making perfume oil. The lower of quantity of desired compound is due to shorter time of hydrodistillation. It is only done for 4 hour for 10grams of dried leaves. Hydrodistillation is known for a simple method and free solvent of extraction but have longer time to extract in order to get high efficiency of extraction. Hydrodistillation method is also convenience and cost effectiveness although some volatile component maybe loss during the extraction. (Demirci, Guven, Dadandi and Baser, 2008).

From table 4.1, fourteen volatile components, including alcohols, aldehydes, esters, carboxylic acids, alkanes and ketones are detected in the essential oil of Cinnamomum Zeylanicum for ultrasonic extraction method. Through GC-MS analysis, Hexane is confirmed to be major component with 102.71% percentages of area, followed by 9-Octadecenoic acid (Z)-, methyl ester with 1.37%. The area percentages of the rest volatile compound are lower than 1%. There is no desired compound found in essential oil which is eugenol and cinnamaldehyde by ultrasonic extraction but more antioxidant compound are found in essential oil such as Phenol, 2,4-bis(1,1-dimethylethyl) with 0.12% of area percentage. It is due to some error might be occurred during preparation of samples such as the volatile components may be loss during rotary evaporation because of unsuitable operating temperature. Ultrasonic extraction is convenient and straightforward method because it had no heat require that lead to loss of volatile compound and of course, it took shorter time to extract the essential oil compared to hydrodistillation.

4.4.3 Perfume oil analysis

From table 4.2, fragrance oil that used to be middle and top notes is lavender and rainforest respectively. Sensory evaluation is carried out to determine whether perfume oil of cinnamon can soothe and relaxing the mind or not. The judges are consisted of 4 students and 1 staff, which included 2 boys and 3 girls. Then it is analysed by data analysis.

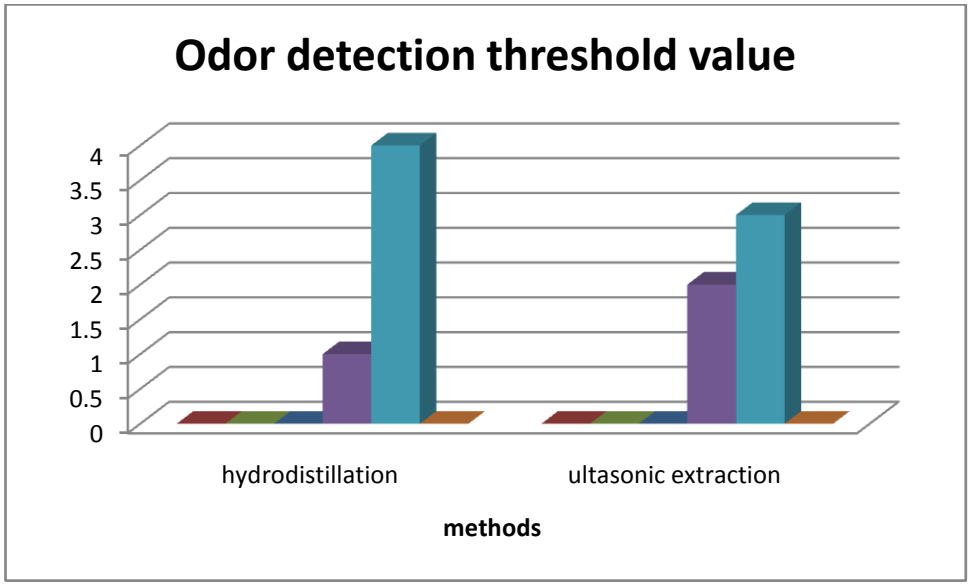


Figure 4.3: Odor Detection Threshold Value

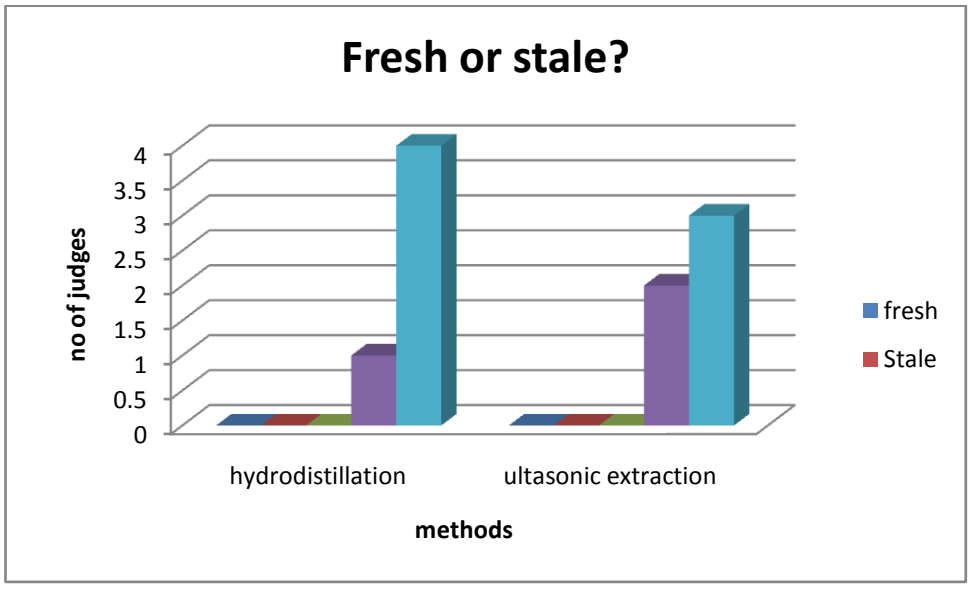


Figure 4.4: First Impression of Aroma Perception

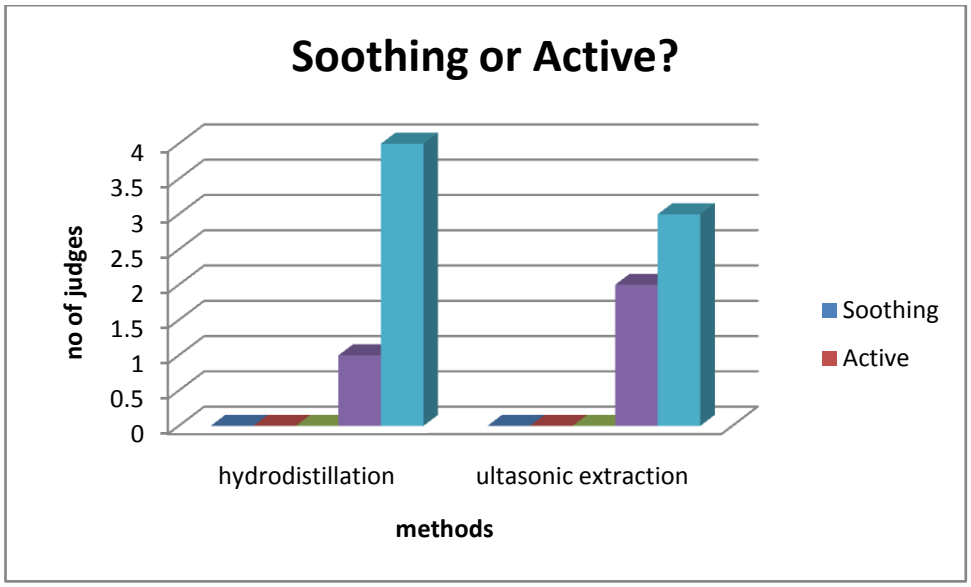


Figure 4.5: Second Impression of Aroma Perception

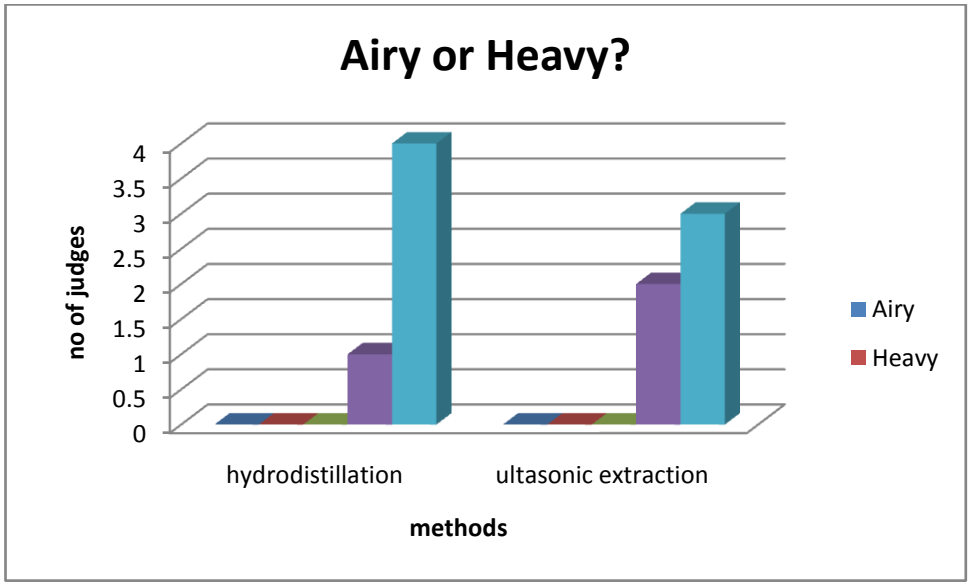


Figure 4.6: Third Impression of Aroma Perception

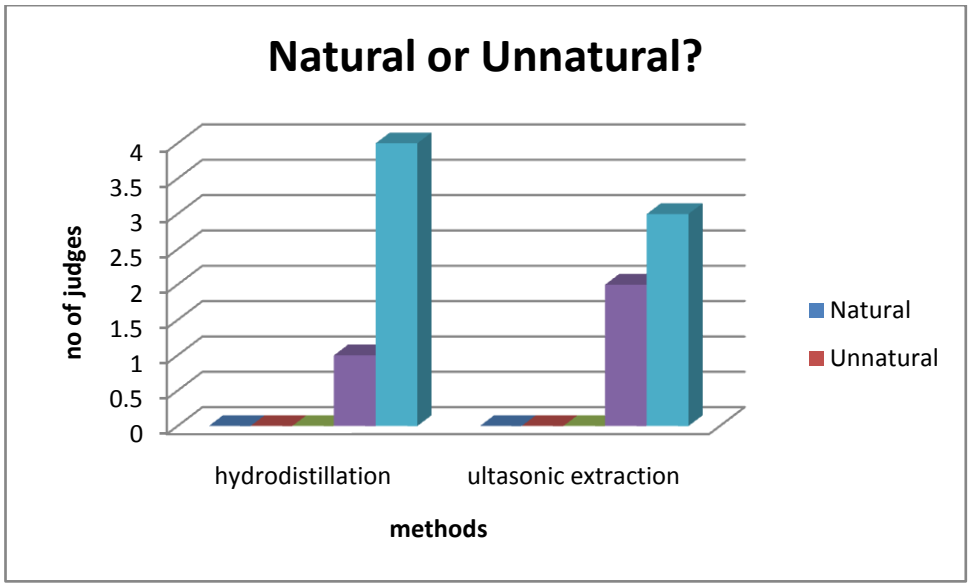


Figure 4.7 Fourth Impression of Aroma Perception

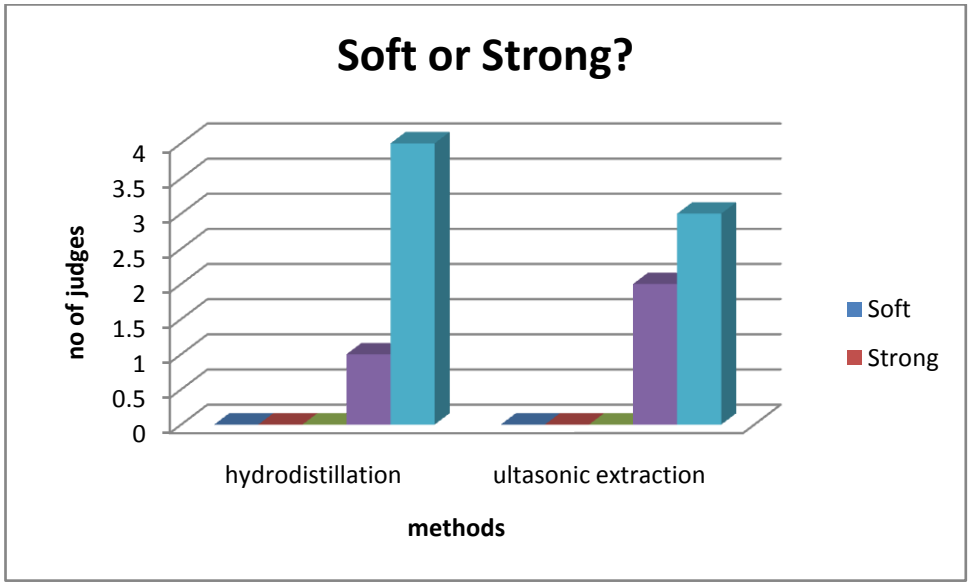


Figure 4.8: Fifth Impression of Aroma Perception

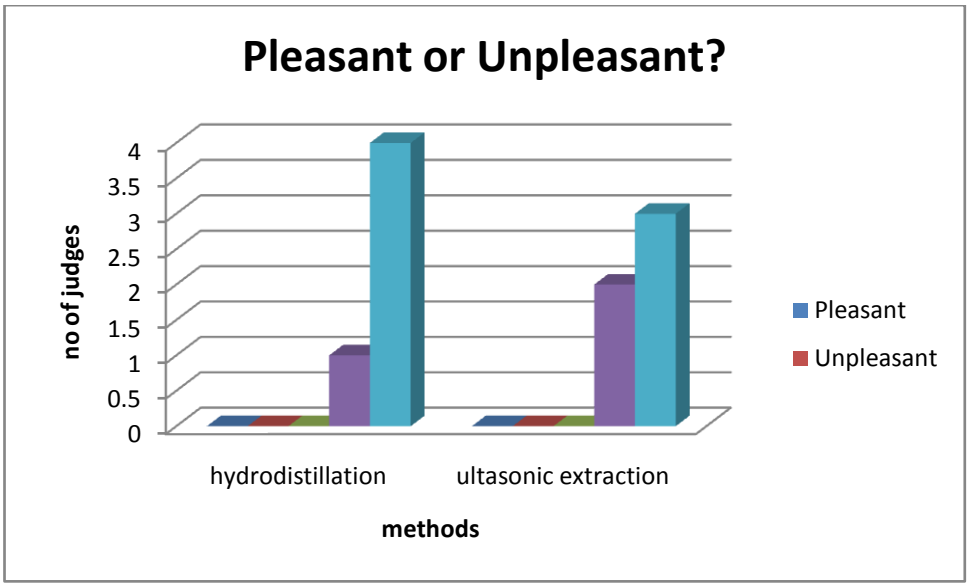


Figure 4.9: Sixth Impression of Aroma Perception

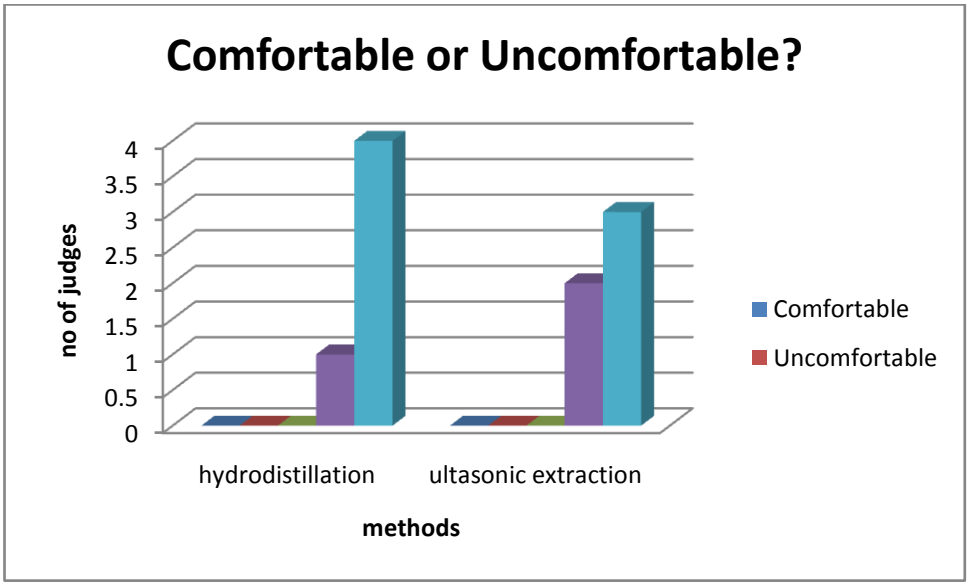


Figure 4.10: Seventh Impression of Aroma Perception

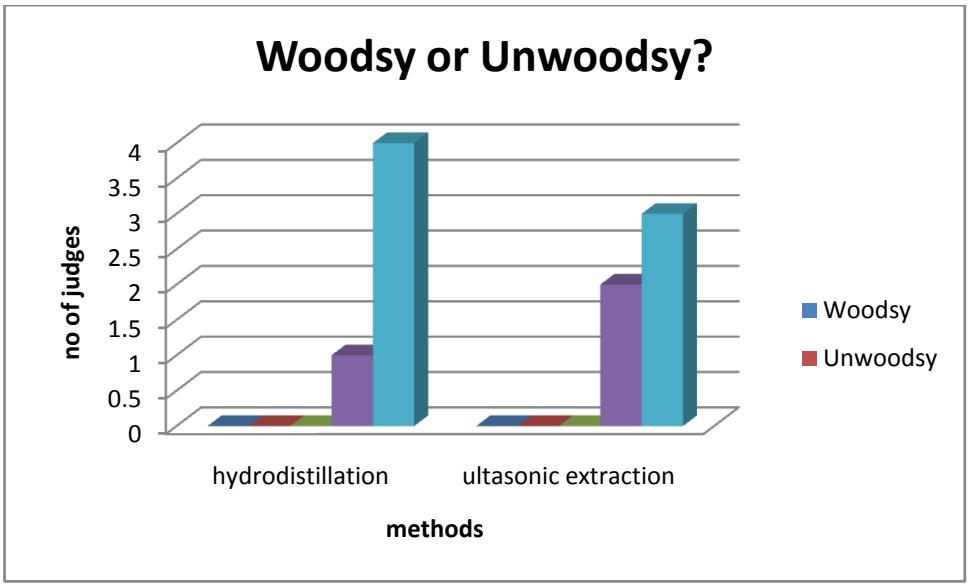


Figure 4.11: Eighth Impression of Aroma Perception

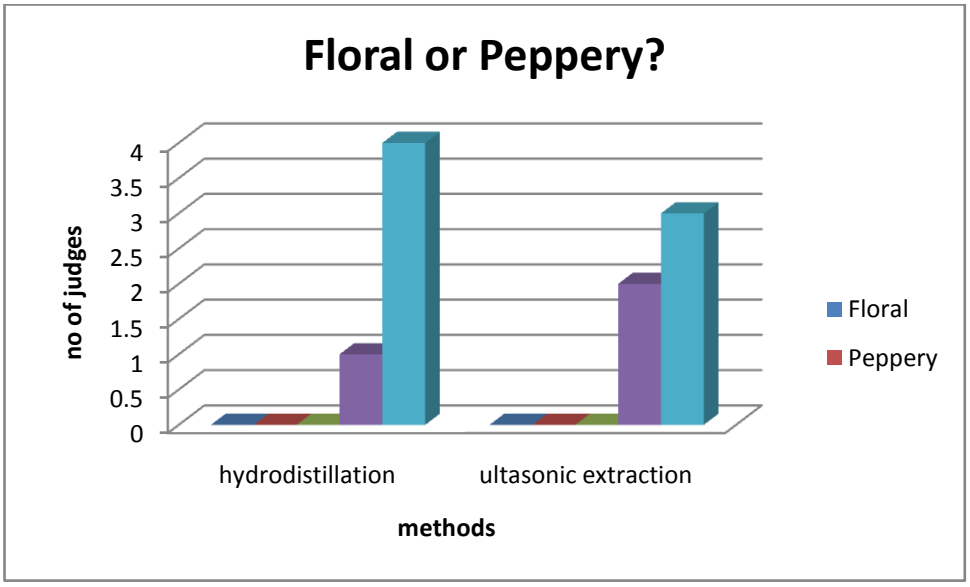


Figure 4.12: Ninth Impression of Aroma Perception

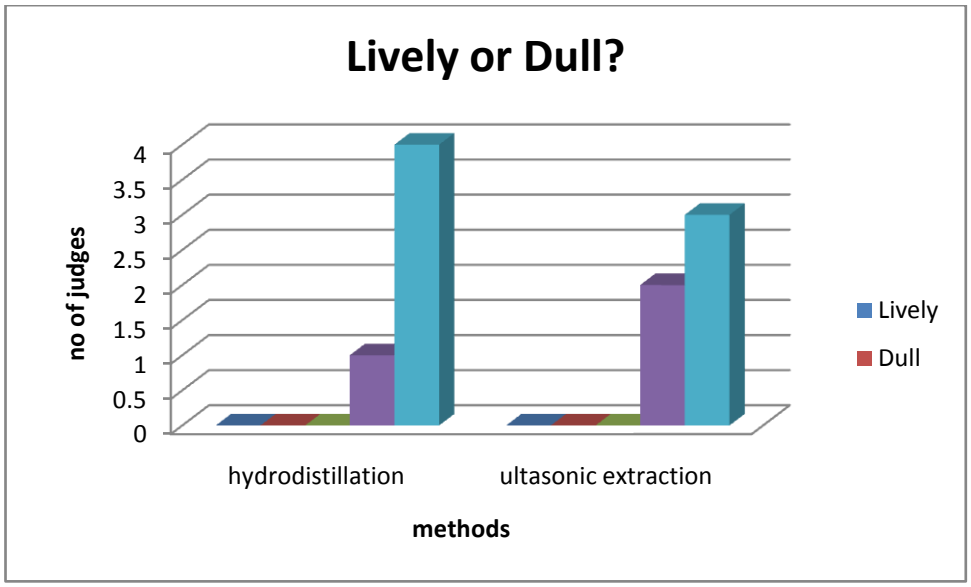


Figure 4.13: Tenth Impression of Aroma Perception

Below is the summary of sensory evaluation of perfume oil for both methods.

Types	Odor detection threshold values	Impression									
		Fresh-stale	Soothing-active	Airy-heavy	Natural-unnatural	Soft-strong	Pleasant-unpleasant	Comfortable-uncomfortable	Woodsy-unwoodsy	Floral-peppery	Lively-dull
Perfume oil with Hydrodist-illation method	Strong odor	fresh	Soothing	Airy	Natural	Strong	Pleasant	Comfortable	Woodsy	Peppery	Lively
Perfume oil with Ultrasonic extraction method	Strong odor	fresh	soothing	airy	natural	strong	Pleasant	comfortable	Woodsy	peppery	Lively

Table 4.3: Summary of Perfume Oil Analysis

4.5 Summary of the chapter

From the result and discussion above, cinnamon oil or the samples from both methods which are hydrodistillation and ultrasonic extraction can be made as perfume oil because they have aromatic compounds that have strong and pleasant smell that give influences in aromatherapy.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

The result shown that *Cinnamomum Zeylanicum* essential oil is better produced by hydrodistillation method compared ultrasonic extraction because by hydrodistillation, active compound which is eugenol is found and of course, several of others volatile compounds found in essential oil of *Cinnamomom Zeylanicum* although the yield of essential oil of ultrasonic extraction is higher than hydrodistillation. The mixing of *Cinnamomum Zeylanicum* essential oil with other is expected can be used as aromatherapy oil or perfume oil in order to soothe and relax the mind.

5.2 **Recommendations**

The first recommendation that I will recommend is to use longer of extraction of time for hydrodistillation method. This is because to get more oil from the extracted plant. Hydrodistillation is known to be the easiest method because it does not use any solvent to extract the oil but has disadvantages which are the process is slow and distillation time is longer because the longer the distillation time, the better the extracted of oil yield.

The second recommendation is to use the same weight of the dry leaf of cinnamon for both methods which are hydrodistillation and ultrasonic extraction. This is because it is easy to compare the oil yield because the same mass is used. Third recommendation is to use the right operating temperature for rotary evaporator process in order to separate the oil and the water and also the solvent. The rotary evaporator is working under vacuum, so the temperature should not be higher, so the working manual of the rotary evaporator must be read and understand carefully.

The last recommendation is to vary the length of time of extraction and weight of dry leaf for both methods to compare the yield of essential oil and also the experiment must be repeated at least three times to get the average result of oil yield, so the result obtained is more accurate and precise.

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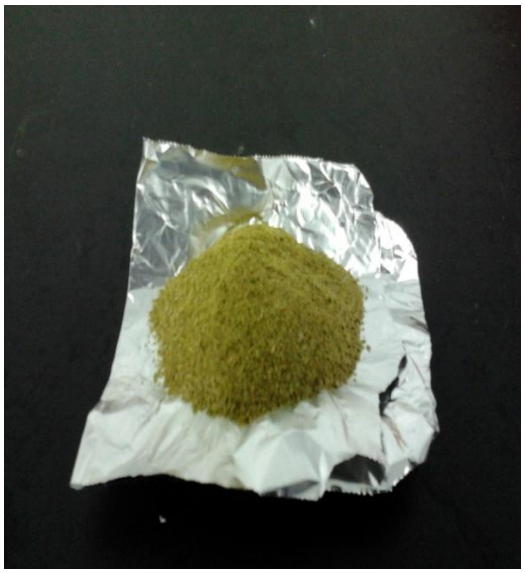
APPENDICES

Hydrodistillation

Ultrasonic extraction

Rotary Evaporator



Leaf powder

Essential Oil Obtained by Hydrodistillation

Essential Oil Obtained by Ultrasonic Extraction

From the left is Jojoba oil, lavender oil and rainforest oil respectively

Appendices

Sensory Test Questionaires

Section A

1. Gender Male ☐ Female ☐

2. Job Staff ☐ Students ☐

Section B

For 3, please rank from 0 to 5.

Scores of odor detection threshold values are established:

0 – Odorless,
1 – Odor barely detectable and the nature of the odor cannot be ascertained,
2 – Very weak odor but the nature of the odor can be discriminated,
3 – Weak odor but the odor can be readily detected,
4 – Strong odor, and
5 – Odor so strong that it cannot be tolerated

Odor detection threshold value	Score
Perfume oil with hydrodistillation method	
Perfume oil with ultrasonic extraction method	

Impression of aroma perceptions of perfume oil

Is it fresh or stale?

First impression	Impression
Perfume oil with hydrodistillation method	
Perfume oil with ultrasonic extraction method	

Is it soothing or active?

Second impression	Impression
Perfume oil with hydrodistillation method	
Perfume oil with ultrasonic extraction method	

It is airy or heavy?

Third impression	Impression
Perfume oil with hydrodistillation method	
Perfume oil with ultrasonic extraction method	

Is it natural or unnatural?

Fourth impression	Impression
Perfume oil with hydrodistillation method	
Perfume oil with ultrasonic extraction method	

Is it soft or strong?

Fifth impression	Impression
Perfume oil with hydrodistillation method	
Perfume oil with ultrasonic extraction method	

Is it pleasant or unpleasant?

Sixth impression	Impression
Perfume oil with hydrodistillation method	
Perfume oil with ultrasonic extraction method	

Is it comfortable or uncomfortable?

Seventh impression	Impression
Perfume oil with hydrodistillation method	
Perfume oil with ultrasonic extraction method	

Is it woodsy or unwoodsy?

Eighth impression	Impression
Perfume oil with hydrodistillation method	
Perfume oil with ultrasonic extraction method	

Is it floral or peppery?

Ninth impression	Impression
Perfume oil with hydrodistillation method	
Perfume oil with ultrasonic extraction method	

Is it lively or dull?

Tenth impression	Impression
Perfume oil with hydrodistillation method	
Perfume oil with ultrasonic extraction method	