EXTRACTION OF ESSENTIAL OILS FROM JASMINE FLOWER USING SOLVENT EXTRACTION METHOD

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I declare that this thesis entitled *"Extraction of Essential Oils from Jasmine Flower using Solvent Extraction Method"* is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

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Special Dedication of This Grateful Feeling to My…

Beloved father and mother;
Mr. Sulong @ A Rashid Mohd and Mrs. Mazzenah Ngah

Loving brothers and sisters;
Noraihan, Ruzaidah, Khairul, Bharuddin, Fadzilah and Madihah

Supportive families;
Uncles and Aunties

For Their Love, Support and Best Wishes.

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ABSTRACT

Jasmine essential oils are primarily used in the perfumery industry and have a very high commercial value due to its therapeutic properties. As Jasmine essential oils are composed of heat-sensitive chemical compounds, the use of conventional steam distillation technique would inevitably inflict thermal degradation to the natural fragrance. In this experimental work, solvent extraction method was employed due to its mild extracting condition and lower operating cost. Two different solvents were used, which are ethanol and methanol, respectively. The extract compositions were compared using gas chromatography analysis. Preliminary results showed that volatile oil compounds were successfully isolated from Jasmine flowers using these solvents. It was found that the main constituents of the essential oils were benzyl acetate and benzyldehyde. Further studies also revealed that the composition and yield of essential oils was mainly influenced by the different types of solvents used. The most optimum yield which is 14.53% was extracted using ethanol. Low yield of the jasmine essential oils can be improved in future study by carrying out the research in larger scale.

ABSTRAK

Pengekstrakan minyak bunga melur terutamanya digunakan dalam pembuatan minyak wangi dan mempunyai nilai komersil yang tinggi disebabkan oleh ciri-ciri terapinya. Minyak ini adalah terdiri daripada komponen yang sensitif pada haba, oleh itu penggunaan pengekstrakan wap air sebagai salah satu cara untuk mengekstrakkan minyak ini secara tidak langsung membawa kepada kesan degradasi haba terhadap bau semulajadi minyak bunga melur. Di dalam kajian ini, pengekstrakan minyak ini dilakukan menggunakan kaedah penggunaan pelarut kerana ia didapati sesuai untuk tujuan pengekstrakan minyak ini dan kos menggunakan cara ini lebih rendah. Dua jenis bahan pelarut yang digunakan ialah etanol dan metanol. Sampel minyak yang didapati daripada kajian ini akan dibandingkan menggunakan analisis gas kromatografi. Keputusan kajian pada peringkat permulaan menunjukan beberapa komponen di dalam minyak ini dapat dikesan menggunakan pelarut-pelarut ini. Komponen utama di dalam minyak bunga melur yang telah dikenalpasti ialah benzil asetat dan benzaldehid. Kajian berikutnya membuktikan pengesanan komponen dan kuantiti minyak ini adalah dipengaruhi oleh faktor utamanya iaitu penggunaan pelarut-pelarut yang berlainan. Hasil minyak bunga melur yang paling optimum iaitu 14.53% diekstrak menggunakan etanol. Hasil minyak bunga melur yang rendah ini dapat dipertingkatkan pada kajian akan datang menggunakan skala yang lebih besar.

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LIST OF ABBREVIATIONS

CO_2 – Carbon Dioxide

FID - Flame Ionization Detector

GC - Gas Chromatography

GC-MS - Gas Chromatography-Mass Spectrometry

µL - Micro liter

µm - Micro meter

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Essential oil or also known as ethereal oil is a concentrated, hydrophobic liquid that contains hundreds of aromatic compounds, organic constituents, including hormones, vitamins and other natural elements. These compounds are extracted from leaves, stems, flowers, bark, roots or other elements of a plant. Essential oil contains highly volatile components.

From the vast number of species of plant that are known, about 3000 essential oils have been well identified, though only some 150 have been exploited for commercial production. The most odoriferous plants are founds in the tropics, where the solar energy (energy that generate from sun) is greatest. Inside the plant, the oils are stored as micro droplets in glands. The oil needs to diffuse through the wall of the glands; subsequently the droplets spread over the surface of the plant before evaporating and filling the air with perfume.

A plant produces its essential oil in the protoplasm of its cells. The oil is an excretion, which does not participate in the metabolism of the plant. The oils are rich in energy and chemically very active; therefore, it is somewhat surprising for the plant to expel such an amount of energy without making use of it. The oils are stored in the form of micro droplets in the glands of the plants. After diffusing slowly through the wall of

the gland, these droplets spread out on the surface of the plant before evaporating and filling the air with perfume.

Essential oils are used for many different reasons and in different ways. They have a profound effect on the central nervous system, relieving depression and anxiety, reducing stress, and relaxing. Many essential oils are used in perfumery. It takes many pounds of flowers to construct ounce of essential oil. Moreover essential oil is utilized as aromatherapy which is a form medicine. Many essential oil often diluted and sometimes the oil is adulterated with synthetic chemicals.

Commercially, essential oils are used in three primary ways :

- **Flavors**
  Present in bakery goods, candies, confections, meat, pickles, and soft drink.
- **Pharmaceuticals**
  Appear in dental products and a wide but diminishing group of medicines.
- **Odorants**
  Use in cosmetics, perfumes, soaps, detergents, and miscellaneous industrial products ranging from animals feed to insecticides to paints

For these particular experiments, local jasmine flowers (local name: Melati; Melur) was chosen. Among flowers, Jasmine has an attractive perfume. This project was undertaken to explore the possibilities of having an absolute essential oils. The essential oil are so called because they were believed to represent the quintessence of odor and flavor from the flower kingdom – differ in composition properties from fatty or fixed oils, which consist for the most part of glycerides and from mineral or hydrocarbon oils. A scientific definition of the term essential or volatile oils are not possible, although several practical definitions exist. The most common one defines an essential oil as a more or less volatile material isolated from an odorous plant of a single botanical species by a physical process.

Jasmine essential oil has a sweet and floral aroma. Jasmine is sought after for its powerful characteristics that aid the body as an anti-depressant, an aphrodisiac, and its

confidence boosting qualities it has on the mind. The Chinese used jasmine in sick rooms to cleanse the air. It was also used by Egyptians to relieve nervous disorders, insomnia and headaches. In today's jasmine essential oil is expensive especially in aromatherapy filed, but it is worth for the skin. It encourages cell growth and increases skin elasticity. The flowers can only be picked at night because they only bloom at night. It takes huge quantities of petals to prepare one ounce of Jasmine's essential oil. Because of the quantity of petals needed to make jasmine's essential oil, it is rare and highly sought after. It was extremely valuable oil in ancient time.

Scenting extracts obtained from flowers are widely used in the perfumery industry and have a very high commercial value. In several cases, raw cosmetics materials are treated at an early stage to avoid degradation of their fragrance. There are several methods to extract essential oil. Most oils are extracted using steam distillation method. In this method the plant is permeated with steam. Consequently, this will cause the plant tissues to break down. As a result the essential oils and water vapor are released, collected and cooled. Conventional steam distillation technique is unsuitable to process such materials, since it induces thermal degradation of many compounds contained in the flowers. It is for this reason that solvent extraction is used. The subsequent solvent vaporization gives rise to a quasi-solid product called a "concrete," which contains fragrance compounds such as hydrocarbon terpenes, oxygenated terpenes, sesquiterpenes, oxygenated sesquiterpenes, and other flavoring compounds. Moreover, concrete can contain fatty acids and their methyl esters, diterpenes, and other high molecular weight lipophilic compounds. High percentages of paraffins (from 50 to 70% by weight and more), belonging to the cuticular waxes covering the surface of flowers, are present too. Another extraction method is using solvent extraction. This method applies the relative solubility concept of an analyte in two immiscible liquid. Alternatively, supercritical carbon dioxide highly pressured (up to 100 atm) can be used to extract mixture of essential oil and other lipophilic plant material.

Taking into consideration the small scale industries using conventional method which are involved in production of perfumeries literature survey was then taken up. It

reveals that extracts of flowers, especially jasmine, rose, *Champak* and leaves of *davana*, have very good market.

The name of the oil is the same as the name of the plant from which it is derived. The function of the essential oil in the plant is not thoroughly understood. It is probable that the odors of the flowers act as attractants (or repellents) for certain insects, aiding in natural selection. Root oils, wood oils and leaf oils may act as a protection against plant parasites and against depredations of animals.

For these particular experiments local jasmine flowers (local name: Melati; Melur) was chosen. The jasmine flowers were grown in most of the houses in this area. The jasmine plants were grown at distances of 45cm x 45cm from each other. The yield of flowers from a healthy plant per day was around 25gm (around 150 flowers). The cost of these flowers varies day to day depending on the market.

1.2 PROBLEM STATEMENT

The use of volatile plant oil, including essential oils, for psychological and physical well being has dated back thousands of years in China and Egypt. With such a long history, it came as a complete surprise that only during the earlier part of the 20th Century; a French Chemist by the name of Rene-Maurice Gattefosse discovered the potential medicinal use of essential oils.

Briefly, essential oil is a liquid that is generally distilled from the leaves, stems, flowers, bark, roots or other elements of a plant. Most of essential oils are clear and contain the true essence of the plant it was derived from. It is not same as perfume or fragrance oils as perfume oils are artificially created fragrances or contain artificial substances and do not offer the therapeutic benefits that essential oils offer.

As the name stands, essential oils can be used for treating burned skin or to heal wounds due to its anti-inflammatory properties. When the oils are applied to the skin, it

will be absorbed into the bloodstream to provide numerous components that are believed to aid in a variety of health, beauty and hygiene condition. When essential oils are inhaled into the lungs, it offers psychological benefits as the aroma of the natural tradition to use essential oils to treat depression, exhaustion, labor pains and sensitive skins. On top of that, some oils, for instance, act as a natural repellent and pesticide, e.g. to keep the mosquitoes away.

In this project, the Jasmine flower is being used as the substrate. *Jasminum officinalis*, or also known as Melur in Malay Language, is commonly extracted for its essential oils using methanol and ethanol as solvent. Conventional steam distillation method is not suitable to process such material since it induces thermal degradation of many compounds contained in the flower. The constituents of the Jasmine solvent-extracted oils contain all the fragrance compounds (among others include benzyl acetate, benzyl benzoate, linalool, phytol, fatty acid methyl ester and paraffins). The latter compounds do not contribute to the scent of jasmine flowers. This extraction product undergoes further processing to separate fragrance compounds from these undesired co-extractives.

Solvent extraction uses very little heat so it is able to produce essential oils from whose fragrance would otherwise be destroyed or altered during steam distillation. Solvent extraction is used on delicate plants to produce higher amounts of essential oils at lower cost. Other than the study on this method it is important to improve the existing products of fragrance and also try to encourage the development of local technologies to take advantage of market opportunities.

Each method of extraction actually has it own advantages and disadvantages. This study is important in discovering solvent extraction method as the most optimal methods for capturing the total spectrum of volatile constituent in this jasmine plant. All in all, the study on this research is important in order to improve the effective extraction time for each solvent to extract the oils and observing the preliminary study on these essential oils of jasmine flower.

1.3 OBJECTIVE

Due to the promising commercialization potential shown by Jasmine essential oil, the main objective of this work is to carry out preliminary study on essential oils and promoting the use of methanol and ethanol as suitable solvents to substitute hexane for producing highest quality of essential oils.

1.4 SCOPE

This research is based on experimental studies of solvent extraction (using methanol and ethanol). In order to achieve the objectives mentioned above, three scopes have been identified**:**

I. Jasmine flowers were acquired locally to prepare the blended sample to be used in extraction process. A standard procedure would be developed from this research work.

II. To determine optimum extraction time in producing highest quality and substantial yield of essential oil.

III. To determine the best solvent in producing highest quality and yield of essential oil.

IV. To analyze the product composition from the extraction process.

CHAPTER 2

LITERATURE REVIEW

2.1 ESSENTIAL OILS – AN INTRODUCTION

Essential oils are liquid that is generally distilled from various parts of plant that have strong aromatic components such as from the leaves, stems, flowers, and roots. For example, in roses it is found in the flowers, in basil it is in the leaves, in sandalwood in the wood, and so on. These aromatic substances are made up of different chemical compounds that can be found naturally in the plant. For instance, alcohol, hydrocarbons, phenol, aldehydes, esters and ketones are some of the major components. Besides that, it may also contain hundreds of organic constituents, including hormones, vitamins and other natural elements. They are 75 to 100 times more concentrated than the oils in dried herbs.

Furthermore, these aromatic characteristics of essential oils may provide various functions for the plants itself including; attracting or repelling insects (odors of the flowers); while in plant metabolism, a few essential oils might involved in this process; Leaf oils, wood oils, and root oils may serve to protect against plant parasites or depredations by animals as well as anti-bacterial agent which is utilizing the hormone in the oil. There are only about 700 plants are considered aromatic among all types of plants in the world thus they are all important for the production of essential oils.

Essential oils are not the same as fragrance oils or perfume where essential oils are derived from the true plants. Perfume oils are unnaturally created fragrances since it

is contain artificial substances, and it may also do not offer the therapeutic benefit that essential oils does. Pure essential oils are very expensive but fortunately they are also highly effective which is only a few drops at a time are necessary to achieve the desired effects. These oils could promote healing of the body and the mind. Moreover, it is widely used in three primary ways:

i. As odorants; in cosmetics, perfumes, detergents, soap and etc
ii. As flavors; in bakery goods, candies, meat, soft drinks, and also as food additives.
iii. As pharmaceuticals; in dental products and group of medicines.

Today, we could also easily find synthetic essential oils in the market where the price would be cheaper than the pure ones. There are a few differences between synthetic essential oils and pure essential oils. Synthetic essential oils are produced by blending aromatic chemicals mostly derived from coal tar. These oils may duplicate the smell of the pure essential oils, but the complex chemical components of each essential oil created in nature determine its true aromatic benefits. While synthetic essential oils are not suitable for aromatherapy, they add an approximation of the natural scent to crafts, potpourri, soap and perfume at a fraction of the cost. The reason of these synthetic products is mainly to reduce the cost of production.

The oil of the essential oils bears the name of the plant from which it was derived, for example Rose oil, and Bergamot oil. Such oils were called essential because they were thought to represent the very essence of odors and flavour.

The odors and flavour of these oils is usually dependent upon this oxygenated compound. Many oils are terpenoids, few are benzene derivatives. Table 2.1 shows the important constituents of the more common essential oils.

Table 2.1: Essential oils from some natural plants.

Name	Part of the plant used	Botanical name	Important constituents	Uses
Lemongrass and citronella	Leaf	*Cymboposon spp*	Citral Citronella Terpenes	Perfumery Disinfectant
Eucalyptus	Leaf	*Eucalyptus globules* *Eucalyptus citriodora* *Eucalyptus dives*	Cineale Citronella Terpenes	Not mention
Cinnamon leaf	Leaf	*Cinnamon zeylanicum*	Eugenol	Used to make artificial vanilla
Clove	Bud	*Eugenia caryophyllus*	Eugenol	Dentistry flavouring
Turpentine	Not mention	*Pinus spp*	Terpenes	Paints
Lavender	Flower	*Lavendula intermedia*	Linalool	Perfumery
Sandalwood	Wood	*Santaium album*	Sanatols	Perfumery
Nutmeg	Nut	*Myristica fragrans*	Myristicin	Not mention
Almond	Nut	*Prunis communis*	Benzaldehyde	Not mention
Corainder	Seed	*Coriandrum sativum*	Linalool Terpenes	Not mention

2.1.1 PROPERTIES AND USES OF THE ESSENTIAL OILS

Each essential oil has it own properties and uses which can classified and identified accordingly to the type of plant it was derived. Table 2.2 shows the properties and uses of the top essential oil.

Table 2.2: Properties and uses of the top essential oils.

Essential oil	Biological Name	Properties	Uses
Clory Sage	*Salvia Sclarea*	Warming, soothing, antiseptic, anticonvulsive, astringent, antiphlogistic, digestive, deodorant, tonic, uterine, bactericidal, antidepressant.	Menstrual problems, anxiety, depression, high blood pressure, acne boils, oily skin and hair, cramp, migraine, the genitor-urinary system disorders such as amenorrhoea, wrinkles, ulcers.
Eucalyptus	*Eucalyptus Globulus*	Antiseptic, analgesic, antineuralgic, antirheumatic, antispasmodic, diuretic, expectorant, antiviral, hypoglycaemic, febrifuge, vulnerary, depurative, stimulant.	Muscular aches and pains, poor circulation, rheumatoid arthritis, asthma, bronchitis, flu, cold, epidermics, chicken pox, headaches, neuralgia, throat infections, skin disorders such as burns, cuts, herpes, wounds, insect bites.
Geranium	*Pelargonium Graveolens*	Soothing, refreshing, relaxing, antidepressant, astringent, antiseptic, antihaemarrhagic, deodorant, diuretic, fungicidal, anti-inflammatory.	Anxiety, adrenocortical glands and menopausal problems, sore throat, tonsillitis, cellulites, engorgement of breast, broken capillaries, eczema, hemorrhoids, oily complexion, mature skin.

Jasmine	*Jasminum Officinale*	Analgesic (mild), antidepressant, anti-inflammatory, antiseptic, antispasmodic, aphrodisiac, carminative, cicatrisant, expectorant, galactagogue, sedative, tonic (uterine).	Depression, nervous exhaustion, and stress related conditions, jasmine is said to produce the feeling of optimism, confidence, euphoria, it is especially good in cases of apathy, indifference, or listlessness. Jasmine is also used for catarrh, coughs, laryngitis, dysmenorrhoea, labor pains, uterine disorders, skin problem such as dry, greasy, irritated, sensitive skin, and for muscular spasms and sprains.
Lavender	*Lavendula Vera Officinalis*	Analgesic, anticonclusive, antidepressant, antimicrobial, antirheumatic, antiseptic, antispasmodic, antitoxic, deodorant, sedative, diuretic, choleretic, hypotensive, stimulant, tonic, vulnery, cytophylatic, insecticide.	Excellent first aid oil. It soothes cuts, bruises and insect bites. One of the most versatile therapeutic essences. For nervous system disorders such as depression, headache, hypertension, insomnia, migraine, sciatica, shock. Useful in treating skin conditions such as acne, allergies, athlete's foot, boils, dandruff, dermatitis, sunburn, eczema. Treatment of disorders such as rheumatism, throat infections, flu, bronchitis, and asthma.

Lemon	*Citrus Limonum*	Refreshing, antiseptic, stimulating, anti-anaemic, antirheumatic, antisclerotic, antitoxic, hypertensive, antiscorbutic, bactericidal, insecticidal, astringent, tonic.	Warts, depression, acne and indigestion, arthritis, cellulites, high blood pressure, nosebleeds, obesity, poor circulation, rheumatism, asthma, throat infections, bronchitis, cold, fever, flu. Treatment of anemia, brittle nails, corns, mouth ulcers, greasy skin, cuts, spots, and varicose veins.
Peppermint	*Menthe Piperita*	Digestive, cooling, refreshing, mentally stimulating, analgesic, anti-inflammatory, antimicrobial, antiseptic, antiviral, astringent, expectorant, stomachic, hepatic, cordial, antispasmodic.	Muscle fatigue, bad breath, toothache, bronchitis, indigestion, and travel sickness, neuralgia, muscular pains, asthma, sinusitis, spasmodic cough, cramp, dyspepsia, skin problem such as acne, dermatitis, ringworm, scabies, and nausea.
Ylang Ylang	*Cananga Odorata ver genuina*	Antidepressant, anti-infections, euphoric, relaxant, antiseptic, hypotensive, aphrodisiac, nervine, regulator, sedative (nervous), stimulant (circulatory), tonic.	Depression, nervous tension, high blood pressure, hyperpnoea, (abnormally fast breathing), tachycardia, digestive upsets. For skin care such as hair growth, acne, hair rinse, oily skin, irritated and insect bites. For nervous system disorders such as frigidity, impotence, insomnia.

From Table 2.2, it can be concluded that the significant use of the essential oil is mainly in pharmaceuticals industry where most of it have the anti-depressant properties. There are also some other ways to enjoy the magnificent scent of these natural ingredients. A few drops of essential oil in radiator fragrance or light bulb ring will fill the room with a wonderful fragrance and ambience. You can choose the oils depending on the mood. You can also add one drop of Geranium oil or Myrrh oil into your facial moisturizer to bring out a radiant glow in your skin. One interesting use of this oil is to freshen the shoes by only dropping a few drops of Geranium oil directly into your shoes or place a cotton ball dabbed with a few drops of lemon oil and leave it in the shoes overnight. For student, they are recommended to use rosemary oil while reading, studying or during exams. This is because this oil is believed to promote alertness and stimulate memory. There are many other ways to apply these oils. But in this study, we do not focus on the use of it but we focus on the production of the oil.

2.1.2 HAZARDOUS ESSENTIAL OILS

One should bear in mind that not all essential oil are safe to be used in aromatherapy even with or without the express administration by a qualified aromatherapy practitioner. This is due to the high toxicity levels that the essential oils might have. Some of the oil can be hazardous as they can cause severe dermal irritation and even damage the mucous membranes and delicate stomach lining in undiluted form. Hence dermal application should be avoided as a general practice; it is advisable to use essential oils only for external remedies. Oils that fall under this category are bitter almond, calamus, camphor (brown & yellow), cassia, cinnamon (bark), fennel (bitter), pine (dwarf), rue, sage (common), thyme (red), wintergreen, garlic, onion, mustard and wormwood.

2.1.2.1 Toxicity

Essential oil such as Ajowan, Basil (exotic), Camphor (white), Cassia, Cedarwood (Virginian), Cinnamon (leaf), clove (bud), coriander, Eucalyptus, fennel (sweet), hyssop, juniper, nutmeg, pepper (black), sage (Spanish), tagetes, thyme (white), turmeric, should be used only on dilution (at least 1:3) and for a maximum of two weeks due to toxicity levels.

2.1.2.2 Photo toxicity

Some oils can cause skin pigmentation if the applied area is exposed to direct sunlight. Essential Oils such as bergamot, cumin, ginger, lemon, lime, orange; should not be used either neat or on dilution on the skin, if the area will be exposed to direct sunlight.

2.1.2.3 Pregnancy

Essential Oils should be used in half the usual stated amount during pregnancy, because of the sensitivity of the growing child. Oils of adjoin, angelica, anise star, aniseed, basil, Cedarwood (all types), celery seed, cinnamon leaf, citronella, clary sage, clove, cumin, fennel (sweet), hyssop, juniper, nutmeg, Spanish sage, and thyme (white); should be totally avoided during pregnancy.

2.1.2.4 High blood pressure

Oils of hyssop, rosemary, sage (Spanish and common) and Thyme are to be avoided in case of high hypertension.

2.1.2.5 Dermal/skin irritation

Oils of basil (sweet), black pepper, borneol, cajeput, caraway, Cedarwood (Virginian), cinnamon (leaf), clove (bud), eucalyptus, garlic, ginger, lemon, peppermint, pine needle (scotch and longleaf), thyme (white) and turmeric; especially if used in high concentration may cause irritation to the skin.

2.2 ESSENTIAL OILS QUALITY

To ensure that each of the oils is in highest quality as well as completely unadulterated some scientific analyses are requires on every essential oil. There are four major analyses that can be carried out.

i. Specific Gravity

The weight of essential oils is measured at 25˚C. Every oil is made up of unique constituents. At given temperature, these constituents have a predictable weight. If the oil has been contaminated, the weight may be thrown off.

ii. Optical Rotation

This technique measures direction, left or right and the degree to which light rays bend or rotate as they pass through essential oil. If the oil has been contaminated, the speed and degree of refraction may be thrown off.

iii. Refractive Index

This technique measures the speed at which light passing through the oil refracted. If the oil has been contaminated, the speed and degree of refraction may be thrown off.

iv. Gas Chromatography

This technique separates the individual constituents of an essential oil and measures the amount of each constituent present. It would positively confirm oil botanical identity by comparing presence and amount of each constituent. This evaluator can screen for non-natural or missing constituents or constituents occurring in unnaturally high ratios, signifying adulteration.

2.3 INTRODUCTION OF JASMINE FLOWERS

Perfumeries say that it takes about seven million jasmine flowers to produce one kilogram of pure oil, valued at approximately RM13, 260. Each flower must be handpicked early in the morning when jasmines possess the highest oil content. Jasmines are very popular among Penang's Hindus, who wear it in their hair during prayers and

auspicious occasions. Jean Patou's Joy, the costliest perfume in the world (RM1, 380 per ounce), uses a heavy concentration of jasmine absolute.

Table 2.3: Properties and uses of the essential oils.

Common name	Jasmine
Botanical name	Jasminum Grandiflorum, Jasminum Officinale
Local name	Melur
Origin	France, Egypt, India
Family	Oleaceae
Color	Orange to brown, deep brown with a golden tinge
Extracted from	Flower
Perfumery note	Middle/Base
Chemical constituents	benzyl acetate, linalool, benzyl alcohol, inclole, benzyl benzoate, cis-jasmone, geraniol, methyl anthranilate, benzoic acids, benzaldehyde, y-terpineol, isophytol, phytol, cis-3-hexenyl benzoate.
Aromatic description	warm, floral, exotic
Properties	antidepressant, antiseptic, antispasmodic, expectorant.

Figure 2.1: Blooming jasmine flowers.

Jasmine is a genus of shrubs and climbing vines with 200 species, native to tropical and warm temperature regions. The majority of species grow as climbers on other plants or on structures. The leaves can either be evergreen or deciduous and are opposite in most species that grows to be approximately 20 feet tall with star shaped flower. The leaf shape is simple, trifoliate or pinnate with up to nine leaflets.

Jasmine flowers are white in most species, but with some species being yellow flowered. Unlike most genera in the Oleaceae which have four petals, jasmine often have five or six petals. They are often strongly and sweetly scented. Flowering is in spring or summer in most species, but a few species, like *J. nudiflorum*, in winter on the bare branches of this deciduous species. Normally jasmine flowers are picked at night where at the period, the aroma is most intense.

The common name 'jasmine' is often given to unrelated plants with pale, sweetly-scented flowers and dark green leaves, such as *Trachelospermum* species (confederate or star jasmine), *Gardenia jasminoides* (Cape jasmine), and *Gelsemium* species (Carolina jasmine).

2.3.1 JASMINE ESSENTIAL OILS

Jasmine is also known as 'King of Flowers' and definitely the most masculine of all the floral aromas, especially *Jasmine Sambac* which is more musky, spicy, mysterious and exotic than the *Jasmine grandiflorium. Jasmine grandiflorium* is softer and gentler.

The potency and incredible fragrance power of Jasmine Essential oil make it a great investment even though it is one of the most expensive oils. *Jasmine grandiflorium* generally works with all oils. It helps to round out scents, and tends to work particularly well with other aphrodisiac oils such as Ylang Ylang and Sandalwood.

Jasmine essential oils are believed to encourage cell growth as well as increase skin elasticity. It is also used to help with muscle spasms and sprains. Additionally, it is recommended for used during childbirth, but not until the later stages of labor. At that point it can be very useful as it strengthens the uterine contradictions and relieves pains. It is also effective in post-natal depression and promotes the flow of breast milk. Beside that it also makes a delightful uplifting perfumes or as room fragrances.

2.4 EXTRACTION OF ESSENTIAL OILS

2.4.1 INTRODUCTION

Essential oils are primarily used in preparation of fragrances such as soap and perfumes. Although some of the chemical components of essential oils are similar to "oils", essential oils are not greasy itself and they are light in weight. However, the high alcohol components in essential oils give higher volatility and faster evaporation rate. The selection of appropriate extraction method will determine the quality and quantity of essential oils. Other factors such as types of plant, chemical make up of oils, and location of oils within the plant (root, bark, wood, branch, leaf, flower, fruit and seed) are also needed to be considered prior to the extraction.

Some plant like rose and jasmine contain very little essential oil. Their important aromatic properties are extracted using a chemical solvent. The end product, known as an absolute, contains essential oil along with other plant constituents. Though not a true essential oils, absolute are commonly used for fragrance cosmetic product like fine perfumes. Some extraction methods are described here in.

2.4.2 METHODS AVAILABLE

2.4.2.1 Supercritical Carbon Dioxide Extraction

When carbon dioxide (CO_2) is subjected to high pressure, the gas turns into liquid. This liquid can be used as a very inert and safe solvent which will extract the aromatic molecules in a process similar to that used to extract absolutes. The advantage, of course is that no solvent residue remains. This is because, at normal pressure and temperature, the carbon dioxide can simply slip back to gas and evaporates. Compare to the steam distillation, if the same essential oil are being extracted the products of supercritical extraction seems to have richer, and more intense scent, since more of the aromatic chemicals are released through this process.

2.4.2.2 Solvent Extraction

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

2.4.2.3 Steam Distillation

Steam distillation is a special type of distillation process (separation process) for temperature sensitive materials like natural aromatic compounds. Through this process

the botanical material is placed in a still and steam is forced over the material. The hot steam will helps to release the aromatic molecules from the plant material. The molecules of these volatile oils are then escape from the plant material and evaporate into the steam. The temperature of the steam therefore needs to be carefully controlled. The temperature should be just enough to force the plant material to release the essential oils, yet not too hot as its can burn the plant material or the essential oils.

The steam which then contains the essential oil is passed through a cooling system to condense the steam, which then form a liquid from which the water and the essential oils is then separated. The steam is produced at high pressure than the atmosphere and therefore it boils at above 100^0C which facilitates the removal of the essential oil at a faster rate and by doing so, it could prevent damage to the oil as well.

Some oils like Lavender is heat sensitive and with this method, it could prevent it from damage and ingredients like linalyl acetate will not decompose to linalool and acetic acid.

2.4.2.4 Enfleurage

Some flowers, such jasmine or tuberose, have such low contents of essential oil or too delicate that heating them would destroy the blossoms before releasing the essential oils. In such cases, this method of extraction is sometimes used to extract the essential oils. Flower petals are placed on trays of odorless vegetable or animal fat, which will absorb the essential oils. Every day or every few hours, after the fat has absorbed the essential oils as much as possible, the depleted petals are removes and replaced with fresh ones.

This procedure continues until the fat or oil becomes saturated with the essential oil. Adding alcohol to this mixture will separates the essential oil from the fatty substance. Afterwards, the alcohol evaporates and only the essential oils remains. And yet this process is a very labor-intensive way of extraction, and needless to say a very

costly way to obtain essential oil and nowadays, only sometimes used to extract essential from tuberose and jasmine.

2.5 SUPERCRITICAL FLUID EXTRACTION

2.5.1 PROPERTIES OF SUPERCRITICAL FLUID

A supercritical fluid is defined as a substance above its critical temperature (T_c) and critical pressure (P_c). The critical point represents the highest temperature and pressure at which the substance can exist as a vapor and liquid in equilibrium. The phenomenon can be easily explained with reference to the phase diagram for pure CO_2 (Figure 2.2).

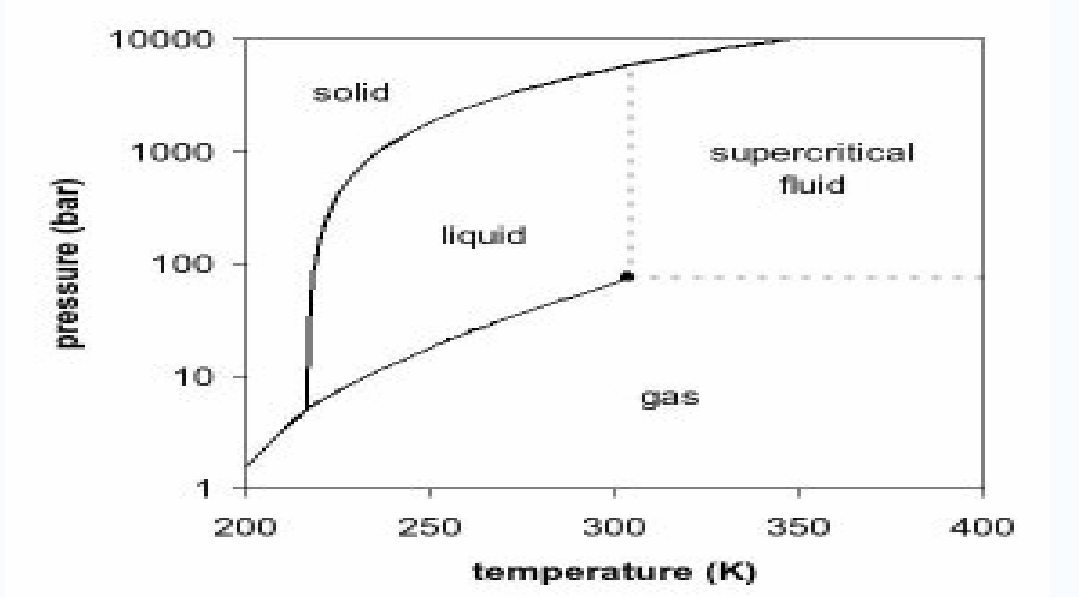

Figure 2.2: Phase Diagram of Carbon Dioxide

It has unique ability to diffuse through solids like a gas as well as dissolve materials like a liquid. Additionally, it can readily change in density upon minor changes in temperature or pressure. These properties make it suitable as a substitute for organic solvents in a process called Supercritical Fluid Extraction. CO_2 and water are most commonly used supercritical Fluids. As a comparison, Table 2.4 shows the critical properties of various solvents.

Table 2.4: Critical Properties of Various Solvents.

Solvent	Molecular weight	Temperature	Pressure		Density
	(g/mol)	(K)	(MPa)	(bar)	(g/cm^3)
Carbon dioxide	44.01	304.1	7.38	73.8	0.469
Water	18.02	647.3	22.12	221.2	0.348
Methane	16.04	190.4	4.60	46.0	0.162
Ethane	30.07	305.3	4.87	48.7	0.203
Propane	44.09	369.8	4.25	42.5	0.217
Ethylene	28.05	282.4	5.04	50.4	0.215
Propylene	42.08	364.9	4.60	46.0	0.232
Methanol	32.04	512.6	8.09	89.0	0.272
Ethanol	46.07	513.9	6.14	61.4	0.276
Acetone	58.08	508.1	4.70	47.0	0.278

2.5.2 SUPERCRITICAL CO_2 EXTRACTION AND ITS CHARACTERISTICS

From Figure 2.2 and Table 2.4, it is shown that the critical point for carbon dioxide occurs at pressure of 73.8 bar and temperature of 31.1^0C. Thus, the supercritical extraction on the compounds responsible for the fragrances contained in vegetable matter is a promising field for the industrials application of supercritical fluid

processing. Indeed, there is considerable interest in replacing the steam distillation and solvent extraction processes traditionally used to obtain these products.

CO_2 is the supercritical solvent of choice in the extraction of fragrance compounds, since it is non-toxic and allows supercritical operation at relatively low pressure and near room temperature. Generally speaking, supercritical CO_2 behaves like a lipophilic solvent but, compare to liquid solvent; it has the advantage that its selectivity is adjustable and can be set to values ranging from gas-like to liquid-like. Furthermore, there are also of course less solvent residues present in the products. The other advantages of using Supercritical CO_2 Extraction are illustrated below:

i. It is safe since CO_2 is cheap but easily obtains and not burn and explode, removing the danger from organic solvent extraction.
ii. The solvents recovery is simple and convenience and save energy resources.
iii. CO_2 is stateless, odorless, non-toxic and chemical inertness and would not contaminate the environment and products. Thus, the material residues can be used without treatment.
iv. The permeability is strong. So, the extractive time may be greatly shorter than that of the extraction time of common solvent.
v. Manipulation temperature is near to room temperature, suitable for the heat sensitive material. Can obtaining a true style and high quality extraction product. The other extraction method could not get this result.