

Extraction of Grapefruit Essential Oil from Grapefruit Peels

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Abstract. This project involves extraction of grapefruit essential oil from grapefruit peels using various oils like castor oil, gingelly oil, olive oil as carrier oils. The main aim of this project is to extract the oil which has numerous medicinal uses. The extraction can be performed by two methods, one by mason jar method and other by crack pot method. Project involves extraction of the oil with various carrier oils in a view to reduce the cost of production and the physical properties of the extracted oil are examined. The cost of production by using other carrier oils like gingelly oil, castor oil etc.. is found to be reduced while compared to the production by using almond oil.

Keywords: Essential oil, carrier oil, medicinal uses, cost of production

1. Introduction

Grapefruit, also known as Shaddock in certain areas of the world, is a Citrus fruit, whose scientific name is *Citrus Paradisi*. It is also known by two other scientific names, *Citrus Racemosa* and *Citrus Maxima*. The latter, is thus named because of that varieties very large size. Like all other citrus fruits, its Essential Oil is present in its peel and extracted by compression. Many of its medicinal properties match those of the essential oils of other citrus fruits. Grapefruit is picked from a glossy-leaved tree, about 10 meters (30 feet) high, with white flowers and large, pale yellow fruit [1]

1.1. Grapefruit

Grapefruit comes in many varieties, determinable by color, which is caused by the pigmentation of the fruit in respect of its state of ripeness. The most popular varieties cultivated today are red, white, and pink hues, referring to the internal pulp color of the fruit. The family of flavors range from highly acidic and somewhat sour to sweet and tart. Grapefruit mercaptan, a sulfur-containing terpene, is one of the substances which have a strong influence on the taste and odor of grapefruit, compared with other citrus fruits.

1.2. Chemical Constituents of Grapefruit Essential Oil

Monoterpene: d-Limonene (92%), myrcene, alpha- pinene, sabinene, beta-phellandrene
Tetraterpenes: beta-carotene, lycopene
Aldehydes: nonanal, decanal, citral, citronellal
Furanocoumarins: aesculetin, auraptene, bergaptol, Sesquiterpene
Ketones: nootketone
Alcohols: octonal. [2]

1.3. Health Benefits of Grapefruit Essential Oil

Acne, antiseptic, Arthritis, Cellulite, Depression, Detoxification, disinfectant, Headaches, Mental or nervous exhaustion, Menstruation, menstrual cramps, muscle fatigue, rheumatism, stiffness and stress. [3]

2. Materials Required

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Grapefruit peels, Almond oil, Olive oil, Gingelly oil, Castor oil, Steam distillation set up, Density meter, Ostwald's viscometer, Closed cup flash point apparatus, Acid value apparatus, Saponification value apparatus

2.1. Method of Production

There are two methods involved in the production of grapefruit essential oil from grapefruit peels using carrier oils as the extracting medium. They are

- Extraction using a Mason jar: 3-4 weeks for production.
- Extraction using a Crock Pot: 8 hours for production.

2.2. Procedure

The production of grapefruit essential oil can be performed in two methods. The procedures are explained in detail below.

2.3. Mason Jar Method

Use the Mason jar method by filling the jar with the grapefruit rind or zest and adding almond oil just to the top of the rind. Avoid using too much oil or you will weaken the product. Cover and allow the Mason jar to sit in sunny windowsill for 3 to 4 weeks. Filter the oil in four to five layers of cheesecloth to get high grade of pure oil.

2.4. Crack Pot Method

Select the grapefruits of moderately thick rind and peel the grapefruit skin leaving the pith behind. Place grapefruit rind or zest in the crock-pot and add almond oil just to the top level of the rind. Be careful not to add too much oil since essential oils are concentrated. Turn the crock-pot on low and cover it. Allow the mixture inside to heat and blend for at least 8 hours. Filter the oil in four to five layers of cheesecloth to get high grade of pure oil. Store the oil in an air tight container and do not refrigerate [4].

2.5. Steam Distillation

The extracted mixture of grapefruit essential oil and the carrier oil was then steam distilled to get the pure grapefruit oil sample.

2.6. Working Procedure

The feed mixture was taken in a round bottom flask and was connected to a hot plate which produced steam. The steam vapourised the highly volatile grapefruit essential oil and the vapours were condensed in a reflux condenser and was collected in the receiver whereas the carrier oil being low volatile was left back in the round bottomed flask. The boiling points of carrier oils and grapefruit essential oil are listed below.

Table 1: The Boiling Points of Various Oils

Oil	Boiling point
Grapefruit essential oil	130 °C
Almond oil	215 °C
Gingelly oil	234 °C
Castor oil	313 °C
Olive oil	300 °C

3. Analysis of Physical Properties

Physical properties such as acid value, saponification value, viscosity, density and flash point of the grapefruit essential oil is determined.

3.1. Determination of Viscosity

Ostwald Viscometer is rinsed with water. A known volume of water whose viscosity of water is known is taken in the viscometer and it is sucked. The time taken by the water to travel between the two marks in left limb is noted. Then the oil whose viscosity is to be determined is taken in viscometer. Then the time taken by oil to travel between the two marks in the left limb of the viscometer is noted. The density of the water at room temperature and the viscosity of the oil is calculated using certain formulas.

Table 2: The Viscosity Calculations

Time taken by water in viscometer (t_1) = 75sec	Viscosity of water (V_1) = 0.01cp
Density of water (D_1) = 0.997g/cc	Time taken by oil in viscometer (t) = 105sec
To find the Viscosity of the oil (V): $(V_1/V) = [(D_1*t_1)/(d*t)]$	Density of oil (D) = 0.853g/cc

3.2. Determination of Flash Point

The flash point of the oil is determined by using closed cup **Pensky Marten apparatus**. This apparatus consists of closed cup of standard size it is held in metallic holder which is placed on a wire gauge and is heated by means of an electric heater inside the metallic holder. A provision is made on the top edge of the cup to hold the thermometer in the position. A standard filling mark as been scribed on the inside of the cup and the sample oil is filled upto the mark. Fill the cup with the given sample of oil upto the standard filling mark of the cup. Note the temperature in digital display of the apparatus when the vapours of the oil produces flash.

Table 3: The Flash Points of the Essential Oils with Various Oils

Grapefruit essential oil from olive oil (°C)	Grapefruit essential oil from castor oil (°C)	Grapefruit essential oil from gingelly oil (°C)
43	51	46

3.3. Determination of Density

An empty bottle is taken and its weight is noted and the bottle is filled with water and the weight of bottle with the water is noted. From this the weight of water is determined. The density of the water at room temperature is calculated and the volume of water which is equal to the volume of vessel is calculated using the general formula **density= mass/volume**. Then fill the bottle with the oil whose density is to be determined. From which the weight of the oil is determined and the density of the oil is calculated.

Table 4: The Density Calculations

Weight of the empty bottle = 10.82g	Weight of the bottle+ water = 21.65g
Weight of water = 10.83g	Density of water = 0.997g/cc
Volume of water = 10.86cc	Weight of the bottle+ oil = 20.06g
Weight of the oil = 9.24g	Thus the density of the oil = 0.853g/cc.

3.4. Determination of Acid Value of Oil

A 4g of oil sample is taken in a conical flask and 20 ml of 95% alcohol and water mixture is added. It is heated for about 10 to 15 minutes and it is cooled under tap water. It is then titrated against 0.1N alcoholic potash taken in burette. A blank titration is carried out without the oil sample. The difference between the two titration values determines the acid value of the oil sample.

Table 5: The Acid Value Calculations

Quantity of oil taken (W) = 3.95g	Value of blank titration (a) = 0.4ml
Value of titration using oil (b) = 1.3ml	Therefore, Acid value of an oil = $[(b - a) \times 5.6]/W$ mg of KOH/g of oil
= $[(1.3 - 0.4) \times 5.6]/3.95$	Acid value of an oil = 1.275 mg of KOH/g of oil.

3.5. Determination of Saponification Value of Oil

Weight accurately about 1g of the oil and transfer it into a round bottom flask. Add from the burette 10ml of 0.5N alcoholic potash. A water cooled reflux condenser is fitted to the flask and refluxed for half an hour. A blank experiment is carried out by following the above procedure without taking the oil sample. The solution in the flask after reflux is titrated against standard 0.5N HCl using phenolphthalein indicator. The difference in the two volumes of acid is equivalent to the KOH used up for saponification.

Table 6: The Saponification Value of Oil Calculations

Volume of N/2 HCl required in blank titration (a) =11.2ml	Volume of N/2 HCl required in saponification (b) =4.2ml
Volume of N/2 HCl used in saponification value	(a-b) = 7ml
Saponification value of oil = $(56.1 \times (11.2 - 4.2)) / (2 \times 1.01)$	Saponification value of oil = 194.40 mg of KOH/g of oil

4. Results

- The essential oil obtained has a pleasant aroma.
- The yield of essential oil by using other carrier oils is similar to the yield by using almond oil and the oil is found to contain same physical properties.

5. Conclusion

The production cost of Grapefruit essential oil by using other carrier oils is fairly reduced to more than half of the production cost by using almond oil. From the above given tabular column it is estimated that gingelly oil may be used as an alternative carrier oil in the extraction of Grapefruit Essential Oil as this gives close approximation of values and also considerably reduces the cost of the extraction process.

6. References

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